B.ED. SPL. EDUCATION

CURRICULUM DESIGNING, ADAPTATION AND EVALUATION

SES HI 02

MADHYA PRADESH BHOJ (OPEN) UNIVERSITY

CURRICULUM DESIGNING, ADAPTATION AND EVALUATION

B.Ed. Spl. Ed

(SES HI 02)

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Bachelor of Special Education

B.Ed. Spl. Ed.

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BLOCK 1: CURRICULUM AND ITS' DESIGNING

INTRODUCTION

Our ears are fixed on either side of our head and when we talk about ears we usually think only of these parts which are easily visible. However, these are the least important parts of our organ of hearing. The vital parts are located inside the head. If we were to follow the sound waves traveling to our brain, it will be from the external ear through the ear canal beyond the eardrum to the middle ear from where these are conducted to the inner ear. At this stage, the mechanical vibrations are converted into electrical impulses in the part of the inner ear, known as cochlea. These impulses then travel through the auditory nerve to auditory areas of the brain, which perceive them as sound.

Defect in or damage to any of these parts will result in hearing impairment of varying degree and type which in turn will create innumerable problems for the child / person.

The first step in the rehabilitation of a born or prelingually hearing impaired child is to get its hearing tested, and, if medical intervention is not possible, to provide a suitable hearing aid as early in childhood as possible. This of course will be of no use if this is not immediately followed by training at home under proper guidance or at an early intervention center. However, in this Block 1 of Paper II (comprising 4 Units), we are mainly concerned about the **'what'** and **'how'** of the process of assessment of hearing.

To understand hearing tests it is necessary to know something about sound. **Unit I** of this block tells you about the properties of sound, and how these are measured and quantified. It also describes the anatomy of the ear and the functions of the different parts of the ear.

Unit 2 is concerned with the medical aspects of hearing impairment, namely the causes of hearing impairment and their treatment.

Unit 3 will help us to know more about the various hearing evaluation tests and the interpretation of these.

Unit 4 describes the different test procedures used for various age groups by using pure-tone audiometry.

As you read through these Units, you will first marvel at the nature's superb creation of such a complicated piece of biological engineering, namely the ear. Then, as you read further, the information about the tests of hearing and the benefits derived from these, will make you wonder at what has been achieved by man as regards the assessment of the malfunctioning ear and development of devices used for the purpose. However, it must always be borne in mind that the provision of a hearing aid is only the first step towards the actual process of education and rehabilitation of a young hearing-impaired child. This process is most difficult and may continue thereafter for years to follow.

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1.1 INTRODUCTION

Sound is a form of energy. This energy is very crucial for us to carry out our day-to-day activities as the predominant mode of our human communication (which is verbal) uses the sound energy. Basic knowledge about the physics of sound is essential for any student dealing with hearing persons or persons with hearing disorders. The word "Physics" comes from a Greek word, the meaning of which is "Nature". Physics is the branch of science, which deals with the study of matter and ENERGY. Sound is a form of energy. Under this unit, one studies the properties of this form of energy. Further, physics is a quantitative science. Hence, this unit also deals with the way the different properties of sound are measured and quantified.

Knowledge regarding the organ of hearing and about how we hear sounds is essential for students dealing with hearing impaired population. This information on ANATOMY (i.e. study of the structure of the body / organ) and PHYSIOLOGY(i.e. study of the functions of the different parts / organs of the body) will help us to understand the different conditions causing hearing loss, about the types of hearing loss and also about the different degrees and nature of hearing loss. In addition to this, it helps us in knowing the reason (i.e. the underlying pathology) for different shapes of " Hearing Curves" (i.e. CONTOUR OF AUDIOGRAM) in various conditions of hearing loss.

1.2 OBJECTIVES

After going through this unit you will be able to :

- Define sound
- State the different physical parameters of sound
- State the different psychological attributes of the different parameters
- Know the units of measurement of the different parameters of sound
- Have a basic idea about the Decibel concept
- Know about different types of sounds around us.
- Name the different parts of the ear.
- Identify the different parts of the ear in a diagram.
- State the functions of external ear, middle ear, inner ear and the auditory pathway.
- State how the sound is conducted from one part of the ear to another.

1.3 WHAT IS SOUND? – DEFINITION

Sound is that form of energy that is produced due to the vibration of the surrounding air or other medium.

It is actually patterns of successive pressure disturbances occurring in some molecular medium, which may be gaseous, liquid or solid.

Sound is that which is or which may be HEARD.

The general properties of sound are:

a) It is generated by vibratory motion. We hear sound when we ring a bell, when we clap, when we strike on the drums, when we vibrate our vocal cords in our voice box during speaking etc.

b) It can be transmitted through a medium, which delays it and attenuates its intensity. Sound can be transmitted through air very well. It can be transmitted through water or other liquids also. It can also be transmitted through solids such as walls, rocks etc. However, it cannot be transmitted in the absence of a medium i.e. in vacuum. Sound takes time to move from one point to another and therefore when it is being transmitted from one point, there will be delay in reaching the subsequent points. If the source of sound is near to a RECIPIENT, the sound will be heard sooner than if it were far from it.

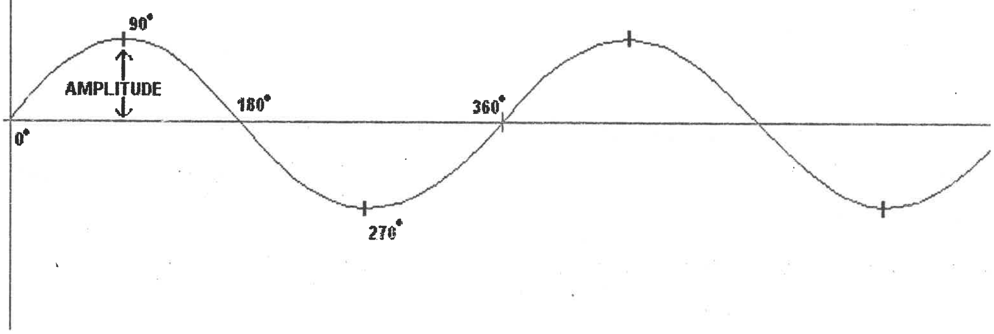
c) When the Sound is transmitted from a source, it also looses some POWER as it moves further and further away from it.

d) It can be received at a point distant from its origin. This is the reason why we can hear the horn of a bus from a long distance, even when the bus is not in sight.

1.4 PHYSICAL PARAMETERES OF SOUND

PARAMETER refers to any measurable or quantifiable characteristic or feature. The three physical parameters of sound are: Frequency, Intensity and phase. These parameters can be easily understood if we consider a SIMPLE HARMONIC MOTION (SHM). SHM is descriptively named. Oscillatory motion of a particle when it is repetitive or cyclic and is unaffected due to any friction etc, it is referred to as simple harmonic motion. Fig.1 shows such a waveform.

Fig.1 Simple Harmonic Motion



1.4.1. Frequency

The number of oscillations performed by a particle in one second is called its FREQUENCY. It is measured in terms of cycles or oscillations or vibrations per second. It is also referred to as HERTZ (HZ), in honour of a scientist named Hertz. If a particle completes 1000 cycles in one second, its frequency is 1000 Hz. i.e.1KHz

The human ear can hear frequencies from 20Hz to 20,000 Hz (i.e.20KHz). The frequencies, which are less than the human audible frequency, are called as SUBSONIC or INFRASONIC FREQUENCIES and those, which are above the human audible range, are called as ULTRA SONIC FREQUENCIES.

1.4.2. Intensity

In physical terms, intensity is referred to as AMPLITUDE. Amplitude is the extent of displacement of the vibratory particles in either direction from the position of rest. (see fig. 1). Intensity of sound is measured on a decibel (dB) scale with a specified reference sound of Sound Pressure Level (SPL) or Hearing Threshold Level (HTL/ HL). Human ear can hear sounds which are as soft as 0dBSPL (i.e. the sounds which are of sound pressure level of 0.0002dynes /sec^2). Sound causes discomfort when it is 120 dB SPL and becomes painful at 140 dB SPL. (See 1.8. for decibel scale)

1.4.3 Phase

Phase is the part of the cycle the sound has reached at a given point in time. It is expressed in DEGREE. A complete cycle extends 360°. In fig.1, the beginning of the wave is 0^0,the 1st peak (compression / Positive peak) is 90^0, the rest following is

180^0 , the 2^{nd} peak (rarefaction / Negative peak) following is 270^0 , the rest point following again is 360^0. This parameter is not of much importance to this paper.

1.5 PSYCHOLOGICAL ATTRIBUTES OF SOUND

When we hear a sound, we perceive it as having certain characteristics or qualities. The physical parameters discussed above contribute to the perception of certain specified characteristics. Thus, each of the physical parameters has certain psychological attributes. They are:

a) PITCH: This is the psychological attribute of frequency. Higher the frequency, higher is the perceived pitch. Thus, we have very high-pitched sounds, which can be described as shrill, low-pitched sounds, which are bass etc. Examples of high-pitched sounds are: sound of a metallic bell, whistle, voice of children etc. Examples of low-pitched sounds are : sound of a drum, buffalo sound, a normal adult male's voice etc.

b) LOUDNESS: This is the psychological attribute of intensity. Higher the intensity louder will be the sound. Thus, we have loud sounds of aeroplanes, orchestra, people shouting etc and soft sounds of whispers, breeze etc.

c) TIMBRE: this is the psychological dimension corresponding to the complexity of the sound. This is also referred to as the quality of the sound.

1.6 DECIBEL SCALE

Since sound is a form of energy, it can be measured using the derived units like power (such as in WATT) or pressure (such as in NEWTON / METER^2 i.e. N/m^2). It can also be measured using smaller units of the same scale such as dynes/cm^2 . However, the energy of the sounds we hear (from softest to the painful sound) is so little that these measures are very impractical and cumbersome to handle. The sound pressure level of the softest sound we hear is 0.0002 dynes / cm ^{2}, where as that of the sound which will be painful has a sound pressure level of 2000 dynes /cm^2 which is 10,000,000 (10 million) times greater. Therefore, a ratio scale comparing the sound in question to a REFERENCE sound level is more convenient. The REFERENCE sound level chosen is the sound pressure level of the softest sound a normal adult human ear can detect, i.e. 0.0002 dynes / cm^2 In humans, the ratio of the highest tolerable sound pressure to the sound pressure that can just be heard exceeds 10,000,000 : 1 Therefore, to make the ratio scale further easy to handle, a LOGARITHMIC RATIO SCALE (to base 10) called as the **DECIBEL SCALE** (dB scale) has been adopted. Thus, for every TEN FOLD increase in the sound pressure level, there is an increase of 1dB only. The logarithmic dB scale also makes the multiplication and division of the sound pressure levels easier. (Please study about logarithmic scale separately for a better understanding of the concept)

The decibel (Sound Pressure Level – SPL) is defined as :

dB (SPL) = 20 $\log_{10}$ P1/P2 , where in P1 is the sound in question for measurement and P2 is the reference sound (i.e. with a SPL of 0.0002 dynes / cm^2).

Table 1 gives the ratios which are relevant for the human audible range of intensity along with the respective levels in dB SPL .It may be noted that even though the ratios range from 1 to 10,000,000 (i.e. one to ten million), the dBSPL level ranges only from 0 to 140.

Table 1. Ratio of dBs in Pressure

Ratio	Pressure (dBSPL)
1	0.0
2	6.0
10	20.0
20	26.0
40	32.0
60	35.6
.	..
100	40.0
10,000	80.0
10,000,000	140.0

1.7 SOME TYPES OF SOUNDS

We hear various types of sounds in our environment. Different types of sounds are used for Audiological evaluation. We also use various types of sounds in training the hearing impaired such as in AUDITORY TRAINING and SPECH AND LANGUAGE TRAINING. Therefore, it is important to know a little about the various types of sound, and their definition so that we can identify them and use them appropriately.

1.7.1. Pure Tones

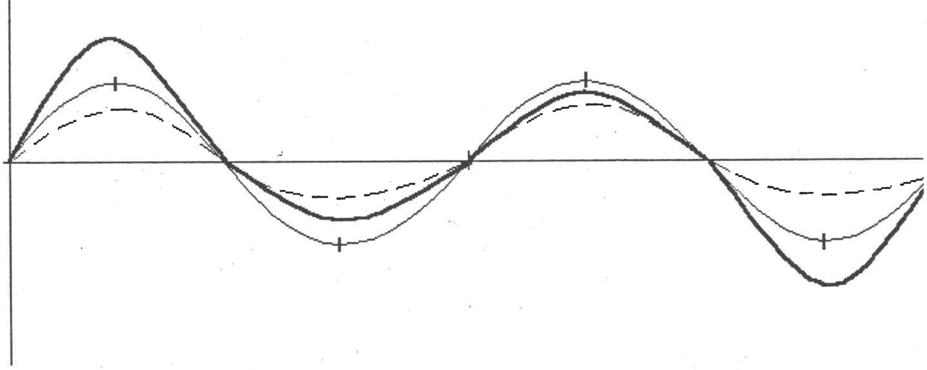
These are the sounds that contain only one frequency .Its waveform repeats itself every 't' seconds. Pure tones are not very frequently heard in our day-to-day activities. However, they are the ideal stimuli for audiological evaluations as information about each pure tone may be obtained.
Examples of pure tones are : the sound produced by TUNING FORKS, PITCH PIPES used by musicians, factory SIRENS etc. Pure tones of 250 Hz, 500 Hz, 1000Hz, 2000Hz, 4000Hz, and 8000Hz are used in PURE TONE AUDIOMETRY. The waveform of pure tones is as shown in fig. 1.

1.7.2 Complex Tones /Sounds

Complex tones are sounds that contain more than one pure tone in a SYSTEMATIC manner. The waveform will be periodic. There will be a pattern in the way the various pure tones are combined and hence the resultant sound is pleasant to hear.
Examples of complex tones are : sounds of the musical instruments, door bell, our speech etc.

The waveform of complex tones is as shown in Fig 2.

Fig.2 Complex Sound



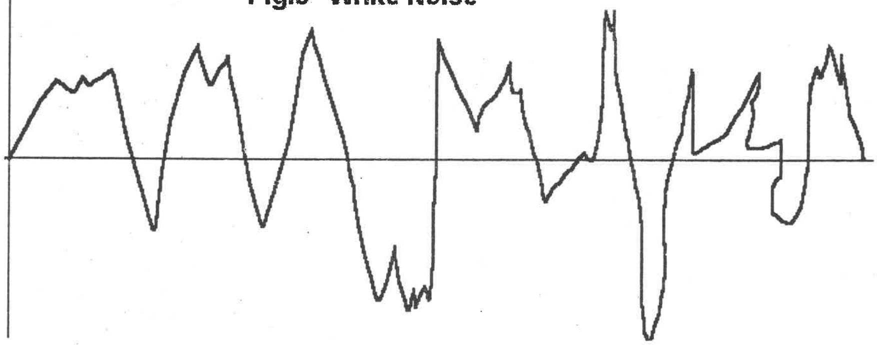
1.7.3 Noise

Noise is said to be an aperiodic signal because it fails to repeat itself at regular intervals. These sounds contain more than one pure tone / complex sound BUT in a haphazard manner and hence the waveform will not be periodic. Because of the irregularity in the combination of the different sounds, noise is unpleasant to hear. Examples of noise are : Traffic noise, noise in a market, sound made by electrical appliances such as fans, mixer –grinder etc.

1.7.4 Different Types Of Noises

a. **Broad Band / White Noise**: These are signals have equal energy on an average at a wide range of frequencies.
Figure 3 shows the waveform of white noise.

Fig.3 White Noise



b. **Narrow Band Noise :** Narrow Band Noise has energy in a narrow band of frequencies with maximum energy at a CENTRE FEQUENCY, and systematically reduced energy at the adjacent frequencies of the centre frequency.

1.8 ANATOMY OF THE EAR

The ear is described as **A Master Piece of Biological Engineering !!**

We have two ears placed on either side of the head in a symmetrical way. The important parts of the ear are hidden inside the head. What we see outside is only a very small and not so important part of the ear. However, the other parts are much more complex and important. The whole of auditory system covers a length of not more than 4 – 5 inches with in the head. However, this sense organ is considered to be the most complex sense organ. This is the only sense organ which is active even when a person is asleep and is far away from the source of sound.

The Auditory system, generally called as the EAR is divided into 4 parts / portions, namely :

- External Ear,
- Middle Ear,
- Inner Ear, and
- The Auditory Pathway.

1.8.1 External Ear

The External ear or the OUTER EAR consists of the PINNA or the AURICAL and the EAR CANAL or the EXTERNAL AUDITORY CANAL (MEATUS).

a. Aurical :

Aurical is the part we can see from out side. This is somewhat cone shaped and is attached to the head, on either side, at about an angle of 30^0 to 40^0. The deep portion in the center is called as CONCHA. The soft lower portion where one puts on the ear ring is called as LOBULE.
The Aurical is made up of ELASTIC CARTILAGE. There is no bone in the auricles. It has blood and nerve supply.

b. External Auditory Canal:

This is an `S' shaped tube open at the pinna and closed in side by the eardrum. It measures about 25 – 40 mm in length and has a volume of about 4 cc. The outer two thirds of the canal has cartilaginous base whereas the inner one third has bony base. The canal is lined with skin (EPITHELIAL CELLS). The outer portion of the canal has hairs on the skin. It also has wax-secreting glands called as CERUMENOUS and SEBACEOUS GLANDS. Like any other part of the body, ear canal also has blood and nerve supply.

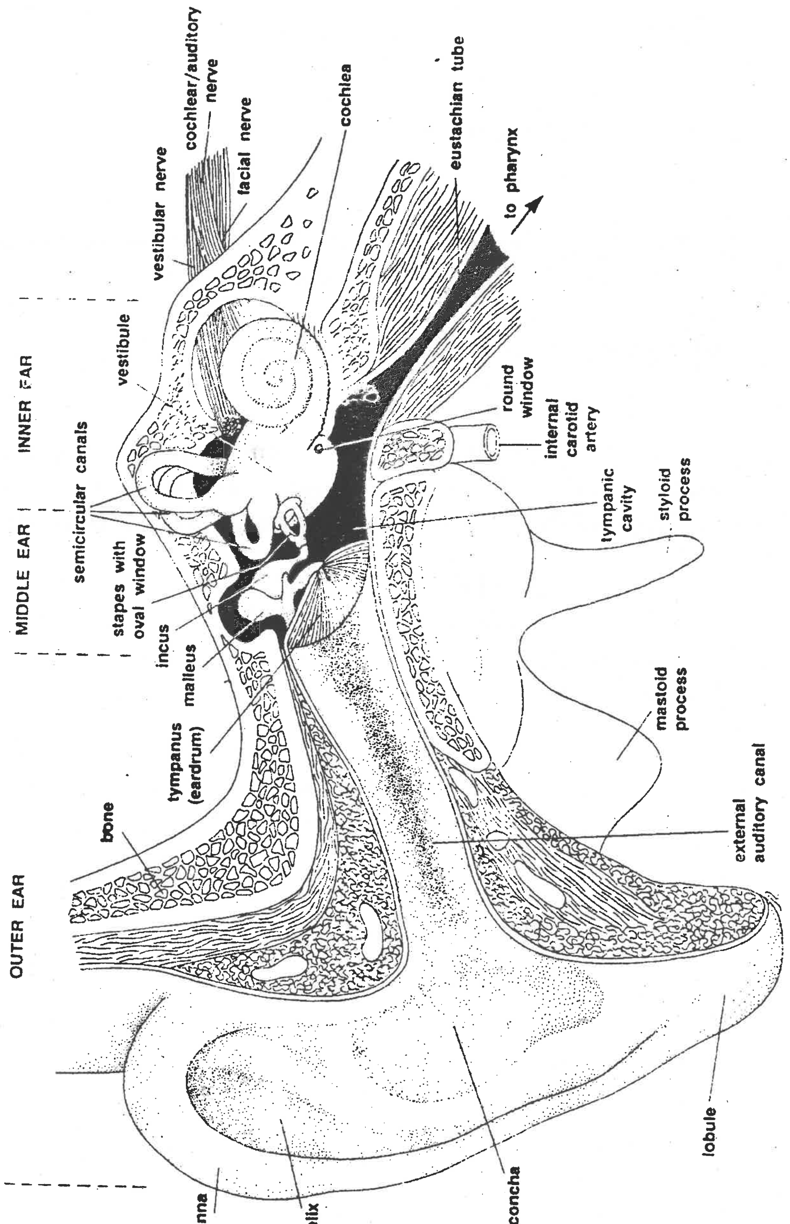


figure 3-1. A diagram showing the main components of the human auditory system.

1.8.2 Middle Ear

Middle ear is a small air filled cavity of about 2 cc. Volume. The eardrum (TYMPANIC MEMEBRANE) separates the external ear from the middle ear. The important parts of the middle ear are :

a. Ear Drum (Tympanic Memebrane):

This forms the outer wall of the middle ear cavity. It is a very thin membrane of about $1/10^{th}$ mm thickness. It is roundish oval in shape. It is also concave. It has an area of about 85 to 90 mm^2. The deepest (center) point of the membrane attaches itself to a little bone (Malleus) inside the middle ear cavity. A small portion of the TM is very thin and is called as PARS FLACCIDA. The rest of the TM is relatively thick and is known as PARS TENSOR.

b. Ossicles :

There are three little bones in the middle ear known as the OSSICLES. These three bones are joined to one another and form a CHAIN. This chain of ossicles is suspended in the air filled middle ear cavity. It connects the TM to the inner ear. The three ossicles are :

i) MALLEUS : This is a hammer shaped bone measuring 8mm in length and 25mg in weight. It has a long handle, which gets attached to the TM at a point called as UMBO and a short handle, which is free.

ii) INCUS : This is an anvil shaped little bone with the same length and weight as the malleus. The head of the incus is attached to the head of the malleus. This ossicle also has two handle-like structures. The long one gets attached to the third ossicle STAPES. The short one is free.

iii) STAPES : This is a stirrup shaped bone. This is the smallest bone not only in the middle ear but also in the whole body. This has a small head and an oval shaped FOOT PLATE. Two curved handles giving it the shape of a stirrup connect these two parts. This bone measures only 2.5mg in weight and less than half the length of malleus and incus.

c. Middle Ear Muscles:

There are two little muscles in the middle ear. TENSOR TYMPANI MUSCLE is attached to the long handle of the malleus. This muscle is supplied by the V^{th} CRANIAL NERVE (i.e. Trigeminal Nerve). The other muscle is the STAPEDIUS

MUSCLE. This muscle is supplied by the VIIth cranial nerve (i.e. Facial nerve). This muscle is attached below the head of the stapes.

d. Eustachian Tube

This is a tube, which runs from the wall of the middle ear cavity that is towards the center of the head (i.e. ANTERIOR WALL). This tube, which is about 30 to 40 mm in length, connects the middle ear to the NASOPHARYNX (i.e. Upper portion of the inside of the mouth).

e. Windows Of The Middle Ear

There are two windows on the inner wall (i.e. MEDIAL WALL) of the middle ear. This is the wall which separates middle ear from the inner ear.

One is called as the OVAL WINDOW, as it is oval in shape. The footplate of the stapes rests on this window and thus the ossicular chain makes contact with the inner ear. The other window is called as the ROUND WINDOW. This window is covered with a very thin (thinner than the TM) membrane. There is a bony prominence (round in shape) in between the two windows. This part is called as the PROMONTARY. The inner ear is placed behind these structures.

1.8.3 Inner Ear

Inner ear is referred to as BONY LABYRINTH as it consists of a set of complicated tubes in it. The inner ear houses both, the organ of hearing called as COCHLEA, as well as the organ of balance called as VESTIBULE. In this unit, our concern is only with the cochlea.

Cochlea is a snail shaped bony structure. The snail shape is obtained as the cochlear tube wounds around a central bony pillar like structure called the MODIOLUS two and two third times. The basal end of the cochlea (which is towards the middle ear) is broader and the apex is pointed. Inside, all along this bony coil, there is a membranous tube. The bony cochlea is filled with a fluid called PERILYMPH. The membranous tube is suspended inside this fluid. The membranous tube is also filled with another fluid known as ENDOLYMPH.

This arrangement of the membranous tube lying inside the bony tube results in the formation of three compartments inside the cochlea. Two compartments have bony wall as their outer wall and these two compartments are connected with each other at the apex of the cochlea. This point of connection is known as the HELECOTROMA. The compartment in contact with the oval window is called as SCALA VESTIBULI. The other compartment, which is in contact with the round window, is the SCALA TYMPANI. It is these two compartments, which contain perilymph. The membranous compartment, which is situated in between these two compartments, is known as the SCALA MEDIA. This division contains endolymph. It is this compartment, which houses the end organ of hearing that is called as **THE ORGAN OF CORTI.**

The Organ of Corti

The Organ of Corti is a cluster of cells situated on the BASILAR MEMBRANE. Basilar membrane is the membrane that separates the Scala Media from the Scala Tympani.

There are, basically, two types of cells in the Organ of Corti. They are, the SUPPORTIVE CELLS and the HAIR CELLS. The hair cells are the most important sensory structures. They have CILIA on top of their cell body and hence get the name HAIR CELL. There are two groups of hair cells separated by some supportive cells called as ROD CELLS. These rod cells make a tunnel like formation and have hair cells on both their sides. The INNER HAIR CELLS are placed in a single row and are few in number, while the OUTER HAIR CELLS are more in number. They are placed in 3 to 4 rows.

There are some important membranes in the Organ of Corti. The membrane which houses the Organ of Corti , as explained earlier , is the Basilar Membrane. There is a leaf like membrane, which hangs over the hair cells and is almost in contact with the cilia of the hair cells. This membrane is attached only on one side and the other end hangs loosely over the organ of corti. This membrane is known as the Tectorial Membrane. There is a very thin membrane that is present at the top of the cell bodies of the hair cells. This membrane is so thin that the cilia penetrate through this and get immersed in the endolymph of the Scala Media. This is the Reticular Membrane. Apart from these 3 membranes, the Scala Media has another membrane which divides it from the Scala Vestibule called as the Reissner's Membrane.

The hair cells are supplied by a complicated network of nerve fibres of the VIII cranial nerve i.e. the AUDITORY or the COCHLEAR nerve. All these nerve fibres join their cell bodies in the SPIRAL GANGLION and join to form the auditory nerve. This nerve traverses out through the modiolus.

1.8.4 Auditory Pathway

The Auditory nerve joins the VESTIBULAR NERVE, coming from the vestibule and leaves the inner ear through a small bony canal called as the INTERNAL AUDITORY MEATUS. It is then referred to as the ACOUSTIC NERVE. This acoustic nerve, along with a couple of other cranial nerves, moves to the BRAIN STEM and ascend up towards the cortex. While moving up in the brain stem, they synapse at various levels of brain stem. In this process, the majority of the nerve fibers from one ear CROSSES OVER to the other side and vice- versa. Then they terminate in the AUDITORY CORTEX in the TEMPORAL LOBE. Thus, the nerve fibers from the left ear terminate in the right temporal lobe of the right auditory cortex and vice- versa.

.1.9 PHYSIOLOGY OF THE EAR

1.9.1 Functions of the External Ear

The functions of the external ear are the following:

- The pinna "collects" the sound and directs it into the ear canal. It also makes the higher frequency sounds (i.e.5000Hz to 7000Hz) a little louder by "RESONATING" it.
- The ear canal transmittes the sound to the ear drum. It also makes certain frequencies (around 2KHz) louder because of its natural resonance.
- The ear canal, because of its "S" shape protects the eardrum from direct injuries from sharp objects.
- The hair and the wax present in the ear canal protects the eardrum by preventing the entry of any foreign body such as insects, worms etc. If they enter, they get stuck to the wax and hence cannot easily reach the eardrum.

1.9.2 Functions of the Middle Ear

The sound falling on the eardrum (Tympanic Membrane – TM) sets it to vibration. This vibration in turn vibrates the ossicular chain. When the sound is conducted through the ossicular chain, the footplate of the stapes starts ROCKING. This rocking motion of the footplate of the stapes passes on the vibration to the inner ear. In this process of transmission of sound from the outer ear to the inner ear the middle ear serves the following functions:

- It conducts the sound from outer ear to the inner ear,
- It acts as a TRANSFORMER by conserving and enhancing the sound so that not much energy is lost due to impedance mismatch while transmitting the sound from air media to fluid media (i.e. to the perilymph in Scala Vestibuli). The transformer action of the middle ear enhances the sound energy up to 27 dB.
- It protects the inner ear in two ways: i) It gives the cushioning effect to the inner ear; ii) the ACOUSTIC REFLEX elicited due to the contraction of the two muscles in the middle ear (i.e. Stapedius and the Tensor tympany) protects the inner ear from damage due to very loud sounds.
- The Eustachian tube helps to maintain the air pressure in the middle ear. It is maintained at par with that of the atmospheric pressure. This helps in the effective conduction of sound from the outer ear to the middle ear.

Eustachian tube also helps to drain out any secretion produced in the middle ear into the NASOPHARYNX.

1.9.3 Functions of the Inner Ear

The rocking of the footplate of the stapes due to the vibrations conducted by the TM disturbes the fluid in the Scala Vestibuli. Thus, the mechanical vibrations of the sound is passed on to the inner ear. The fluid (i.e. perilymph) in the scala vestibuli in turn displaces the Reissener's membrane which separates the scala vestibuli from scala media. This displacement of the thin membrane sets the endolymph to vibrate. When the endolymph is set in to motion, it ends up activating the hair cells in the Organ of Corti. Hair cell activation triggers the nerve impulse in the VIII nerve. This impulse will be electrical in nature and will be conducted along the auditory pathway.

Sound may also reach the inner ear by other routes. Sound can directly travel across the middle ear and stimulate the round window; it can also be transmitted through the bony structures of the skull. Irrespective of the mode of conduction of sound to the inner ear, the inner ear has the following functions :

- It acts as a transformer by converting the mechanical energy (sound vibrations) into electrical impulses by the functions of the hair cells. This process is called as the TRANSDUCTION PROCESS.
- Cochlea has FREQUENCY TUNING function. Thus, at the cochlear level itself the analysis of the frequency of the sound takes place.
- Similarly, the intensity analysis also starts at the cochlear level.

1.9.4 Functions of The Auditory Pathway :

Sound converted as electrical impulse is referred to as ACTION POTENTIALS. This is transmitted through the auditory nerve to the brainstem. As mentioned before, the majority of the impulses from the right side cross over to the left side and vice–versa. These impulses carry all the information regarding the frequency, intensity and time of the sound very systematically till they reach the Auditory cortex. Once the impulses reach the various parts of the auditory cortex, the sound will be PERCEIVED AND HEARD. Thus the auditory pathway functions as a RELAY and CONTROL center.

1.10 SUMMARY

- Sound is a form of energy . This is a very important form of energy for us as we use this energy to talk and communicate effectively.

- There are three physical parameters of sound namely : **frequency, intensity** and **phase.** Frequency is expressed in Hertz (Hz), Intensity is expressed in db scale and Phase is expressed in degree.
- Decibel scale is a logarithmic ratio scale , constituted to make the measurement of sounds easy.
- We hear sounds from 20 Hz to 20,000 Hz. The softest sound a normal person hears is 0dBSPL , which has a sound pressure level of 0.0002 dynes / cm ^{2} and the sound which causes pain is 140 dBSPL (with a sound pressure level of 2000 dynes / cm ^{2}).
- The psychological correlate of frequency is PITCH, that of the intensity is LOUDNESS.
- There are different types of sounds around us namely, pure tones (with single frequency sounds), Complex tones (with more than one pure tones but are periodic and hence pleasant to hear), noise which are combination of sounds in an aperiodic manner and hence unpleasant to hear.

Anatomy and Physiology of the Ear :

- The ear is divided into three parts namely, **external ear, middle ear and the inner ear,**
- Pinna and the external auditory canal make up the external ear,
- Middle ear is an air-filled cavity. It has the ear drum and the ossicles,
- The inner ear has both the end organ of hearing as well as the organ of balance,
- The end organ of hearing is called a cochlea,
- The end organ of balance is called a vestibule,
- The auditory nerve starts from the inner ear and carries auditory messages to the brain through the auditory pathway,
- External ear collects the sound and directs it to the ear drum via the external auditory meatus,
- The ear drum and the ossicles vibrate and pass on the sound to the inner ear,
- Both the external ear and the middle ear make certain frequency sounds louder due to resonation,
- The inner ear converts the sound into electrical energy and activates the nerve impulse,

- The nerve impulse is passed on to the brain through the auditory pathway.

1.11 SELF STUDY

1. Listen to the sounds in your environment and list them. State whether they are

   a) pure tones, b) complex tones, or c) noise.

2. State the pitch and loudness of each sound you have listed.
3. Study the Logarithmic table to understand the dB concept.
4. list out the types of noise you hear in your environment.
5. Observe the pinna of some persons to remember its shape and parts.

1.12 ASSIGNMENTS

1. Find out the intensity level of sounds in the environment in dBSPL from the books listed at the end of this unit.
2. Prepare a diagram of different parts of an ear on a chart paper and label it .
3. "Look into" the ear canal of a subject by pulling the pinna upwards and backwards and try to see the ear drum. Flash a torch to have a better view. Explain why you had to pull the pinna upwards and backwards.

1.13 POINTS FOR DISCUSSION

After going through the unit you may like to have further discussion on some points and clarification on other. Note down those points below :

1.13.1 Points for Discussion

1.13.2 Points for Clarification

1.14 REFERENCES

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UNIT 2: APPROACHES AND STEPS FOR CURRICULUM DESIGNING

STRUCTURE

2.1 INTRODUCTION

You have studied the structure and function of an ear in the previous module. In Audiology by **'normal ear'** we mean the ear of a young adult (from18 to 22 years) which has had **no known pathology or no known history of infection** nor any other kind of **disorder.** In terms of hearing levels -10dB to 20dB is considered as a **normal hearing level. A disorder of hearing** is defined as any **significant deviation** from the behavior of the average normal ear. In this module we shall be concerned with the **medical aspect** of hearing impairment, the causes of various hearing impairments and their treatment. We will also find out the information about incidence of hearing loss in India and the preventive measures that can be taken to reduce this incidence.

2.2 OBJECTIVES

At the end of the unit students will be able:

- To differentiate between organic and non-organic hearing loss.
- To explain the types of hearing loss.
- To enumerate the causes of conductive loss.
- To describe the treatment of conductive loss.
- To differentiate between conductive and sensory neural loss.
- To understand the causes of sensori-neural loss.
- To explain prevention of hearing loss.
- To understand the incidence of hearing loss in India

2.3 DEFINITIONS OF VARIOUS TERMINOLOGIES

Hearing losses are classified taking into account age of onset, site of lesion, genetic factors, degree of loss etc. The specific terminologies are used to describe the different classes and types. Let us get familiar with these terminologies.

Organic hearing loss: The term organic hearing loss implies to a **definite defect in auditory system** (that may be in external, middle, or inner ear or in the auditory nerve) resulting into hearing loss. Majority of hearing defects fall into this category.

Non organic hearing loss: The hearing loss that **is not due to physical impairment** in auditory system is called as non- organic loss. The cause of this loss is rather **psychological** than **anatomical.** This loss is also referred to as **psychogenic or functional hearing loss.** The functional loss may be **combined with organic loss** or in some cases arises from organic loss. Example: Sometimes the patient may have a mild to moderate degree of actual organic loss but behave as if his hearing were profoundly impaired. This patient would be described as having a ‘ **functional overlay** ‘ on a true hearing loss.

Malingerer: An entirely different sort of assumed hearing loss occurs in the case of the malingerer, who **adapts the role of deafness** or hearing impairment **consciously** and **deliberately** for purposes of his own. Sometimes these purposes are concerned with financial reimbursement for ‘ injury ‘ incurred on the job.
The person is well aware of the true state of his hearing.

Hereditary hearing loss: Hereditary hearing loss may be defined as the loss caused by **factors present in the genetic make up** of the fertilized ovum. Hereditary hearing loss may be transmitted as a **dominant** or **recessive** characteristic.

Congenital hearing loss: Congenital hearing loss means the condition of hearing loss **existing since birth**. Congenital hearing loss may be hereditary or may develop during prenatal or natal period.

Acquired hearing loss: The term indicates that the hearing mechanism was normal at one time and hearing loss developed at a **later stage due to some reasons** like severe illnesses, accidents etc. Acquired hearing loss is further grouped into pre-lingual and
post-lingual hearing loss.

Pre-lingual hearing loss: The term pre lingual indicates that hearing loss developed **prior to the language learning age**. The hearing loss developed during the first three years of life is considered as pre lingual loss.

Post-lingual hearing loss: The term post lingual loss suggests **that hearing loss developed after the language had developed significantly**. Post-lingual hearing loss can be sudden or progressive in nature.

Sudden hearing loss: Sudden hearing loss results due to **one time insult** to the auditory system. The damage to the auditory system remains as a permanent hearing loss. Example: Hearing loss developed due to trauma.

Progressive hearing loss: This term indicates that hearing loss is getting **worse with time** This may be due to any infection or hereditary disorder. Any significant deviation form the behaviour of the average normal ear can be considered as a

hearing disorder. The disorders of hearing can result from defects or diseases in outer middle or inner ear or auditory nerve. They are classified into **three major types**, taking into account the part of the ear affected,
a) Conductive impairment , b) Sensori-neural impairment, c) Mixed Impairment.
This classification is used by otologists and audiologists for the purpose of diagnosis and treatment. These three types of hearing disorders, their causes and treatment are discussed below.

2.4 CONDUCTIVE IMPAIRMENT

Any **dysfunction of the outer or middle ear** in the **presence of a normal inner ear** is termed a **conductive impairment** of hearing. In other words, the difficulty is not with the perception of sound but with the conduction of sound to the analyzing system. **Acquired hearing losses** in children are more likely to be of the **conductive type**. The conductive hearing loss can be congenital or acquired. Some of the common causes of conductive loss are listed below:

2.4.1 Causes of Conductive loss

Conditions of the outer ear:

a.) <u>**Atresia:**</u> The atresia means absence of external ear. Occasionally **babies are born with missing or rudimentary and occluded canals.** This condition is referred to as **agenesis** of the pinna and **atresia** of the external auditory canal. More often congenital atresia is accompanied by the anomaly of the middle ear as well. Frequently **the drums and ossicles are missing entirely.** By and large children with **congenital atresia have conductive hearing loss** as their inner ear is well developed structurally. However in some cases middle ear anomaly is also associated with deformities in the inner ear.

b.) <u>**Wax in external auditory canal:**</u> The commonest cause of hearing due to the improper functioning of the outer ear is a **blocking or plugging of the ear canal by an excess accumulation of cerumen(wax).** Ear wax formation and its outward movement towards the pinna is a self- **cleaning mechanism** of the external auditory system. Some people produce much more cerumen than they need for the ordinary protection of the ear drum, with the result that the cerumen builds up into a plug, which effectively prevents sound waves from reaching the ear drum. Sometimes wax gets hardened in the ear canal and becomes impacted.

c.) **Foreign body obstruction:** It is possible for **the canal to be blocked by other substances** besides wax. The obstruction of the external canal by a foreign body may give rise to conductive hearing loss especially in children. The **children may stuff objects** like beans, wads of papers, beads, pieces of crayons etc in the canal. Hearing loss is usually not a major concern in such cases unless the foreign body has ruptured the ear- drum.

d.) **External Otitis:** External Otitis is **an inflammation of the skin** of the external auditory canal, most frequently due to **bacterial or fungal infection.** Usually the canal skin is red and edematous and only a small amount of discharge is present. In some cases the condition may not result in hearing loss however if the **swelling of the canal** is so marked that it obstructs the canal conductive loss will result. Some varieties of **otitis externa** are associated only with dry, scaling canal skin with little discharge.

Conditions of the middle ear:

- **Otitis Media:** The **most common cause** of conductive impairment is an **inflammation or infection of the middle ear** known as Otitis Media. There are various types and forms of **Otitis Media** One form produces **retraction** (forcing inward) of the drum owing to lack of sufficient pressure in the ear. The other form of Otitis Media causes the drum to **be distended or forced outward from the pressure** within the ear. The distention of the drum is sometimes caused by the **presence of fluid** in the middle ear cavity, usually as a result of infection in the nasopharynx. The term **serious Otitis Media** refers to various **conditions of the fluid** in the middle ear cavity. **If the fluid is clear and not pus the condition is called as Non-suppurative Otitis Media** and **if the fluid is pus the condition is referred as Suppurative Otitis Media.** The temporary condition of infection and inflammation of middle ear is named as **Acute Otitis Media.** The term **Chronic Otitis Media** is used for the **recurring and frequent infections** of the middle ear. If Acute Otitis Media remains untreated can result into Chronic Otitis Media which may lead to conditions such as **perforation** of the ear drum, **growth of granulation** tissue and **infection** of the temporal bone.

- **Cholesteatoma:** It is a condition associated with Chronic Otitis Media. A marginal perforation of the drum may result in an in-growth of skin forming a **pseudo-tumor** called **cholesteatoma** which invades the middle ear and mastoid space and **can also destroy ossicular chain.**

- **Otosclerosis:** Otosclerosis is a **hereditary disease** that is more **common in females** than in males. The disease begins at a young age. This is a disease process that affects the bony capsule of the inner ear, turning the normally hard bone into spongy bone. Typically the **oval window is covered with bony deposit** and the **footplate of the stapes becomes fixed** in the oval window in such a way that normal movements do not occur. The **fixation of the stapes** occurs **gradually** over a period of years and produces a progressive hearing loss. Usually **otosclerosis** produces a **conductive** type of loss because **of failure of transmission of vibrations** to the fluid of the inner ear. At later stages the disease invades the inner ear and causes destruction of some nerve fibers.

2.4.2 Treatment of Conductive Loss

The patients with conductive hearing loss may avail **medical and surgical line of treatment**, which usually can improve the hearing. If inner ear is normal, the cases of **congenital atresia** can be treated surgically. A bone conduction type of hearing aid can also be used temporarily till the time of surgery. Impacted wax or foreign bodies can be carefully removed by otologists.

The treatment for **otitis media** is usually the **administration** of the **antibiotic drugs** in order to control the infection in the ear. If there is any danger that the drum might spontaneously rupture due to the fluid collection, the operation is performed to allow the middle ear cavity to drain. This operation is called **myringotomy**. Sometimes the surgical procedure called **tympanoplasty** is done in order to **improve hearing** through **repair or reconstruction of damaged parts of middle ear**. In chronic Otitis Media with drainage through a perforation and possibly with the presence of cholesteatoma, there is always the danger that the infection or the growth will reach the covering of the brain and cause meningitis or other complications. It may be necessary for otologists to perform an operation called **mastoidectomy** as a **preventive measure**. The surgical procedure used for Otosclerosis to restore hearing is called as **Stapedectomy**.

2.5 SENSORI-NEURAL IMPAIRMENT

When the loss of hearing function is due to **pathology in the inner ear** or along the nerve pathway from the inner ear to the brain stem, the loss is referred as **sensori-neural impairment** (also written as sensorineural or sensory-neural). A pure sensori-neural impairment exists when the sound conducting mechanism, i.e. the outer and the middle ear is normal in every respect. In other words, sound is conducted properly to the fluid of the inner ear but it cannot by analyzed or perceived normally. **Sensori-neural impairment** can be **present at birth** or can be **developed in the later stage of life.**

2.5.1 Causes of Sensorineural Loss

Some of the causes of sensori-neural impairment are listed below:

- **Heredity:** Some cases of congenital sensori-neural loss may be attributed to heredity, **A defect in the genes.** Genes are found in chromosomes in the nuclei of all the cells that compose our body. Hereditary **hearing loss** may be **transmitted** as a **dominant** or **recessive** characteristic.

  Heredity appears to be responsible for a fairly consistent percentage of hearing loss cases. Such hereditary factors involve epithelial cells that are destined to form the inner ear. This may take the form of a **failure to develop specialized cells** that form the nerve element of the Organ of Corti, or there may be a tendency toward **early degeneration** of the fundamental cells. The mechanism by which this defect is transmitted in the blood- line is the same as that for such things as hair colour, facial features etc.

  Hereditary **hearing loss may be associated** with other stigmata such as renal involvement, degenerative diseases of nervous system, mental retardation and metabolic abnormalities etc.

- **Damage to the Embryo in Utero(pre-natal causes):**

  Many times, **congenital deafness** can be explained in the terms of **damage to the Embryo in Utero.** It is known, for example that when the mother incurs certain diseases early in pregnancy, usually during the **first three months of pregnancy**, the **embryo** is subject to **injury** of various sorts, including impairment of the hearing. **German Measles** (rubella) is one of the most **insidious diseases** in its effects on the embryo. It may produce such anomalies, singly or in combination, as deafness, blindness, cleft palate, cerebral palsy and mental deficiency. The other diseases incurred by the mother during pregnancy **and** having harmful effect on the embryo are influenza, toxoplasmosis, **bacterial** meningitis.

  Maternal alcoholism and **drug addiction** is also known etiological factors of hearing loss. Maternal irradiation, toxemia, diabetes and severe systemic maternal illnesses have **been documented** as causes of hearing loss. Maternal **use of certain drugs** such as **quinine** and salicylic acid (derivatives of which may be used to relieve pain) may **affect the fetus** and lead to hearing loss.

- **Natal Causes (causes occurring during the process of birth):**

- **Hemorrhage** occurring **during the process of birth** and **shortly after birth may be responsible** for hearing losses. There are numerous causes for hemorrhage including trauma from prolonged or rapid delivery, caesarian section, breech presentation, other abnormal birth conditions and inept obstetric practice. Another common cause of injury is **oxygen deprivation** (anoxia) **and failure to breathe** (apnea) during the process of birth. The **blood abnormalities** (high level of bilirubin and jaundice) caused by **Rh incompatibility**, which may be present when certain differences in blood type exist between the parents can lead to hearing loss.
- **Infectious diseases:** It has been found that **bacterial and viral infections** can **destroy cochlear hair** cells leading to permanent hearing loss. The diseases that may cause sensori-neural impairment include measles, mumps, scarlet fever, diphtheria, whooping cough, and any of the unnamed viral infections.

- **Drug Induced Hearing loss:** There is a group of **ototoxic drugs** which has a predilection for causing **cochlear and in some cases vestibular damage**. Drugs that are particularly toxic to the ear are certain antibiotics, salicylates and quinine. Streptomycin, which is prescribed for cases of tuberculosis, is a vestibulo toxic and ototoxic drug. The drugs such as kanamycin, neomycin, gentamicin and viomycin are ototoxics and should be used in treatment when no non- toxic drug is available.

- **Noise induced hearing loss:** As the civilization has progressed, the noise in the human environment has increased. The **adverse effects of noise are widespread** with respect to human physiology and produce changes in many bio-systems including ear. **Traumatic noise levels** invariably affect the hearing threshold at **4000 Hz** first and as the **exposure continues the damage extends to other frequencies.** There are many occupations in which the workers are subjected to extremely noisy environment and are susceptible to noise induced hearing loss that is caused due to damage to the hair cells in cochlea. The use of **ear- muffs and ear-protectors is recommended for such persons.** Exposure to **intense noise** for even **brief periods** can also **cause permanent damage** to the nerve fibers in the cochlea.

- **Presbycusis:** Presbycusis is a sensori-neural loss caused due to degenerative changes of aging. It is the most common cause of sensori-neural loss in the adult population. Recent statistics show that hearing impairment can occur in as many as 25 % of those in the age group of 65 to 70 years. This percentage can increase up to 40% in the age group over 75 years. The **degenerative effects** of aging **can involve variety of locations and cell types in cochlea.** It is for this reason that presbycusis in some individuals may be mild to moderate whereas may be profound for some other individuals.

- **Meniere's disease:** This is a condition confined to the middle ear and a cause of sensori-neural impairment. The symptoms of Meniere's disease are tinnitus, vertigo (dizziness) and hearing loss. The immediate cause of these symptoms is apparently an **increased fluid pressure** within the

  Membranous labyrinth hence the disease is also referred to as **endolymphatic hydrops.**

2.5.2 Treatment of Sensori-neural Loss

The inner ear structure has been considered as the most **complex structure** in the body. Any effect in the inner ear is permanent in nature. **The inner ear defect cannot be cured, controlled or rectified by any medical or surgical intervention.** The term sensori-neural is self-explanatory and means that sensori system is affected. The persons with sensori-neural hearing impairment are advised to use amplification device i.e. **Hearing aid.** The congenital hearing loss or pre-lingual hearing loss had adverse effects on speech and language development of a child. Early identification of such hearing loss is essential so that the **rehabilitation process** can be started as early as possible. The rehabilitation program includes fitting of hearing aid, auditory training, language stimulation, speech correction, parental counseling etc.

Some children with no recordable hearing and not benefiting from hearing aid may be tried with **cochlear implant**, if otherwise found suitable.

2.6 MIXED HEARING IMPAIRMENT

There are many instances of persons exhibiting symptoms of both conductive and sensori-neural types of loss. An elderly patient with presbycusis may also have some conductive loss because of otitis-media or an otosclerotic may have some secondary nerve involvement. Such cases demonstrating some degree of both types of hearing loss are referred to as mixed impairment. The term **mixed hearing loss refers to hearing loss due to involvement of inner ear as well as outer or middle ear.** A patient with mixed hearing impairment shows some **loss by bone conduction but a greater loss by air conduction**. The treatment of mixed impairment can vary from patient to patient and decided by an otologist. The treatment could be medical, surgical or use of hearing aid.

2.7 INCIDENCE OF HEARING LOSS IN INDIA

The incidence of hearing impairment in India is **quite alarming. Even though the** exact figures are not available, several studies have **documented the incidence of** hearing impairment to be between 6.8% (ICMR Study, **1983) to 37%** (Jain, 1967). Stated below are the various studies conducted and the **incidence of hearing** loss found (ref. status of disability in India 2000, page 106)

Reported Incidence of Hearing Impairment in India

Reported by/ Year of study	Population studied	Type of loss	Incidence
1. Gupta, 1965	General Population	Hearing Impairment (in general)	35.4 %
2. Kapoor, 1967	General Population	Hearing Impairment (in general)	16.3 %
3. Jain, 1967	General Population	Hearing Impairment (in general)	37 %
4. ICMR Multicenter study 1983.	Rural Area	Hearing Impairment (in general)	10.7 %
	Urban Area	Hearing Impairment (in general)	6.8 %
	Rural Area	Conductive Impairmen	48 %
	Urban Area	Sensori-Neural Impairment	41.7 %
5. Nikam, 1970	School going children	Hearing Impairment (in general)	3.9 %
6. Vishwanath 1971	Rural School going children	Hearing Impairment (in general)	18.9 %
7. WHO, 1988	Population with hearing impairment	Genetic Hearing Impairment	52%
	Population with hearing impairment	Genetic Recessive	75.88%

India is a vast country. To reach out to masses has been one of the challenging tasks. We have yet to know the exact number of hearing impaired persons.

A comprehensive country wise sample survey of persons with disabilities was undertaken by National Sample Survey Organization. (NSSO), in its 36th round in 1981. Another survey was conducted by NSSO in 1991 to estimate the magnitude of disabilities of the people in India. Estimated hearing and speech disabled number is shown in table given below.

Estimated number of disabled persons in India: 1991

Category: Hearing and Speech Disability					No. in Millions
Type :	Rural		Urban		Total
	Male	Female	Male	Female	
Hearing	1.409	1.164	0.339	0.330	3.242
Speech	0.942	0.557	0.298	0.169	1.966
Hearing & Speech	2.009	1.490	0.557	0.426	4.482

The survey has also estimated the causes of various disabilities, the findings are **summarized in the following table showing per thousand distribution of persons with** hearing impairment separately for rural and urban areas.

Causes	Rural	Urban
German Measles/Rubella	9	14
Ear discharge	175	143
Other illnesses	186	197
Burns	2	2
Injury other than burns	35	52
Medical/surgical intervention	10	21
Noise Induced hearing loss	17	18
Old Age	310	316
Other Reasons	77	88
Not known	179	149

2.8 PREVENTION OF HEARING LOSS

Prevention of hearing loss is **not yet an organized activity in India**. However certain important measures are bound to alter the incidence of hearing loss in India. **The actions need to include:**

1. **Immunise** all adolescent girls and women in child- bearing age against Rubella.
2. **Avoid** consanguineous marriage in families.
3. **Increase facilities** for early detection of pregnancy and to know the Rh-factor.
4. **Encourage** hospital delivery.
5. **Educating** the medical doctors on the need for judicious use of ototoxic drugs while treating patients especially pregnant woman and infants.
6. To carry out **immunization programs** against diseases like mumps, measles, tuberculosis etc.
7. **Creating awareness** regarding noise induced hearing loss among the masses especially among those who are working in noisy surroundings. **Encouraging** the use of ear-protectors and ear-muffs among people working in environment where the noise levels are injurious to hearing mechanism.

A **World Health Organisation (WHO)** 1980 report summarizes the **main causes** of hearing impairment as **infection, neglect and ignorance**. Low socioeconomic conditions, inadequate health care and malnutrition are the factors responsible for the above mentioned causes. According to WHO document of 1980, three levels of prevention are defined as follows:

- **Primary prevention** that includes the action aimed at preventing the impairment from occurring.
- **Secondary Prevention** that includes the action to be taken once impairment is present either to cure the disease or to control it. Example: Treatment of Otitis Media.
- **Tertiary prevention** includes habilitation and rehabilitation aimed at compensating for the hearing impairment by the use of amplification. It also includes special education, vocational training, and counseling to the parents of the hearing impaired.

The national and collaborative efforts for prevention of hearing impaired are a part of general measures undertaken for the prevention of all disabilities. Some of the measures which are carried out are mentioned below:

- **National measure of immunization:** Expanded program of immunization was launched by the WHO in 1974 and was implemented in India in 1978 with the collaboration with WHO. This is also one of the programs incorporated in National Health Policy of 1983. The universal immunization program is aimed at control of vaccine preventable diseases namely diptheria, pertussis, tetanus, tuberculosis, poliomyelitis and measles. **Hearing impairment is a sequel** of some of these infectious diseases or hearing impairment may result due to ototoxic drugs administered to manage the disease. **Implementation of this program is resulting in reduction in the incidence of hearing impairment** to some extent by controlling the infectious diseases.
- **National Iodine deficiency disorder control program:** Iodine deficiency is reported to result in several disorders like goiter, mental retardation and hearing impairment.

The population of Sikkim was screened for hearing loss (Roy Etal, 1991). It was found that 42.47% of the Iodine deficient population studied had hearing loss, especially for higher frequencies (3000Hz, 4000 HZ and 6000 Hz). **National Iodine Deficiency Disorder Control Program helps in prevention of hearing impairment by controlling the cause of deafness.**

- **Child survival and safe motherhood program:** This program was launched in 1992-93 as a seven year project with the financial assistance of World Bank and the UNICEF. The aims and objectives of the project were:-
  - **Sustaining and strengthening universal immunization program,** oral re-hydration therapy to control diarrhoea.
  - **Improving the maternal care** at community level by providing training to the traditional birth attendants and providing disposable delivery kits.
  - **Control of acute upper respiratory track** infection for children below five years of age.
  - **Setting up sub district level first referral units to attend emergency cases.** These projects aim at hygienic deliveries and immunization of the newborns that helps in early detection and control of infections. Indirectly this program is useful in controlling the causes of hearing loss.

2.9 EFFECTS OF HEARING LOSS

The **overall impact** that a hearing impairment will have on a life is greatly influenced by the age **of onset,** the **age at which** the hearing loss was **diagnosed, degree of impairment,** the **etiology.** The child who loses his hearing at the age of 4 or 5 years after he has acquired speech and language, obviously will not be as handicapped as the child who has hearing loss from birth. Since hearing loss may range quantitatively from mild to profound, it is axiomatic that the **greater the loss the greater the handicap.**

The effects of hearing loss are discussed below:

- **Hearing is a prerequisite for the development of normal speech and language.** A child with normal hearing learns to speak by **listening to** the speech and language stimulation provided in his environment and **modeling** his own utterances in an orderly sequence as he grows. The average child will have achieved **basic competency** in his or her primary language by the age of **about 3½ years.** By about seven years of age the speech and language development is almost complete but the process of hearing continues to help the child in overall learning and act as the **primary feedback mode for monitoring speech throughout the life.**

The children with hearing loss run the **risk of failing to learn** language at the normal time or rate because the learning of language is a **primarily auditory event.** The hearing impaired children have deficit in **vocabulary depending upon he degree of hearing loss** while general vocabulary knowledge increases with age the **gap** between children with normal hearing and the children with hearing loss in word usage **widens** as the children grow older. Children with hearing loss do not learn as much incidental vocabulary as do children with normal hearing. **Hearing impairment affects the acquisition of grammatical rules** for use in comprehension and expression of spoken language.

- The process of hearing is useful as a primary feedback mode for monitoring speech throughout the life. The children who have mild to moderate hearing loss exhibit **misarticulations**, similar to those of children with normal hearing, who have developmental disorders of articulation. Children with severe to profound hearing loss produce fewer consonants and develop them later than children with normal hearing. Abnormal patterns of speech rhythm may constitute the most deviant aspect of speech for these children.

- **Deficits in communication functions, interferes** seriously with **educational process** during the early years and in all school years to follow.

Any degree of hearing impairment can put a child at a risk for **reduced academic achievements.** The underlying cause of poor academic achievement is the language deficit incurred as a result of hearing loss. The children with hearing loss may **demonstrate reduced performance** in those academic subjects that are language based and / dependent on the ability to learn new information through reading. Even mathematic performance is affected although to a lesser extent than are other subjects.

- A barrier to the child's progress that is second in importance only to oral language is **a failure to learn to read.** Practically all of the information not presented to the child in the form of oral language will reach in printed form as a general rule. The children with severe hearing loss do not exhibit sufficient knowledge of language to ensure a basis for the normal development of reading skills. For children with hearing loss, the task of learning to read is a duel one. They are expected to learn language and reading simultaneously.

- The children with hearing loss do not follow conversation and occasionally not aware that they are being spoken to without facility with spoken language, these children depend upon the goodwill of adults, both teachers and parents, to interpret, rephrase and verbally mediate when necessary. The inability to hear and react appropriately makes them unpopular and their friends may avoid them. The end result is one of social isolation and the reduced self-esteem that occurs due to which they feel rejected by those children with whom daily interactions are necessary. It is the reaction of the family, peers other adults and poor communication that contribute to **social adjustment difficulties.**

- **Effects of hearing loss on parent child interaction:** The parents are impacted emotionally by confirmation of hearing loss. The common reactions of parents include grief, denial, anger, depression, guilt etc. Some parents tend to **overprotect** their child and exempt him from discipline. Some parents make **constant apology** for the child, cover up his hearing defect or keep him from the public eye. Acceptance of the hearing impaired child is of cardinal importance. Parents should **accept the hearing handicap unreservedly** as they have to play an important role in rehabilitation program of their child.

- The goal for all children with hearing loss must be **early detection** followed immediately by **appropriate intervention.** The development of language is the foundation for all other aspects of human behavior, growth and development. **Without language subsequent effects** are seen in the academic achievements and social developments. Through **early detection** and **appropriate intervention** we must work with children and their families to enable them to **achieve optimum personal development.**

2.10 LET US SUM UP

- Different terminologies are used to describe hearing losses.
- Hearing impairments are divided into three types: conductive, sensori-neural and mixed.
- Conductive loss is due to defect in the outer and/or middle ear.
- Conductive loss may be amenable for medicine or surgery.
- Sensori-neural hearing loss is due to the defect in the inner ear or in the auditory nerve.
- There is no known medical or surgical cure for sensori-neural loss.
- Usually the persons having sensori-neural loss are advised to use hearing aid.
- Mixed hearing loss refers to hearing loss due to involvement of inner ear as well as outer or middle ear.
- The incidence of hearing impairment in India is quite alarming.
- The incidence of hearing loss can be controlled by taking preventive measures.

2.11 SELF STUDY

1. Differentiate between the following terms:
   a. Pre-lingual and post-lingual loss.
   b. Organic and non-organic loss
   c. Congenital and acquired loss
   d. Sudden and progressive loss
2. Enumerate the causes of conductive loss
3. Describe the nature of treatment used for conductive hearing impairment.
4. Differentiate between Conductive and sensori-neural loss.
5. Discuss the etiology of sensori-neural hearing impairment

6. Why a hearing aid is recommended for a case of sensori-neural hearing loss?
7. Write a short note on mixed loss
8. What preventive measures can be taken to reduce the incidence of hearing impairment in India. ?
9. Discuss the effects of hearing loss.

2.12 ASSIGNMENT

a) Describe causes and treatment of conductive hearing loss.

b) Define sensori-neural loss and innumerate its causes.

c) Describe how hearing loss can be prevented.

2.13 POINTS FOR DISCUSSION AND CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification on other. Note down those points below :

2.13.1 Points for Discussion

2.13.2 Points for Clarification

2.14 REFERENCES

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2. Handbook of clinical Audiology by Jack Katz.
3. Status of Disability in India 2000

UNIT 3:
CURRICULAR NEEDS OF CHILDREN WITH HEARING IMPAIRMENT IN SCHOLASTIC AREAS

STRUCTURE

3.1 INTRODUCTION

Hearing loss can develop due to various pathological conditions. At the **outer ear** level there could be excessive formation of wax or an obstruction due to a foreign body. At the **middle ear** level, there could be infection, discharge or ossicular chain discontinuity. At the **cochlear** level, the hearing loss can occur at birth or may occur due to certain infections.

The degree of loss may vary in individuals. Some individuals may display mild hearing loss, others may exhibit severe hearing loss. The effects of hearing loss could also vary. One person may develop poor language skills, another may have difficult in localising the source of sound. One child may display poor academic progress, while another may develop poor self concept and may lack self confidence.

The objective is to learn more about hearing evaluation techniques. There are various types of hearing tests. Some tests are aimed at identifying the hearing impaired individuals. Other tests help to study the type and degree of hearing loss in details. The interpretation of some tests depends upon the subjects responses. In other tests, the test interpretation does not depend upon the subject's responses.

In this unit, we shall be discussing different tests, their merits and de-merits and how these tests can be used for early identification of hearing impairment.

3.2 OBJECTIVES

At the end of the unit students will be able

- to understand need for hearing evaluation
- to describe objectives of various tests
- to enumerate difference between informal and formal test
- to understand high risk criteria
- to list various symptoms of partial hearing loss
- to elaborate formal subjective test
- to explain need for objective tests
- to select appropriate test for various age groups.

3.3 OBJECTIVES OF HEARING TESTS

Why do we test one's hearing ? Isn't it sufficient for an E.N.T. doctor to examine the ears to draw his conclusions ? The fact is that the doctors can only examine the **physical structure** or the condition of the ear. This is also limited to these areas which are **visible**. But this examination does not give any information about the **functioning** of the system. An EN.T. doctor can not examine the inner ear with simple instruments in his clinic. It is the **physiological function** ,which tells us more about the function and the capacity of the inner ear. There is a need to perform certain tests, to interpret the results and to give more definite answer, regarding whether the hearing is normal or abnormal. If the hearing mechanism is abnormal, then it is essential to know the degree and the type of hearing loss. The objectives of hearing tests can be stated as follows :

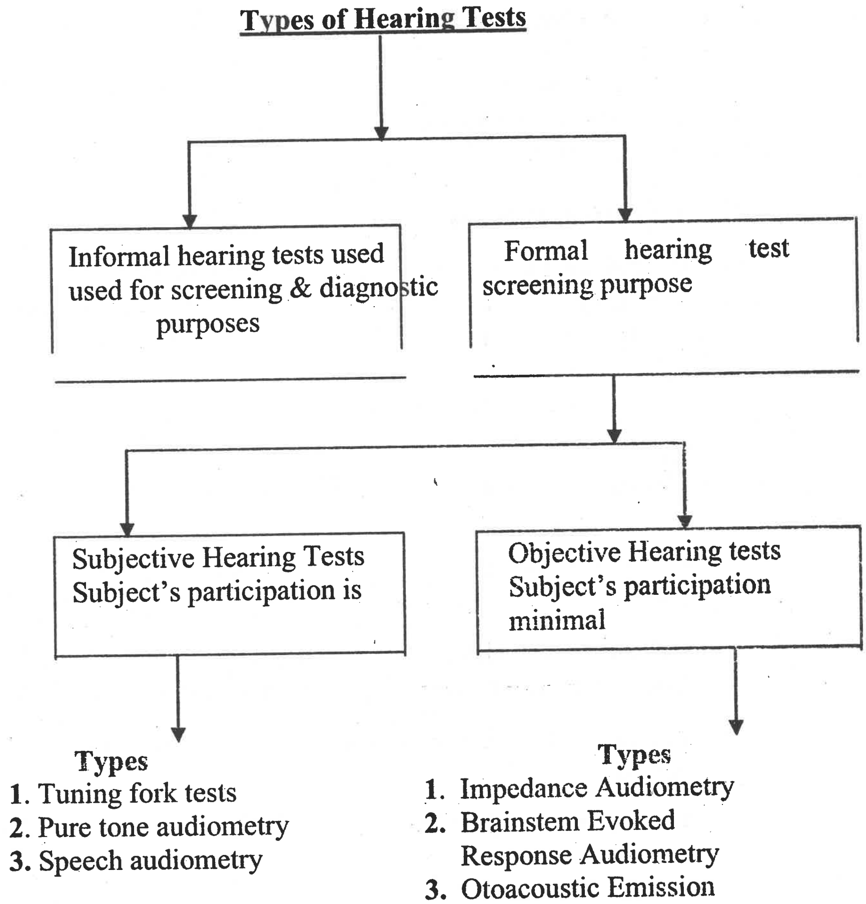
- **Early identification of hearing loss** : A child needs to have **normal** hearing sensitivity to achieve normal and age-appropriate language development. Various medical conditions may lead to hearing loss, which will ultimately affect language development of a child. It is important **to identify** this condition at a **very early stage** so that rehabilitation can begin at an early stage. It can be done in the hospital or in the primary health centre. Such tests are called **screening tests**. Screening is the process of applying a test to a large number of individuals. The procedure should be simple, fast and should be capable of identifying probable hearing disorders.
- **Medical diagnosis** : Another important purpose of a hearing test is **to assist in medical diagnosis**. The audiologist performs and interprets the test results to find out whether the auditory system is normal or not. If the system is not normal, what type of problem does one have ? Does it involve

the outer/middle/inner ear ? Is it the degree of loss mild/moderate or severe type ? The test results give information about the hearing mechanism **qualitatively and quantitatively**. This diagnosis helps the doctors to **understand the problem and to plan treatment**.

- **Monitoring of hearing status** : The purpose is to understand the **changes in hearing capacity over a period of time**. People who have a long - standing history of exposure to loud noise, or who have been working in a noise - hazardous environment. These are usually people working in a military or factory environment and are likely to develop hearing loss over time. It is essential to **monitor** their hearing sensitivity on a **regular basis**. Similarly, cases with progressive hearing loss, or those who have fluctuating hearing loss, need to be monitored for their hearing status.
- **Auditory fitness** : Hearing assessment and a proper diagnosis are essential to understand a person's **auditory fitness**, i.e. his hearing capacity, certain jobs such as telephone operators, pilots and armed forces personnel require good auditory skills. Only if the hearing tests display normal hearing, the person would be accepted for such jobs.
- **Planning of rehabilitation program** : The hearing tests give information about the degree of loss. This helps to plan the rehabilitation programme; selection of hearing aid and fitting of the hearing-aid. A complete assessment of a hearing impaired child would help to plan whether he requires special or integrated schooling. The programme will also help the child's speech and language development.

3.4 TYPES OF HEARING TESTS

There are various types of hearing tests. These can be classified into different groups. Each classification uses a different criterion. There are various instruments used to perform the tests. These instrumentation vary from very simple tools to the most sophisticated; computerized tools. All these tests have a **common aim, - to find out the hearing capacity**. Each test has its own merits and demerits. We need to study these tests and to understand their utility.



3.5 INFORMAL HEARING TESTS

An informal test is based on **behaviour observations** of a subject in response to various auditory stimuli . This test has a single objective -'**early identification of hearing loss**'. This test can be performed on **new-born** babies in the hospital. It can also be performed at primary health centres, and on **school-going** children in the school environment. Informal hearing tests can be performed by a semi-skilled person, **who has a basic knowledge about child development and auditory behaviour of various age group**. An informal hearing test assesses whether a child has normal hearing or has a probable hearing loss. In other words, this procedure **only identifies** potential hearing loss cases, but this test procedure **does not measure** the degree of hearing. Screening for hearing sensitivity has been an acceptable practice since 1927. At that time, screening tests were carried out on children at the age of two to five years; Now, sophisticated hearing tests have made it possible to assess hearing sensitivity of new born babies as well. Informal tests are commonly carried out on infants and children under two years of age; but the tests can be performed on school-going children as well. To perform hearing tests on all children will be very time-consuming and may not be cost-effective. A question arises, who should be chosen for a hearing test ? The next point will answer this question.

3.5.1 High Risk Criteria

Children who are likely to have hearing disorders are the ones who have a **strong family - history** of hearing problems or who have a **significant history of certain illnesses**. There are some children who have had a problem at the time of birth, or have had a problem immediately after birth. These conditions are grouped in a category known as **'High Risk Criteria'**. Following are the few conditions associated with the high risk group.

1. **Hereditary Hearing Loss** : There is one or more hearing-impaired persons in the family.
2. **Consanguinity** : Marriage of parents is between close relatives. e.g. first cousins.
3. **Rh Incompatibility** : Two different blood groups, of mother and baby (foetus) which are not acceptable because of basic differences.
4. **Prematurity** : Birth of a child before completion of normal pregnancy period.
5. **Low birth weight** : Weight of a baby at birth is considered as low if it is less than 1500 gm.
6. **Asphyxia** : The child does not breathe, or has difficulty in breathing, immediately after birth.
7. **Hyperbilirubinemia** : The child develops severe jaundice immediately after birth.
8. **Birth defects of ear, nose, throat** : The child may have congenital atresia (absence of external ear), cleft palate and or lip.
9. **Severe Infections:** Infections in the early weeks after birth : e.g. meningitis, measles.
10. **Birth defects of head ,face ,and neck** The child may have small head, or abnormally large head

The above stated conditions are likely to be associated with hearing loss - hence a hearing check for those cases is essential. However, hearing loss is only one of the disabilities associated with the above group. **These children may also be likely to**

display mental retardation, visual impairment, or cerebral palsy. The tester must be aware of this fact, so that early detection and rehabilitation is possible. This early detection of hearing loss is possible by way of informal hearing tests.

Informal hearing tests for various age groups : Children respond to various auditory stimuli differently. Their **response** pattern **varies** with age. The Auditory system of human beings starts **functioning** when the **baby is in womb**, and it **matures** with age. **Generally, by eighteen months of age, the auditory system reaches maturity and starts functioning as an adult auditory system.** Naturally, auditory response varies from birth to two years of age. It is important to define the auditory response patterns of various age groups.

3.5.2 Arousal test

A simple arousal test, using a high intensity signal **to awaken** the infant, has been accepted as a test for hearing screening. A baby who is in a light sleep normally gets **disturbed, or gets startled**, when loud sounds are presented. The stimulus can be a clap or a bang.

The loud sound should be presented at a distance of one foot, and the response should be observed. If the baby gets disturbed or gets startled; the child's hearing sensitivity is likely to be normal. Other body reactions may be opening of the eyes; a stirring movement of the whole body, indicating arousal from sleep; or a strong and immediate eye-blink followed by one of the above responses. These responses should be elicited two or three times during the procedure. If the child repeatedly fails to respond to sound, formal hearing test is recommended.

3.5.3 Orienting Test

Sir Alexander and Lady Ewing (1944) were the first to describe orienting responses in infants. They had recommended the use of various noise-makers. (such as a toy-xylophone, a cup and a spoon, a rattle, tissue paper) and voice and unvoiced consonants. The responses they described are time tested. These are eye-shifts, or head-turns towards the sound. **These response patterns get well defined with age.**

3.5.4 Informal Test for Various Age

The expected responses of a normally hearing child to various sound stimuli at different age levels are :

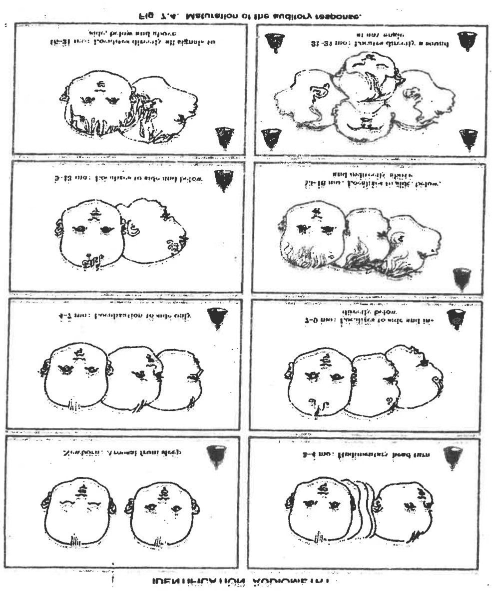
- **Birth to four months of age** :- A simple arousal test using a loud sound to awaken the child has been accepted as an informal hearing test. In addition, to this, widening of the eyes, eye blink, frowning etc. are other common body responses. If the child fails to respond to three successive sound presentations, refer the child for a formal hearing test.

- **Four to seven months of age** :-. This stimulus should be presented out of the child's field of vision and at a distance of one foot.. **An immature head turn in a horizontal plane, or a wobble of the head**, is observed as a response to sound. This response pattern **gradually matures**, and around six months of age the **head turn is definite**.

Normally by this age, the child responds **to familiar voices** of parents and of siblings. He smiles, stops crying and interrupts his play when he hears these familiar voices. The mother should be asked whether her child is responding in this way. If the child fails to respond, a formal hearing test is required.

- **Seven to twelve months of age** :- The sound is presented in various planes, such as at the side, below the child and indirectly above, at a distance of one foot from the child. The sound should not be presented within the child's field of vision. The response expected from a child with normal hearing would be a turning of the head towards the source of the sound.

By this age, the child can understand the meaning of the word 'no'. **His babbling** (i.e. vocalizations like ba-ba-ba, da-da-da) **increases**. By the age of ten months, he will look towards the object named. If you ask, "Where is the ball ? ", he will look around for it. The parents have to be asked whether the child is **capable of making such responses**.



- **Thirteen to twenty-four months of age** :- The child of one year of age or above demonstrates **orientation to the sound source by locating a sound, presented at any angle. The full maturation** of the auditory behaviour of the child occurs at about **eighteen months**, and does not change significantly after that. **Spontaneous expressive language** i.e. speech development, is another strong indicator for normal hearing sensitivity. But specific information from the informant can help to give a better idea of the child's ability. The informant is asked the following questions

1. Does your child respond to simple instructions?
2. Does he identify and does he name body parts?
3. Does he try to communicate simple sentences?
4. What is his vocabulary size ? (10 words, 20 words)
5. Does he try to imitate simple nursery rhymes?
6. Does he use too many gestures?
7. Do the parents need to use many gestures for the child to understand them ?

If the answers are negative to the above first five questions, and positive to the last two questions it is advisable to refer the case for complete diagnostic audiological evaluation.

Remember : If the informal method results point to a possible hearing problem, formal tests of hearing have to be performed.

- **Behavioural symptoms of hearing impairment in older age group children** (Two years and above age) :-

A **severe to profound** hearing loss can be **detected** very easily, as the symptoms are obvious. However, a **mild or a moderate** loss may go **undetected**. These children may be labelled as 'dull', 'stubborn', 'inattentive'.

If a child presents any of the following symptoms he may be having a possible hearing loss. If any of these are detected, he should be referred for formal hearing tests. The teacher and parents can use the following **check - list** to identify hearing impaired children.

The Symptoms are :

1. The child has problems paying attention in the school.
2. The child finds it difficult to understand speech if presented behind him.

3. He may answer questions irrelevantly.
4. Repetitions of speech may be required before he can follow an instruction.
5. The child puts the TV / Radio too loud.
6. The child does not respond if called from another room.
7. He hears only when he wants to, 'is a very common comment by parents and teachers.'
8. The child may display poor vocabulary and grammar.
9. He may exhibit voice problems and mispronunciation.
10. The child may speak too loudly or too softly.
11. The child may not mix easily with other children of his age.
12. The child may favour to use one of the ears for listening purposes. e.g. He always turns his right ear towards the source of sound or speech.
13. He performs better in school if placed in the front row.
14. The child uses too many gestures.

If the answer is yes to 50 % of the above symptoms, the child may have a hearing problem, and he should be sent for formal hearing tests.

3.5.5 Merits of informal hearing tests

1. No special instruments are required.
2. The test can be performed in a short time.
3. Do not require trained professionals to carry out the test.
4. These are cost-effective techniques.
5. These are useful in early identification of hearing loss.

Demerits of informal hearing tests

1. These tests do not provide a definite conclusion about the hearing status.
2. These tests do not give any definite diagnosis about the type or degree of hearing loss.
3. False results may be frequently seen.
4. Test - retest reliability varies significantly.

An informal hearing test has the **single objective** of **early identification** of hearing loss. In a country like ours, where people have difficulty in getting access to necessary services, an informal test carries significant importance. If the subject fails in an informal test, he should be referred for formal hearing test. Before we start on formal hearing tests, we need to take a complete case history of the subject. This may give an indication of the cause of hearing loss. Similarly, a physical examination of the ear by an ENT doctor is essential.

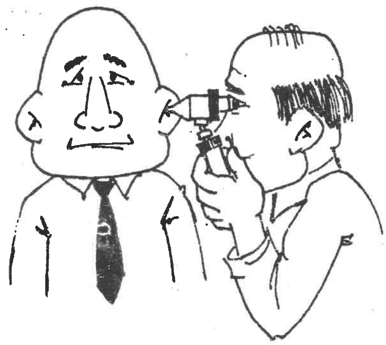


Fig II

3.6 PRE-REQUISITES OF A FORMAL HEARING TEST

Before a hearing test is actually performed, certain basic procedures need to be followed.

(a) **Examination by an ear specialist** :- It is necessary for a doctor to **examine** the ears to detect any **anatomical or pathological** anomalies which may be present. When the ENT specialist examines the ear, he uses an instrument called an **'otoscope'**. This instrument has a magnifying glass with an attached light; when it is inserted in the external ear canal, the doctor can see the magnified structures clearly. It is essential to remove any obstructions (e.g. wax, foreign body) which may be present in the ear canal, before the hearing test is performed. The doctor can examine the **tympanic - membrane**, and can draw some conclusions about the middle-ear status.

Case History : The case-history helps to obtain certain **relevant information**, about the patient's problem. An adult patient is questioned regarding the **medical aspects** of the problem, such as duration of the problem; pain in the ear, a discharge from the ear, and other signs of hearing loss. And medical problems such as **diabetes and hyper - tension**. All this information is useful in the hearing test results. This helps to reach a diagnosis of the hearing disorder. In case of a child, family members can be asked a few questions about the child's general health, his birth history, any other major family history for hearing loss etc. **This information is valuable to understand the cause of deafness, and to plan remedial measures to the extent possible.**

3.7 FORMAL HEARING TESTS

These tests are carried out using simple or elaborate equipment. The tests are performed by professionals. There are two subgroups under formal hearing tests. They are **subjective** hearing tests and **objective** hearing tests.

Subjective Hearing Tests

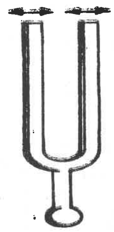
Hearing is a very personal experience; The subject needs to actively indicate that he has heard the sound. The individual has to **actively participate** in the test, along with the tester. Naturally the subject himself should meet certain basic requirements, to participate in these tests. **Basic requirements** for participation in the formal hearing test are , the subject should **understand all the instructions** given to him prior to the test. He should have the **desired attention - span**, and should have **focussing skills** to listen and to respond to various auditory stimuli. An individual needs to wear headphones to listen to various stimuli and he needs to keep those headphones on for a certain length of time, at least a minimum of ten minutes. **The hearing tests, which involve subject's active participation, are called ' subjective tests'.**

Types of Formal Subjective Hearing Tests : These are the **diagnostic tests**. The instrumentation, procedures and interpretations of the test results are **standardized**. These tests have **universal acceptance** in the medical, audiological and educational field. There is a well-developed test battery, which includes tuning fork test, pure tone audiometry and speech audiometry among others. These tests have **strong reliability** and **validity**. These are the important tests used in the clinical and rehabilitation fields.

3.7.1 Tuning Fork Tests

Tuning forks are very **simple instruments**, used even today by E.N.T. doctors. They have been used for over two centuries. The forks are of **different sizes and frequencies**. These frequencies are 256 Hz, 512 Hz, 1024 Hz, 2048 Hz and 4096 Hz. Tuning fork tests are effective tests for **qualitative** evaluation. A doctor can diagnose conductive loss or sensorineural loss in his office, and can plan a line of treatment immediately after the test.

There are two basic tests with tuning forks. These are Rinne' test and Weber test.



Tuning Fork (Fig III)

Rinne' Test

Compares the hearing sensitivity of a subject via **air conduction and bone conduction**. The qualitative comparison of these two modes of hearing, gives information about conductive hearing loss and sensori-neural loss.

Weber Test

Compares the hearing sensitivity **via bone conduction in the two ears**. Weber test is generally performed to support Rinne' test findings.

Merits of Tuning Fork Test

1. The test helps in qualitative evaluation of the hearing loss.
2. It uses very simple tools.
3. The test requires no special test room.
4. There is no recurring cost involved.
5. The test can be performed in a short time.

Demerits of the Tuning Fork Test

1. The test findings can not give quantitative evaluation.
2. False responses are common.
3. This test can not be performed on small children.
4. The test is difficult to perform on severe to profound hearing loss cases.
5. The test requires active participation of the subject.

3.7.2 Pure Tone Audiometry

Pure tone audiometry is the **well accepted diagnostic** test. The pure tone audiometry has an electronic oscillator-circuit which generates pure tone frequencies, with controlled output levels. The audiometer can generate frequencies from 125 Hz to 8000 Hz. Its intensity or output is regulated from 10dB to 120dB, in steps of 5dB. **The purpose of the test is to find out the faintest tone a subject can hear at various desired frequencies.** This faintest intensity level is called **threshold of hearing**. These thresholds are determined for two main purpose 1) to assist in the diagnosis of ear pathologies (2) to acquire information which may be used in obtaining appropriate habilitation or rehabilitation programmes for hearing impaired individuals.(The details of test procedure are given in unit 4.)

Merits of Pure Tone Audiometry

1. It is a very reliable diagnostic tool.
2. The test results help to understand the qualitative conductive / sensorineural / mixed hearing loss) and quantitative (mild/moderate/severe) nature of the hearing loss.
3. The test assists an ENT doctor in planning the medical treatment for the patient.
4. The test results help audiologists and speech therapists and teachers of the hearing - impaired to plan habiltation and rehabilitation measures.
5. The test findings provide guide- lines to select a hearing aid.
6. The results would be accepted by Government agencies to ascertain auditory fitness.

Demerits of Pure Tone Audiometry

1. It requires a very special sound treated room. It can not be performed in any ordinary room.
2. Regular calibration and servicing of the audiometer is a must.
3. Only trained professionals can perform the test.
4. It requires active participation of the patient.
5. The initial expenses are high.

3.7.3 Speech Audiometry

Speech audiometry is a supplementary tool to the pure tone audiometry procedure. This test is more than a hearing acuity measurement test. **It is a test of the overall performance of a subject in hearing, understanding and responding to speech.** Speech audiometry is particularly suitable for the general assessment of hearing and the estimation of the degree of practical handicap related to a hearing problem.

The procedure of speech audiometry is very simple. The test material is speech. Words or sentences are spoken into a microphone, which is a built-in part of the audiometer. This signal is passed through a calibrated attenuator , and is heard by the listener through the headphones, or through the loudspeakers. The listener is asked to identify the words. He may repeat the test words or he may check them on a multiple choice list, or he may write them down on a paper. There are two main types of tests (1) Speech Recognition Threshold test (S.R.T.) (2) Word Recognition Score Test (W.R.S.Test).

Speech recognition threshold (SRT) is defined as the **lowest level of intensity,** which **elicits 50% of correct responses.** SRT has proved to be a **reliable test,** and can be used to test the **validity** of pure tone thresholds (PTA). It has been very well documented that SRT value is in good agreement with PTA values. If the test threshold levels for pure tones and for speech do not agree, it strongly suggests that the defect is either neurological or it's an error of technique.

The second type of speech test is called word recognition score test, (W.R.S.Test), **which aims to measure how well the listener hears and discriminates words in general.** It measures the maximum percentage of words that are intelligible at the most comfortable listening level. **A normal** hearing person and a person with **conductive loss** can achieve **nearly 100% score** at the comfortable listening level. But in **sensorineural loss,** the maximum discrimination scores **fall markedly**.

Speech audiometry is considered as one of the sensitive tools in diagnosis. However, in a country like ours, with a multicultural and multilingual environment, to develop standardized speech test material in all languages has been a difficult task. In spite of this, speech test materials have been developed in nearly 12-15 languages.

Merits of Speech Audiometry

1) It gives an assessment of the subject's practical hearing capacity.
2) It is a good validity test for pure tone audiometry .

Demerits of Speech Audiometry

1) It requires a special sound treated room with a two-room situation.
2) Only trained professionals can perform the test.
3) The subject should have a minimum vocabulary of fifty to sixty words.
4) The test material has cultural biases.
5) The tester and speaker should be speaking the same language.
6) The initial expenses are high.

3.8 OBJECTIVE HEARING TESTS

These tests do not require active participation of the subject. Using modern and sophisticated instruments, the hearing capacity of the subject is detected. The tester has to be a well-trained audiologist. As the subject does not participate in the test, the test results do not depend on his level of intelligence, co-operation or attention span. The objective tests are **standardized universally**. The various tests are as follows

1) Impedance audiometry
2) Brainstem evoked response audiometry (BERA)
3) Otoacoustic Emission Tests.(OAE)

All the tests are reliable tests and help in a detailed diagnosis of the hearing problem.

3.8.1 Impedance Audiometry

Impedance audiometry is an **objective means of assessing the function of the auditory system**. A small probe is inserted into the ear canal. With the help of a pressure release pump, air pressure is exerted on the eardrum. **The drum responds to the change of air pressure** in the outer ear canal. This results in some degree of displacement of the eardrum. This **movement of the eardrum is measured**. The instrument shows this movement in a graphical form, which is called as 'tympanogram'. There are various types of tympanograms, which give significant information to the doctor.(Fig.4). The modern instrumentation is fast and reliable. The entire test can be completed in three to four minutes duration.

Fig.IV.

Various types of tympanogr..ns:

Type A: Normal middle ear function.

Type B: Fluid in the middle ear.

Type C: Eustachion tube blockage.

Type As: Fixation of the ossicular bone.

Type Ad: Ossicular chain discontinuity

Types of Tympanograms (Fig IV)
Type A: Normal middle ear function, Type B: Fluid in the middle ear
Type C: Eustrachian tube blockage, Type AS: Ossicular

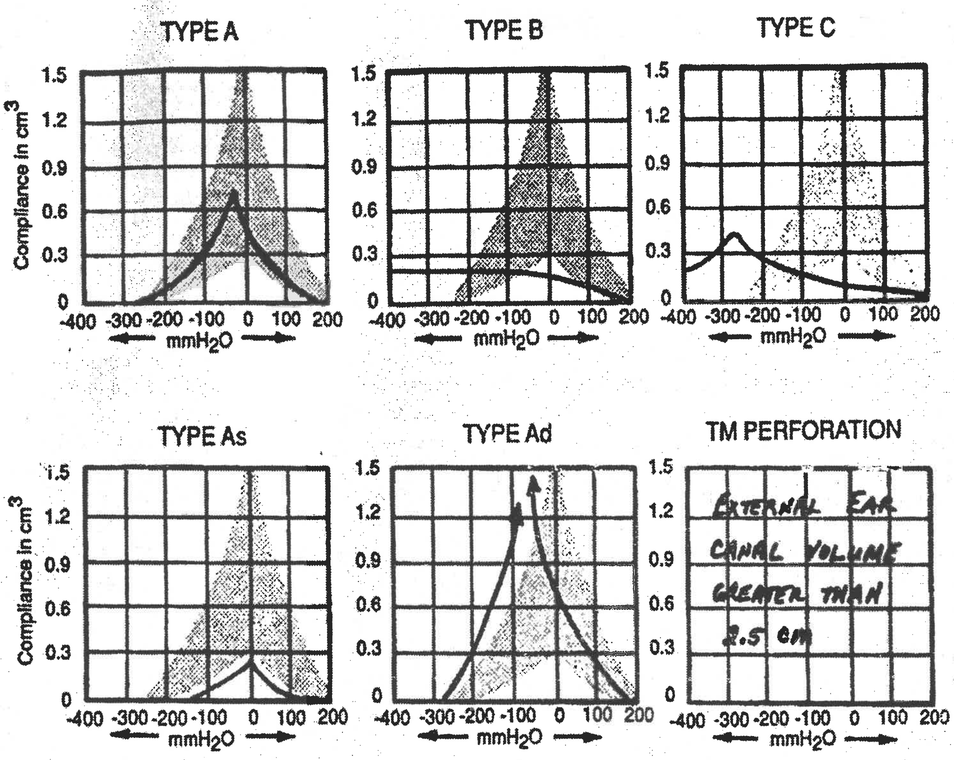


Figure 20.2. Tympanogram types most often encountered clinically when recorded with a single component (e.g., admittance) and a common relatively low (e.g., 226 Hz) probe tone frequency.

Merits of Impedance Audiometry

1) It requires minimal participation of the subject.
2) It takes a few minutes to perform.
3) It provides useful diagnostic information about the status of the middle ear, to the doctor.
4) It is a very reliable test.

Demerits of Impedance Audiometry

1) It requires a fairly silent environment to perform the test.
2) Regular calibration and servicing of the instrument is a must.
3) Only trained professionals can perform the test.
4) The test can not be carried out if the child is crying, drinking milk, vocalizing or talking. Sedation may be required in such a case.
5) The initial expenses are high

3.8.2 Brainstem Evoked Response Audiometry

Our brain has **continuous ongoing** electrical activity. This activity can be measured. If any sensory stimulation is provided, this activity undergoes a change, and a very definite particular waveform pattern emerges. This waveform can be **recorded** and can be **measured** with the help of computerised technique. **With reference to auditory stimulation, typical seven peaks waveform pattern is seen on the computer screen, which is called auditory, evoked response** (Fig.4). This activity is measured with surface electrodes, which are placed on the mastoid bone of the test ear, the forehead and central point of the head (vertex). Various auditory stimuli are presented through the headphones, which are placed on the ears. **This electrical response is very stable, and is recorded at low intensity of sound levels**. The test can be performed on very young infants and new born babies too.

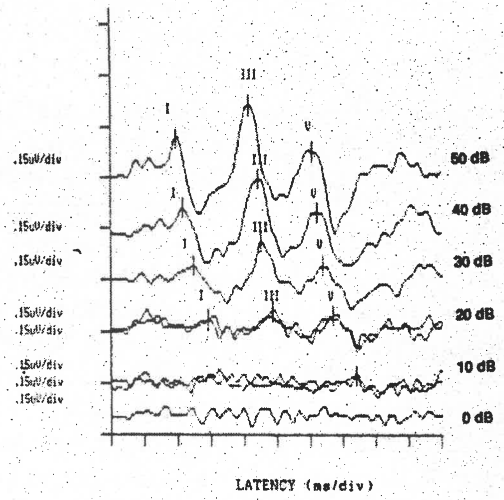
Brainstem evoked response audiometry is also called 'Auditory Evoked Potential (AEP) and Auditory Brainstem response (ABR) test. The test can be performed on newborn babies. This test is done effectively when the infant child is asleep. Thus, most of the time, testing is done under induced sleep (i.e. sedation).

Merits of BERA Test

1) It requires minimal participation of the subject.
2) It provides useful diagnostic information to the doctors, audiologists and teachers; with reference to the degree of hearing loss.
3) It is a very reliable test.
4) It is a non-invasive technique, i.e. the skin is not punctured or pierced at any point.

Demerits of BERA Test

1) It is a time-consuming test.
2) It requires a fairly silent room.
3) Only trained professionals can perform the test.
4) Sedation is required for infants and children.
5) **This test gives information about hearing sensitivity between 2000 Hz to 8000 Hz; If a child has better hearing between 250 Hz to 2000 Hz, a true picture of hearing status may not be documented.**
6) The initial and recurring expenses are high.



(Fig V)

Typical BERA waveform of a normal hearing individual.

3.8.3 Octoacoustic Emission Test

The outer hair cells of the normal healthy cochlea generate some sound. This sound is either spontaneous, or it is in response to some auditory stimulation. **This generated sound can be measured** by inserting a probe microphone in the ear canal. This measurement technique is called ' Otoacoustic Emission Test.' **This activity is absent in the presence of hearing loss.** It has become a very valuable tool to test new-born babies for early identification. The test is done in a few minutes. Those who fail in this test, are subjected to BERA test.

Merits of Otoacoustic Emission Test

1) It is a quick test.
2) It can be performed on newborn babies.
3) There is no participation of the subject.
4) Test results are reliable.

Demerits of Otoacoustic Emission Test

1) The test does not quantify hearing loss.
2) It requires a fairly silent environment.
3) The baby should be in a sleeping state.
4) Initial cost is high.

3.9 LET US SUM UP

This unit has given us an understanding of various hearing tests. Normal speech and language development is dependent upon normal hearing function. For various reasons, if the auditory system fails to respond, a child's speech and language development and consequently his educational and social development will be affected. It is essential to measure the hearing sensitivity at an early age. The informal hearing tests are quick and effective tools to identify probable hearing impairment. Those individuals who fail in the screening test, or those who have a significant family or medical history, are subjected to various formal hearing tests. Formal test battery consists of subjective and objective hearing tests. Subjective hearing tests are the ones where individual participation in the test procedure is expected; while objective hearing tests do not require the subject's active participation.

Once the qualitative and quantitative evaluation is done, the line of action to be taken can be decided. They can be grouped into two categories. Those cases that can be treated medically are referred to the medical doctors. Cases, who have permanent hearing disability, need to be considered for a rehabilitation programme.

3.10 SELF STUDY

1) Why is it important to detect hearing loss at an early age?

2) What is an informal hearing test ? Where can it be carried out ?

3) Why is it important for you to be aware of the "High Risk Criteria?" List all conditions included in the high risk criteria.

4) State True/False

   a) Children falling in the high- risk criteria may develop only a hearing loss.

   b) A baby whose birth weight is 1100 gm. would be considered as low birth weight.

   c) A child's auditory maturation is completed by 18months age.

   d) a child labelled by his teacher as "dull", "stubborn", "inattentive" may actually be having a hearing impairment.

   e) Pure tone audiometry results are not accepted by government agencies to prove fitness of hearing.

5) What are the arousal responses an infant less than 4 months would show, when presented a loud sound?

6) A child of 19 months is brought to you. The parents mention he does not respond to sounds and he has not yet developed speech.

   a) What are the basic questions you would ask the parents ?

   b) What informal test would you carry out in the room ? What response would you expect at 19 months age?

   c) In case the child fails the informal tests, where would you refer the child?

7) A teacher of the first standard class feels one child has a probable hearing loss. Name six 'symptoms' she may have observed in the child.

8) Which formal hearing test/tests can be recommended for a three months old child who had jaundice at birth?

3.11 ASSIGNMENT

1) Write various types of formal subjective hearing test.

2) Discuss behaviour response patterns of an infant to various sound stimuli.

3) Describe behavioural symptoms of four year old hearing impaired child.

3.12 POINTS FOR DISCUSSION AND CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification on other. Note down those points below :

3.12.1 Points for Discussion

3.12.2 Points for Clarification

3.14 REFERENCES

1. Handbook of Clinical Audiology : Ed. Jack Katz
2. Hearing in Children : Northen and Downs
3. Hearing and Deafness : Davis and Silverman

UNIT 4: CURRICULAR NEEDS OF CHILDREN WITH HEARING IMPAIRMENT IN NON-SCHOLASTIC AREAS

STRUCTURE

4.1 INTRODUCTION

If you are observant enough, you will realize that a **sizable number of individuals suffer from some degree of hearing loss.** You are already familiar with the various types of hearing impairments, their causes and treatment. In the earlier module, you have studied the various types of hearing tests available for the diagnosis of hearing loss. Pure-tone audiometry is a simple and a basic test which is conducted first in most of the hospitals and clinics when a person complaints of a hearing loss. This module will cover the process of hearing assessment using pure-tone audiometry in details and the interpretation of the results.

The earlier the loss is detected the better is the rehabilitation. Keeping this purpose in mind the pure-tone audiometry is modified to suit various age groups. The test procedures used for various age groups are also discussed briefly in this module.

4.2 OBJECTIVES

At the end of this unit students will be able:

- To describe the parts of pure-tone audiometer.
- To understand pure-tone audiometry and its importance.
- To explain the step by step, procedure of pure-tone audiometry.
- To plot an audiogram using proper symbols.
- To interpret an audiogram for type and degree of loss
- To calculate average hearing loss
- To describe free field test.
- To differentiate between close field and sound field- test
- To describe the test procedures used for infants and children.

4.3 INTRODUCTION TO PURE-TONE AUDIOMETRY

We have seen that hearing impairment can be caused due to various **structural and physiological changes** in the auditory mechanism. The effect of these changes is exhibited as hearing loss, which may be identified by observing the individual's behavior. It is necessary to find out **the qualitative** (type of loss **) and quantitative** (degree of loss) status of auditory system, for which pure tone audiometry is used.

A Pure tone audiometry is a subjective test carried out by controlling many physical and behavioural factors. It came into effect after Second World War and is used as an established procedure worldwide. As the name indicates, the **pure tones**

i.e. sounds of single frequency are used as stimuli in this test. The thresholds for air conduction and bone conduction are measured independently and separately for each ear. In psychological and physiological work in the field of sensation, **threshold** is defined as the **intensity of stimulus required just barely to elicit a sensation** in whatever sensory modality is being studied. A threshold of hearing may be defined as the **minimum intensity level of a tone at which sound is detected as a sensation from silence and elicits a response.**

A Pure-tone audiometry is carried out using an instrument called **audiometer,** which produces different pure tones of variable intensities. It is necessary to carry out this test in a **sound treated room** as the presence of ambient noise in the test room would affect the test results. **A sound treated room** has specially designed walls, floor, ceiling and doors. Minimum furniture and heavy carpeting are essential. These special features prevent external sounds from entering the room and also absorb any sounds generated within the room. Ideally ventilation is achieved by central air-conditioning.

The results of pure tone audiometry are shown in a form of a graph called **audiogram,** which is a representation of frequency intensity function

4.4 IMPORTANCE OF PURE-TONE AUDIOMETRY

Pure tone audiometry is a **simple test** that provides useful information **about hearing impairment.** Let us find out how the test results of pure tone audiometry are useful to otologists, audiologists and the teachers of the hearing impaired.

- The **qualitative information** regarding hearing impairment can be obtained. You are already familiar with different types of hearing impairment and their treatment. As the decision regarding treatment of hearing impairment depends upon the type, it is indeed very important for otologists to obtain this information from audiogram.

- The **quantitative information** such as mild, moderate, severe or profound loss can be obtained. This information regarding degree of hearing impairment is useful in planning appropriate habilitation or rehabilitation programs for hearing impaired persons.

- **Both the ears are tested separately** during the procedure and the independent information is obtained for each ear. The hearing sensitivities of the two ears can be

  thus compared.

- Some hearing losses are progressive in nature. If the pure tone audiometry tests are carried out at regular intervals the **changes in hearing sensitivity can be identified.**

- **The comparison of pre-treatment and post-treatment** documentation of hearing sensitivity is useful in assessing the benefits of treatment. In many clinics and hospitals, it is a common practice to record pre-surgery and post-surgery audiograms to obtain information regarding changes in hearing sensitivity.

- The results of pure tone audiometry are useful in **selecting a hearing instrument** of appropriate gain and **adjusting its tone control.** The decision regarding monaural or binaural amplification will also depend upon the findings. The information obtained from the test is useful for setting up amplification levels in speech trainers, group hearing aids etc.

- Pure Tone test is a basic test in Audiology which **gives guidelines for further management** and provides direction for further investigations.

4.5 DESIGN AND FUNCTIONS OF AUDIOMETER

Audiometer is an instrument **designed and calibrated** to **international standards.** It produces different pure tones of variable intensities. Audiometer has a basic electronic circuit called an **oscilloscope,** having a capacity to generate number of frequencies. There are several models of pure tone audiometers available commercially. They vary from simple portable models to research type audiometers. Various types of audiometers like portable models, table models, computerised models are available in the Indian Market. Regardless of the make and type of pure tone audiometers, certain necessary controls are common to all instruments. It is necessary to know about these controls in order to perform hearing tests. Let us get familiar with the various **controls of an audiometer.**

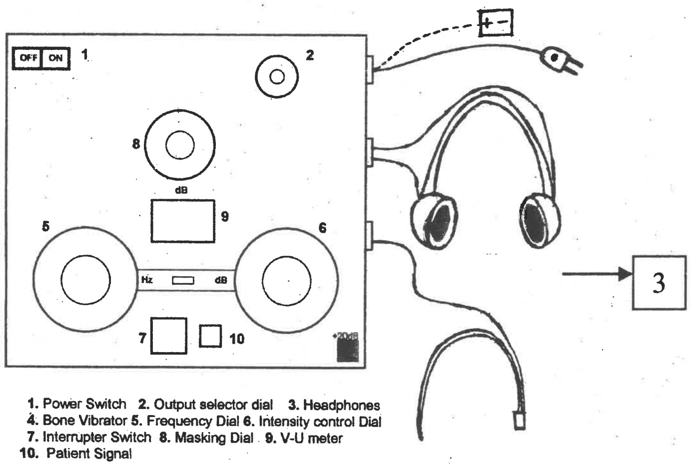


Diagram1 : The basic controls of an Audiometer

The basic controls of an audiometer are:

a) **Power Switch:** This is used to switch the audiometer off and on. Audiometer **needs power** which can be supplied by D.C or batteries.

b) **Output Selector Dial:** Using this switch, the tester can **select** left earphone, right earphone or bone vibrator for presenting tone.

c) **Headphones:** The air conduction test is carried out using headphones. The headphone with a **red mark** is to be placed on the **right ear** and the one with a **blue mark** is to be placed on the **left ear** during testing. This colour code is according to international standards. The headphones are attached to a headband which can be adjusted in such a way that headphones remain well fixed over the pinna.

d) **The Bone Vibrator:** The bone vibrator is used for **bone conduction** testing. It is placed on the mastoid process of temporal bone during testing. It is held in place over the skull with the help of a headband.

e) **Frequency Dial:** The various frequencies generated for testing procedure are indicated on this selector. The frequencies commonly available on the selector are 125 Hz, 250 Hz, 500Hz, 1000Hz, 1500Hz, 2000Hz, 3000Hz, 4000Hz, 6000Hz and 8000Hz. On the frequency selector dial of most audiometers a small number printed under the frequency designation indicates the maximum hearing level that is available for the specific frequency. For example if the figure of 90dB appears beneath the frequency 250Hz, it means that 90dB is the maximum intensity level that the audiometer will produce for the frequency of 250Hz.

f) **Intensity control Dial – Attenuator :** This control can vary intensity of any given frequency from 10dB to 100dB. The intensity can be varied in **steps of 5dB** for example 30dB, 35dB, 40dB, 45dB and 50dB. Some audiometers have the facility of extending the upper limit of intensity upto **120dB** using a special button.

g) **Interrupter Switch:** This switch is used by the tester to **present the tone** to the patient. The switch when depressed turns the tone on and when released turns the tone off. The interrupter switch is spring loaded and hence returns to its off position when tester releases it. By using this switch, the tester can decide **when to present** the tone and what should be the **duration of presentation.**

h) **Masking Dial:** If there is a **significant difference** in **hearing levels** of the two ears, then it is necessary to introduce masking sound in the better ear. In such cases sound energy presented to the worse ear can get transferred via skull bone to the better ear. Thus the patient may give response as the better ear has heard the tone but not the worse ear. Unless we make the better ear nonfunctional, we cannot test the other ear independently. To make the better ear **nonfunctional,** masking is used. This prevents the tone from being heard by the better ear. The masking noise can be varied from 0dB to 100dB. The level of masking to be used is calculated by using various formulae.

i) **V-U Meter:**_V-U Meter gives an indication whether or not **power is entering the audiometer**. This is present on most audiometers. When the interrupter switch is pressed, if the voltage is adequate, the needle will deflect to the right indicating that tone is generated.

j) **Patient Signal:** This facility is available in some audiometers. The person who is taking a hearing test is given a switch-button and is instructed to press it when he hears a sound. When the switch is pressed a light on the audiometer gives signal to the tester that the patient has heard the given signal. The tester can then increase or decrease the intensity level of the signal as per the need.

The circuit, external design and the arrangement of the audiometer's basic controls will differ from instrument to instrument, however every audiometer has the above mentioned controls.

4.6 PURE TONE AUDIOMETRY TEST PROCEDURE FOR ADULT POPULATION

The Pure-tone test for adults is carried out placing headphones over the ears therefore called as **closed field testing**. Here the tones reach the ears directly. This is in contrast to sound field testing to be discussed later. (4.12)

In order to obtain valid hearing testing results there must be some control over the conditions under which the Pure-tone test procedure is performed. Ideally, the **testing should be performed in a sound treated room** in which external noise level is minimum. The step by step procedure for pure tone audiometry is described below:

i. Plug in the audiometer and ensure the proper electric supply.

ii. Turn on audiometer's power switch making certain that the instrument actually does receive power by seeing that the dials light up or the tubes in the instrument begin to glow. Check the V-U meter needle deflection.

iii. If the headphones and bone vibrator are not plugged into the audiometer, plug them in, confirming that they go into the proper jacks. Check that the audiometer functions by placing headphones or bone vibrator on self and varying the frequency and intensity levels.

iv. Make sure that the patient sits in such a way that he will not see the audiometer or the movements of the tester. The ideal situation will be where the subject sits in one room while the tester and audiometer are in an outside room as shown in the diagram 2. This will enable the tester to see the subject's facial expressions and his responses to tones.

Diagram 2 : Arrangement for Close Field Test

v. Take relevant information from the patient regarding his hearing problem and medical history.

vi. Ladies should be requested to remove ear-rings, hair-pins etc as they can cause discomfort when headphones are placed over the ears.

vii. Assure the patient that it is a very simple test and instruct him the following manner --------

' The objective of this test is to find out the **softest sound you can hear** in each ear. The headphones will be placed over your ears. You are going to hear certain beeps through the headphones. Please raise your hand every time you hear a beep. As soon as you stop hearing, please lower your hand. Gradually the sound will get softer and softer. You should concentrate on hearing the beeps. You should raise your hand for barely audible sounds also. Feel free to take a guess. You will hear the sound in one ear only. Once the test is completed with one ear, the other ear will be tested.' The above instructions should be given before placing the headphones. The tester should raise his voice while instructing if necessary and articulate clearly. Instructions should be repeated if necessary. Gestures can also be used if needed. If the patient cannot understand oral instructions, written instructions can also be used. '

viii. Place headphones over patient's ears, making it sure that the **red headphone** is placed on the **right ear** and the **blue** on the **left ear**. The headband should be adjusted in such a way that the headphones cover the pinnae properly.

ix. Always begin with the testing of the **better ear**, so that if there is a difference between sensitivity of the two ears, appropriate masking levels can be used while testing the worse ear. The decision regarding the better ear will be based on the information given by the patient prior to testing. If the patient reports no such difference, any ear can be tested first.

x. **Always begin a test at the frequency of 1000 Hz** since the ear is most sensitive to intensity changes at this frequency. It has been demonstrated by research that 1000 Hz has highest **test – retest reliability** of any frequency in audiometric testing. This means that at 1000 Hz the most reliable responses are obtained. Generally the result does not change by more than 5 dB (Higher or Lower) on retesting during the session.

xi. As you are already aware, in this test we try to find out hearing thresholds for pure-tones of various frequencies. For obtaining threshold at any frequency three different methods can be used.

a.) The **ascending method** in which the examiner starts from the lower intensity level and gradually increases the intensity level to find out the threshold.

b.) The **descending method** in which the examiner starts from higher intensity level and gradually lowers the level of intensity to find out the threshold.

c.) **Bracketing method** which is a combination of ascending and descending method and is commonly practiced.

Let us discuss the steps to be followed for **threshold determination** at each frequency- At what intensity level do we begin the test? If the patient understands conversational speech fairly well then begin the test at 60 dB. If he cannot understand conversational speech, begin at 100 dB. Present the tone by pressing the interrupter switch. If the patient hears the tone then the intensity of the signal should be reduced by 10 dB. Again press the interrupter and present the tone. If the patient's response indicate that the tone is not heard, the intensity should be increased by 5 dB and the tone should be presented. By increasing and decreasing the intensity level, as per the requirement, the lowest intensity level at which sound is heard i.e. threshold is determined.

Example:

a) We have started the test at 60 dB level and presented the tone. If the patient responds at 1000 Hz we reduce the tone by 10 dB. Thus, we now present the tone of 50 dB.

b) If the patient again responds, we further reduce the tone by 10 dB and present the tone at 40 dB level by pressing the interrupter.

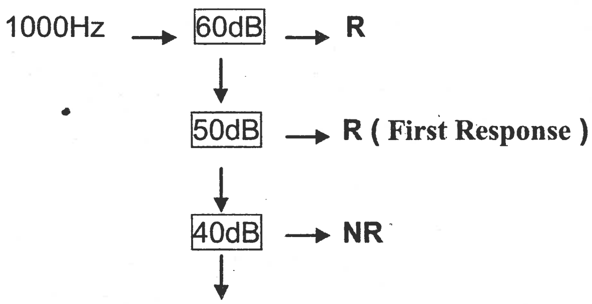
c) If the patient does not respond, we increase the intensity of the tone by 5 dB i.e. present the tone at 45 dB.

d) If he still does not respond, again we increase the intensity by 5 dB and present the tone at 50 dB.

e) If he responds at 50 dB level, this is likely to be his threshold level. However the process of increasing and decreasing intensity level is is continued till at least **three reliable responses** are seen at the same intensity level. This decibel level is recorded as the threshold. So if three consistent responses are obtained at 50 dB level, then the threshold for 1000 Hz is confirmed as 50 dB.

f) Note that at each step we either reduce by 10 dB every time the patient responds or increase by 5 dB every time he does not respond.

g) The same **example** is shown in a form of flow chart where R indicates response and NR indicates no response.



$\boxed{45dB}$ → **NR**

↓

$\boxed{50dB}$ → **R (Second Response)**

↓

$\boxed{40dB}$ → **NR**

↓

$\boxed{45dB}$ → **NR**

↓

$\boxed{50dB}$ → **R (Third Response)**

Threshold for 1000Hz is recorded as 50dB.

Note: Do not change the frequency dial until you have confirmed the threshold for one particular frequency.

The interrupter should not be pressed for a long duration. At the same time the duration should not be too short. The interrupter should not be pressed at regular time intervals, as this may enable the patient to guess when the next tone is likely to be heard.

xii. After you have succeeded in getting the threshold at 1000 Hz, change the frequency dial to 2000 Hz and using the same method find out the threshold for 2000 Hz and record it.

xiii. Change the frequency dial to 4000 Hz and repeat the procedure to find out the threshold. Occasionally the thresholds for 6000Hz and 8000Hz are also obtained if required.

xiv. Again test at 1000 Hz. This is to confirm the reliability of the test. Pay no attention to the previous threshold obtained at this frequency until you have completed the steps necessary to obtain another threshold measurement. Compare the second threshold with the first. If they **match exactly** or **differ by no more than 5 dB** in either direction, then the test results can be considered reliable. If on the other hand, there is a **difference of more than 5dB between the first and the second threshold** measurement at 1000 Hz, the reliability of **the test is in doubt.** It is advisable to repeat the test from the beginning in such cases.

xv. After rechecking the threshold at 1000 Hz, find out the threshold for 500 Hz and then for 250 Hz.

xvi. After completing threshold testing of one ear change the output selector dial to the other ear. Proceed in the same way and obtain thresholds for the other ear. If essential, the **masking** should be introduced in the better ear while testing the worse ear.

xvii. Remove the headphones and place the bone vibrator on the **mastoid process** of the temporal bone. It is placed on the **mastoid of the better ear first.** The maximum intensity level available for bone conduction testing in most of the audiometers is **50 deciBel**. Find out bone conduction thresholds for 250 Hz, 500Hz, 1000 Hz, 2000 Hz and 4000 Hz. Begin with 1000 Hz as for air conduction and follow the **same method** and order of testing frequencies. Assume that you are testing the bone conduction of that ear, where you have placed the vibrator. In certain cases, masking is required in bone conduction too.

4.7 THE FACTORS INFLUENCING THE RESULTS OF PURE-TONE AUDIOMETRY.

It has been found that there are certain factors which influence the results of pure-tone audiometry. Some of them are listed below.

i.) Instrumental Factors:

The accuracy of testing depends upon the proper functioning of audiometric equipment. audiometers must be **calibrated and serviced** regularly once a year to ensure that the frequency and hearing level outputs are actually as indicated on the controls. The audiometer can go out of **calibration** due to changing characteristics of electronic components, excessive voltage fluctuations, rough handling and dropping of headphones, bone vibrator etc. The audiometer which is out of calibration can affect the results of pure-tone audiometry. The **zero reference level** of the audiometer, the upper and lower output capability of the audiometer and standards adapted for calibration are also some of the factors that can influence the test results.

ii.) Subject Variability:

The variability in threshold measurement is often related to the **motivation and physical conditions** of the person being tested. Some subjects are not interested in giving the test and do not give their full attention to the listening task. Some get tired easily or are in pain and have difficulty in attending to the listening task.Some people may not have the **intellectual capacity** to maintain **sustained interest** in the test procedure.

Patient comfort is another **important factor**. Uncomfortable seating arrangements, poor room ventilation or lighting, improperly placed headphones can cause discomfort to the patient, **leading to the patient becoming inattentive**

iii.) **Tester Variability:**
The instructions given by the tester to the subject can also affect the results of audiometry. If different methods of threshold detection are used they may not give the same threshold values. You are already aware that ascending, descending and bracketing are methods used for the threshold detection.

iv.) **The level of ambient noise:**
Excessive ambient noise in the testing room would also **affect the test results**. It is therefore necessary to adopt the international standards of permissible noise levels for a sound-treated room to be used for testing.

4.8 PLOTTING AN AUDIOGRAM

The results of pure-tone audiometry are recorded in the form of a graph which is called as an audiogram. **Frequency** along the **abscissa (X – Axis)** and **intensity** along the **ordinate (Y-Axis)** are the two dimensions of an audiogram. The patients hearing threshold at each frequency tested is plotted on the audiogram. For **plotting audiograms, specific symbols, which are standardized at the international level**

Audiogram Symbols

	RIGHT	LEFT
COLOUR	RED	BLUE
AIR CONDUCTION UNMASKED	O	X
AIR CONDUCTION MASKED	△	□
AIR CONDUCTION UNMASKED NO RESPONSE	O↙	X↘
AIR CONDUCTION MASKED NO RESPONSE	△↙	□↘
BONE CONDUCTION UNMASKED	<	>
BONE CONDUCTION MASKED	[	]
BONE CONDUCTION UNMASKED NO RESPONSE	<↙	>↘
BONE CONDUCTION MASKED NO RESPONSE	[↙	]↘
SOUND FIELD		
UNAIDED	S	
AIDED	A	
NO RESPONSE	↓	

Diagram 3: Audiogram Symbols

are used. The **separate symbols** for air conduction (AC) and bone conduction (BC) of each ear are used. **Separate colours** are used for right ear and left ear, **Red** denoting the **right** ear and **blue** the **left.** The following chart shows the symbols used in plotting the audiogram.

4.9 INTERPRETATION OF AUDIOGRAM FOR TYPE OF LOSS.

As you are aware the audiogram provides us with the **qualitative information** regarding the type of hearing loss. By interpreting an audiogram we can diagnose the type of hearing impairment. **The interpretation for each ear is done separately.** The **air conduction and bone conduction** threshold level also the **air-bone gap** (i.e. difference between air and bone conduction thresholds) is **taken into account while interpreting the audiogram for type of loss.** The features of various types of audiograms are listed below.

1. **Audiogram indicating normal hearting sensitivity:** In this type of audiogram, the thresholds of air conduction and bone conduction range from **–10 dB to 20 dB**. The bone conduction thresholds are equal to air conduction thresholds or less than that. The thresholds of AC and BC do not

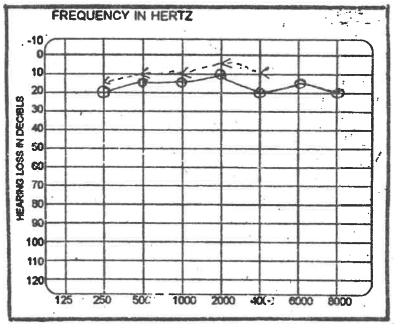


Diagram 4 : Audiogram showing normal hearing sensitivity

much differ from each other.

2. **Audiogram showing conductive hearing loss:** In this audiogram **air**

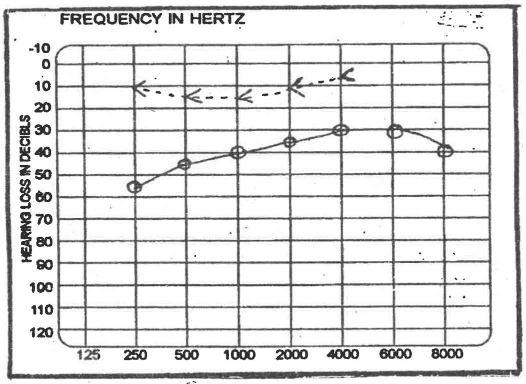


Diagram 5 : Typical Conductive Impairment

conduction threshold levels are abnormal but **bone conduction threshold levels are normal**. Conductive loss results due to malfunctioning of the outer and / or middle ear hence the audiogram shows loses by air conduction only. However bone conduction is normal, as the inner ear mechanism is not affected.

3. **Audiogram of sensory neural loss:** The audiogram of sensory neural loss shows **loss by both air conduction and bone conduction.** The thresholds of AC and BC do not differ much from each other. The difference between AC and BC thresholds is upto 10 dB or less than that.

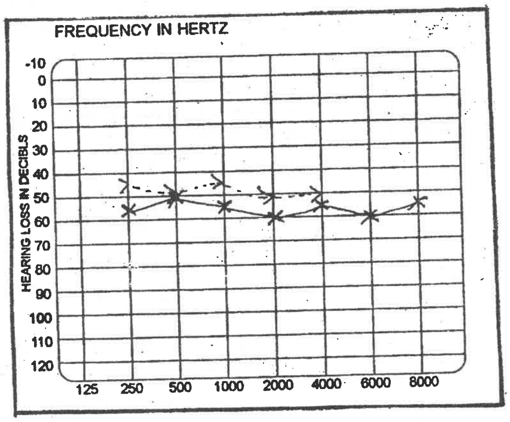
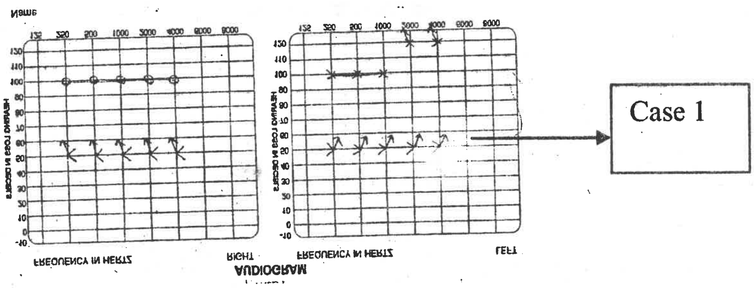
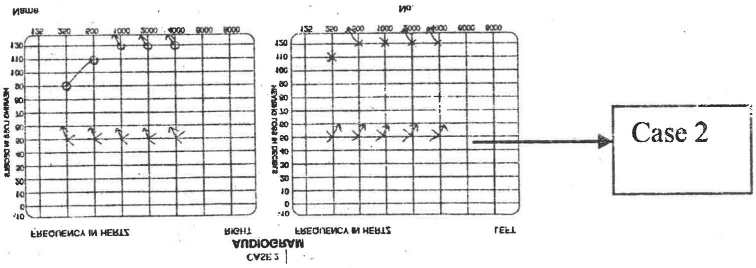
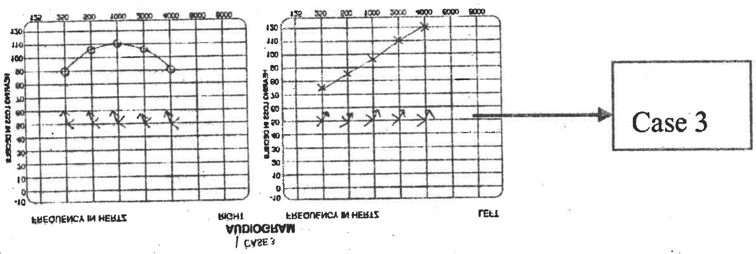


Diagram 6 : Typical Sensori-Neural Impairment

The different types of audiograms seen in hearing impaired children with congenital hearing loss are shown in **Diagram 7** below.







4. **Audiogram of mixed loss:** A mixed loss occurs when there is an involvement of the outer and / or middle ear and the inner ear.A mixed impairment will produce an audiogram which shows **some loss by bone conduction** but more **severe loss by air conduction**. In the audiogram of mixed loss air conduction and bone conduction differ each other by 15 dB or more.

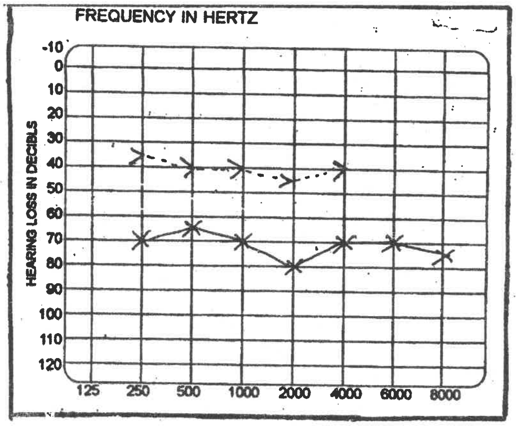


Diagram 8 : Typical Mixed Impairment

Keeping in mind all the above features of different types of audiograms, you can use the following flowchart for interpretation.

a. Find out if AC and BC thresholds are upto 20 dB or less than that.. If so, then **hearing sensitivity is within normal limits.**

b. If not, then find out if bone conduction thresholds alone are within normal limits. If yes, then **hearing impairment is conductive in nature.**

c. If air and bone conduction thresholds both are abnormal then look for AC-BC gap (i.e. the difference between AC and BC thresholds at each frequency). If the gap is 10 dB or less then the **hearing impairment can be interpreted as sensori-neural.**

d. If air and bone conduction thresholds are both abnormal and AC-BC gap is 15 dB or more, the **hearing impairment is mixed in nature.**

To sum up

	Air Conduction	**Bone Conduction**	**AC-BC air bone gap**
Normal Hearing	Normal (–10 dB to 20 dB)	Normal (–10 dB to 20 dB)	Minimal
Conductive	Abnormal	Normal	Wide AC-BC Gap
Sensori-neutral	Abnormal	Abnormal	10 dB or less

Mixed	Abnormal	Abnormal	15 dB or more

4.10 INTERPRETATION OF AUDIOGRAM FOR DEGREE OF LOSS

a.) **In terms of average hearing loss:** For purpose of calculating average hearing loss, the AC thresholds of 500 Hz, 1000 Hz, 2000 Hz are averaged to one single figure. This single figure is called pure-tone average. **For example**: In an audiogram AC thresholds for right ear are as follows –

500 Hz - 90 dB

1000 Hz - 50 dB

2000 Hz - 40 dB

Average hearing loss $= \frac{90\text{ dB} + 50\text{ dB} + 40\text{ dB}}{3} = \frac{180\text{ dB}}{3} = \mathbf{60\text{ dB}}$**.**

b.) **The degree of hearing loss** on the basis of average hearing loss:

Degree of Hearing Loss	Average Hearing Loss
Normal Hearing	20 dB HL
Mild Hearing Impairment	21 dB to 40 dB
Moderate Hearing Impairment	41 dB to 55 dB
Moderately severe Hearing Impairment	56 dB to 70 dB
Severe Hearing Impairment	71 dB to 90 dB
Profound Hearing Impairment	more than 90 dB

4.11 CONDITIONING TECHNIQUE

The procedure mentioned previously is difficult to administer on children below a certain age. In **order to suit the pure-tone audiometry test procedure to the pediatric population, conditioning techniques are used.** Instead of asking the child to raise the hand as a response the child is asked to respond to sound in a different manner. For example – holding a block near the ear and dropping it down whenever he hears the tone or picking up a toy displayed on the table whenever he hears a tone. The child is conditioned to perform a certain action only when he hears.

The **conditioning sequence** starts with a demonstration by the tester. For example – the tester holds a block near the patient's ear, presents a sound of gong and drops the block down. Thus the child sees the gong and hears the sound together (**visual + auditory clues**). After a few demonstrations of this nature, the child should be offered the block and the tester should guide a few responses. The right responses should be rewarded with hand clap, gestures or vocal praise. When the child responds well, the tester then goes behind the child and presents the sound. Now the child has to respond only on hearing the sound, as he cannot see the gong (**only auditory clue**). To begin with, the intensity of stimulus must be fairly high.
As the child responds independently, the intensity levels are gradually decreased. **The reliable conditioning can normally be established after four to five demonstration responses and a further four or five guided responses.**
At this stage it might be possible to introduce headphones and obtain thresholds for AC first, for both ears and later for BC using bone vibrator. If the child refuses to use headphones then sound field thresholds for different frequencies can be obtained (refer 4.12). The hearing thresholds obtained in this case will represent binaural hearing sensitivity. During testing procedure, the tester should **vary the pause interval quite unpredictably to reduce the possibility of anticipatory responses from the child**. If the tone is given at regular intervals, the child may put a block down according to the time interval rather than on hearing the tone. To speed up the test, the tester should be economical with time. For which it is necessary to use larger increments and decrements instead of ' down 10dB, up 5 dB'. This is necessary as the child will pay attention for a limited span of time.

Conditioning technique can be successfully used between age group 5 to 7 years. It can also be used for age group 3 to 5 years, if the child can follow instructions. It may be necessary to have more than one testing session for this age group as they are likely to lose their interest within a short span of time.

4.12 SOUND FIELD AUDIOMETRY

This test is used for young children and babies who cannot be tested using headphones. This test is also known as **free field test or sound field test.** The clinical audiometer having provision for sound field audiometry is used for the test. For sound field audiometry, two room test facility is required, so that the tester and the child are in separate rooms. The tester can observe the child through a glass or one way mirror. **The sound or speech is presented** to the child **through speakers** installed in the test room. The frequency and the intensity of pure tones presented to the child can be varied using the audiometer. **The response of the child is likely to be turning the head towards the source of sound,** ceasing of an activity or smiling. If possible, the child can also be taught to drop a peg or pick up a toy displaced on the table whenever he hears the tone or speech. The tone of higher intensity may be used at first. As the child responds ,the intensity is gradually decreased. The responses of the child to sound can help the audiologists to judge the degree of hearing loss. This unit also has a **talk back system** which enables the tester in the control room to hear what the subject in the test room says.

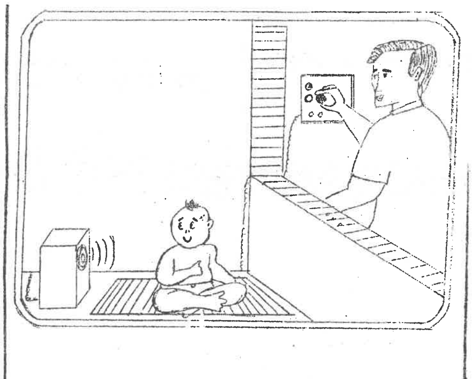


Diagram 9 : Arrangement for sound-field Test

Early identification of hearing impairment is necessary as it has several advantages. Considerable progress in testing the hearing of infants and children has been made in the past few years. Procedures used in the assessment of hearing of an individual child are determined by the responses he is capable of making. This will depend upon several factors like **mental age, neurological status** etc. There will be variations in test procedures and the responses to be expected at different age levels. Let us study briefly the test procedures used for auditory evaluations at different age levels.

4.13 TEST PROCEDURE FOR AGE GROUP ZERO TO TWELVE MONTHS

Assessment of hearing sensitivity during the first 6 months is generally quantitative, not qualitative. In early months of this age range (upto 4 months), auditory assessment is limited to the **elicitation of reflexive responses to relatively intense auditory signals.** The useful responses are **auropalpebral reflex (APR) and startle reflex.**

Auropalpebral reflex represents contracture of the orbicularis palpebrae muscles. It is seen as a **quick closing of the eyes (an eye blink),** or **tightening of the lids** if the eyes are already closed., as a response to an intense auditory signal. The startle reflex is seen as a **small jump** of the infant's body immediately following the auditory stimulus of high intensity. The arms go apart, the fingers spread, the legs extend, the eyes open and the head is thrown backwards as a response to loud sound.Both auropalpebral reflex and startle reflex tend to disappear quickly upon repeated presentation of sound stimulus. Thus the tester should be alert and quick in his/her observations. If auropalpebral reflex or startle reflex is not observed for intense auditory signal it is advisable to carry out Brainstem Auditory Evoked Response Test, to rule out the possibility of hearing loss.

The sound of known intensity and frequency can be presented in the sound field testing situation or a headphone can be held near the baby's ear, out of the baby's visual field. It is ideal to have two testers to perform this test. One can present the sound and the second tester can control baby's attention and also can observe the reactions of the baby. **After the age of 6 months,** it is expected that the child will **turn towards the source of sound, as a response.**

4.14 TEST PROCEDURES FOR AGE GROUP ONE TO THREE YEARS .

The common techniques used for hearing assessment of this age group are **'visual reinforcement audiometry'** and **'conditional orientational reflex.'** For this procedure a two room testing situation is needed as in sound field test . The child is made to sit in one room with the parent. The tester is in the other room. Two small loud speakers are placed on either side of the midline, behind the child. Above each loud speaker an attractive picture or a doll is placed. There is a **bulb inside the doll** or the picture which can get **illuminated** to make it **visible each time a sound is presented**. A pure-tone of known intensity is presented from one of the loudspeakers and at the same time the doll or a picture is illuminated. Initially through a few trials, the child is made to understand that when the sound is heard a light will glow in the doll or the picture. The child soon understands the association between the sound and light, which is pleasurable and rewarding. Once this association has been made the sound can be presented alone. If the child turns when the sound is presented, **the response is rewarded** with **visual reinforcement** by allowing the doll or the picture to light up. The intensity level of the signal can be lowered to find out the lowest intensity level at which the child responds. The audiologists can assess the hearing sensitivity of the child using this technique.

In addition to this, the child can be presented with different ' speech games'. As the child sits with a parent in one room, the tester can speak to the child, controlling the intensity of speech through an audiometer. The child can be asked to pick up a specific toy or a picture which is placed in front of him, or can be asked to obey simple commands. The child's response will enable to assess his hearing sensitivity.

The objective test like BERA is also a useful tool for this age group, especially children who refuse to co-operate and for children with additional problems such as mental retardation, cerebral palsy etc.

4.15 TEST PROCEDURES FOR AGE GROUP THREE TO FIVE YEARS

The conditioning technique described earlier (section 4.11) may be tried with this age group. **Using reinforcement the child may be encouraged to give correct responses.** It is possible that the child of this age group may soon lose interest in the test and may not respond. It is wise to complete audiometry within two to three sessions completing few frequencies at a time. The tester should be experienced and should be quick in completing the test by obtaining reliable responses. The tester should use reinforcement technique to hold the interest of the child throughout the testing procedure. If the child refuses to wear headphones, the test can be done in sound field using conditioning technique, however the threshold obtained in this case will represent binaural hearing status. By this age, some children may have good speech and language abilities. These children can be tested using speech as a stimulus as described earlier.

4.16 LET US SUM UP

- Pure-tone audiometry is a subjective test carried out to understand the qualitative and quantitative aspects of a persons hearing loss. It is performed in a sound treated room.
- An audiometer is the instrument used to carry out this test. Various models of audiometer are available. For audiometry pure-tones of different frequencies 250 Hz, 500 Hz, 1 KHz, 2 KHz, 4 KHz, 6 KHz, 8 KHz are used.
- The intensity level for each frequency can be varied.
- An audiogram is a graph plotted, representing frequency-intensity functions. The results are important for otologists, audiologists and teachers for the hearing impaired.
- Thresholds at different frequencies are plotted for air conduction and bone conduction.
- Test can be conducted in sound field or close field.
- Different audiometric procedures are used for different age groups.
- For infants aged 0 to 4 months reflexive responses are noted in sound field.
- For children, age group 6 to 12 months, turning of the head towards the source of sound may be a response.
- For children, age group 1 to 3 years, visual reinforcement and condition oriented reflex are used in sound field. Speech games are also used.

- For children, age group 3 to 5 years, conditioning techniques are used in sound field or close field.
- For children above five years conditioning is used in close field.
- From the audiogram, one can interpret the type of hearing loss (Normal, Conductive, Sensori-Neural or Mixed) and the degree of hearing loss.

4.17 SELF STUDY

i. Why is a sound treated room used for audiometry ? What are its special features ? (4.3)

ii. What are pure-tones ? (4.3)

iii. Define Threshold. (4.3)

iv. What are the uses of pure-tone audiometry ? (4.4)

v. Describe the various parts of an audiometer. (4.5)

vi. Describe the procedure for finding out threshold at each frequency . (4.6)

vii. When masking is used during audiometry ? (4.6)

viii. What are the factors that affect audiometry results ? (4.7)

ix. Using the correct symbols plot the audiogram for the following thresholds: (4.8)

Frequency	Right Ear AC	Right Ear BC	Left Ear AC	Left Ear BC
250 Hz	40dB	35dB	50dB	40dB
500Hz	45dB	40dB	50dB	40dB
1000Hz	50dB	45dB	45dB	45dB
2000Hz	55dB	50dB	60dB	50dB
4000Hz	55dB	45dB	55dB	50dB

x. Find average hearing loss and degree of loss for the following levels of thresholds: (4.9)

500Hz	1000Hz	2000Hz	Average Hearing Loss	Degree of Loss
a. 80dB	60dB	40dB	____________	____________
b. 60dB	70dB	90dB	____________	____________
c. 100dB	110dB	120dB	____________	____________

xi. Describe the features of an audiogram showing
a) Normal Hearing b) Conductive Loss c) Sensori-neural Loss d) Mixed Loss. (4.10)

xii. When is the conditioning technique used ? (4. 11)

xiii. Discuss how you would perform a pure-tone audiometry for a five year old child having difficulty in hearing . (4.11)

xiv. What does sound field test mean ? When is it used ? What are the various responses of a child in sound field ? (4.12)

xv. Describe the test procedures used to assess the hearing of children in the age group one to three years . (4.14)

xvi. Discuss the methods of assessing hearing of children in the age group three to five years.

(4.15)

4.18 ASSIGNMENT

a) With a neat labeled diagram of an audiometer describe the basic parts and their functions.

b) How will you conduct pure-tone audiometry test for an adult ?

c) Classify hearing disorders as per i.) Types, ii.) Degree.

4.19 POINTS FOR DISCUSSION AND CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification on other. Note down those points below :

4.19.1 Points for Discussion

4.19.2 Points for Clarification

4.19 REFERENCES

1 Audiology by Hayes Newby.

2 Handbook of clinical Audiology by Jack Katz.

3 Pediatric Audiology zero to five years by Barry McCormich.

4 Hearing care for Children by Frederick N. Martin & John Green Clark.

UNIT 5: CURRICULAR FRAMEWORK FOR 21ST CENTURY.

STRUCTURE

- **Introduction to Hearing Aids**
- **Objectives**
- **History of Hearing Aids**
- **Hearing Aid Electronics**
  - Technical terms used for Hearing Aids
- **Types of Hearing Aids fittings**
- **Types of Hearing Aids**
- Ear Moulds
  - Procedure for making ear mould
  - Types of Ear Moulds
  - Ear Mould modification.
- **Hearing Aid care**
- **Checking of Hearing Aid**
  - Common faults of Hearing Aid
- **Hearing Aid selection**
- **Causes for not accepting Hearing Aid**
- **Records to be maintained in School**
- **Let us sum up**
- **Self Study**
- **Assignment**
- **Points for discussion and clarification**
- **References**

5.1 INTRODUCTION TO HEARING AIDS

Early appropriate amplification is fundamental to the success of any auditory rehabilitation program.

Hearing is prerequisite for the development of normal speech and language. A child with normal hearing learns to speak by listening to the speech and language stimulation provided in his environment and modeling his own utterances in an orderly sequence as he grows. The normal process of auditory based speech and language development is disrupted to a greater or lesser extent depending upon the degree of the hearing loss. For congenitally hearing impaired children, particularly those with significant degrees of 'residual hearing', **acoustic amplification is the primary mechanism for the development of speech and language skills.**

An **individual hearing aid** could be considered as an **auditory prosthesis** to help the hearing impaired person to hear as much as possible, in a wide range of acoustic environments. The hearing instrument should be fitted immediately after hearing loss is detected. The audiologists selects a hearing aid that will make audible as great a portion of acoustic speech spectrum as is possible, keeping output of the instrument at safe and comfortable level.

There is a fundamental difference between the significance of hearing aids for hearing impaired adults and for congenitally hearing impaired children. Hearing aid selected and used by adults are coupled to existing auditory based speech and language skills. The task for adults is simply to recognize a linguistic code learned and mastered in their early years. When a hearing instrument is fitted to a congenitally hearing impaired child, the underlying assumption is that **amplified sound is the most effective therapeutic tool** for minimizing or averting the linguistic and educational ramifications of a hearing loss

In this unit we are going to study the most useful amplification systems for hearing impaired i.e. hearing aids.

5.2 OBJECTIVES

At the end of the unit students will be able:

- To understand the need of hearing aid
- To describe the history of hearing aid
- To explain hearing aid electronics and technical terms
- To describe types of individual hearing aids and hearing aid fittings

- To understand the need of ear mould and explain the ear mould making procedure
- To describe the different types of ear moulds and ear mould modification
- To explain hearing aid care and procedure for checking of hearing aid
- To discuss common faults of hearing aids and their solutions
- To elaborate the procedures used for hearing aid selection
- To maintain hearing aid records in the school

5.3 HISTORY OF HEARING AIDS

As mentioned earlier, the function of a hearing aid is to amplify sounds to a degree, and in a manner, that will enable a hearing-impaired person **to utilize** his or her **residual hearing in an effective way**. A hearing aid must be cosmetically acceptable, to be effective.

Perhaps, the **first "amplification system"** to be used was the **placing of a person's hand behind the ear.** This provided approximately 15 dB amplification. This amplification appeared to be just sufficient for a person with mild hearing loss to get the desired clarity of speech.

Mechanical hearing aids such as **horns and speaking tubes**, which were held at the ear-canal entrance of the affected person, were in use as early as the seventeenth century.

Mechanical hearing-aids were followed by **Carbon hearing-aids**, which came in use at the beginning of the last century. These were based on the principles of the telephone.

In 1938, **Vacuum-Tube Hearing-Aids** appeared and offered much greater amplification possibilities, a wider frequency response and lower harmonic distortion.

Today's hearing aids are based on the invention of the **transistor by Bell Telephone Laboratories**. Transistors were introduced into hearing aids in the 1950s. This development made possible much smaller

sized aids, requiring less battery consumption. It also permitted a flexibility of design, which had never been possible before.

Miniaturization of hearing-aid circuits became a reality due to the advanced development of amplifiers and integrated-circuits. The

integrated-circuit consists of **transistors, resistors and wiring**, all on a tiny wafer of silicon or similar material. It is inherently low in power needs, and is relatively robust.

5.4 HEARING AID ELECTRONICS

Hearing aids are available in different shapes and sizes. However, the basic electronics of all the aids is the same. Hearing aids are made up of the following parts:

a) **Microphone:** This picks up the **sound energy** and **converts** it into **electrical energy.**

b) **Amplifier:** This **increases the strength of the electrical signal.** A battery provides power to the amplifier. The battery used in a hearing-aid will depend upon the type and size of the hearing-aid.

c) **Receiver (earphone):** This converts the **electrical energy back into sound energy**.

d) **Telecoil:** Telecoil is an **optional feature** in a hearing aid and when it is activated it **converts the magnetic vibrations** (related to telephone signals) **into electrical signals**, which are then fed to the amplifier.

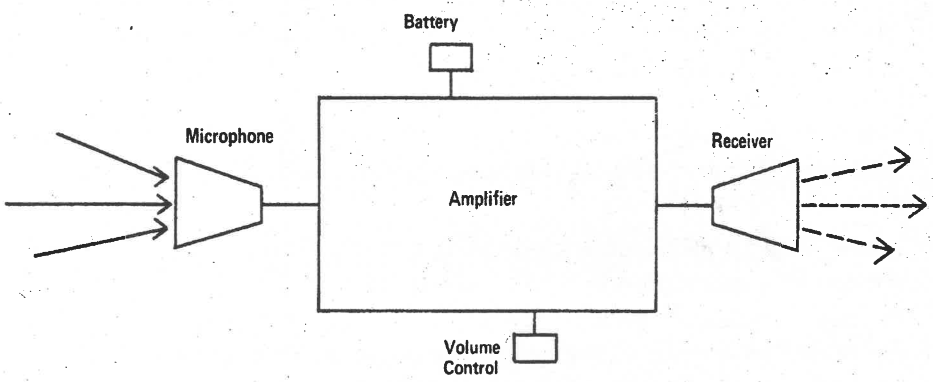


Diagram – Block diagram of a simple hearing aid.

With these components, how does a hearing aid function?
The microphone or telecoil of the hearing aid picks up the sound signals, and converts them into electrical signals. This low-energy

electrical signal is fed to the amplifier, which converts it into a powerful electrical signal. This reaches the receiver, where the electrical signal is converted back into sound, and this now enters the ear of the hearing aid user. This, in a simple way, is how a hearing aid works.

5.4.1 Technical Terms Used For Hearing-Aids

Hearing aids are commonly described in terms of **gain, maximum output, frequency response and bandwidth.** Let us understand the meaning of each term.

a) **Gain:** The gain of any hearing aid is simply the **difference, in db, between the input and output of the system.** Thus, if a 60 dB sound is at the microphone [input], and 100 dB is measured at the receiver [output], the gain of that aid is 40 dB. However, hearing aids do not provide the same gain throughout the entire frequency range. Certain frequencies may have more gain than others, depending on internal components. **The gain expressed by the hearing-aid manufacturer** is usually the **average gain of a hearing aid**, covering all frequencies.

By studying the audiogram (the degree of hearing loss) an hearing aid of appropriate gain is selected for the hearing-impaired person.

b) **Maximum output:** All amplifying systems **can amplify sounds only to a certain maximum limit.** Till this limit, there is a linear relationship between input and output. Once this **maximum level of amplification is reached,** the **output cannot increase further**, no matter how much the input may increase. Thus, a **saturation point** is reached, beyond which no more amplification occurs.

Let us consider an aid with a gain of 40 dB. If the input signal is of 50 dB, the output is expected to be 90 dB. If the input is now increased to 100 dB, the output expected would be 140 dB. Usually, this much of an output is not desirable for the user, and can even be harmful in certain cases. All precautions must be taken so that the output does not exceed the threshold of discomfort [threshold of pain], which is around 140 dB. Therefore, the system will limit the output to a level below 140 dB.

Most often, the limiting is achieved by **Peak clipping**, where the amplitude of the amplified signals are flattened at their peaks, once the maximum output level of the aid is reached. However, this may lead to distortion of sounds, and poor quality of sound signals.

Hearing-aid manufacturers often provide curves of the hearing aid's maximum output, as shown below.

c) **Frequency response:** The gain of an aid is not same for all frequencies. Hence, **a chart** is made **to show the gain for the different frequencies** which are amplified. The resulting curve represents the particular aid's gain per frequency, and is called the frequency response of the aid as shown in diagram.

d) **Bandwidth:** The **frequency range** in which a **hearing aid effectively amplifies** the signal, is called **the bandwidth of the hearing aid**. To calculate the bandwidth, a line is drawn across the frequency response curve, 15 dB below the average gain of the aid. The lowest and highest frequencies where the line intersects the frequency responses, are the lower and upper limits of the bandwidth.

Thus, if the gain of an aid is 40 dB, a line is drawn 15 dB below this, which is at 25 dB. If this line intersects the frequency response curve at 230 Hz and 4800 Hz, then the bandwidth of this particular aid is 230 Hz to 4800 Hz.

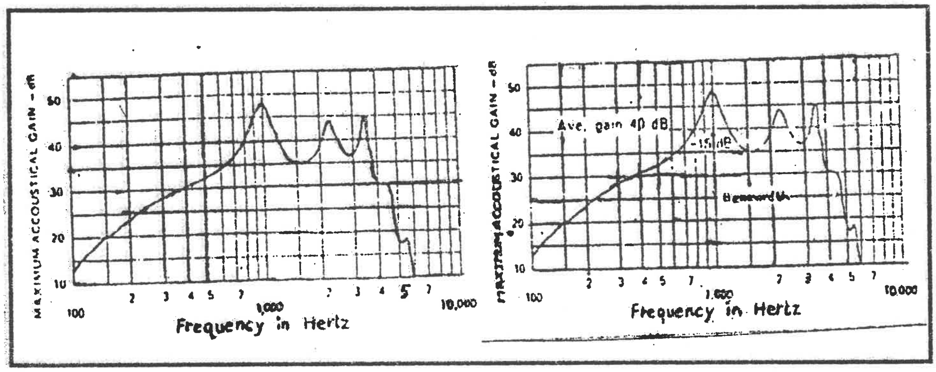


Diagram showing frequency response and bandwidth of a hearing aid.

These **technical details like gain, maximum output level, frequency response and bandwidth, are available with the hearing-aid manufacturers and with the dispensers.** These are all taken into account while choosing an appropriate hearing aid for a hearing-impaired individual.

5.5 TYPES OF HEARING-AID FITTINGS

The following are the various hearing-aid fittings available.

- **Monaural:** If the hearing aid is **used only in one ear**, the fitting is termed as monaural fitting.

- **Binaural or real binaural:** If **two hearing aids are used**, [i.e. a separate aid for each ear], the fitting is termed as binaural or real binaural. Such a fitting provides **several advantages**, such as **improved localization** of sound sources, **better discrimination** of speech in the presence of noise, and improved quality of sound. Binaural aids are recommended frequently for young children with severe or profound impairments. However, a binaural fitting almost doubles the expenditure, and it may not be possible for some to afford.

- **Pseudo-binaural fitting:** This third type of fitting is possible only with pocket-model aids. Using **one pocket-model aid with a V or Y-shaped cord and two receivers**, sounds can be received in both ears simultaneously. Such fitting is called pseudo-binaural fitting.

5.6 TYPES OF INDIVIDUAL HEARING AIDS

A wide range of different types of hearing aids are available for the users. They are designed in a variety of shapes and sizes. Let us study the most common types of hearing aids.

- **Body worn hearing aid (pocket –model):** Until the mid 1960s the body style was the most common type of aid available. **Body worn instruments** are either **worn in a pocket** or **with special harness** or **clipped to the clothing**. This aid consists of a **box, a receiver and a cord**. The electronic circuit and components are inside the box. These include a microphone, a battery, and an amplifier. The microphone converts the sound signals into electrical signals. These are amplified by the amplifier. These amplified electrical signals are then carried, via an electric cord, to the receiver. The receiver converts the electrical signals back into sound signals, which are fed into the ear via the ear mould or ear tip. They are the most common aids used by hearing-impaired children in schools.

The parts of a typical pocket-model aid are shown below.

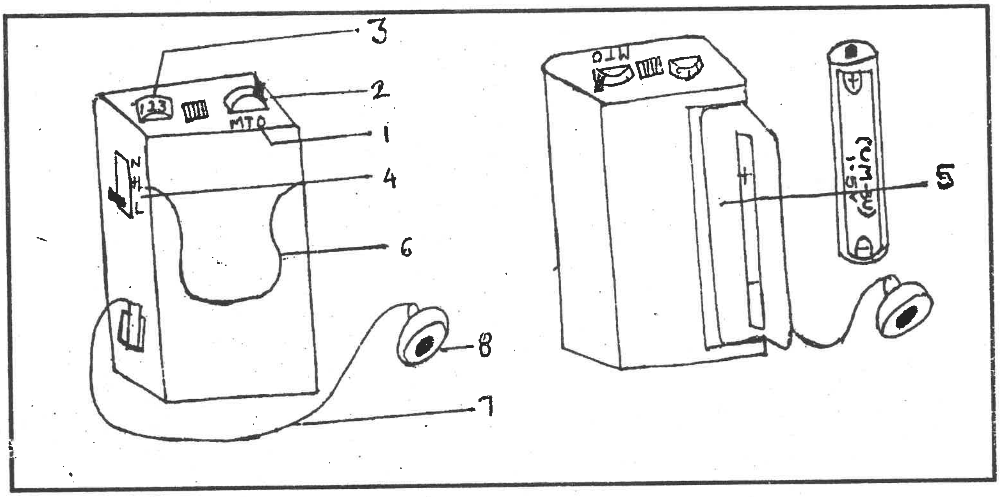


Diagram showing parts of a typical pocket model aid.

1. On & Off switch
2. Microphone
3. Volume control
4. Tone control
5. Battery compartment
6. Clip
7. Cord
8. Receiver

Now, to study each individual part

Microphone: The microphone inside the aid **picks up sound signals**, and **converts them into electrical signals.**

Receiver (or earphone): The receiver is attached to a cord, and **is responsible for converting electrical energy into sound energy**. A plastic ear-tip or ear-mould, which goes into the ear canal, is fitted on the earphone. Receivers have various values and this value should be compatible to the electronic circuit.

Cord: The **cord carries electric signal from the amplifier to the receiver** of the hearing aid. The cord fits in a socket, and attaches the body of the hearing aid to the receiver. For a monaural fitting, single cord is used. **For pseudo-binaural fitting, a V or Y-shaped cord is chosen.**

On-off switch: This is used for **switching the aid on or off**. There are three settings available: O- which stands for off; M- which stands for on (i.e. microphone is in use) and T- which stands for telecoil, and is set during telephonic use or while using loop induction system in classroom.

Volume control: The volume control is used **to increase or to decrease the audibility of sound.**

This enables the wearer to adjust the output of the amplifier to suit his particular needs.

Tone control: It is used **to select the frequency emphasis for amplification**. Normally, there are three options available: L-used for low frequency emphasis; H- used for high frequency emphasis; and N- i.e. normal-no special emphasis for any particular frequencies.

By studying the audiogram, the position of the tone control is selected and recommended.

Battery compartment: A **pencil- sized battery**, with **voltage of 1.5volts,**is used in the aid. The positive and negative markings in the compartment indicate the way the battery should be placed.

Clip: The hearing aid can be fitted to a pocket or a harness, using a fixing clip.

Seal washer: A small plastic washer is placed between the receiver and the ear mould/ear-tip. This gives a **better sealing effect.**

Advantages of body worn hearing aids:

These aids are **robust, high power and relatively cheaper**, as compared to other aids. In our country, this is definitely a positive point while selecting an aid. It also has an advantage for profoundly deaf children, as it is a means for them to hear their own voices. The **use of pencil size battery** in this instrument makes it **cost effective**.

Disadvantages of body worn hearing aids:

The main disadvantage of this type of hearing aid is the **size and weight of the hearing aid**. As the hearing aid is seen easily, it has **negative cosmetic value**. The placement of the hearing aid on the person's chest makes it susceptible to **'body-baffle'**, which leads to relative emphasis on low frequency sounds. This occurs due to the absorption of high frequency energy by clothing and body tissues, while low frequency energy is reflected. The placement of the microphone on the chest also makes it more vulnerable to damage from spilt food, dribble and vomit, in case of children. Body worn hearing aids **do not help is sound localization** or **identification of the source of sound.**

- **Post-aural hearing aids:** These are also referred to as "**Behind-The-Ear**" [BTE] aids. The body of this instrument is worn behind the ear. A thin acoustic tube or a plastic hook, which fits over the ear, connects the body of the aid to the receiver. The receiver is attached to the ear-mould or the ear-tip, which fits into the ear canal.

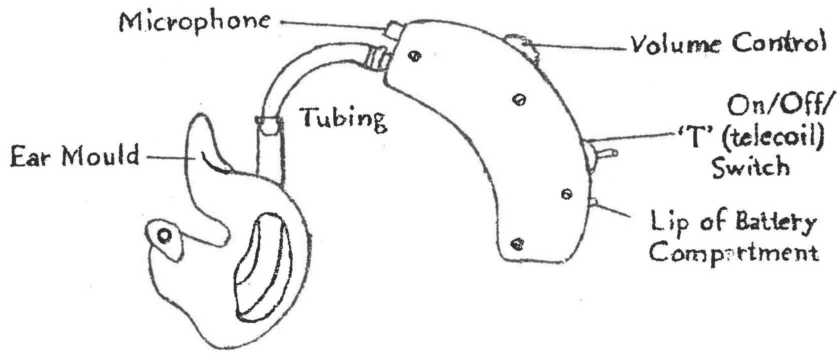


Diagram showing parts of behind the ear hearing instrument.

A BTE hearing instrument can be **worn comfortably by children as well as adults. Various sizes** are available, such as mini, midi and large, to fit all ears. Button-type batteries having size 13 or 675 are used for BTE hearing aids. **A wide variety of hearing losses can be compensated** by using BTE aids. These even help those with severe and profound degree of hearing loss.

With advances in hearing-aid technology, **a wide range of circuit choices** are now available for BTE hearing aids. These are **conventional, programmable and digital circuits.**

Like a pocket-aid, a BTE aid also has a microphone, receiver, volume control, on-off switch and battery compartment. It has **trimmers to adjust frequency emphasis.**

Advantages of BTE hearing instruments:

A BTE instrument offers benefits such as **compactness, convenience** and a **cosmetic appeal,** as it is not seen easily. As the microphone of BTE is positioned at the ear level, the placement **resembles natural hearing** to a greater extent. **Amplification can easily be controlled by the user while wearing the hearing aid.** If worn binaurally BTE aids are useful for **sound localization.**

Disadvantages of BTE hearing instruments:

BTE hearing aids are **costlier** than pocket-model aids. **The recurring expenditure of batteries, maintenance and repairs is also high**. Sweat is the main cause of failure of these instruments.

- **In-the-ear hearing instruments (ITE):**

  These aids consist of a **hard plastic shell**, which **contains all the electronic components**. These aids **sit in the ear canal and concha.** Often, this plastic shell is cast by taking the ear impression of the person's ear canal. Thus, the fitting can be very precise. In-the-ear hearing aids are available in **three different types:**

Concha: The hearing aid sits in the ear canal, and extends completely into the outer ear.

In-the-canal hearing aid(ITC): This is a smaller version of the in-the-ear hearing aid. It sits in the ear canal, and extends partly into the outer ear.

Completely in the canal hearing aid (CIC): These hearing aids sit completely and deeply in the ear canal, and can only be seen in side-view of the face. As they are smaller, **they do not have some of the features** available in the other aids like volume control, on & off switch, telecoil etc.

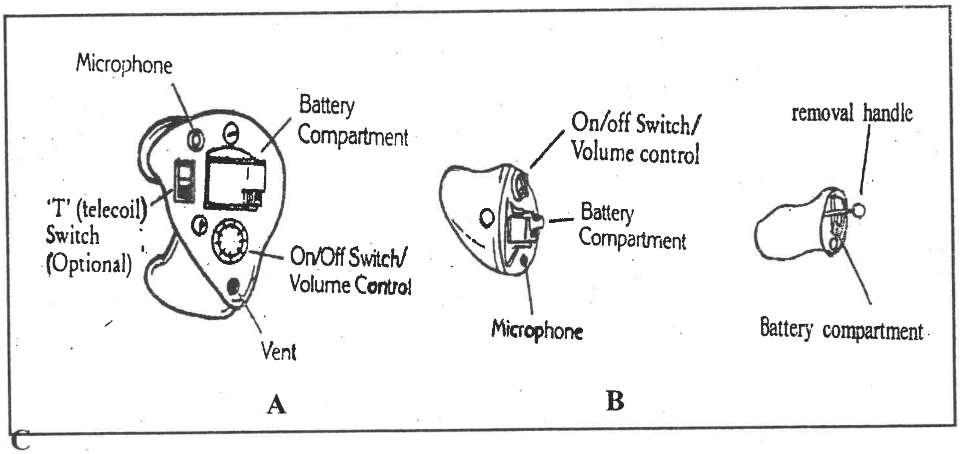


Diagram showing types and parts of in-the-ear hearing aids a) Concha b) ITC c) CIC.

Advantages of ITE hearing instruments:

There are **several benefits** that wearers enjoy. Besides **cosmetic benefit**, the other advantages are **improved localization of sounds, very close to "natural" hearing** due to the placement in the ear, **reduced distortion, and increased wearing comfort**. The use of ITE aid facilitates pinna's function.

Disadvantages of ITE hearing instruments:

These are **expensive hearing instruments** and cannot be afforded by all. Further, this type is regarded as **unsuitable for children**, due to the need to remake the shell [casing of aid] as the pinna and ear canal grow in size with age. ITE hearing aids are available for mild to moderately severe hearing loss. **Severe and profound hearing loss cases cannot be considered** for the fitting of ITE hearing aids also the recurring expenditure of batteries, maintenance and repairs is high. .

- **Spectacle hearing aid:**

  Here, the hearing aid is **incorporated into the frame of the spectacles**. They may be provided monaurally or binaurally. Usually, the **output of the aid is delivered to the ear in the same way as with the post-aural aid**, i.e. through an acoustic tube fitted into an ear mould. Alternatively, **a bone vibrator may be fitted into the tip of the spectacle frame**, which lies against the mastoid process, and this can be used as a bone-conduction aid.

Neither version is commonly used, as the use of spectacles becomes mandatory. In cases of young children, this type is not used due to the need to replace the frame as the child grows.

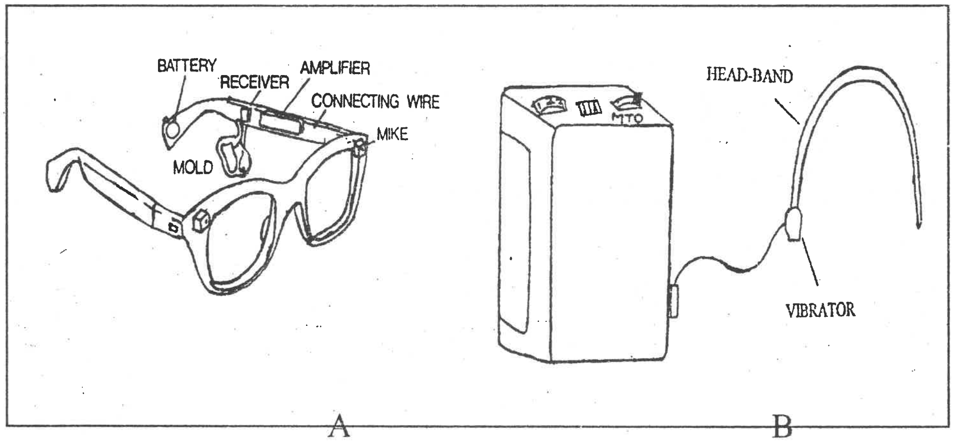


Diagram of A Spectacle Hearing Aid and B Bone Conduction Hearing Aid.

- **Bone-conduction type of hearing aid:**

All the aids where the sound is transmitted via a ear mould into the ear canal, are called air- conduction aids. **The bone- conduction type of aid is fitted to transmit sound energy to the cochlea, via bone conduction.** The **prerequisite** for the fitting of bone conduction type hearing instrument is **normal hearing by bone conduction.** These instruments are fitted for those who are not able to use body-worn or post-aural aids. These would include those with **abnormalities of the external ear, absent or rudimentary pinna, a narrow or malformed ear canal**, or **persistent ear discharge**.

The bone-conduction hearing aid has a **headband and vibrator,** which rests on the mastoid process, and transmits sound energy to the cochlea, by vibration of the mastoid bone.

The **drawbacks** which make this type of aid unpopular are **lack of aesthetic appeal** of the bone vibrator, **physical discomfort, lack of a firm connection**, and the **difficulty of keeping the head-band in place.**

- **CROS system / aid:**

CROS (Contralateral Routing Of Signals) system is **used in cases of unilateral** or asymmetrical hearing loss. The principle is to collect the sound signals received by the poorer ear, and to route them into the better ear.

The hearing aid consists of **two units** similar in appearance to post-aural aids. **One unit contains a microphone and amplifier**, and goes behind the poorer ear. The **other unit** contains only **a receiver**, and is fitted to the better ear, using an open mould.

Technical variations in hearing aids:

Hearing instruments can be classified with their technical performances as follows:

- **Analog Hearing aids:** In analog hearing aids, signal processing is done using analog technology. Fitting is done by mechanically adjusting resistor values. For each adjustable parameter of the instrument a separate trimmer is required. The effect of trimmers is limited to simple controls such as N,L,H, peak clipping etc. **The frequency response of analog aid can be altered by using tone control or trimmers** to some extent however **has its limitations.**
- **Programmable hearing aids:**

Programmable hearing instruments are far more advanced then the conventional types. These type of hearing instrument incorporate integrated circuits with a memory chip that can store necessary information or data. Unlike conventional types, there hearing instruments can be modified in terms of their response characteristics by altering various parameters with the help of software fed into a computer. Thus the number of available parameters that can be altered are relatively more in a programmable hearing instrument. Programming is done with the help of a computer, software and **hipro box. Hipro box is a interface between hearing instrument and a computer**.

The frequency response of the aid becomes very precise for each wearer, as the programming is

done exactly as per the audiogram.

Programmable instrument is a tailor made hearing aid that can be fitted to all types of hearing losses.

- **Digital hearing aids:**

Digital hearing aids use state-of-the-art technology.

In essence, the digital hearing aid is a wearable computer. It eliminates the need for conventional components such as transistors, capacitors and resistors instead **it has a microchip**. This microchip identifies speech and noise. **Every signal entering** into the hearing aid **is analysed and enhanced only if it is speech and suppressed if it is noise.** This technique solves the problem of background noise and feedback, and presents very clear speech. It provides a solution to the various problems faced by hearing aid users. All the functions of this aid are **programmed by a software**. Digital hearing aid can be fitted to all types of hearing losses.

5.7 EAR MOULDS

The discussion about hearing aids will be incomplete without including the topic of ear moulds. **The ear mould is a plastic or Silicon insert** designed to conduct the amplified sound from the hearing aid receiver into the ear canal. Although ready-made ear tips available can be used as a substitute for ear moulds, the hearing aid should ideally be used with **ear mould** as it has **several advantages**.

History of Ear mould

Although **the first ear mould appeared about the turn of the century**, ear moulds as we know them today did not begin to appear until the 1920s. It was about that time that **Western Electric Laboratories patented a hearing aid ear mould**. It was not really a 'custom' ear mould but rather a series of stock ear moulds in various sizes. **A dentist in New York initiated the idea that ear mould**

should be custom-made and subsequently began manufacturing custom ear moulds.

With the development of the post-auricular hearing aid in the 1950s, the styles of ear moulds began to appear. The various styles are described below separately. Initially Plaster of Paris was the most common material in making ear mould impressions. During the late 1940s and early 1950s a soft pliable material became available for use in making impressions. This material was a substantial breakthrough since there were many problems inherent in the use of Plaster of Paris the most common of which was the difficulty in removing from the ear ones as it hardened.

In 1962 the National Association of Ear mould Laboratories (NAEL) was formed. Prior to that time there was no general agreement as to designation of ear mould styles, tubing sizes, or ear mould materials. In recent years, the NAEL has standardized tubing sizes, adopted standard nomenclature for ear mould styles and assisted in the development of new ear mould materials.

To have a properly fitting ear mould, it is necessary to have it custom-made. An impression of the person's concha and external auditory canal is taken, and using certain procedures, the custom ear mould is made.

Advantages of using custom-made ear moulds

In the amplification process, the role of the ear mould is **to link the hearing aid to the hearing impaired person.** This facilitates efficient transfer of acoustic energy to the tympanic membrane. A mould that fits well helps in this **efficient transfer.** The ear mould is **comfortable to wear, easy to fit and remove, and has a good cosmetic appearance**. The ear mould serves as **an anchor for hearing aids** affording retention of the hearing aid to the ear. A properly fitted ear mould will prevent the hearing aid from falling, under most circumstances. For body aids the ear mould provides a retainer for the receiver in the ear. The ear-mould can be used to modify the frequency response of the hearing aid to some extent. This can be achieved by making slight modifications in the ear mould.

5.7.1 Procedure For Making Ear-Moulds

Taking an ear-impression

An accurate ear-impression is fundamental to design an effective ear mould. If the impression is not taken properly, the resulting ear mould can be uncomfortable to wear and will have a poor fit in the ear. This would affect the efficiency of the aid negatively.

- **Ear impression equipment and materials:** Otoscope or ear light, cotton or foam block, nylon thread, mixing bowl, spatula, tweezers, impression powder, syringe and scissors.
- **Examination of Ear:** Prior to taking the ear- impression, it is **necessary to inspect the ear canal** with an **otoscope**. The **presence of wax, discharge** or **obstruction by a foreign body** are all **contra-indications** for taking a ear-impression.
- A suitable size of **cotton-wool ball tied properly to a thread** (temp), should be **inserted into the ear canal. The target spot** for placing the cotton ball is at the **junction of the cartilaginous and bony canal**. The attached thread should be in the middle of the back of the temp, and should run out of the ear and hang freely down the side of the cheek. (See the diagram given below)
- The next job is to prepare the **impression material**, and then **invest the material into the ear**. The impression material must be invested into the ear by means of a syringe in such a way that no distortion of the aural tissues occurs. The important point to note is that the impression material should spread properly in the concha and the external ear canal. The material that can be used for taking ear impression is available in two varieties. Alginate material is mixed with water and the paste is invested into the ear using a syringe. The Silicon based material can be just mixed and invested providing better dimensional accuracy.

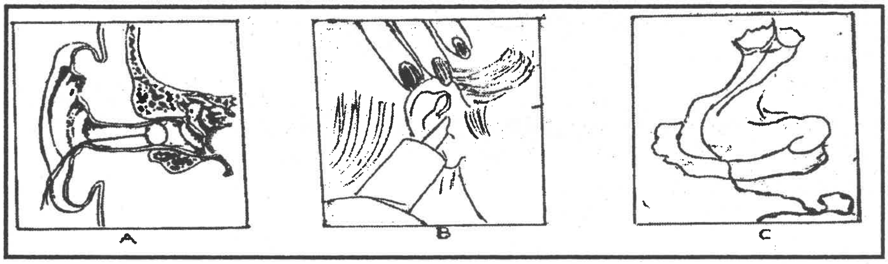


Diagram – a) Insertion of cotton block b) filling the impression material c) finished impression.

- When the material is cured, **impression should be carefully removed** avoiding undue stress or strain. The thread should be pulled out gently and slowly. To remove the impression first move the ear away from the impression and with the thumb and forefinger take hold of the impression at the center back and pull slightly forward. Then pull out the top (helix) and pull straight out with a bit of upward and clockwise motion. The impression should release and come out easily. Be sure to check the ear for any bits of material that might have remained. **Be sure also that the cotton block comes out with the impression.**

Trimming and casting of the ear impression

- **The ear impression should be trimmed to the desired length** with a scalpel or scissors. It should be cleaned to remove the deposits of cerumen, if any. The silicon impression should be left to stand on a tile to allow the complete polymerisation. The impression is then **invested in plaster of Paris** or alternate model making material and left to dry.

- The **original impression is removed** from the plaster and the **cast is obtained** which is filled using the material of choice. (The types of ear mould materials are described below)

Fabrication and finishing

- The mould is taken out from the plaster and processed which includes **drilling a canal in the mould, cutting the undesired portion and buffing of the mould**. A small electric motor with an '0 to ¼ chunk' will suffice for this purpose. The ear mould laboratory need tools such as drills, burrs, stones, polish wheels and polish. The electric motor should be 1/6 HP (horse power) and not more than ¼ HP. It should have a double shaft i.e. a usable shaft on each side. It should be a two speed 1725/3450 rpm motor. One end of the shaft is for mounting the buff wheel and the other one is for the chunk in using the drills, stones etc.

- After polishing **a snap ring (plastic or metal) is fitted** in the mould if to be used for a pocket model aid. For a **post aural aid the mould** need to be **fitted with a plastic pre-bent tube.**

Fixing the mould on the hearing aid

- The fitting of the ear mould is checked on the user. **The ear mould should be comfortable to wear, easy to insert and remove.** It should be possible to set the **desired volume control level without acoustic feedback.** Acoustic feedback is the characteristic high pitch sound emanating from hearing aid when worn. It is by definition, the return of some of the energy of the output signal from hearing aid receiver back to the microphone of the hearing aid. **Improper ear mould fitting can lead to feedback.** It results into ineffective amplification due to inadequate usable gain.

- **The user must be given careful guidance on how to use and clean the ear mould.** In case the user being a child the parents should be guided. The practice in insertion and removal of the ear mould should be part of the program of introduction to the hearing aid system. It will be necessary for parents to obtain new ear moulds for their children quite frequently in early years of life. It is not possible to put a time span on the life of an ear mould.

  The professionals and parents should be on the **lookout for allergy** to the ear mould material. **Dry flaking skin or itching of the concha and meatus** are clearly signs of this problem. The referral to a doctor and use of alternative material is the solution of this problem.

<u>Ear Mould Material</u>

The most commonly used material for making ear mould is lucite plastic, **a hard, durable clear material. The chemical name for this lucite material is methyl methacrylate. Besides being available in a clear material it can be manufactured in various shades. Any style of ear mould can be made out of lucite material.** Another soft material known as PVC (Polyvinylchloride) is leading soft material **in use today as it has excellent acoustical properties. It is available in various degrees of softness. However it tends to crack and break.** Currently various Silicon materials are available **and are used in hard and soft form. This material needs ultra violet curing.**

Some hearing aid users tend to have allergic reactions to some of the standard ear mould materials. These reactions often take the form of itching, irritation or swelling in the canal and / concha. Therefore, a nonallergenic polyethylene has been developed for use with ear moulds.

5.7.2 Types of Ear Moulds

The ear mould for a pocket model **aid is a** full, solid mould with a metal or plastic snap ring **to hold a receiver directly to the ear mould. The ear moulds for behind the ear hearing instruments have different styles like shell mould, skeleton mould, half-shell mould, etc.**

Shell mould **is, by design, the best ear mould available in terms of acoustic seal. It** fills the concha completely, **yet has excellent cosmetic qualities and is used to great advantage in fitting more severe losses where higher levels of gain and output are needed.**

Skeleton mould **is the same basic style as the shell mould with the** center of the bowl portion removed, **leaving instead a 'ring' around the posterior perimeter of the concha for retention. It is used with mild and moderate gain instruments. The skeleton mould and its variations are the most widely used ear moulds today.**

Half shell mould **The name of this mould denotes its style.** The base of the mould covers only about half of the concha **bowl that portion of the lower concha covering the canal , filling the tragus and anti tragus areas. This is good mould for mild to moderate losses and is generally considered cosmetically acceptable.**

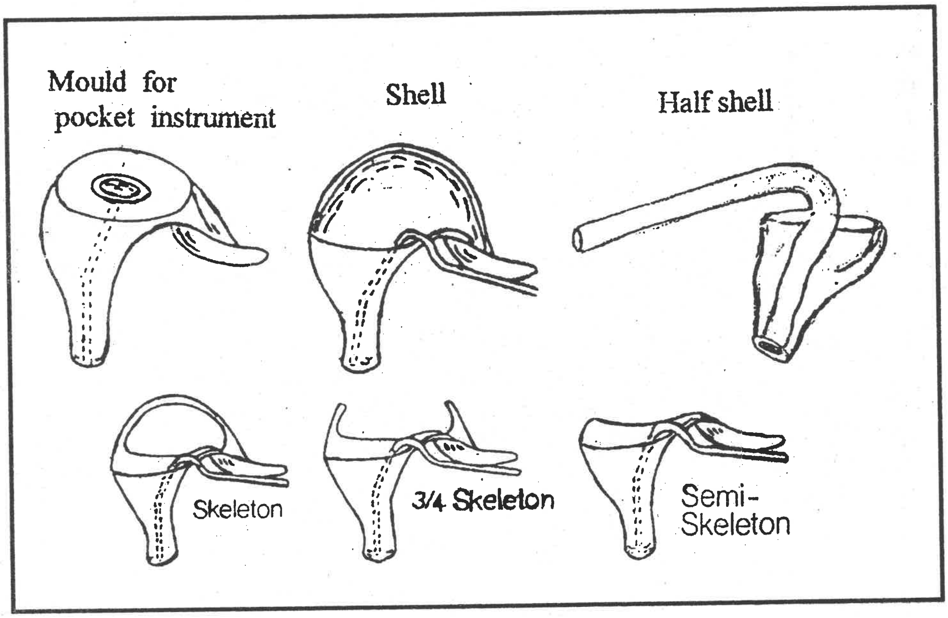


Diagram of different types of ear moulds.

5.7.3 Ear Mould Modification

It is technically possible to manipulate the entire frequency response of a hearing aid by making modifications in the ear mould. **These modifications are changes in the length and diameter of the sound tube, the use of ear mould venting, use of damping elements etc.** Sometimes ear mould modifications are also used to increase the comfort of the subject not altering the frequency response appreciably.

- **Venting** the ear mould is done by **drilling a small hole from the outside of the ear mould** either into the sound bore or to the end of the canal. Venting reduces amplification of low frequencies, increases the overall acceptance and comfort of the hearing aid, reduces the occlusion effect.

The vent can cause feedback and caution must be taken when it is used. **Venting is not advised when the user is wearing a high gain instrument.**

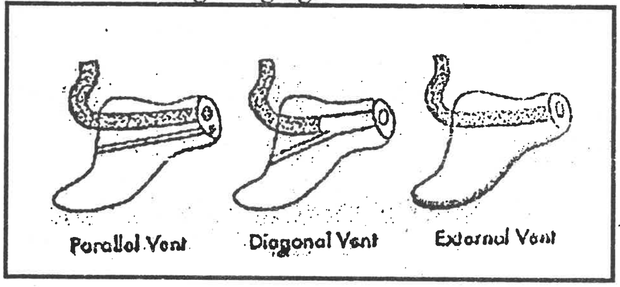


Diagram showing types of vents.

Vents can be classified into three types **parallel, diagonal, external.**

A **Parallel vent** runs parallel to the sound bore to the end of the canal.

A **Diagonal vent** runs into the sound bore at an angle, not reaching the end of canal.

With a Diagonal vent, there is an increased chance of acoustic feedback.

An **External vent** is a groove cut into the surface of the ear mould from the outside to the mould to the tip of the canal. An External vent is used when space does not permit the use of either diagonal or parallel vent. An External vent is also used when the patient suffers from excessive moisture in or drainage from the ear.

- **The change in bore diameter** modifies hearing aid response by the way of high frequency reduction (above 1 KHz). The reduction occurs as the diameter of the bore is decreased.

- **Damping** is **facilitated by fused mesh elements or mechanical inserts** that fits snuggly into the ear hook or ear mould tubing. This is used to reduce the resonance effects in the sound transmission channel of post aural aids, resulting in a smoothing of the frequency response, effective in the 1-3 KHz zone. Dampers are colour coded, for different frequency band. Specific dampers are designed for specific models of hearing aids and this information is available with hearing aid manufacturers.

5.8 HEARING AID CARE

Hearing aid is an electronic device. Dust, humidity, sweat, body heat, mishandling can have adverse effect on hearing aid. **Hearing aid care is very important**. It is very essential to explain the following points in detail to the parents and the hearing aid users. If the aid is looked after well, it can give good service.

- The hearing aid should be kept in a cool, dry place.
- The hearing aid should not be exposed to high temperatures.
- It should not be handled carelessly or roughly.
- The hearing aid should be protected from water.
- Care must be taken to see that the hearing aid is switched off before it is removed from the ear. If not, the battery will soon get drained out.
- The appropriate battery should be used. Care should be taken to place the positive and negative terminals correctly, while placing the battery in the battery compartment.
- If the hearing aid is going to remain unused for a long time, it is better to remove the battery from the hearing instrument. This prevents leakage of the battery.
- No cloth should directly cover the microphone, as the sound of the cloth movements causes great disturbance to the user.
- In case of children, a hearing aid should be used with a harness or with proper straps. It is also essential to have a protector on the pocket-model instrument, to protect the microphone and switches from spilt food, water,

dribble and vomit. A BTE instrument can be used with a ring, called BTE lock.

- The hearing aid and mould should be kept in an open box when not in use, to let any moisture present evaporate. It is better to keep ITE and BTE instruments in a dehumidifier kit after usage.
- The ear mould should be cleaned daily, by wiping it with a tissue, a damp cloth or a prepared hearing aid solution.
- If the output hole of the ear mould gets blocked with wax, it will prevent the sound from entering the ear. This wax should be removed with a wax hook or a stick, regularly once a week.
- It is essential to get the hearing aid serviced regularly.

If these basic precautions are taken, the hearing aid can give long and valuable service to the user.

5.9 CHECKING OF HEARING-AIDS

It is essential for the teacher of the hearing-impaired to check the hearing-aid every morning , to find out whether it is working properly.

You can check the hearing aid in the following way:

- Place the hearing aid on the table, with the earpiece [receiver] at a distance of 12-18 inches from the microphone.
- Switch on the hearing aid to the maximum volume.
- There should be a strong whistling sound heard. This sound, called feedback, indicates that the hearing aid is working. The feedback should be continuous, and not intermittent.
- Then set the hearing aid to a comfortable volume setting, place the mould in your ear, and listen to the quality of sound. Clarity of sound indicates that the hearing aid is working well.

1.9.1 Common Faults of Hearing Aids, And Their Solutions

You may find the following faults with the hearing aids of your children. There are a few checks to be made by you, before you send it to a hearing-aid technician for repairs.

- When the aid is being checked, there is no feedback, or the aid is dead

The casting [body] and /or receiver may be cracked or broken. Check them.

The controls [switches] of the aid may not be in their correct positions. Check them.

The battery may be weak. Check and replace, if required.

The battery terminals may be dirty. Clean them.

The cord may be broken. To check, wiggle the cord between finger and thumb, especially near the plugs. If an intermittent sound occurs, it means the wire is broken. Change the cord, and check if the aid works well now.

The canal of the ear mould or ear-tip may be plugged with wax. Clean it.

The receiver may be damaged. Replace it with a new receiver, and check.

- The hearing-aid is too weak

The canal of the ear mould or ear-tip may be clogged with wax. Clean it.

The battery may be weak. Try a new battery.

The hearing thresholds of the person may have changed [worsened]. Conduct the audiogram again. A hearing aid of higher gain may be required.

- The hearing-aid works intermittently

The cord may be broken. Try a new cord.

The battery contact may be dirty. Clean battery contacts with sharp-edged object.

- The hearing-aid is giving feedback [whistling], while being worn

The ear mould or ear-tip may not be fitted properly in the ear. Fit it properly.

The ear mould or ear-tip may not be of the correct size. Make a new ear mould, or fit a new ear-tip of proper size.

For a pocket-aid, the distance between the microphone and the receiver may not be sufficient. Try to increase the distance, by changing the position of the hearing aid.

The seal washer between the receiver and ear mould may be missing or worn out. Replace the washer.

The hearing aid may be turned on too loud. Adjust the volume to the degree necessary to hear well.

On post-aural aids, check the microphone inlet and ear hook for blockage. Check the connecting tubing for cracks, moisture or debris.

When trying to determine the nature of a fault on a hearing aid, **follow a logical, step-by-step procedure**. Rule out each possible fault, one at a time. In case you are still unable to get the hearing aid working, contact a hearing-aid technician.

5.10 HEARING-AID SELECTION

It is essential to choose a hearing aid that will suit a person's hearing loss. Recent advances in hearing-aid technology have made a wide range of hearing aids available, suitable for different degrees of hearing loss.

A hearing aid should be selected after a careful process, which includes the following procedures.

Speech audiometry

This test can be performed when there is adequate speech and language development of the hearing-aid user. **The speech reception thresholds** and **the speech discrimination scores,** obtained with and without a hearing aid, can be used in the selection process.

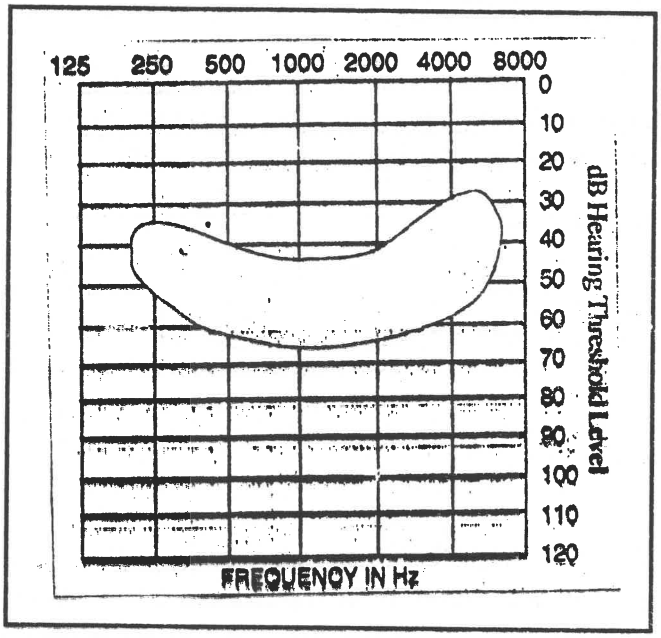
An assessment of a person's ability to follow conversational speech, with and without a hearing aid, can also be carried out. This is a good testing tool, especially for partial hearing-loss cases.

Unaided and Aided audiograms

A sound field test is done to measure unaided thresholds of different frequencies.

Then the person is made to wear a hearing aid, and the sound-field thresholds for the same frequencies are again noted. This gives an aided audiogram. **The difference between the unaided and aided thresholds can provide information regarding the benefit obtained from a hearing aid**. This helps to select a suitable hearing aid. The primary goal of amplification fitting is to provide perception of speech signal to a hearing impaired individual. The overall average intensity of a speech signal is approximately 65 dB SPL as measured at 1metre distance from a speaker. The speech spectrum varies in frequency. The aim of providing hearing aid is to amplify this frequency spectrum and to provide signal at 30 dB sensation level. The desired audible zone is shown in a shaded portion in the audiogram called as **speech banana. The speech banana is an area of an audiogram that covers the frequencies of all vowel and consonant sounds, as well as the intensities within which they can be heard by person having normal hearing sensitivity.**

For a hearing aid to be considered suitable, it is also essential that the graph of the aided audiogram should lie within the **speech banana**. If the aided audiogram falls within this range, it means that the hearing-aid user will benefit significantly from the amplification.



The Diagram of Speech Banana representing a spectrum of formants for most phonemes with the frequency and intensity levels indicated.

Daniel Ling's six sound test

An extremely useful and simple test to check whether a hearing aid is enabling a child to detect all the sounds that his residual hearing permits, has been devised by Daniel Ling. Originally, the test used five sounds, and was called **"Daniel Ling's Five Sound Test"**. As one more sound was added, now the test is called **"Daniel Ling's Six Sound Test"**. The six sounds used are: **"oo" as in boot, "a" as in ear,**

"ee" as in see, "sh" as in shop, "s" as in saw, "m" as in man.

These sounds have been chosen because of the frequency ranges they cover. The three consonant sounds are to be spoken without the sound being followed by a vowel. Thus, "sh" is similar to the sound used when we want people to keep quiet, "s" is similar to the hissing of a snake, "m" is a humming sound.

The child is made to wear an aid, and it is checked if he can hear these sounds. Older children are simply asked to clap their hands or raise a finger when they hear the spoken sound, using a hearing-aid. With babies, Ling has used "conditioned orientation reflex audiometry". The sounds are said first when the child is looking and listening with his hearing aid, and then when listening alone.

Ling states

" All children with measurable hearing upto 1000Hz should be able to hear the three vowel sounds spoken in a quiet voice, at a distance of at least five yards, with a hearing-aid. Children with measurable hearing upto 2000 Hz, should be equally well able to hear the "sh" sound. Children with measurable hearing upto 4000 Hz, should also detect the "s" sound. Ability to hear all five sounds using a hearing aid demonstrates the child's ability to detect all aspects of speech, according to Ling, since these five sounds encompass the frequency range of all phonemes. The three vowel sounds also contain harmonics, which are sufficient to include supra-segmental information i.e. intensity, duration, rate and pitch of voice.

Thus, using these three tests, one is able to select an appropriate aid for the person.

5.11 CAUSES FOR NOT ACCEPTING HEARING AID

Sometimes the hearing aid users do not accept the aids and are reluctant to use aids. The following are the common reasons for this non acceptance.

- **Cosmetic reasons:** Most of the hearing aids, except CIC and ITC are seen easily and reveal the hearing loss of a person. Some hearing aid users **feel conscious and shy** about their loss and consider it as social stigma. Some may avoid the use of hearing aid for cosmetic reasons, especially females and young persons.
- **Selection of unsuitable aid:** The hearing aid gain should be suitable to the hearing loss of a person. **If the gain of the aid is more then required, the user may find it irritatingly loud. If the gain of the aid is less than required, the person may find the sound too soft and unclear**. In both these situations the user may not like to use the aid, as he is not getting any significant benefit from the hearing aid.
- **Recruitment:** Some aid users also find that they are **unable to adjust their hearing aids to a volume setting** that is **comfortably loud**. The aid seems to sound either too soft or too loud. This may be the result of what is known as **recruitment**. By definition recruitment is abnormal increase in loudness with increase in intensity.

Many hearing impaired persons suffer from recruitment and as a result are **very sensitive to relatively small increase in loudness. They may find a level of loudness just significantly above the point where they cannot hear at all, is irritatingly loud or even almost painful.**

That is why many hearing impaired persons especially when they are wearing aids, seem

so sensitive to raised voice and other loud noises.

If this is a problem for a hearing aid user, encourage him to consult Audiologist for advise. Now a days hearing aid technology has improved and the hearing aids which can take care of the above mentioned problem are available.

- **Ill-fitting ear moulds:** If the ear moulds are not made precisely **may cause feedback**. This is disturbing to the user. He is not able to raise the volume sufficiently so that he can hear well. **If the ear mould is ill-fitting and hurts the patient can cause discomfort** and the **user may reject the hearing aid.**

5.12 RECORDS TO BE MAINTAINED IN A SCHOOL

The **records to be maintained by a teacher** of the hearing-impaired, relate to the audiogram and the hearing aid.

Audiogram: Each child's recent unaided and aided audiograms should be displayed. Information regarding threshold of discomfort, dynamic range, Pure Tone Average, speech awareness level and, if feasible, the speech discrimination score, should also be displayed.

Hearing-aid information

The teacher should maintain the following details for each child:

The make of the hearing aid

The model of the hearing aid

The type of fitting used [monaural, binaural or pseudo-binaural]

The category of the aid [mild, moderate or strong class]

The date when the aid was issued or bought

The serial number of the hearing aid

The date when the cord was last changed

The date when the cell was last changed

The date when the aid was repaired last

The electro-acoustic test report of hearing instrument, if available

The date of the last ear examination

The date when the last ear mould was made

These records should always be up to date, and should be easily available when required.

5.13 LET US SUM UP.

- The **important rehabilitative need** of the hearing impaired individual is **amplification device**
- A **hearing aid** is an **amplifying device.**
- There are **many types of hearing aids** however they all share a number of **common features.**
- The important parts of hearing aids are **microphone, amplifier and receiver.**
- Some hearing aids have a **telecoil,** which is used in telephonic conversation.
- **Gain, maximum output bandwidth frequency response** are some of the technical notes used for hearing aids. These details are available with haring aid manufacturers and dispensers.
- **Monaural, Binaural and Pseudo-binaural** are types of hearing aid fittings. Binaural hearing aid fitting provides many advantages.
- A wide range of types of hearing aids are available. The most common types are – **body-worn aid, behind the ear aid, in the ear aids, spectacle type of aid, bone conduction type of aid, CROS aid**
- **Analog, Programmable and Digital** are the technical variations in hearing aids.
- It is important to use a hearing aid with **properly fitting ear mould.**
- **Ear mould is prepared by taking an impression** of the shape of the persons Concha and external auditory canal.
- **A variety of ear mould materials** are available.

- Ear moulds can be made in **different styles.**
- It is technically possible **to manipulate the frequency response** of a hearing aid using **ear mould modification.**
- The **ear mould modification** is done by **venting, changing bore diameter, damping** etc.
- **It is important to take proper care of hearing aid**. The hearing aid users and the parents of hearing aid users in cases of children should be counseled regarding the care and maintenance of the hearing aid.
- It is essential for the teacher of the hearing impaired, **to check the hearing aid every day** and find out whether it is working properly.
- The **minor faults** of hearing aids **can be solved in classroom by teachers.**
- The procedures such as **aided audiogram, speech audiometry** are used for **hearing aid selection.**
- The **concept of speech banana** is used for **hearing aid selection.**
- **Daniel Ling's six sound test** can be used by the teachers of hearing impaired **to assess the benefits of hearing aid.**
- The **proper records should be maintained in school** about hearing aids of the children.

5.14 SELF STUDY.

Q1. What is the basic function of a hearing aid ?

Q2. Draw a schematic representation of hearing aid's electronic setup.

Q3. Mention the functions of 1. Microphone 2. Receiver 3. Amplifier 4. Telecoil.

Q4. Draw a neat labeled diagram of a pocket model hearing aid. What are the advantages and disadvantages of pocket model hearing aid ?

Q5. Write a short note on behind the ear hearing aid.

Q6. Differentiate between 1) Monaural and binaural fitting 2) Binaural and pseudobinaural fitting

Q7. How would you council the parents of a hearing impaired child regarding care of hearing aid ?

Q8. Discuss the technical variations in hearing aids.

Q9. Describe the different types of hearing aids available.

Q10. Being a teacher of the hearing impaired, what are the records you should maintain in a school ?

Q11. Explain the concept of speech banana ?

Q12. Explain the steps in ear mould making ?

Q13. Explain Ling's 6 sound test.

Q14. What is a vent modification ? How does it help ?

Q15. What do you understand by aided audiogram ?

Q16. Why ear mould is used with a hearing aid ?

Q17. Explain various ear mould styles.

Q18. Why binaural amplification is considered superior to monaural ?

Q19. Explain the common faults observed in the pocket hearing aids. How as a teacher for hearing impaired you can rectify this faults in the classroom ?

5.15 ASSIGNMENT

Q1. With the help of a neat diagram, explain parts and functions of a pocket type hearing aid.

Q2. Explain steps in custom making of ear mould. List out tools and instruments required for starting ear mould laboratory in your school.

Q3. What do you understand by care and maintenance of hearing aids. How will you troubleshoot a hearing aid for its defects and correct the same as a class room teacher ?

5.16 POINTS FOR DISCUSSION/CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification on other. Note down those points below :

1.16.1 Points for Discussion

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1.16.2 Points for Clariiication

5.17 REFERENCES.

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BLOCK 2:
DEVELOPING LITERACY SKILLS: READING

UNIT 1: PRE-REQUISITES FOR READING AND EMERGENT READING SKILLS

STRUCTURE

- **Introduction**
- **Objectives**
- **Language – a part of human behaviour**
- **Biologic bases of language**

Localization of the functions of the brain –

- Broca's work
- Carl Wernicke's work
    - **Size of damage than site of damage is more important**
    - **Functional hierarchy of the brain**
    - **The asymmetry of cerebral hemisphere of the brain**
        - Wada test
        - Dichotic listening studies
    - **Proof of biological foundation for language acquisition**
    - **Acquisition of language**
        - Speech – an intrinsic part of spoken language
    - **Conditions conducive to language acquisition**
        - Ample exposure to adult language related to shared experiences
        - Repetitive language usage focused on child's needs and interests
        - Summary of factors that have relevance for developing language in H.I. children

- **Important features of the process of language learning**
- **Stages in language development**
  - The growth of vocabulary
  - Reading and writing
  - Language competence and literacy
  - Summary of stages of language development
- **Theories of language learning**
  - Language and cognition
- **Language development – the main problem of the deaf**
- **Premises for language development of the hearing impaired**
  - The language difficulties of H.I. children
  - Errors often seen in the language usage of H.I. children
  - Teaching verbal language skills to the H.I.
- **Summary**
- **Self Study**
- **Assignments**
- **References and suggested readings**

1.1 INTRODUCTION

Acquisition of language is one of the most important achievements of childhood. A language system is extraordinarily complex as can be seen from what we have discussed in the previous unit. The system involves highly abstract organizational principles.

It still amazes linguists that the young child is able to acquire the rules of a language and gradually use them more like the adult version. If a child gets sufficient exposure to two languages in childhood, he will probably learn both equally well. Since the child is not taught these formally but makes it as if it was all by himself, it has been suggested that human children have an innate capacity (generic ability) to acquire language.

Study of language acquisition covers three areas.

1. Factors leading to development of language (innate abilities plus the environmental factors).
2. Theories of language acquisition,
3. Developmental stages : how language is developed.

In this unit we will study somewhat in detail the brain mechanisms that underlie its acquisition and use, the process of language acquisition by hearing as well as hearing-impaired children, and will briefly talk about the theories of learning language.

1.2 OBJECTIVES

After studying this unit you would be able to ;

- Understand how the human brain controls language behaviour,
- State the main factors responsible for language acquisition,
- Explain the stages in which language development occurs,
- Discuss the theories of language learning,
- Explain the areas of difficulty in language usage for the hearing impaired.

1.3 LANGUAGE - A PART OF HUMAN BEHAVIOUR

Language is defined as a "System of arbitrary vocal symbols by means of which two or more Persons interact and communicate". It is a part of communication. It is described as a code for communication. Language is known to have developed / evolved as a highest form of behaviour present only in human beings. Although animals do communicate, that behaviour is considered as lower to human language. This is mainly so because of the nature of language. Language is a generative behaviour governed by specific rules. Thus, it depends on :

- inputs from sensory receptors,
- decoding of input signals,
- analysis of information, and
- organization of motor system for language expression (output).

Thus, it is a brain oriented cognitive process.

1.4 BIOLOGIC BASES OF LANGUAGES

The physical substrate responsible for human language is the human brain that controls and processes the language. It has been recognized that the brain has two identical halves called hemispheres. Each hemisphere is further subdivided in to four lobes. Starting from anterior to posterior (front to back), they are named as frontal, parietal, occipital & temporal lobes:

(Fig 1) : Explaining the basic lobes of brain

Though both right & left hemispheres look identical and same, there are anatomical (structural) and Physiological (functional) differences observed between them.

Lenneberg (1967) in his book on Biological foundations of language explains that the language is the highest behaviour observed in human beings and contends that biological mechanisms responsible for language is specific to man. It is well known that when some portions of the human brain get damaged, deficits in language function are observed. Following landmark studies have proved this :

1.4.1 Localization of the Functions of the Brain

i) Broca's Work

One of the major neurological discoveries of the nineteenth century showed that the **left hemisphere of the brain primarily carries out the language functions.** This feature that language is lateralized to left-brain was first noticed and explained by Paul Broca (1861). Paul Broca provided postmortem evidence for **loss of speech** due to injury to the frontal portion in the left hemisphere of brain in his patient. By 1863 Broca could show in 18 of his patients, that injury to posterior portion of 3rd frontal convolution results in loss of speech. This finding led to further research on localization of functions in Brain.

ii) Carl Wernicke's work

Carl Wernicke's (1875) soon after presented findings that language function could also get disturbed and disrupted when there is damage to areas in left temporal lobe of the cerebral cortex. He suggested a relation between hearing and speech and described Aphasia (loss of language due to brain damage) resulting from damage to auditory projection area. The language disturbances seen in Wernicke's patient were different than that were seen in Broca's patients. Wernickes' patient suffered damage to their first temporal gyrus & could speak fluently. Their speech however was confused and made little sense. They could hear speech but could not understand or repeat what they heard. Wernicke hypothesized that this type of disturbance is because of disconnection of nerve fiber which connect the **two speech areas**; one which involved in **speech movement (Broca's area),** and the other involving the **comprehension of speech (Wernicke's area).**

Wernicke attempted to explain through his neuro automic model of Speech production and perception, the different types of language disturbances that could occur because of damage to different portions of the brain. According to this model the temporal lobe played an important role as sensory receptor organ. He produced evidence that damage to the first temporal convolution in left temporal lobe causes sensory aphasia, which supported that it is the second speech centre in addition to motor speech centre in the frontal lobe explained by Broca. He further explained that anatomical disconnection of these areas from one another, as well as, damage to any of them could cause aphasia.

1.5 SIZE OF DAMAGE THAN SITE OF DAMAGE IS MORE IMPORTANT – A DIFFERENT THEORY

The findings cited above lead to mapping of brain for localization of functions by several scientists. However, Henry Head countered the localizationists and stated that they tend to over simplification of the deficits following the brain damage. Ann Goltz conducted a series of experiments on dogs by removing specified areas in brain and studying the behavior. Goltz's experiments suggested that size of damage (lesion) than site or location is more important and revealed that removal of parts of cortex did not result in abolishing of movement as expected, instead decortications (crossing over of nerves) resulted in reduction of all functions.

1.6 FUNCTIONAL HIERARCHY OF THE BRAIN

John Hughlings Jackson – founder of modern neuropsychology explained that the human brain and nervous system are organized on the basis of functional hierarchy. His explanation views nervous system in terms of levels. Spinal cord, Mid brain, diencephalons, basal ganglia, and cortex. Each level controls more complex aspect of behavior.

i) **The Level of Spinal Cord :** At the level of spinal cord simple motor reflexive functions are controlled. They are mostly related to somatosensory system.

ii) **The Level of Brain Stem :** At the level of brain stem, postural support, righting reflexes and regulation of sleep/ wake functions are mediated.

iii) **The Level of Mid Brain :** The mid brain supports at least 3 functions :

- First – auditory, visual stimulation control,
- Second - linking these sensory systems to voluntary motor systems.
- Third - control of automatic stereotype behaviour – such as chewing & sucking etc.

iv) **The Level of Thalamus, Hypothalamus and Basal Ganglia :** Next stage of Thalamus, hypothalamus and basal ganglia add dimensions of increased energy and coordinated voluntary movements, and control such behaviour as rage & fight.

v) **The Level of Cortex :** Finally, the cortex controls and constructs sequences or patterns of **voluntary movements in response to internal & external cues & discriminates patterns of sensory input.**

According to Hughlings Jackson – disorder or damage to highest corticular level results in dissolution of behaviour (regression). The organism can retain and perform only simpler behaviour as seen in organisms which have not evolved higher level behaviours. He believed these symptoms to be an expression of released activity of lower centres of brain when their higher centres are damaged. Haughling Jackson instead of attempting to explain organization of language with reference to structures that have been damaged in aphasics – tried to suggest that aphasia be regarded as a reflection of activity of the undamaged parts of the brain.

Alexander Luria (1966) a Russian Psychologist also proposed a similar hierarchic organization of brain function.

We have already seen that language is a mental phenomenon. The code resides in the mind of the speakers / users, and unless the talker and the listener both know / share the same underlying language code, the messages will not be meaningful.

Normally, speech is the main modality for use of language and hence we do not think of speech and language as two distinct abilities. But at times, in the training and education of hearing impaired children, these are to be treated as two distinct aspects of linguistic communication, which need to be attended to separately. Thus while dealing with a young hearing impaired child, the teacher's efforts will be geared to :

- Assisting the child to acquire the language code so that he will understand and act in social situations and educational situations; and
- Then helping him to learn the mechanics of speech, so that having developed an understanding of the language code, he can become articulate and use his language knowledge for communication.

Spoken language can be learnt in a natural way only via audition. We shall now see how language code is acquired by hearing children.

(‘Speech and Teaching of Speech’ are dealt with in ‘Paper II, Block 3 and 4.’)

1.10 CONDITIONS CONDUCIVE TO LANGUAGE ACQUISITION

Linguists and others who have been interested in the study of the process of acquisition of language by children have still not understood it quite clearly. Yet, from whatever has been the outcome of these studies, certain factors have emerged as quite important for learning of a verbal language. The studies indicate that, though children have the brain potential for verbal learning, it will occur only if suitable conditions are present in the child's environment. These are :

- Ample exposure to adult language related to shared experiences,
- Language usage focused on child's needs and interests.

1.10.1 Ample Exposure to Adult Language Related to Shared Experiences

As the child grows and starts moving around, he understands and learns more about the people and things in his surroundings. He gradually realizes how these affect him and how he can influence their behaviour and actions – cognitive development. The accompanying language interaction, related to the experiences shared by the adult and the child, helps the growth of vocabulary and comprehension. It is important to note that the child's comprehension always precedes his expression, i.e. he understands before he can use particular words and phrases. Day by day, out of a multitude of apparently small events, his vocabulary grows. However, it is essential to remember that in the initial stages, since the child does not speak yet, it is the mother/caretaker who plays a double role by asking questions as well as providing the answers herself. This makes the child aware of the role of language in everyday dealings. Soon he realizes that his own vocalizations are an efficient tool to draw adult's attention and to satisfy his needs. His attempts at speech, however small and incorrect, are always rewarded by approval and interest by the people around him, and gradually he finds himself able to communicate his needs and excitements by this new means. Thus, it can be said that children usually learn their first language through abundant experience of its reception and production, and in situations that are interesting and meaningful to them. By the age of two, they acquire the knowledge and use of syntax too quite effortlessly as they communicate.

1.10.2 Repetitive Language usage focused on child's needs and interests.

The interaction between the child and the caretaker usually is focused on the child's needs, interests, and the child's first hand experiences gained through play, other routine activities, and the situational context.

ACTIVITY

SITUATION

EXPERIENCE

All of these, the play, activities, adult's actions in response, the situational context and the accompanying speech, which most of the times are simultaneously perceived by the child, **form the base** for communication by speech. The important components of such communication are:

- **The adult's and child's shared attention to each other and to the same objects and events, and**
- **The adult's spoken commentary such as explanations and descriptions on them.**

The words uttered in the course of experiences shared between the child and the adult get attached to their meanings (objects, events, actions, relationships between these, etc.) for normally hearing children **over many months before they utter their first word**. The everyday activities in which babies hear spoken language are greatly **repetitive and enjoyable** for them. The adult's speech is directly related to the care giving activities such as bathing, dressing, feeding and play situations. Adults often **comment on and explain** the salient features of whatever has attracted the child's attention. Normally they do not expect or stress that the child should respond by imitation or answering questions. In fact the adults themselves do this job. Thus initially, **for a long time**, children are helped to understand how to respond verbally.

(This particular aspect of language development is greatly significant for teachers of the deaf.)

2.10.3 Summary of factors that have relevance for developing language in H.I. children

McAnally and others have outlined certain factors vital for development of language. These are as given below:

1. The need to communicate precedes the ability to communicate.
2. Interaction is essential to language development.
3. Prosodic elements of language appear to be more important initially than words.
4. The form of adult input influences early language development.
5. Feedback to children on how well they have represented their intended meanings is important to language development.
6. Children's vocabularies grow rapidly and follow patterns through several repetitions.
7. Children's syntax also grows rapidly and follows patterns with opportunities and encouragement to use language.

1.11 IMPORTANT FEATURES OF THE PROCESS OF LANGUAGE LEARNING:

1. The child is interacting with his environment and gaining varied experiences through his senses.

2. He is receiving some sample utterances from the language mostly related to his firsthand experiences, e.g. Mother brings the ball to the child and says," Here is a big ball for Munna, a big red ball." Then she rolls the ball and says," Oh! Oh! The ball is gone, go get it." Then she may herself go and get the ball and say," Ah! I have got the ball." The child has now become aware of the words ball, big, red and the action word 'get/got. Simultaneously, he has observed the situation, object and the language used in the event. The repetitions of such concrete play situations will provide the necessary input for learning language.

3. Many linguistic interactions allow the child to see the situation and sentence in opposition against each other that make it meaningful, e.g.

I am here You are there

One can see that there is a fundamental opposition of situations that are matched by the words in the sentences. The child is deriving meaning from the **mental comparison of the elements of the situation with the elements of language**. This kind of **situation - sentence pairs** constitute the input to language learning where the child is learning meanings and the related forms of words and sentences, e.g. the child sees an ice cream, tastes its sweetness, feels its coldness, likes it, and simultaneously hears the words 'ice cream', 'cold', 'sweet' 'Do you like it?', 'Do you want some more?', etc. This means that he is learning different sound combinations (words) for these meanings, may try to repeat these words and those get fixed in his mind for future use.

4. The spoken language is reinforced for the child by **tens of thousands of repetitions in meaningful situations.** Thus the language becomes so familiar to a normal hearing child that it not only provides a means of communication but also a tool for thought. Every time a person speaks to a hearing child, he is exposing that child to the pronunciation of the word and to the patterns of phrases and sentences which the child masters in time.

1.12 STAGES IN LANGUAGE DEVELOPMENT :

The typical child uses single word sentences at about the age of eighteen months. The one word that he says may represent a whole sentence, e.g. 'water' may mean 'I am thirsty' or 'I want water'. When he says his own name, it may mean to him, 'That thing belongs to me.'

Shortly after this stage, he puts two or more words together to form short sentences that do not necessarily correspond to adult sentences.

By the age four, the child will be in possession of the essential structure of the language. He begins to ask questions and initiates and enjoys conversations. Up until now, the child has asked concrete questions like 'what?' and 'where?'. Now the child begins to use the more abstract questions like 'why?' and "when?'. The child, being inquisitive by nature, wants to know about everything that he sees around, and these early 'why?' questions are asked quite persistently which provide opportunities to get exposure to language usage in varied situations. However, it must be remembered that acquiring / learning language is practically a full time occupation for the child over a period of three years, which represents a very large number of language learning hours.

1.12.1 The growth of vocabulary:

With age and with entry in the school the child's general knowledge and language knowledge increases very rapidly. The size of vocabulary is a good indicator of the general mental growth of an individual. One's vocabulary grows in proportion to one's education, but it also grows in proportion to one's inborn power to acquire verbal ideas.

1.12.2 Reading and writing

The use of graphic language, both for reading with comprehension and written expression, comes later in the child as it came later in the human race. An average child is taught to read at the age of 5/6 and to write a year or two later in school. Learning to write is a matter of acquiring skills in the use of some rather fine muscular pattern. Just copying is a mechanical skill. The child may not necessarily understand what he is writing. (The teacher of the deaf has to take special care to see that does not happen in her class.)

1.12.3 Language Competence and Literacy

It has been observed that millions of people in this world have not learned to read and write, i.e. they are not literate. Yet they are seen to lead lives quite normally; they can all speak and understand and can participate in discussions as well as literate persons can. However, anybody who has acquired a language can learn to read and write that language with some effort and training. But learning a language and learning to read are somehow different. The latter is almost entirely dependent upon one's ability to use language fluently, and same as speech, reading too is a modality of linguistic communication. It is not language itself.

This point is very important for the teachers and parents of the H.I. children. Reading should not be introduced to **young** deaf children unless they have acquired sufficient functional verbal language.
(For details see Paper III, Block 2)

1.12.4 Summary of Stages of Language Development

Stern & Stern (1907) is generally considered to be the first real classic in child language. He starts his periods of acquisition at 1;0, with the onset of the first word, because he feels that speech really begins 'from the moment in which the child, for the first time, utters a sound with full consciousness of its meaning and for the purpose of communication'.

Summary of Stern's (1924) Preliminary stage and four periods of language acquisition :

1.13 THEORIES OF LANGUAGE LEARNING

We have already seen that language is a learnt behaviour and that the child does not learn the language all at once but in stages. As such, the theories of learning have been applied to language learning also. These are discussed in the paper on psychology. In this unit we are mainly interested in the theories that have been suggested to explain the acquisition process.

- The **Imitation Theory** claims that children learn their language by imitating the speech of adults.
- The **Reinforcement Theory** proposes that children are conditioned into speaking correctly by being positively reinforced for "correct" language usage and negatively reinforced for "errors" in usage.

However, none of these theories can give a satisfactory explanation as to how children learn the rules that they are seen to use to produce novel sentences. There is no doubt that imitation is involved to some extent. But it cannot account for language usage such as 'I goed' at the word level, or 'he go out' at the sentence level. Studies indicate that children are not able to imitate sentences that cannot be generated by the grammar that has been formed in their own mind at a particular level.

The reinforcement theory assumes that children are being constantly corrected for using incorrect sentences and are encouraged when they use correct grammatical constructions. Here again it has been observed that the correction that takes place is more for the content of the message than for its grammar. Besides, adults are really delighted that their toddlers are talking at all and just are not bothered about correcting their children's speech for grammar. (It must be noted here that the mother often repeats the child's one word or two word utterances by just expanding them into full correct sentences. She does not insist that the child should repeat after her.)

- Children form their own rules and construct a grammar.
  From the Studies on language acquisition, it looks as though children form their own most simple and general rules from the language input they receive and use these in expression till they learn to use the correct ones .

1.13.1 Language and cognition

Several studies have been done in the past concerning the relationship between 'cognition' and 'language'. The early position, known as **language dominant position**, was that language was primary and that thinking (beyond early and primitive stages) took place in language. In this view, the child's linguistic development is determined largely by experience with language, and language accounts for the concepts that are expressed within it (Quigley & Kretschmer, 1982).

The opposing and the presently prevailing view is the **cognitive-dominant hypothesis** which proposes that basic perceptual and cognitive development precedes language and provides the basis / underpinning for linguistic development. Language in this view is a natural extension or subset of the previously developed cognitive processes (Slobin, 1979).
Furth (1966) perceived his research as confirming that cognitive operations exist largely independently of language and that language is of minor concern in investigating cognition. His research can also be interpreted, however, as being supportive of the view that language and its acquisition are natural outgrowths and the direct result of basic cognitive processes and operations.

Bowerman's (1981) argument in this regard is worth mentioning here. 'She suggests an interactive model, in which meaning is promoted out of cognition into domain of language,- what is to be learnt. New forms can still be mapped onto meaning derived from cognition; but meaning can also be developed through attention to linguistic forms, presumably using cognition (discriminating, categorizing etc) as a vehicle. This **interactionist view of cognition and language** is now popular. Language skills are not isolated from rest of the cognitive development; level of intelligence is not always independent of language level (Wells 1979); what children are doing is attending to **both linguistic form and perceptible properties of the** situation to understand meaning.'

1.14 LANGUAGE DEVELOPMENT – THE MAIN PROBLEM OF THE DEAF

A severely and profoundly deaf child will most probably never develop any language and speech unless very special help is given from the early stage. Deaf children with mild and moderate loss of hearing are likely to develop some language and speech skills. However, the quality and quantity of these skills will depend not only on the degree of the hearing loss but also on the child's intellectual level and his total environment. The table given below will give some idea of the difference that may be seen in the development of communication skills between the hearing and the average profoundly deaf children.

1.15 PREMISES FOR LANGUAGE DEVELOPMENT OF THE HEARING IMPAIRED

- A typical child is born with a biological predisposition / capacity to learn language,
- Not all children learn language equally well and at the same rate,
- The pattern of language development is the same in the normal hearing child, the hearing impaired child or the language delayed child,
- The majority of hearing impaired experience language delay,
- With good school programme and early training, the child is likely to move at a normal pace,
- Exploitation of the residual hearing is a very important factor,
- Language development is dependent upon the communication between the child and those in his environment,
- Parent involvement is necessary for the development of language,
- Good programmes of language development are based on a developmental model following the pattern of normal language development,
- There is no conclusive evidence that indicates the superiority of one communication approach over any other,
- Language is learnt by seeing and hearing connected language in discourse with others, and not through use of single words. (The child must gain competence in all aspects of language – pragmatics, semantics and syntax.)

1.15.1 The Language Difficulties of Hearing Impaired Children

Severe hearing impairment from birth in most cases imposes a language handicap. Such a child will acquire language with difficulty even with special help. Considering the nature of his handicap, whatever he learns in terms of language and speech is truly quite an achievement. The incidental exposures and reinforcement of colloquial language patterns and knowledge are greatly limited owing to his poor social contacts. The retardation in both comprehension and expression adversely affects his educational performance and tends to mask his potential ability.

1.15.2 Errors often seen in the language usage of H.I. children

The following errors often occur in the speech and written language of the severely hearing impaired children :

- Errors and omissions in the use of **verbs**. The number of verbs in the stock or a deaf child's vocabulary is generally very limited. A determined and conscious effort has to be made by the teacher and the parents to help him learn and use verbs in his speech,
- Incorrect use or omissions of functions words such as articles, prepositions, etc.
- Errors or omissions in use of **plurals** and **tense endings**,
- Great difficulty in learning the **gender, number, person concord** that exists in most of the **Indian languages**. E.g. 'Lada**ka** ro**ta** th**a**', and 'Lada**ki** ro**ti** th**i**', or 'bad**a** kutta' and 'bad**i** billee', or 'eak gho**da** 'and 'char gho**de**'.
- Errors or omissions in the use of **case markers** which appear at the end of the nouns and are not heard or seen that easily on the lips by the deaf children.
- Use of stereotype sentences such as 'subject–verb-object' patterns.
- Sentences are telegraphic in quality and both the speech and the written work lack in abstract concepts.

Many teachers and parents feel (wrongly though) that the difficulties in understanding spoken language can always be overcome through reading. However, a hearing impaired child whose language base is weak, may also show retardation in the area of reading. In such cases focus will still have to be on reinforcing, consolidating and strengthening his language base through sustained efforts along the lines described in Paper III, Block 1 and 2.

Some of the strategies to assist H.I. children in developing their knowledge and language comprehension and expression through reading are discussed in Paper III, Block 2, Unit 3.

1.15.3 Teaching Verbal Language Skills

It is generally agreed that at least three overlapping stages are required in order to assist language development. These are :

- Reception (listening with understanding)

- Internal symbolization (interpreting, reasoning, and concept building), and
- Expression (communicating by speaking or by writing).

Between reception and internal symbolization, we require a process of decoding the incoming signals into a form that is readily interpreted in terms of previous traces in the brain. Similarly the outcome of reasoning is thought to be converted or encoded into a form, which enables an individual to communicate to his fellows. (For hearing children these forms would be spoken or written words; where as for the deaf, these may be stored in the brain as visual patterns of signs or patterns seen on the lips.)

The teacher of the deaf will have to make special and planned efforts to provide opportunities to her children to go through all these stages repeatedly in an enjoyable and interesting manner so that the linguistic forms get fixed in their brain through their use. For the purpose she can make use of natural situations or contrived situations such as visits, story telling, directed activities, conversations based on news, daily routine, etc. It must be borne in mind that in the case of deaf children, results will not be seen immediately. She will have to make sustained efforts over a long period of time to get responses in terms of language from these children.

1.16 SUMMARY

Language usage is the highest form of behaviour present only in human beings. Since its acquisition depends on input to the brain through the sensory organs, decoding and analysis of the information and the output (expression) monitored by the speech center in the brain, it is said to be brain oriented cognitive process. It is seen that children achieve a fluent control over the language of their speech community regardless of their genetic or racial characteristics. Though the process of language acquisition by children is still not understood very clearly, certain factors have been identified as vital for it, such as repetitive language usage focused on child's needs and interests, the adult's and child's shared attention to each other and to the same objects and events, and, the adult's spoken commentary such as explanations and descriptions of these.

A child begins his one-word utterances by age 1 year, which represent his full thoughts, and by age 4, the child will be in full possession of a vocabulary of minimum 2,000 words and the essential structures of the language. It is generally accepted now that the basic perceptual and cognitive development precedes language and directly influences its acquisition.

Deaf children do have innate ability i.e. brain potential to acquire language, and with special efforts and training, many of them can achieve a somewhat limited use of language. However, grammar happens to be the stumbling block for the hearing impaired. There is no conclusive evidence that indicates the superiority of one communication approach (modality of linguistic communication) over any other.

1.17 SELF STUDY

1. Collect random language samples (about 10 to 15sentences each) of 5 H.I. children of 8 to 15 years of age in spontaneous conversation and / or through picture description. Analyze the errors in language usage. Also note for each child the age at onset of deafness, degree of hearing loss, age at intervention and the quality of the training. See if there is a connection between these factors and the child's performance.

1.18 ASSIGNMENTS

1. Study the language development of 2 hearing children of 3 and 6 years of age. Note these against Stern's table of Stages of language development citing the examples of utterances.
2. State with examples the main factors responsible for the development of language in hearing children.
3. Write a brief note on biological foundations of language.

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UNIT 2: ASSESSMENT OF READING SKILLS AT DIFFERENT LEVELS

STRUCTURE

2.1 INTRODUCTION

Hearing impaired person tries to find suitable amplification devices. These are called as individual hearing aids. These **hearing aids have some built in limitations**. It amplifies limited frequency range, and is unable to amplify complete speech frequency spectrum. (A spectrum is a graphic representation of the distribution of frequency components in a given acoustic signal.) It is ineffective at a long distance, and in presence of background noise. Hearing aid amplifies everything, even though not required by the hearing impaired person.

The person who is using a hearing aid **experiences instrument being very noisy**. So there is a need to explore other amplification devices, which may resolve above stated problems, and may offer better quality auditory inputs to hearing impaired person. **Teaching hearing- impaired children** essentially **depends upon good quality of auditory inputs**. Classroom amplification devices act as alternative devices, which provide flexibility to the teacher as well as to the students.

There are other assistive listening devices, which may work independently of, or in conjunction with the hearing aid. These devices are used for television, telecommunication etc. It has been observed that **profound hearing loss cases do not receive significant benefit from individual hearing aids**. Naturally they tend to rely more on speech reading and not on auditory cues. These individuals need different kind of stimulation mode. Cochlear implant and tactile aids are the other options to them.

Appropriate acoustical conditions in a classroom are crucial, as all these **devices do not have** selectivity **to amplify only speech and no other inputs**. Similarly acoustic environment is a constantly changing environment. **Thus background noise may adversely affect the listening skills** of hearing impaired children, resulting into poor academic performance in schools. It is essential to study acoustics, noise levels in and around the classroom and various measures to reduce this noise level.

2.2 OBJECTIVES

At the end of this unit students will be able

- To understand various classroom amplification devices.
- To compare and to contrast classroom amplification devices.
- To describe cordless amplification.
- To list various assistive listening devices.
- To understand cochlear implant and tactile aids.
- To list various sources of noise, in and around the classroom.

- To elaborate measures to reduce classroom noise.
- To explain reverberation and how to reduce it.

2.3 CLASSROOM AMPLIFICATION DEVICES

There are different types of amplification devices, which are used in the classroom. These instruments have **better, and wider frequency response curve**, than an individual hearing aid. They have **high level of amplification**. Most of the systems are coupled to set of headphones; hence problem of feedback is minimal. Also, background noise reduction becomes possible. This noise reduction is achieved by placing a microphone as near to the speaker's mouth as possible. This minimizes the adverse effects of distance between the speaker and the microphone and also minimizes background noise. **Improvement in signal-to-noise ratio is the primary goal**, which, can be achieved with these classroom devices. Signal-to-noise ratio expresses the ratio of speech intensity (S) to noise intensity (N). The difference in dB between a sound of interest and a competing sound is called the signal –to- noise ratio. The S/ N may therefore be interpreted as a relation between two acoustic signals. **Speech intensity has to be louder than background noise to understand speech**. But we have no control on variables of acoustic environment; hence this ratio keeps on changing. Every effort is made to control signal to noise ratio in all these classroom devices. Common classroom devices are as follows, speech trainer, hard wire system or group hearing aids and loop induction system. Let us study these units in details.

2.3.1 Speech Trainer

A speech trainer can be considered as a **large size hearing aid**. It is a kind of master hearing aid, which can be used for different types of hearing losses. The speech trainer constitutes two microphones, amplifier and a set of headphones. The two microphones can be built-in in the speech trainer or can be attached externally. There are independent gain controls, tone control along with one on-off switch on the speech trainer (fig1). There are two types of speech trainers, **a) monotype, and b) stereotype**. Monotype speech trainer has single amplification circuit, and stereotype consists of two independent amplification circuits. The output level of the speech trainer can be adjusted individually in stereotype speech trainer. In mono- type speech trainer, independent volume controls can adjust the output level of each ear.

Fig 1-a Monotype Speech Trainer Fig 1-b Stereotype Speech Trainer

The teacher can adjust the output level of the speech trainer, according to hearing-loss of an individual. **Generally amplification level is kept 30dB above the pure tone average**. The frequency response curve of any speech trainer is from **100Hz to 8000Hz**. This wide frequency response curve can facilitate better speech inputs. Some speech trainers have **tone control**. The function of the tone control is same as, that of any tone control of hearing aid. Speech trainers also have **VU meter or LCD lights**. The needle of a VU meter in a speech trainer deflects when an individual speaks; the deflection of the needle indicates output level or loudness of the input. If the deflection of a needle is very minimal, when a child speaks he can be explained a need to monitor his own voice. Similarly LCD lights are effective to give information on loudness of voice. **These visual cues are important to monitor intensity of individual's voice**. These are additional visual inputs to the hearing impaired child. Some speech trainers are batteries operated, in that case VU meter or the LCD lights gives **indication about the low**

voltage of the battery. Speech trainer is being a portable unit; it gives flexibility to use it in various environments such as at home, in the classroom etc.

Merits of Speech Trainer

- It has a wide frequency response curve.
- It has maximum output level of 140dB.
- It can be used for all types of hearing losses.
- VU meter or LCD lights can give visual cues to the child.
- It has high-quality amplification.
- It is useful in auditory training activity.

De-merits of Speech Trainer

- The headphones are bulky for infants.
- It affects the mobility of a child.
- It can be worn for short period [20-30 minutes].
- A trained person is required to handle the instrument.

2.3.2 Group Hearing Aids

High-fidelity sound input is the need of hearing impaired children; and if this input is given to the whole class simultaneously, classroom teaching will be easier to the teacher. Group hearing aid or hardwired system provides such input to all the children in the class simultaneously. **The system consists of microphones, amplifier and few sets of headphones**. The system is installed in a classroom; generally it is fixed to the students' tables.

The system is made available for a group of six/eight/ten children. At teacher's desk one microphone is installed. Other microphones are installed in such a way that single microphone is shared with two children. **The inputs are fed into the microphone, which transmits electrical signals to the amplifier. Amplifier amplifies electric signals, which is fed to a series of student control boxes.** Each control box is equipped with an **independent gain control** for the left and the right headphone. In this way, amplification can be adjusted as per the audiogram of an individual. All children have set of headphones. Generally classroom furniture is designed in **a half circle shape,** but one can have different furniture styles. **Half circle arrangement appears to be more convenient for children to speech read their teacher**. The preferred seating arrangement may be as, children with minimal residual hearing are seated at the center and others with relatively good residual hearing are seated sideways. This system facilitates desired, and high –fidelity quality auditory inputs to all the children simultaneously. (Fig.2)

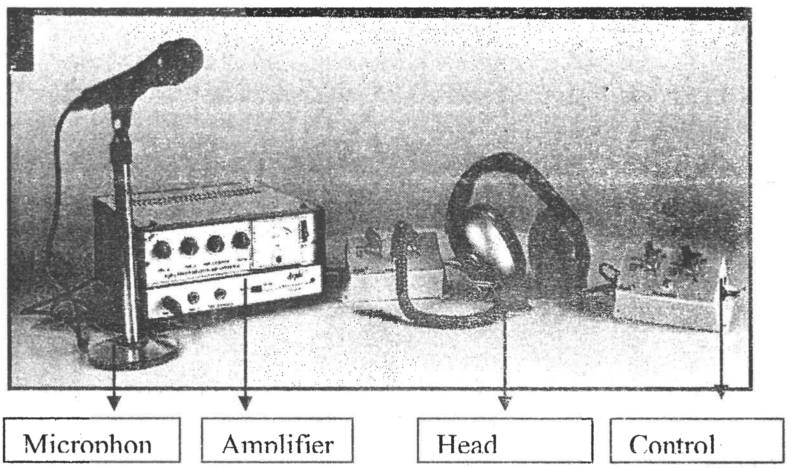


Fig 2 : Group Hearing Aids

Merits of hard wired/ group hearing aid system

- High fidelity inputs are provided to all the children, simultaneously.
- Distortion of amplified speech is at minimal level.

- Signal to noise ratio is improved and maintained.

De-merits of group hearing aid system.

- Mobility of children is affected.
- Heavy headphones cause discomfort to children.
- Wear and tear of the system is very common, as children misuse hard wires, control boxes etc.
- Requires constant maintenance.

2.3.3 Loop Induction Amplifying System

High quality amplification is a need of all hearing impaired children. But children should have mobility in the classroom, children should be able to participate in various activities in the classroom, then group hearing aid is not a solution. **Loop induction system has provided better alternative for classroom amplification**. The system differs from the conventional amplifying system, that the output from an amplifier is fed into a loop of wire instead of directly to the headphones. The sound waves are picked up by the microphone and transduced into electrical current in the normal way. **The signal is then strongly amplified and fed into a loop of wire that runs around the entire room. The flow of current within this wire causes a magnetic field to be set up within the room**. Telecoil of an individual hearing aid will be able to pick up the signal from the magnetic field. This signal is amplified and transformed back into acoustical energy by the earphone. **This telephone pick up circuit is sensitive to variation in the magnetic field**; so the child will be able to pick up various auditory cues. The great advantage of this system is **the mobility of children**. Regardless of position of children in a classroom, children are able to **hear their teacher's voice clearly, and constantly**. **Signal-to-noise ratio remains unaltered** irrespective of the distance between the microphone and the receiver.

Merits of Loop Induction System

- Child gets similar kind of input constantly, irrespective of the distance in the classroom.
- Signal-to-noise ratio is improved and maintained.
- Child is free for any activity.

Demerits of Loop Induction System

- If the two systems from the adjacent classrooms are on, child may hear the activity that is going on in the next room. This is called as **Spillover.**
- The **performance and success** of the loop induction system depends on **quality** of individual's hearing aid.
- The child is **unable to hear his own voice**, as the microphone of his instrument gets disconnected, when hearing aid is set to T position.

Speech trainer, group hearing aid system, and induction loop system are the commonly used as amplification devices in the classroom. These devices have advantages over individual hearing aids with reference to performance but they **do not completely satisfy audiological requirements** of highly effective system of amplification. The next generation of assistive amplification devices is **infrared system and FM system**. These are the cordless devices.

2.4 CORDLESS AMPLIFICATION DEVICES

We have seen how the loop induction system attempts to provide mobility by using a magnetic field to convey the signal from the amplifier to the receiver. The next generation system attempts to provide the advantage over the loop system without the disadvantages stated above. Currently there are two systems available to hearing impaired individuals.

2.4.1 Infrared System

Infrared system does not use a hardwire connection. The sound that is picked up by the microphone is **converted into infrared light waves through the use of diodes**. (Diode is an electronic device in which the electric current passes in one direction only.) These waves are **dispersed through out the room**. The receiver, worn by the hearing-impaired listener **transforms the infrared light waves back into an auditory signal**. The receiver looks like a stethoscope. This receiver serves as an amplifier and can be adjusted as per the need of an individual (fig3).

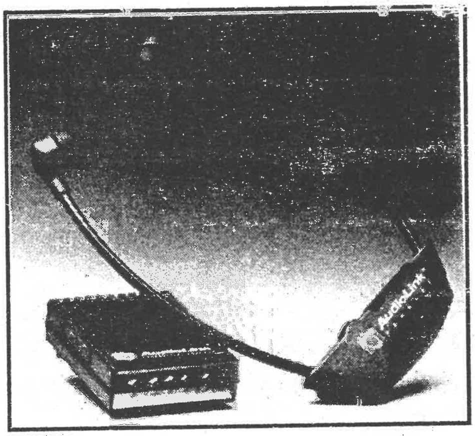


Fig 3 : Infrared System
Source : Handbook of clinical Audiology

Merits of the Infrared System

- It can be used for any listening activity.
- It can be coupled in variety of ways to headphones, and hearing aids
- Signal-to-noise ratio is maintained.
- System can be fitted for individual use or for a group.

Demerits of Infrared System

- The system can be used **only in enclosed situations.**
- The room should be **free from any obstacle** such as furniture, as infrared light waves cannot pass through or bend around obstacles.
- Infrared system cannot be used outdoors.

2.4.2 FM Systems

FM system or the frequency modulated system works on a **principle of radio-frequency waves** to carry the information in the same way as a radio and television station broadcast the signals. This signal can be picked up by anyone with a radio receiver.
The classroom teacher is fitted with a cordless microphone and a **transmitting unit that transduces** the audio-speech signal into radio waves. These are then **transmitted into the environment.** The children wear a small radio receiver that **picks up** the radio signal being transmitted by the teacher's transmitting unit and **transduces it back into an audio** signal at a headphone or a hearing aid. FM system has been found, to be the **most effective device** among the existing assistive listening devices (fig.4).

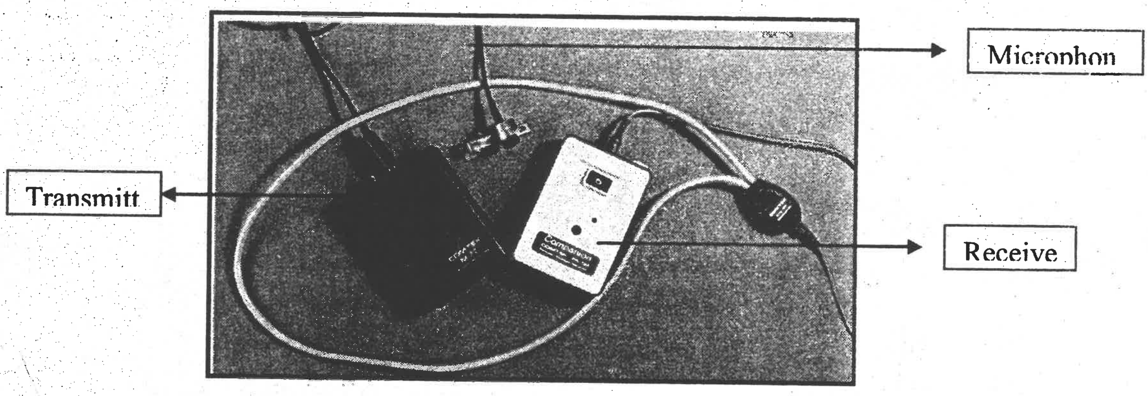


Fig 4 . FM System

Source : Handbook of Clinical Audiology

Merits of FM System

- It can be used as **outdoors, as well as indoors**.
- It does not have a problem of Overspill from adjacent classrooms, since **multiple of frequency channels** are available for transmission, which can be used simultaneously.
- It **monitors** the signal-to- noise ratio more effectively.
- It has **high quality** sound reception.

Demerits of FM System

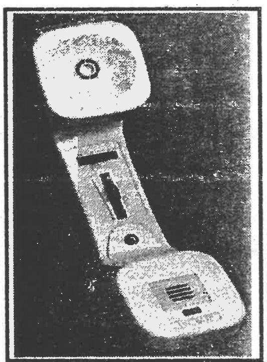
- FM system can function in a radius of 50 meters or 100 meters **depending upon the strength** of the transmitter.
- FM systems are **expensive.**

2.5 TELEVISION ENHANCEMENT TECHNOLOGY

Television plays an important role in the lives of almost all individuals. It can be used as a source of information and education tool and as well as a source of entertainment. But for hearing impaired individuals and their families, it can be a source of great frustration. To solve this difficulty in listening a **special device is connected** to a hearing aid via hardwire or via infrared or FM system. A microphone is placed near the television's speaker or through the output jack. **Individual receives direct input**, which is **distortion free, and gives clarity in listening**. This device is good for mild to moderately severe hearing loss cases.
Many individuals with severe to profound hearing loss or poor speech recognition ability, the basic amplifying system **neither provide sufficient amplification nor speech recognition**. These individuals require **visual information to supplement or replace the audio signal**. The process by which this is accomplished is known as " **Closed Captioning**". Closed captions are hidden subtitles that are provided in one band of the televised signal .**To visualize these subtitles a decoder is required**. Currently such system is not available in India.

2.6 TELECOMMUNICATION TECHNOLOGY

Telephone communication is a major component of the auditory activities of daily living. In the past the only **amplification option was through magnetic induction**. The hand -sets of the telephones was equipped with such telecoil. Present scenario is different. Telephone instruments are not compatible to a hearing aid. Hence the need for different amplification devices for telephone use became strong. (Fig 5 and 6) Show three types of telephone amplifiers. These devices increase the loudness of the incoming telephone signal. The devices have subtle difference; such as handset (fig 5) has a volume control. And the listener makes adjustments. In-line amplifiers are interfaced between the body of the telephone and the hand set (fig6).



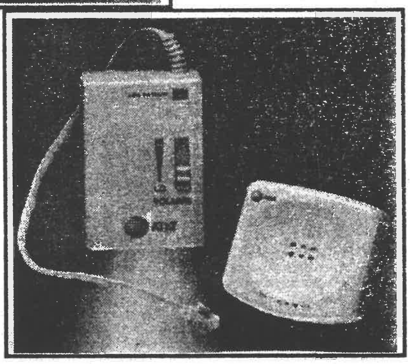


Fig 5

Telephone Handset Amplifiers

Fig 6

Portable telephone

Source : handbook of Clinical Audiology

Portable strap-on amplifiers (fig 6) are available for use on a variety of phones. They are small, portable systems that can be used by individuals who use several different telephones. But these strap-on amplifiers can be used only on hearing aids compatible telephones.

Amplification devices may not always be able to provide the necessary amplification for individuals with severe to profound hearing loss or poor speech recognition. For these individuals **visual systems** are available to help make telephone communication accessible. **Text telephone (TT) also known as Telephone Devices for the Deaf (TDD) or Teletypewriters (TTY) are based on teletypewriter technology and transmit visual signals over the standard telephone line.**

Fig 7. Text telephone, Source : Handbook of Clinical Audiology

It is necessary one person types his message, the signal is transmitted along the telephone line is decoded at the other end by the TT receiver. The message is seen on a line screen built into the TT (fig 7). TTY is also not available in India.

2.7 SIGNAL / ALTERING TECHNOLOGY

Auditory activities of daily living, such as hearing a doorbell or a telephone ring, waking to an alarm clock or listening for a baby cry may not be heard by many hearing impaired individuals and may therefore be a source of great anxiety and frustration. This has led to the development of signal-alerting technology for the purpose of **alerting hearing –impaired persons to the presence of environmental signals.** Alerting can be done through the use of **auditory (amplified), visual, or tactile signals**. Alerting devices can be simple individual units for use with a single telephone or doorbell, or multi-line systems using FM transmission for signal detection throughout an entire living environment. By and large any **signal such as doorbell or telephone activates electrical system and a lamp lits up**. This system is the most effective system for hearing-impaired individuals and is very commonly used by many. FM transmission system generally gives auditory signal but individual has to wear the hearing aid all the time.

There is another new concept of **training to hearing ear dog**. These dogs are professionally trained to alert their hearing- impaired owner to a number of different sounds in a variety of listening situations. **The dog and an owner must train together at a specified training setting and for a period of time, within the owner's home environment. The hearing dog's responsibility is to attract the attention of the owner, when he hears the doorbell, telephone, fire alarm etc.** And lead the hearing- impaired individual towards the source of sound.

Assistive listening devices have been popular and commonly used in the western countries, but in India, picture is different. Hearing – impaired individuals and their family members are not aware of such facilities. But time has come that educators should advocate usefulness of assistive listening devices.

2.8 OTHER AMPLIFICATION DEVICES

The majority of hearing impaired individuals with sensari-neural hearing loss receives significant benefit from the use of conventional hearing aids. But there are those, who appear to receive little or no benefit from hearing aids. These are profound hearing loss cases and for them alternative approaches need to be considered such as, cochlear implants and tactile aids.

2.8.1 Cochlear Implant

Cochlear implants are designed to provide **direct stimulation** to the auditory nerve. In the normal auditory system, the sound energy entering the outer ear is converted to neural signals in the cochlea. The neural signals are transmitted along the auditory nerve, and further to the brain. It has been very well documented that cochlea is severely damaged in severe to profound hearing loss. **There is a breakdown in the conversion into neural signals**. So cochlear implant is designed to restore some hearing by way of **bypassing the defective sensory mechanisms, and directly stimulating the auditory nerve.** The **biocompatibility** (the ability of machines to be used together with living things.), and **surgical safety** of the implants have been studied in details. It has been approved by various scientific organizations, to provide implant to infants, as young as twelve months of age. There are some **pre-requisite tests** to decide the candidacy of an implant. The two important pre-operative investigations are radiological study of the ear structure by way of CT Scan, and MRI (Magnetic Resonance Imaging.) and audiological investigations to document that the child has severe to profound hearing loss and has no significant benefit with a high power hearing aid. The other medical tests are routinely done for the medical fitness for surgery. Post -operative hospitalization is for two to three days only.

The components of the implant are, a) A microphone, which picks up the acoustic signals and converts them into an electric signal. b) Externally worn speech coding unit, here the signal is manipulated into desired electrical pattern, c) A system for transmitting the signal from the processor to the internal components. d) Surgically implanted electrodes, which are capable of exciting the nerve fibers. (Fig 8)

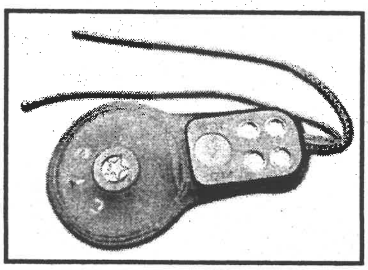


Fig 8a : Implant

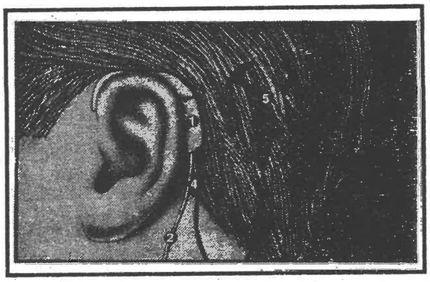


Fig 8b; Microphone & magnetic coil

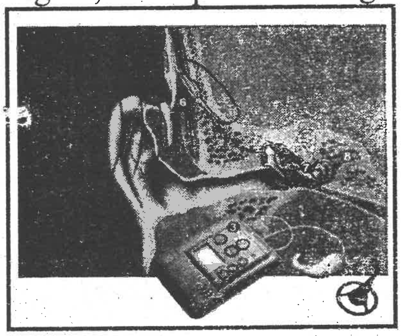


Fig 8c : External processor

Cochlear implant has been one of the options in auditory rehabilitation. It is safe for children. There are minimal risk factors, may be as minimal as that of any ear surgery. **A structured auditory program** is essential, which starts one-month post –operatively and may continue for two years. It has been documented that cochlear implantees perform well in language development, and their auditory responses are well within **'Speech Banana.'** It has been observed that children progress well in auditory training program. This technique is available in India, but is very expensive at this stage.

2.8.2 Risk Factors Involved in Cochlear Implant

Before one decides to go for the expensive procedure of cochlear implant (minimum Rs. 10 to 12 lacs as on today), it is important to be aware of the potential risks.

- The procedure of cochlear implant is not considered dangerous or particularly painful.
- Complications that have been seen include those associated with any surgical procedure – anesthetic risks, the possibility of inflammation, infection and bleeding, as well as those particular to this type of ear surgery – numbness or stiffness about the ear, taste disturbance, facial weakness, neck pain, dizziness or increased tinnitus (head noises).
- However these problems may usually be only temporary and in most cases would resolve with time and healing of incision.
- Other possible risks may occur after surgery, e.g. a perilymph leak from the cochlea which can be quickly repaired surgically, facial twitching can be caused by current escaping from the cochlea and stimulating the facial nerve; but this is usually alleviated by programming the speech processor.
- The presence of any foreign body under the skin can result in irritation, inflammation or breakdown of the skin in the area around the receiver / stimulator. Such complications may require additional medical treatment, surgery, and/or removal of the device.
- Failure of component parts could result in the perception of an uncomfortable loud sound sensation. If a failure occurs with the implanted electronics, they can be replaced.
- Potential hazards include new bone growth in the cochlea or deterioration of the nerve cells.
- However, it may be a relief to note that, now, if the implant is carried out by a well-known expert implant team, then the total number of complications and device failures could be very low.

2.8.3 Tactile Aid

Systematic attempts to develop tactile communication aids for the deaf goes back to the pioneering work of Gault in the 1920's, (Terry Hnath-Chisolm). Initially researchers proposed **to use touch as a substitute for the impaired hearing mechanism**. Early devices were simple, the speech -signal transmitted directly to the skin through a single vibrator. Experimental results indicated that **single channel** devices provided only a **limited amount of information** about speech. They were useful in supplementing speech reading and in speech production training.

Multiple vibrator system was the need for more speech information. Now multiple vibrator systems are commercially available.

All tactile aids consist of the basic components, a) microphone for picking up the sound signal and transducing it into an electrical signal. b) Processing unit to send the stimulation to tactile transducers. c) Tactile vibrators, which are wrapped in a wristband.

The fingertips of the hands are the most sensitive areas, through which tactile stimulation can be given. Children, who do not appear to receive adequate benefit through hearing aids, may be considered for tactile aid. Since it is a **noninvasive** gadget, there appears to be no limiting factor to recommend tactile aid. Various studies have shown that tactile aids can be effectively incorporated into speech and language training programs for deaf children. (Terry Hnath- Chisolm) Tactile aids are currently not available in India.

Cochlear implants and tactile aids currently are being used effectively in the treatment of profound hearing loss cases. There are few comparative studies available to comment upon their performance. **Studies suggest higher performance level with implant than tactile aid. But longitudinal studies are required to compare both types of stimulation mode.** (TerryHnath-Chisolm).

We have discussed various amplification devices used for hearing impaired persons. But their **limited dynamic range** (Dynamic range is defined as difference between threshold of hearing and threshold of discomfort.) and **limited residual hearing** imposes lot of difficulty in processing auditory information. Background noise does interfere in this auditory information processing. **Few instruments have been successful to maintain signal- to-noise ratio but it is indeed a difficult task.** It is always advisable to monitor noise level in the classroom, and to make every effort to maintain the noise level at low level.

2.9 CLASSROOM ACOUSTICS

Speech produced at one location in a classroom should be **clear and intelligible** everywhere in the room. But this may not be always possible. Speech intelligibility in rooms is influenced by a) the level of speech, b) room reverberation, c) background noise. These are the fluctuating factors. Normal hearing person can easily adjust in such a variable acoustic environment. But hearing impaired person has lot of **difficulty in listening in noise**. It is a difficult task for the defective auditory system. Children have to focus on listening task and this activity can be tiring. The educator's role is to understand

Reverberation, background noise and to understand various measures to reduce this noise level.

2.9.1 Identification of Various Noise Sources

It is essential **to identify, to measure** the specific source of noise. Noise sources within a room include external noise, internal noise and noise within the room.

External noise: Noise that is generated from outside the building, such as traffic, playground, industrial or other noise generating activities in the neighborhood.

Internal noise: Noise that originates from within the building but outside the classroom, such as rooms adjacent to the classroom, gymnasiums, and busy hallways.

Room noise: Noise that is generated within the room noise includes individuals talking, sliding of chairs or tables and shuffling of hard-soled shoes.

2.9.2. Reduction of Noise Levels:

Rooms must be located away from high noise sources, such as busy traffic. Thick concrete walls provide good attenuation than windows and doors. If windows are located externally, they must be properly installed, heavy weighted, or doubled paned.

Certain landscaping strategies can also diminish the effect of external noise sources. Placement of trees or shrubs around the school building is one such strategy. For reducing internal noise in a classroom, false ceiling, acoustic paneling, placement of absorptive materials etc. is recommended. The noise caused by the shuffling of hard-soled shoes, movement of the desks or chairs can be dampened by installation of thick carpeting with adequate padding.

Jute mats may be a preferred option. The placement of some form of rubber tips on the legs of desks and chairs can decrease room noise. This is particularly important if the room is not carpeted. The hanging of thick curtains or venetian blinds over window areas can dampen room noise levels effectively.

2.9.3 Reverberation

Reverberation is defined as a noise that continues for some time after it has been produced, because of repeated reflection of the sound. These reflections affect the quality of the sound. Eventually the sound can no longer be detected in the room. This process of sound energy decay can be long or short depending on the room surfaces. **This reverberation time should be less than 0.4 seconds**, however in reality it can be more than one second. There is a strong need to monitor this reverberation. **Reverberation can be reduced, by covering the hard reflective surfaces in a room with absorptive materials**. The material can be used, such as, acoustic paneling, cork bulletin boards, carpeting and wooden shelves, cupboards can also be strategically placed on the walls. Curtains can be placed to cover the hard reflective surfaces of windows. Thick carpeting on the floors can also significantly reduce reverberation. Positioning of mobile boards, black boards at angles rather than parallel to opposite walls will also reduce reflection of sound. Teachers may use some creative artwork to help absorb noise and, to reduce reverberation. Small classrooms, low ceiling heights are also recommended.

Appropriate acoustical conditions in a classroom are vital to the academic achievement of children. Studies have shown that excessive classroom noise and / or reverberation can be detrimental to all academic areas, such as speech perception, language development, reading ability, behavior, attention, psychosocial function and concentration. Poor classroom acoustics have also been shown to affect the vocal hygiene, and overall effectiveness of teachers.

The American speech and hearing (ASHA) guidelines recommend limiting background noise levels to 30dB –35dB (A). Signal to noise ratio at the child's ear level must be +15dB or better and reverberation time of the classroom setting should not exceed 0.4sec. (Classroom Acoustics: Carl C. Crandell et.al.)

2.10 LET US SUM UP

We have studied various amplification devices used in the classroom. Speech trainer is the ideal unit for one-on-one training program. It certainly gives high quality input to a child; it becomes easy to elicit responses on auditory training activities. Speech trainer can be a good facilitator for speech corrections. Hard wired group hearing aids can give high fidelity auditory inputs simultaneously to all children in a classroom, however, it has a limitation of mobility and children often complain off profuse sweating. Induction loop system is ideal for toddler group. We have also studied advanced technology of infrared and FM systems. Assistive listening devices are necessary to meet individual's specific auditory needs. There are large number of hearing impaired individuals who do not benefit from hearing aids. Cochlear implant and tactile aids are good alternatives for them. When children are equipped with the state -of –the art technology, classroom acoustics is equally important issue. It is important to study, various sources of noise, how to reduce this noise level, and how to provide optimum listening environment to hearing impaired children to enrich their language skills.

2.11 SELF STUDY

1) Discuss limitations of individual hearing aids.
2) Explain signal –to- noise ratio, and its adverse effects on classroom teaching.
3) What the different types of classroom amplification devices?
4) Compare and contrast performance of a speech trainer and performance of an individual hearing aid.
5) Describe cordless amplification devices.
6) Describe various gadgets used for television and telecommunication enhancement.
7) Discuss need for other amplification devices, and describe their function.
8) What is reverberation?

9) What are the measures to reduce noise levels in and around the class room

2.12 ASSIGNMENTS

1) Describe need for other amplification devices.

2) Why do we need to study room acoustics? How to reduce the reverberation in the classroom?

3) Describe personal assistive listening devices used in various listening activities.

2.13 POINTS FOR DISCUSSION/CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification on other. Note down those points below :

2.13.1 Points for Discussion

2.13.2 Points for Clarification

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UNIT 3: APPROACHES AND STRATEGIES TO DEVELOP READING SKILLS AND INDEPENDENT READING

STRUCTURE

3.1 INTRODUCTION

Language is a tool for communication. It is the code through which one expresses his/her thoughts, feelings and ideas. Spoken language / oral communication i.e. speech is one form of language and is predominantly an auditory code. Unless one hears the sound, develops recognition of sounds and their inter and intra relation with source, oral language does not conceptualize. Thus hearing or sense of audition is a pre-requisite for normal speech development.
According to Calvert and Silverman, "Learning to speak is so universal and apparently so effortless that we take it for granted that speech comes naturally. However, when development of language and speech are delayed or deviant or impeded, our attention gets drawn to the process of development. Only then one realizes as to how complex this process is."

Hearing loss is a major impediment of speech development and this is because 1) It severely restricts reception of speech and 2) reduces the ability of the speaker to monitor his own speech. For children who are pre-lingually deaf, hearing loss creates a greater problem, because a child's awareness and acquisition of spoken language depends upon the ability to hear the messages of others as well as perceive his or her own attempts to imitate. A hearing loss in a young child restricts these processes and may delay or inhibit both his speech and language development.

3.2 OBJECTIVES

The study of the unit on Auditory Training will help the trainees -

- To realize the importance of maximum use and utilization of residual hearing for betterment of language and speech development
- To know the various approaches of Auditory Training.
- To understand the importance of early intervention and a team approach for the success of aural rehabilitation.
- To get guidelines for planning activities to Auditory training.
- To acquaint with the various stages of Auditory training.

3.3 WHAT IS AUDITORY TRAINING?

The majority of the hearing impaired is not totally deaf. Very often they have remnants of hearing i.e. residual hearing as if the gates were slightly open. Making use of it and training the child to use this residual hearing is auditory training.

Auditory training is the process by which children learn to recognize and understand auditory signals available to them (Jill L.Bader).

Sanders(1971) defines auditory training as a systematic procedure designed to increase the amount of information that a person's hearing contributes to his total perception. Auditory training assumes that there are specific exercises or experiences that will help a hearing impaired person use his/her hearing better than he would with constant amplification alone without such training.

According to Calvert and Silverman (1975), the training is presumed to improve the person's ability to use what he hears rather than improving the power of hearing itself.

Alpiner (1978) defined auditory training as consisting of three distinct factors (1) Discrimination of individual speech sounds, (2) Hearing aid orientation and (3) Improvement of tolerance levels.

Auditory training was defined as the creation of special communication conditions in which teachers and audiologists help hearing impaired children acquire many of the auditory speech perception abilities that normally hearing children acquire naturally without their intervention (Erber, Boothroyd, 1967)

3.3.1 Auditory Training and its importance in young children

Auditory training is the backbone of an oral aural educational set up. It is the very foundation on which the whole edifice of a child's oral communication skills depends. It opens up the entire world to the child as most human beings around the child transact and communicate with spoken language. Spoken language is normally received at the brain via the auditory channel. The brain is able, stage-by-stage to develop awareness of the acoustic cues underlying linguistic distribution and thus to separate the pattern which make up language. Similarly it is through audition that the child experiments with and monitors motor speech production as development proceeds from babbling to conversation. In order to recognize and produce speech patterns the child must have adequate if not consistent exposure to oral language in a context which is meaningful to him.

The acquisition of language is further linked to auditory sense in human beings because it is a time locked function related to early maturational periods in the infant's life. The earlier and larger the auditory language stimulation, the better and efficient will be the language and speech skills. On the contrary, if the gap between onset of hearing impairment and age of detection and age of intervention becomes larger, then the language and speech of such hearing impaired will be poorer and less efficient.

The importance of early auditory stimulation is very high because the development of biological functions and language is time bound and known to occur at the fastest rate between 0 to 3 years (Lenneberg 1967, Chomsky,1966). This period is known as the critical age of development. A baby, who is deprived of appropriate language stimulation during these first 2 to 3 years of life, will not fully attain and develop to the same extent as those who have been stimulated and made use of hearing in critical period. Whether the deprivation is from lack of hearing or from lack of high quality language exposure or mental sub normality, such children are known to suffer from inadequate and delayed speech and language development.

It is for these reasons that it is necessary to tackle the hearing problems at the earliest possible age in childhood and develop use of all other skills, knowledge and insights in the hearing impaired child.

3.4 DIFFERENT APPROACHES TO AUDITORY TRAINING

A) The different approaches as explained by Erber (1982) are

1) Natural Conversational approach
2) Moderately structured approach
3) Practice on specific tasks

1. In Natural Conversational Approach, the teacher eliminates visible cues and speaks to the child in a natural way.

2. In the Moderately Structured Approach, the teacher applies a closed set of auditory identification task, but follows this activity with some basic speech development procedures and a related comprehension task.

3. In Practice on specific tasks, the teacher preselects the set of acoustic speech stimuli and also the child's range of responses, prepares relevant materials and plans the development of the task.

B) The Carhart Approach (1974)

Carhart viewed the goals of auditory training as aiding in (a) Developing a command of language (b) Developing speech and language (c) Encouraging adjustment to the world of hearing people.

His approach to auditory training comprises of four major stages.

1st **stage** is development of awareness of sound. The goal of this stage is for the child to recognize when a sound is present and to attend to it.

2nd **stage** involves the development of gross sound discrimination . The child is trained to distinguish between highly dissimilar non-speech sounds, such as bells, drums, as well as other environmental sounds are often employed simple speech patterns. By now the child is practically aware that sounds differ and is ready to apply this knowledge to the understanding of speech.

3rd **stage** involves development of discriminations among simple speech patterns.

4th **stage** involves the development of fine description of speech. The child is taught to make all of the discriminations among speech sounds that are possible within the limits imposed by the hearing impairment.

C) Acoupedic Approach (Pollack, 1970)

Pollack believed that the use of audition is hampered when attention is divided between two or more sensory inputs, so she proposed a unisensory approach towards education and rehabilitation of hearing impaired children. This is known as acoupedic method and excludes all visual cues such as speech reading during early training .

D) Kretschmer's Approach –The auditory / language pattern programme

The approach developed by Kretschemer (1974) was designed as a means of teaching language and speech skills to the hearing impaired children through extensive training in the use of auditory channel. In this method, exercises are directed towards having the child learn and apply linguistic rules through audition / auditory expansion and language rehearsal techniques. This is to eventually be able to put utterances together to form cohesive sentences. The inclusion of non-linguistic tasks such as the recognition of environmental sounds, occurs only when such sounds relate to the specific therapy experiences used to develop a particular linguistic principle or model.

E) Cognitive Auditory Approach by Grammatico (1975)

This approach is similar to Pollack's in which auditory training is not viewed as an activity to be set apart from other educational procedures. Her approach stresses 1) sound awareness, 2) discrimination, 3) localization, 4) imitation of intonational patterns, 5) memory.

F) The traditional approach as given by Hirsh (1966) Erber and Ling (1976).

They have described four levels of audition that contribute to the perception of conversational speech. They are a) Detection, b) Discrimination, c) Identification, and d) Comprehension.

- Detection: This requires the child only to distinguish between the presence and absence of sound.
- Discrimination: This requires the child to differentiate speech sounds and indicate whether they are same or different.
- Identification: This requires the child to recognize the speech signal and to be able to identify it in some way, such as pointing to a picture, writing the word or syllable heard or repeating the stimuli.
- Comprehension: This finally involves understanding the message on a cognitive and linguistic basis. The child demonstrates comprehension by answering questions or performing appropriate tasks like answering questions like what is your name ? or following directions like shut the door. Erber and Hirsh (1976) suggested an auditory training programme in which increasingly complex speech stimuli are presented for processing through the 4 levels of audition, resulting in an auditory skills matrix as given below.

	Speech elements	**Syllable**	**Words**	**Phases**	**Sentences**	**Connected Discourse**
Detection						
Discrimination						
Identification						
Comprehension						

Many auditory training curricula or guidelines include the discrimination of environmental or non-verbal sounds. It is implied that greater skill at discriminating a bell from a whistle will somehow assist in the perception and discrimination of speech sounds.
(Lovell & Stoner 1960, Pollack 1971)This idea cannot be supported.

The brain does have hemispheric specialization for the reception of speech and non-speech sound. (Liberman et. Al.1967), and thus it is likely that it uses different strategies to process each type of acoustic information. Further speech and environmental sounds have vastly differently temporal characteristics. Certainly learning to discriminate environmental sounds may have some importance in itself, but there is no evidence that it will promote improvement in speech discrimination.

Before an educator or the audiologist plans the auditory training session there are certain pre-requisites which would help them decide the path to be followed. They need to have some information about the child's residual hearing and more importantly the speech perceptual abilities.

3.5 TOOLS USED FOR ASSESSING AUDITORY RECEPTION

3.5.1 The audiogram:

The audiogram of a child is one important tool to know the hearing abilities or the residual hearing of the child. It is currently the most useful, single predictor of degree, type and nature of hearing loss. But predictions made simply on the basis of audiogram are not enough. It is crucial that teachers establish early whether a hearing impaired child can perceive sufficient spectral information to identify speech components or whether the child seems to perceive only intensity patterns. Sound has 3 aspects – intensity, frequency and duration. The audiogram provides no information on how well a child may be able to process the time relationship i.e. the durational aspect which is important to develop speech intelligibility. Therefore it is also essential to know the speech perceptual abilities of the children.

3.5.2 Auditory Speech Perception - Its importance

In order to learn how to speak, the hearing impaired must in some way, receive the speech patterns on which he can model his own production. For both normal and hearing-impaired listeners, speech perception and speech production are closely related events.
A child's ability to produce intelligible speech depends to a great extent on his or her ability to perceive its spectral and prosodic qualities. Auditory perception thus plays a vital role in speech communication during both reception and production.

Speech perception category for profoundly hearing impaired children as given in early speech perception test designed by Ann Geers and Jean Moog is as follows.

a) Category 1 – No pattern perception

At the lower end of the category are those who cannot detect even amplified speech. This category also includes children who can detect speech but cannot discriminate auditorily
among speech patterns like words or phrases that differ in gross duration patterns(e.g. cup vs.. Lunch box).

b) Category 2 – Pattern perception:

Children of this category have developed minimal skills in perceiving speech. At the lower end of this category are children who are just beginning to discriminate between words or phrases that differ in durational pattern in a closed set. At the upper end are those children who can differentiate between words that differ in stress (e.g. apple vs. tooth brush).

c) Category 3 – Some word identification:

This category includes children who demonstrate minimal ability to make use of spectral or intonational information. These children are able to discriminate among words or phrases of similar stress and durational pattern presented in a closed set with highly different vowels (e.g. tooth brush vs. raincoat).

d) Category 4 – Consistent word identification

This category includes children who demonstrate greater facility in using spectral information for discrimination. They can discriminate among single syllable words containing different vowel sounds presented in a large closed set (e.g. bag, bus, boot etc.)

3.6 FACTORS IMPORTANT FOR AUDITORY TRAINING

3.6.1 Selection of hearing aids

After obtaining the audiogram and the speech perception ability category of the child, another important task for educator is the proper fitment of hearing aids. Without sufficient and proper amplification of speech the perception will not improve. It is also an established fact that production depends upon perception. Hearing aid selection for very young hearing impaired children is difficult because of the difficulties in conditioning and also they often have very little vocabulary or language with which to describe their auditory sensation. Therefore several trials and behavior response observations must be conducted for the selection of aids.

3.6.2 Parent's involvement

Parent's commitment is also equally important. They should be committed to believe that their child's auditory capacity can be developed.

Commitment of professionals

The teachers and audiologists should also be equally committed and should remember that it is the child's use of, not the amount of, residual hearing that is valuable to functional communication.

They should then decide together the plan and activities for the children. It should be remembered that the activities should be age appropriate and the achievements in the auditory training should be incorporated in speech therapy sessions.

General steps to be followed while undertaking the Auditory Training Sessions

1) Ensure that the hearing aids are working in optimum conditions.
2) Give the child an auditory verbal stimulus and show him the expected response (whether to raise a finger, pull a bead, jump, move a toy train etc.)
3) Next give the child only auditory stimulus by covering lips and show him the expected response (while covering lips care should be taken not to reduce the intensity of stimulus i.e. sound and also ensure that the child does not get clues from teacher's movement of eyebrows , shoulders etc.)
4) Then give the auditory stimulus only and note the child's response.
5) Give a lot of reinforcement to the child and make the auditory training session enjoyable.
6) Incorporate the child's achievements in Auditory Training in speech production and also use the same in classroom teaching and at home.

3.7 SOME ACTIVITIES FOR AUDITORY TRAINING

3.7.1 Detection

a) Detection of 6 sounds | a | | u | |i| |sh| |s | |m |. The teacher will give the stimulus and the child may be asked to pull beads, raise finger or put stickers of stars etc. on chart. Care should be taken not to give the 6 sounds daily in a sequence in a set order but to give them randomly.

b) Detection of onset and termination of sound. The teacher can give any continuous sound e.g. – o ---- The child is expected to move a toy train or a car after hearing the sound and stop when the sound terminates.

c) Detection of repetitive syllable:- Teacher may give an auditory stimulus of any repetitive syllable e.g. hop --- hop--- hop ---- and the child is expected to make the rabbit hop.

d) Detect sound in a natural situation:-The teacher may note the child's response to his name or to environmental sounds in a natural situation.

3.7.2 Discrimination

a) Continuous sound vs. discrete sound.
Ex . mooooo vs. ball.
(child manipulates the cow vs. points to the ball).

b) Continuous sound vs. intermittent
Ex. Kooooo vs. ba.. ba.. ba..
(child moves an engine vs. makes the sheep walk).

c) Long sentence vs. short sentence.
Ex. Blow the balloon vs. she likes to eat vanilla ice-cream.
The car zoomed vs. the little girl sleeps in her bed.
The teacher could use sentence cards with lines drawn under the sentence to indicate a short or a long sentence.

d) Speech patterns of differing intensity.
Loudly spoken syllables or words vs. quietly spoken syllable or words
Stop vs. Stop.

e) Speech pattern of differing pitch.
High pitched speech sound vs. low pitch sound.
The child may put a monkey toy on the tree or at the bottom of the tree for high or low pitch.
Continuous ascending pitch pattern vs. continuous descending pitch pattern.
The child may manipulate toy airplane flying high or low for ascending and descending pitch.

f) Speech stimuli differing in rhythm and duration

(i) A word vs. a phrase vs. a sentence.
Ex. 'Moo' vs. 'A purple hat' vs. 'The boy kicked the ball'.

The child can point out to the sentence cards.

(ii) Sentence differing in rhythm.
Ex. Oh no ! Daddy is angry.
The cat jumped.
The baby has a red ball.

3.7.3 Identification

The activities mentioned for discrimination could also be taken for identification. The child could be instructed to identify the given stimulus.

a) Identify speech stimuli identical in number of syllables but differing in rhythm.
Ex. Oooh ! The water is cold.
The girl plucked the flower.
The bubbles went pop, pop !
Quack, Quack, says Daddy Duck.

b) Identify sentences according to stress or phrase boundaries.
Ex. John ran to the store.
John ran to the store.
John ran to the store.

3.7.4 Comprehension

Activities for comprehension could be –

1. Picture description
2. Story with comprehension questions
3. Guessing games
4. Following directions "Simon says"
5. Conversation

3.8 SUMMARY

Hearing or sense of audition is a pre-requisite for normal speech development and its sustainment. Prelingually deaf children generally exhibit delay in language and speech acquisition. However, majority of the Hearing Impaired children are not totally deaf and have some amount of residual hearing. Auditory Training is aimed at using this residual hearing to improve a person's ability to use and understand what he hears with the help of suitable amplification devices.

It is crucial to note that the first 3 years are the critical years and the importance of early auditory stimulation is very high because the development of biological functions and language is time bound and known to occur at a fastest rate between 0-3 years. It is therefore necessary to give adequate auditory stimulation and training to a congenitally hearing impaired child during the critical period.

There are many approaches of Auditory Training. They generally proceed from Detection or Awareness then Discrimination followed by Identification and finally training the children to auditorily comprehend and respond to what he `hears'.

Proper selection and consistent usage of Hearing Aids, Parents involvement and commitment of the professional team of Educator, Audiologist and Speech Therapist would assist the child in using his residual hearing. They should remember that the achievements in Auditory Training should be incorporated into the speech and language therapy and should also be emphasized at home. It is very important for professionals and parents to note that `it is the child's use of , not the amount of residual hearing that is valuable to functional communication.

3.9 SELF-STUDY

1. Do you think hearing is important for language and speech acquisition ? Justify your answer.
2. 'Auditory Training is not just clapping hands or beating drum'. Elaborate the statement.

3.10 ASSIGNMENTS

1. State the different approaches to Auditory Training.
2. Plan out activities for Auditory Training for each stage of Detection, Discrimination,

   Identification and Comprehension in your language.
3. Which are the factors important for Auditory Training ? List out the general steps to be followed while undertaking Auditory Training in your class.

3.11 POINTS FOR DISCUSSION/CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification on other. Note down those points below :

3.11..1 Points for Discussion

3.11.2 Points for Clarification

3.12 REFERENCES AND BOOKS FOR FURTHER READING

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UNIT 4:
TYPES AND MODELS OF DEVELOPING READING SKILLS

STRUCTURE

- **Introduction**
- **Objectives**
- **Communication, Language and Speech**
- **Functions of Speech**
- **Parameters of speech**
    - Voice
    - Articulation
    - Fluency
    - Prosody
    - Speech Intelligibility
    - Segmental, Supra-segmental and Non-segmental aspects
- **Characteristics of good speech**
- **Summary - Things to remember**
- **Assignment**
- **Check your progress**
- **Points for discussion / clarification**
- **References / Further reading**

1.1 INTRODUCTION:

All living creatures are connected to each other by a constant **flow of messages**. The process that makes this connection possible is the process of **COMMUNICATION**. Communication is the essence of life. It is the binding force, so essential for society and the human culture. Men, women, children and infants are basically **social beings** and depend on human interaction and companionship for survival.

Human beings communicate with one another principally through **SPEECH**. Speech is unique and fundamental to human beings. It is the **most frequent and important** way of sharing our minds and relating to each other. Human beings **speak as easily** as they breathe. However, later through this course you will realize that the act of speaking is a **complex and highly coordinated** process involving many systems of the human body. Also, you will realize that a problem with any of these systems or in co-ordination of these systems may lead to **impairment** in the final product i.e. SPEECH.

1.2 OBJECTIVES:

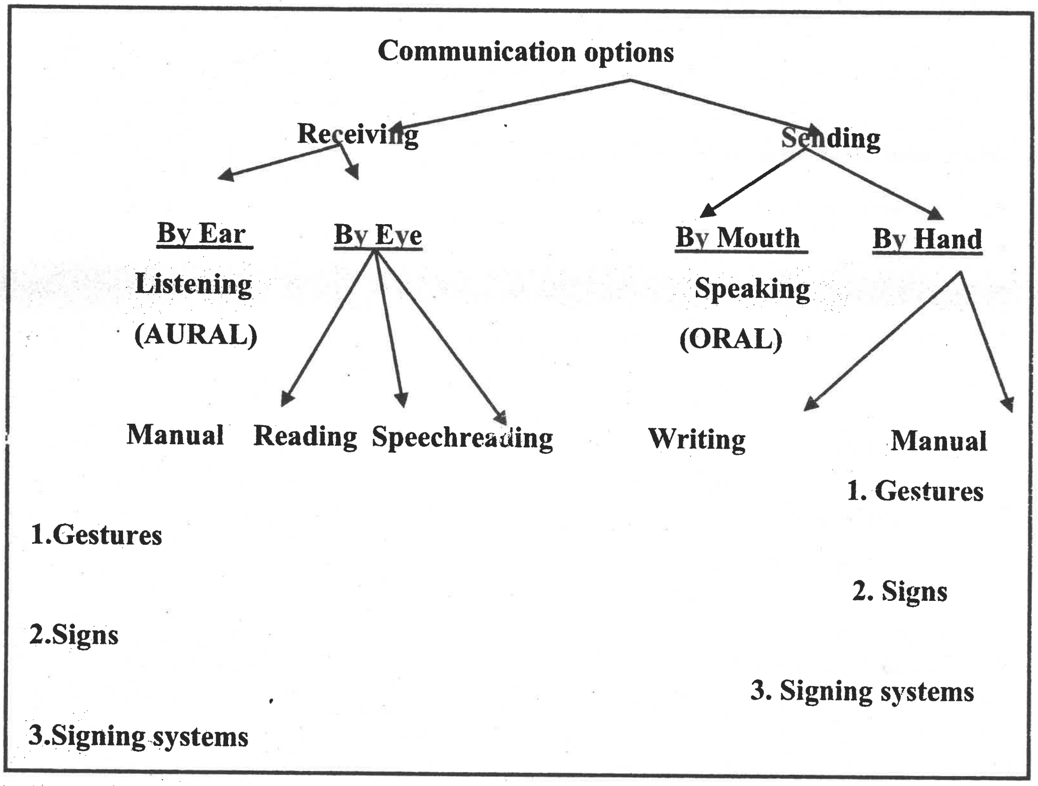
At the end of this unit you will be able to:

- Explain the **importance of communication** in the lives of human beings
- State the different **communication options** available to an individual
- Explain the **relationship** between communication, language and speech
- List the **functions** of speech
- Describe the **processes involved in communication** using speech
- Explain the various **parameters of speech**
- Explain the concept of **intelligibility of speech**
- Explain the characteristics of **good speech**

1.3 COMMUNICATION, LANGUAGE AND SPEECH:

COMMUNICATION is the process of exchanging and/or sharing information, thoughts, ideas and opinions. Most often this exchange is via language. **LANGUAGE** is a code consisting of symbols ordered in particular sequences for the purpose of conveying information. The **symbols of language** mainly consist of oral symbols, written symbols, etc. Depending on the symbols used, communication can be carried out in different ways. These communication options are shown in the figure below. For example, when communication involves use of written symbols, it is achieved through **reading and writing**. Use of hand gestures or signs for the purpose of communication is involved in the non-verbal or **manual**

mode of communication. **Typical ways** of communication include speaking and listening and also reading and writing.



The term communication is often used to include **only the spoken word**, that is SPEECH and HEARING. However, speaking and listening comprise but one of the many aspects of communication and are the foundation and the **primary medium** of most human communication.

In-text activity:

Try communicating the following sentences to a friend using each of these options viz. **GESTURES, SPEECH and WRITING.**

Sentence 1: What is the time?

Sentence 2: I do not go swimming because I am scared of water.

Sentence 3: The day after tomorrow my friend is coming from Hyderabad for her cousin's wedding.

What does **your experience** tell you as regards the most efficient communication option? You will surely agree that sentence 1 can be easily communicated using gestures as well as speech. Sentence 2 cannot be clearly communicated only through gestures. Especially the feeling of being "scared" cannot be **unambiguously** communicated through gestures. The gesture for "being scared" could be misinterpreted for "feeling cold". Sentence 3 is definitely communicable most effectively through speech alone. All three sentences can of course be communicated effectively by writing. However, this will be **time-consuming**.

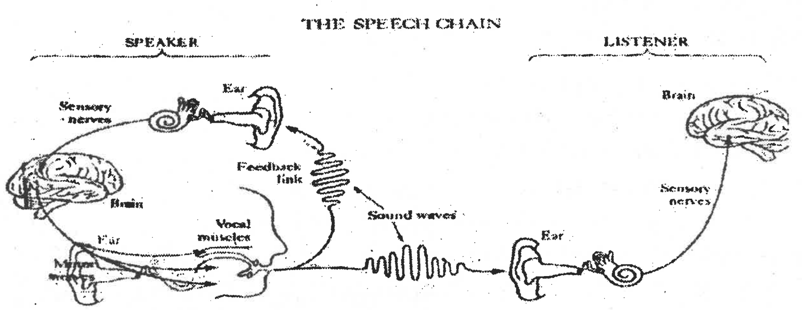
This activity was given to you to emphasize the fact that an **effective communication system** is one that permits the user to exchange information with

- high degree of ease,
- flexibility
- speed and
- accuracy in a wide variety of circumstances.

You will surely agree that speech appears to meet these conditions. **Nonverbal cues** such as our facial expression and bodily gestures **support and facilitate** communication; however, they cannot replace SPEECH. Therefore most educators lay tremendous emphasis on choosing speech as the communication option for the **hearing impaired**.

The process of communication is a **two-way process** that involves **sending** of a message by one individual and receiving of that message by another individual. The **sender encodes** a message using the code that he wants to use and sends this message to the receiver who is capable of understanding that code. The **receiver** receives this message and **decodes** it in order to understand the information in it. The process of sending a message is called as **expression** and that of receiving the message is called as **reception or comprehension**. For communication to occur, the receiver and the sender must share a common code. For example, if an individual chooses to send a message using hand gestures or sign language, his communication partner should be one who understands this code of non-verbal symbols. If both the partners do not share a common code, communication will **fail to occur**.

FIGURE 1: THE SPEECH CHAIN



Many things must happen in order for a speaker **to speak efficiently:**

(Refer Figure 1-Speech Chain)

a. The brain must **create an idea** it wants to communicate to someone else.
b. The brain must then send this idea **to the mouth.**
c. The brain must tell the mouth which **words** to say and which **sounds** make up those words.
d. The brain must also send the proper signals to the **vocal muscles**, those that control the tongue, lips and the jaw through the **motor nerves.**
e. These muscles have the **strength and co-ordination** to carry out the brain's commands.
f. The lungs must have sufficient **air** and the muscles in the chest must be strong enough to force the **vocal folds to vibrate.**
g. The vocal folds must be in a good working condition for speech to sound **clear and be loud** enough to be heard.
h. The words produced must be **monitored by our hearing** sense (feedback link). This helps us review what is said and hear new words to imitate in other situations.

If the communication process has to be complete, the second part of the "speech chain" is equally important. The **listeners** should have a normal **hearing** mechanism. The **sound waves** of the message should reach the ears of the listener. The **sensory nerves** should carry the message to the **brain**, which should interpret it.

1.4 FUNCTIONS OF SPEECH:

Speech is one of the **most fundamental** qualities of human beings. It is the most **frequent** and **efficient** way of communication used by humans. Speech can serve a number of **functions**. Some of these are:

- **Gaining attention:** The most primary function of speech can be that of helping an individual in gaining attention of another person. **Calling out** someone's name or using some predetermined words to **signal** someone are examples of this.
- **Exchange of information:** Individuals can give and get information about a lot of things by speaking. Information about happenings, incidents, news, etc. can be shared by speaking. As it is very commonly seen, information spreads very fast by **"word of mouth"**. Exchange of information can occur not only between two individuals, but also between members of two groups, two cities, two countries and two generations. Important information about legacies, traditions, religious rituals, etc. is passed on from **one generation to another** through speech.

- **Sharing of emotions:** Speech is an important medium through which an individual expresses his or her emotions and feelings. By doing this, individuals can **relate better** with each other, build sound **interpersonal** relations with each other and promote **intimacy**. Speech also serves as a medium for **ventilating** one's pent-up emotions.
- **Speech as a controlling medium:** Through speech an individual can influence and control the behavior of another individual. Speech can be used for intents such as requesting, asking, reprimanding, convincing, warning and many more which help in changing, monitoring or **controlling behaviors of others**. Speech can also be used effectively for gaining **co-operation** of other persons in a co-operative endeavor. It is through speech that great leaders could gain the respect and co-operation of their countrymen.
- **Speech reflects individuality:** An individual can express his or her individuality by speaking his or her mind or by expressing his or her opinion. It is through speech that an individual can achieve his or her **identity and entity**. Actors and other public figures are often remembered by their unique styles of speaking.
- **Speech as recreation:** Some of the best forms of recreation and **entertainment** use speech as the medium. Theatre, cinema, drama, mimicry and singing all make use of the oral mode of communication. Though silent movies, mime acts and other forms of non-speech entertainment are available, they are not as popular.

The functions of speech thus can be **summarized** as follows:

1. To gain attention
2. To give information
3. To get information
4. To bind one generation to another
5. To express emotions
6. To promote intimacy
7. To influence others' behavior
8. To facilitate co-operative activities
9. To express individuality
10. To create new worlds

In-text activity:

- Try getting the attention of a friend of yours while walking on a **crowded road** by **clapping** or making a **whistling** sound. You will be surprised to see that a number of people will turn back to find out whether they are being called.

Instead, if you call out the name of the friend, you can surely get his/her attention.

- At your workplace or college, try doing your **work without speaking** much to your colleagues/ peers. You will definitely find it difficult to get your colleagues to co-operate with you when you have a task to deal with together. They may think of you as being aloof, asocial or "snobbish". Also, at the end of a few days you will find your feelings to be **bottled up** within yourself due to lack of an opportunity to express your feelings openly.

Interesting observations:

- Many individuals attribute their **likes or dislikes of people** to the way these people speak. We often think of individuals with "good" speaking skills as **interesting** people and those with "not-so-good" speaking skills as **dull** people.

1.5 PARAMETERS OF SPEECH:

Speech is produced by a **complex** interaction between the processes of **respiration, phonation, articulation and resonation**. Speech has a number of **parameters** that are considered to be a result of the various **processes** involved in the production of speech. The main parameters of speech can be enumerated as **voice, articulation, fluency and prosody**. Let us look at each of these in some detail.

1.5.1 Voice:

Voice is the **sound** (tone) generated by the **vocal folds in the larynx** (voice box). It is the result of the **processes** of respiration, phonation and resonation. The various parameters of the **vibration** of the vocal folds determine the parameters of voice. Different aspects of the **respiratory** and **resonatory** processes also affect the parameters of voice. Voice can be described in terms of its **pitch** - which depends on the fundamental frequency of vibration of the vocal folds, **loudness** - which depends on the amplitude of the vibration of the vocal folds, and **quality** - which depends mainly on the resonatory effects.

1.5.2 Articulation:

Articulation is the process of **speech sound production**. It consists of a series of overlapping movements of the articulators, placing varying degrees of **obstruction** to the outgoing air stream and simultaneously **modifying** the size, shape and coupling of the resonating cavities. Correct articulation of all the phonemes in a language is necessary for speech to be understood clearly. Correct articulation requires **accuracy** in the **placement** of articulators, **timing, direction** of movement, **strength** of movement, **speed** of movement and the **co-ordination** of all events. The products of the process of articulation are the speech sounds or phonemes.

Speech sounds are classified mainly as **vowels and consonants**. Consonants are further classified depending on the **place** of articulation, **manner** of articulation and presence of **voicing** during articulation. You will study the description of speech sounds in one of the other units in detail.

1.5.3 Fluency:

Fluency is the **smoothness** with which sounds, syllables, words and phrases are **joined** together during speaking. Speech that flows **uninterrupted**, at an optimal **rate** and **easily** without unusual hesitations, pauses or breaks is considered as fluent. In other words, appropriate and timely **sequencing** of these units of speech is necessary to maintain the fluency of speech. **Fluent speech,** then, is that which is

- relatively effortless,
- relatively free of abnormal pauses or discontinuities,
- moves forward quite rhythmically and easily, and
- spoken at an optimal rate, that is, which is neither too fast nor too slow.

1.5.4 Rhythm Or Prosody:

Prosodic features of speech are those which give speech its **melody** and **rhythm**. Speech rhythm **carries meaning, aids understanding, conveys emotional state** and **expresses esthetic qualities**. Rhythm features are produced by changes in **voice** and **articulation**, and usually by a combination of the two.

Features such as **intonation, emphasis, phrasing and rate** of speech contribute to the prosody of speech. Because prosodic features such as stress, intonation and emphasis are often spread over more than a single consonant or vowel, they are often referred to as the **"suprasegmental"** aspects of speech.

Rhythm features that are relevant to teaching speech include:

- **Emphasis:** Increased **stress** to a word in a phrase. Emphasis is produced primarily by an increase in **intensity** and **duration** of syllables within the stressed word. An accompanying change in **frequency** also occurs.
- **Intonation:** Change in **pitch** from syllable to syllable, rather than from word to word. Important linguistic **information** can be conveyed through intonation without using additional words.
- **Phrasing:** Organization of words into **groups** related to units of meaning. It has **two components** -the words **linked** in speech and the **pauses** between phrases. Pauses help the speaker to **inhale** air, to mark **grammatical boundaries** and to provide time for **planning** of new material while speaking.
- **Rate: Number** of syllables uttered in per unit of time. Individuals **vary** in the rate at which they talk. Rate is usually measured as the **number of words** per

minute or the number of syllables per second. Most adults **read** orally from **160 to 180 words per minute**. In connected conversational **speech**, we average 5 to 5.5 syllables per second or about **270 words per minute**.

1.5.5 Speech Intelligibility:

Intelligibility refers to the **degree** to which a message can be **understood**. It is the **clarity** with which an average listener can understand one's utterances. In other words, it is that aspect of oral speech-language output that allows a listener to understand what a speaker is saying. We therefore **describe** a person's speech in terms of its intelligibility. For example, Mr.X's speech intelligibility is good. Mr. Y's speech intelligibility is poor. In one of the later units, you will realize that this description is useful when we have to describe the speech of a **hearing impaired** child who is being trained to communicate verbally. You will need to work on **improving** his speech intelligibility if it is poor.

Intelligibility of speech **depends on** various factors such as

- Appropriate use of the speech **parameters** discussed above,
- Listener's ability to **predict** parts of the message,
- Location of **pauses,**
- **Speed** with which the utterances are produced, and
    - Grammatical **complexity** of the sentences.

In-text activity:

- Observe a person speaking while **chewing pan**, smoking a **cigarette** or with a **limited** mouth opening. Depending on the degree of mouth opening you will find it **difficult** to understand their speech.
- While listening to others speaking, try to **make judgements** about how intelligible their speech is. You will realize that the speech of some persons is clearer and easier to understand than that of others. Try to **analyze the reasons** for poor intelligibility of some speakers.

1.5.6 Non-Segmental, Segmental And Suprasegmental Aspects:

Very often, the parameters of speech discussed above are referred to in a different way that categorizes them into the segmental, non-segmental and the supra-segmental aspects of speech. This system of reference to the parameters of speech is very commonly used for **teaching** of speech to the **hearing impaired** children. Therefore, let us discuss these terms.

A **segment** refers to any discrete unit that can be **identified** in the stream of speech. Segmentation can take place using either physical or auditory criteria. A **segment** can be any unit in a sequence, which may be **isolated** from the rest of the sequence. Because the **phonemes** or speech sounds are discrete and definitely identifiable units of speech, these are referred to as the **segmental** aspects. The **vowels, consonants, diphthongs, semivowels** are all included in the segmental aspects of speech.

On the other hand, segments that are not easily identifiable units are classified as non-segmental or supra-segmental aspects. **Ling (1976)** provides an extensive discussion about these aspects for the purpose of **teaching** of speech to the hearing impaired. According to Ling, **non-segmental** features of speech are

- pitch and its control,
- loudness and its control,
- duration and its control and
- quality.

The **supra-segmental** aspects are the **prosodic** features such as

- intonation,
- phrasing,
- rate,
- emphasis and
- rhythm.

1.6 CHARACTERISTICS OF GOOD SPEECH:

In order for speech to be **effective** and contribute to appropriate **social interactions**, it must have certain characteristics. We will now discuss these.

(a) **Purposiveness:** For speech to be effective, it should be purposeful. It should serve the purpose with which the speech was initiated to begin with. If speech is meant to seek **information** about something, it should do so. If it intends to express an **emotion**, it should do so correctly. Speech that does not serve its purpose is not effective.

(b) **Communicativeness:** Speech should be purposive and should carry a sense of personal **contact** and **rapport** with the listeners. Communicativeness is possible only when there is a full realization of the **meanings** that are being conveyed. Also, for speech to be communicative, it should be **direct** and **logical.**

(c) **Agreeable voice quality:** To be most effective as an instrument of communication, the speaker's voice should be of good quality. It should not be **breathy, harsh, shrill,** excessively **nasal** or **unpleasant**. It should be **age-** and **gender-appropriate,** of **optimum pitch** and adequately **loud.**

(d) **Flexibility**: Flexibility of speech refers to flexibility of features such as pitch, loudness, rate, quality and stress. Without flexibility, speech will become **monotonous** and **boring**. Flexibility refers to variations that a speaker creates while speaking. This can be achieved by varying the **quantity** of speech i.e. varying the length of the sentences, varying the **rate** of speech and varying the number and length of **pauses**.

(e) **Adequate projection**: Projection refers to speech and voice that is **sufficiently strong**. Good projection arises from a good voice **mechanism**, proper **use** of the voice mechanism, **interest, enthusiasm** and **animation** on the part of the speaker. Failure to open mouth adequately, failure to provide adequate breath stream and indistinct articulation lead to **inadequate projection**.

(f) **Adequate articulation**: **Distinctness** of speech requires flexibility and agility of the speech organs. For correct and adequate articulation, the **sounds** in the language should be formed at the right **place** of articulation and in the correct **manner** of articulation.

(g) **Correct pronunciation**: The pronunciation of a good speaker should be **acceptable** by the listeners. This is especially relevant to the variations in the pronunciation of a particular word in different **dialects** and **regions**.

(h) **Animation**: For speech to be effective, it should contain **liveliness, alertness** and **interest**. A speaker who is dull, lifeless and uninterested is not considered a good speaker by many.

(i) **Ease of bearing**: The posture and the body language of the speaker convey a lot about the speaker. Awkwardness, stiffness and an immovable and inflexible posture may not convey **ease and comfort** on the part of the speaker. An erect posture, but not and arrogant or rigidly tense one, may be more effective.

(j) **Absence of excessive fear and timidity**: A **wholesome attitude** towards speaking, one that is free of fear, anxiety and timidity will definitely be more effective to the listener. If the speaker reflects these feelings, it may give an impression that the speaker is **not well versed** with the topic of discussion.

(k) **Semantic/Linguistic Soundness**: A good and effective speaker is one who makes good and apt choice of the **right words** in the right context. A **powerful vocabulary** with good knowledge of linguistic rules contributes immensely to effective speech.

1.7 SUMMARY - THINGS TO REMEMBER

- **The process of communication** is a two-way process that involves sending of a message by one individual and receiving of that message by another individual. For communication to occur, the receiver and the sender must share a **common code**.

- **Typical ways** of communication include speaking and listening and also reading and writing.
- An **effective communication system** is one that permits the user to exchange information with high degree of ease, flexibility, speed and accuracy in a wide variety of circumstances.
- **LANGUAGE** is a code consisting of symbols ordered in particular sequences for the purpose of conveying information.
- Speech can serve a number of **functions** such as gaining attention, exchanging information, sharing emotions, controlling others, establishing individuality and as a source of recreation.
- **The main parameters** of speech can be enumerated as voice, articulation, fluency and prosody.
- **Speech intelligibility** refers to the degree to which a message can be understood. It is the clarity with which an average listener can understand one's utterances.
- Features such as intonation, emphasis, phrasing and rate of speech contribute to the **prosody of speech.**
- **A segment** refers to any discrete unit that can be identified in the stream of speech. Because speech sounds (vowels, consonants, diphthongs, semivowels) are discrete and definitely identifiable units of speech, these are referred to as the segmental aspects.
- **Characteristics of good speech** include purposiveness, communicativeness, flexibility, agreeable voice quality, adequate projection, adequate articulation, correct pronunciation, animation, ease of bearing, absence of excessive fear and timidity and semantic/linguistic soundness.

1.8 ASSIGNMENT

Explain the parameters that influence speech intelligibility.

1.9 CHECK YOUR PROGRESS:

❖ FILL IN THE BLANKS WITH APPROPRIATE WORDS

1. The process of ____________ is a two-way process.
2. _________ is the most common mode of human communication.
3. The process of sending a message is called as _______.
4. The main parameters of speech include _____, _______, ________ and _____.

5. The process of speech sound production is called as ______.
6. Voice is generated by the _______ in the larynx.
7. _________ is the smoothness with which sounds, syllables, words and phrases are joined together during speaking.
8. Prosodic features such as stress, intonation and emphasis are often spread over more than a single consonant or vowel, they are often referred to as the __________ aspects of speech.
9. Rhythm features are produced by changes in ______ and ______, and usually a combination of the two.
10. ______________ is produced primarily by an increase in intensity and duration of syllables within the stressed word.
11. Control of pitch, loudness, duration are referred to as ____________ features.

❖ **QUESTIONS**

1. Explain the difference between Communication, Speech and Language.
2. List the various communication options you know of after reading this study material.
3. Explain the speech chain.
4. List the functions of speech.
5. Enumerate the parameters of speech.
6. What are the different aspects of rhythm?
7. What do you understand by the term ' Intelligible'?

1.9 POINTS FOR DISCUSSION/CLARIFICATION:

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

1.9.1 Points for Discussion

____

____

____

____

1.9.2 Points for Clarification

1.9 REFERENCES / FURTHER READING:

1. Crannell, K.C. (1987). Voice and Articulation. California: Wordsworth Publishing Co.
2. Denes, P.B. and Pinson, E. N. (1993). The Speech Chain – The Physics and Biology of Spoken Language. Baltimore: Williams and Wilkins.
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4. Ling, D. (1976). Speech and the Hearing-impaired Child: Theory and Practice. Washington DC: Alexander Graham Bell Association for the deaf.
5. VanRiper, C. and vonEmerick. (1984). Speech Correction – An Introduction to Speech Pathology and Audiology. (7th Ed.). Englewood Cliffs – Prentice Hall Inc.

UNIT 5: CHALLENGES AND REMEDIAL STRATEGIES

STRUCTURE

- ***Introduction***
- ***Objectives***
- ***Structures involved in speech production***
- ***Speech as an overlaid function***
- ***Respiration***
- ***Phonation***
- ***Articulation***
- ***Resonation***
- ***Regulation***
- ***Summary - Things to remember***
- ***Check your progress***
- ***Points for discussion / clarification***
- ***References / Further reading***

1.1 INTRODUCTION:

*The process of speech production comes very **naturally** to human beings. Human beings speak as naturally as they **breathe**. However, the process of speech production is a very **complex** and highly **coordinated** act involving a number of processes in the human body. The major **components** of the process of speech production include:*

1. ***Respiration** or breathing, which provides the power source for speaking i.e. the air stream from the lungs,*
2. ***Phonation** or voice production, which provides the sound source i.e. the vibration of the vocal folds in the larynx,*
3. ***Articulation** or speech-sound production, which forms the different phonemes or speech sounds by the movements of the tongue, lips, teeth and palate,*
4. ***Resonation** or modulation of the sound produced by the larynx, which is carried out by the cavities of the mouth, nose and throat,*
5. ***Regulation** or control of the process of speech production, which occurs in the centers in the brain.*

In this unit, we will look at the different processes involved in the act of speech production.

1.2 OBJECTIVES:

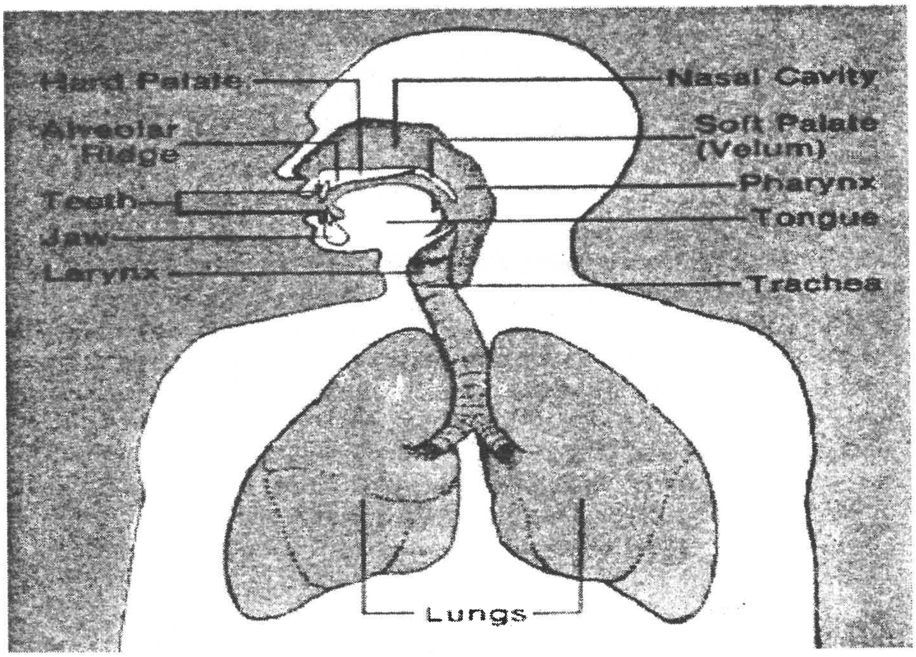
At the end of this unit you will be able to

- *Describe the **main processes involved in the production** of speech*
- *Describe the **structures involved** in speech production*
- *Differentiate **breathing** for life from breathing for **speech***
- *Describe the process of production of **voice***
- *Describe the process of **speech sound** production*
- *Discuss the **resonatory** effects on speech*
- *Enumerate the centers in the central nervous system that **control** speech production*

1.3 STRUCTURES INVOLVED IN SPEECH PRODUCTION:

*The structures involved in speech production are the **organs** and structures that are a part of the **systems** in the human body that participate in the speech production act.*

FIGURE 1- THE SPEECH MECHANISM



These structures include:

*(a) Structures in the **respiratory** system: **lungs**, trachea, bronchi, the rib cage; diaphragm and other muscles of respiration.*

*(b) Structures in the **phonatory** system: **larynx**, the vocal folds in the larynx and the muscles of the larynx.*

*(c) Structures in the **articulatory** system: lips, **tongue**, teeth, jaw and palate.*

*(d) Structures in the **resonatory** system: **oral cavity** (mouth), **nasal cavity** (nose) and **pharyngeal cavities** (throat).*

*(e) Structures in the **nervous system** which act as controlling or regulating centers during speech production.*

1.4 SPEECH AS AN OVERLAID FUNCTION:

*All the above structures and the muscles involved in speech production are used for other **bodily activities** that are important for **sustaining life**. **Breathing** which provides the airstream for speaking is very necessary for life. The lungs transfer oxygen to the blood and then to the muscles and remove impurities. The **larynx** or the voice box has the basic function of **preventing foreign objects** and **food** from* *entering the lungs. The vocal folds also help to cough up anything, such as food and phlegm, which the lungs reject. The larynx also helps in* ***fixation of the chest cavity*** *(making the chest cavity rigid) during activities such as* ***pushing, pulling, lifting heavy objects*** *and* ***childbirth****. The structures in the* ***articulatory*** *system are basically used for* ***chewing*** *and* ***swallowing*** *which are also functions necessary for life. The* ***tongue*** *directs food to the back of the oral cavity, the* ***lips*** *help in keeping the food from escaping out of the mouth, the* ***teeth*** *cut, grind and chew the food, the* ***palate*** *provides a hard upper surface for swallowing and the* ***velum or soft palate*** *keeps food from entering the nasal cavity. The* ***resonating*** *structures are the cavities through which necessary* ***food or air passes****. But these same organs are also used to produce very delicately and very accurately modulated* ***chains of sound*** *through which we communicate. Because the speech process utilizes the same structures that are used in important biological (bodily) functions, speech is called an* ***overlaid function****. This means that speech is a* ***secondary function*** *of the organs which basically work towards sustaining life.*

In-text activity:

- Try **speaking** few words while you are **swallowing** something. You will observe that it will not be possible for you to do this because when you are swallowing, the **movement of airstream through the larynx is stopped**. This is because the vocal folds shut tightly to prevent food from entering into the lungs which are below the larynx.

- *Try* ***lifting*** *a heavy object and* ***speaking*** *at the same time. You will find that voice is produced very* ***effortfully*** *as the vocal folds are tightly closed to allow for fixation of the chest cavity during the strenuous activity.*

1.5 RESPIRATION:

Respiration is the process of ***breathing air in and out****. It is accomplished by a complex interaction of the muscles of the* ***thoracic*** *(chest) and* ***abdominal*** *(stomach) cavities. Respiration consists of two* ***phases****:*

1. ***Inspiration*** *or inhalation is the process by which air is* ***taken in*** *through the nose or mouth and travels through the pharynx and trachea to the lungs.*
2. ***Expiration*** *or exhalation is the process by which the air from the lungs is* ***given out*** *through the nose or mouth.*

During quiet and normal breathing, the relative ***duration*** *of inhalation and exhalation is about the same. One inhalation and one exhalation together form one* ***respiratory cycle****. In* ***adults****, there are about* ***twelve*** *respiratory cycles per minute in quiet breathing. It is during the exhalation phase of the respiratory cycle that* ***voice***

***production** and speech occurs. The air stream being exhaled from the lungs passes through the **larynx**, during which voice is produced.*

RESPIRATORY SYSTEM:

*The respiratory system **starts** at the openings of the mouth and the nose and **ends** at the lungs. The oral and the nasal cavities connect to the **pharynx** (foodpipe), **larynx** (voice-box) and the **trachea** (windpipe) below. The trachea divides into the **left** and the **right** branches called as **bronchi**. Each branch enters the lung on the respective side and further **subdivides** into branches called as **bronchioles**. Each **lung** is a cone-shaped, sponge-like structure and is made up of millions of **air sacs** called the **alveoli**. The **oxygen** from the air that is breathed in is **exchanged** for carbon-dioxide in these air sacs. The **carbon-dioxide** is then given out by the lungs during exhalation. The contraction and expansion of the lungs and the chest during breathing is brought about by the **muscles of respiration**. The important muscles of respiration include the dome-shaped **diaphragm** and the **abdominal** muscles.*

TYPES OF BREATHING / BREATHING PATTERNS:

Depending on the muscles that are **used predominantly** during breathing, there can be different breathing patterns in different individuals. Most normals use rib-cage movements predominantly, although at times **rib-cage** and **abdominal** movements both occur simultaneously and regularly. The different **types** of breathing patterns can be described as follows:

- **Diaphragmatic breathing:** In this type, a downward movement of the **diaphragm** is accomplished by an expansion of the lower ribs. This technique provides **easier**, more **flexible** control over exhalation.
- **Clavicular breathing:** In this type, the speaker raises the **shoulders** (clavicles) and collar bone while inhaling. This type of breathing can be very **exhausting** and also adds to the **tension** in the laryngeal area.
- **Thoracic breathing:** In this type, the **sternum** (breastbone) is elevated during inhalation and often pulls in the lower rib cage.
- **Abdominal breathing:** In this type, there is very little costal movement, but the movement of the **abdominal wall** is evident as the diaphragm moves up and down.

BREATHING FOR SPEECH:

The normal breathing of human beings is a regular, **reflexive** and **involuntary** activity. Also, inhalation and exhalation take **equal time** when we breathe regularly. For the purpose of **speech**, however, this breathing pattern is modified. When we speak, breathing goes from involuntary to **voluntary control**. We may take in **more air** during inhalation in order to speak loudly or to speak a longer sentence. Also, **inhalation** for speech is **quicker** and **exhalation** is **slower**. While speaking, inhalation may also take place through the **mouth**. The **length** of the exhalation is modified according to the length of what we have to say.

In-text activity:

- Sit in a **relaxed** position. Take a deep **breath** without applying too much force or effort while inhaling air in. Place one **hand** on the chest and one on the abdomen (stomach). **Feel** how these two parts move as you breathe air in and out. Depending on the type of breathing you are using, you will observe significant **movement** of the chest or the abdomen.
- Stand in front of the **mirror** and **observe** the movements of your shoulders, chest and stomach. Try to decide which type of breathing **pattern** you use. You will be able to **confirm** the observation that you have made in the above activity.
- Using the second or minute hand of your watch try to count the number of **respiratory cycles** per minute in your breathing.
- Ask a friend or a family member to say these **two sentences**. "How are you?" and "When I went to the exhibition yesterday, I saw a very attractive and bright red vase." Observe the differences in the **length** of his inhalations and exhalations while he says the short sentence and the long sentence. Give attention to the places where he **pauses** during a long sentence to take air into the lungs.

1.6 PHONATION:

The process of the larynx acting on the exhaled air stream is called **phonation**. The larynx is a structure made of **cartilages** and **muscles** and is situated in the neck, above the trachea and below the pharyngeal cavity. At the anterior (front) of the larynx the **thyroid cartilage** forms the **"Adam's apple"** on the neck. This can be very prominently seen on the neck in **males**. The small **cricoid cartilage** rings the bottom of the larynx. A pair of **arytenoid cartilages** rest on the thyroid cartilage. On this pair of arytenoid cartilages are attached the **vocal folds** or vocal cords. The vocal folds are two **muscle bands** which serve to open and close the trachea by **vibrating** to and fro. When the vocal folds are **open**, free flow of air from the trachea to the oral and nasal cavities is possible. The opening between the two vocal folds is called the **glottis**. During normal **breathing**, the vocal folds are separated from each other (glottis is open), allowing air to flow easily. When the vocal folds **vibrate** to and fro, the air stream coming from the lungs is released into the cavities above the larynx in small **air puffs**. This results in the production of a complex sound called the **laryngeal tone**.

The laryngeal **muscles** play an important part in opening and closing the glottis. The glottis can be **completely open** when the vocal folds are parted from each other and it can be completely closed when the vocal folds are **tightly closed** against each other. The laryngeal muscles can also close the glottis only **lightly** so that the vocal folds can be parted by **air pressure** from the lungs, causing **rhythmic** opening and closing of the glottis for phonation. During phonation, the vocal folds follow a rhythmic **cycle**:

- closing of the glottis
- increasing air pressure below the glottis
- opening up of the vocal folds due to the pressure
- emission of a puff of air
- closing of vocal folds again due to the decrease in air pressure and constant muscle tension.

When the vocal folds close, air pressure below the glottis again increases and the pattern is **repeated**. The resulting periodic puffs of breath (air) give the sound of **voice**.

The frequency of **vibration** of the vocal folds (number of vibrations per second) determines the **fundamental frequency** of the voice. The fundamental frequency of the voice depends on an interaction between the **height** of the larynx in the neck and the **length, thickness** and **tension** of the vocal folds. The vocal folds of **males** vibrate at a lower frequency while that of **females** vibrate at a higher fundamental frequency. The frequency of vibration is the highest in **children**. The fundamental frequency of vibration decides the individual's **vocal pitch**. When the increase in air pressure below the glottis is considerable, the vocal folds are forced **farther apart** during the close-open-close cycle. This leads to an increase in the **loudness** of the voice. The pitch and loudness of the voice can be **voluntarily changed** by an individual to some extent.

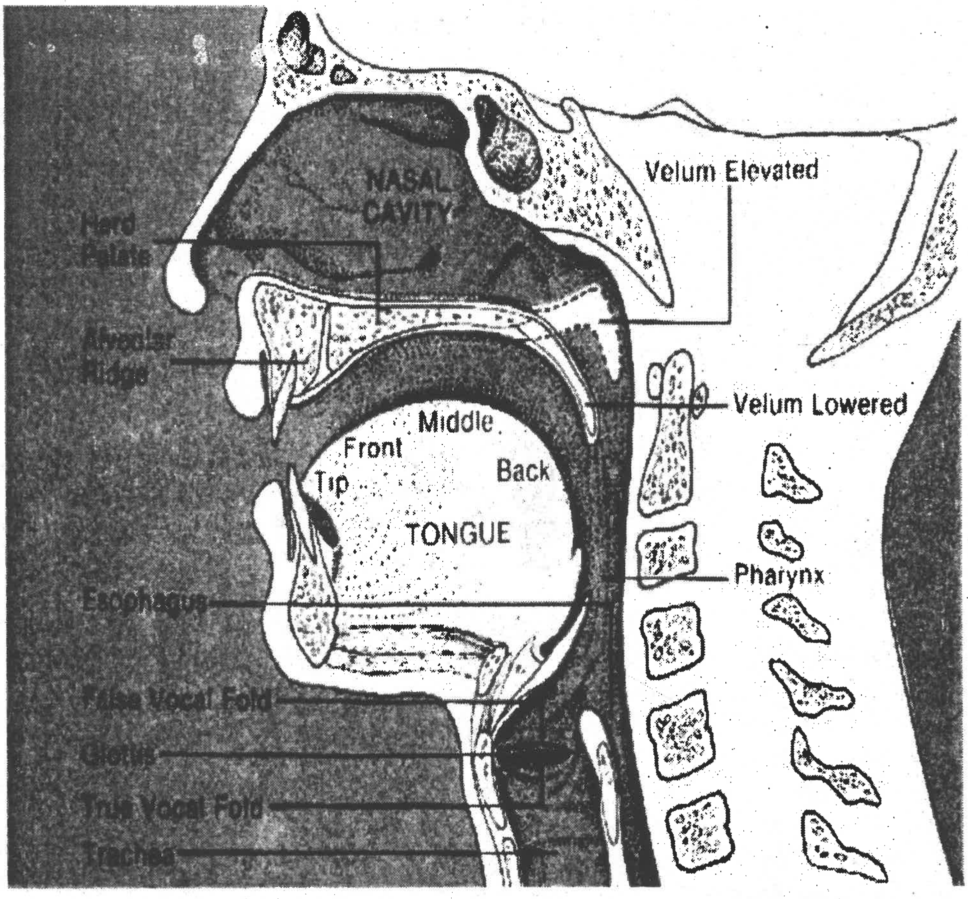
In-text activity:

- **Listen** carefully to the differences in the voices of **males, females** and **children**. You will realize that most of the males have **low-pitched** voices while females have **high-pitched** voices. High-pitched voices sound **thin** while low-pitched voices sound **thick**. The voices of children sound the **thinnest**, that is, they are the highest in pitch.
- When you get an opportunity, listen to the seven tones (swaras) on the musical scale on the **harmonium.** The first /sa/ is the lowest in pitch. The pitch goes on increasing from /re/ to /ni/. The last /sa/ is the highest in pitch.
- Ask **five persons** to say a prolonged /a/ along the musical scale i.e. change the pitch from the lowest to the highest. Observe what happens in the laryngeal area. You will find that in most people, the larynx **moves upward** while increasing the pitch.
- You will realize during your practicum work that most **hearing impaired** children speak in a higher pitch.
- Notice the amount of air you breathe in before saying something in a **loud voice**. You will realize that you need to take in **more air** in order to create more pressure below the glottis. Compare **soft voice** with a loud voice.

1.7 ARTICULATION:

The air stream coming out of the larynx is molded into speech sounds by the **vocal tract**. This process is called as **articulation**. The vocal tract extends from the glottis to the oral and nasal cavities. The vocal tract consists of three main **cavities** (air-filled passages) - the **pharyngeal** cavity, the **nasal cavity** and the **oral** cavity. The **configuration** (shape) of the cavities in the vocal tract at a particular moment determines what **speech sound** (phoneme) will be produced. The oral cavity is the one which significantly affects the production of most of the phonemes in languages such as English, Hindi and Marathi. The nasal cavity affects production of **nasal sounds** such as /m/ in **m**u**mm**y, /n/ in **n**ose and /n/ in goi**ng**.

FIGURE 2: THE VOCAL TRACT



*The **structures** in the oral cavity which are responsible for articulation of the phonemes are called the **articulators**. These include the tongue, lips, teeth, lower jaw (mandible), the hard palate and the soft palate (velum). The articulators can be classified into two **types**:*

- ***Active articulators** are the organs in the oral cavity which take an active part in articulation. These include the parts which **move** to change the shape of the vocal tract. Active articulators in the vocal tract are lips, tongue, mandible and soft palate.*
- ***Passive articulators** are the organs in the oral cavity which do not move but take part articulation by providing a **surface** for contact by the active articulators. The alveolar ridge (gums just behind the upper front teeth), hard palate and teeth are passive articulators.*

Let us look at each of the articulators in detail.

1. ***Tongue:** The tongue is a **highly mobile** muscular organ arising from the floor of the mouth. It occupies most of the space in the oral cavity. **Muscles** within the tongue enable it to change its **shape** easily. Other muscles coming from **various sites** allow important movements such as tongue **elevation** or upward movement, **protrusion** or outward movement, **retraction** or backward movement and **lateralization** or side to side movement. The tongue can be divided into its **tip, middle portion** and **back**. The tongue can **narrow** and **point** as it does for the sound /l/ as in **l**etter, or it can present a **broad front** surface as it does in the production of the sound /**sh**/ as in **sh**irt. The **back** of the tongue can be elevated independently of the front portion as in the production of the sound /**k**/ as in **k**ite. The **vowels** and **diphthongs** of our speech are produced primarily by the movement of the tongue. The tongue is the most important structure for articulate speech.*
2. ***Lips:** The lips are made up mainly of **facial muscles** which make it possible for them to **spread, round, come together** or **pucker**. They are the most visible structures of the mouth and are also used in various **facial expressions**. The lips can close to stop the air stream as in the production of sounds such as **/p/** in **p**arrot, **/b/** in **b**ag and **/m/** in **m**u**mm**y. The lower lip can touch the upper front teeth for production of sounds such as **/f/** in **f**ather and **/v/** in **v**an. Rounding the lips and changing the degree of lip opening contributes to the production of vowel sounds such as /**u**/ in p**u**ll and /**o**/ in f**o**ur.*
3. ***Teeth:** The teeth that are most important for production of speech sounds are the **four front** teeth in each jaw - lower and upper. They are used in the production of sounds such as **/f/** in **f**ather, **/v/** in **v**an, **/s/** in **s**ix and **/z/** in **z**ebra.*
4. ***Alveolar ridge:** This is the **gum ridge** just behind the upper front teeth. This is an important **point of contact** by the tongue for sounds such as **/t/** in **t**en, **/d/** in **d**og, **/n/** in **n**ose, **/l/** in **l**etter, **/s/** in **s**ix and **/z/** in **z**ebra.*
5. ***Mandible:** The **lower jaw** or the mandible helps in opening or closing of the mouth (oral cavity). It also changes the **size** and **shape** of the oral cavity*

required for different vowels. Mandibular movement is also important in maintaining optimal vocal ***resonance****.*

6. ***Palate:*** *This is the structure* ***separating*** *the oral and the nasal cavities. It extends from the alveolar ridge to the back of the mouth. The part of the palate just behind the alveolar ridge is* ***bony*** *and* ***hard****. This is called as the* ***hard palate****. The part toward the back of the oral cavity is* ***soft, muscular*** *and* ***mobile****. This is called as the* ***soft palate*** *or the* ***velum****. The hard palate helps to* ***direct*** *the air stream toward the front of the mouth during consonant articulation. It also contributes to vowel* ***resonance****. It provides various* ***points of contact*** *by the tongue for articulation of different speech sounds. The soft palate is a mobile structure and can be* ***raised up*** *or* ***lowered down****. When elevated, it is in contact with the wall of the throat* ***(posterior pharyngeal wall)****, thus separating the oral cavity from the nasal cavity. When it is not elevated, air can flow from the oral and pharyngeal cavities to the nasal cavity. This is required in production of* ***nasal sounds*** *like* ***/m/*** *in* ***m****at and* ***/n/*** *in* ***n****ose. The velum also serves as a* ***point of contact*** *for the back of the tongue during production of sounds such as* ***/k/*** *in* ***k****ite and* ***/g/*** *in* ***g****o.*

In-text activity:

- *Stand in front of the* ***mirror****, open your mouth* ***wide*** *enough and try to* ***identify*** *the active and the passive articulators such as the soft palate, hard palate, alveolar ridge, tongue, lips, teeth and the mandible.*
- *Observe movements of the* ***lips*** *when you say sounds such as* ***/u/, /o/, /p/ and /m/*** *repeatedly. Also observe movements of other articulators while you are saying these sounds.*
- *Bring your tongue out of the mouth* ***(protrusion)****, turn it up towards the nose as high as you can* ***(elevation)****, move it from side to side as far as you can* ***(lateral movement)****, take it in and try to turn it back and up towards the back of the mouth* ***(retroflexion)****. Observe the movement of the* ***back portion*** *of the tongue while repeating the sound* ***/k/****. Observe how* ***easily*** *the tongue can make these movements and also note the* ***range*** *of movement.*
- *Try to* ***feel*** *the upper portion of your mouth with your tongue and* ***identify*** *the hard palate and the soft palate.*

1.8 RESONATION:

The laryngeal tone is selectively ***amplified*** *and* ***modulated*** *by the pharyngeal, oral and nasal cavities. This process is called as* ***resonation****. Since these cavities are* ***flexible*** *and differ in* ***size*** *and* ***wall thickness*** *from person to person, each individual has a distinct resonance or* ***vocal quality****. The* ***velum*** *or soft palate is an important* *structure in determining resonance of speech sounds. When the velum is lowered, the nasal cavity and the oral cavity are coupled together, thus giving the sound a predominantly **nasal resonance** or nasal quality. On the other hand, when the velum is elevated, the nasal cavity is separated from the oral cavity, giving the sound a predominantly **oral resonance**.*

In-text activity:

- *Standing in front of the **mirror**, open your mouth **wide** enough for you to see the velum clearly. Use a **torch** and observe the position of the velum when it is **at rest** i.e. when no speech is being produced. Then start saying an **/a/** as in **father** and observe the upward movement of the **soft palate** at the beginning of the vowel. If you **prolong** the vowel /a/ you will observe that the velum continues to be raised upward and is **lowered** only when you stop the /a/.*
- *Experiment with this and try to bring about **voluntary** raising and lowering of the velum.*

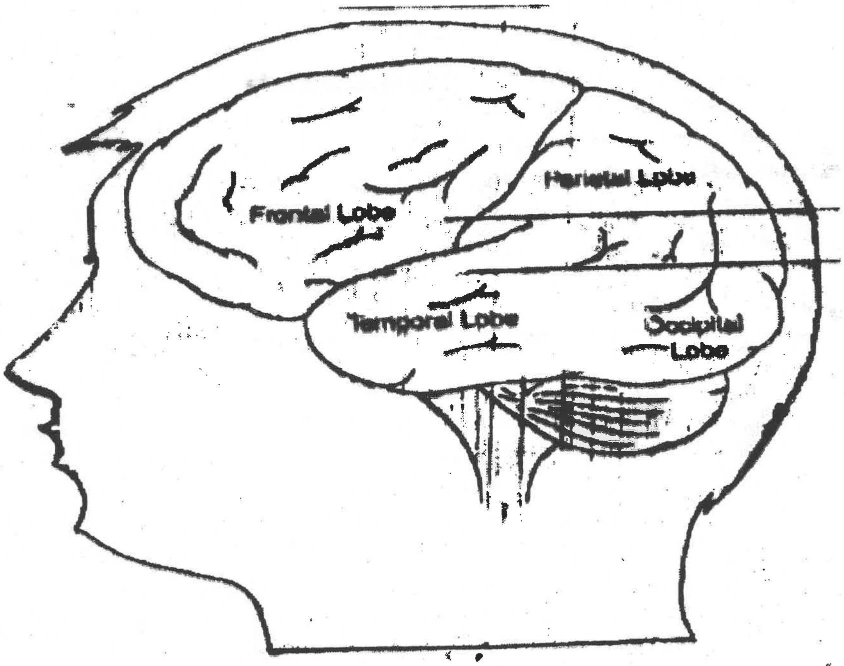
2.9 REGULATION:

*The highly co-ordinated act of speech production involving the above systems in the human body is regulated by centers in the **nervous system**. The human central nervous system consists of two major parts – the **left** and **right** hemispheres (besides the brainstem, medulla, pons and cerebellum). Each hemisphere is divided into **four lobes***

1. *Frontal lobe*
2. *Temporal lobe*
3. *Parietal lobe*
4. *Occipital lobe*

*Unlike the other components of the speech production process which are borrowed from their basic biologic functions, the central nervous system has **specialized areas** which fulfill the purpose of **receiving**, **organizing** and **formulating** messages. Besides, the impulses (orders from the brain) are relayed (carried) to the brain by special nerves known as the cranial nerves.*

FIGURE 3: REGULATORY CENTERS FOR SPEECH & LANGUAGE FUNCTIONS



1. *The **centers** in the brain responsible for the various speech and language functions include:*

- ***The Broca's area :** In most individuals, an area located on the side of the **frontal lobe** of the **left cerebral hemisphere** is responsible for motor speech. This is called as Broca's area and is the command center for originating, **planning** and carrying out the **transmission** of messages. Damage to this area leads to a problem in the **production** of speech. Comprehension of spoken language may also be affected but to a lesser degree.*
- ***The Wernicke's area:** In most individuals, an area located in the **temporal lobe** of the **left cerebral hemisphere** is responsible for **comprehension** or understanding of speech. This is called as Wernicke's area and damage to this area results in a problem in **understanding** spoken language. The production of speech may also be affected, but in a way **different** from that of a damage to the Broca's area.*

- ***Cerebellum:*** *The cerebellum plays an important role in the* ***co-ordination*** *of the movements required for production of speech.*

2. ***Cranial nerves:*** *The command centers in the cerebral hemispheres* ***relay*** *orders to the specific muscle groups of speech production and* ***receive*** *information from the sense organ of hearing through the* ***peripheral*** *nervous system. This is done through the cranial nerves. There are* ***twelve pairs*** *of cranial nerves emerging from the base of the brain and are named primarily according to the* ***function*** *they serve. The cranial nerves important for the control of the* ***speech mechanism*** *are the* ***fifth*** *(trigeminal),* ***seventh*** *(facial),* ***ninth*** *(glossopharyngeal),* ***tenth*** *(vagus) and* ***twelfth*** *(hypoglossal) nerves. The* ***eighth*** *cranial nerve is the auditory nerve which is responsible for* ***hearing and balance.***

2.10 SUMMARY –THINGS TO REMEMBER:

- ***The act of speaking*** *is a complex and highly coordinated process involving many systems of the human body. A problem with any of these systems or in co-ordination of these systems may lead to impairment in speech.*
- ***The major components*** *of the process of speech production include respiration, phonation, articulation, resonation and regulation.*
- ***The main structures*** *involved in speech production include lungs, larynx and the vocal folds, structures in the oral cavity (mouth), the nasal cavity (nose), pharyngeal cavities (throat) and the structures in the nervous system which act as controlling or regulating centers.*
- *Because the speech process utilizes the same structures that are used in important biological (bodily) functions, speech is called an* ***overlaid function.***
- **Breathing for speech** is a voluntary act. Inhalation during speech is quicker and exhalation is slower. More air may be inhaled while speaking than quiet breathing. Inhalation may also take place through the mouth. The length of the exhalation is modified according to the length of what we have to say.
- **During phonation,** the vocal folds follow a rhythmic cycle that involves closing of the glottis, increasing air pressure below the glottis, opening up of the vocal folds due to the pressure, emission of a puff of air and closing of vocal folds again due to the decrease in air pressure and constant muscle tension.
- The **velum** or soft palate is an important structure in determining resonance of speech sounds.
- **The central nervous system** has specialized areas which fulfill the purpose of receiving, organizing and formulating messages.

2.11 CHECK YOUR PROGRESS:

❖ *FILL IN THE BLANKS WITH APPROPRIATE WORDS*

1. *The main processes involved in speech production include ______, ______, ______, _________ and _________.*
2. *Speech is called as an __________function.*
3. *The _____ _____ can touch the upper front teeth for the production of sounds such as /f/ and /v/.*
4. *The lips can close to stop the air stream in the production of sounds such as ________, _________, and _________.*
5. *Teeth are used in the production of sounds such as ______ _______ ______ and ______.*
6. *The gum ridge just behind the upper front teeth is known as ________. It is important for production of sounds such as _________.*
7. *The laryngeal tone is selectively _________ and _________ by the resonating cavities.*
8. *When the velum is lowered, the oral cavity and nasal cavity are ___________, thus giving the sound a predominantly ________ quality.*
9. *When the velum is elevated, the oral cavity and nasal cavity are ________, thus giving the sound a predominantly__________ quality.*
10. *_____________ of the voice depends on the fundamental frequency of vibration of the vocal folds.*
11. *Loudness of voice depends on the _________ of the vibration of the vocal folds.*
12. *Speech sounds are classified mainly as _________ and ___________.*
13. *Consonants are classified depending on the ___________ of articulation, ___________ of articulation and presence of _________ during articulation.*

❖ *QUESTIONS*

1. *List the processes involved in speech production.*
2. *List the structures in the respiratory system.*
3. *List the structures in the phonatory system.*
4. *List the structures in the articulatory system.*
5. *List the structures in the resonatory system.*
6. *Explain why speech is called an 'overlaid function.'*
7. *Explain the two phases of respiration.*
8. *Briefly explain the different types of breathing patterns.*
9. *How is breathing for speech different from breathing for life?*
10. *Describe the rhythmic cycle of the vocal folds during phonation.*
11. *What is articulation? Briefly explain active articulators and passive articulators.*
12. *Briefly describe the structure and functions of the tongue.*
13. *Briefly describe the structure and functions of the hard and soft palate.*

14. *List the areas in the brain that are important for speech and language functions.*
15. *What are cranial nerves? How many pairs of cranial nerves exist in a human brain?*

1.12 POINTS FOR DISCUSSION/CLARIFICATION:

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

1.12.1 Points for Discussion

1.12.2 Points for Clarification

1.13 REFERENCES / FURTHER READING:

1. *Boone, D. R. and Plante, E. (1993). Human Communication and its Disorders. (2nd Ed.). Englewood Cliffs – Prentice Hall Inc.*
2. *Calvert, D. R. and Silverman, S. R. (1983). Speech and Deafness. (2nd Ed.). Washington DC: Alexander Graham Bell Association for the Deaf.*
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5. *Ling, D. (1976). Speech and the Hearing-impaired Child: Theory and Practice. Washington DC: Alexander Graham Bell Association for the Deaf.*
6. *VanRiper, C. and vonEmerick. (1984). Speech Correction – An Introduction to Speech Pathology and Audiology. (7th Ed.). Englewood Cliffs: Prentice Hall Inc.*

BLOCK 3:
DEVELOPING LITERACY SKILLS: WRITING

UNIT 1: PRE-REQUISITES FOR WRITING AND EMERGENT WRITING SKILLS

- Introduction
- Objectives
  - **Defining Phonetics, Phonology and Phoneme**
  - **Review of the processes of speech production**
  - **Classification of speech sounds**
  - **Description of Vowels**
  - **International Phonetic Alphabet (IPA)**
  - **Summary - Points to remember**
  - **Check your progress**
  - **Points for discussion / clarification**
  - **References /Further reading**

1.1 INTRODUCTION:

Try to **produce** the sound **'p'** as in /pəℓ/ ( ) and observe in front of the mirror as to how you produced it. You must have observed that you put both your lips together for a moment and then released the contact. Next, produce the sound **'b'** as in /bəℓ/ ( ) and you will observe that you have produced this sound also in the **same way**. What then is the difference?

This unit is devoted to the understanding of all these details, that is,

1) How are sounds **produced**?
2) What is the basis for the **classification** of sounds?
3) How each of the sounds can be **described**?

Note that all examples throughout the unit are also written using **IPA** as in the examples above. This is with the idea of familiarizing you with this system. Kindly refer to the section **1.8** of this unit for a detailed explanation.

1.2 OBJECTIVES:

At the end of this unit, you will be able to

- Describe how speech sounds are **produced**
- **Classify** speech sounds of any language

- Describe **vowels and consonants**
- Use phonetic symbols from the **IPA** system
- Describe the phonemes of **Hindi** and **English** language

3.3 PHONETICS AND PHONOLOGY:

Human beings are capable of producing a **large** number of different speech sounds. The **branch** which deals with the study of all these speech **sounds** themselves, how they are **made**, how they are **perceived** and the **physics** involved is known as **'Phonetics'.** In other words, Phonetics is the systematic study of **all** human **speech sounds.** It provides a means of describing and classifying virtually all the sounds that can be produced by human vocal tracts. However, each language uses only a **limited** number of these sounds. In a language, each sound which is capable of bringing about a **meaning** difference when it substitutes another sound in a word is known as a **'phoneme'**_(Refer to the same example of /pəl/ and /bəl/. By substituting the sound /b/ by /p/ the meaning of the word changes). Every language has a definite number of such meaning differentiating units, that is phonemes. **'Phonology'** is the study of how sounds are **organised** and **combined** into systems to be used for a particular language. The phonology of each language, therefore, is different from that of every other language, as each language will have its **specified** number of phonemes and its own **set of rules** for combining into words. Both these disciplines i.e. Phonetics and Phonology are heavily **dependent** on each other. In other words, the study of speech sounds in general is Phonetics while the function of speech sounds within a language is termed 'Phonology'. Example, the sound /k'/ is a speech sound and has a function in Hindi language (e.g. k'ɑnɑ-________) but has no function in the Tamil language.

We have already seen that modifying the **volume** and **direction** of a moving column of **air** using the specific **systems** of the human speech production mechanism creates speech sounds. We need to consider the **state** of the various parts of these systems to facilitate the **description** and **classification** of the sounds of human language. Therefore, before we start describing the speech sounds, we will **only review** the major aspects of the speech production process which we have already discussed **in detail in unit 2.**

1.4 THE MECHANISM OF SPEECH PRODUCTION:

The organs involved in the production of speech can be divided into three groups —

1. the respiratory system,
2. the phonatory system,
3. the articulatory system.

We need a **source of energy** for setting up sound waves in the air. Usually it is the air-stream coming out of **the lungs** that is used for this purpose. The apparatus that sets up the air-stream is called **the initiator.** If the lungs are the initiator, the air-stream mechanism is called **pulmonic**. Normally we use an **egressive** pulmonic air-stream for the production of speech. The sounds of **English** and almost all the sounds of the **Indian** languages are produced in this way.

The **Phonatory** system consists of the **larynx**, which contains the **vocal folds**. The vocal folds play an important role in the production of **voice**. They open and close regularly many times a second and the air-stream passes through in a series of small **puffs**. Thus the vocal folds act as **a vibrator** and produce a buzzing sound technically known as **voice.** This process is called **phonation.** When the vocal folds vibrate, the resultant sounds are known as **voiced**. If they do not vibrate, the resultant sounds produced are known as **voiceless.** For example all vowels and consonants like [m,n,l,v,z,] as in the Hindi words /maℓa/ ( ) /nəhi / ( ) / ℓatʰi/ ( ) /vəhə/ ( ), /zəɤuɤət̲/, are said to be voiced. This **vibration** can be felt by touching the neck at the larynx and saying [z]. The buzzing noise can also be heard by putting the fingers in the ears. The **difference** between a voiceless and a voiced sound can be realized by saying [p] and /b/ as in the **Hindi** words /kəp/ ( ) and /kəb/ ( ), one after the other.

The air-stream coming through the larynx is **modified** by the shapes of the cavities of the **pharynx,** the **mouth** and the **nose.** These cavities also act as the **resonators** of the note produced in the larynx. The **velum or soft palate**, as we have discussed in unit 2, can be raised or lowered. When it is raised, the air can flow only into the oral tract, that is, the mouth; sounds produced in this way are known as **oral sounds.** When the velum is lowered, air flows into both mouth and nose, resulting in **nasal sounds** such as the sound 'm' in the **Hindi** word _____ /mat̲a./ and sound 'n' in the Hindi word ______ /nəℓ/. All sounds in the Hindi language, except the nasal consonants [m,n, ŋ] are oral.

The tongue is the most flexible of the organs of speech in the **articulatory** system and it can assume a large number of different **positions**. Any part of the tongue can be raised to any **height** within the oral cavity and may even be brought into **contact** with the roof of the mouth to produce various sounds. The **lips** can also assume various shapes and thus affect the shape of the **cavity** in the mouth. They can be held tightly shut or held apart but sufficiently close together so that the air escapes with **friction**. The articulation of the various vowel and consonant sounds thus depends on the various positions of the movable organs of speech – the soft palate, the tongue and the lips. The description of each of the sounds is discussed a little later in this section. You will realize how important these aspects are for the classification and description of speech sounds.

To summarize, the **major aspects of speech production** are

- ✓ The **air stream** mechanism – determines where the air used in speech starts from and which direction it is travelling.
- ✓ The state of the **vocal folds** – whether or not the vocal folds are vibrating, which determines voicing.
- ✓ The state of the **velum** – whether it is raised or lowered, which determines whether a sound is oral or nasal.

1.5 CLASSIFICATION OF SPEECH SOUNDS:

Speech sounds can be grouped into two major categories **Consonants and Vowels.**

1.5.1 CONSONANTS:

Consonants are produced by a **closure** or **narrowing** of the air passage so that the air stream is blocked completely in the mouth or comes out with an **audible noise** (friction). They can be described using a **three-fold classification system.** The classification parameters include **place** of articulation, **manner** of articulation and **voicing.**

1.5.2. PLACE OF ARTICULATION

This refers to the **articulators** involved in the production and the **place** where the moving column of air is **obstructed**. There are **eight** such places along the vocal tract. These include bilabial, labio-dental, dental, alveolar, retroflex, palatal, velar and glottal. The description of phonemes in **Hindi** and **English** according to place of articulation is given in Table 1.

TABLE 1

Description of sounds	Examples in languages.			
	Hindi		English	
	Phonemes	Words	Phonemes	Words
1. **Bilabial sounds** are made with both lips.	/p/	/pɑni:/	/p/	/pɛn/ pen
	/p^h/	/p^huℓ/	--------	----------
	/b/	/bɑ: ℓ/	/b/	/bɔℓ/ ball
	/b^h/	/b^huℓ/	-------	-------
	/m/	/mən/	/m/	/mæn/ man

2. **Labiodental sounds** are produced by placing the lower lip on the upper teeth and blowing air through the narrow constriction thus formed.	/f/ /v/	/fɛsℓɑ/ /vəɤʃɑ/	/f / /v/	/fɑðəɤ / father /væn/ van
3. **Dental sounds** are made by placing the tongue at the back of the upper front teeth.	/t̪/ /t̪^{h}/ /d̪/ /d̪^{h}/	/t̪ot̪ɑ/ /t̪^{h}odɑ/ /d̪ɑd̪i/ /d^{h}ɑgɑ /	---- /θ/ ------ /ð/	------- /θIn/ thin ----- /ðe/ they
4. **Alveolar sounds** are produced by moving the tongue tip upward and forward to make contact with the upper gum (alveolar ridge).	/ℓ/ /ɤ/ /n/ ------ ------	/ℓɑ: ℓ/ /ɤɑ:t̲/ /nɑnɑ/ ------- -------	/ℓ/ /ɤ/ /n/ /t/ /d/	/ℓIv/ live /ɤop/ rope /n∈m/ name /tebʌℓ/ table /dɔ:ℓ/ doll

5. **Retroflex sounds** are produced by raising the tip of the tongue and curling it back to touch the hard palate.	/ʈ/ /ʈ^h/ /ɖ/ / ɖ^h/	/ʈopi/ /ʈ^{hi}I:k/ / ɖa:ℓ/ /	-------- --------- --------- ---------	------- -------- -------- --------
6. **Palatal sounds** are produced by lifting the front of the tongue to the hard palate.	/tʃ/ /tʃ^h/ /dʒ/ /dʒ^h/	/tʃIɖIja / /tʃ^{h}aʈa/ / dʒa:ℓ/ /dʒ^{h}ən ɖa/	/tʃ/ --------- /dʒ/ --------- /ʃ/ /ʒ/	/tʃeɤ/ chair ------ /dʒʌ dʒ/ judge ------- /ʃIp/ ship /meʒə/ measur e

7. **Velar sounds** are made by lifting the back of the tongue up to the soft palate(velum).	/k/	/kəℓ/	/k/	/kæt/ cat
	/kʰ/	/kʰIℓɔna/	----------	--------
	/g/	/gəℓa/	/g/	/gɔɖ/ god
	/gʰ/	/gʰoɖa/	-------	---------
	/ŋ/	/əŋgu	/ŋ/	/siŋ/ sing
8. **Glottal Sounds** are produced by an obstruction, or a narrowing that causes friction but not vibration between the vocal folds.	/h/	/həm/	/h/	/hæt/ hat

REFER TO APPENDIX FOR FIGURE

1.5.3 MANNER OF ARTICULATION:

This refers to the description of **how** the sounds are made, that is, the **way** in which the air stream is **obstructed**, and **how** the air is released from the vocal tract. Consonants can be grouped into six categories on the basis of **how** they are formed. Each of these **six categories** has been described in the following TABLE 2. Please note that only sounds in each category will be listed and for **examples** you can refer to the table 1.

TABLE 2

Description	Hindi	English
1. Plosives are produced by a complete closure of the air passage, with the articulators in contact with each other and the nasal cavity also shut off by velic closure. The column of air is thus held up **momentarily** but **completely** and then released with an explosion. Hence they are known as plosives. Plosives can be **voiceless** or **voiced, unaspirated** or **aspirated.** Aspirated sounds are produced with a puff of air. The sounds with an asterisk mark (*) are the **aspirated** sounds and those without are unaspirated. Sounds which are in bracket { }are voiced and those not in bracket are voiceless. This notation will be used throughout this unit for convenience. Plosives can be formed at different places of articulation in the oral cavity with different sets of articulators. For example, you can have **bilabial** plosives, dental plosives, retroflex plosives and velar	p, * p^h { b } *{b^h} $\underline{t}$ * $\underline{t}^h$ {$\underline{d}$}*{$\underline{d}^h$} ʈ *$ʈ^h$ k * k^h { g } *{g^h}	p, b t, d k, g
2. Nasals are made by lowering the soft palate, blocking the oral airway and directing the sound through the nasal passages	m n ŋ	m n ŋ
3. Fricatives are made by forcing air through a narrow vocal tract creating a hissing or turbulence against the teeth and gum ridge	f v s z ʃ h	f v s z ʃ ʒ h θ ð
4. Affricates are made by linking a plosive to a fricative sequentially.	tʃ dʒ $tʃ^h$ $dʒ^h$	tʃ dʒ
5. Flaps are produced by a single tap of the active articulator against the passive articulator	ɣ $ɣ^h$ $\underline{ɾ}$	
6. Laterals: English language has one lateral sound, the /l/, half consonant and half vowel, in which the tongue makes a sustained contact with the hard palate while the voiced air stream flows around its sides.	ℓ	ℓ

Description	Hindi	English
1. Plosives are produced by a complete closure of the air passage, with the articulators in contact with each other and the nasal cavity also shut off by velic closure. The column of air is thus held up **momentarily** but **completely** and then released with an explosion. Hence they are known as plosives. Plosives can be **voiceless** or **voiced, unaspirated** or **aspirated.** Aspirated sounds are produced with a puff of air. The sounds with an asterisk mark (*) are the **aspirated** sounds and those without are unaspirated. Sounds which are in bracket { }are voiced and those not in bracket are voiceless. This notation will be used throughout this unit for convenience. Plosives can be formed at different places of articulation in the oral cavity with different sets of articulators. For example, you can have **bilabial** plosives, **dental** plosives, **retroflex** plosives and **velar**	p, $*p^h$ $\{b\}$ $*\{b^h\}$ $\underline{t}$ $*\underline{t}^h$ $\{\underline{d}\}*\{\underline{d}^h\}$ ʈ $*ʈ^h$ k $*k^h$ $\{g\}$ $*\{g^h\}$	p, b t, d k, g
7. Semi-vowel is an accidental sound produced when articulators move from one place of articulation to another. These are also called **glide** sounds because the articulators move from one position to another during their production. For example, to produce the /w/ as in ***we*** /wi/, you must for your tongue and lips for the vowel ***oo*** /u/ and then shift or glide into the vowel ***ee*** /i/, the distinctive sound of /w/ being made during the transition.	w j	w j

3.5.4 VOICING:

This is the last dimension commonly used for classifying consonant sounds. This is a binary dimension and refers to whether or not a consonant is accompanied by laryngeal tone. Consonants that have vocal fold activity are termed ***voiced; voiceless*** is the term applied to consonants that are not accompanied by vocal fold vibration. Note (see Tables 3 and 4) that many consonants, for example, /s/ and /z/, occur in pairs that differ solely by the variable of voicing.

The classification system may seem confusing and a bit cumbersome to you at first, but assigning sounds to the categories of place, manner and voicing provided a convenient way in which to understand how consonants are produced. Using this system, you can describe sounds in a detailed way as the following examples will make it clear. You can similarly describe any of the sounds in the language using the tables given above.

The sound /p/ is a bilabial voiceless unaspirated plosive.
The sound /g / is a velar voiced unaspirated plosive.
The sound /gh/ is a velar voiced aspirated plosive.
The sound /t/ is a dental voiceless unaspirated plosive.
The sound /s/ is an alveolar voiceless fricative.

A speech clinician, by comparing the errors made by the child with respect to any of the categories shown in the table, will be able to understand the nature of errors that make the child's speech unintelligible. This facilitates the correction or teaching process.

TABLE 3: CONSONANTS IN HINDI LANGUAGE

	Bilabial	Labio-dental	Dental	Alveolar	Retroflex	Palatal	Velar	Glottal
Plosive	p, b p^h, b^h		t, d t^h, d^h		ʈ ɖ $ʈ^h$ $ɖ^h$		k, g k^h, g^h	
Nasal	m		n		ɳ		n	
Fricative		f v		s z	ʃ			h
Affricate						tʃ dʒ $tʃ^h$ $dʒ^h$		
Flap					ϒ $ϒ^h$ ɾ			
Lateral				ℓ	ɤ			
Semi-vowel	w					j		

TABLE 4: CONSONANTS IN ENGLISH LANGUAGE

	Bilabial	Labio - dental	Dental	Alveolar	Palato-alveolar	Palatal	Velar	Glottal
Plosive	p, b		t , d				k , g	
Nasal	m		n				n	
Fricative		f, v	θ, ð	s, z	ʃ, ʒ			h
Affricate						tʃ, dʒ		
Flap								
Lateral				ℓ, ɤ				
Semi-Vowel	w					j		

3.6 DESCRIPTION OF VOWELS:

Vowels are produced in a relatively open vocal tract, that is, without any closure, or narrowing that will produce audible friction. All vowels require laryngeal tone (voicing), and they provide the carrying power of voice. The quality of a vowel depends on the shapes of the cavities of the pharynx, the mouth and nose, which in turn depend on the positions of the soft palate, the tongue and the lips.

The contours (shape) of our tongues vary with each vowel, for there are

- ✓ Front vowels.
- ✓ Middle Vowels
- ✓ Back vowels.

Each vowel family has several members distinguished by

- ✓ The height of the tongue bulge
- ✓ The amount of the mouth opening.
- ✓ The amount of lip rounding.

To produce vowel sounds, some part of the main body of the tongue is generally raised, so that the upper surface of the tongue is convex. To describe the tongue position for a vowel, therefore, it is enough to indicate the position of the highest point of the tongue along the horizontal axis and the vertical axis. We have to say which part of the tongue is raised and how high it is raised. For the vowel / i:/ as in the Hindi word ( ) /gi:t̪/, for example, the front of the tongue is raised, but for [ɑ] as in the word /ɑ:m/, there is only a slight raising of the back of the tongue.

For purposes of description, we refer to three points on the horizontal axis to indicate the position of the highest point of the tongue – **front, central and back.** / i:/ as in ( ) /ʃi:t̪/ is an example of a front vowel, [ə] as in ( ) /pər/ is an example of a central vowel, and [ɑ] as in ( ) /ɑ:p/ is an example of a back vowel. Along the vertical axis we use a four-point scale- **close, half-close, half-open** and **open.** For a close vowel the tongue is brought close to the roof of the mouth, but the passage for the air-stream is not so narrow as to cause audible friction. [i:] as in ( ) /ʃi:t̪/ is an example of a close vowel, while [ɑ] as in ( ) /ɑ:p/ is an example of an open vowel.

The lips can assume various positions for vowel sounds. They can be **spread,** that is, the corners are drawn back, or they can be **rounded,** that is pushed forward. [i:] as in ( ) /ʃi:t/ is produced with spread lips, while [u:] as in ( ) /ru:p/ is produced with rounded lips. The term **unrounded** can also be used instead of **spread.**

A three term label is used to describe vowels and indicate the tongue and lip positions. For example [I:] as in 'sheet' / ʃI:t/] can be described as 'front close unrounded' and [u:] as in 'shoot' /ʃu:t/ as ' back close rounded'.

Vowels can have different **durations.** The sign [**:**] is used to indicate a comparatively long vowel. For example the vowel /i/ in /t̪i:n/ ( ) is long and therefore we use the marker **:** after the vowel.

Some of the vowels are produced with the column of air directed through the nasal passage, particularly when the vowel is preceded by a nasal consonant. For example, in the word /nɑ:m/

( ), the vowel /ɑ/ is nasalized because of the preceding nasal consonant. To indicate this, the marker /~ / is used to indicate the nasalization.

TABLE 5: VOWELS IN HINDI LANGUAGE

	Front	Central	Back
Close	I		U u:
Half-close	ɪ:		ʊ:
Half-open	e:	ə	
Open	æ	ɑ	ɔ ɔ:

TABLE 6: VOWELS IN ENGLISH LANGUAGE

	Front	Central	Back
Close	I	3	u: U
Half-close	I:	ə	ɔ:
Half-open	∈	Λ	
Open	æ	ɑ:	

DIPHTHONGS:

Vowels may vary in length because they are continuous sounds. When there is a change in quality during their production, that is, when the articulators move from one vowel to another in a close sequence and perceptually gives the impression of a different vowel, such vowel combinations are known as 'Diphthongs'.

Following are some examples of diphthongs in Hindi language:

əI ---- bʰəIjɑ ( )

əU --- kəUɑ ( )

Following are some examples of dipthongs in the English language:

/**ɑi** / as in the English word [ℓ**ɑi**t] -light

/**ɑu**/ as in the English word [k**ɑu**tʃ]-couch

In any language, a number of diphthongs are possible while uttering certain words. Only two examples are given in this unit for an understanding of the concept of diphthongs.

Intext Activity:.

Using the above tables, complete the following table, giving the examples of Hindi words for the vowels in Hindi Language. The Phonetic Transcription for the words are given :-

Vowel	Description of the vowel	Devanagiri script	IPA
i:	Front close unrounded vowel		i:d̲
I			pʃɑpt̲I
e:			e:k
æ			kæ:sɑ
ɑ			ɑ:dz
ɔ			ɔʃ

o:			do:
ə			əpna
U			vəstU
u:			a:ℓu

1.6 THE INTERNATIONAL PHONETIC ALPHABET

As a special teacher you need to listen to the speech of a hearing impaired child and **analyze** the errors, if his speech is not intelligible enough. To be able to do this, you will have to systematically write down which sounds the child substitutes for which sound and which sounds he is not able to produce at all (omissions). You can do this easily using the **Devanagiri** script because Hindi is a phonetic language, that is we write exactly as we speak. But how can an individual who does not know this language but wants to study and analyze the errors in Hindi Language do this? He can do this by using a kind of notation which is **universal.** This universal alphabet is known as **International Phonetic Alphabet (IPA)**. You are well aware that the spelling system in English is inconsistent. Different letters may represent a single sound, for example 'to', and 'two', 'through' and 'threw'. A single letter may represent different sounds, for example 'cell' and 'call'. A combination of letters may represent a single sound, for example 'shoot', 'character', 'physics'. All these discrepancies between spelling and sounds gave rise to the concept of **IPA,** that is having universal alphabet. The recording (writing) of the speech production of any individual in any language using the IPA is known as **Phonetic Transcription.** Therefore the need for the IPA is three-fold:-

1. To enable an individual to record the speech of an individual in any language, even when one is not familiar with that particular language.
2. To analyze the errors in speech production. For example, errors in the speech of a hearing impaired child can be analyzed irrespective of the language.
3. To enable an individual to learn the correct speech production of a new / foreign language, he or she is learning.

Therefore as a special teacher you will find the IPA useful, sometime or the other due to the reasons explained above.

1.8 SUMMARY - POINTS TO REMEMBER:

- The study of speech sounds in general is **Phonetics** while the function of speech sounds within a language is termed '**Phonology**'.
- In a language, each sound which is capable of bringing about a meaning difference when it substitutes another sound in a word is known as a **'phoneme'.**
- The Major aspects of speech Production are:-

The Air Stream Mechanism - where the air used in speech starts from and which direction it is travelling.
The state of the vocal cords – whether or not the vocal cords are vibrating, which determines voicing.
The state of the velum– whether it is raised or lowered, which determines whether a sound is oral or nasal

- Speech sounds can be grouped into two major categories **Consonants and Vowels.**
- **Consonants** can be described using a **three-**fold classification system, namely - the **place of articulation, the manner of articulation** and **voicing.**
- **Vowels** can be described using **three** parameters namely - **the height of the tongue, the place of the tongue** in the oral cavity along the horizontal axis and the **rounding or unrounding of the lips.**
- Every sound in any language can be written/recorded using a universal set of alphabets known as **International Phonetic Alphabet**.

1.9 CHECK YOUR PROGRESS - EXERCISES:

Studying a new subject often involves learning a large number of technical terms. Phonetics is particularly difficult in this respect. Read over the definitions of the terms in this unit, and then try the exercises below. Listen to the sounds of words, and be careful not to be confused by spellings. Using a mirror may be helpful.

1. **Circle the words that begin with a bilabial consonant:**

   Hindi :-

   English :- call, mug, boat, table, purse.

2. **Circle the words begin with a velar consonant.**

   Hindi :-

   English :- kill, might, call, top, goat.

3. **Circle the words that begin with a labiodental consonant.**

   Hindi:-

   English:- wheat, father, big, van, soap.

4. **Circle the words that begin with an alveolar consonant.**

   Hindi:-

   English :- Sunday, matter, zèbra, letter, same.

5. **Circle the words that begin with a dental consonant.**

   Hindi :-

   English :- tub, road, dog, teacher, give.

6. **Circle the words that end with a palato-alveolar consonant.**

   Hindi :-

   English :- brush, measure, rice, lash, pleasure.

7. **Write five words using IPA, beginning with:-**

- Fricative.

- Affricate.

- Plosive.

- Nasal.

- Lateral.

8. Write five words each, in any language, using each of the following vowels, using IPA:-

- 1.Front close unrounded vowel
- 2.Back half open rounded vowel
- Front open unrounded vowel
- Central half open unrounded vowel
- Back close rounded vowel

9. Describe the consonant sounds that have been highlighted after transcribing them :-

Hindi :- ______________________________

English :- **Sh**ip , **j**oker , ro**bb**er , fa**th**er , su**nn**y

3.10 POINTS FOR DISCUSSION / CLARIFICATION:

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____

____

____

1.11 REFERENCES / FURTHER READING:

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2. Chaturvedi, M.G. (1973); A contrastive study of Hindi English Phonology. National Publishing House ,23, Darya Ganj.

3. VanRiper,C & Emerick L. (1990); Speech correction ,5th ed. Prentice –Hall ,Inc.

4. Ladefoged, P. 2nd Edition. A Course in Phonetics.

APPENDIX

DIFFERENT PLACES OF ARTICULATION

a. Refers to alveolar place of articulation.

b. Refers to labio-dental place of articulation.

c. Refers to dental place of articulation.

d. Refers to bilabial place of articulation.

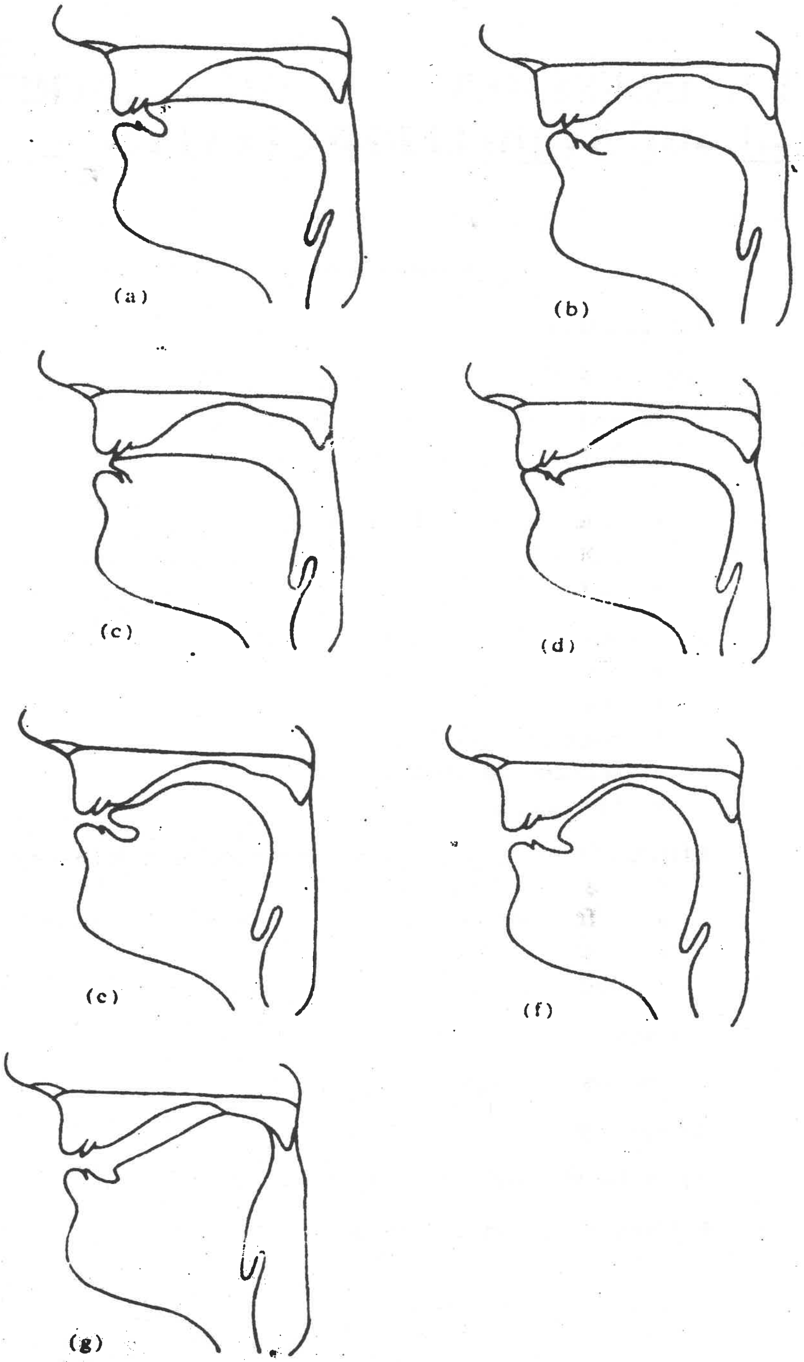
e. Refers to palatal place of articulation.

f. Refers to place of articulation.

g. Refers to velar place of articulation.

REFER NEXT PAGE FOR FIGURE

Figure of place of articulat



UNIT 2: ASSESSMENT OF WRITTEN LANGUAGE AT DIFFERENT LEVELS

STRUCTURE

- **Introduction**
- **Objectives**
- **Prerequisites for normal speech development**
  - Normal neuromotor maturation
  - Normal auditory system
  - Adequate physical and emotional health
  - Normal intelligence and cognitive development
  - Stimulating environment full of love and care
- **Stages in normal speech development**
  - Reflexive utterances
  - Babbling
  - Socialized babbling
  - Inflected vocal play
  - First words
- **Effects of hearing impairment on normal speech development**
  - Pre-lingual hearing loss
  - Effects of different degrees of hearing loss on speech
  - Post-lingual hearing loss
  - Speech Insurance
- **Summary - Points to remember**
- **Check your progress**
- **Assignment**
- **Points for discussion / clarification**
- **References / Further reading**

2.1 INTRODUCTION

By now you have realized the importance of verbal communication **i.e. spoken language because of its efficiency in transferring one's message. Most children develop this skill of speaking in a meaningful way** effortlessly **in the first few years of life. Little does one realize how** complicated **this whole process is. You have already read about the** various systems **in our body, which work in co-ordination to produce speech. We will now discuss the development of speech in a** normal hearing **child. Though speech and language cannot be separated from one another, in this unit we will be restricting our discussion to development of verbal language (speech) only. Once you know how normal development takes place, you will be able to appreciate the** problems **faced by hearing impaired child in a better manner.**

2.2 OBJECTIVES

At the end of this unit you will be able to

- Discuss the **prerequisites** for normal speech development
- Describe the various **stages** in normal speech development
- Discuss the effects of **pre-lingual** hearing impairment on speech development
- Describe how **different degrees** of hearing impairment can affect speech development
- Describe effects of **post-lingual** hearing impairment on speech

2.3 PREREQUISITES FOR NORMAL SPEECH DEVELOPMENT

Before going through the stages in speech and language development, we will highlight the **pre-requisites** for speech and language development. They are:

1. Normal **neuro-motor** maturation
2. Normal **auditory** system
3. Adequate **physical** and **emotional** health
4. Normal **intelligence** and cognitive development
5. Stimulating **environment** full of love and care

2.3.1. Normal Neuro-Motor Maturation

You are already aware of the role played by the **nervous system** in controlling ongoing speech production. (Refer to Unit 2.5.7). Hence maturation of central nervous system is a pre-requisite for learning of any **rapid and fine motor skill** during the developmental years. Let us take the **example** of the motor skill such as **walking**. A **newborn** baby is not able to perform this finely coordinated motor act. But as the child grows and his nervous system undergoes maturation, he is able to balance himself and perform the act of walking, further followed by running, jumping etc.

Maturation of the nervous system is important not only in learning of such motor skills but also in learning to **understand and produce speech**. e.g. A child who is 3 months old is not able to locate the direction of the sound source. However the same child by the age of **6 months** is able to **localize** the sound source. This is possible because of **maturation** of auditory processes of central nervous system. In other words, child's response to sound and speech develops as a function of central nervous system (CNS) maturation. Similarly during the period of **3-6 months** the infant produces **pleasurable** (cooing) and **distress** (crying) sounds **involuntarily**. Later as CNS matures he goes through series of speech development stages and reaches a stage of producing first meaningful word **voluntarily**.

2.3.2. Normal Auditory System

Speech is acquired and monitored **primarily** through hearing. Hence children who have hearing loss prior to acquisition of speech and language are most likely to show **delay/absence** in the development of speech. The effects of hearing loss on development and conservation of speech are discussed in detail later on in this unit.

2.3.3. Adequate Physical and Emotional Health

A child who **frequently** falls ill and requires frequent hospitalizations, will have restricted activities. His parents might lose lot of time catering to his health needs. In this process child is likely to be **deprived** of an enriched language environment and communicative interaction. Similarly emotional health of the child and support from the family members are also an extremely important factor. **Negative family environment** such as frequent quarrels, divorce, disturbed family relationship is likely to have an adverse effect on a sensitive child, thereby disturbing the child's emotional health. Poor physical health and lack of emotional support from the family members will **restrict his/her communicative interactions,** thereby **affecting the development of speech and language.**

2.3.4. Normal Intelligence And Cognitive Development

To acquire oral language, a child must have the **mental capacity** (normal intelligence) for using **symbols.** To use symbols appropriately, he must be able to **attend, recognize, associate, generalize and store** items in memory. As the child's ability to reason expands, his language skills improve. Mental development is the necessary **base** to handle symbols.

Language development is closely linked **with cognitive development. In other words the child should have the facility to** grasp concepts, **and this facility of grasping concepts should develop at an appropriate age. You will learn more about normal cognitive development in Psychology. Let us look at an** example **of how cognition and language develop hand in hand. Around the age of 9-12** months, **a child acquires the concept of** object permanence. **This means that he becomes aware that an object exists even when he cannot see it. Only after a child develops this concept does he learn to use** words to label **objects and events.**

2.3.5. Stimulating Environment Full Of Love And Care

Three environmental factors are essential in speech development.

- A relationship of **love and care** between the child and the person from the environment. This person should consistently be **encouraging** the child's attempts to speak.
- At least one person from the environment should be speaking in **simple but well formed language patterns.**
- A child should have enough **opportunities to explore** and have a number of day-to-day **experiences,** which encourage him to communicate.

It is generally observed that children brought up in **orphanage** have delayed development of speech and language in spite of prerequisite 1,2,3,4, being present. This is because nurturing and stimulating environment is not adequate.

2.4 STAGES IN NORMAL SPEECH DEVELOPMENT

As child **matures,** he/she gains **control** over speech mechanism. Before the child starts speaking meaningfully he goes through a stage known as **prelanguage.** During this stage he builds the **foundation** for the true speech which is still to come. In the very early **reflexive** sounds of crying and comfort cooing, we certainly find him **practicing** respiration and phonation. In his babbling we see him **exploring** articulation, and gradually child comes to **meaningful** first word stage. Let us now look at that a child undergoes from birth through the early years of life.

2.4.1 Reflexive Utterances

Much of the behavior of the **newborn** is **reflexive** (involuntary) and beyond his/her immediate volitional control. In the first 3 months the child has a very **limited repertoire** of vocal behavior. The most common sounds made by the newborn are **cries and comfort sounds.** These sounds generally reflect the child's **physiological** state.

a} **Crying sounds**: By the end of the **first month** cries become **differentiated** and mothers can usually tell the **type of cry** by its pattern. Non-crying sounds of the newborn include normal **phonation**, which are predominantly **nasalized.** When baby is **2 months old**, parents can identify several **distinct types** of crying patterns, e.g. anger, pleasure, pain, and hunger. During crying child **practices** the essential motor co-ordinations, besides establishing the necessary **feedback loop** between the larynx, the mouth and the ear. In addition, crying, particularly when differentiated, establishes a primitive **communication link** between child and parents.

b) **Comfort sounds**: Reflexive utterances like **gurgles, sighs and grunts** are called cooing or **comfort** sounds. They generally appear during or after relief from distress. E.g. feeding, diaper changing. By now the infant has developed **muscle control** to stop and start oral movement definitively. **Back consonants** and **mid and back vowels** predominate but they are not nasalized. At this stage the child will show the signs of **social awareness** i.e. tracking or following an adult movements with his eyes and smiling. He responds **selectively** to the speech of an adult. He co-ordinates his bodily movements with **melody** of speech, also **discriminates** speech from non-speech sounds. Evidently babies are born with a special capacity for recognizing and processing speech.

2.4.2 Babbling (4-6 Months)

Babbling is a **universal** phenomenon found in all human infants. It is characterized by the **chaining and linking of sounds together on one exhalation.** The child begins to **experiment** with sounds and to gain increasingly independent **control** of the parts of vocal mechanism. The baby seems to be **playing** with his tongue, lips and larynx in much the same fashion he plays with his fingers and toes. We hear

syllables of **CV** (consonant vowel) combination as in **/ba/** or **VC** (vowel consonant) combination as in /ab/ or **CVC** (consonant vowel consonant) combination as in /aba/. **Neuromuscular control** moves from the back of the oral cavity to the front. These strings of syllables have **no semantic meaning** and some of the sounds may not be present in his native language. This activity is also known as "**vocal play**" and is carried out when the child is alone. It is very important for a child to feel and hear sounds repeatedly. **Babbling is self-imitation of purest variety.** If babbling is interrupted or delayed due to illness, true speech will also be delayed. A **hearing-impaired child** begins to babble at normal time, but since they cannot hear the sounds they produce; they lose interest and hence have much less true vocal play than the hearing child. However it is possible to compensate. The adult or caregiver can be particular about giving the **visual feedback** of their imitation of child's utterances. This has a rewarding value for the child.

2.4.3 Socialized Babbling

By six months of age babbling appears to have an **instrumental function**. Child uses it to get **attention**, to support **rejection** and to express **demand.** He starts using his primitive speech both to express himself and to modify the behavior of others. This stage is characterized by syllable repetition or **doubling of sound** in his vocal play e.g. /d̲ad̲a/. Now child seems to take more pleasure in public practice. He is talking to himself but also sometimes to parents/caregiver. This is "**socialized vocalization**".

Inflected Vocal Play

In this stage vocal play takes on the **tonal characteristics** of adult speech. Baby uses **inflections** that sound like questions, commands etc. **Private** vocal play and **social** vocal play continues. Marked gain in **back vowels** and **front consonants** are seen. He begins to sound as though he is talking. Child, through his vocal gymnastics, masters **co-ordination** necessary to meaningful speech. He **responds** to parent's speech. His **imitation** is more hesitant but more purposive. It begins to resemble parent's utterances. During this period, simple musical tones, songs are especially good **stimulation**. Social **reinforcers** like parental smile or gesture or touch or spoken word will increase the frequency of his vocal play.

2.4.5 The First Words

Words are **comprehended** before they are used. Before first words are uttered, the child has shown by his behavior that he understands the gestures, intonations and meanings of some of the parent's speech. Babies' first meaningful utterances are

single words; these words are often **duplicative,** (e.g. /baba/ for daddy, /mma/ for mummy) perhaps showing the influence of his previous babbling. The **labial and dental sounds** are the most prominent in the first words.
The first sounds are the **sentence words**. E.g. Same words can be spoken at one time with the intonation and stress of a declarative statement and at another time as a command or even as a question. Often an appropriate gesture will accompany the utterance. Even though only one morpheme is used, the **tone of voice** and gesture show the other parts of the implicit sentence. Thus the child has made a beginning in his efforts to **communicate** in verbal world.

The stages in the development of speech are shown in Table 1.

In-text Activity:

Observe children of different age groups (below 12 months) in your family/locality. **Tabulate** your observations as regards the production of the above mentioned sounds/phonations with respect to the various ages.

Age of the	Observations of the child's utterances
2-3 months	
3-6 months	
6-9 months	
9-12 months	

TABLE 1: NORMAL SPEECH DEVELOPMENT

Age	Stage	Speech	Other Development
0-1 mth	Newborn	Reflexive behavior	Can't raise head when on stomach
		Non-differentiated crying Vegetative sounds	Sensitive to volume, pitch, and duration of sound
2-3 mths	Cooing	Definite stop and start to oral movement	Holds head up briefly while on stomach or sitting supported
		Back consonants and	Visually searches
		back and middle vowels	Social smile
4-6 mths	Babbling	Greater independent	Turns head to localize sound
		control of tongue	Mouths objects
		Prolonged strings of sounds More lip or labial sounds Experiments with sounds	Selective attention to faces
6-10 mths	Reduplication babbling	Repetitive syllable production Increased lip control	Progress from creeping through crawling to standing
		Labial and alveolar plosives (/p, b, t, d/), nasals, /j/, but not fully formed	Explores objects through manipulation Imitates others physically
11-14 mths	First words	Elevates tongue tip	Stands alone

	Intonational patterns	First steps
	Predominance of /m, w, b, p/	
	First words primarily CV, VC, CVCV reduplicated, and CVCV	
2 yrs	Has acquired /p, h, w, m, n, b, k, g/	Walks without support
	Short incomplete sentences	
	200-300 word vocabulary	
3 yrs	Has acquired /d, f, j, ʈ, n, s/, all vowels	Rides tricycle
	Subject and verb sentences	Make believe play (Imaginative)
	900-1000 word vocabulary	Shares toys briefly
4 yrs	Has acquired /v, f, tf, z/	Walks stairs with alternating steps
	Tells stories	Role plays
	Asks many questions	Cooperative play
	1500-1600 word vocabulary increasing	
5 yrs	Has acquired /ℓ,ʈ,dʒ,ɖ,ɣ/	Simple game playing
	2100-2200 word vocabulary	
	Syntactic acquisition about 90% complete	
6-8 yrs	Has acquired /z/, blends	Rides bicycle

	2600 word expressive vocabulary	Enjoys action games
		Competitiveness
		Enjoys an audience

2.5 EFFECT OF HEARING IMPAIRMENT ON NORMAL SPEECH DEVELOPMENT

The effect that hearing-impairment has on speech and its development can vary according to the onset of the hearing impairment. **Here, we are going to look at the effect of pre-lingual and post-lingual hearing-impairment on speech.**

2.5.1 Prelingual Hearing Loss

The ear is a **natural channel** through which we learn to speak. A serious impairment in hearing before acquisition of speech and language is known as **prelingual hearing loss**. Such a loss **hinders child's normal development of speech and language**. E.g. a child who is born deaf, never learns to talk unless special training is undertaken early in life. His deafness denies him a chance through which he would acquire both knowledge of speech and **control** of speech organs normally. Consequently the mechanical difficulty in speech production encountered by the prelingually hearing-impaired child is compounded by the deficiency of his knowledge of the phonologic, semantic and structural features of language. He must know the right word, place it in the right order, and avoid syntactic error. Therefore the task of the prelingual hearing-impaired child is essentially one of **development of spoken language** rather than its conservation. Any substantial loss of hearing at birth or occurring soon thereafter will hinder both language development and establishment of adequate speech habits.

In-text activity:

Switch on your T.V. and select a channel, which telecasts programs in a **language you are not at all familiar with**. View it for 5 minutes and try to understand content of a play / movie / news that was probably going on when you switched on.

Did you understand even a word? Your obvious answer is 'NO'. Why? Obviously you will say you have never had an exposure to that language and therefore had **no opportunity** to learn it and hence you could not understand.

Similarly a **young hearing-impaired child** cannot learn to understand a language he / she has never heard / or is probably never going to hear.

The two factors responsible for this are:

- Hearing loss reduces sharply the **number of listening experiences** that the child has and thus slows down the process of learning to talk.
- Losses of certain types make it impossible for the child to **distinguish some of the elements** of speech. Hence he will not be able to pronounce sounds he does not hear, unless he has special training. For example, a child with high frequency loss may misarticulate high frequency sounds such as /s/ or /f/, particularly because he is not able to hear them.

The effects of auditory impairment on speech can be discussed with respect to the three main aspects of speech.

A) Phonetic elements or segmentals:

Phonemes are the **shortest units** in human speech that can be recognized as having stable identity. Speech problems characterized by imperfect production of phonetic elements and the transitions between them are called **"articulatory defects".** Here the hearing loss prohibits the **initial mastery** of phonemes and/or removes the auditory control needed to **maintain** precise pronunciation. In such instances, an effective program of speech training should be implemented early in life.

B) Non-phonetic elements or suprasegmentals:

Human speech possesses four aspects that are relatively unstandardized but which nevertheless contribute to naturalness and acceptability of oral communication. These features are melody, quality, time and stress. **If properly blended during connected speech, non-phonetic elements help in** clarifying the meaning **and** adding interest **to spoken language.** Severe auditory impairment **makes it impossible for a person to hear these non-phonetic elements in his own speech, thus may cause** unnatural **use of these elements. This disturbs the** effectiveness **of his oral communication. The characteristic speech errors made by person/child with hearing loss will be discussed in detail in** next unit.

C) Loudness of voice:

The speaker ordinarily **adjusts the loudness of his voice to the situation** in which he is talking. The speaker has consciously learned to raise his voice when background noise is strong or when the listener is at a little distance. Generally we unconsciously soften our voice in quite surroundings. In short we tend to maintain a favorable margin between the loudness of our speech and the background noise so that our listeners will not find our speech unpleasantly loud.
A hearing loss disturbs the ability to adjust the levels of one's voice to the situation. This happens due to the fact that person with hearing loss does not hear much of the background noise and does not judge the requirements of situation. **Secondly he may receive false impression of the loudness of his own voice.** e.g. person with **sensorineural** loss hears his own voice softly hence has a tendency to talk loudly, regardless of surroundings, whereas a person with **conductive** loss hears his own voice loudly through bone conduction hence he speaks softly.

The speech produced by hearing impaired children is directly related to the severity of the hearing loss and the degree to which an auditory- verbal feedback loop can be established.
As the effects of hearing loss depend primarily on **its degree, configuration and age of onset**, it does not cause one specific kind of communication problem.

2.5.2 Effects of Different Degrees of Hearing Loss on Speech

1) Effects of mild hearing loss: (26-40 dBHL)

- Language learning may not be affected.
- Vowel sounds are heard clearly but voiceless consonants may be missed.
- The short unstressed words and less intense speech sounds are inaudible.
- They may exhibit mild misarticulations.
- Voice quality is normal.

2) Effects of moderate hearing loss: (41-70 dBHL)

- Miss all sounds at conversational level.
- Show inattention, language retardation, speech and learning problems.
- Vowels are heard better than consonants.
- Articulation errors include omitted and distorted consonants.
- Strangers may have difficulty in understanding speech of a child with this loss.
- Hearing aid, speech reading, auditory training, speech training are necessary.

3) Effects of severe hearing loss: (71-90 dBHL)

- Language and speech will not develop spontaneously.
- They cannot hear sounds or normal conversation without amplification.
- They may hear their own vocalizations, loud environmental sounds or speech sounds spoken loudly at close range.
- With amplification, they can differentiate vowel sounds and difference in manner of consonant articulation.
- Generally they have severe language, speech, learning problems.
- They can be integrated into regular school with supportive help given by the special school.

4) Effects of profound hearing loss: (91 dBHL and above)

- They hear speech only with intensive special education.
- Without amplification, they are unable to hear any sounds.
- With amplification they may hear the rhythm patterns of speech, loud environmental sounds.
- Generally they have severe language, speech, learning problems.

2.5.3 Post-Lingual Hearing Loss

As the ear serves as a guide to **accurate control** of speech mechanism, degeneration of speech is often seen in individuals who suffer from hearing loss **later in life**. The hearing loss that occurs after acquisition of speech and language is known as **post-lingual hearing loss**. Because of this, the sharpness and precision of **articulation** disintegrates and **intonation, emphasis, phrasing, rate and loudness of voice** suffer. To get an insight into this, **experience** the following: ask one of your family members to listen to a walkman through headphones at a normal volume. Now ask him a question. You will observe that he responds with normal loudness of voice. Now ask him to increase the volume of his walkman considerably and ask him a question. You will notice that he responds with a very loud voice.

As auditory feedback controls our speech production, **deterioration** of speech occurs after severe hearing impairment. But this deterioration is neither **instantaneous nor complete**. When **sudden bilateral hearing loss** occurs either due to meningitis or mumps, speech is usually maintained intact for a short time and then begins to deteriorate rapidly. With **gradual hearing loss** as in presbycusis or otosclerosis, speech deteriorates slowly as hearing loss progresses.

Following **defects** are generally noted in the speech of post lingual hearing impaired person:

- Defects of **articulation** usually appear first and are characterized by **distortion or omission** errors of high frequency sounds such as /s/, /f/. Final consonants are affected first.
- Voice **quality** is affected.
- Control of **loudness** is lost.
- Irregularities of **rhythm** are noted.

2.5.4 Speech Insurance

Special type of training based on the concept of **"Speech Insurance"** is necessary for **conservation** of speech in individuals with post-lingual hearing-impairment. Here the patient is hearing-impaired but has normal habits of speech. Hence **main educational task** is to teach him to retain these habits in order to conserve the skill he already has. If training starts early, no deterioration in speech may occur. The technique is to give the person **substitute channels** for controlling his speech efforts, since his ear no longer serves as a fully effective monitor when he talks.

When the hearing loss is profound or severe speech insurance must depend mainly on learning effective use of **kinesthetic cues**. Here the patient should first become acquainted with the nature of speech process. He must understand the activity that he wishes to control.

1) He must learn to **preserve the articulation** of speech by becoming fully aware of the kinesthetic cues of each element.

2) He must develop awareness of bodily **sensations associated with proper control of melody, quality, rhythm and emphasis.**

3) He must maintain physical **alertness**, facial expressiveness, and spontaneous gestures.

It is very important for a person to learn to maintain **effective control of the loudness** of his voice. We have already seen earlier in this unit, how and why hearing loss affects the person's ability to adjust the loudness of his voice to the situation in which he is talking. Now let us see how he can learn to control the loudness of his voice.

1) The person must master the ability to talk at each of four or five general **levels of loudness**. He must then learn to shift at will from one level to another. These levels which are under kinesthetic control must range from **soft speech to very loud speech**.

2) The person must **study and classify typical sound environments**. He should learn what level of background noise he is most likely to encounter in each type of situation. He can then meet the requirement of loudness with reasonable success by speaking at the level that is ordinarily demanded by the situation at hand.

2.6 UNIT SUMMARY : POINTS TO REMEMBER

- **Prerequisites** for normal speech and language development include

1. Normal neuro-motor maturation
2. Normal auditory system
3. Adequate physical and emotional health
4. Normal intelligence and cognitive development
5. Stimulating environment full of love and care

- Before the child starts speaking meaningfully, he goes through a stage known as **prelanguage.** During the period of prelanguage child builds the foundation for true speech.

- The main **stages** in speech development include:

1. Reflexive utterances
2. Babbling
3. Socialized babbling
4. Inflected vocal play
5. The first word

- The **effects of hearing loss** depend primarily on it's **degree, configuration, and age of onset.**
- A hearing loss that occurs before acquisition of speech and language i.e. at birth or soon thereafter is known as **pre-lingual hearing loss.**
- Hearing loss that occurs after acquisition of speech and language is known as **post-lingual hearing loss.**

- Hearing loss affects main aspects of speech: **segmentals and suprasegmentals.**
- A young hearing impaired child **cannot learn to understand** a language he / she has never heard / or is probably never going to hear because of

  1. a sharp reduction in the number of listening experiences and
  2. a difficulty in distinguishing some of the elements of speech.

  - A special type of training known as **"Speech Insurance"** is necessary for individuals with post-lingual hearing loss.

2.7 CHECK YOUR PROGRESS

Fill in the blanks:

1. ____________ is the primary channel through which we learn to talk.
2. ________ ________ denies him a chance to acquire normally both knowledge of speech and control of speech.
3. The ear serves as a guide to accurate control of __________ __________.
4. Generally a speaker consciously learns to raise his own voice when the background noise is ___________ or when the listener is at a ___________ .
5. A person with sensorineural hearing loss speaks ___________ whereas a person with conductive loss speaks __________.
6. Effects of hearing loss depend primarily on ____________, ____________, and ________ of hearing loss.
7. Poor physical health and lack of emotional support __________ his /her communication interaction.
8. Language development is closely linked with __________ development.
9. Much of the behavior of the newborn is ____________.
10. ___________ sounds generally appear during or after relief from distress.

Answer the following questions:

1) Give the two main reasons that hinder both language development and establishment of adequate speech habits.
2) List the three main aspects of speech.
3) Define pre-lingual and post-lingual hearing loss.
4) What are "articulatory defects"?
5) List the aspects of speech that attribute to naturalness of oral communication.

6) Why is a person with hearing loss not able to adjust the level of his own voice with the situation?
7) List the effects of mild hearing loss, moderate hearing loss and severe hearing loss.
8) List the factors affecting speech and language development.
9) Explain the three environmental factors essential for development of speech.
10) What is prelanguage?
11) Discuss normal development of speech in the first year of a child's life.
12) What is object permanence?
13) What is babbling?
14) Why do hearing- impaired children stop babbling? What can be done to rectify it?
15) Discuss the effects of profound pre-lingual hearing loss on speech.

2,8 ASSIGNMENT

a) Discuss the various stages in normal speech development.
b) Discuss the effects of prelingual hearing impairment on speech development.

1.9 POINTS FOR DISCUSSION / CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

1.9.1 Points for Discussion

1.9.2 Points for Clarification

2.10 REFERENCES / FURTHER READING:

1 Shames, G. H. and Wiig, E. H. (1986). " Human Communication Disorders." 2nd edition. Charles. E. Merill. Publishing Company.

2 Davis, H and Silverman, S. R. (1978). " Hearing And Deafness." 4th edition. Holt, Rinehart and Winston.

3 Van Riper, C. and Emerick, L. (1984). " Speech Correction." 7th edition. Prentice Hall Inc.

4 Davis, J. M. and Hardick, E. J. (1981). " Rehabilitative Audiology for children and adults." John Wiley and Sons, Inc.

UNIT 3:COMPONENTS AND TYPES OF WRITING

- ***STRUCTURE***

- ***Introduction***
- ***Objectives***
- ***Classification of speech errors***
- ***Deviations in respiration***
- ***Errors in phonation***
- ***Errors in articulation***
  - *Vowel articulation*
  - *Consonant articulation*
  - *Diphthong articulation*
  - *Analysis of articulation errors*
- ***Errors in supra-segmentals***
- ***Speech intelligibility***
- ***Speech characteristics associated with mild to moderate hearing loss***
- ***Assessment / Evaluation of speech of the hearing-impaired***
  - *Oral peripheral examination*
  - *Assessment of phonetic level skills*
  - *Assessment of phonological level skills*

- ***Summary - Points to remember***
- ***Check your progress***
- ***Points for discussion/clarification***
- ***References/Further reading***
- ***Annexure***

3.1 INTRODUCTION

*The **role of hearing** in **acquiring** normal speech and in **monitoring** speech production is well established. By now you have studied in detail the **effect of** prelingual and postlingual hearing impairment **on speech**, its development and its monitoring. The development of speech in children with severe to profound prelingual hearing impairment is usually **delayed** if intervention does not start early. Also, the characteristics of the speech that they develop are **different** from that of normal hearing children in a number of ways. Different studies carried out to describe in detail the speech of the hearing-impaired report differences in the following aspects of speech:*

- ***Respiration and its control***
- ***Phonation and its control***
- ***Articulation***
- ***Suprasegmentals***

*In general, speech production of the hearing impaired consists of **poor co-ordination** between respiratory, phonatory and articulatory systems. Also, due to errors in the aforementioned aspects of speech, the **intelligibility** of the speech of the hearing impaired may be poor.*

*In this unit, we will discuss the various speech errors of the hearing impaired. To begin with, we will stress on speech errors predominantly associated with **severe to profound prelingual** hearing impairment.*

3.2 OBJECTIVES

At the end of this unit, you will be able to

- *List the parameters of speech that may be **affected** in the hearing impaired*
- *Describe the various **articulatory** errors in the speech of the hearing impaired*
- *Describe the **voice** problems in the speech of the hearing impaired*
- *Describe the errors in **suprasegmentals** in the speech of the hearing impaired*
- *Discuss the factors affecting **intelligibility** of speech of the hearing impaired*
- *Discuss how **breathing** for speech may be affected in the hearing impaired*
- ***Assess** the speech of the hearing impaired*
- ***Profile** the speech of the hearing impaired child in your classroom*

3.3 CLASSIFICATION OF SPEECH ERRORS

Errors in the speech of individuals with severe to profound sensorineural hearing impairment are mainly classified as

1. Deviations in respiration and its control:

Predominant features of respiration in the hearing impaired include

- *inappropriate breathing* ***patterns,***
- *inadequate breath* ***support,***
- *inadequate breath* ***control*** *and*
- ***forced expiration*** *while speaking.*

2. Problems in voice and control of its parameters:

Voice problems reported in the literature include

- *disorders of* ***pitch and pitch control,***
- *disorders of* ***loudness and loudness control*** *and*
- *disorders of voice* ***quality.***

3. Errors in articulation:

Articulatory errors in speech of the hearing impaired may be in

- ***vowel*** *production,*
- ***consonant*** *production and*
- *production of* ***diphthongs and semivowels.***

4. Errors in suprasegmentals:

Prosodic or suprasegmental errors in the speech of the hearing impaired include

- *irregularities in* ***rate*** *of speech,*
- *inappropriate* ***phrasing*** *patterns,*
- *inappropriate* ***intonation*** *patterns and*
  - *inappropriate* ***stress*** *patterns.*

We will now look at each of the category of errors in detail.

3.4 DEVIATIONS IN RESPIRATION

In Unit 2, we have looked at the ***importance*** *of breathing for speech. You are also aware of the* ***differences*** *between breathing for* ***life*** *and breathing for* ***speech****. It is also established that a* ***fine co-ordination*** *between the systems of respiration, phonation and articulation is extremely important for production of good speech.*

A number of authors/researchers have studied speech breathing in hearing-impaired children and adults. Findings from these studies indicate that

a) Children with severe to profound prelingual hearing impairment have a particular problem in learning to ***co-ordinate*** *control of their breathing in producing speech.*

b) They may attempt to ***speak on inspiration*** *as well as expiration.*

c) They tend to produce ***short bursts*** *of speech and then run out of breath because they do not take* ***sufficient*** *amount of breath before beginning to speak. This results in a lot of* ***pauses*** *while speaking, interfering with speech flow.*

d) Poor co-ordination of breathing and phonation leads to an ***increase*** *in their articulatory and suprasegmental errors.*

3.5 ERRORS IN PHONATION

Voice of the hearing-impaired has been studied with respect to ***all its aspects*** *viz. Pitch, loudness and quality. Let us look at errors in each of these.*

a) Pitch: *Deviations in the pitch of the hearing-impaired include*

- *Use of a* ***higher pitch*** */ fundamental frequency*
- ***Reduced range*** *of pitch (i.e. reduced ability to vary pitch from low to high)*
- ***Poor*** *ability to* ***control*** *pitch according to linguistic requirement or intent of communication*

b) Loudness: *Normal speakers regulate loudness of voice according to* ***distance*** *from listener and the* ***noise*** *present in the surrounding. Hearing-impaired speakers may be* ***unable*** *to realize these conditions. Problems reported in hearing-impaired speakers include*

- ***reduced*** *loudness,*
- ***excessive*** *loudness and*
- *reduced loudness* ***variations*** *across utterances*

c) ***Quality:*** *The voice quality of the hearing-impaired speakers has been described using* ***terms*** *such as hollow, dull, tense, piercing, flat, breathy, throaty, etc. Voice quality of the hearing-impaired may be characterized by*

- ***Breathiness:*** *Feeling of* ***excessive*** *amount of* ***air*** *during phonation. May be attributed to* ***inadequate closure*** *of vocal folds.*
- ***Harshness:*** *Feeling of excessively* ***"noisy"*** *speech. May be due to applying extra* ***effort/pressure*** *while phonating.*
- ***Nasality:*** *Hypernasality, resulting due to opening of the* ***velopharyngeal port*** *when not necessary for an utterance, is very commonly found in hearing-impaired speakers.*

3.6 ERRORS IN ARTICULATION

Hearing-impaired speakers can have ***variable*** *degrees of errors in their speech. This is especially true of* ***articulation****. However, despite the variability, certain difficulties / errors may be found very* ***commonly*** *in most hearing-impaired. Two* ***main features*** *common to the articulation skills of the hearing-impaired are:*

- *Errors in the production of* ***vowels, consonants*** *as well as* ***diphthongs***
- *Among these, consonant errors* ***more common*** *than vowel or diphthong errors*
- *Also, some* ***typical*** *and* ***systematic*** *error patterns are encountered in the articulation skills of the hearing-impaired.*

3.6.1 Vowel Articulation

Vowel production is ***important*** *in most spoken languages because vowels form the important parts (nuclei) of words.* ***Accuracy*** *of vowel production is important for good speech* ***intelligibility****. As already discussed in unit 3,* ***production*** *of vowels is dependent on mouth opening, lip rounding and place and height of the tongue within the oral cavity. Vowels are* ***particularly difficult*** *for the prelingually profoundly hearing-impaired. This is because the articulators rarely come into contact during vowel production, thus providing* ***little or no*** *tactile and kinesthetic* ***feedback****.*

Various studies have shown that hearing-impaired speakers tend to use a more ***centralized*** *tongue position during production of different vowels, i.e. the tongue is placed in the* ***middle*** *of the oral cavity irrespective of the vowel being produced.*

This results in the production of the ***neutral / central*** *vowel* ***/ə/*** *( ) for many other vowels. This means that* ***"neutralization"*** *or the tendency for all vowels to* *resemble the neutral vowel /ə/ is the most common error in vowel production. An example of neutralization error is producing /**pɑnə**/ for /**pɑni**/, where the vowel /i/ is substituted by the vowel /ə/. Neutralization error is also considered as an error of **substitution** where the vowel is substituted by the neutral vowel.*

The other errors found in vowel production of hearing-impaired include

a) ***Substitution:** Substitution error means **replacing** the target sound by some other sound. In the context of vowels, an **example** is /**pi**ℓɑ/ produced as /**pe**ℓɑ/. In this example, the vowel /i/ is substituted by the vowel /e/.*

b) ***Nasalization:** Nasalization of vowels means production of a **nasal** vowel in place of a **non-nasal** one. This happens when the **velum is lowered** to allow sufficient air stream to pass through the nasal cavity. For **example**, in the word /**hɑt̠hi**/ the vowels /ɑ/ and /i/ are both non-nasal vowels. However, a hearing-impaired person may produce both these vowels as nasal. This is an error of **nasalization**.*

c) ***Diphthongization:** Diphthongization error means production of a **diphthong** instead of a vowel. This error is **not** very commonly encountered in the speech of the hearing-impaired. An **example** of this kind of error is production of the diphthong **/əI/** instead of the vowel **/i/** in the word /piℓɑ/, thus making the word sound /pəIℓɑ/.*

d) ***Prolongation or vowel lengthening:** The duration of vowels in connected speech should **vary** according to **context**. However, it has been found that hearing-impaired speakers tend to produce vowels with **minimal** durational differences. They tend to produce vowels with **excessive duration** i.e. the vowels are **prolonged**. For **example**, the short vowel /I/ in the word /**pI̠ɑʤi**/ may be produced as long /i/. In addition to this, the **other vowels** i.e. /ɑ/ and /i/ may also be lengthened, giving a perception of the speech being **prolonged**.*

e) ***Aspiration:** All vowels are voiced. However, hearing-impaired speakers may **forcefully exhale** air before production of vowels. This forceful release of air **(aspiration)** is perceived by the listener as **/h/** sound. For **example**, the vowel /ɑ/ in the word /**ɑːm**/ may be released forcefully, resulting in the word being perceived as /**hɑːm**/.*

f) ***Distortion:*** *As we recall, vowels are produced by* ***fine variations*** *in mouth opening, place and height of tongue, and lip rounding. Hearing-impaired speakers may be slightly* ***off-target*** *with respect to one or more of these required variations, particularly in those vowels with very* ***low kinesthetic*** *feedback.*

This applies especially to vowels /i/, /e/ ***and /a/*** *where lip rounding is not available as a cue for monitoring the vowel production. This results in the hearing-impaired speaker producing a vowel that is not similar to the target vowel. Not only this, the produced vowel may be one that is* ***not present*** *in the speaker's* ***language****. This is an error of* ***distortion****.*

3.6.2 Consonant Articulation

As already discussed in unit 3, consonants ***differ*** *from vowels in several different ways. Consonants require* ***faster*** *and* ***precise*** *adjustments of the articulators. Also, while vowels can be produced in* ***isolation****, many consonants cannot. However, consonants provide relatively* ***strong*** *tactile and kinesthetic* ***feedback*** *during production.*

Errors *in consonant production are* ***more common*** *than vowel errors in the speech of the hearing-impaired. Consonant errors are generally* ***classified*** *as errors of* ***omission, substitution, addition*** *and* ***distortion****. Let us look at each of these.*

A. Errors of Omission: *An error of* ***omission*** *means omitting,* ***deleting****, or* ***dropping*** *of a consonant in an utterance. Studies have shown that omission or deletion of a consonant can occur for consonants in the* ***initial*** *position or* ***final*** *position in a word.*

- *Omission of a* ***final consonant*** *by young hearing-impaired children is sometimes caused by* ***forgetting*** *to articulate the consonant. In older children, final consonant deletion may be due to* ***reduced force*** *while producing the consonant or an* ***abnormal lengthening*** *of the vowel before that consonant. For* ***example****, the final consonant /ℓ/ may be omitted in the word /****phuℓ****/ i.e. the word may be produced as /****phu****/.*

- *Omission of a consonant in the* ***initial position*** *of a word may occur if it is produced with* ***reduced force****. This is especially relevant to* ***plosive*** *consonants, which are often produced with insufficient force. For* ***example****, the initial* *consonant /p/ may be omitted in the word **/pɑni/** i.e. the word is produced as **/ɑni/**.*

- *One **characteristic** error of omission reported by many authors is the omission of consonant **/s/ in all contexts**. This error is **frequently** found in the speech of the hearing-impaired. For **example**, the **initial** /s/ in the word /s**ɑp**/ may be omitted, i.e. the word is produced as /**ɑp**/. The **final** /s/ in the word /**gIɭɑ**s/ may be omitted, i.e. the word is produced as /**gIɭɑ**/.*

B. *Errors of Substitution:* *Substitution error means **replacing** one consonant by some other consonant. Substitution errors in the speech of the hearing-impaired can be **categorized** as following:*

- ***Voiced-voiceless substitution:** This is the most **commonly** encountered error in the speech of the hearing-impaired. This error consists of substitution of a **voiced** consonant by the **voiceless** consonant having the **same place** of articulation or vice versa. For **example**, the voiceless stop consonant /p/ may be substituted by its voiced counterpart /b/ as in /**bɑni**/ for /**pɑni**/ or the **reverse** may happen wherein the voiced consonant /b/ may be substituted by the voiceless /p/ as in /**pɑɭ**/ for /**bɑɭ**/. Voiced-voiceless substitution may be caused **due to** continuation of **voicing** of the preceding vowel into the consonant. Also, **reduced force** during the production of a voiceless stop may lead to the consonant being perceived as its voiced counterpart.*

- ***Nasal-oral substitution:** A **nasal** consonant may be substituted for its **oral** counterpart. For **example**, a hearing-impaired speaker may produce **/m/ for /b/** as in /**mɑɭ**/ for /**bɑɭ**/, or /n/ for /d̲/ as in /**nɑnɑ**/ for /**d̲ɑd̲ɑ**/. Also, hearing-impaired speakers may substitute an oral consonant for its nasal counterpart i.e. **/b/ for /m/** as in /**bəʈəɤ**/ for /**məʈəɤ**/ or /d̲/ for /n/ as in /**d̲ɑm**/ for /**nɑm**/. This type of substitution is primarily due to improper closure of the **velum** or soft palate.*

- ***Low-feedback substitution:** Production of some sounds is likely to provide little **sensory feedback**. These sounds may be substituted by sounds that provide more feedback, especially **tactile**. For **example**, consonants **/t̲/** or **/t̲h/** may be substituted for the low feedback consonant **/s/** as in /**t̲ɑp**/ for /s**ɑp**/. The speaker seeks increased **tactile** feedback by touching the tongue and alveolar ridge for /t/ or seeks increased perception of **friction** by producing /th/.*

*Other **types** of substitution errors include:*

- *Using **stops** in place of corresponding **fricatives** (as in /t̪/ for /s/)*
- *Using **fricatives** in place of corresponding **stops** (as in /s/ for /t̪/)*
- *Using **glides** in place of **liquids** (as in /j/ for /ℓ/)*
- *Substitutions between **aspirated** and **unaspirated** consonants (as in /p/ for /ph/ or /bh/ for /b/)*
- ***Fronting** of consonants (as in the back consonant /k/ produced as /t̪/ in which the tongue placement is in the front of the oral cavity)*

*C. **Errors of Addition:** This means adding or **inserting** an extra sound where it is not required. Errors of addition may include:*

- ***Insertion of a vowel between consonants:** This occurs more often when two consonants occur next to each other. For **example**, the word /**bℓu**/ is often produced as /**bəℓu**/ or the word "**fUʈbɔℓ**" may be produced as "**fUʈəbɔℓ**". In both these instances, a vowel is inserted between **two consonants**.*
- ***Unnecessary release of final stop consonants:** The hearing-impaired speakers may produce a stop consonant in the **final** position by **forcefully** releasing it. This leads to **perception** of an added vowel at the end. For **example**, the final stop /d/ in the word /**bæɖ**/ may be forcefully released leading to the word being heard as /**bæɖə**/. Another example is the word /ek/ produced as /**ekə**/.*

*D. **Errors of Distortion:** Distortion occurs when a consonant is substituted by a sound **not occurring in the language**. Errors of distortion may occur when consonants are produced with either too much or too little **force**. For example, stops /p/ and /t̪/ are often distorted due to too much bilabial or lingua-alveolar pressure combined with excessive **jaw movements**. Distorted articulation in the speech of the hearing-impaired may also be due to **prolonged** articulatory contacts or **slow** articulatory movements.*

3.6.3 Diphthong Articulation

Diphthongs are a combination of two continuously phonated vowels with the first portion longer than the second. Errors in the production of diphthongs in the speech of the hearing-impaired include:

- ***Simplification*** *of the diphthong by* ***splitting*** *it into two separate vowels or* ***omitting*** *one component. For example, the word /ℓaɪt/ may be produced as /ℓa:ɪ:t/ where the two components of the diphthong are separated or as /ℓat/ where the component /i / is omitted.*

- ***Errors in timing*** *include producing the second portion of the diphthong longer than it needs to be.*

3.6.4 Analysis Of Articulation Errors

Many studies have looked at the ***articulation errors*** *in the speech of the hearing-impaired with respect to the* ***type*** *of error, the* ***position*** *of the error in the word,* ***degree*** *of hearing loss, etc. Results of these studies suggest that*

- *In* ***severely*** *hearing-impaired,* ***omission*** *is the most frequent type of error followed by substitution and distortion. In* ***partially*** *hearing-impaired,* ***substitution*** *errors are more common followed by omission and distortion.*
- *For* ***both*** *severely and partially hearing-impaired subjects, errors involving* ***final*** *consonants are more common than errors involving the* ***initial*** *consonants.*
- *In terms of* ***place of articulation****, the visibility of phonemes is an important factor in determining correct production. In general,* ***bilabials*** *and labiodentals are more correctly produced consonants, while alveolars, palatals and* ***velars*** *are more prone to be produced incorrectly.*
- *In terms of* ***manner of articulation****, studies suggest that* ***laterals****, glides and stops head the list of correct production followed by fricatives, nasals and* ***affricates****.*
- ***Consonant cluster*** *reduction process may include*
    - *reduction of a fricative-stop cluster to a stop consonant*
    - *reduction of a nasal-stop cluster to a stop consonant*
    - *reducing a liquid consonant in a cluster to a glide*

It is important to ***remember*** *that errors of articulation are not only confined to production of individual phonemes, but are also* ***influenced*** *by the preceding and following sounds. For* ***example****, a hearing-impaired child may be able to produce the consonant /s/ correctly in isolation but may omit or distort it in connected speech.*

3.7 ERRORS IN SUPRA-SEGMENTALS

*In Unit 1 we have discussed the aspects of speech that contribute to its **rhythm** or prosody. The various supra-segmental features such as emphasis, intonation, phrasing and rate are achieved by controlled variations of loudness, pitch and duration. Studies indicate that supra-segmental characteristics of speech of the hearing-impaired show problems with **all the aspects**.*

*Supra-segmental errors in the speech of the hearing-impaired appear to be due to speaker's **difficulty** in varying loudness, pitch and duration. Even if a hearing-impaired speaker achieves these skills, he may not know when to apply them in the context of the **linguistic requirement**.*

- ***Intonation:** Intonation is characteristically **absent** in the speech of the hearing-impaired. The most **common** errors include:*
    - *a) **monotonous** rate*
    - *b) **insufficient** variability of intonation*
    - *c) **excessive** variability of intonation*
    - *d) use of **durational** cues in place of intonation*

- ***Stress:** In general, stressed syllables have higher fundamental frequency, greater intensity and longer duration than the unstressed syllables. Studies reveal that hearing-impaired **fail to produce durational difference** between stressed and unstressed syllables. They produce unstressed syllables with longer duration.*

- ***Rate:** Hearing-impaired individuals speak at a rate **slower** than that of speakers with normal hearing. Slow speaking rate has been related to the **prolongation** of individual phonemes and the presence of **lengthy pauses** within utterances. Some investigators report that slow rate may be used by hearing-impaired speakers as a **compensatory strategy** to improve intelligibility. Speakers with hearing-impairment have been found to use frequent and lengthy inter- and intra-word pauses.*

3.8 SPEECH INTELLIGIBILITY

The concept of speech intelligibility was introduced in **Unit 1.** The perceived intelligibility of speech depends on both **suprasegmental and segmental** features. In other words, speech intelligibility is influenced by **stress, intonation, voicing, oral-nasal distinction and positioning of the articulators.** Segmental features tend to be more **influential** in determining speech intelligibility.

Studies have shown that individuals with ***mild to moderate*** *hearing loss have* ***better speech intelligibility*** *as compared to those with severe to profound hearing loss. Because of problems in* ***producing and harmonizing*** *the several aspects of speech, the speech of children with severe to profound prelingual hearing loss is generally hard to understand. The general outcome of* ***various studies*** *of speech intelligibility of individuals with severe to profound hearing loss indicates that the mean intelligibility figure is between* ***18 to 25 %.*** *In other words* ***listeners not used to speech of the hearing impaired*** *can understand only about 25% of their speech.*

Various studies have looked into the **factors associated** with speech intelligibility.

- ***Degree of hearing loss*** *is negatively correlated with speech intelligibility i.e. the greater the hearing loss poorer is the speech intelligibility.*
- *Speech intelligibility also appears to be correlated with* ***linguistic ability*** *perhaps because hearing-impaired children will be able to speak more fluently if they have a fair knowledge of the language.*
- *The effectiveness of* ***speech training procedures*** *also seems to have an impact on speech intelligibility. There is evidence that hearing-impaired children can improve their speech intelligibility to some extent with speech training.*
- *Children who make* ***good use*** *of their* ***hearing aids*** *show significantly superior speech intelligibility to children who do not use their aids to such advantage.*
- *In some children, a deficit in* ***tactile and kinesthetic feedback*** *may contribute to errors in articulation leading to poor speech intelligibility.*
- Difficulties with **consonants** cause more intelligibility problems than difficulties with vowels.

3.9 SPEECH CHARACTERISTICS ASSOCIATED WITH MILD TO MODERATE HEARING LOSS

You have already looked at the effects of different degrees of hearing loss on speech production in unit 4. The ***greater the hearing loss,*** *the* ***more effect*** *it has on different aspects of speech production.*

Studies taken up on speech of individuals with mild to moderate hearing loss are relatively ***limited.*** *Generally, this group of individuals appears to have* ***fairly intelligible*** *speech.* ***Vowel*** *production errors are rare and voice* ***quality*** *and* ***suprasegmental*** *features are generally either normal or mildly deviant. However, primary speech errors of this population are related to misarticulations of* ***single consonants*** *and* ***consonant clusters*** *(consonant-consonant combinations). Sounds most commonly in error are the* ***affricates and fricatives****. Stop plosives, nasals and glides are not commonly misarticulated. Common types of errors reported are* ***substitutions,*** *followed by distortions and omissions.*

3.10 ASSESSMENT / EVALUATION OF THE SPEECH OF THE HEARING-IMPAIRED

In order to **develop** age-appropriate speech skills and **correct** speech errors in the hearing-impaired children, one must know what spoken language skills, if any, the child has already acquired. This information can only be obtained through **systematic evaluation,** which involves **observation** and **assessment** as training proceeds. The main components of a systematic evaluation procedure include

- **Oral peripheral examination** of the child's speech organs (structure and function)
- Assessment of his **phonetic level** skills i.e. assessment of control over pitch, duration and loudness in **vocalizations** and assessment of segmental skills (speech sound production) at **isolation** level
- Analysis of his **phonological level** speech i.e. assessment of segmental and supra-segmental skills in a **meaningful linguistic context.**

To understand the concept of **phonetic and phonological** level, let us consider this **example**. When the child is at the stage of babbling and produces the syllable /baba/, it is non-meaningful and thus can be considered to be at the phonetic level. But as the same child starts saying /baba/ consistently to indicate his father, it is associated with a meaning and hence becomes a phonological level production.

As a teacher, you may have to carry out speech assessment for children with varying degrees of **proficiency in spoken language**. Some children may have very limited spoken language skills while you assess them. For such children, assessment should be carried out keeping in view the level at which the child is functioning. For example, if a child has no meaningful verbal output, phonological level assessment cannot be carried out. For another child who is speaking in sentences and has good vocabulary, assessment at phonetic as well as phonological levels can be carried out. It should also be remembered that speech assessment of one child may take more than one session. Especially for children who are verbal and the complete phonetic and phonological assessment needs to be carried out, assessment may not be a one-time process but may take more number of sessions.

Let us now look at each of the components of assessment in brief. Details of the phonetic and phonological level sub-skills and teaching of these will be done in detail in the next unit.

3.10.1 Oral Peripheral Examination

The structure and function of each of the speech organs should be assessed systematically to ensure that the physical requirements for speech production are met. Following are the structures that should be looked at.

- **Lips:** The appearance of the lips should be checked for its symmetry and continuity of the upper border. Lip movements that should be assessed include **spreading** (as in producing /i/), **rounding** (as in producing /u/), and **coming together** or **puckering** (as in producing /p/).
- **Mandible:** The symmetry of the mandible and its relation to the maxilla (upper jaw) should be assessed. The movements of the mandible that need to be assessed include **opening and closing** of the jaw and **side to side** movements.
- **Tongue:** The tongue should be assessed for its **size** (by asking to protrude the tongue). Important movements such as tongue

elevation or upward movement, **protrusion** or outward movement, **retraction** or backward movement and **lateralization** or side to side movement need to be assessed.

- **Teeth: Alignment** of the teeth should be checked. Also, missing teeth or overlapping teeth need to be noted.
- **Hard palate:** Check for any kind of an organic deformity in the hard palate such as a **cleft** or an opening.
- **Soft palate:** It should be checked if the soft palate is also intact and there exists no opening or cleft. Also, movement of the soft palate can be observed as described in the in-text activity of 2.8 in unit 2.

3.10.2 Assessment Of Phonetic Level Skills

Phonetic level evaluation includes assessment of **non-segmental** aspects and **segmental** aspects.

1. **Non-segmental analysis** is to determine the extent to which the child has acquired control over vocalization. Presence of **spontaneous vocalizations** should be assessed. It should also be assessed whether the child vocalizes whenever it is required or **demanded**. Control of **duration also needs to be determined.** The child should be able to produce sustained vocalizations for at least 3 seconds, a series of brief vocalizations lasting one half second or less and a stream of upto four vocalizations containing sounds varied in duration. Control of **loudness** can be considered to be present if child can produce sounds of 3-second duration in loud voice, soft voice and whisper as well as several syllables varying in loudness. **Pitch control** may be considered acquired if child can produce sounds in low high and mid pitches, and also combinations of low-mid-high, high-low-mid, etc. Ratings of each of these can be given as **present, present but inadequate** or **absent.**

2. **Segmental analysis** aims at finding out

   a) whether the child can produce different **speech sounds** to the extent required,

b) whether **patterns** such as vowel-consonant **(VC)**, consonant-vowel **(CV)**, consonant-vowel-consonant **(CVC)**, etc. can be reliably repeated,

c) whether these patterns can be **alternated** with other patterns at an acceptable rate, for example, CV with CVC, VC with CV, etc.

d) whether segments can be varied in **duration, loudness and pitch**; for example vary pitch, loudness and duration for the CV segment /bi/.

For assessment of phonetic level skills, utterances can be **elicited** from the child on **imitation** after the teacher. The teacher can **model** the target response that is expected from the child in a clear and precise manner. The child should then repeat this and his performance should be **evaluated.** Stimuli for assessment of duration, pitch and loudness control can be production of **different vowels** and if possible CV or VC combinations. Getting the child to **imitate** all the phonemes in the language can help in carrying out segmental assessment.

3.10.3 Assessment of Phonological Level Skills

Phonological level analysis means evaluation of speech in a ***linguistic context****. For this purpose, a sample of* ***50 utterances*** *(words, phrases, sentences, etc.) should be obtained from the child. This can be done in two ways.* ***One****, words, phrases and sentences uttered spontaneously by the child can be tape-recorded and later analyzed. However, with this method, all the phonemes in the language may not be tested adequately. The sample will be limited to the vocabulary known to the child. The* ***other method*** *of obtaining a sample for assessment is by using* ***pictures*** *of words or actions or incidents that are familiar to the child. Words should be chosen in such a way that each speech sound will be tested in the word* ***initial, medial and final positions****. An example of this is the three words /pɑni/, /pəpit̪ɑ/ and /kəp/ which test the phoneme /p/ in word initial, medial and final positions respectively. The sample should not be limited to words only. Longer* ***phrases and sentences*** *should also be recorded for the purpose of assessment of supra-segmental skills. It will help if this sample is* ***tape-recorded*** *and then analyzed. The aim of the* ***segmental*** *analysis is to see the extent to which particular sounds have become incorporated in the child's phonology. The errors made by the child for each of the sounds can be categorized as errors of substitution, omission, distortion* *or addition. The **supra-segmental** parameters that need to be rated include rate, phrasing, intonation, emphasis and so on.*

While assessment of the various non-segmental, segmental and suprasegmental features is being carried out, the errors made by the child can be categorized according to the various errors discussed so far in this unit.

3.11 SUMMARY – POINTS TO REMEMBER

- ✓ *The development of speech in children with severe to profound prelingual hearing impairment is usually **delayed** if intervention does not start early.*
- ✓ *Speech production of the hearing impaired consists of **poor co-ordination** between respiratory, phonatory and articulatory systems.*
- ✓ *Errors related to **respiration and its control** include*
    - *inappropriate breathing **patterns**,*
    - *inadequate breath **support**,*
    - *inadequate breath **control** and*
    - ***forced expiration** while speaking.*
- ✓ ***Voice** problems in hearing-impaired speakers include*
    - *disorders of **pitch and pitch control**,*
    - *disorders of **loudness and loudness control** and*
    - *disorders of voice **quality**.*
- ✓ ***Articulatory** errors in speech of the hearing impaired may be in*
    - ***vowel** production,*
    - ***consonant** production and*
    - *production of **diphthongs and semivowels**.*
- ✓ Prosodic or **supra-segmental** errors in the speech of the hearing impaired include
    - *irregularities in **rate** of speech,*
    - *inappropriate **phrasing** patterns,*
    - *inappropriate **intonation** patterns and*
    - *inappropriate **stress** patterns.*

✓ *Speech of individuals with **mild to moderate hearing** loss is fairly intelligible with relatively limited or no errors.*

✓ The main components of a systematic evaluation procedure include

- **Oral peripheral examination** of the child's speech organs (structure and function)
- Assessment of his **phonetic level** skills
- Analysis of his **phonological level** speech.

3.12 CHECK YOUR PROGRESS

❖ ***Questions:***

1. *What aspects of speech are affected in the hearing-impaired?*
2. *Enumerate deviations in respiration found in hearing-impaired speakers.*
3. *List the supra-segmental errors in the speech of the hearing-impaired.*
4. *What articulatory errors are found in the speech of the hearing-impaired?*
5. *Explain the voice problems commonly found in the speech of the hearing-impaired.*
6. *Discuss the factors affecting speech intelligibility of hearing-impaired speakers.*
7. *Discuss the speech characteristics of individuals with mild to moderate hearing loss.*
8. *Discuss how the speech of the hearing-impaired can be assessed.*
9. *Enumerate vowel production errors in the speech of the hearing-impaired.*
10. *Discuss consonant errors in the speech of the hearing-impaired.*
11. *Discuss assessment of non-segmental, segmental and supra-segmental aspects of the speech of the hearing-impaired.*

❖ ***Fill in the blanks with appropriate words:***

1. *Deviations in the pitch of the hearing-impaired include use of a _______, _______ of pitch and poor ability to _______ pitch.*
2. *Hearing-impaired speakers may use ______ or __________ loudness while speaking.*

3. _______, ______ or ______ *may characterize voice quality of hearing-impaired speakers.*
4. *Articulatory errors include errors in the production of* _______, ________ *and* _______.
5. *Consonant errors are* ________ *than vowel errors.*
6. *Errors in vowel production include* ________, ________, ________, ________, ________ *and* ________.
7. *Errors in consonant articulation include* ______, ________, ______ *and* ______.
8. ________, __________ *and* __________ *are types of substitution errors.*
9. *A child saying "ismile" for "smile" is an error of* _______.
10. ________ *and* ________ *characterize errors in diphthong articulation.*
11. *Intonation is characteristically* _________ *in hearing-impaired speakers.*
12. *Rate of speech of hearing-impaired speakers is* _______ *than normal speakers.*
13. *Factors affecting intelligibility of hearing-impaired speakers include* _______, _______ *and* ________.

❖ ***Assignment:***

a) Discuss characteristics of the speech of the hearing-impaired and the intelligibility of their speech.

b) *Discuss phonetic and phonological level assessment of the speech of the hearing-impaired.*

3.13 POINTS FOR DISCUSSION/CLARIFICATION:

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

3.13.1 Points for Discussion

____

____

____

____

3.13.2 Points for Clarification

3.14 REFERENCES / FURTHER READING

1. *Bench, R. J. (1992). Communication skills in Hearing-impaired Children. London: Whurr Publishers.*
2. *Calvert, D. R. and Silverman, S. R. (1983). Speech and Deafness. (2nd Ed.). Washington DC: Alexander Graham Bell Association for the Deaf.*
3. Ling, D. (1976). Speech and the Hearing-impaired Child: Theory and Practice. Washington DC: Alexander Graham Bell Association for the deaf.
4. Schow, R. L. and Nerbonne, M. A. (1996). Introduction to Audiologic Rehabilitation. (3rd Ed.) Boston: Allyn and Bacon.

Annexure

Proforma for speech assessment

Child's name: ***Age/Sex:***

Audiological evaluation: ***Date:***

A) Oral peripheral examination:

Speech organ					
	Normal	*Abnormal*	*Present*	*Present but inadequate*	*Absent*
Lips					
Mandible					
Tongue					
Teeth					
Hard palate					
Soft palate					

B) Phonetic level Assessment:

1. Non- segmental Analysis

	Present	*Present but inadequate*	*Absent*
Spontaneous vocalization			
Vocalization on demand			
Duration Control			
a) sustained vocalization for 3 sec.			
b) series of brief vocalizations lasting one half second or less			
c) stream of upto 4 vocalizations varying in durations			
Loudness Control			
a) sound of 3 sec duration in loud voice			

b) sound of 3 sec duration in a soft voice			
c) sound of 3 sec duration in a whisper			
d) several syllables varying in loudness			
Pitch Control			
a) sound of 3 sec duration in a high pitch			
b) sound of 3 sec duration in a mid pitch			
c) sound of 3 sec duration in a low pitch			

2. ***Segmental analysis:***

		Correct	*Incorrect*
Bilabials	/p/ /pʰ/ /b/ /bʰ/ /m/		
Labiodentals	/f/ /v/		
Dentals	/t̪/ /t̪ʰ/ /d̪/ /d̪ʰ/		
Alveolars	/ℓ/ /ɤ/ /n/		
Retroflex	/ʈ/ /ʈʰ/ /ɖ/ /ɖʰ/		

Palatals	/tʃ/ /tʃʰ/ /dʒ/ /dʒʰ/		
Velars	/k/ /kʰ/ /g/ /gʰ/ /ŋ/		
Glottals	/h/		

C) Phonological level Assessment:

1. ***Segmental analysis:*** *For this purpose, elicit the phonemes in the word initial, medial and final positions as explained in 5.10.3. For each position of each phoneme, mark correct if the sound is correctly articulated. If not, write the error made by the child in the respective column. The first sound is analyzed for you as an example.*

		Initial	*Medial*	*Final*
Bilabials	/p/ /pʰ/ /b/ /bʰ/ /m/	*correct*	*Substitutes by /b/*	*Substitutes by /b/*
Labiodentals	/f/ /v/			
Dentals	/t̪/ /t̪ʰ/ /d̪/ /d̪ʰ/			
Alveolars	/l/ /ɤ/ /n/			

Retroflex	/ʈ/ /ʈʰ/ /ɖ/ /ɖʰ/			
Palatals	/tʃ/ /tʃʰ/ /dʒ/ /dʒʰ/			
Velars	/k/ /kʰ/ /g/ /gʰ/ /ŋ/			
Glottals	/h/			

2. ***Supra-segmental assessment:*** *For this purpose, longer utterances such as phrases and sentences should to be analyzed. Spontaneous utterances of the child may not be sufficient to elicit all the information. So stimuli could be prepared to elicit the different intonation and stress patterns and to enable use of phrasing and pauses. For eliciting* ***intonation****, for example, two sentences with different intonation patterns may be included as stimuli. These may include a question (rising intonation) and a statement (flat intonation). Rate of speech can be judged during* ***conversation*** *with the child.*

	Present	*Present but inadequate*	*Absent*

Intonation			
Emphasis / Stress			
Phrasing			
Rate			

UNIT 4:STEPS AND STRATEGIES IN DEVELOPING WRITING

STRUCTURE

- Introduction
- Objectives
    - o Developmental model, its stages, target behaviors and sub-skills at both the phonetic level and phonological level
        - Stage 1: Vocalizations freely and on demand and using vocalizations as a means of
        - communication
        - Stage 2: Bases of suprasegmental patterns and using different voice patterns meaningfully
        - Stage 3: Acquiring all diphthongs and vowels and using different vowels to approximate words
        - Stage 4: Acquiring consonants by manner and some words said clearly with good voice patterns
        - Stage 5: Acquiring consonants by place and using more and more words
        - Stage 6: Acquiring consonants by voicing and more words said clearly with good voice patterns
        - Stage 7: Acquiring initial and final blends and all speech intelligible.
- **Approaches for teaching speech**
    - o Auditory global approach
    - o Multi-sensory syllable unit approach
    - o Associated phoneme unit approach
- **Summary-Points to remember**
- **Check your progress**
- **Assignment**
- **Points for discussion/clarification**
- **References/Further reading**

4.1 INTRODUCTION

"One of the greatest achievements in the world is that of a child born deaf who learns to talk" (A.G.Bell Association, 1979). Anyone who is involved in the teaching of speech to hearing impaired children would agree wholeheartedly with this statement. Teaching the hearing impaired child to talk is indeed a great achievement and helping him speak with **ease and intelligibility** appears to be one of the greatest **challenges** facing the educators of the deaf today. There are many models, approaches and strategies for teaching speech to the hearing-impaired.

One of the **models**, which are extensively used, is the **developmental and corrected model** developed by **Ling** (1976). In this unit we will discuss various **stages, goals and sub-skills** of this model. We will also discuss the manner in which a teacher in the Indian context, can implement the above mentioned goals and sub-skills. The various **approaches and strategies** for teaching speech to the hearing-impaired will also be discussed.

4.2 OBJECTIVES

At the end of this unit, you will be able to:

- List the seven major stages of **Ling's developmental model** at the phonetic and the phonological levels
- Identify the **target behaviors** and the **sub-skills involved** at each stage of the model
- Use the **activities** suggested for achieving the various sub-skills
- Apply the various **approaches** to speech teaching

4.3 DEVELOPMENTAL MODEL FOR SPEECH TEACHING

A normal hearing child acquires speech in a particular order and pattern. The order or pattern in which a normal hearing child acquires speech is already discussed in Unit 4. The developmental model uses the same **order and pattern** to teach speech to the hearing- impaired child. The **purpose of the model** is to enable the teachers to develop speech in the hearing impaired children in a systematic and effective way. It also describes precise **evaluation procedures** which allow the teacher to determine what patterns have been learned by the child at the **phonetic and phonological level** (refer to Unit 3 for definition of phonetic and phonological level). Teachers can use this model with children of various ages, hearing impairment and having **different speech characteristics**.

The teaching process can be considered sequential and is divided into **seven major stages of speech acquisition**. Each stage has two levels – the phonetic and the phonological. For example if the child vocalizes randomly, then his vocalizations are considered to be at the phonetic level. However if he uses his vocalizations to attract attention his vocalizations are considered to be at the phonological level. These two levels have to be worked on simultaneously. In each stage work on phonological level will follow work on phonetic level. At the phonological level the requirements are:

- constant **exposure** to speech
- **a lot of drill work** on the use of speech skills as they are acquired at the phonetic level
- **reinforcement** of the speech patterns accurately produced.

Each of the seven stages of acquisition consists of a number of **target behaviors**. What are target behaviors? Target behaviors are **short-term goals** upon which the teacher can make an individual plan for each child depending on the child's needs. For e.g. one of the target behaviors can be – Teaching production of the consonant /s/ when a child is unable to produce it. To achieve each target behavior, a number of **sub-skills** are suggested.

In what way can this model help the teacher? With the help of this model the teacher can:
1. **Assess** the speech skills present in the child
2. **Formulate** goals
3. **Plan** effective strategies for the different sub-skills

This can be done taking into consideration the following:
1. The **capacity** of the student
2. Student's **age**
3. **Hearing level** of the student

The teacher should remember the above mentioned factors and should use the **model flexibly** depending on each student's needs. Further, to achieve each of these target behaviors the child must master a series of **specific sub-skills**. To develop any given target behavior, the teacher must—

- select first the various sub-skills involved
- carry it through

- plan her teaching strategy
- evaluate the result of her work

If the sub-skill has been mastered, she may proceed to teaching the next sub-skill; if not, she must re-plan her work, using different strategies and materials and begin again.

The stages are as follows:

Phonetic Level Phonological Level		
Stage 1	Vocalizations freely and on demand	Uses vocalization as a means of communication
Stage 2	Bases of suprasegmental patterns	Uses different voice patterns meaningfully
Stage 3	Acquires all diphthongs and vowels with voice control	Uses different vowels to approximate words
Stage 4	Acquires consonants by manner	Some words said clearly with good voice patterns
Stage 5	Acquires consonants by place	Uses more and more words
Stage 6	Acquires consonants by voicing	Most words said clearly with good voice patterns
Stage 7	Acquiring initial and final blends	All speech intelligible and voice patterns normal

4.3.1 STAGE 1, at phonetic and phonological level, i.e. vocalizations freely and on demand and using vocalizations as a means of communication:

The target behaviors are:

1. Spontaneous production of at least twelve voluntary vocalizations during three-minute observation period.
2. Consistent use of voice to attract attention
3. Vocalizing on demand. In other words, vocalizing in response to a question or when asked to imitate. (Refer to Unit 4 for definition of vocalization).

The first stage is applicable to younger hearing-impaired children (specifically 2-3 years old). The model gives the sub-skills and the teaching strategies for the above target behaviors.

1. Spontaneous production of at least twelve voluntary vocalizations during three-minute observation period: The sub-skill involved in vocalization is the **production of voice**, which results when breath is released and the vocal folds are adducted (refer to Unit-2 for production of voice). Every child vocalizes/produces voice involuntarily

- always in laughter,
- usually when crying, coughing, sneezing or exercising,
- and in active play.

If the child has to use voice voluntarily and abundantly he should derive pleasure from vocalization. What kind of pleasure do you think a child can get through vocalizations?

a. Internally- he can get the feeling or feedback from his own voice, which he can enjoy.
b. Externally- in the form of reinforcement from others.

Observe how a parent responds when his/her child vocalizes:

- parents praise the child,
- pat him/her,
- imitate the child's vocalizations,
- smile,
- give attention, etc.

Initially, most hearing impaired children use voice spontaneously and voluntarily at least to some extent. A child born with hearing impairment does not vocalize often enough as he has received too little intrinsic or extrinsic (internal and external) reinforcement / reward. His vocalizations will therefore be limited to involuntary voicing e.g. laughter. To develop voluntary vocalizations the teacher must-

a. provoke / elicit involuntary vocalizations
b. reinforce the child's vocalizations

Children can be made to vocalize involuntarily in a number of ways for example laughing, crying, vocalizing during exertion. Generally she should select the involuntary vocalization, which are already present in the child- for example laughter.

Activities, which the teacher can use in order to elicit laughter, can be-

a. Tickling.

b. Physical play.

Other means of provoking vocalizations may be necessary. This is because the child should learn to produce voice in other contexts also, for example vocalizations during exertion. Games such as tug of war, one arm table wrestling can also provoke vocalizations.

The following **reinforcement** can be given-

a. Patting on the child's back.

b. Praising the child.

c. Giving the child his favorite toy to play.

Intext activity:
Observe a 3-year-old hearing-impaired child, who expresses his needs only by using gestures. Consider eliciting laughter to be your goal.

List the following-

a. Games which you will play with the child to elicit laughter.

b. What kind of reinforcement / reward will you give to the child once the child starts vocalizing.

2. Consistent use of voice to attract attention:

In order to use voice to attract attention the game known as "blind man's buff "can be played. In this game one person is blindfolded. The blindfolded person is supposed to touch / catch the others. The teacher can modify this game. The blindfolded person should touch the child who vocalizes and should reward the child. Each time the child vocalizes, he is touched and given a star. If he collects ten stars he should be given a chocolate.

Intext activity:
Think of how you will encourage the child to vocalize and how you will reward him.

3. Vocalization on demand:

When the child starts vocalizing voluntarily, he should use his voice to attract attention or use his vocalizations to fulfill his needs. If the child communicates his

needs only by using gestures, or by pulling or pushing, he should be taught to accompany his non-verbal behavior with vocalizations.
Thus, as soon as the child starts vocalizing involuntarily, the teacher should select **vocalization on demand as her next goal.**

This goal can be achieved by carrying out the following **activities**: -
1. Do not respond or respond slowly when the child communicates non-verbally.
2. React quickly and pleasantly if non-verbal means of communication are accompanied by vocalizations.

In text activity:
In order to elicit vocalizations on demand following games can be played: -
1. Games such as throwing and catching the ball— give the ball to the child only when he vocalizes;
2. Simon says-In this game one person says-"Simon says clap your hands" And the others have to do what that person says. Here first gross body imitations can be done followed by imitation of vocalizations.

4.3.2 Stage 2, at phonetic and phonological level i.e. bases of suprasegmental patterns and using different voice patterns meaningfully:

The target behaviors are:
a. Gross control over **duration of voicing.**
b. Control over **voice intensity.**
c. Control over **voice pitch.**
(Refer to Unit 5 for definition of duration, intensity and pitch).

If at Stage 1 the child has vocalized a lot, then it is more likely that he will have voice patterns, which will vary in duration, intensity and pitch. If the child's spontaneous vocalization is reinforced in a variety of situations the child will produce varied or different types of vocalizations. If it is reinforced only in one type of situation, then the child will produce only one type of vocalization. I.e. the vocalizations will be monotonous. For example:
1. The vocalizations produced during laughter are different from those produced when one is angry.
2. The vocalizations produced when one is cheering a cricket match are different from those produced when one is telling a secret in his/her friend's ears.

Intext activity:

What are the different vocalizations observed when children play? Observe the duration, intensity, pitch and intonation of these vocalizations. Do you observe any change in the facial expressions along with change in vocalizations?

a. Sub-skills related to vocal duration:
A child may be considered as having acquired basic control over duration of voice when he can in one breath, imitate groups of up to four distinct vocalizations varying in duration.eg. a, a----, a--------, a------------------. (The dotted line indicates duration, for e.g. a----=2seconds, a--------=4seconds etc).

The **sub-skills** underlying this target include ability to :-

1. Sustain vocalization for at least 3 seconds. In other words the child should be able to take in a deep breath and on exhaling say 'a' for at least 3 seconds.
2. Imitate separate vocalizations differing in duration, each on one breath. In other words the child should be able to imitate the teacher's production of 'a' varying in duration e.g. a, a---, a--------, a-----------------------.

Ability to sustain a vocalization for at least 3 seconds duration ensures that the child is now ready for subsequent development of differential intensity and pitch patterns in his vocalizations. Similarly, the breath grouping of utterances of various durations, i.e. being able to say a, a---, a---------, a---------------- in one breath is essential to the regulation of breath in the production of voice.

Sub-skill 1: The production of vocalizations, which are sustained for 3 seconds.

The teacher can play games in which if the child vocalizes for 3 seconds he will be rewarded.

For example:

1. As long as the child vocalizes the teacher may move a toy car along the road or move a toy train along a railway track.
2. The teacher can continue to pour sand or liquid into a long vessel as long as the child sustains vocalizations for 3 seconds.
3. The teacher can draw a line with points drawn at an interval of 3". At these points the teacher can stick small appropriate sized pictures. The child can be made to vocalize until he reaches the different pictures at different points.

The imaginative teacher can invent many such duration-related activities. Games can be chosen in which other children are also involved. For e.g., musical chairs can be played by listening to a child's vocalization as well as by listening to music.

Intext activity:
Give examples of games, which you would play with the child in order to make him vocalize for 3 seconds.

Sub-skill 2: To develop the ability to imitate and to approximate separate or vocalizations differing in duration, each on one breath.

Teaching strategies: -

1. First start with the imitation of non-verbal behavior. E.g. imitation of hand movements, head movements etc.
2. This can be followed by imitation of lip movements.
3. Tactile cues can be used to make the child understand the concept of duration. E.g. the teacher can trace her finger down the child's arm while producing a long vocalization (a long a------------------) vs. patting his hand while producing a short vocalization.

Remember first teacher should give a model and then ask the child to imitate.
As the production of several short vocalizations on one breath is important for release of breath co-ordinating with words in connected speech, the development of this sub-skill should not be hurried.

b. Sub-skills relating to vocal intensity:
The child is considered to have achieved a control of vocal intensity, if he can imitate a series of several short vocalizations varying in intensity from loud speech to a whisper, on one breath.
The sub-skills relating to vocal intensity are: -

1. Production of brief, loud utterances.
2. Production of brief quiets utterances.
3. Production of a whisper.

Sub-skill 1: Production of brief loud utterances.
To achieve this sub-skill the following games can be played:

1. The teacher pretends to sleep and will open her eyes only when the child produces a sufficiently loud sound/vocalizations.
2. Ask one of the child's friends to stand at the corner of the room. Ask the child to stand at the other corner. Ask the child to call out to his friend. The friend should look back only if the child calls out in a loud voice.
3. Surprising the child by playing a prank. For example, hiding behind the door and surprising him when he comes into the room.

4. Ask two boys to pretend to do boxing and one of them should pretend to have got hurt and start moaning loudly.

Sub-skill 2: Production of brief quiet utterances:

Activities:

1. Giving routine examples like—if the teacher is teaching in class and the child wants to talk to his friend, will he talk loudly or softly?
2. If two friends want to share a secret, will they talk softly or loudly?
3. If two children want to tease another child and they do not want the other child to listen, will they talk/vocalize loudly or softly.

Sub-skill 3: Production of whispered speech:

Even children, who do not hear above 1000Hz, can hear a forced whisper if they are fitted with an appropriate hearing aid and if the microphone is close to the speaker. Whisper at a distance of 3" from the microphone is as intense/loud as a shout from a few yards.

Simplest strategy to develop whisper is through imitation, through use of residual hearing. Children, who have insufficient residual hearing, may be taught to whisper through use of touch.

Activities:

1. Produce a breath stream that can be felt by hand.
2. Make the child say /a/ forcefully, but without voicing.
3. A child can pretend to sleep and the other child can be asked to whisper a sentence into the child's ears.

c. Sub-skills related to vocal pitch:

The target behaviors are:

Production of 3 vocalizations on one breath, each at a different pitch .

The **sub-skills** underlying this target behavior include:

1. Vocalizing / saying a prolonged /a/ for 3 seconds in high pitch and in low pitch in one breath.
2. Varying pitch between low-high and high low, while vocalizing /a/.

Teaching strategies:

Sub-skill 1: Vocalizing /a/ in high and low pitch for 3 seconds in high pitch and low pitch in one breath.

1. Child should first be taught to identify /a/ produced by the teacher in high pitch and in low pitch.
2. Visual cues can be given. E.g. a high pitched /a/ may be associated with a hand stretched above the head and a low-pitched /a/ with a hand lowered below the waist level.
3. When the child can understand the pitch of the teacher's voice correctly with visual cues, he should then be trained to identify pitch through residual hearing alone.
4. For children with profound hearing loss the following are the strategies: -

a. To decrease pitch, in other words to enable the child to vocalize in a low pitch-----

   Ask the child to lower his chin towards his chest, and relax his arms and shoulders. Child's attention should be directed to the low pitch produced. Another method is to apply downward pressure on the thyroid cartilage. This action reduces the tension on the vocal cords and increases their mass and thus lowers the pitch.

b. Similarly, for raising pitch, in other words enabling the child to vocalize in a high pitch, ask the child to raise his neck and then say /a/. This will increase the tension in the vocal cords and reduce their mass, thereby increasing the pitch.

c. If the child has no useful residual hearing, or if he cannot modify voice pitch without tactile cues, he can be asked to feel the upward and downward movement of the teacher's larynx as she / he alternately produces a high pitch and a low pitch vocalization. Then by feeling his own larynx he can attempt to match his own laryngeal movements with that of the teacher's.

d. Children with no residual hearing may be able to hear the high pitched sound of the aeroplane. A taped sample of the aeroplane can play to the child in order to help him identify the high pitch.

e. For identifying low pitch, the sound of a dog bark can be taped and played to the child.

Once the child has learnt to vary the pitch of voice through the sense of touch, then he should be made to monitor the pitch changes in his voice only through hearing. Whether the child can hear pitch change or not, extensive practice must be given in order to ensure the oro-sensory motor patterns which underlie controlled pitch production.

Sub-skill 2: Varying pitch between low high and high-low, while vocalizing /a/.

1. This sub-skill can be developed when the child can vocalize in a high and a low pitch.

2. A smooth and continuous change in pitch from low to high and high to low is difficult to perceive through touching the larynx. It can be indicated visually. E.g. teacher can represent it by raising or lowering her hand.
3. Pitch breaks can occur when this sub-skill is attempted. Such breaks take place if the child can vocalize in the low pitch but cannot do so in the high pitch. Or it can also occur if the high pitch is established but not the low. When breaks occur teacher should work at establishing one pitch, either the low or high first and then stabilize the other.

The child can be considered to have adequate control when he is able to vary his pitch of voice smoothly from the highest to the lowest point, both rapidly in one second and slowly over 3 seconds.

Simultaneously the above skills should be used meaningfully i.e. at phonological level in the following manner:

1. Vocalizing with rising pitch for asking for some toy.
2. Vocalizing in a lower pitch when he (the child) does not get what he wants.

4.3.3 Stage 3, at phonetic and phonological level i.e. acquiring all diphthongs and vowels and using different vowels to approximate words:

How vowels are formed is described in Unit 3.

The vowels in Hindi are a, e, I, u, o, ae,

The commonly heard diphthongs in Hindi are

The sub-skills for production of each vowel are: -

1. Differential shaping of the vocal tract.
2. To be able to maintain each vocal tract configuration for at least 3 seconds.
3. Rapid repetition of each vowel.
4. Being able to rapidly alternate the articulators so that they can assume position for each vowel from whatever position they previously occupied. In other words rapid alternations of vowel target positions

Teaching Strategies:

The strategies for developing the above mentioned subs-kills will vary depending on the extent of the residual hearing of the child and his ability to use it. All other variables such as age and previous experience will have secondary importance.

Sub-skill 1: Differential shaping of the vocal tract.

The following are the strategies: -

1. Auditory strategies.

2. Tactile strategies.
3. Visual strategies.

Auditory strategies:

The simplest and the most effective strategy to teach vowels are to teach through auditory imitation. Not all children have sufficient hearing to acquire all vowels through audition. However the hearing-impaired child can hear back vowels.

Activities:

1. First step is to provide the child with a lot of auditory stimulation while interacting/communicating with him. For this, techniques similar to those specified for development of abundant vocalizations (Stage 1) can be used.
2. With very young children sounds made by different toys can be associated with different vowels

   E.g. a) a train with the sound made by its whistle u---u----.

   b.) an aeroplane with it's sound I----I---

   c.) sounds made by farm animals. Cow with moo, lamb with ba, and duck with kwae.

   d.) games and songs such as 'Old McDonald had a farm e—a—e—a—o--.

   *Remember to reinforce every attempt of the child to imitate. For reinforcement a variety of toys can be used.e.g.a) On imitation of /a/ a doll blinks its eyes. b) On production of /u/ a toy train moves forward. You can think of your own ideas.

Tactile strategies:

The child can feel configuration/shape for most of the vowels if he places a finger on the teacher's tongue as he speaks. The child is then expected to imitate the tongue height and position.

This involves four steps:

1.a) feeling with a finger the steady state position of the teacher's tongue.

b) Feeling with a finger the movement of the teacher's tongue.

2.Imitating the tongue configuration. This can be done by using another finger to feel tongue position in his own mouth.

3.a) Finger should be withdrawn.

b) Maintaining tongue position after the finger is withdrawn.

4.Trying to achieve tongue position without using fingers as a guide.

The last two steps require memory for lip position and motor kinesthetic memory. This strategy is important in order to focus the child's attention on motor kinesthetic patterns that are important for the production of vowels.

Feeling the tongue with a finger gives a kinesthetic feedback. This feedback provides information on the width and the tension in the tongue. This helps to differentiate certain vowels that have different tongue height and lip shape viz.- tense vowels (i, e, u, a) and lax vowels (I, E, U and a). The tongue is more wide spread and feels much hardness in tense vowels.

Once the tongue position for a given vowel has been established through touch, tactile strategies should be discontinued. The child should be reinforced so that he learns to maintain vowel production through normal-proprioceptive mechanism—the oro-sensory motor patterns associated with tongue placement.

Visual strategies:

Simpler ways of using visual strategies are: -

1. Using a 3 dimensional model, which allows the teacher to manipulate an artificial tongue within a visible mouth cavity.
2. Line drawings.
3. Using hand configurations e.g. using one hand to indicate position of the tongue and another to indicate position of the hard palate. Move the hand representing the tongue to indicate position of the tongue in the production of that vowel.

Remember:

1. Tongue position for vowels cannot be adequately visualized unless teacher makes exaggerated movements.
2. Giving an exaggerated model will lead to habitually exaggerated movements by the child.

Sub-skill 2: Maintenance of target vocal tract configuration:

Sustaining each vowel for several seconds serves 3 purposes: -

1. It enables the child to establish/achieve an ideal target position for the vowels.
2. It lays the foundation for maintaining tongue position. This foundation is important for the first stage of teaching consonants.
3. It provides control of articulators for sufficient duration. This is useful for making laryngeal and articulatory adjustments for the production of vowels.

Teaching strategies:

1. If auditory strategies have been used strategies similar to those used to achieve control of vocal duration can be used.

2. If tactile strategies have been used to develop a target vowel the same strategy can be used for the above sub-skill.

One can sustain vowels for a long duration depending on the breath supply, but one cannot sustain diphthongs.

Sub-skill 3: Rapid repetition of targets.

1. Once the first few vowel targets have been achieved and each can be sustained in isolation for about 3 seconds, the child should be taught to say them with a labial consonant preferably /b/ e.g. ba, bi, bu. Child should be taught to produce a string of ba, bi, bu on one breath.
2. Same can be done with other vowels—be, bu, bo etc.

He teacher should take care that there is no diphthongization.

Activities:
Nursery rhymes such as ba ba blacksheep etc can be used.

Sub-skill 4 Rapid alternations of vowel target positions:

The purpose of this sub-skill:

1. To further strengthen the motor-kinesthetic patterns associated with each vowel.
2. To ensure that the child's speech organs are trained to take target positions from the previous positions.
3. To enable the child to achieve movements associated with vowel formation to be made at rates commonly observed.

Teaching strategies:

1. The teacher may use the child's left hand to indicate one vowel and his right hand with another vowel.e.g the teacher can lift the child's left hand while saying /i/ and then his right hand while saying /u/.
2. Two vowels can be alternated on separate breaths i.e. /i/ on one breath and /u/ on the other.
3. Two vowels can be alternated slowly on the same breath.e.g.i---u-----.
4. Child should be able to achieve the rate of at least 2 vowels per second on one breath.
5. Later strings of several vowels can be alternated.

Order of target and sub-skill development:

1. Step 1:- Teach /a/, /i/, /u/, /au/, /ai/. All 4-5 sub-skills underlying the three vowels should be taught before progressing to step 2.

2. Step 2: - Teach /o/, /oi/, /E/, /u/ and /I/.

Diphthongs should be taught in a similar manner.

At phonological level:

As soon as the child has learnt to produce first two or three sub-skills for producing vowels or diphthongs at phonetic level, the child must be encouraged to use these phonemes in phonologic speech i.e. meaningfully.

Activities:

There are various ways in which a child can be encouraged to use vowels. Child's imitations can be encouraged in everyday situations: -

1. /au/ can be used when a child is hurt or when he is pretending to be hurt.
2. Child can be made to use /u/ to indicate surprise or pleasure e.g. following games can be played:-

---Pretending to fall on a banana peel and saying /au/, /u/

---Vocalizing /a/, /u/ when pinched

---Throwing plastic toy insects and saying /a/, /u/, /o/ in surprise

4.3.4 Stage 4, at phonetic and phonological level, i.e. consonants by manner with /a/, /u/ and /i/:

Teaching production of:

1. Plosives-/p/, /b/.
2. Nasal-/m/
3. Fricative-/h/.
4. Fricatives-/f/, /v/.

Refer to Unit 3 for manner of production of plosives, nasals, and fricatives.

The following are the **sub skills** - for the production of /p/:

1. Production of /p/ in single syllables releasing various vowels, viz./a/, /u/, /i/. i.e. /pa/, /pi/, /pu/.
2. Production of /p/ in a series of repeated syllables formed with any vowel. E.g./pupupu/, /pipipi/ etc.
3. Production of /p/ in a series of repeated syllables formed with various vowels e.g./pupipa/, /papipu/.
4. Alternation of syllables released with /p/ and syllables released with other consonants. E.g. /pama/, /pimi/, /pifi/.
5. Production of /p/ in inter-vocalic position e.g./apa/, /epa/ etc.

6. Production of /p/ in final position e.g. /ap/, /ep/.

Similarly, the sub-skills for production of all the other consonants viz./b/, /m/, /h/, /f/, /v/ are the same as those mentioned for the production of /p/.

The teaching strategies are as follows:

a. Auditory strategies.
b. Visual strategies.
c. Tactile strategies.

a. Auditory strategies:

Auditory strategies consist of listening to the teacher and imitating the teacher's model without exaggeration.

The visual and tactile strategies, which can be used by the teacher for teaching the production of plosives, nasal /m/ and fricatives are as given below: -

Plosives /p/, /b/ Nasal /m/
Fricatives /h/, /f/, /v/

Visual strategies Objects such as paper Visual strategies for
/h/ use strategies similar to
Or feather can be used production of /m/ are
those used for plosives. For /f/
The movement of these less effective.
and /v/ place of production can
Objects which occurs be
shown---viz. upper teeth
As a result of the burst,
touching the lower lip. However,
can be shown . the
breath flow to produce friction

cannot
be visualized. Breath flow

can be
shown by demonstrating

how light objects can be blown

if held close to the mouth, while

producing /f/ and /v/.

Tactile strategies Allow the child to see This is the most
These strategies are most effective
the bilabial closure in the effective way of
in teaching /h/- as breath flow is
mirror and let him feel the teaching /m/.
greatest while producing /h/. Make
cheeks. Then let him feel a. vibrations can
the child feel the breath on the
the burst of energy on felt on the bridge of the nose.
back of the palm.

his finger tips. b. make the child feel the emission of air through the nostrils.

4.3.5 Stage 5, at phonetic and phonological level, i.e. place distinctions in consonant production:

Most of the consonants discussed in this stage are produced in the same manner as in Stage 4. However, they differ in the place of production.

The order of teaching is as follows:-

Step-1:- Teaching of production of lingua-dental (t̲, d̲, l, n), lingua-alveolar (s, z), and retroflex (t, d,) phonemes.

Step 2 :- Teaching production of lingua-palatal (ch, dz) and velar (k, g) phonemes.

Sub-skill 1: Production of /t/ releasing various vowels e.g. /ta/, /ti/, /tu/

Sub-skill 2: Production of /t/ in a series of repeated syllables formed with more than one vowel.e.g.--/tatata/, /tititi/ etc.

Sub-skill 3: Production of /t/ in a series of repeated syllables e.g. /tatitu/, /totite/ etc.

Sub-skill 4: Alternation of syllables released with /t/ and syllables released with other consonants e.g. /tono/, /tiwi/ etc.

Sub-skill 5: Production of /t/ in syllables varying in intensity.

Sub-skill 6: Production of /t/ in medial position with vowels e.g. /ata/,/ita/ etc.

Sub-skill 7: Production of /t/ in final position e.g./at/, /it/ etc.

Similarly the sub-skills for production for all the phonemes of this stage are the same as those listed for the production of /t/.

The teaching strategies are divided into:-

1. Auditory strategies.2.Visual strategies.3.Tactile strategies.

Auditory strategies comprise of imitation of teacher's model without any exaggeration.

Lingua-dental phonemes	Lingua-alveolar	Retroflex
Phonemes/t̲/	**phonemes /l/**	**/t/**
Demonstrate place of production production	Demonstrate the place of production by	Demonstrate place of
by demonstrating how to place tongue tip	opening the mouth wide, showing the	by showing how the
The tongue tip behind the upper palate, air	tongue point against the alveolar ridge.	curls up against the
front teeth, slowly releasing the followed by	Point out to the openings on both the sides	pressure builds up
contact and producing an exploded contact and	reduce the mouth opening to normal	the release of the
/t/. Let the student attempt to imitate /t/.	and produce a steady /l/.	producing an exploded
this production with a mirror if he cannot produce without.		
/d̲/	**/n/**	**/d/**
...e taught in the same way as /t/. same way	Let the student feel the vibrations on the	To be developed in the
Develop the unreleased /d/ if the can be	nose during the production of /n/.	as /t/. Voicing present
released /d/ is accomplished. the child	Explain the difference from /m/ by showing	explained by making

If necessary demonstrate that level of final /d/is not released by teacher placing her finger over her lips to prevent release.	the child the closure point of tongue and alveolar ridge.	feel the vibrations at the larynx.
	/s/ First explain the production of /th/. Produce friction gradually withdrawing the tongue and bringing the teeth together for production of /s/. Show by diagram that tongue tip moves up towards the alveolar ridge as it is withdrawn.	
	Demonstrate emission of steady breath with Feather or strip of paper.	

4.3.6 Stage 6, at phonetic and phonological level, i.e. Acquiring consonants by voicing:

Teaching strategies related to voiced voiceless distinctions:

The plosives /b, d, g/ vs /p, t, k/ :

Sub-skill 1: Production of /ʌp/ vs /ha/.
Sub-skill 2: Production of /ʌp/ and /ha/ (i.e. /ʌphaʌpha/).
Sub-skill 3: Production of /pha/
Sub-skill 4: Repetition of /pha/ (i.e. /papapa/).
Sub-skill 5: Production of /p/ with all vowels.
Sub-skill 6: Alternation of syllables released with /p/ and syllables released with other consonants. For example /pumupumu/, /pɔbɔpɔbɔ/.
Sub-skill 7-12: Production of /t/ in six steps above.
Sub-skill 13-18: Production of /k/ in six steps above.
Sub-skill 19: Repetition of sequences including /p, t, k/ and /b, d, g/.
Sub-skill 20: Comparison of inter-vocalic /b, d, g/ and inter-vocalic /p, t, k/.
For example, /ipi-ibi/, /itu- idu/.

Auditory strategies:
Auditory strategies should be successful with most hearing-impaired since some acoustic cues on voiced- voiceless distinction are present below 500 Hz.

Visual strategies:
Visual strategies are limited to use of electronic devices that provide a visual display. The presence or absence of voice cannot be seen through speech reading.

Tactile strategies:
Tactile strategies include feeling the vibrations produced by voice by touching the neck for the voiced consonants i.e. for /b/, /d/, /g/.

The fricative / f, ʃ, s / versus /v, ʒ, z/:

Target and sub-skills:
Turbulent flow is important for the production of fricatives. For the production of voiced fricatives vocal fold vibration is necessary.

Teaching strategies:

Steps are as follows:

- Make the child practice sustaining the fricative in syllables such as /af, a v/, / æʃ, æʒ/ and /us, uz/.

This provides the child with the oro-sensory motor patterns which will help him in differentiating between the voiced and the voiceless counterparts.

- Once the voiced and voiceless fricatives are learnt they should be contrasted and practiced within a program of sub-skills. The sub-skills suggested above are useful.

The affricate / ʧ / versus /ʤ/

Since these sounds are blends consisting of plosive and fricative component, the targets, sub-skills and teaching strategies for learning them are similar to those explained for plosives and fricatives.

4.3.7 Stage 7, at phonetic and phonological level, i.e. acquiring initial and final blends and all speech intelligible:

For the production of any blend the following strategy can be adopted:- for example for the production of /pr/, teacher should ask the child to produce /p/ without the vowel and then immediately say /r/. In other words the child should first say the first consonant and then glide over the next consonant in the blend. The other frequently used blends of Hindi, for example /sm/ as in "smita"; /sn/ as in "snan"; /shr/ as in "shruti"; /kr/ as in "kram"; and /ksh/ as in "lakshman", can be taught using similar strategies.

The teacher and the parents can also give the hearing-impaired child, a lot of exposure to music and rhythm. How the above will help will be discussed in detail in the Unit 7.1.

4.4 APPROACHES FOR TEACHING SPEECH

There are three extensively used approaches for teaching speech to the hearing-impaired.

These approaches are:

1. **Auditory Global Approach.**
2. **Multisensory Syllable Unit approach.**
3. **Associated Phoneme Unit approach.**

These approaches have some common features, but inspite of the common features, the three approaches are **distinct approaches.**

They differ in:

1. The **sensory channel** used.
2. The **size of the unit of speech** used for teaching.
3. The way in which the teacher can elicit speech.
4. The importance each of the approaches places on the **four phases of speech acquisition and development viz.-**
   i. Child is provided with **speech and language stimulation**.
   ii. Child **imitates** speech.
   iii. Child **responds to speech** of others **by answering**, rather than imitating.
   iv. **Spontaneous speech**-In other words child initiates speech or begins to speak on his own without stimulation from others.

4.4.1 Auditory Global approach

In this approach the instructions and the techniques which are used for teaching are chosen systematically. These techniques are called methods.Different terms or labels are used for different methods e.g. 'Auditory-Oral','Aural-Oral', 'Acoupedic', 'Auditory-Verbal' and 'Acoustic' method.
However, there are certain **principal features**, which are common to these methods which are as follows-

1. The primary, 'although not the only' channel used for speech development is the **auditory channel.**
2. The **main input** given to the child is **fluent, connected speech.**
3. The **first phase of speech acquisition** (which is stimulating the child with
4. A number of speech patterns) is considered to be the most important.

1. The primary, 'although not the only' channel used for speech development is the **auditory channel**:

According to this approach, in order to achieve intelligible speech, auditory channel i.e. use of hearing or use of auditory feedback is most important.

In developing speech, use of hearing is for the following purposes-

a. Directing spoken language to the child:

By giving an input of spoken language to the child, we are giving a lot of exposure to different speech patterns, which he can later imitate. This will provide an enriching and stimulating environment to the child for learning to speak. The earlier the child is given a lot of speech stimulation, the more likely he is to achieve speech and language milestones, at the same age as acquired by a normal hearing child. This will ensure that there will be no significant delay in his speech and language milestones.

In providing spoken language stimulation to the child, the teacher should remember the following points—

The child is using the appropriate / suitable hearing aid, which has been prescribed to him by an experienced **Audiologist.**

- The teacher should talk to the child at an appropriate distance and volume, so that the speech signal reaches the child.
- Ensure that noise in the surrounding / background noise is less.
- There should be adequate light on the teacher's face. This will enable the child to observe the teacher's speech movements.
- The teacher should speak clearly, at a normal rate and not exaggerate her speech movements.

b. To elicit specific units of speech:

Auditory channel can serve as a primary channel for eliciting specific units of speech.

To elicit a specific unit of speech such as a phoneme /a/ or a syllable /ma/ the teacher must-

- Cover her mouth, ask the child to listen carefully and then imitate her.
- If the first attempt of the child is not satisfactory, the teacher must repeat the speech unit several times.
- If the child still does not imitate, the teacher should give him a visual feedback. In other words, she should let the child see her speech movements as well as hear the stimulus.
- When there is improvement she should increase the size of the speech unit. In other words the teacher should use the target unit in words, phrases and later in sentences.

c. For monitoring speech:

The purpose of the auditory global approach is not only to establish the auditory channel as primary for receiving speech models, but as the primary channel for child's own feedback to facilitate monitoring his speech.

In order to be able to do so the following points should be taken into account:

i. **Amount of connected speech** directed to the child

ii. The **content** and **nature** of connected speech

iii. The **way** in which connected speech is **directed** to the child

i. Amount of connected speech:

The overall amount of connected speech input should be more than that which is normally directed to a child without hearing impairment. The child with normal hearing listens to conversations effortlessly. Speech is not always directed to him. A hearing- impaired child needs speech to be directed to him. A concentrated effort needs to be made to increase the amount of speech purposely directed to the child. Using connected speech, parents and teachers should describe and explain what they and the child are seeing and doing. They can narrate stories, describe their experiences. Situations should be arranged to provide the child with a lot of speech and language stimulation.

ii. Nature of connected speech:

When child has learnt to use words meaningfully. the parents and the teacher should employ the strategy of **expansion.** In expanding what the child has said, the adult imitates the child's words, usually retaining the same word order, but adds something to them to form a complete grammatically correct sentence. For example if the child has said, 'Dog bark," the adult might expand his utterance saying, "Yes, the dog is barking". This kind of expansion provides the child with a corrective model. After the child has learnt to say some phrases, the parents and teachers can use the strategy of **modeling.** To model speech and language is to comment relevantly on what the child has said, rather than to improve it by expansion. If the child has said, "Dog bark," the teacher might say, "Yes, because the dog has seen the cat is in the tree". This not only serves to reward the child but may also enrich his vocabulary and improves his syntax.

iii. Directing connected speech to the child:

Speech should be directed to the child. For this purpose proper use of amplification is very important. The microphone distance from the speaker and its placement is very important. To avoid distortion the microphone should be held a little to the side of the teacher's mouth. The microphone should not be held too far from the teacher's mouth as this may cause the speech signal to fall below classroom noise level.

Although systematic and coordinated auditory stimulation is the central focus of the Auditory Global approach, it achieves its full potential only if the intervention is timely, comprehensive and generally individualized. Teacher should remember though the approach is good it is not suitable for every child. It will be more suitable for a child having a good amount of residual hearing, since it does not permit the use of other sensory channels.

3.4.2 Multisensory Syllable-Unit Approach:

The multisensory syllable-unit approach is considered to be the "traditional" approach to teaching speech to the hearing-impaired.

The distinctive characteristics of this approach are:

1. multisensory stimulation for speech production,
2. the syllable as the basic unit for speech instruction,
3. the teacher applies direct efforts at school towards development of speech units through,
4. emphasis on the second and third phase of speech development (refer Page 18 ii. & iii.)

1. Multisensory stimulation for speech:

According to this approach the impaired auditory system of the hearing-impaired is inadequate for speech development. Other sensory channels must therefore be used. The auditory, visual, tactile, and kinesthetic senses are used selectively and discriminatingly for speech instruction. The teacher may emphasize one sensory channel or the other, or may use a combination of channels to develop a strong sensory impression for the child.

The multisensory syllable unit approach assumes that speech will not develop just from the child's hearing and seeing connected speech during conversation, nor will it develop completely with a special program of speech stimulation. Accurate articulation of speech sounds and their combinations will need special instruction

2. The syllable as the basic unit for speech instruction:

The syllable is considered as a basic unit of speech because-

a. it does not demand much motor memory
b. it is small enough to allow for accuracy of articulation
c. it is sufficient enough to demonstrate co-articulation of phonemes

3&4 Direct efforts applied by the teacher and emphasis on the second and third phases of speech development:

The teacher applies direct efforts. The steps are as follows:

a. In the initial stages the child is required to imitate babbled syllables such as /bububu/.

b. As the child progresses, drills include the combinations of vowels and consonants.

c. Drills proceed from simple drills to more complex ones. For example, first an inventory is made of vowels and consonants in the positions in which they commonly occur. If the target phoneme is "t" (for example), it should be practiced with accompanying vowels (V)- when "t" is in initial position (tV), in the final position (Vt), and in the medial position (VtV). In other words, drills for "t" with the vowel "i" should include "ti", "it" and "iti". Later "t" can be practiced in words using other consonants. First drills should include monosyllabic words, followed by bi and multisyllabic words, later drills should include consonant clusters(blends).

Unlike the auditory global approach in which speech sounds are taught in any order, in the multisensory syllable unit approach, speech sounds are introduced few at a time in a pre-determined order. Those sounds, which are easiest to learn, are taught first, progressing to sounds of increasing difficulty.

It is recommended that the teacher should maintain in the classroom a visible inventory of each child's development of speech sounds. This can be done by considering the phoneme development in three ways:

- **Production:** i.e. whether and how well a phoneme can be produced.
- **Practice:** i.e. whether a phoneme does or does not occur when prompted in exercises for speech practice.
- **Purpose:** i.e. whether the phoneme is used when the child's spoken language is intended for purposeful communication.

The teacher may observe three levels of achievement:

☐ - absent

⧄ - emerging, i.e. partially successful, but not fully developed

☒ - developed or mastered fully.

The above can be used as a record of the speech development of the child. Such records are known as individual speech program or Individualized Educational Program (IEP).

Each of the three areas, viz. Production, practice and purpose are divided into 3 areas:

Production is divided into-

- production of phoneme in **isolation**
- Production of phoneme in **syllables**
- Production of phoneme in **various phonetic contexts**

Practice is divided into-

- Practicing the phoneme on **imitation**
- Practicing the phoneme on **reading aloud**
- Practicing the phoneme on **extended memory**

Purpose is divided into-

- Use of the phoneme on **prompted response**
- Use of the phoneme in a **formulated answer**
- Use of the phoneme in **spontaneous speech**

Let us see how the teacher can teach the phonemes using the above mentioned manner.

Isolation:

The teacher explains and gives instruction for teaching the phonemes in isolation. (For learning each phoneme refer to the teaching strategies as given in the developmental model of Ling).

Syllables:

After the child has learnt to produce the syllable in isolation, the teacher gives drills to the child to produce the phoneme in monosyllables, in which the target phoneme occurs in the initial, medial and final position. For example, if the phoneme to be taught is /s/, then the drills will consist of syllables with /s/ in initial, medial and final position eg. /si/, /isi and /is/, or with vowel /o/, the syllables will be /so/, /oso/ and /os/. Similarly other vowels can be used.

Phonetic Contexts:

This means producing the target phoneme in various phonetic contexts, for example if the target phoneme is /t/, then drills should be given where /t/ occurs in most of the phonetic contexts. E.g. /tb/ as in batboy, /tk/ as in what kite, /td/ as in hotdog, /tn/ as in last night, etc.

Imitating:

Once the child has learnt to produce the phoneme in the first stages of production, he should learn to practice the correct production of the phoneme. Practice can be given through imitating the phoneme in syllables in a number of drills consisting of other consonants. Drills should be such that they require the short term memory for speech. Following is the examples of the syllables which can be used for drill work- /sobo/, /obos/, /usub/, /busu/ etc with other consonants.

Reading Aloud:

Another way of practicing the target phoneme is reading aloud. When reading aloud, most hearing-impaired children are more likely to produce a phoneme such as /s/, when they see it written than when they are to produce it when prompted by a picture or when using it spontaneously.

Extending Memory:

Here exercises are included which require extending memory for the production of speech units. Simple imitation requires a short-term memory. Since the main purpose of learning speech is to produce the appropriate speech unit at an appropriate time in future, long-term memory is required. Such exercises are of the kind in which the teacher says a word or phrase and then asks the child to turn around and say the unit to another person. This is an example of delayed imitation. Another way in which this can be done is that the teacher can ask the child to read a phrase silently and then to say it from memory.

Prompted Response:

Here the child is required to remember and then give an appropriate response to a stimulus. For example, the teacher shows the child single objects or pictures and then asks him to say the name of each object or picture shown. Another way is to show the child some pictures having actions and the child is supposed to describe the actions. These exercises give the child a number of experiences in using the phoneme while he is formulating spoken language.

Formulated Answer:

The most common way of eliciting spoken language is to ask a question. The answer requires the child to formulate language, use appropriate grammatical structures and produce the newly learnt phoneme adequately. So the teacher will ask a question whose answer will comprise of a sentence in which the newly learnt phoneme can be used.

Initiated Spontaneous:

Here the child is asked to talk about an event, for example, his vacations, his family etc., thereby, giving him practice in the correct production of the phoneme while speaking spontaneously.

Thus, in this approach, a structured way of producing, practicing and using the target phoneme is given.

4.4.3 Associated Phoneme Unit Approach

The characteristics of this approach are:

1. Multisensory stimulation for speech
2. The individual phoneme is the basic unit for speech instruction
3. Emphasis on the third phase of speech development (refer to Page 18. 4 iii)

1. Multisensory stimulation for speech:

Like the multisensory syllable unit approach, all sensory channels are used selectively for speech development.

2. The phoneme is the basic unit for speech instruction:

As the phoneme requires the shortest motor memory, it is considered as the basic unit for speech instruction. The phonemes which can be taught in isolation are taught first, for example /f/, /s/, /sh/. The other phonemes are taught along with the vowel /u/. Drills are given for achieving correct production of the phoneme in syllables, followed by practice of the phoneme in words and later in sentences. Once the child has learnt to produce a unit in spoken language, he is expected to reproduce it without prompting.

Writing is always associated with oral production.

3.Of the four phases of acquisition of speech, this approach emphasizes phase 3, in which the child is prompted to respond, not by imitating but by answering with an appropriate verbal response.

4.5 SUMMARY- POINTS TO REMEMBER

√ One of the extensively used model for teaching speech to the hearing –impaired is the **developmental model** put forth by **Daniel Ling**.

√ A normal hearing child acquires speech in a particular order and pattern. The developmental model uses the same order and pattern to teach speech to the hearing-impaired child.

√ The **purpose** of this model is to enable the teachers to develop speech in the hearing-impaired children in a systematic and in an effective way.

√ This model describes:

- the **seven stages** for developing speech at the **phonetic and phonological level,**
- the **target behaviors** and **sub-skills** involved in each stage,
- the **activities** for achieving the various sub-skills.

Besides the Ling's model there are other approaches for speech teaching.

√ There are three extensively used approaches for teaching speech. They are:

- the **auditory global** approach
- the **multisensory syllable unit** approach
- the **associated phoneme unit** approach

√ These approaches have some common features, inspite of the common features, they are distinct approaches.

4.6 CHECK YOUR PROGRESS

QUESTIONS:

1. Enumerate the purposes of the Ling's developmental model.
2. Enumerate the seven stages of the developmental model.
3. Discuss the sub-skills and the target behaviors for the Stage 1.
4. What the teaching strategies used for developing the sub-skills for the Stage 2 and 3.
5. Discuss the auditory, visual and tactile strategies for teaching the phoneme /s/.
6. Discuss the strategies for teaching voicing and voiced distinctions.

4.7 ASSIGNMENT

a. Draw a **flow chart** or **diagram** illustrating the Ling's developmental model.

b. Discuss the advantages and disadvantages of the three approaches used for teaching speech.

4.7 POINTS FOR DISCUSSIONS / CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

4.7.1 Points for Discussion

4.7.2 Points for Clarification

4.8 REFERENCES / FURTHER READING

1. Ling D. (1976). Speech and the Hearing-impaired Child: Theory and Practice. Washington DC : Alexander Graham Bell Association for the Deaf.

2. Calvert, D. R. and Silverman, S.R. (1983). Speech and Deafness. (2nd Ed.). Washington D. C: Alexander Graham Bell Association for the Deaf.

UNIT 5: CHALLENGES AND REMEDIAL STRATEGIES

STRUCTURE

- Introduction
- Speech teaching
- Corrected model for Teaching aids
- Equipment for auditory, visual and tactile feedback for speech
  - Summary – Points to remember
  - Check your progress
  - Assignment
- Points for discussion / clarification
- References / Further readings

1 INTRODUCTION:

During the developmental stage the child may not acquire the target behaviors adequately. This may be because—

1. Pre-requisite behavior for the development of new skills may not have been adequately established.
2. All sub-skills may not be adequately acquired.
3. Newly learnt skills may not have been incorporated at the phonological level.

Hence **deviant patterns** in the speech of the hearing-impaired children are most likely to occur. The corrected model suggests a range of strategies that may be used in the remedial treatment of deviant patterns.

Deviant patterns at STAGE 1 (Vocalizations freely and on demand) and STAGE 2 (Bases of suprasegmental patterns):

At this stage the child may develop the following deviant patterns- breathy voice, pharyngeal tension, vocal abuse, and falsetto voice.

Breathy voice:

This occurs when there is relatively little tension on the vocal folds. Breathiness is usually due to failure to approximate the vocal folds firmly.

This may be corrected by using the following strategies:

1. Exercises involving exertion
2. Games in which the child has to hold his breath for some time and then vocalize. For example- the child holds his breath with his mouth open ready for voicing and vocalizes when the teacher signals to him. In this way the vocal folds are adducted in preparation, and they will be sufficiently tense. This will result in a strong voice.

Pharyngeal tension:

This can occur when-

1. exercises involving exertion are used
2. child is learning to modify pitch by raising and feeling his larynx

To prevent this the child should be given an opportunity to produce voice freely in play.

Vocal abuse:

Vocal abuse occurs due to:

1. Strained vocalizations, which may lead to inflammation or structural changes of the larynx.

2. Unnecessary laryngeal tension.
3. Continuous use of exercises involving exertion.
4. Use of either too high or too low- pitched voice.

This may be corrected by using the following strategies:
1. Use of other strategies for voicing.
2. Vocalizing achieved through fun and games. Thereby, overall tension is minimal.

Falsetto voice:
Falsetto voice is commonly acquired in:
1. Children who have no residual hearing.
2. Children who make no use of the residual hearing they have.

During the production of falsetto voice the vocal folds first approximate / come close together. They tense to a much greater extent than is required. These adjustments take a long time.

This may be corrected by using the following strategies:
1. Develop skill in rapid **alternation of voiced and unvoiced sounds** at phonetic as well as phonological level. For example saying /data/, /bapa/ etc. alternately. By doing so, time is not available for the child to tense his vocal folds.
2. Production of different kind of laryngeal tension, for example a **forced whisper.** Forced whisper involves as much as tension as falsetto. But for the vocal folds to take any other position after forced whisper , they i.e. the vocal folds should be relaxed. Thereby tension is reduced.

Deviant patterns at STAGE 3 (Production of vowels and diphthongs):
The following deviant patterns are seen:
1. Substitution.
2. Neutralization.
3. Prolongation.
4. Diphthongization.
5. Exaggeration.
6. Nasalization.

1. **Substitution:**
   Substitution means replacing one vowel by another. If this occurs at the phonological level then:
   a. Each of the 5 sub-skills described for the production of diphthongs and vowels must be developed.
   b. Strategies already described for teaching should be applied.

c. Adequate phonetic to phonologic transfer should take place. In other words after the child has learnt to produce the vowel or diphthong, he should be given an opportunity to use the vowels and diphthongs meaningfully in words and sentences in everyday situations.

If error occurs at the phonological level then:

a. Teacher should build up a key vocabulary of words containing that particular vowel or diphthong.
b. Teacher should work on pronounciation using previously mentioned strategies.

2. **Neutralization:**

(Refer to Unit 4 for definition and explanation of neutralization).

Neutralization occurs due to insufficient practice. This may lead to speech containing no differentiating stress patterns and abnormally slow rate.

The remedial strategies are as follows:

a. Giving sufficient practice to the child both at phonetic and phonological level.
b. Child should be trained to use vowels accurately in words receiving stress.
c. Child should be trained to use speech at a normal rate.

3. **Prolongation:**

In order to correct prolongation, phonologic speech at the normal rate should be provided by the teacher as a model. Attention should be given to the development of non-segmental and suprasegmental features rather than only on segmentals. Skills demanding rapid repetition and alternation should be practiced.

4. **Diphthongization:**

When there is diphthongization of vowels, it means that the tongue is travelling much further than the point required for the target vowel. In order to remediate dipthongization:

- All vowels should be redeveloped through the procedures mention earlier.
- The child should master all the sub-skills required for the production of vowels at the phonetic level.
- They should be used in phonologic speech at normal speaking rates in words and phrases commonly used by the child.
- Teacher must ensure that unwanted diphthongs are habitually replaced by vowels.

5. Exaggeration:

Exaggeration occurs due to inappropriate teaching strategies. Since the child is hearing-impaired, there is a tendency amongst the teachers and others in the child's environment to provide visual feedback by producing the sounds with exaggerated lip and jaw movements.

There are two strategies for remediation of exaggeration:

a. The child must be provided with normal speech models and not exaggerated ones.
b. All five vowel sub-skills should be should be rehearsed without exaggeration. Attention during this should be gradually shifted from visual to auditory and motor kinesthetic patterns associated with learning each target vowel.

6. Nasalization:

Nasalization of vowels occurs when the velopharyngeal port is open during the production of the vowels. Due to this the breath stream passes through the nasal cavity. The reason why hearing-impaired children produce this is that nasality provides stronger orosensory patterns and more intrinsic feedback. For remediating nasalization the following can be done:

- Yawning, sucking, blowing and whistling all require a raised velum. Make the child alternate sniffing with yawning, sucking and blowing, or whistling, in order to help strengthen velar action.
- Most children, including those who are hearing-impaired, like to whistle and should be taught to do so because this skill usually involves more pharyngeal action to help in velopharyngeal closure than blowing.

The following deviant patterns may be observed in the production of consonants:

1. Faults due to inadequate breath control.
2. Nasalization and denasalization.
3. Tension.
4. Exaggeration and prolongation.
5. Intrusive consonants and voicing errors.
6. Substitution, omission and distortion.

1. Faults due to inadequate breath control:

Faults in production of consonants that may be caused by inadequate breath control include:

- Voicing errors.
- Errors in aspiration.

Adequate breath control is required for appropriate voicing. Thus if there is inadequate breath control it will give rise to voicing errors. Inadequate breath control affects consonants and vowels equally. In other words if the aspirated consonants are produced with inadequate breath control they will be produced with less aspiration. Similarly if the vowels are produced with excessive breath, they will be heard as aspirated.
Remediation begins with:

- Training the child to produce vowels and diphthongs with different intensities.
    - Drills in repetition of strings of syllables, which are made up of voiced consonants, should be practiced.

Due to this

Faults affecting aspiration i.e. de-aspiration of aspirated phonemes, can be remediated by repetition of sub-skills described for the production of /h/. Some hearing-impaired children may produce certain sounds with an excess of breath. If speech is breathy, then it is usually because there is poor control of the larynx, poor adjustment of the articulators or both. The fault is usually best treated by strengthening the voice.

1. Nasalization and denasalization:
These deviant patterns are due to inadequate development of velar target behaviors. The most common reason is that the nasal / non-nasal distinction has not been adequately taught. The solution is to develop or redevelop the consonants by means of the earlier mentioned strategies.

2. Tension:
Problems in consonant production may arise because the articulators are too tense or too lax. Tension which may be generalized throughout the body or focussed in the head or neck region, is usually associated with apprehension, insecurity, or inexperience in speech production. Frequently such problems may be overcome simply by making the speech training in class and speech experience out of school interesting.

•

3. Exaggeration and prolongation:
Exaggerated lip, jaw, or tongue movements are behaviors that have been taught and reinforced. To prevent exaggeration and prolongation the teacher should speak to the child normally during conversations and lessons, avoid the presentation of exaggerated models in the speech teaching process, accept and reinforce only those

patterns produced by the child that are very close to the desired target behaviors, and provide specific training to develop adequate rates of production.

4. Intrusive consonants and voicing errors:
Intrusive voicing occurs if the child has not learned to make voiced-voiceless distinctions. The remediation can be done by teaching the child to make voiced–voiceless distinctions as discussed earlier (sub-skills and strategies of Stage 6 of developmental model).

5. Substitution, omission and distortion:
These can occur because the child may have mastered the adequate production of the phoneme at the word level, but not at the sentence level. In order that the faulty patterns be remediated, considerable practice of the appropriate pattern in the sentence structures should be done.

5:-Place distinctions in consonant production:-

ected model:-

For older children who have acquired few words, phrases etc.(i.e. communicating verbally to some extent) use the corrected model.
For eg. if a child has acquired skills till Stage 3, then the teacher needs to proceed to Stage 4. Stage 4 consists of 7 target behaviors—namely production of 7 front consonants which differ mainly in manner of production and should be developed as soon as the essential range of vowels i.e. Stage 3 has been established.
Eg. nasality is a common problem in the hearing impaired children, as is denasalization of /m/ . To avoid such problems we need to select and teach sub-skills with great care to ensure automatically correct target production. By following the proposed model we can be sure that the anticedent behavior required for adequate production are present. These behaviors are vocalization on demand (Stage 1): control of voice duration, intensity and pitch (Stage 2) and production of several vowels and diphthongs. (Stage 3).

Sub-skills required for acquisition of /m/ are listed below:-
1. Direct production of /m/ in isolation.
2. Repeated production of /m/ in isolation.

3. Production of /m/ in final position different vowels.eg. mumima following vowels /u/,/a/ and /i/.
4. Repeated production of vowel initiated syllables ending in /m/ eg. aam.
5. The production of /m/ as a releasing consonant.—syllables formed with various vowels including /u/,/a/,/i//--mu, ma, mi.
6. Repeated production of /m/ in an initial position in a string of syllables, each containing the same vowel eg.mumumu.
7. Repeated production of /m/ in initial position in a string of syllables containing.
8. Alternation of syllables containing /m/ with syllables containing other sounds. Eg.mabi.
9. Humming over a range of at least fifth 8 semitones.
10. Production of various syllables initiated with /m/ at high, mid, and low pitch over a range of at least 8 semitones.

In a similar way---

5.7 CHECK YOUR PROGRESS

1. Discuss the objectives of the speech teaching strategies at K.G., primary and intermediate level.
2. Discuss the deviant patterns that occur at Stages 1 and 2.
3. Discuss the remedial strategies for the deviant patterns occurring at Stages 1 and 2.
4. List out deviant patterns occurring at Stages 3, 4, 5, 6 and 7.
5. Enumerate the various teaching aids used for speech teaching and correction.
6. Write a note on use of visual aids for speech teaching and correction.
7. Discuss the importance of role of parents in development and maintenance of intelligible speech.

5.8 ASSIGNMENT

1. Identify a child having deviant patterns at Stage 3, and write a report of the remedial strategies used by you to correct the deviant patterns.
2. Describe in detail any teaching aid that you have seen during your clinical work. Discuss its advantages and disadvantages.

5.9 POINTS FOR DISCUSSIONS / CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

Points for Discussion

Points for Clarification

5.9 REFERENCES / FURTHER READING

1. Children and Adults of Manitoba By Harris G. M. (1970).

BLOCK 4:
CURRICULAR ADAPTATION

UNIT 1: CURRICULAR ADAPTATION-MEANING AND PRINCIPLES

STRUCTURE

- Introduction
- Speech teaching strategies for K.G., Primary and Secondary school level
- Corrected model for correcting the deviant patterns in the speech of the hearing-impaired
- Teaching aids and equipment for auditory, visual and tactile feedback for speech
- Parent / care giver involvement in the development and maintenance of speech
- Summary – Points to remember
- Check your progress
- Assignment
- Points for discussion / clarification
- References / Further readings

1.1 INTRODUCTION

In unit 6 we have looked at the developmental model for teaching of speech to the hearing-impaired. In this unit we will discuss more strategies **for developing speech at the KG, primary and secondary school level. By now you are well acquainted with the developmental stages and the various skills and target behaviors that a child should acquire at each developmental stage. However, due to a number of factors, some children may fail to achieve the target behaviors at the right stage, resulting in deviant speech patterns. We will discuss the** corrective strategies **for eliminating these deviant patterns and also review the various** teaching aids **that can be used for optimizing use of other sense modalities for acquiring intelligible speech. To sum up the unit, we will look at few strategies for ensuring parent participation in development and maintenance of speech. This is important as it is established that a team effort involving the** teachers, speech-language pathologists and the parents **is crucial in developing good speech patterns in the hearing-impaired child.**

1.2 SPEECH TEACHING STRATEGIES FOR K.G., PRIMARY AND SECONDARY SCHOOL LEVEL:

Teaching speech to the hearing-impaired preschool and primary children is not only a challenge but also a **rewarding experience.** Also, hearing-impaired children at primary and secondary school level need to have intelligible speech for **effective communication.** It is difficult to develop clear intelligible speech in children with severe hearing impairment.

For intelligible speech to be achieved a speech program must-

- Be based on sound **principles**
- Have demanding yet attainable **objectives**
- Employ / use a variety of workable **strategies**

A) Preschool and primary children:

Preschool and primary children have **unique needs** that must be taken into account when planning a program of speech instruction. Some of the needs of young hearing-impaired children that should be considered when planning a program for speech instruction are:

- The need to be **actively involved** in the program not just verbally but physically as well
- The need for success and positive **reinforcement**
- The need for **love and support** for all efforts
- The need for personal one to one **attention**

These basic needs may be incorporated in the speech program in various ways:

1. Lessons should include some kind of **activity or game** to keep the child actively involved and to stimulate interests and motivate him.
2. Practice items / **drills** should be included which will give the child a feeling of success.
3. Items involving development of **new skills** should be a part of every lesson.
4. Teacher should constantly **praise and reward** the child's efforts during the speech lesson. For example verbal expression of approval, points, stars or other tangible rewards should be given.

5. Lessons should be conducted on a one-to-one basis, in order to give the child **undivided attention.**
6. Each child's **strengths and weaknesses** should be determined. The strengths should be capitalized upon and the weaknesses should be remediated / lessened.
7. Since speech develops in an orderly manner in a normal child, the hearing-impaired child should be taught in the same **orderly manner.**
8. Since speech is learned best through audition, maximum use of **residual hearing** should be a part of all speech instruction and should be supplemented by use of **touch and vision** when needed.
9. Speech is a learned skill, which must be taught to the hearing-impaired child. Since it is a skill it requires **sufficient practice** for mastery. Therefore daily individual speech training is required for preschool and primary children.
10. Speech is developed most effectively in an **environment** that is relaxed yet demanding when it comes to use of speech. Therefore the child should be encouraged to use speech in classrooms, hallways, dining rooms, play areas etc.

Overview of the speech program:

There are four basic components to the pre-school-primary speech program:

- Tongue drills and breath control exercises,
- Sound development and syllable drills,
- Vocabulary and sentence work,
- Auditory development with utilization of visual and tactile cues when necessary.

This program is supported by a number of **other services** offered outside the classroom, for example-daily rhythm and music class, where they are taught songs, dances and rhythmical movement. Every child in the pre-school and primary receives 15 minutes of individual speech work everyday.

Objectives for speech development:

1. To vocalize and use voice meaningfully.
2. To develop a pleasant and relaxed voice quality.
3. To vocalize with proper pitch, intensity and duration.
4. To develop speech imitation skills.
5. To develop good tongue and breath control.

6. To make maximum use of residual hearing to improve reception and aid speech production.
7. To supplement auditory reception of speech with visual and tactile cues.
8. To correctly articulate the vowels and consonants in syllables, words and sentences.
9. To use skills mastered on the phonetic level in spontaneous speech.
10. To feel pleased and satisfied with communicative efforts, using speech.

To think that all objectives are accomplished with every child by the end of preschool would be a false assumption. Some of the objectives are **ongoing** and receive attention throughout the child's academic years.

Strategies for speech development:

The teachers working with the young preschool child should use **all opportunities** for encouraging vocalizations. The children are expected, encouraged and helped to

- Ask for what they want or need
- Verbally react to situations they encounter throughout the day
- Use speech in their interactions with one another and with adults in their environment

These are examples of speech at the **phonological** level.

Formal speech training can begin immediately as most children at 31/2 or 4 years of age will be already vocalizing and using their voices meaningfully.

- ♦ The primary technique used is **imitation.** Syllables, words and sentences are spoken first by the teacher and then imitated by the child. With young children who have difficulty in understanding imitation of speech, begin imitating **simple gross motor movements** and then move to imitation of lip movements and **rhythm**. This can be done using rhythm sticks or dance to establish patterns for imitating. These activities help to develop imitative motor skills that contribute to speech development. Throughout the speech lesson the use of **audition** is emphasized. In the initial development of speech skills, **group amplifiers** are used as they amplify a wider range of frequencies than the hearing aid and are generally more powerful and more consistent.

- ♦ As speech is a skill involving adequate control of tongue movements and breath control, the children in preschool and primary should spend a brief part of each lesson concentrating on **tongue movements and breath stream.** The purpose of breath control exercises is to help the child maintain a continuous flow of speech without having to pause unnaturally for breath. To achieve this, the child takes a deep breath and babbles continuously until he / she runs out of air. Blowing pin-wheels and balloons are examples of other activities which develop breath control.

- The development of **phonetic elements** of speech with the preschool and primary children is carried out utilizing the **Ling's model.** The ultimate goal of the speech development program is to enable the child to use the skills he has mastered during the speech period, in his spontaneous communications throughout the day. This depends on:
  - The motivation of the child
  - The awareness and encouragement of those who his speech monitors, teachers and parents.

- The teacher must be alert to help the child **use the skills** developed. She must keep the parents informed of the child's progress. Working together toward the goal of intelligible speech will eventually bring results well worth the time and the effort.

B) Intermediate level:

Ling (1978) puts forth that, "Faulty speech of the hearing-impaired is more frequently due to inadequate teaching rather than to the impairment per se".

The **teacher** is the key to the success of any speech program and must possess **basic qualities.** For this the teacher must have:

- Knowledge of **physiology and neurology** of the auditory and the speech mechanism in order to plan out appropriate speech teaching strategies.
- The skill necessary to identify those **factors which influence** a child's speech production. To develop this skill extensive practice to listening to the speech of the hearing –impaired is necessary.
- The teacher must be skilled in the use of both the **formal and the informal assessment** of speech, objectives and must be experienced in the application of various approaches.

Objectives:

1. To develop the child's imitative ability.
2. To encourage meaningful vocalizations

3. To develop good tongue and breath control
4. To develop the non-segmental aspects of speech i.e. pitch, intensity and duration
5. To develop the phonetic elements of speech emphasizing co-articulation and automaticity
6. To assure use of skills acquired at phonetic level to phonological level using proper rhythm, accent, intonation and phrasing.

To achieve these objectives the following **strategies** are used:

1. Repetitive speech tasks to develop **imitative ability**.
2. **Babbling** to maintain a pleasant voice and to gain control of breath stream.
3. Use of xylophone, piano, songs and rhymes to improve auditory **perception for pitch**.
4. To develop and maintain **control of pitch, duration and intensity** during speech.
5. **Phonetic skill** development utilizing the techniques suggested by Ling (1978)

In all instructions, consistent use of **appropriate amplification** is required. The **auditory trainer** has been found to be more effective in the development of speech skills. As children move to the middle grades (5, 6, 7) teachers should work on speech targets given by Ling. To facilitate **transfer of skills** to phonological level, vocabulary from content subjects, songs, poems, prayers can be used extensively.

At the intermediate level:

1. **Vocabulary development** for comprehension and expression receive major emphasis.
2. At 9 years of age children are expected to **classify syllables** and words under correct spellings. The teacher can dictate syllables or words and children should identify the correct sound by writing the syllable or word.

Content of the speech program for children from 5th to 8th standard:

For 5th standard children, practice materials / drills for **mastery of consonant blends** appearing in words should be given. For 6th standard children **rules for syllabification** should be taught. Different consonant combinations and unusual pronunciation of words with "ch" should be taught. For 7th standard children exercise for "j" sound, rules and practice for pluralization, past tense, changing verbs to nouns, work on homographs and similar looking words should be carried out. For 8th standard children, practice should be given to change nouns to adjectives, to use analogies, to use unusual words, stress-syllable drills, syllabification of words, spelling words, telling number of syllables in a word, identify accent, identify similarities in words. Speech lessons can be built around (incidental) day to day language needs during activities like bowling, swimming, school sports etc. Speech skills mastered on the phonetic level should be practiced on the phonological level. Activities such as acting, reading, conducting class meetings, choral singing provide opportunities to use the mastered speech skills.

C) Secondary school level:

Studies carried out by Donnelly (1964) and Subtelny (1978), indicate that both receptive and expressive skills can be improved in the hearing-impaired students of college age.

Objectives:

The normal hearing individuals continue to develop language and increase their language skills at the college level. Hearing-impaired are no exception. The only difference is that more efforts need to be put in to ensure that their language skills continue to improve at the secondary level. Hence a few modifications are necessary.

Modifications include:

- Reducing the drill work and concentrating on the pragmatic applications of skills. In other words focus on the use of speech skills in day to day activities.
- Focussing on the speech activity requested by the student.
- Building up the speech program around the special interest of the individual.

Principles and strategies:

For the hearing-impaired adolescent:

- The rapid growth in the size and mass of the larynx, results in lowered fundamental frequency of voice. This may contribute to difficulty in controlling voice. (Refer to unit 2 for explanation). If the voice pitch does not stabilize appropriately, specific voice therapy will be needed.
- The teacher should adopt a flexible approach. Guiding the hearing-impaired adolescents to make full use of a speech program requires sensitivity, integrity and maturity on the part of the speech teacher. The strategies for guiding the hearing-impaired teenagers through the process of speech development must be specially tailored to suit the attitudes and interests of the adolescents.

1.3 CORRECTED MODEL

During the developmental stage the child may not acquire the target behaviors adequately. This may be because—

4. **Pre-requisite behavior for the development of new skills may not have been adequately established.**
5. **All sub-skills may not be adequately acquired.**
6. **Newly learnt skills may not have been incorporated at the phonological level.**

Hence deviant patterns **in the speech of the hearing-impaired children are most likely to occur. The corrected model suggests a range of strategies that may be used in the remedial treatment of deviant patterns.**

A) DEVIANT PATTERNS AT STAGE 1 (Vocalizations freely and on demand) and STAGE 2 (Bases of suprasegmental patterns):

At this stage the child may develop the following deviant patterns- breathy voice, pharyngeal tension, vocal abuse, and falsetto voice.

- Breathy voice: **This occurs when there is relatively little tension on the vocal folds. Breathiness is usually due to failure to approximate the vocal folds firmly. This may be corrected by using the following** strategies:

3. **Exercises involving exertion**
4. **Games in which the child has to hold his breath for some time and then vocalize. For example- the child holds his breath with his mouth open ready for voicing and vocalizes when the teacher signals to him. In this way the vocal folds are adducted in preparation, and they will be sufficiently tense. This will result in a strong voice.**

- Pharyngeal tension: **This can occur when exercises involving exertion are used or when child is learning to modify pitch by raising and feeling his larynx. To prevent this the child should be given an opportunity to produce voice freely in play.**

- Vocal abuse: **Vocal abuse occurs due to:**

a) **Strained vocalizations, which may lead to inflammation or structural changes of the larynx.**

b) **Unnecessary laryngeal tension.**

c) **Continuous use of exercises involving exertion.**

d) **Use of either too high or too low- pitched voice.**

This may be corrected by using the following strategies:

3. **Use of other strategies for voicing (Refer Unit 6, 6.3.1).**
4. **Vocalizing achieved through fun and games. Thereby, overall tension is minimal.**

- Falsetto voice: **This is commonly found in children who have no residual hearing or children who make no use of the residual hearing they have. During the production of falsetto voice the vocal folds first approximate / come close together. They tense to a much greater extent than is required. These adjustments take a long time. This may be corrected by using the following strategies:**

7. **Develop skill in rapid** alternation of voiced and unvoiced sounds **at phonetic as well as phonological level. For example saying /data/, /bapa/ etc. alternately. By doing so, time is not available for the child to tense his vocal folds.**
8. **Production of different kind of laryngeal tension, for example a** forced whisper. **Forced whisper involves as much as tension as falsetto. But for the vocal folds to take any other position after forced whisper, the vocal folds should be relaxed. Thereby tension is reduced. After a forced whisper, the vocal folds tend to be relaxed. The child should be asked to say words or vocalize after the forced whisper. Thereby the words that are said after the forced whisper, are said in a relaxed manner. Thereby, tension is reduced and falsetto voice is prevented.**

B) DEVIANT PATTERNS AT STAGE 3 (Production of vowels and diphthongs):

Deviant patterns during production of vowels and diphthongs were discussed in Unit 5. The following deviant patterns are seen:

7. **Substitution.**
8. **Prolongation.**
9. **Diphthongization.**
10. **Neutralization.**
11. **Exaggeration.**

12. Nasalization.

1, 2 & 3. Substitution, Prolongation and Diphthongization:

If this occurs at the phonetic level then:

d. **Each of the 5 sub-skills described for the production of diphthongs and vowels must be developed.**

e. **Strategies already described for teaching should be applied.**

f. **Adequate phonetic to phonologic transfer should take place. In other words after the child has learnt to produce the vowel or diphthong, he should be given an opportunity to use the vowels and diphthongs meaningfully in words and sentences in everyday situations.**

If error occurs at the phonological level then:

c. **Teacher should build up a key vocabulary of words containing that particular vowel or diphthong.**

d. **Teacher should work on pronunciation using previously mentioned strategies.**

4. Neutralization: **(Refer Unit 5 for definition and explanation of neutralization). Neutralization occurs due to insufficient practice. This may lead to speech containing no differentiating stress patterns and abnormally slow rate. The remedial strategies are as follows:**

d. **Giving sufficient practice to the child both at phonetic and phonological level.**

e. **Child should be trained to use vowels accurately in words receiving stress.**

f. **Child should be trained to use speech at a normal rate.**

5. Exaggeration: **Exaggeration occurs due to inappropriate teaching strategies. Since the child is hearing-impaired, there is a tendency amongst the teachers and others in the child's environment to provide visual feedback by producing the sounds with exaggerated lip and jaw movements.**

There are two strategies for remediation of exaggeration:

c. **The child must be provided with normal speech models and not exaggerated ones.**

d. **All five sub-skills for vowels should be rehearsed without exaggeration. Attention during this should be gradually shifted from visual to**

auditory and motor kinesthetic patterns associated with learning each target vowel.

6. Nasalization: **Nasalization of vowels occurs when the velopharyngeal port is open during the production of the vowels. Due to this the breath stream passes through the nasal cavity. The reason why hearing-impaired children produce this is that nasality provides stronger orosensory patterns and more intrinsic feedback. For remediating nasalization the following can be done:**
   - **Yawning, sucking, blowing and whistling all require a raised velum. Make the child alternate sniffing with yawning, sucking and blowing, or whistling, in order to help strengthen velar action.**
   - **Most children, including those who are hearing-impaired, like to whistle and should be taught to do so because this skill usually involves more pharyngeal action to help in velopharyngeal closure than blowing.**

C) DEVIANT PATTERNS at STAGE 4, 5, 6,and 7:

The following deviant patterns may be observed in the production of consonants:

7. **Faults due to inadequate breath control.**
8. **Nasalization and denasalization.**
9. **Tension.**
10. **Exaggeration and prolongation.**
11. **Intrusive consonants and voicing errors.**
12. **Substitution, omission and distortion.**

1) Faults due to inadequate breath control:

Faults in production of consonants that may be caused by inadequate breath control include voicing errors **and errors in** aspiration. **Adequate breath control is required for appropriate voicing. Thus if there is inadequate breath control it will give rise to voicing errors. If the child has voicing errors then tactile strategies for contrastive pairs should be used. Drills in repetition of strings of syllables, which are made up of voiced consonants, should be practiced (Refer Unit 6, 6.3.6).**

Faults affecting aspiration i.e. de-aspiration of aspirated phonemes, can be remediated by repetition of sub-skills described for the production of /h/.

Some hearing-impaired children may produce certain sounds with an excess of breath. If speech is breathy, then it is usually because there is poor control of the larynx, poor adjustment of the articulators or both. The fault is usually best treated by strengthening the voice.

2) Nasalization and denasalization:

These deviant patterns are due to inadequate development of velar target behaviors. The most common reason is that the nasal / non-nasal distinction has not been adequately taught. The solution is to develop or redevelop the consonants by means of the earlier mentioned strategies (Refer Unit 6, 6.3.4).

3) Tension:

Problems in consonant production may arise because the articulators are too tense or too lax. Tension that may be generalized throughout the body or focussed in the head or neck region is usually associated with apprehension, insecurity, or inexperience in speech production. Frequently such problems may be overcome simply by making the speech training in class and speech experience out of school interesting.

4) Exaggeration and prolongation:

Exaggerated lip, jaw, or tongue movements are behaviors that have been taught and reinforced. To prevent exaggeration and prolongation the teacher should

- **speak to the child normally during conversations and lessons,**
- **avoid the presentation of exaggerated models in the speech teaching process,**
- **accept and reinforce only those patterns produced by the child that are very close to the desired target behaviors, and**
- **provide specific training to develop adequate rates of production.**

5) Intrusive consonants and voicing errors:

Intrusive voicing occurs if the child has not learned to make voiced-voiceless distinctions. The remediation can be done by teaching the child to make voiced–voiceless distinctions as discussed earlier (sub-skills and strategies of Stage 6 of developmental model).

6) Substitution, omission and distortion:

These can occur because the child may have mastered the adequate production of the phoneme at the word level, but not at the sentence level. In order that

the faulty patterns are remediated, considerable practice of the appropriate pattern in the sentence structures should be done.

Talking and singing are usually natural and pleasant experiences for any child, and for the hearing-impaired child it can be just as pleasant. Inform the mother of the child to make the child enjoy music in his earlier years. This will be advantageous to the child from the time his hearing impairment is discovered and before he is ready for a wearable hearing aid. This can be done in the following way:

- **In the early years sing and talk to the hearing-impaired child near his ear.**
- **After specific training has been started, every opportunity should be used to utter a word and a tune near his ear.**
- **This technique is very simple and effective and it encourages children to use voice. It may be carried out while the child is lying down, while he is looking at books and pictures, during speech and speech reading lessons and on many other incidental occasions during the day.**

The above activities will ensure that the child will get the sense of rhythm, which will eventually get carried over to speech. Besides, music is also known to give relaxation to the body. This will help the child to move his articulators in a smooth and easy manner. Thereby, making his voice and articulation more natural.

1.4 TEACHING AIDS AND EQUIPMENT FOR AUDITORY, VISUAL AND TACTILE FEEDBACK FOR SPEECH:

During speech production, speakers primarily use their sense of hearing (audition) to monitor what is being spoken and how it is spoken. However, either at a conscious or unconscious level they can also feel the different places within the oral cavity where the tongue touches. Not only this, the speaker also receives a feedback about the way in which the different speech organs move in relation to each other (kinesthesis). In short, speakers make use of **auditory, tactile and kinesthetic feedback** in order to monitor speech production. However, normal hearing individuals do not realize the contributions made by touch and kinesthesis as hearing is readily available to them for monitoring speech. In case of hearing impaired individuals, however, as the sense of hearing is not available for monitoring their speech production, other senses have to be used more. During teaching or correcting the speech of the hearing-impaired, use of all sense modalities is thus very important. There are a number of **teaching aids and equipment** that have been developed to facilitate use of audition, vision, touch and kinesthesis for providing feedback during teaching of speech to the hearing-impaired. Let us look at a few of these.

1) **Auditory aids:** Auditory aids are those that facilitate optimal use of residual hearing by the hearing-impaired individual. A number of such aids are available. You must have already read about these in the section on Audiology. These aids include

    - Personal **hearing-aids** of all types
    - **Group amplification systems** such as hard-wire systems, induction loop systems, FM systems etc.
    - **Speech trainers**

We will discuss auditory speech trainers in brief here.

Speech trainer: Various types of speech trainers are commercially available. Some of these make use of auditory and tactile modalities while some make use of the auditory modality only. Basically, a speech trainer consists of an external **microphone, amplifier and headphones.** The instrument has controls that can adjust the intensity of the output signal. This can be done separately for the two ears. A **tone control** is also available on some instruments. Also, some instruments have a **vibrator** that can be used simultaneously with the headphones. Thus, the speech trainer with a vibrator allows the hearing-impaired individual to use the auditory as well as tactile modality for learning to speak.

2) **Visual aids:** Visual aids are ones that provide visual feedback about the aspects of speech production. Use of vision is very important for the hearing-impaired for the purpose of understanding speech (speech reading). Not only this, visual feedback is also valuable for explaining the various aspects of speech production to the hearing-impaired. **Simpler ways** of providing visual feedback include

    - Using a **mirror** for showing placement of the articulators for certain speech sounds,
    - Using **pictures and diagrams** of the oral cavity to show the placement of the various articulators,
    - Using **hand positions** and movements to demonstrate placement of active and passive articulators,
    - Using visual **prompts** to indicate vocal pitch and loudness,
    - Using **written markers** to indicate prosodic features of speech, etc.

With improvement in technology, various electronic and computerized equipment is available for maximizing visual feedback during speech production. Most of these equipment have a **microphone** that picks up the speech signal. This speech signal is **processed and displayed** on a visual monitor or screen in the form of a waveform. Types of information that can be displayed include fundamental frequency, intensity, duration, voicing, frication, various prosodic features, etc. The visual screen can be divided into two parts (**split-screen**). The teacher can use the upper part of the screen to model the correct production. The second part can be used for recording the child's production. The child has to look at the teacher's pattern and try to match his own production to it. The teacher must highlight the feature that is being dealt with and explain the strategy of its production. The child can practice for a number of times, keeping the model production constant. **Examples** of visual equipment available commercially include Visi-pitch, Vocal II, Vaghmi, Speech Spectrographic Display (SSD) and PM Pitch Analyzer.

3) **Tactile Aids:** Tactile aids are the ones that make use of the modality of **touch** for providing feedback about speech production. A simple way of providing tactile feedback to the hearing-impaired child is to place his hand on the **neck, cheeks or the nose** of the teacher and draw his attention to the vibrations occurring while different sounds are produced. There are also a number of instruments/aids that are designed to provide tactile feedback to the hearing-impaired individual. These aids consist of a **microphone** that picks up the speech signal, a **processor** that converts this signal to a tactile signal and a **transducer** that carries this tactile information to the hearing-impaired individual. The user usually wears the transducer of a tactile aid (vibrator) on the **inner part of the wrist**. Some researchers also recommend the fingertips for stimulation. Tactile aids are usually of two types: **vibrotactile and electrotactile**. In vibrotactile aids, the speech signal is presented to the skin of the user using mechanical transducers or a vibrator. In electrotactile aids, the speech signals are presented to the skin as an electrical current. Research has shown that tactile aids are useful as a **supplemental**

aid for speech reading and in speech training. These aids help the hearing-impaired user in sound detection, in discriminating sounds differing in duration, in tracking connected discourse, and in developing awareness to speech. Tactile aids have not been useful in developing discrimination between finer aspects of speech production. These are shown to be helpful for individuals with profound hearing-impairment who do not appear to receive adequate help from conventional amplification. **Examples** of tactile aids available commercially include Mini Fonator, Fonator Speech Trainer and Fonator Auditory Speech Trainer.

You will get **an opportunity** to get acquainted with some of the teaching aids used for providing feedback during teaching and correction of speech.

1.5 PARENT / CAREGIVER INVOLVEMENT IN THE DEVELOPMENT AND MAINTENANCE OF SPEECH:

Parents exert a good amount of control **over their children's speech as well as over their general behavior. Parents spend** much more time **with their children than does a teacher. Many parents are** motivated **and can be motivated to take up some of the challenges necessary to ensure that the child will carry-over the speech skills taught to the child in the class. Success of any intervention program depends on the involvement of the parents in the program on a** consistent / regular basis. **If the parents do not actively participate, the efforts taken by the teacher will not stabilize and the child's speech will continue to have errors in his day to day conversations.**

Research and clinical experience have documented the fact regarding the **effectiveness of the parents' role** in the treatment of their children. At every stage in the intervention program, careful training and creating favorable parent-teacher relationships can hasten progress and time can be saved.

Guidelines to involve parents:

1. The importance of parents' role should be explained and emphasized in every parent meeting right from the beginning.
2. Demonstrations on a child can be scheduled periodically to help parents in learning ways of training the child. This can be done for groups of 8-10 parents at a time.
3. Specific written programs will make the goals and activities clearer to the parents.
4. Parents should be explained the importance of using interesting, game-oriented activities to make the whole process enjoyable.
5. The teacher should encourage the parents continually to make appropriate, interesting and innovative stimulus material on a regular basis.
6. A specific time should be scheduled everyday during which parents can listen to the child's speech in a relaxed manner and give the practice of carry-over.
7. The teacher and the parents should maintain a daily record of the child's progress. This should be done in such a way that it easy for the child to understand and will thereby motivate him/her to perform better.
8. Regular feedback to the parents on how effective they have been will maintain their motivation.
9. The importance of consistent use of hearing aids should be emphasized as amplification can prove to be valuable in development and maintenance of good speech habits as the child will be able to monitor his speech with ease.
10. The teacher should caution the parents against rejection or over protection of the child as this will lead to a marked reduction in learning opportunities for the child.
11. The teacher should help the parents realize that the emotions of the child should be considered sensitively. He / she should be taken for outings, gatherings and social functions as this further facilitates the carry-over of good speech habits. This should be emphasized to parents whom the teacher may suspect to be having feelings of rejection.

The daily home practice with the help of parents can go a long way in helping the child develop, transfer and maintain intelligible speech. The teacher can find innovative ways to ensure the motivation of both the parents and the child. This will lessen the time demand on the teacher .

1.6 SUMMARY – POINTS TO REMEMBER

- **During the developmental stage the hearing-impaired child may not acquire the target behaviors adequately. Hence deviant patterns are most likely to occur in the speech of the hearing-impaired children.**
- **The corrected model suggests a range of strategies that may be used in the remedial treatment of deviant patterns.**
- Four basic components to the pre-school-primary speech program are:
  - Tongue drills and breath control exercises,
  - Sound development and syllable drills,
  - Vocabulary and sentence work,
  - Auditory development with utilization of visual and tactile cues when necessary.
- At the intermediate level
  - Vocabulary development for comprehension and expression receive major emphasis.
  - Children are expected to classify syllables and words under correct spellings.
- Parents have an important role to play in the development and maintenance of intelligible speech. Teachers must encourage optimum parent participation at each stage to ensure carry over of intelligible speech in daily communication.
- There are a number of teaching aids and equipment that have been developed to facilitate use of audition, vision, touch and kinesthesis for providing feedback during teaching of speech to the hearing-impaired.

1.7 CHECK YOUR PROGRESS

8. Discuss the objectives of the speech teaching strategies at K.G., primary and intermediate level.
9. Discuss the deviant patterns that occur at Stages 1 and 2.
10. Discuss the remedial strategies for the deviant patterns occurring at Stages 1 and 2.
11. List out deviant patterns occurring at Stages 3, 4, 5, 6 and 7.
12. Enumerate the various teaching aids used for speech teaching and correction.

13. Write a note on use of visual aids for speech teaching and correction.
14. Discuss the importance of role of parents in development and maintenance of intelligible speech.

1.8 ASSIGNMENT

3. Identify a child having deviant patterns at Stage 3, and write a report of the remedial strategies used by you to correct the deviant patterns.
4. Describe in detail any teaching aid that you have seen during your clinical work. Discuss its advantages and disadvantages.

1.9 POINTS FOR DISCUSSIONS / CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

4.9.1 Points for Discussion

4.9.2 Points for Clarification

1.9 REFERENCES / FURTHER READING

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UNIT 2:NEED ASSESSMENT AND DECISION MAKING FOR ADAPTATION

- **Introduction**
- **Objectives**
- **Definitions**
- **Summary**
- **Revision**
- **Assignment/Activity**
- **Points For Discussion And Clarification**
- References / Further Readings

- **Introduction**

There is no recipe for adapting general education curriculum to meet each student's needs. Each teacher, each student, each classroom is unique and adaptations are specific to each situation. Keep in mind that curriculum does not always need to be modified. By providing multi-level instruction you will find that adapting a lesson may not always be necessary. Differentiating instruction and providing multiple ways assess allows more flexibility for students to meet the standards and requirements of the class. At other times, the curriculum can be made more accessible through accommodations. In addition, supports for one student may not necessarily be the same in all situations, e.g., a student who needs full time support from a paraprofessional for math may only need natural supports from peers for English, and no support for art. And, supports should not be determined by the disability label, instead supports should be used when the instructional or social activity warrants the need for assistance. (Fisher and Frey, 2001). The forms and examples on the following pages provide information about curriculum and types of adaptations that could be considered in developing the appropriate strategy for a particular student. Examples are provided for both elementary and secondary levels.

1. Can the student actively participate in the lesson without modification? Will the same essential outcome he achieved? 2. Can the student's participation he increased by changing the instructional arrangement? From traditional arrangements to: • Cooperative groups • Small groups • Peer partners • Peer or cross-age tutors 3. Can the student's participation be increased by changing the lesson format? • Interdisciplinary/thematic units • Activity-based lessons, games, simulations, role-plays • Group investigation or discovery learning • Experiential lessons • Community-referenced lessons 4, Can the Student's participation and understanding be increased by changing the delivery of instruction or teaching style? 5. Will the student need adapted curricular goals? • Adjust performance standards • Adjust pacing • Same content but less complex • Similar content with functional/direct applications • Adjust the evaluation criteria or system (grading) • Adjust management techniques Examine the Learning Environment 6. Can the changes he made in the classroom environment or lesson location that will facilitate participation? • Environmental/physical arrangements Examine the Structure of the Instruction Curriculum Modifications & Adaptations

- **Objectives**

Curricular Adaptations are changes permissible in educational environments which allow the student equal opportunity to obtain access, results, benefits, and levels of achievement. These adaptations consist of both accommodations and modifications. ¾ Some curricular adaptations do not fundamentally alter or lower standards or expectations in either the instructional or assessment phases of a course of study and can be designated as "accommodations." These accommodations provide access to participate in the L.R.E. and an opportunity to demonstrate mastery of performance standards. ¾ Some adaptations do alter or lower standards or expectations and can be termed "modifications." These modifications, although providing access, will necessitate careful selection of assessment components to achieve accountability for performance.

- **Definitions**

As is described in I.D.E.A. Reauthorization, individuals with disabilities are to receive a free and appropriate public education (F.A.P.E.). This education must occur in the least restrictive environment (L.R.E.), with supplementary aids and supports when necessary. Section 504 of the Rehabilitation Act of 1973 provides some clarification as to how these aids and supports are provided in the L.R.E. for individuals with disabilities: Aids, benefits, and services must afford an eligible student equal opportunity to obtain the same result, to gain the same benefit, or to reach the same level of achievement in the most integrated setting appropriate to the student's needs. These aids, benefits, services are not required to produce the identical result, or level of achievement for both students with disabilities and students without disabilities. For the purposes of clarification, the following definitions are suggested to differentiate how individuals with disabilities receive "equal opportunity to obtain results and benefits" but may not necessarily "produce identical results or levels of achievement" as compared to students without disabilities. Students participate in "least restrictive" learning environments and are held accountable for performance in those environments through curricular adaptations.

- **Summary**

A student may be learning the same curriculum as others, but require substantially altered materials or instruction much lower in the developmental sequence of general curriculum in order to progress towards academic mastery. The IEP team will consider which, if any, assessment components, with modifications, validly measure progress. Additional, multiple measures of progress may also be selected by the IEP team. A student may be participating in activities in the classroom through the use of highly modified curriculum. The goal of this participation may be to access the environment in order to work on alternate functional curriculum, with goals to achieve maximum independence and quality of life. Highly modified curriculum may be the means of achieving inclusion in the activities to achieve other outcomes. The IEP team may therefore determine that participation in general assessment does not meaningfully measure educational achievement. Assessment for this student will be an alternate assessment that validly measures the intended outcomes of the instruction. Additional, multiple measures of progress may be also selected by the IEP team.

- **Assignment/Activity**

y Accommodations are changes in course content, teaching strategies, standards, test presentation, location, timing, scheduling, expectations, student responses, environmental structuring, and/or other attributes which provide access for a student with a disability to participate in a course/standard/test, which DO NOT fundamentally alter or lower the standard or expectations of the course/standard/test. y Modifications are changes in course content, teaching strategies, standards, test presentation, location, timing, scheduling, expectations, student responses, environmental structuring, and/or other attributes which provide access for a student with a disability to participate in a course/standard/test, which DO fundamentally alter or lower the standard or expectations of the course/standard/test.

- **Points For Discussion And Clarification**
- **<u>Curriculum for Learning Disabled Students: More Than Just Textbooks and Workbooks</u>**
  The National Challenged Homeschoolers Association Network (NATHAN) supports this web site and this article was written by Dr. John Sutton. The article includes a traditional and modern definition of curriculum and argues that commercially produced educational products may not be appropriate for students with learning disabilities. Dr. Sutton provides many suggestions for how to approach selecting educational materials for home-schooled children and how to go about employing these materials to teach students with learning disabilities in a home school curriculum.
- **<u>Curriculum Modifications</u>**
  This link provides access to a wealth of information on working with students who are considered "special needs" because they are gifted. The links within this site provide information on the needs of gifted students and how they differ from other children in the classroom as well as suggestions for accommodating these students. Some links provide specific information and others provide the user with source information on a particular topicwhile additional links provide access to research on the topic. The home site is copyrighted by "Carolyn K," and the site is called Hoagies' Gifted Education Page.

- References / Further Readings

- Birnbaum, B. W. (2001). Using computers to modify the curriculum for students with learning disabilities. Learning Disabilities: A Multidisciplinary Journal, 11(1), 19-25.

- Birnbaum provides practical ways to modify curriculum using technology. The author identifies five areas to consider when teachers incorporate technology into curriculum for students with learning disabilities: (a) criteria for the selection of software, (b) using computer games, (c) the Internet as a tool for teaching across the curriculum, (d) using multimedia, and (e) using hypermedia. A list of web sites useful across subjects is provided for teachers.
- Bray, M., Brown, A., & Green, T. D. (2004). Technology and the diverse learner: A guide to classroom practice. Thousand Oaks, CA: Corwin Press, Inc.
- This book is designed for those who are teaching diverse learners and who want to incorporate technology into instruction. The diverse students on whom this text is focused include female and male students, students with different cultural backgrounds, English second language learners, students with disabilities, and gifted and talented students. The authors provide practical ideas of technology solutions for each group of diverse students as well as overviews of each group's characteristics. The appendices at the end of this book include useful resources of which particular technology and instructional strategies are suitable for a particular group of students.
- Buxton, C. (1999). Designing a model-based methodology for science instruction: Lessons from a bilingual classroom. Bilingual Research Journal, 23(2&3), 113-143.
- The authors of this article present empirical findings from a three-year longitudinal science project, the Science Theatre Project, in which modified science curriculum was provided to elementary aged Spanish-English bilingual children in a two-way bilingual program. The researcher reported upon the effectiveness of modified science curriculum to students' academic success. Buxton emphasized the consideration of students' cultural backgrounds in the process of modification.
- Cawley, J. F. &Parmar, R. S. (1990).Issues in mathematics curriculum for handicapped students.Academic Therapy, 25(4), 507-521.
- Cawley and Parmar explain the curriculum modification procedure in mathematics necessary for students with handicaps. The authors describe that curriculum modification in mathematics has to include curriculum reorganization, which focuses on the concepts relevant to

a specific subject rather than simply on material and the amount of information provided. Theoretical backgrounds and examples of curriculum reorganization are presented within the framework of the National Council of Teachers of Mathematics (NCTM) standards.

POINTS FOR DISCUSSIONS / CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

Points for Discussion

Points for Clarification

UNIT 3: ADAPTING CURRICULUM- CONTENT, TEACHING-LEARNING MATERIAL, AND INSTRUCTION

- **Introduction**
- **Objectives**
- **Definitions**
- **Summary**
- **Revision**
- **Assignment/Activity**
- **Points For Discussion And Clarification**
- References / Further Readings

- **Introduction**

Modifying existing general curriculum has been an effective way to create more accessible learning environments to support all students and their teachers in various educational contexts. There are many terms in use regarding changes made to curriculum, such as enhancements, accommodations, overlapping, and adaptations. We differentiate *curriculummodification* from *curriculum enhancement* for the purposes of this paper. In this way, we can clarify the definition and nature of curriculum modification to emphasize its effectiveness in improving education for all children, and to provide vivid examples and useful resources which will enrich actual classroom practices for diverse learners. Although both ideas, *enhancement* and *modification*, become pivotal when we consider improving

accessibilities of general curricula in relation to individual students' needs, the approach, design, and methods that result from each idea may differ significantly.
Curriculum *enhancement* is most likely to be built around existing general curriculum and to involve teachers' alterations of curriculum. Frequently, teachers will enhance curriculum with additions of instructional strategies. Frequently enhancements are created to evaluate and teach adequate background knowledge in preparation for a new task. Additionally, teachers may incorporate a variety of instructional materials and procedures to meet students' needs, including the use of co-teaching and/or instructional collaboration.

- **Objectives**

Curriculum *modification* differs from curriculum enhancement in that modification is a more extreme alteration to the curriculum than that of an enhancement. Modifications involve combinations of altered content, conceptual difficulty, educational goals, and instructional method versus building scaffolding and bridges between existing curriculum and people involved in the educational process. Such differentiation between curriculum modification and curriculum enhancement is based on ranging degrees in which our educational approach becomes distinct from or maintains the similarities to existing general curriculum. In other words, educational practices in which student and teacher interactions differ from those designed in existing general curriculum are present to a greater extent when curriculum is *modified* than when enhanced.
There are numerous ways curriculum modifications are put into practice for different purposes and outcomes on various levels (such as individual, classroom, and school-wide). Due to a flexible nature and countless applications, curriculum modification often remains an ambiguous concept and is understood as an umbrella term to include multifarious aspects of everyday teaching practices. We have refined our definition of curriculum modification based on understandings of its nature and potentialities. The discussion below introduces a way to understand the concept and some concrete practices of curriculum modification through to presenting how we have defined curriculum modification, how components can be categorized, what research says about its effectiveness, and how such empirical evidence can be applied to general education settings. We provide, in the final section, a list of useful web resources and related literature for the reader.

- **Definitions**

It is important to note that no single definition of curriculum modification exists. Many researchers offer many definitions from various fields of discipline. In other words, the practice of curriculum modification has been discussed in different languages by many researchers from various specialty areas in education. For instance, in addition to the most frequently used terms, *accommodation* and *adaptation*, some use terms such as *alteration*, *differentiation*, *change*, *revision*, *enhancement*, *compacting*, *integration*, and *scaffolding* to discuss teaching events involving curriculum modification. Another issue is that discussions regarding curriculum modification are often interwoven with ideas of strategy use for intended educational purposes. This creates a situation in which we face the difficulty of separating literature focusing on teaching strategies from those focusing on curriculum modification.

Our challenge is to clarify these ambiguities and to refine the definition of curriculum modification. In this review, we define *curriculum modification* as *modified content, instruction, and/or learning outcomes to meet diverse student needs*. In other words, curriculum modification is not limited to instructional modification or content modification but includes a continuum of a wide range of modified educational components. Similarly, Comfort (1990) defines curriculum modification as "the adapting or interpreting of a school's formal curriculum by teachers into learning objectives and units of learning activities judged most reasonable for an individual learner or particular group of learners" (p. 397). Curriculum modification involves change to a range of educational components in a curriculum such as content knowledge, the method of instruction, and students' learning outcomes, through the alteration of materials and programs (Comfort, 1990; King-Sears, 2001; MacMackin & Elaine, 1997; Reisberg, 1990).

Although some may distinguish instruction from curriculum and argue that mere instructional modification should not be considered as curriculum modification, defining curriculum modification requires us to understand curriculum as a broad concept which involves various educational components and people involved in educational processes. After all, content, instruction, input and output inseparably construct daily teaching and learning. We also conceive school curriculum as a framework for guiding teachers (Comfort, 1990). In short, the way that we interpret curriculum influences our understanding of curriculum modification. Reisburg (1990) lists examples of *the modifications of content*, such as teaching learning strategies, simplifying concepts or reading levels, teaching different sets of knowledge and skills needed by students, and setting up specific objectives and examples of *modifications to instructional methods* including reducing distractions, altering the pace of lessons, presenting smaller amounts of work, clarifying directions, and changing input and response modes. All of these teaching events should be considered as examples of *curriculum modification*.

For the purpose of this report, we have adopted the categorization of curriculum modification suggested by King-Sears (2001). King-Sears identified four types of curriculum modification: (a) accommodation, (b) adaptation, (c) parallel curriculum outcomes, and (d) overlapping curricula on a continuum. This categorization represents the relation between modified curriculum and general curriculum in terms of differences and similarities in educational input including content knowledge and conceptual difficulty, educational output including educational goals, and methods of instruction. The extent to which a modified curriculum differs from the general curriculum becomes greater as educational practice moves from accommodation to overlapping curricula. For instance, in accommodation, the only educational components which may differ from general curriculum are instructional method and educational goals, whereas, in overlapping curricula, all components—input, output, and instructional methods that students receive—can be totally different from those designed in general curriculum.

As conceptualized along this continuum, curriculum modification that King-Sears suggests contains a wide range of educational practices and shares the essence of the aforementioned definition of curriculum modification:*modified content, instruction, and/or learning outcomes for diverse student needs*. Modifications identified by King-Sears, for example, range from an educational practice of simply providing an audio book to some students who have reading difficulties during reading lessons to an educational practice of having some special needs students work on individual (IEP) goals, such as following directions, while they engage in general science lessons. Moreover, these four types of curriculum modification, according to King-Sears, are extensions of curriculum enhancement within the process for teachers to determine the degree of accessibility of their classroom for students with disabilities. In other words, curriculum modification, in King-Sears' view, is a suggested step to take when curriculum enhancement alone is not effective to achieve objectives for inclusion.

King-Sears' clear categorization and analysis of the components of curriculum modification is valuable for educators to capture the essence of curriculum modification. As stated above, her categorization consists of a wide range of educational practices. Since curriculum modification is practiced in numerous ways, it is important to broaden the definition rather than limiting it to particular events.

- **Summary**

As noted above, the components of curriculum modification are well categorized by King-Sears (2001) into four types: (a) accommodation, (b) adaptation, (c) parallel curriculum outcomes, and (d) overlapping curricula. Switlick (1997) explains that the purpose of modifying curriculum is "to enable an individual to compensate for intellectual, physical, or behavioral challenges" and to create learning environments which "allow the individual to use existing skill repertoires while promoting the acquisition of new skills and knowledge" (p. 236). We need to understand that these are the purposes which underlie the four types of curriculum modification identified by King-Sears.

In the following section, brief explanations of each type of curriculum modification with examples from actual classrooms are presented. Actual educational practices reflecting modified curriculum vary in many ways,as modification occurs in various educational settings across diverse subject areas, students, assignments, assessments, evaluations, and so on. Presenting examples for *all* educational situations is beyond the scope of this paper. Therefore, we selected a range of examples across four types of curriculum modification with a special focus on the examples from integrated general classrooms. For instance, the section regarding accommodation involves an example of using assistive technology in writing class for students with learning disabilities and an example of using audio books for English Language Learners in a reading lesson. Likewise, various settings (math, language arts, social studies, and science) and learners (students with moderate to severe disabilities as well as students identified as gifted and talented) appear in the examples presented across the four types of curriculum modification.

Following the description and examples of each curriculum modification type is a table illustrating comparisons among four types of curriculum modification in relation to components modified and the extent to which modified curricula differ from the general curriculum. The table helps us visually recognize that, as we move forward from accommodation to overlapping curricula, focused components shift from instruction-oriented to content-oriented and that educational practices reflecting modified curriculum become more distant from educational practices based on general curriculum.

Accommodation

The term *accommodation* is used to mean a modification to the delivery of instruction or method of student performance and does *not* change the content or conceptual difficulty of the curriculum (see Table 1). Both teachers and students can play a role in the changes to instructional methods in order to achieve the same intended instructional outcomes suggested in general curriculum. Examples of accommodation are countless. Some include incorporating different types of teaching devices and techniques (such as use of audio or other formats as an alternative to print), technology, graphic organizers, and pictorial representation; and changing the amount of input, time-frame for learning, and levels of support for individual students' needs.

Among these examples, using assistive/adaptive technologies typically exemplify an accommodation to general curriculum. Bray, Brown,and Green (2004) define assistive/adaptive technologies as "content-free technologies" (p. 34) which does not address curriculum or promote specific learning butrather helps students overcome inaccessibility due to individual differences. In an actual classroom, a student with physical disabilities may use computer input devices, such as a trackball mouse which requires less hand movement oran alternate keyboard with extra large keys, to complete his/her writing task. In this case, the content and difficulty level of tasks remain the same as the tasks in which other students in the class engage. An accommodation through the use of assistive/adaptive technologies allows students to complete their tasks required in general curriculum which would be difficult to complete otherwise.

Another example of accommodation is making audio versions of books available for students who are English Language Learners (ELLs) and students with print disabilities when they engage in reading sessions focusing on reading comprehension skills. Instead of providing the traditional written or printed form of text, teachers can have these students work individually or in a small group to read an assigned book with auditory support. Again, through this type of accommodation, students with diverse needs can acquire the same content knowledge as other students and move onto the next stage of learning with them. In the case of ELLs, students can comprehend the text with audio support and then participate in the follow-up activities with other classmates based on their understanding of what was read. Frequently, teachers regard ELL students' developing language proficiency as a disadvantage which causes a necessary lag-behind (Valdes, 2002). As a result, teachers may provide curriculum modification with more content-focused alteration, which simplifies the content, may change the standards and goals, does not provide enough cognitive challenge and academic stimulus, and does not help students' acquisition of the English language. Although it is important to understand that acquiring a second language, especially academic language, is not a quick fix and takes many years of instruction (Cummins, 2000), teachers also need to know that ELLs, like other general students, should receive an appropriate cognitive challenge with appropriate conceptual difficulties and a sense of belonging to their class regardless of their developing language proficiencies(Igoa, 1995). When used with students with appropriate language proficiency levels, an accommodation to general curriculum can be a powerful tool to support ELL students' unique linguistic, academic, and social needs.

Switlick (1997) has listed other examples of accommodations, such as requiring completion of every other word problem on a math worksheet or providing for oral performance instead of written. As we see in these examples, accommodation is not a change of educational input designed in general curriculum, such as content knowledge and the conceptual difficulty of the subjects. Rather, accommodation is a modification of instructional methods intended to meet individual student's needs of acquiring necessary input from lessons. The information that students receive remains the same. However, an accommodation to curriculum modifies the way that students acquire and/or respond to the information.

Another important point to add is that the intended goals of accommodated curriculum may change from those of general curriculum depending on educational contexts. For instance, using an audio book in a reading comprehension lesson creates an opportunity for students to use their listening skills in addition to reading or decoding skills. If the students were English-speaking children with reading difficulty who had already established English listening skills, the intended goals of curriculum would remain the same as those in general curriculum. However, if the students were ELLs who were still in the process of developing their listening skills, teachers could indicate an additional goal for them (which is the development of listening skills). Thus, accommodation has a flexibility of adjusting intended educational goals based on context.

Adaptation

Adaptation is a modification to the delivery of instructional methods and intended goals of student performance that does not change the content but does *slightly change* the conceptual difficulty of the curriculum (see Table 1). Adaptations usually require more teacher effort and time than simply changing instructional methods or access as in an accommodation. An adaptation is a goal-driven process: in order to decide on an adaptation to curriculum, teachers first need to specify intended goals for individual students. Again, examples of adaptation abound, and include providing differentiated activities, homework, and evaluations, and using adapted or different instructional materials and activities for individual students.

Adaptations in integrated general classrooms often occur when teachers differentiate instruction. For instance, teachers can create writing lessons that meet individual students' unique needs by having students work on adapted assignments. While some students are engaging in a writing assignment individually, students with learning disabilities may work on their assignment in a small group with teacher support. The teachers may also modify the content of the writing activity depending on students' needs. While the teacher requires some students to compose using the five new vocabulary words from the lesson, the students with a learning disability may select three of the five new words from the lesson and make appropriate use of them in the context of their work. King-Sears (2001) suggests that a variation of this type of lesson can be providing students with disabilities fewer practice tasks. She also points out that reducing the amount of tasks seen in an accommodated instruction should be differentiated from that provided in adapted instruction. On the one hand, the *accommodated* instruction may modify the amount of tasks (for instance, teachers provide only five math problems to students with math difficulties while others work on ten problems) without changing the conceptual difficulty of the tasks. On the other hand, *adapted* instruction involves a slight change in conceptual difficulty to meet students' needs.

In another example provided by King-Sears (2001), a math teacher may instruct a student with a disability to work on mastering division of mixed fractions with like denominators while other students work toward mastering division of mixed fractions with unlike denominators. In this case, the conceptual difficulty of the knowledge that students with a disability need to acquire slightly changes although the content knowledge of mathematics, namely the concepts of divisions and fractions, remains the same. Switlick (1997) suggests other examples, including providing picture cards for key words in a story and using a calculator to complete a math assignment. Switlick also provides an adaptation planning worksheet (p. 245) for teachers who are interested in incorporating adaptation into their instruction.

Thus, adaptation involves not only the modification of instructional methods but also includes a slight change in conceptual difficulties introduced to students. Like accommodation, adaptation occurs within the same learning content. In many cases, adaptation should be practiced when teachers determine that a student is able to learn the same content knowledge as other students if a slight change is made to modify conceptual difficulty.

Parallel Curriculum Outcomes/Parallel Instruction

Parallel curriculum outcomes are modifications to the delivery of instruction and to intended goals regarding student performance. Like adaptation, parallel curriculum outcomes do not change the content knowledge and the underlying principle of the educational goals for individual students. The difference between adaptation and parallel curriculum is the extent of change in conceptual difficulty. While adaptation slightly changes the conceptual difficulty of curriculum, parallel curriculum outcomes involve a *significant change* of conceptual difficulty (see Table 1).

Similar to accommodation and adaptation, the practice of parallel curriculum outcomes depends on educational contexts and individual student needs. There is a range of application to this type of modification and students with varying learner characteristics and abilities benefit from parallel curriculum outcomes. For example, many students identified as gifted and talented require more advanced or challenging conceptual difficulties in instruction and application. Therefore, the significant change of conceptual difficulty seen in parallel curriculum outcomes often suits the curriculum modification needed for these students. Many educators synonymously use the term *enrichment* with the term parallel curriculum outcomes when addressing such curriculum modifications.

Students with varying disabilities also benefit from the parallel curriculum type of modification. For instance, King-Sears (2001) described a classroom situation in which most students develop science projects that include analysis of cause-and-effect problems. In the same classroom, a student with multiple disabilities may engage in a science project with a focus on one experimental process. In this way, teachers are able to include the student with multiple disabilities in the same content lesson as all students and support the student with disabilities so that she/he may achieve the appropriate educational goals.

Other examples suggested by Switlick (1997) include providing special needs students in English/Language Arts classes a paper with all or part of a story and asking them to locate target words or letters while other students are reading the story; having students with special needs complete worksheets for counting from 1 to 10 while other students are assigned a math worksheet on fractions; and allowing some students to orally report three things remembered from listening to others reading the newspaper in a citizenship/current events class, while other students read aloud and answer a series of questions.

Thus, parallel curriculum outcomes do not change the broader content knowledge of a lesson but significantly change the *conceptual difficulties* for students. The educational practices categorized under parallel curriculum outcomes closely connect to what Switlick (1997) described as a concept of "partial participation" (p. 236)—an underlying concept associated with modification. Switlick explains that we fundamentally believe that it is appropriate for diverse students, especially students with severe disabilities, to participate in the general education classroom even though they may not acquire the same level of conceptual understanding as other classmates and that teachers can pursue this practice by applying parallel outcomes/instruction curriculum modifications. As Switlick indicates, the use of parallel curriculum outcomes is a modification that "goes a step beyond what is usually considered when adapting instruction" (p. 244). Modifying the conceptual difficulty of curriculum in a significant way creates a learning environment in which we can broaden the idea of inclusion to a wider range of diversity among students.

Overlapping Curricula/Overlapping Instruction

Overlapping curricula is a modification to curriculum such that the modification creates *overlapping* or *common* goals for learning outcomes of diverse students. Overlapping curricula is not a direct modification of general curriculum. Rather, it is an incorporation of specific individual goals and expectations for students with diverse needs. Teachers can practice overlapping curricula when expectations for specific goal accomplishments in general education are presented.Overlapping curricula enables diverse students to be involved in general education curriculum activities and promotes the idea of partial participation. There are various ways to practice overlapping curricula. In most cases, the components of curriculum, such as background knowledge, conceptual difficulties, and methods of instruction, for special needs students are designed very differently from those for general education students (see Table 1). Practicing overlapping curricula sometimes requires teachers to creatively design and provide shared educational activities, such as cooperative learning and peer-mediated interventions. In such shared activities, the educational goals and expectations for the students with diverse needs overlap with those for general education students.

While students with diverse needs are learning to achieve their individual educational goals (for instance vocational and social skills development) they also are able to be involved in the same content lesson with their general education classmates. Based on the modified intended educational goals, educational input (content knowledge and conceptual difficulty) and instructional methods become different from those designed in general curriculum. King-Sears described an example in which a student with emotional disturbance may have an IEP goal to develop appropriate interactions with peers in a small group setting. Although this student may never engage in social studies activities at the same conceptual levels as other students or never develop content knowledge in the subject, teachers can provide him/her with an appropriate task to complete in a small group in order to create an opportunity to interact with others. When the general curriculum also focuses on students' interaction as one of the intended goals for the social studies lesson, there is an overlap evident between the intended goals for students with special needs and those for regular students. In short, this type of modification allows students with specific needs to be involved in general education curriculum activities while accomplishing different curriculum goals.

The following example depicted in Switlick (1997) clearly describes a classroom practice using overlapping curricula. The studentin this example, Jamie, has objectives to make eye contact and acknowledge an interpersonal interaction using audible sounds:

> *Jamie has a tray on his wheelchair. He holds on his tray the manipulatives students are using during math class. As students pick up their materials from Jamie's tray, they speak to Jamie. To meet his instructional goal, Jamie should look at each student and acknowledge the greeting with an audible sound. The same interaction is duplicated as students exchange materials and return materials (p. 246).*

Thus overlapping curricula provides Jamie the opportunity to practice appropriate social interactions with peers in the general classroom setting. At the same time, his peers also benefit from the social interaction and are able to prepare their manipulatives and engage in a math activity efficiently with Jamie's help.

Like other types of curriculum modification (accommodation, adaptation, and parallel curriculum outcomes), examples of overlapping curricula can be innumerable. Additional examples from the work by Switlick (1997) include having a student with a severe physical disability use an adaptive switch to activate an audio recorder and work on holding up his head for increased amounts of time while other students are recording a rough draft of a play they are creating, and having the same student make sure everyone in the class has a test tube and a worksheet while other students are engaging in a chemistry experiment in small groups.

As we see in these examples, the educational practices in which the student with special needs engage for their intended goals and those in which general education students engage for their intended goals may create mutual benefit due to the

overlap evident in their goals. Through applying overlapping curricula to general curriculum, teachers are able to create a learning environment where students with special needs play meaningful roles in a classroom and where not only students with special needs learn from being included in a general classroom but also their general education peers have an opportunity to learn and receive supports from the students with special needs.
The following table contains the four types of curriculum modification features described above. The first column contains a list of the modifications and the top row contains curriculum components: content knowledge, conceptual difficulty, intended goals, and method of instruction. If a modification is evident in certain components, the table shows the extent of modification, for example, slight or significant. This table serves as a summary of curriculum modification ideas and information about the characteristics of each type thusenabling teachers to select which type would be most beneficial fortheir students.

- **Revision**

It is important that students with disabilities have meaningful opportunities to access the general education curriculum, interact with peers in the same classroom, and receive instruction from general education teachers. Findings from two large size studies showed positive correlations between the amount of time students with disabilities spent in the general education classroom and academic achievement. Cosier, Causton-Theoharis, and Theoharis (2013) examined a data set that included 1,300 elementary-aged students with disabilities within 180 school districts. The results showed that each hour which students with disabilities spent in the general education classroom resulted in a .49 point higher score on reading assessment and a .37 point higher score on math assessments. Hehir, Schifter, Grindal, Ng, and Eidelman's (2014) comprehensive review of special education in Massachusetts showed that students with disabilities in full inclusion placement outperformed similar students in substantially separate placement. Hehir, et al. looked at data of students with disabilities from 2006–2012 and followed 3 cohorts of students from 9^{th} grade to graduation. They found that, on average, students educated in full inclusion classrooms earned higher scores on standardized, state-wide assessments and graduated high school at higher rates than similar students who were educated in substantially separate classrooms. Together, both studies suggest that more access and time spent in a general education environment provided students with disabilities more opportunities to acquire the academic knowledge and skills essential for post-secondary attainment and career readiness.
Curriculum modification is an essential ingredient for students with disabilities to access the general education environment. The empirical evidence regarding the

effectiveness of curriculum modification is available in many studies. The following sections include the literature review of 15 empirical studies issued between 1989 and2014 which report the impact of curriculum modification on various areas of interest and 4 conceptual studies relevant to the empirical findings. For the purpose of this report, which is to display empirical evidence of effectiveness, our main focus is on the empirical findings, and we use conceptual studies to supplement the background of reviewed empirical studies.
A total of 19 studies were identified and then organized into four major categories by area of impact for which the modified curriculum was designed: (a) modification designed for students' learning, (b) modification designed for behavioral reasons,(c) modification designed for inclusion, and (d) self-determination training to enhance modification. The majority of the studies are detailed in articles from major peer-reviewed journals, such as *Academic Therapy, Bilingual Research Journal, Behavioral Disorders, Journal of the Association for Persons with Severe Handicaps, Learning Disabilities:A Multidisciplinary Journal, Journal of Applied Behavior Analysis, Equity & Excellence in Education, Journal for Education of the Gifted, Gifted Child Quarterly, Journal of Early Intervention, Teacher Educator, Journal of Special Education, and Remedial and SpecialEducation*—with a few exceptions of studies published in books.

Modifications Designed for Students' Learning

In 9 of 19 studies reviewed, the authors focused on demonstrated effectiveness of modifications designed for studentlearning, which include 7 empirical studies and 2 conceptual papers. This section contains three sub-sections based on the types of diverse students, namely general education students, English Language Learners, and gifted and talented students.

Modification for General Education Students

We found two empirical studies comparing the effect of modified curriculum to that of regular curriculum on general education students' learning performance, including engagement, motivation, and achievement, as well as teacher perceptions regarding the use of modified curriculum (Tieso, 2001). The number of studies focusing on the effectiveness of curriculum modification for general education students alone is limited since a majority of studies in this topic target student populations in need of modification to existing general curriculum. Tieso's (2001) qualitative study involved 12 mathematics teachers from different school sites (2 teachers used regular textbook curriculum, 10 teachers used the modified curriculum). From these classrooms, 6 students in grade 5 through 8 were selected for interviews. During the 3 weeks of data collection, Tieso investigated teacher and student perceptions regarding the necessity and effectiveness of modified math units and the academic achievements of the students after receiving the modified units. The curriculum was redesigned so modified units would provide enhanced learning objectives, authentic resources and assessment techniques, engaging lesson introductions, and include an emphasis on the major principles and concepts of the

discipline. The existing units of study were carefully aligned with constructivist teaching and learning activities and the teachers received training in curriculum modification. Data were collected through individual interviews, focus groups, observations, and examinations of students' artifacts.
The authors reported that teachers perceived the modified unit as more effective in motivating and engaging students. The modified unit also seemed to meet the needs of all students by challenging the students and posing high expectations. Based on these results, the author's indicate that students believed the modified units were more fun, complex, engaging, and challenging than a regular textbook unit. Additionally, the students showed pride in completing their final projects. In summary, the author stated that teachers and students preferred the modified unit, which involved hands-on activities, the infusion of writing into the math curriculum, the opportunity of collaboration among students, and the comprehensive and authentic nature of the final project.
A second study on curriculum modification by Moon and Callahan (2001)researched the effectiveness of curriculum modification on general education student's learning achievement. In this 2-year longitudinal study, a mixed method, curriculum modification was one of the interventions designed for a project called Support To Affirm Rising Talent (START). The subjects included 273 elementary students with diverse backgrounds in terms of race, ethnicity, and socio-economic status. The students were first or second graders from 16 schools in an urban school district and more than a half of them were from lowsocioeconomic environments. Curriculum modification in this study followed a constructivist approach, which emphasized a student-centered approach in modification. Curriculum modification involved various components of learning in daily classroom activities.Some modification practices included organizing lessons relevant to students' lives, considering a pattern of classroom interaction, and using materials familiar to students from varied cultural backgrounds. During the implementationof this curriculum modification, student's academic achievement was measured using a standardized norm-referenced measure in basicskills (vocabulary, reading, language arts, and mathematics).

- **Assignment/Activity**

There are a small number of empirical articles available investigating the effectiveness of curriculum modification on students' inclusion. One of the possible reasons is that many researchers discuss curriculum modification as a part of inclusion strategies. Also, many studies do not clearly identify curriculum modification as a strategy for inclusion and therefore were not reviewed for this paper.

The research studies reviewed in this section, Evidence of Effectiveness, showed the potentialities of curriculum modification for various groups of students and teachers. With its flexibilities, curriculum modification seems to be effective in countless ways. Therefore, stating all possible effective areas is beyond the scope of this report. The similarity found among these studies was their emphases on the constructive view of curriculum design with a student-centered approach. All studies suggested that the process of an effective modification requires the deep analysis and assessment of students' needs and their learning contexts. Students' needs play essential roles in the process of modification. Clear evidence was seen in the approach of functional analysis/assessment. These studies also suggested that important elements for curriculum modification, such as personal interests, may be commonly considered for all students, whereas others may be specific to certain groups, such as linguistic and cultural integration for ELLs. The affordance of curriculum modification can be greatly enhanced if students are supported to develop the the knowledge and skills of self-determined learners.
Most importantly, the findings of these studies reported the effectiveness of curriculum modification for various groups of students, including general education students, ELLs, gifted and talented students, and students with a variety of disabilities. These findings suggested the potentialities of curriculum modification for all students. In order for teachers to learn more about the empirical evidence of curriculum modification in educational settings similar to their own, further research is needed with a wider range of educational contexts.

Factors Influencing Effectiveness

This section describes four factors influencing the effectiveness of curriculum modification: (a) individual needs, (b) subject-specific needs, (c) teachers' roles and school support, and (d) use of technology.

- **Points For Discussion And Clarification**

Individual Needs

When teachers modify curriculum, they first need to analyze and assess educational contexts and to determine the method of modification based on individual student needs. In other words, the impetus of curriculum modification derives from individual needs identified in actual educational settings. Although the extent of curriculum modification widens from accommodation to overlapping curricula, this extent does not represent the degree of effectiveness. Some students may benefit from a minor modification rather than from major changes regardless of student levels of disability or needs. Also, applying curriculum modification for all students may actually have a negative impact on the students who do not need it.

King-Sears (2001) suggested, for example, that teachers can practice curriculum modification when curriculum enhancement alone is not effective. This, however, does not mean that curriculum modification is closer to ideal for those who need greater supports to access general curriculum. Curriculum enhancement may work better in some situations than curriculum modification and vice versa. It is crucial to determine the most appropriate method for approaching general curriculum based on our understandings of students' unique needs and educational contexts. King-Sears stated that for those students who need further modifications, "the design and delivery of [modifications] should be done in a manner that is thoughtful and considerate of individual student needs" (p. 11).

Both formal and informal analysis and assessment of individual needs are useful for teachers to design effective curriculum modification. Learning about specific needs of particular groups of children, in addition to identifying individual needs in actual classroom settings, may also be a good starting point for teachers to plan curriculum modification.

Subject-Specific Needs

Other contextual variables, such as the subject of learning, play important roles when determining modified goals for students. For instance, CawleyandParmar(1990) suggest that, in the field of mathematics, curriculum modification which benefits students with disabilities cannot "simply consist of reduction in the quantity of information or the rate of presentation" (p. 518). Instead, they assert that curriculum modification should include curriculum reorganization, which focuses on the conceptual content and individual relevance of the curriculum including "mathematical reasoning, understanding, and the ability to apply computation in real-life situations" (p. 518-19, Cawley&Pamar, 1990). Thus, the goals of modified curriculum are influenced not only by a particular student's unique needs but also by the particular way of knowledge-building associated with content area.

Teachers' Roles and School Support

Teacher involvement may play a key role for successful curriculum modification. Comfort (1990) acknowledged that practicing curriculum modification is a professional task and asserts that teachers should be encouraged to take part in curriculum and instructional decision-making regardless of the pressures of the standardized testing movement built around curriculum standards. Comfort suggests four factors that foster curriculum modification: (a) a school system curriculum of appropriate breadth and specificity, (b) curriculum development and implementation processes that include an integral role for teachers, (c) an expectation of greater collaborative relationship, and (d) the provision of orientations to and encouragement of the practice of curriculum modification.

In order to meet these factors, teachers need an extensive amount of support at the school level, including teacher training and professional development opportunities. MacMackin,et al.(1997), point out that many general and special education teachers are interested in meeting the diverse needs of students but do not know how to make appropriate modifications.

In reality, many teachers tend to make inconsistent and unsystematic use of curriculum modification due to lack of training and their doubts of ineffectiveness. Some teachers first tend to express doubts about students' reactions to the modified units but are usually surprised at the positive outcomes (Tieso, 2001). Further efforts are necessary to promote more school-wide support and demonstrate empirical evidence of effective curriculum modification.

Use of Technology

Technology contributes to the effectiveness of curriculum modification when used appropriately (Birnbaum, 2001). Birnbaum suggests that the selection and the practice of technology, such as software, computer games, the Internet, multimedia, and hypermedia, need to follow the student's IEP in relation to the general curriculum. Based on the individual student's needs, teachers can select technologies with features promoting active learning, experimentation, controlled interactions, and independence. For instance, use of a computer game (such as Jumble by the Tribune Company) may be appropriate for ELLs or students with reading difficulties since it can provide an opportunity to learn and enforce vocabulary. Thus, when modifying curriculum with technologies, teachers need to remember that the features of those technologies have to match individual students' needs.

Teachers also need to recognize that computer experience may vary greatly among students.Teachers need to consider what Bray, et al. (2004), called digital divide—"the gap between those in society who have access to computer technology and those who do not" (p. 3). Again, obtaining information about individual students is a key to successfully incorporating technology use into curriculum modification.

Overall, the four factors discussed above reflect how successfully teachers utilize their knowledge of individual students, educational contexts, and how effectively teachers and students select and use available resources to meet students' unique needs. As we see in Comfort's statement, "curriculum modification is firmly grounded in the practical realities of the classroom" (1990, p. 398), the effectiveness of curriculum modification is deeply influenced by many factors existing in actual classrooms.

Applications to General Education Classroom Settings

Curriculum modification consists of potential benefits for not only the students who need special support but also other students who learn in the same learning environment at any age level. For instance, general education students may benefit from modified curriculum designed for students with behavioral problems in general classroom settings. Through the increased positive behavior and learning productivity of those students, other students in the same classroom may experience a more optimal learning environment and opportunities for mutual understanding and more interactions. In another situation, integrating students' linguistic and cultural needs may provide other students with the opportunity to learn a new language and culture and may increase their multicultural awareness and mutual respect. In short, when a particular group of individual students in a classroom benefit from curriculum modification, there is a great possibility that other students receive benefits as well. The mutual benefit can be planned as a shared goal as in the process of overlapping curricula, or such shared learning can naturally occur in our everyday teaching.

It is important for teachers to know that various factors affect the effectiveness of curriculum modification. A teacher's understanding of students' backgrounds, resources and materials, and school support are some of the important factors to consider. Professional development opportunities are especially necessary in order for teachers to improve their skills and knowledge in curriculum modification.

In actual classrooms, modifying curriculum may require teachers to use their creativity and flexibility. For instance, they may need to form small groups for somestudents during a lesson or practice differentiated instruction as needed. (For more information, see the literature review of Differentiated Instruction on the AEM Centerweb site). Teachers may also need realistic numbers of adults working in their classrooms and vitality to make extra efforts to modify existing curriculum. Switlick (1997) suggested that curriculum modifications become successful when including FLOW:Fit into the classroom environment, Lend themselves to meeting individual student needs, Optimize understanding for each student, and Works well with the activity planned for the lesson.

Curriculum modification can be applied to general classrooms in multiple ways in order to enhance learning potentialities for all students. Only when contextual factors and principles of successful modification are taken into consideration, and the modification is well designed to fulfill individual students' needs determined through extensive analyses and assessment, does curriculum modification play a vital role to move students forward in their learning.

- **References / Further Readings**

POINTS FOR DISCUSSIONS / CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

Points for Discussion

Points for Clarification

UNIT 4: TYPES OF ADAPTATION AND PROCESS

- **Introduction**
- **Objectives**
- **Definitions**
- **Summary**
- **Revision**
- **Assignment/Activity**
- **Points For Discussion And Clarification**
- References / Further Readings

- **Introduction**

Adaptation is, first of all, a *process*, rather than a part of a body.[2] An internal parasite (such as a liver fluke) can illustrate the distinction: such a parasite may have a very simple bodily structure, but nevertheless the organism is highly adapted to its specific environment. From this we see that adaptation is not just a matter of visible traits: in such parasites critical adaptations take place in the life cycle, which is often quite complex.[3] However, as a practical term, adaptation is often used for the *product*: those features of a specieswhich result from the process. Many aspects of an animal or plant can be correctly called adaptations, though there are always some features whose function is in doubt. By using the term *adaptation* for the evolutionary *process*, and *adaptive trait* for the bodily part or function (the product), the two senses of the word may be distinguished.[4][5][6][7]
Adaptation is one of the two main processes that explain the diverse species we see in biology, such as the different species of Darwin's finches. The other is speciation (species-splitting or cladogenesis), caused by geographical isolation or

some other mechanism.[8][9] A favorite example used today to study the interplay of adaptation and speciation is the evolution of cichlid fish in African lakes, where the question of reproductive isolation is much more complex.[10][11]

Adaptation is not always a simple matter, where the ideal phenotype evolves for a given external environment. An organism must be viable at all stages of its development and at all stages of its evolution. This places *constraints* on the evolution of development, behavior and structure of organisms. The main constraint, over which there has been much debate, is the requirement that each genetic and phenotypic change during evolution should be relatively small, because developmental systems are so complex and interlinked. However, it is not clear what "relatively small" should mean, for example polyploidy in plants is a reasonably common large genetic change.[12] The origin of eukaryotic symbiosisis a more dramatic example.[13]

All adaptations help organisms survive in their ecological niches.[14] These adaptive traits may be structural, behavioral or physiological. Structural adaptations are physical features of an organism (shape, body covering, armament; and also the internal organization). Behavioral adaptations are composed of inherited behavior chains and/or the ability to learn: behaviors may be inherited in detail (instincts), or a capacity for learning may be inherited (see neuropsychology). Examples: searching for food, mating,vocalizations. Physiological adaptations permit the organism to perform special functions (for instance, making venom, secreting slime, phototropism); but also more general functions such as growth and development, temperature regulation, ionic balance and other aspects of homeostasis. Adaptation, then, affects all aspects of the life of an organism.

- **Objectives**

From the above definitions, it is clear that there is a relationship between adaptedness and fitness (a key population genetics concept). Differences in fitness between genotypespredict the rate of evolution by natural selection. Natural selection changes the relative frequencies of alternative phenotypes, insofar as they are heritable.[18] Although the two are connected, the one does not imply the other: a phenotype with high adaptedness may not have high fitness. Dobzhansky mentioned the example of the Californian redwood, which is highly adapted, but a relict species in danger of extinction.[15] Elliott Sober commented that adaptation was a retrospective concept since it implied something about the history of a trait, whereas fitness predicts a trait's future.[19]

1. Relative fitness. The average contribution to the next generation by a genotype or a class of genotypes, relative to the contributions of other genotypes in the population.[20]This is also known as Darwinian fitness, selection coefficient, and other terms.
2. Absolute fitness. The absolute contribution to the next generation by a genotype or a class of genotypes. Also known as the Malthusian parameter when applied to the population as a whole.[18][21]
3. Adaptedness. The extent to which a phenotype fits its local ecological niche. This can sometimes be tested through a reciprocal transplant this allows them to create an experiment

- **Definitions**

The following definitions are mainly due to Theodosius Dobzhansky.

1. *Adaptation* is the evolutionary process whereby an organism becomes better able to live in its habitat or habitats
2. *Adaptedness* is the state of being adapted: the degree to which an organism is able to live and reproduce in a given set of habitats
3. An *adaptive trait* is an aspect of the developmental pattern of the organism which enables or enhances the probability of that organism surviving and reproducing.

- **Summary**

Adaptation Characteristics and Processes

Adaptation refers both to the *process* of adapting and to the *condition* of being adapted. The term has specific interpretations in particular disciplines. In ecology, for example, adaptation refers to changes by which an organism or species becomes fitted to its environment (Lawrence, 1995; Abercrombie *et al.*, 1997); whereas in the social sciences, adaptation refers to adjustments by individuals and the collective behavior of socioeconomic systems (Denevan, 1983; Hardesty, 1983). This chapter follows Carter *et al.*(1994), IPCC (1996), UNEP (1998), and Smit *et al.* (2000) in a broad interpretation of adaptation to include adjustment in natural or human systems in response to experienced or future climatic conditions or their effects or impacts—which may be beneficial or adverse.

Components and Forms of Adaptation

As both a process and a condition, adaptation is a relative term: It involves an alteration in something (the system of interest, activity, sector, community, or region) to something (the climate-related stress or stimulus). Description of an adaptation requires specification of who or what adapts, the stimulus for which the adaptation is undertaken, and the process and form it takes (Downing *et al.*, 1997; Krankina *et al.*, 1997; UNEP, 1998; Pittock *et al.*, 1999; Risbey *et al.*, 1999; Reilly and Schimmelpfennig, 2000). These elements are summarized in Figure 18-2 and addressed in turn in subsequent subsections.

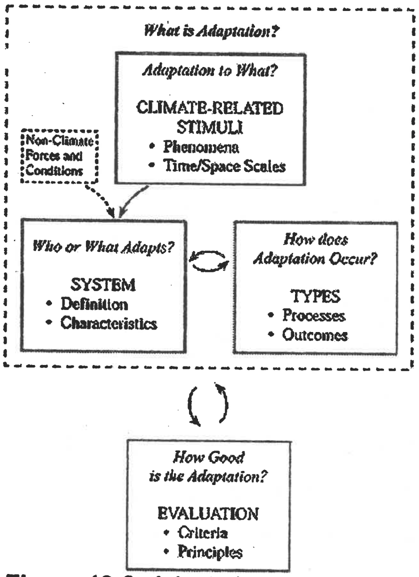

Figure 18-2: *Adaptation to climate change and variability (from Smit et al., 2000).*

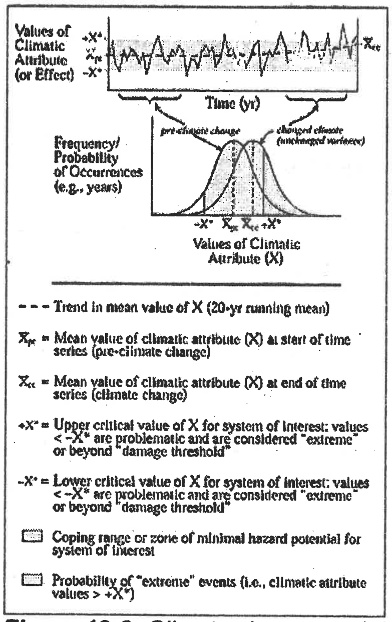

Figure 18-3: *Climate change, variability, extremes, and coping range (after Hewitt and Burton, 1971; Fukui, 1979; Smit et al., 1999; and others).*

Climate Stimuli for Adaptation

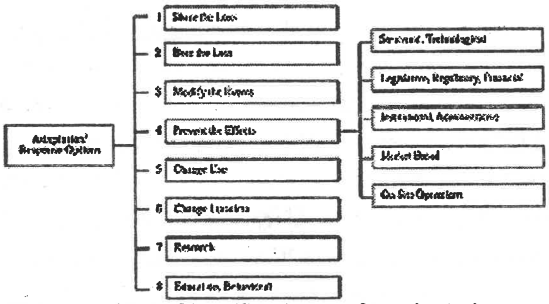

Figure 18-4: *Classification of adaptation options (Burton, 1996).*

Most impact and adaptation studies to date have been based on climate change scenarios that provide a limited set of possible future climates—invariably specified as average annual conditions, such as temperature and moisture. Yet the climate change-related stimuli for which adaptations are undertaken (i.e., adaptation to what?) are not limited to changes in average annual conditions; they include variability and associated extremes. Climatic conditions are inherently variable, from year to year and decade to decade. Variability goes along with, and is an integral part of, climate change (Mearns *et al.*, 1997; Karl and Knight, 1998; Berz, 1999; Hulme *et al.*, 1999): A change in mean conditions actually is experienced through changes in the nature and frequency of particular yearly conditions, including extremes (see Figure 18-3). Thus, adaptation to climate change necessarily includes adaptation to variability (Hewitt and Burton, 1971; Parry, 1986; Kane *et al.*, 1992b; Katz and Brown, 1992; Downing, 1996; Yohe *et al.*, 1996; Smithers and Smit, 1997; Smit *et al.*, 1999). Downing *et al.* (1996), Etkin (1998), Mileti (1999), and others use the term "climate hazards" to capture those climate stimuli, in addition to changes in annual averages, to which the system of interest is vulnerable. Climate change stimuli are described in terms of "changes in mean climate and climatic hazards," and adaptation may be warranted when either of these changes has significant consequences (Downing *et al.*, 1997). In water resource management, changes in the recurrence interval of extreme conditions, which are associated with changes in means, are the key stimuli (Beran and Arnell, 1995; Kundzewicz and Takeuchi, 1999).

Furthermore, for most systems and communities, changes in the mean condition commonly fall within the coping range (see Figure 18-3), whereas many systems are particularly vulnerable to changes in the frequency and magnitude of extreme events or conditions outside the coping range (Baethgen, 1997; Schneider, 1997; Rayner and Malone, 1998; Kelly and Adger, 1999). Interannual variations are key stimuli in many sectors (Rosenzweig, 1994; Adams *et al.*, 1995; Mearns *et al.*, 1997; Bryant *et al.*, 2000).

Natural and human systems have adapted to spatial differences in climate. There also are examples of adaptation (with varying degrees of success) to temporal variations—notably, deviations from the annual average conditions on which climate change scenarios focus. Many social and economic systems—including agriculture, forestry, settlements, industry, transportation, human health, and water resource management—have evolved to accommodate some deviations from "normal" conditions, but rarely the extremes. This capacity of systems to accommodate variations in climatic conditions from year to year is captured in Figure 18-3 in the shaded "coping range." This capacity also is referred to as the vulnerability or damage threshold (Pittock and Jones, 2000). The coping range, which varies among systems and regions, need not remain static, as depicted in Figure 18-3. The coping range itself may change (move up or down, expand or contract), reflecting new adaptations in the system (De Vries, 1985; de Freitas, 1989; Smit*et al.*, 2000). The coping range indicated in Figure 18-3 can be regarded as the adaptive capacity of a system to deal with current variability. Adaptive capacity to climate change would refer to both the ability inherent in the coping range and the ability to move or expand the coping range with new or modified adaptations. Initiatives to enhance adaptive capacity (Section 18.6) would expand the coping range.

Adaptation Types and Forms

Adaptations come in a huge variety of forms. Adaptation types (i.e., how adaptation occurs) have been differentiated according to numerous attributes (Carter *et al.*, 1994; Stakhiv, 1994; Bijlsma *et al.*, 1996; Smithers and Smit, 1997; UNEP, 1998; Leary, 1999; Bryant *et al.*, 2000; Reilly and Schimmelpfennig, 2000). Commonly used distinctions are purposefulness and timing. Autonomous or spontaneous adaptations are considered to be those that take place—invariably in reactive response (after initial impacts are manifest) to climatic stimuli—as a matter of course, without the directed intervention of a public agency. Estimates of these autonomous adaptations are now used in impact and vulnerability assessment. Planned adaptations can be either reactive or anticipatory (undertaken before impacts are apparent). In addition, adaptations can be short or long term, localized or widespread, and they can serve various functions and take numerous forms (see Table 18-1).

Adaptations have been distinguished according to individuals' choice options as well, including "bear losses," "share losses," "modify threats," "prevent effects," "change use," and "change location" (Burton *et al.*, 1993; Rayner and Malone, 1998). The choice typology has been extended to include the role of community structures, institutional arrangements, and public policies (Downing *et al.*, 1997; UNEP, 1998; see Figure 18-4).

- **Revision**

In any school whether it be an ordinary school, a full service school, a special school or a special schools as a resource centre, there will be learners with diverse needs. Within the majority group there will be different needs which can be dealt with in a classroom at the lesson plan level through differentiated tasks/activities and alternative assessment. Within the variety of learner needs there will be a minority or an individual learner or two that need more or different support than the others, whether it is in a ordinary school or class or any other type of school, centre or class. This minority group or individual learner may not be able to work towards the assessment standard(s) selected for the rest of the group. However, it is important that the learning opportunities for these learners be planned against assessment standards within the same learning outcome(s) and that their learning opportunities also show conceptual progression. In order to plan their learning more than differentiated tasks may be needed. Teachers may have to adapt the assessment standards (attainment targets) to suit their level of development within the same context and/or content and learning outcomes so that they can still be working within the same class or group. All learners must therefore experience their learning meaningful and they must be working towards the same type of activity. The availability of the type of support plays a major role in accommodating these learners in an education system. For the minority learners individual learning plans must be a viable option where the specific needs of that particular learner must be addressed. Such individual adaptations should include a learning pathway that will consist of an individual learning programme, a work schedule or year plan and the specific adapted lesson plans. Such specialised planning should be done in collaboration with the Institution Level Support 20 Team (ILST) based on appropriate available resources, skills and knowledge, values and attitudes. Further guidelines on the planning of adapted individual lesson plans, work schedules and learning programmes will be discussed in the next section. 2.2.2 Influence of the learner profile of a special school, special school as resource centre or full service school The needs of the majority of learners in a special school, special school as resource centre or full service school will be different to the needs of the majority of learners in a ordinary school. Therefore special schools, full service schools and special schools as resource centres need to take their learner profile into account when designing learning programmes, work schedules and lesson plans. The level and type of resources and activities in the full service schools, special schools and special schools as resource centres must be true to the profile of the majority of the learners in those schools. The availability of resources, whether human, physical or material is a further determining factor. The learners who experience barriers because of intellectual disability will require a curriculum which straddles two or more grades or phases. This has implications for planning learning programmes, work schedules and lesson plans. In the case where learners learn in a language which is not their home language it could create a barrier to learning. This may require intensive adaptation of the existing Language Learning Programmes or even the planning of new Language Learning Programmes to support the learners. This includes learners whose home language is South African Sign Language (SASL). Some learners may need South African Sign Language (SASL) support, others may need tactile communication support, and yet others may need reinforced spoken language support as well as assistive devices. It is important that teachers understand that the majority of learners who need SASL support have parents who are not proficient in SASL and therefore cannot give their children the required support at home. This also means that these learners have limited language acquisition prior to entering school. Optimal exposure to mature users of SASL 21 is essential for proficient language acquisition for learners for whom SASL will be the language of learning, teaching and assessment. The structure of sign language is very different to that of spoken and written language. It is therefore not desirable to sign and speak simultaneously. Learners who experience auditory, oral, visual and physical barriers to learning will require specialised and specific adaptations to existing learning programmes, work schedules and lesson plans in order to access the curriculum. Learners for whom the language of learning and teaching is not their home language will require support in acquiring the language of learning and teaching. All learning programmes and Learning Area teachers should be Language teachers because learners experiencing barriers need continuous focus on language acquisition. Planning learning programmes, work schedules and lesson plans for multi-grade classes presents an exciting challenge to teachers teaching several grades in one classroom. Home tasks are critical in the learning and development of a learner who experiences barriers to learning. Caution must be taken not to overload the learner with homework. Where more than one teacher teaches a particular class it is essential that a homework timetable be in place. The homework tasks should be clearly explained in the classroom, and written down by the learners. When learners encounter barriers to reading and/or writing, alternative methods of recording homework tasks should be utilised. Peer support for learners experiencing barriers to learning is of great value and can be enhanced through a "buddy" system. 2.3 Implications for adapting learning programmes, work schedules and lesson plans at special schools, special schools as resource centres and/or full service schools Learning, teaching and assessment strategies must be differentiated or adapted to meet the individual needs of all learners. Adequate and timeous planning and modification of existing phase long learning programmes, year long work schedules and lesson plans can ensure that all learners will learn effectively and achieve their full potential. 22 Designing down is one of the important principles of Outcomes Based Education and the Revised National Curriculum Statement. In some learning areas Designing down involves breaking down the assessment standard in order to build it up in a logical progressive way. Simply put, designing down involves looking at an assessment standard and dividing this minimum expected set standard for the year end into smaller, achievable components which are spread across the duration of the year. In other learning areas the content must be identified and the learning outcomes which are process learning outcomes should be applied to the content. This allows time for each component to be achieved step by step and thus working gradually towards achieving the assessment standard by the end of the year. The assessment standards of all learning outcomes are the minimum requirements per grade to be demonstrated at the end of a year. For learners experiencing barriers to learning, the strategy of "designing down", "breaking down" or "scaffolding" (these terms are inter changeable) of assessment standards into manageable units is highly recommended. This process should include the practical demonstration of skills, knowledge and values.

POINTS FOR DISCUSSIONS / CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

Points for Discussion

Points for Clarification

- References / Further Readings

1. Huxley 1942, p. 449
2. **Jump up^** Mayr 1982, p. 483: "Adaptation... could no longer be considered a static condition, a product of a creative past, and became instead a continuing dynamic process."
3. **Jump up^** Price 1980
4. **Jump up^** *Daintith, John; Martin, Elizabeth A., eds. (2010) [First published 1984 as Concise Science Dictionary]. "adaptation". A Dictionary of Science. Oxford Paperback Reference (6th ed.). Oxford; New York: Oxford University Press. p. 13. ISBN 978-0-19-956146-9.LCCN 2010287468. OCLC 444383696. Any change in the structure or functioning of successive generations of a population that makes it better suited to its environment.*
5. **Jump up^** Bowler 2003, p. 10
6. **Jump up^** Patterson 1999, p. 1
7. **Jump up^** Williams 1966, p. 5: "Evolutionary adaptation is a phenomenon of pervasive importance in biology."
8. **Jump up^** Mayr 1963
9. **Jump up^** Mayr 1982, pp. 562–566
10. **Jump up^** *Salzburger, Walter; Mack, Tanja; Verheyen, Erik; Meyer, Axel (February 21, 2005). "Out of Tanganyika: Genesis, explosive speciation, key-innovations and phylogeography of the haplochromine cichlid fishes" (PDF). BMC Evolutionary Biology (London: BioMed Central)* **5** *(17). doi:10.1186/1471-2148-5-17. ISSN 1471-2148. PMC 554777.PMID 15723698. Retrieved 2015-08-15.*

11. **Jump up^** *Kornfield, Irv; Smith, Peter F. (November 2000). "African Cichlid Fishes: Model Systems for Evolutionary Biology". Annual Review of Ecology and Systematics (Palo Alto, CA:Annual Reviews)* ***31****: 163–196. doi:10.1146/annurev.ecolsys.31.1.163. ISSN 1545-2069.*

POINTS FOR DISCUSSIONS / CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

Points for Discussion

Points for Clarification

UNIT 5: ADAPTATION AND ACCOMMODATIONS IN STUDENT'S EVALUATION AND EXAMINATIONS

- **Introduction**
- **Objectives**
- **Definitions**
- **Summary**
- **Revision**
- **Assignment/Activity**
- **Points For Discussion And Clarification**
- References / Further Readings

- **Introduction**

The Revised National Curriculum Statement adopts an inclusive approach by specifying minimum requirements for all learners. The special educational, social, emotional and physical needs of learners will be addressed in the design and development of appropriate learning programmes (DOE, 2002: Overview of Revised National Curriculum Statement, p10.) Adaptations to the RNCS should not be viewed as creating a new or alternative curriculum to the RNCS. It is intended to supplement the Teacher's Guides for the Development of Learning Programmes for the Foundation Phase and those for the different Learning Areas (Intermediate Phase and Senior Phase) of the General Education and Training Band. The purpose of this guide with the guidelines that follow is to provide guidance to teachers on how they could adapt the Revised National Curriculum Statement so all learners who experience barriers to learning can access the curriculum. Learning programmes, work schedules and lesson plans can be adapted to cater for the individual needs of learners. Curriculum adaptations are modifications that relate specifically to instruction or content of a curriculum. A curricular adaptation is any adjustment or modification to: (i) learning, teaching and assessment environment, (ii) learning, teaching and assessment techniques, (iii) learning, teaching and assessment support material that enhances a learner's performance or allows at least partial participation in a learning activity (iv) structure and number of learning programmes and (v) assessment. The RNCS has several components that are flexible enough to allow for adaptation. Examples of these flexible features include: • "The outcomes and assessment standards emphasise participatory, learnercentred and activity-based education. They leave considerable room for creativity and innovation on the part of teachers in interpreting what and how to teach." (DOE, 2002: Overview of Revised National Curriculum Statement, p14.) • Learning outcomes do not prescribe content or method. Therefore, content and methodology could be appropriate for a learner's needs. (DOE, 2002: Overview of Revised National Curriculum Statement, p14.) • Activities can be flexible. (DOE, 2003: Teacher's Guide for the development of Learning Programmes, p.10) 8 • The context can be made relevant to the learners' needs. (DOE, 2003: Teacher's Guide for the development of learning Programmes, p.10) • More time can be provided for assessment and execution of a task. (DOE, 2003: Teacher's Guide for the development of Learning Programmes, p.11) • Assessment strategies are flexible. (DOE, 2003: Teacher's Guide for the development of Learning Programmes, p.1) • The learning programme can be structured to meet the needs of the specific learners. (DOE, 2003: Teacher's Guide for the development of Learning Programmes, p.2) • Learners can communicate using SA sign language, Braille, assistive devices or any other communication method. (DOE, 2003: Teacher's Guide for the development of Learning Programmes, p1) • Expectations can be adapted to the abilities of the learner within the framework of high expectations. (DOE, 2002: Overview of Revised National Curriculum Statement, p12.) • The curriculum emphasizes the principles of social justice, healthy environment, human rights and inclusivity. (DOE, 2003: Teacher's Guide for the development of Learning Programmes, p.5) • Teachers are encouraged to consider any particular barriers to learning and/or assessment that exist in different Learning Areas and make provision for these when developing learning programmes. (DOE, 2003: Teacher's Guide for the development of Learning Programmes, p.7) • assessment standards can be broken into finer components. (DOE, 2003: Teacher's Guide for the development of Learning Programmes, p.1) • A lesson plan time allocation can range from a single activity up to a term's teaching or more time if necessary, depending on the needs of the learner. (DOE, 2003: Teacher's Guide for the development of Learning Programmes, p.1) • Time allocation and weightings regarding learning outcomes and learning programmes should vary according to the learner's needs. (DOE, 2003: Teacher's Guide for the development of Learning Programmes, p.6) • The number and nature of learning programmes at a special school, special school as resource centre or full service school can vary depending on the availability of staff, resources and the needs of learners. • Flexibility in the selection of appropriate assessment standards according to the individual needs of a learner is possible on the recommendation of the assessment team in the case of a learner not capable of achieving a GETC. • Work Schedules are not limited to a grade/year. Differently gifted learners may require acceleration or slowing down of the process. 9 The scale and scope [extent] of any curriculum adaptations will only be determined after a thorough assessment of individual learners. Learning programmes, work schedules and lesson plans have to be designed on the basis of the needs and strengths (profile) of the majority of learners at a school or in a phase or grade. Lesson plans have to provide differentiated learning, teaching and assessment activities to ensure effective multi-level teaching. However, adaptation of learning, teaching and assessment activities will be required at lesson plan level for learners in a class who need specific additional support because of individualised barriers to learning. Those involved in this process of adaptation must include the teachers, parents, school based and district based support teams (where they exist). Other relevant professionals from the community can also be consulted.

- **Objectives**

Understanding disability as a barrier to learning and development Most understandings of disability relate to individual deficit. Therefore, disability has always been regarded as a barrier to learning. These barriers include: • Visual barriers • Auditory barriers • Oral barriers • Cognitive barriers • Physical barriers • Medical barriers • Psychological barriers 10 Policy implications and guidelines for addressing disability as a barrier Learners who experience barriers to learning as a result of disability should be welcomed in ordinary school environments provided that the necessary support is in place for learners to achieve their full potential. Teams that include parents, teachers and other relevant professionals should establish the nature and extent of support needed by the learner. Below are a few examples of how the system could be modified or changed to meet different kinds of support that individual learners may require: • Modified access to buildings e.g. ramps, adapted toilets and speaker systems in where applicable. • Brailed signage on doorframes, passages and outbuildings. • Enlarged print. • Appropriate assistive devices e.g. Braillers, hearing aids, tape recorders, splints, adapted computers, wheelchairs, walkers, modified tricycles and standing frames. • Therapeutic intervention. • Learner based and learner paced teaching. 1.2.2 Language and communication What are the common barriers associated with language and communication? There are normally three main barriers related to language. Firstly, learners are often forced to communicate and learn in a language which they do not usually use at home and are not competent to learn effectively. Secondly, learners who use South African Sign Language as a language for teaching and learning and as a (language) subject did not have access to the language. Thirdly, learners experience difficulties with communication. Learners who are nonspeaking due to the severity of their disability experience enormous barriers to learning and development. These barriers arise from the general unavailability of augmentative and alternative communication (AAC) strategies to enable them to engage in the learning 11 process, and more often than not find themselves totally excluded from learning and development experiences. AAC systems could consist of alternative communications systems, supplements to vocal communication and communication through facilitators. Policy implications and guidelines to address language and communication barriers • All learners are to learn their home language and at least one additional official language which include South African Sign Language. Braille as a code can be used as a medium of teaching and learning. • When learners enter a school where the language of learning and teaching is not their home language, the teachers of all the learning areas/programmes and the school should provide support and supplementary learning in the language of learning and teaching until such time that learners are able to learn effectively through the medium of that particular language. It is the responsibility of each individual teacher to ensure that the language of learning and teaching does not become a barrier to learning in such instances. Ideally, parents should be encouraged to participate in interventions regarding language. • Learners should receive extra support in the language ("subject') which is also the language of learning and teaching. The learner should work towards and be assessed against the assessment standards of the appropriate language level (Home Language, First Additional Language or Second Additional Language). 1.2.3 Lack of parental recognition and involvement Barriers and difficulties which arise as a result of a lack of parental recognition and involvement • Parents whose children do not utilise oral communication experience communication barriers with their children. • Difficulties around parental support of learners may arise due to a range of situations e.g. a parent who cannot read Braille would not be able to support a grade one learner with his or her Braille homework. • Parents are not always adequately informed of their children's problems or progress, and therefore are often deprived of the opportunity to participate in their children's development. 12 • Parents who are unable to understand the emotional and/or behavioural problems of their children may aggravate their barriers • Non-involvement and non-recognition of parents by the system creates a lack of respect for parents as, informed role players in the assessment and future development of their children. • A lack of communication and support around HIV/Aids infected or affected families creates barriers for learners from such families. • Some parents abdicate all responsibility for all their children. Policy implications and guidelines for addressing lack of parental recognition and involvement • At school level, partnerships should be established with parents in order to equip them with skills and knowledge to participate effectively in their children's learning and school life. • Parents should also be fully involved and informed regarding the identification, screening and assessment and placement of their children. • Parents should be encouraged to take an active interest in the teaching, learning and assessment of their children. • In order to facilitate early intervention for children with disabilities parents may consult community based clinics and/or other professional practitioners including teachers to conduct an initial assessment and to plan a suitable course of action for the learner. • Schools which use South African Sign Language are encouraged to run accredited SA Sign Language courses for parents and teachers. • Braille courses should be run to enable parents to communicate with their children and assist them with homework, reading and writing in Braille. • General newsletters can assist in keeping parents informed of developments and programmes at the school. This is particularly important for boarding schools where distance separates parents from the school. • Schools can run information sessions and workshops to enable parents to better understand their children and their emotional and behavioural problems. Staff from district based support teams, including psychologists and social workers, could assist at such workshops. • Where appropriate, school-based support teams should be strengthened with expertise from the local community, district-support teams and higher education. • It is essential that schools maintain open channels of communication with families infected and/or affected by HIV/Aids, and render support to parents and 13 learners wherever possible. This could be facilitated by openly displaying a clear HIV/Aids policy for the school. Shared HIV and Aids status could also help destigmatise the disease

- **Definitions**

How do we overcome negative attitudes towards learners who experience barriers and their inclusion in ordinary education? • Labelling of learners should be discouraged since it makes it difficult for learners to grow beyond the limitations of the label. It is important for teachers, parents and peer groups to adopt positive attitudes towards learners who experience barriers. Even learners who were once regarded as ineducable benefit from appropriate intervention. • Learners should not be categorized since they often are placed in a particular learning environment merely because of the category and not because of the particular learning needs of the individual learner. In many cases, the categorisation was convenient for the system and not in the best interests of the learner. • Do not discriminate against learners who are HIV positive or who have AIDS since a lack of knowledge about this issue has led to negative assumptions associated with the disease. All learners and staff should be treated equally. When it comes to blood all cases are treated as universally HIV positive. • All learners should be viewed in a positive light and there should be a determined effort to establish what their real strengths are for the purpose of further development. • Do not create conditions for fear of learners with disabilities to develop, since negative attitudes often result from beliefs that are illogical and encourage discrimination. • Schools must be welcoming environments for all learners, since any negative attitude by adults in a school environment influences learners. • Schools should embark on positive awareness campaigns about difference and the value of celebrating diversity based on new South African policy and principles. • Acknowledge and respect differences in learners, whether due to age, gender, ethnicity, language, class, disability or HIV status, sexual preference, etc. 16 1.2.6 Inadequate Programme-to-Work Linkages (White Paper 6, p. 21 and p.32 par. 2.2.6.3) How do we understand the barriers created by inadequate programme-to-work linkages? • Learners with cognitive barriers who are unlikely to achieve a full GETC as well as learners who, due to age constraints and social barriers, need specific programmeto-work linkages. • Appropriate accreditation and certification for the level of skills achieved need recognition to facilitate life long learning. • A lack of partnerships between education and industry which would facilitate job accessibility could be a stumbling block to learners. How do we overcome the inadequate programme-to-work linkages? • Weighting of learning areas and time allocation can be adjusted to allow for chosen learning areas or learning programmes to become the major tool or vehicle for learning, thus fulfilling the vision of Education White Paper 6 of providing more options for learners as ways to learn and to provide programme-to-work linkages. • Linkages across learning areas will allow for assessment standards from various learning areas and from different grades to be achieved within the skills learning programmes allowing for work related linkages. • Collaboration between teachers within and across a phase or grade would be essential in the planning of learning programmes for specific learners or groups of learners to ensure effective programme-to-work linkages. • At local school level partnerships with industry should be established to assess the educational requirements of future employers and to facilitate hands-on work experience for learners. • Schools may issue a certificate of competency that includes specific reference to Learning Pogrammes that reflect programme-to-work linkages to learners who do not achieve a GETC. • Learners should not be expected to show competence in all the learning areas for the end of the GETC band at the same time, but should be allowed to show their competence in the different learning areas/programmes over a period of time in order to be eventually awarded a GETC or Grade 9 promotion. 17 PROPOSED RECOMMENDATIONS FOR CHANGES TO LEGISLATION • The schools section within the Department of Education should establish partnerships with SAQA, Umalusi and other relevant stakeholders. • Qualifications should be developed and assessed for appropriate accreditation leading to life long learning for those learners who cannot achieve the GETC

- **Summary**

Presently learners in the GET-band who experience barriers to learning can attend ordinary schools, full service schools, special schools or special schools as resource centres. Some of these schools already have a range of human and physical resources which can be utilised to expand opportunities for learners who experience barriers to learning. These can include teachers with specialised competencies, adapted or modified classrooms, workshops, computer rooms etc. for addressing all barriers to learning and the teaching of work related skills where applicable. Programmes-to work linkages and other learning programmes should become the vehicles or tools through which learners demonstrate their performance as required by the Learning Areas Statements of the RNCS Grade R -- 9 (Schools) (2002). Adaptations made to existing learning programmes, work schedules and lesson plans as well as newly designed learning programmes, work schedules and lesson plans that provide lifeskills training and programme-to-work linkages to meet the needs of learners must by no means compromise the standard of the curriculum as prescribed by the RNCS Grade R-9 (Schools) (2002). An attempt is made here to provide principals, school management teams, institution level support teams, district based support teams and all teachers with guidelines that will assist them with differentiation, modification, adaptation, planning and management of the curriculum to address diversity. In conceptualising the framework for adaptation of the curriculum, a wide range of factors that have direct impact on the learner, the school and its resources, the parents and the community were considered. The effects of these factors as well as strategies to address them are discussed briefly in this document. Before the above mentioned issues are addressed it is imperative to emphasise that readers are familiar with the Revised National Curriculum Statement (Overview) as well as Section 1 (a generic section) of the Teacher's Guides for the Development of Learning Programmes (Foundation Phase and all Learning Areas e.g. Languages, Mathematics for the Intermediate and Senior Phase, 2003). 19 2.2 Learner Needs The developmental needs of learners should not prevent them from progressing with their age cohort as the value of peer interaction is essential for social development, self-esteem, etc. The 1998 policy on Assessment allows for learners to spend a maximum of one extra year per phase. An additional year over and above what the policy currently states may be granted by the head of education of the province. This would mean that learners experiencing barriers to learning may be older than their peers. 2.2.1 The learner profile of a school In any school whether it be an ordinary school, a full service school, a special school or a special schools as a resource centre, there will be learners with diverse needs. Within the majority group there will be different needs which can be dealt with in a classroom at the lesson plan level through differentiated tasks/activities and alternative

assessment. Within the variety of learner needs there will be a minority or an individual learner or two that need more or different support than the others, whether it is in a ordinary school or class or any other type of school, centre or class. This minority group or individual learner may not be able to work towards the assessment standard(s) selected for the rest of the group. However, it is important that the learning opportunities for these learners be planned against assessment standards within the same learning outcome(s) and that their learning opportunities also show conceptual progression. In order to plan their learning more than differentiated tasks may be needed. Teachers may have to adapt the assessment standards (attainment targets) to suit their level of development within the same context and/or content and learning outcomes so that they can still be working within the same class or group. All learners must therefore experience their learning meaningful and they must be working towards the same type of activity. The availability of the type of support plays a major role in accommodating these learners in an education system. For the minority learners individual learning plans must be a viable option where the specific needs of that particular learner must be addressed. Such individual adaptations should include a learning pathway that will consist of an individual learning programme, a work schedule or year plan and the specific adapted lesson plans. Such specialised planning should be done in collaboration with the Institution Level Support 20 Team (ILST) based on appropriate available resources, skills and knowledge, values and attitudes. Further guidelines on the planning of adapted individual lesson plans, work schedules and learning programmes will be discussed in the next section. 2.2.2 Influence of the learner profile of a special school, special school as resource centre or full service school The needs of the majority of learners in a special school, special school as resource centre or full service school will be different to the needs of the majority of learners in a ordinary school. Therefore special schools, full service schools and special schools as resource centres need to take their learner profile into account when designing learning programmes, work schedules and lesson plans. The level and type of resources and activities in the full service schools, special schools and special schools as resource centres must be true to the profile of the majority of the learners in those schools. The availability of resources, whether human, physical or material is a further determining factor. The learners who experience barriers because of intellectual disability will require a curriculum which straddles two or more grades or phases. This has implications for planning learning programmes, work schedules and lesson plans. In the case where learners learn in a language which is not their home language it could create a barrier to learning. This may require intensive adaptation of the existing Language Learning Programmes or even the planning of new Language Learning Programmes to support the learners. This includes learners whose home language is South African Sign Language (SASL). Some learners may need South African Sign Language (SASL) support, others may need tactile communication support, and yet others may need reinforced spoken language support as well as assistive devices. It is important that teachers understand that the majority of learners who need SASL support have parents who are not proficient in SASL and therefore cannot give their children the required support at home. This also means that these learners have limited language acquisition prior to entering school. Optimal exposure to mature users of SASL 21 is essential for proficient language acquisition for learners for whom SASL will be the language of learning, teaching and assessment. The structure of sign language is very different to that of spoken and written language. It is therefore not desirable to sign and speak simultaneously. Learners who experience auditory, oral, visual and physical barriers to learning will require specialised and specific adaptations to existing learning programmes, work schedules and lesson plans in order to access the curriculum. Learners for whom the language of learning and teaching is not their home language will require support in acquiring the language of learning and teaching. All learning programmes and Learning Area teachers should be Language teachers because learners experiencing barriers need continuous focus on language acquisition. Planning learning programmes, work schedules and lesson plans for multi-grade classes presents an exciting challenge to teachers teaching several grades in one classroom. Home tasks are critical in the learning and development of a learner who experiences barriers to learning. Caution must be taken not to overload the learner with homework. Where more than one teacher teaches a particular class it is essential that a homework timetable be in place. The homework tasks should be clearly explained in the classroom, and written down by the learners. When learners encounter barriers to reading and/or writing, alternative methods of recording homework tasks should be utilised. Peer support for learners experiencing barriers to learning is of great value and can be enhanced through a "buddy" system. 2.3 Implications for adapting learning programmes, work schedules and lesson plans at special schools, special schools as resource centres and/or full service schools Learning, teaching and assessment strategies must be differentiated or adapted to meet the individual needs of all learners. Adequate and timeous planning and modification of existing phase long learning programmes, year long work schedules and lesson plans can ensure that all learners will learn effectively and achieve their full potential. 22 Designing down is one of the important principles of Outcomes Based Education and the Revised National Curriculum Statement. In some learning areas Designing down involves breaking down the assessment standard in order to build it up in a logical progressive way. Simply put, designing down involves looking at an assessment standard and dividing this minimum expected set standard for the year end into smaller, achievable components which are spread across the duration of the year. In other learning areas the content must be identified and the learning outcomes which are process learning outcomes should be applied to the content. This allows time for each component to be achieved step by step and thus working gradually towards achieving the assessment standard by the end of the year. The assessment standards of all learning outcomes are the minimum requirements per grade to be demonstrated at the end of a year. For learners experiencing barriers to learning, the strategy of "designing down", "breaking down" or "scaffolding" (these terms are inter changeable) of assessment standards into manageable units is highly recommended. This process should include the practical demonstration of skills, knowledge and values.

- **Revision**

The adaptation of the design of learning programmes in special schools, special schools as resource centres and full service schools to suit the needs, strengths and interests of learners experiencing barriers to learning could influence: • The straddling of Grades and Phases • The number of learning programmes • The weighting of learning programmes • The duration of learning programmes • The use of programmes-to-work linkages to facilitate access to the curriculum • Measures for portability • Decision-making criteria around progression and certification. 2.4.1 The straddling of Grades and Phases The GETC band of education ranges from Grade R - 9. This band is divided into three phases: Foundation (Gr R – 3), Intermediate (Gr 4 – 6) and Senior Phase (Gr 7 – 9). Learners who experience one or more of a range of barriers to learning may not fit comfortably within a particular phase or grade. In such cases straddling must be implemented. Straddling is when a learner or group of learners at a specific grade or 23 level work towards attaining assessment standards from more than one grade within learning areas or learning programmes. Learning programmes for such learners, which will be designed to fit the individual needs of a learner, may straddle both grades and phases e.g. Harry who experiences cognitive barriers to learning is extremely gifted at pottery and gardening and can achieve at Grade 7 level in assessment standards which relate directly to skills which are achieved within Technology and Arts and Culture and Natural Sciences and Economic and Management Sciences, while he achieves at Grade 4 level in Languages and at Grade 3 level in Mathematics. Learning programmes for learners such as Harry must therefore accommodate Harry's diverse needs, strengths and interests and will draw learning outcomes and assessment standards from a number of grades and phases across all the Learning Areas. When the needs of the majority of learners in a special school, special school as resource centre or full service school require straddling of grades and phases it should be reflected in the learning programmes designed for such groups of learners. The recording and reporting of learner performance have to reflect this. 2.4.2 The number of learning programmes The number of learning programmes within the Intermediate and Senior Phases at special schools, special schools as resource centres and full service schools could vary according to the needs, strengths and interests of the learners and available human and physical resources of the individual schools. It is essential that the learning outcomes and assessment standards as stated in the eight Learning Areas be addressed by the various learning programmes at a school, irrespective of the final number of learning programmes offered. Learners should be in a position to select a set of learning programmes from a variety of learning programmes depending on the resources. These learning programmes may be academically or practically based using specific programme-to-work linkages as tools to achieve the learning outcomes and assessment standards. The knowledge, skills and values learned in the practical components of learning programmes should be transferable to the cognitive component of the learning programme for the achievement of learning outcomes and assessment standards. 24 In special circumstances extended learning programmes could be implemented to address the needs of learners e.g. blind learners may have a learning programme which focuses on mobility and orientation or Reading Braille. In the case where learners are given the option to select learning programmes from an available set of learning programmes the schools should ensure that all the learning outcomes (LOs) and assessment standards (ASs) are covered in the set.

- **Assignment/Activity**

The variety of learning programmes that is presented for learners must ensure that all learning outcomes and assessment standards of the eight Learning Areas are effectively and comprehensively pursued. The learning outcomes and assessment standards achieved within the range of learning programmes must be recorded against the appropriate Learning Areas and according to the grades in which they were achieved. For example the performance of learning outcomes shown in practical learning programmes such as manicure, woodwork and panel beating should be recorded against the appropriate Learning Areas e.g. Life Skills, Technology, Economic and Management Sciences.

- **Points For Discussion And Clarification**

The minimum requirements for achieving the General Education and Training Certificate (GETC) as spelt out in the RNCS may not be compromised. However, within this flexible learner-based and learner-paced approach to the curriculum all learners will be enabled to achieve their full potential irrespective of whether the end result will be a formal GETC or not. Learners with intellectual disability may not necessarily achieve a GETC or Grade 9. The contexts, content and selection of learning outcomes and assessment standards for a learning programme should be decided upon for the duration of that Leaning Programme. In planning a 4 year long learning programme at a specialised learning site e.g. for Mathematics, the learning outcomes and assessment standards drawn from a range of Learning Areas should be used to guide the activities of this Mathematics Learning Programme. The assessment standards chosen should reflect progression and integration within and across grades/years.

- References / Further Readings

GUIDELINES FOR INCLUSIVE LEARNING PROGRAMMES S.A. 2005

POINTS FOR DISCUSSIONS / CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

Points for Discussion

Points for Clarification

BLOCK 5: CURRICULAR EVALUATION

UNIT 1: CONCEPT, NEED FOR CURRICULAR EVALUATION

- **Introduction**
- **Objectives**
- **Definitions**
- **Summary**
- **Revision**
- **Assignment/Activity**
- **Points For Discussion And Clarification**
- References / Further Readings

• Introduction

Evaluation has a long history. As Guba and Lincoln (1981) pointed out, a Chinese emperor in 2200 b.c. required that his public officials demonstrate their proficiency in formal competency tests. In the United States, the concern for evaluating schools can be traced at least as far back as the recommendations of the Committee of Ten, which at the end of the 19th century set perhaps the first example of "evaluative standards" for the nation's secondary schools (National Education Association, 1969). In recent years, however, the interest in curriculum evaluation in particular has seemed to increase markedly. The public's insistence on educational accountability, the experts' demands for educational reform, and the educators' concomitant need for evidence of results have all contributed to the current interest in theories and methods of curriculum evaluation. Unfortunately, much of this interest seems to have resulted in an ill-conceived obsession with test results. A broader perspective and more diversified approaches seem necessary. This desired breadth and diversification have been reflected throughout this work. Chapter 6 described a comprehensive assessment model that can be used in improving a program of studies. Chapter 8 emphasized the importance of evaluating new courses of study. Chapter 11 described the importance of curriculum alignment. The intent of this chapter is to bring all these approaches into focus and to provide for greater understanding of the evaluation process. To that end, it begins by proposing a broad definition of the term curriculum evaluation. It then describes several evaluation models. It concludes by proposing a comprehensive and eclectic process that can be used to evaluate a field of study, which is perhaps the most difficult curricular element that evaluators face. Curriculum Evaluation CHAPTER 12 • What principles best define curriculum evaluation? • What curriculum evaluation models are most effective? Questions addressed in this chapter include the following: CHAPTER 12 Curriculum Evaluation 357 The foci of curriculum evaluation also need to be expanded. To use the concepts of this present work, curriculum evaluation should be concerned with assessing the value of a program of study (all the planned learning experiences over a multiyear period for a given group of learners), a field of study (all the planned learning experiences over a multiyear CURRICULUM EVALUATION DEFINED That broader perspective mentioned above requires a less constricting view of both the purposes and foci of curriculum evaluation. In reviewing the literature and acquiring a broader understanding of purpose, two concepts delineated by Guba and Lincoln (1981) seem especially useful: merit and worth. Merit, as they use the term, refers to the intrinsic value of an entity—value that is implicit, inherent, and independent of any applications. Merit is established without reference to a context. Worth, on the other hand, is the value of an entity in reference to a particular context or a specific application. It is the "payoff" value for a given institution or group of people. Thus, a given English course may seem to have a great deal of merit in the eyes of experts: It may reflect sound theory, be built on current research, and embody content that experts deem desirable. The same course, however, may have relatively little worth for a teacher instructing unmotivated working-class youth in an urban school: It may require teaching skills that the teacher has not mastered and learning materials that the students cannot read. In this sense, then, curriculum evaluation should be concerned with assessing both merit and worth. Key to Leadership Successful curriculum leaders realize that evaluation in education is to help the educational process better relate to individual learners. • What criteria should be used to develop a curriculum evaluation model? • How can learning experiences be organized for effective instruction? • How can the effectiveness of learning experiences be evaluated? • How can a field of study be evaluated? • How can effective teaching be identified?

- **Objectives**

How can the merit and worth of such aspects of curriculum be determined? Evaluation specialists have proposed an array of models, an examination of which can provide useful background for the process presented in this work. Bradley's Effectiveness Model How can a developed curriculum be assessed and evaluated for effectiveness? Bradley's (1985) book Curriculum Leadership and Development Handbook provides 10 key indicators that can be used to measure the effectiveness of a developed curriculum. The chart in Exhibit 12.1 is designed to help you identify your perceptions regarding the 10 indicators to appraise curriculum effectiveness in your school building or district. To assess how your school or district meets each of the indicators, respond with a Yes or No in the column provided. Indicator Description Yes or No Vertical curriculum continuity The course of study reflects a K–12 format that enables teachers to have quick and constant access to what is being taught in the grade levels below and above them. Also, upward spiraling prevents undue or useless curricular repetition. Horizontal curriculum continuity The course of study developed provides content and objectives that are common to all classrooms of the same grade level. Also, daily lesson plans reflect a commonality for the same grade level. Instruction based on curriculum Lesson plans are derived from the course of study, and curriculum materials used are correlated with the content, objectives, and authentic tasks developed. Curriculum priority Philosophical and financial commitments are evident. Clerical assistance is provided and reasonable stipends are paid to teachers for work during the summer months. In addition, curriculum topics appear on school board agendas, administrative meeting agendas, and building-staff meeting agendas. EXHIBIT 12.1 Bradley's Effectiveness Model for Curriculum Development Indicators CHAPTER 12 Curriculum Evaluation 359 Indicator Description Yes or No Broad involvement Buildings in the district have teacher representatives on the curricular committees; elementary, middle level or junior high, and high school principals (or designees) are represented; and school board members are apprised of and approve the course of study. Long-range planning Each program in the district is included in the 5-year sequence and review cycle. Also, a philosophy of education and theory of curriculum permeate the entire school district. Decisionmaking clarity Controversies that occur during the development of a program center on the nature of the decision, and not on who makes the decision. Positive human relations Also, the initial thoughts about the curriculum come from teachers, principals, and the curriculum leader. All participating members are willing to risk disagreeing with anyone else; however, communication lines are not allowed to break down. Theory-intopractice approach The district philosophy, vision, mission, exit (graduation) outcomes, program philosophy, rationale statement, program goals, program objectives, learning outcomes, and authentic tasks are consistent and recognizable. Planned change Tangible evidence shows that the internal and external publics accept the developed program course of study for the school district. The process of developing a course of study for each program or discipline in a school district is no longer one of determining how to do it, but one of determining how to do it better. If any of the 10 indicators are identified with a No (negative), consideration should be given to make it a Yes (positive) indicator. SOURCE: The 10 indicators of effective curriculum development were adapted from Curriculum Leadership and Development Handbook (pp. 141–146), by L. H. Bradley, 1985, Englewood Cliffs, NJ: Prentice Hall. The indicators for effective curriculum development represent working characteristics that any complex organization must have in order to be responsive and responsible to its clients. Further, the measurement can be oriented to meet the needs of any school district—from large to small—and it can focus on a specific evaluation of a district's curriculum area, such as reading, language arts, math, or any content area designated. The models (Tyler's objectives-centered model; Stufflebeam's context, input, process, product model; Scriven's goal-free model; Stake's responsive model, and Eisner's connoisseurship model) presented below give some support to Bradley's effectiveness model. Tyler's Objectives-Centered Model One of the earliest curriculum evaluation models, which continues to influence many assessment projects, was that proposed by Ralph Tyler (1950) in his monograph Basic Principles of Curriculum and Instruction. As explained in this work and used in numerous 360 PART III CURRICULUM MANAGEMENT large-scale assessment efforts, the Tyler approach moved rationally and systematically through several related steps: 1. Begin with the behavioral objectives that have been previously determined. Those objectives should specify both the content of learning and the student behavior expected: "Demonstrate familiarity with dependable sources of information on questions relating to nutrition." 2. Identify the situations that will give the student the opportunity to express the behavior embodied in the objective and that evoke or encourage this behavior. Thus, if you wish to assess oral language use, identify situations that evoke oral language. 3. Select, modify, or construct suitable evaluation instruments, and check the instruments for objectivity, reliability, and validity. 4. Use the instruments to obtain summarized or appraised results. 5. Compare the results obtained from several instruments before and after given periods in order to estimate the amount of change taking place. 6. Analyze the results in order to determine strengths and weaknesses of the curriculum and to identify possible explanations about the reason for this particular pattern of strengths and weaknesses. 7. Use the results to make the necessary modifications in the curriculum. (as cited in Glatthorn, 1987, p. 273) The Tyler model has several advantages: It is relatively easy to understand and apply. It is rational and systematic. It focuses attention on curricular strengths and weaknesses, rather than being concerned solely with the performance of individual students. It also emphasizes the importance of a continuing cycle of assessment, analysis, and improvement. As Guba and Lincoln (1981) pointed out, however, it suffers from several deficiencies. It does not suggest how the objectives themselves should be evaluated. It does not provide standards or suggest how standards should be developed. Its emphasis on the prior statement of objectives may restrict creativity in curriculum development, and it seems to place undue emphasis on the preassessment and postassessment, ignoring completely the need for formative assessment. Similarly, Baron and Boschee (1995), in their book Authentic Assessment: The Key to Unlocking Student Success, stress that "we are encountering fundamental changes in the way we view and conduct assessment in American schools" (p. 1). And "sixty years have passed since we experienced such a deep-seated and thoughtful revaluation of our assessment methods" (p. 1). Stufflebeam's Context, Input, Process, Product Model These obvious weaknesses in the Tyler model led several evaluation experts in the late 1960s and early 1970s to attack the Tyler model and to offer their own alternatives. CHAPTER 12 Curriculum Evaluation 361 The alternative that had the greatest impact was that developed by a Phi Delta Kappa committee chaired by Daniel Stufflebeam (1971). This model seemed to appeal to educational leaders because it emphasized the importance of producing evaluative data for decision making; in fact, decision making was the sole justification for evaluation, in the view of the Phi Delta Kappa committee. To service the needs of decision makers, the Stufflebeam model provides a means for generating data relating to four stages of program operation: context evaluation, which continuously assesses needs and problems in the context to help decision makers determine goals and objectives; input evaluation, which assesses alternative means for achieving those goals to help decision makers choose optimal means; process evaluation, which monitors the processes both to ensure that the means are actually being implemented and to make the necessary modifications; and product evaluation, which compares actual ends with intended ends and leads to a series of recycling decisions. During each of these four stages, specific steps are taken: • The kinds of decisions are identified. • The kinds of data needed to make those decisions are identified. • Those data are collected. • The criteria for determining quality are established. • The data are analyzed on the basis of those criteria. • The needed information is provided to decision makers. (as cited in Glatthorn, 1987, pp. 273–274)

- **Definitions**

Michael Scriven (1972) was the first to question the assumption that goals or objectives are crucial in the evaluation process. After his involvement in several evaluation projects where so-called side effects seemed more significant than the original objectives, he began to question the seemingly arbitrary distinction between intended and unintended effects. His goal-free model was the outcome of this dissatisfaction. In conducting a goal-free evaluation, the evaluator functions as an unbiased observer who begins by generating a profile of needs for the group served by a given program 362 PART III CURRICULUM MANAGEMENT (Scriven is somewhat vague as to how this needs profile is to be derived). Then, by using methods that are primarily qualitative in nature, the evaluator assesses the actual effects of the program. If a program has an effect that is responsive to one of the identified needs, then the program is perceived as useful. Scriven's main contribution, obviously, was to redirect the attention of evaluators and administrators to the importance of unintended effects—a redirection that seems especially useful in education. If a mathematics program achieves its objectives of improving computational skills but has the unintended effect of diminishing interest in mathematics, then it cannot be judged completely successful. Scriven's emphasis on qualitative methods also seemed to come at an opportune moment, when there was increasing dissatisfaction in the research community with the dominance of quantitative methodologies. As Scriven himself notes, however, goal-free evaluation should be used to complement, not supplant, goal-based assessments. Used alone, it cannot provide sufficient information for the decision maker. Some critics have faulted Scriven for not providing more explicit directions for developing and implementing the goal-free model; as a consequence, it probably can be used only by experts who do not require explicit guidance in assessing needs and detecting effects. Stake's Responsive Model Robert Stake (1975) made a major contribution to curriculum evaluation in his development of the responsive model, because the responsive model is based explicitly on the assumption that the concerns of the stakeholders—those for whom the evaluation is done—should be paramount in determining the evaluation issues. He made the point this way: To emphasize evaluation issues that are important for each particular program, I recommend the responsive evaluation approach. It is an approach that trades off some measurement precision in order to increase the usefulness of the findings to persons in and around the program. . . . An educational evaluation is a responsive evaluation if it orients more directly to program activities than to program intents; responds to audience requirements for information; and if the different value perspectives present are referred to in reporting the success and failure of the program. (p. 14) Stake recommends an interactive and recursive evaluation process that embodies these steps: • The evaluator meets with clients, staff, and audiences to gain a sense of their perspectives on and intentions regarding the evaluation. • The evaluator draws on such discussions and the analysis of any documents to determine the scope of the evaluation project. • The evaluator observes the program closely to get a sense of its operation and to note any unintended deviations from announced intents. CHAPTER 12 Curriculum Evaluation 363 • The evaluator discovers the stated and real purposes of the project and the concerns that various audiences have about it and the evaluation. • The evaluator identifies the issues and problems with which the evaluation should be concerned. For each issue and problem, the evaluator develops an evaluation design, specifying the kinds of data needed. • The evaluator selects the means needed to acquire the data desired. Most often, the means will be human observers or judges. • The evaluator implements the data-collection procedures. • The evaluator organizes the information into themes and prepares "portrayals" that communicate in natural ways the thematic reports. The portrayals may involve videotapes, artifacts, case studies, or other "faithful representations." • By again being sensitive to the concerns of the stakeholders, the evaluator decides which audiences require which reports and chooses formats most appropriate for given audiences. (as cited by Glatthorn, 1987, pp. 275–276) Clearly, the chief advantage of the responsive model is its sensitivity to clients. By identifying their concerns and being sensitive to their values, by involving them closely throughout the evaluation, and by adapting the form of reports to meet their needs, the model, if effectively used, should result in evaluations of high utility to clients. The responsive model also has the virtue of flexibility: The evaluator is able to choose from a variety of methodologies once client concerns have been identified. Its chief weakness would seem to be its susceptibility to manipulation by clients, who in expressing their concerns might attempt to draw attention away from weaknesses they did not want exposed.

- **Summary**

Elliot Eisner (1979) drew from his background in aesthetics and art education in developing his "connoisseurship" model, an approach to evaluation that emphasizes qualitative appreciation. The Eisner model is built on two closely related constructs: connoisseurship and criticism. Connoisseurship, in Eisner's terms, is the art of appreciation—recognizing and appreciating through perceptual memory, drawing from experience to appreciate what is significant. It is the ability both to perceive the particulars of educational life and to understand how those particulars form part of a classroom structure. Criticism, to Eisner, is the art of disclosing qualities of an entity that connoisseurship perceives. In such a disclosure, the educational critic is more likely to use what Eisner calls "nondiscursive"—a language that is metaphorical, connotative, and symbolic. It uses linguistic forms to present, rather than represent, conception or feeling. Educational criticism, in Eisner's formulation, has three aspects. The descriptive aspect is an attempt to characterize and portray the relevant qualities of educational life—the rules, the regularities, the underlying architecture. The interpretive aspect uses ideas from the social sciences to explore meanings and develop alternative explanations—to explicate social phenomena. The evaluative aspect makes judgments to improve the educational processes and provides grounds for the value choices made so that others might better disagree.

The innovative practices to which many educators aspire can accommodate and build on more traditional mandates (Ferrero, 2006). Although the models above seem sharply distinct from one another, some evidence of congruence exists in current theories of evaluation. This congruence is quite evident in the ASCD monograph Applied Strategies for Curriculum Evaluation (Brandt, 1981), in which seven experts in evaluation were asked to explain how their "evaluation model" would be used in evaluating a secondary humanities course. While the models proposed by the experts (Stake, Scriven, Eisner, and Worthen) differed in many of their details, several common emphases emerged in the approaches: Study the context, determine client concerns, use qualitative methods, assess opportunity cost (what other opportunities the student is missing by taking this course), be sensitive to unintended effects, and develop different reports for different audiences. By using these common emphases, along with insights generated from analyzing other models, it is possible to develop a list of criteria that can be used in both assessing and developing evaluation models. Such a list is shown in Exhibit 12.2. Districts with sufficient resources to employ an expert consultant can use the criteria to assess the model proposed by the consultant; districts developing a homegrown process can use the criteria to direct their own work. The criteria will obviously result in an eclectic approach to evaluation, one that draws from the strengths of several different models. Such an eclectic process has been used successfully in evaluating a field of study; this same process also can be used to evaluate a course of study with the scope of the evaluation reduced.

- **Revision**

The rapid changes occurring in computer technology also pose a challenge to establishing effective evaluation programs. Technology capabilities have continued to change faster than educational researchers can sustain. For example, initial evidence on the use of computers in the classroom showed that "drill and practice" activities were successful in reinforcing skills. Now, with continued advances in software and technology, teachers are using computers in classrooms in entirely different ways. It therefore has been difficult for researchers to complete large-scale, controlled studies that lead to solid conclusions because by the time their research is published, new technologies are providing new opportunities for teachers and students. With the exception of National Educational Technology Standards and the International Society for Technology in Education, the lack of correlated state technology standards and guidelines at times creates a barrier to providing quality assessment. Currently, a limited number of districts in the country have established formal guidelines for evaluating the effectiveness of technology in their schools. Strong evidence of technology's effectiveness will surely further strengthen public and political support. Richard Mayer, Miriam Schustack, and

William Blanton (1999) stated, Our research provides encouraging evidence that appropriate experience with educational technology can promote important cognitive changes in children, including improvements in content knowledge about computing, strategies for comprehending written instruction, strategies for devising problem-solving plans, and even in basic academic skills. (n.p.) As the demand for technology in the classroom increases, the need for evaluation also increases. Administrators, teachers, and parents want to know and understand the impact that technology has made on district goals relating to student learning, staff development, and program content.

- **Assignment/Activity**

"How good is our K–12 science curriculum?" The answer to this question comes from evaluating a field of study—a multigrade sequence of learning experiences in one discipline, subject area, or field. Such evaluations are almost always made for a single purpose— to identify strengths and weaknesses in order to plan for improvements. The process of evaluating a field of study includes five important phases: preparing for the evaluation, assessing the context, identifying the evaluation issues, developing the evaluation design, and implementing the evaluation design.

POINTS FOR DISCUSSIONS / CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

Points for Discussion

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Points for Clarification

- References / Further Readings

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UNIT 2: FACTORS ASSOCIATED WITH CURRICULAR EVALUATION (LEARNER, CONTENT, INSTRUCTOR AND RESOURCES)

• Introduction

The multiple educational evaluation models and definitions developed by evaluation theorists reflect the diversity of ideas and approaches towards educational evaluation. The diverse meanings and definitions of the evaluation concept includes viewing evaluation as an assessment of the worth or merit of some educational objects (Stufflebeam, 2000a, 2000b; Trochim, 2006); assessment of the achievement of objectives which is also known as the Tylerian view of evaluation (Madaus & Stufflebeam, 2000); and proving the success or failure of a programme. According to Madaus and Stufflebeam (2000) these are the conventional views of evaluation. As the field of evaluation continued to develop, Cronbach (1963) pointed out that the evaluation process should be focused on gathering and reporting information that could help guide decisionmaking in an educational programme and curriculum development. Nonetheless, while the models differ in many of their details, the decision to choose an evaluation model depends on a few important factors such as the evaluation questions, the issues that must be addressed, and the available resources (Madaus & Kellaghan, 2000). This paper begins with clarifying the position of curriculum evaluation in the curriculum development model (Oliva, 1992). Curriculum process 2 evaluation focuses on instructional activities in the teaching and learning process. A study on the teaching and learning of Science in English (TeSME) programme was conducted in year 2005. In this evaluation study, the process dimension of the CIPP (Stufflebeam, 2000) forms the basic framework. The process-improvement evaluation aims to detect strengths and weaknesses in the instructional process and to suggest constructive feedback about how things might be improved.

- **Objectives**

Curriculum evaluation is seen as a sub model and the final component in the curriculum process in Razali Arof's (1991) and Oliva's (1992) curriculum development model. Oliva's (1992) curriculum model conceptualised four main components – curriculum goals, curriculum objectives, organisation and implementation of the curriculum, and evaluation of the curriculum. Figure 1 shows the feedback line in which information obtained in the evaluation component would provide useful data for each of the components of the Curriculum Model

Oliva (1992) points out that to consider students' achievement in their cognitive, affective and psychomotor learning as the effectiveness of the curriculum is not accurate. This is because, according to Oliva (1992), Curriculum goals Curriculum objectives Organisation and implementation of the curriculum Evaluation of the curriculum 3 the primary purpose of curriculum evaluation is to determine whether the curriculum goals and objectives are being successfully carried out or not. In addition, Oliva (1992) asserts that in the course of the instructional process, there are other questions curriculum planners would like to know, too. Questions suggested by Oliva (1992:479) that are relevant in the context of this study are: i. whether the curriculum is functioning while in operation ii. if the best material is being used and following the best methods iii. whether the programmes are cost-effective – whether we are getting the most for the money spent (Oliva, 1992:479) It is the consensus of most curriculum developers that once a developed curriculum is implemented in schools, appropriate evaluation procedures shall be devised to examine the effectiveness of the curriculum in achieving the aims, goals and objectives of the curriculum. Feedback obtained shall also include any unintended outcomes so that information about the curriculum can provide useful data to enable further modifications in the curriculum, if necessary. A new curriculum once implemented in schools is in progress until a time when the need arises it will not be terminated. Therefore, since a curriculum is ongoing, curriculum evaluation, teacher evaluation and programme evaluation are seen as the main components of process evaluation (Print, 1993).

- **Definitions**

Process evaluation aims to gather information to expound on the internal dynamics of how a programme operates. According to Print (1993:188), 'Process evaluation examines the experiences and activities involved in the learning situation i.e. making judgements about the process by which students acquired learning or examining the learning experience before it has been concluded'. Concurrent with this view, Patton (1990) asserts that process evaluation focuses on how something happens. Thus, process evaluation includes the evaluation of instruction, the teachers' teaching and the students' learning (Patton, 1990). Teacher evaluation includes conducting evaluation on teachers' instructional methods, studentteacher interaction, classroom interaction, teachers' characteristics, teachers' performance in the classroom and other dynamics of the teachinglearning situation. This type of evaluation is carried out with the intention to help teachers enhance their performance in the teaching and learning process (Print, 1993). Viewing curriculum as a process (Mednick, 2006; Smith, 2000), it is essentially observing what actually happened and how these elements interacted to make meanings within the classroom (Smith, 2000). Inside the classroom there are a number of elements such as teachers, students, classroom environment and knowledge which are constantly interacting with each other (Huitt, 2003). Figure 2 depicts McIlrath and Huitt's (1995) and Huitt's (2003) model of instructional process which identifies the major categories of variables that are related to school achievement. **Summary** Huitt (2003) explains that the category of Teacher Behaviour consists of all the actions a teacher would make in the classroom and includes three additional subcategories: Planning, Management, and Instruction. Planning refers to the preparations a teacher does to interact with students in the classroom. Management refers to class control and Instruction is the activity used by the teacher in guiding student learning. Student behaviour includes all of the actions students would make in the classroom. Consequently, curriculum process evaluation intends to delineate, obtain and provide useful information (Stufflebeam, 2002) about what is going on in the classrooms so that decision alternatives can be made to maintain or to modify or even to eliminate the instructional strategies. In the CIPP model, Stufflebeam (2000b) notes that process evaluation is an ongoing check on a programme's implementation which has three main objectives: i. to detect or predict defects in the procedural design or its implementation during stage ii. to provide feedback about the implementation of the planned activities iii. to maintain a record of the procedure as it occurs. In short, process evaluation aims to monitor, document and assess programme activities. Hence, this study was focused on the classroom process component. In relation to this study the process evaluation of the Revised Lower Secondary Science Curriculum taught in English will investigate the implementation at the school level. The study investigates if the instructional methods used in the classroom conform to the learning objectives, learning activities and learning outcomes as stipulated in the Curriculum Specifications handbook produced by the Ministry of Education, Malaysia. Procedural barriers, unintended outcomes, unanticipated issues that may arise in the particular situation will also be identified.

- **Revision**

The following section is the argument for doing an evaluation study on the implementation process of the TeSME programme. Patton (1990) advocates that 'implementation evaluation' (Patton, 1990:104) is imperative for monitoring and getting feedback about the programme as to whether it is running effectively or not and what kind of intervention is needed before evaluating the outcomes of the implemented programme. Evaluators need to know what produced the observed outcomes in order to decide on what intervention ought to be taken to improve the programme. Hence, implementation evaluation informs researchers what is going on in the programme, how the programme has developed, and how and why the programme has or has not deviated from the objectives as planned (Patton, 1990).

- **Assignment/Activity**

A qualitative evaluation research was undertaken to investigate the teaching and learning of Science in English. Holliday (2002:24) says, 'Getting into qualitative research is very often about grasping opportunities which address a good idea or longer-standing preoccupation'. Qualitative research allows one to find out the social realities in the natural settings. Qualitative researchers feel that human behaviour is always bound to the context in which it occurs and therefore, behaviour must be studied holistically, in context, rather than being manipulated. By employing qualitative methods in this educational research, it enables me to investigate teachers' and students' attitudes, beliefs and preferences and to investigate the setting (i.e. in the classroom). My intention was to observe the science teachers make meanings in their science lessons i.e how the science teachers are coping with their task and why they are adopting the instructional strategies in their natural setting (i.e. the science classroom). This concurs with the characteristics of qualitative research emphasized by Bogdan and Biklen (2003:42) - 'naturalistic, inductive and the concern with process and meaning'.

- References / Further Readings

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POINTS FOR DISCUSSIONS / CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

Points for Discussion

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Points for Clarification

UNIT 3: AREAS OF CURRICULAR EVALUATION: CONTEXT, INPUT, PROCESS AND PRODUCT

- **Introduction**
- **Objectives**
- **Definitions**
- **Summary**
- **Revision**
- **Assignment/Activity**
- **Points For Discussion And Clarification**
- References / Further Readings

- **Introduction**

This module seeks to guide curriculum professionals through the several factors to be taken into consideration when revising curriculum change policies. It contains three activities:

1. **Change to improve quality.** To discuss the multiple meanings of "quality" in education.
2. **International trends in curriculum change.** To consider the main directions in which reform is taking place.
3. **Curriculum as process and product.** To broaden the conception of curriculum including several material and practical components.

Following these activities is a "Resources" section which contains a list of discussion papers and other resources referred to in the activities.

- **Objectives**

This module is about policy dialogue –the process of formulating curriculum-related public policies by engaging and consulting with stakeholders. It is these policies which set the parameters for the work of curriculum developers. The module offers opportunities for curriculum professionals to develop their understanding of this process by exploring:

- National issues that commonly prompt and shape changes in the curriculum and the education system;
- The various participants or stakeholders involved in education reform and curriculum change and their respective roles and interests in policy formulation;
- Potential problems and areas of conflict that may arise from formulation and implementation of changes in the curriculum;
- Ways of managing / dealing with conflict and resistance and mobilizing popular support for ongoing or proposed change in the curriculum;
- Examples of sensitive or challenging curriculum policy issues in particular socio-political and cultural contexts.

The six activities in this module seek to guide curriculum professionals through the stages of curriculum policy formulation:

1. **Rationales for promoting a change.** Why does curriculum change occur.
2. **Actors and context for change.** Conducting "contextual scans" of the educational system and wider environment.
3. **Design of consultation processes.** How to identify legitimate stakeholders in the curriculum and how to engage them in policy dialogue and consultations.

4. **Advocacy before educational authorities.** The way curriculum specialists can have productive conversations with government decision-makers to achieve support and leadership in the process of curriculum change.

5. **Hints for planning a consultation process.** With a view to generating as much consensus as possible among stakeholders and popular support for the substance and direction of the curriculum policies.

6. **Sensitive issues.** How countries in various parts of the world have dealt with some politically and or culturally sensitive curriculum policy issues to preserve and promote national goals and interests.

Following these six activities there is a "Resources" section which contains the discussion papers and other resources referred to in the activities, plus a list of additional readings.

- **Definitions**

This module provides opportunities to explore current developments in curriculum design and to understand the central concepts involved in:

- Defining national curriculum standards.
- Defining curriculum outcomes, standards, competencies, objectives, content.
- Current approaches to curriculum integration, diversification and differentiation with particular reference to the following examples:
  - Citizenship and/or values education and social transformation;
  - Science and Technology Education (STE);
  - School health and HIV and Aids prevention;
  - Coping with emergency situations;

- Common or connected student learning outcomes.

- The principle and practice of curriculum design for Education for Sustainable Development (ESD).

The curriculum professionals are guided into an analysis of the building blocks of curriculum at the macro level, through three activities:

1. **The structure of a curriculum framework.** Includes the typical components of curriculum frameworks to be used as a structural analysis tool.

2. **Formulation of what students should know and be able to do.** Helps the participant to revise and choose several alternatives to define the expected achievements of students.

3. **Approaches to curriculum integration.** Reviews existing strategies for curriculum integration with different focus and depth.

Following these activities is a "Resources" section which contains a list of discussion papers and other resources referred to in the activities, as well as a list of additional readings.

Conceptual framework

Many education systems across the world are moving away from centralized models of curriculum decision-making towards more democratic, decentralized models. As a result of this trend, decision-makers are considering ways of organizing the curriculum in ways other than the traditional subject approach in which all students learn the same content at the same time. Increasingly curriculum is being structured in ways which:

- are appropriate to the needs and circumstances of regions and

- address more effectively the needs of students.

One example is the trend towards adopting curriculum frameworks as overarching curriculum documents. The purpose of a curriculum framework is to establish the parameters within which curriculum should be developed. It often expresses the state's aims of education, and can define minimum standards for content and assessment, as well as teacher qualifications, educational resources and learning materials, management, and evaluation. Such a framework is often approved by a competent authority as a first step in the curriculum development process. The framework then provides guidelines for the developers of more specific learning area syllabuses.

Another example of changing curriculum structures is the remodeling of learning experiences of many separate subjects into a more integrated content. This is because the compartmentalization of knowledge into discrete subjects is antithetical to how students experience life and the real world. Learning that is integrated enables students to apply knowledge and skills more easily to their daily lives. On a higher level, integrated content can be more readily "internalized" and reflected in behaviour. Learning then becomes integrated into the self and becomes a part of one's being.
This module describes trends in curriculum development and illustrates integrated learning through the examples of citizenship and social transformation and science and technology, which can serve as models for other types of integration.

This module offers opportunities for curriculum professionals to develop their understanding of policies and processes of system management and governance by exploring:

- Possible models for managing curriculum development and implementation with particular attention to processes of curriculum localization;
- Some modalities of regulation and control in education systems:
    - keeping balance between centralization and decentralization,
    - school-based management of the curriculum,
    - localization of curriculum in national and local specific contexts in view of ensuring greater responsiveness to local needs and realities,
    - different concepts of decentralization: devolution, de-concentration, decentralization of decision-making;

- Opportunities and challenges of the broader involvement of stakeholders (local government, civil society, parents and local community) in curriculum development and implementation.

Two activities have been selected:

1. **A balance of national and local needs and interests.** Helps in reflecting the set of needs and interests of different scale that have to be balanced to achieve an acceptable implementation of the curriculum.
2. **Curriculum localization.** Challenges and opportunities. Leads to reflection about the constraints that limit and also enable localization processes. Following these activities is a "Resources" section which contains a list of discussion papers and other resources referred to in the activities, as well as complementary reading material.

Conceptual framework

Education systems are multi-faceted and consist of a number of inter-connected elements. Curriculum is a fundamental component of any education system, but its development and implementation relies on other components of the broader system – such as teacher training, the resources provided and the ways teachers are supervised. The structures of education management and governance and the quality of related systems can therefore influence the quality of the curriculum that is developed and the effectiveness of its implementation.

Curriculum development and implementation themselves are processes which require good management – planning, monitoring and evaluation. At the subject or learning area level, writing syllabuses is normally the domain of subject experts who can be drawn from universities, schools or other organizations relevant to the subject area itself. Their work can be informed by a range of other experts, such as developmental psychologists, parents, practicing teachers and, in some cases, representatives of employer groups or industry.

The syllabus writing process, however, also needs to be coordinated and managed so that the various subject syllabuses remain consistent in approach and philosophy. Syllabuses should reflect the same beliefs about how students learn and about teaching methodologies. They should be similar in format and tone and use terms consistently so that teachers of more than one subject can easily access the information and guidance which the syllabuses offer.

Therefore, what are the best ways to manage these complex processes?

System Management

System Management may be defined as the process of planning, implementing, monitoring and evaluating the various parts of a system. In education, these parts can include strategic and operational planning, human and financial resources, teacher education and accreditation, curriculum and student assessment.

Traditionally curriculum has been centrally determined and the expectation of central authorities is that students across the system will be taught the same thing the same way and often at the same time. While this approach might give the perception of control over the quality of teaching, it does not guarantee that the needs of individual students and of local communities are met.

Governance

The concept of governance refers to the ethics of an organization and the professional conduct of its employees. Good governance is important in education systems because it ensures that systems focus on delivering what is best for students and society.

There has therefore been a trend in curriculum development to more genuinely acknowledge the social and economic needs of local communities and individual groups within society by decentralizing curriculum, in effect by allowing local authorities and schools to develop their own curriculum. This approach also has its risks, particularly in the degree to which:

- the quality of curriculum can be guaranteed,
- the risk of "factionalism" can be reduced, and
- national goals and priorities will be pursued in a consistent way.

If these risks are managed well, decentralization of curriculum development can offer many benefits. For example, it can increase the democratization of education by granting local stakeholders greater autonomy and participation in curriculum design, implementation and evaluation consistent with the achievement of national goals and standards.

Decentralization

Decentralization in education is the transfer of authority to regional, provincial and local levels. The interdependencies of related educational organizations cannot be simplified into a hierarchical structure or "solved" via a "top-down" approach.

The diverse modalities of decentralization may include:

- the devolution of power and authority from a higher to a lower level,
- wider sharing of educational management and governance functions,

- broader participation in decision making processes, or
- increased local autonomy in limited policy or management issues.

In some cases this trend has led to significant change in the bureaucratic structure of ministries of education. For example, decentralization may mean the devolution of administration and implementation functions from central to regional, provincial or local levels (administrative de-concentration).

The remainder of this section focuses on decentralization as a contemporary trend in system management and governance, particularly in relation to curriculum processes. Decentralization has the potential to foster the development of localized curricula which directly address a diversity of local (sub-national) cultural and socio-economic realities. The final section explores opportunities, issues and challenges presented by decentralization and localization of curricula through individual case studies.

- **Summary**

Equal access to quality basic education is a key educational policy target of all countries. In this framework, quality teaching and learning materials are expected to be available for all students.

The textbook is one type of resource and a vital one in many contexts. In developing countries, textbooks are a de facto syllabus and, apart from the teacher, the most important support for the acquisition of knowledge and skills. They may also be the only source of information about the curriculum

for the teacher; the only books available in the average child's household, and the main source of reading for the child4.

This module explores trends in and processes of textbook development. In so doing the module examines the obstacles that publishers, ministries of education, and other actors in this field may encounter in their attempts to provide easily accessible and high quality textbooks. Policy strategies and best practices are included.

Ideally teachers should have teaching-learning resources available in addition to textbooks. Access to the internet opens up enormous opportunities to provide materials to supplement textbooks and enrich the learning environment. However, the ready availability of these new materials also presents challenges to traditional approaches to the evaluation and approval of teaching-learning resources.

- **Revision**

This module offers opportunities for curriculum professionals to develop their understanding of approaches to piloting by exploring:

Possible rationales and objectives for piloting;

Models for piloting;

Key issues in pilot planning and design;

Issues in monitoring and evaluating pilots;

Lessons and insights from successful pilots;

Piloting practices in local contexts in light of the experience of other countries;

The challenges involved making the transition from pilot initiative to mainstream provision.

The reflection proposed to the reader is organized in three activities:

Models for piloting. Discusses several possible models that could be selected to design and conduct a pilot.

Pilot design. Helps in analyzing variables to be considered during the piloting.

From pilot to policy. Mainstreaming innovation. Helps participants to identify possible potholes in the process to transfer pilot experiences to the whole educative system.

Following these activities is a "Resources" section which contains a list of discussion papers and other resources referred to in the activities, as well as additional reading material.

Conceptual framework

A pilot occurs when an authority trials curriculum in a controlled, limited way in order to:

evaluate the likelihood of its success when fully implemented, and

identify its strengths and weaknesses.

If curriculum changes are introduced without the benefit of a pilot, the legitimacy of the change can be challenged, resistance can increase and final implementation can be jeopardized. An effective pilot can provide an operating curriculum model and an implementation model which will be attractive to policy makers.

A pilot can be an important tool in curriculum development and can provide significant benefits at a number of levels. As part of a change strategy, a curriculum pilot can:

Determine the feasibility of a proposed curriculum change;

Provide empirical evidence of curriculum viability;

Determine curriculum relevance to a variety of selected contexts;

Develop new curricula in realistic settings;

Encourage experimentation and creativity;

Promote or influence processes of policy change;

Identify possible impediments to change;

Build consensus around proposed policy change; and

Develop models or capacity for implementation.

Pilots are normally commissioned by government curriculum authorities, but may be conducted by universities, non-governmental organizations (NGOs) or schools.

Effective piloting depends on the choice of an appropriate model and on strategic planning. The selection of pilot groups and evaluation methods are often key issues but the development of strong partnerships with stakeholders and the effective dissemination of findings are also likely to be important.

Participants in pilots also experience significant personal and professional development and can take ownership of the proposed change. Lessons derived from the pilot can provide significant insights as they help shape thinking, challenge assumptions, and contribute to the improvement of practice and to the growth of research and theory building. However, pilots are often small scale projects, and the challenges of moving from innovative pilot to mainstream implementation can only be met through collaborative planning and long-term commitment from policy makers.

- **Assignment/Activity**

The term "evaluation" generally applies to the process of making a value judgment. In education, the term "evaluation" is used in reference to operations associated with curricula, programs, interventions, methods of teaching and organizational factors. Curriculum evaluation aims to examine the impact of implemented curriculum on student (learning) achievement so that the official curriculum can be revised if necessary and to review teaching and learning processes in the classroom. Curriculum evaluation establishes:

- Specific strengths and weaknesses of a curriculum and its implementation;
- Critical information for strategic changes and policy decisions;
- Inputs needed for improved learning and teaching;
- Indicators for monitoring.

Curriculum evaluation may be an internal activity and process conducted by the various units within the education system for their own respective purposes. These units may include national Ministries of Education, regional education authorities, institutional supervision and reporting systems, departments of education, schools and communities.

Curriculum evaluation may also be external or commissioned review processes. These may be undertaken regularly by special committees or task forces on the curriculum, or they may be research-based studies on the state and effectiveness of various aspects of the curriculum and its implementation. These processes might examine, for example, the effectiveness of curriculum content, existing pedagogies and instructional approaches, teacher training and textbooks and instructional materials.

Student assessment

The ultimate goal of curriculum evaluation is to ensure that the curriculum is effective in promoting improved quality of student learning. Student assessment therefore connotes assessment of student learning. Assessment of student learning has always been a powerful influence on how and what teachers teach and is thus an important source of feedback on the appropriateness implementation of curriculum content.

Fulfilling the diverse objectives of diagnosis, certification and accountability requires different kinds of assessment instruments and strategies selected to achieve specific purposes. Assessment of student learning could be summative or formative, and there are various types of tests to address different needs such as standardized tests, performance-based tests, ability tests, aptitude tests and intelligence tests.

POINTS FOR DISCUSSIONS / CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

Points for Discussion

Points for Clarification

- References / Further Readings

Training Tools for Curriculum Development. A Resource Pack

UNIT 4: METHODS AND TOOLS FOR CURRICULAR EVALUATION

- **Introduction**
- **Objectives**
- **Definitions**
- **Summary**
- **Revision**
- **Assignment/Activity**
- **Points For Discussion And Clarification**
- References / Further Readings

- **Introduction**

The essence of the achievement of curriculum objectives depends on its evaluation process during development. If the process indicators involve comprehensively at grass root level the product will be valid for use. Content selection regarding objective consideration and with respect to the content organization is somewhat critical during the process of curriculum development. Since often no evaluation of the implemented curriculum is carried out; hence no feedback is received to revise the curriculum. This study addresses the curriculum development process issues. A validated questionnaire consisting of 84 statements was developed. Data was collected from 810 personals involved in curriculum development process and analyzed by Statistical Packages for Social Sciences (SPSS) using Chi Square. Result shows a significant association between existing process and desired process for curriculum development. Some new trends showed a mark difference like Memorandums of Understanding, Expressions of Interest, study tours and learner cognitive level. 1. Introduction Process evaluation is believed as Guarantee of Quality product. Evaluation of the process of curriculum development plays a vital role in channelizing and keeping the direction of young generation on the desired way for the achievement of national objectives and keeping the system update respect to changing scenario of time. Curriculum development process also undergoes transformation due to newer developments in education and its evaluation keeps it valid, reliable and keeps it in the right direction. Recommendations through evaluation for any process have a message of eternity for it. Therefore the needs to organize the curriculum development process in such a way which should prepare young men and women for pursue of the higher education as well as to make them able to adjust with their practical life meaningfully and productively are necessary. Because the goals of education can be attained only through valid reliable curriculum and proper evaluation of the process for updating and fulfilling required social needs.

- **Objectives**

Characteristics of a Good Curriculum: Following are the characteristics of good Curriculum• Development of Social Understanding:• Promotion of Maximum Personal Development:• Promotion of Continuity of Experience:• Provision for Educational Goals:• Maintenance of Balance among All Goals:• Utilization of Effective Learning Experiences and Needed Resources• 2.3 Curriculum Development Process 2.3.1 Situation Analysis: Nicholls and Nicholls (1974, p.65) refer to the process of situation analysis as, "A situation which is made up of a number of factors such as pupils" home and background, school, its climate, its staff, facilities and equipment. Analysis of those factors, together with a self analysis, followed by study of their implications for curriculum planning constitutes one step towards the rational approach of curriculum". Print, (1993, p.122) a situation analysis is an obvious commencement point for the construction of a curriculum it is an ideal opportunity for curriculum developers, aware of the curriculum presage factors affecting them, to bring a reasoned, rational approach to the development of curricula. Above all, it is an opportunity for curriculum developers to take account of local factors when developing curriculum to meet student needs. Analysis of factors which constitute the situation: a) Cultural and social changes and expectations including parental expectations, employer requirements, community assumption and value, changing relationships (e.g. between adults and children) and ideology. b) Educational system requirements and challenges, e.g. policy statements, examinations, local authority expirations or demands or pressures, curriculum projects, education research. c) The Changing nature of the subject matter to be taught. d) The potential contribution of teacher-support system, e.g. teacher training college, research institutes. e) Flow of resources into the school. f) Pupils: aptitudes, abilities and defined education needs. g) Teachers: value, attitudes, skills knowledge, experience, social strengths and weaknesses, roles. h) School ethos and political structure: Common assumptions and expectations including power conformity to norms and dealing with deviance. i) Material resources including plant, equipment, and potential for enhancing these. j) Perceived and felt problems and shortcomings in existing curriculum. Nicholls and Nicholls (1974, p.69) the need for conducting a situational analysis is fundamental precept of effective curriculum development. Developers commencing their task should ask important questions such as, what do we know about the context the students, teachers, school environment – of this curriculum and why is it need? This provided then with an information base to pose an even more fundamental question: what do our learners need?A recommended approach to conduct a situational analysis involves four steps i) identify problems in contents; ii) select approach factors; iii) data collection; and analysis iv) make recommendations.

- **Definitions**

Curriculum evaluation refers to the collection of information on which judgment might be made about the worth and the effectiveness of a particular programme. It includes, of course, actually making those judgments so that decision might be made about the future of programme, whether to retain the programme as it stand, modify it or throw it out altogether. Stocked approaches curriculum evaluation through a conceptual analysis of the term "Evaluation", in his analysis, he identifies four central features of evaluation given under: 1. Evaluation is appraisal in which we make judgment. 2. Such judgments are made in the light of criteria. 3. Criteria issue from, and are appropriate in respect of particular contents. 4. Such Criteria embody human resources, and evaluation model, therefore, inform decisions. The important methods and techniques employed in curriculum evaluation include discussion, experiments, interviews (group and personal) opinion of various agencies stakeholders, observation – procedures, questionnaires, practical performance and official record. Guba and Stufflebeam (1970, p.109) identify four types of decision which are involved in curriculum evaluation certain features of their work are useful as an organizing framework for examining curriculum evaluation. These types include the decision about: 1. Planning intention, e.g., which objectives to select. 2. Planning procedures, e.g., which personnel, methods and material employ. 3. Implementing procedure, e.g., whether to continue, modify or abandon a procedural plan. 4. Outcomes, e.g., which intentions are realized, to extent and by whom. Evaluation conceived in this manner is an integral part of curriculum development, beginning with the concern about objective and ending with assessment of their attainment. 4. Models of Evaluation It should now be clear that evaluation is nothing if not a problematic business, and in summarizing the nature of difficulties it is logical to look first at ways in which evaluation might proceed. In considering how to evaluate, we can think of a range of approaches or models. There are many different evaluation models, because different specialists have undergone somewhat different experiences in learning and doing evaluation and used different values and world views in reflecting on their experiences. Maurice Holt (1981, p.23) identifies six models of evaluation which are as follows: 1. The classical (or agricultural-botanical) research model. 2. The research and development (or industrial, factory) model. 3. The illuminative (or anthropological, responsive) model. 4. The briefing decision-makers (or political) model. 5. The teacher as researcher (or professional) model. 6. The case-study (or eclectic, portrayal) model. David Cohen (1977, p.87) identifies three schemes of models of curriculum evaluation: 1. The Curriculum Materials Analysis Scheme (CMAS) developed by Social Science Education Consortium. 2. The Sussex Scheme for the analysis of curriculum material developed at the University of Sussex. 3. Curriculum Material Analysis Scheme (CMAS) for Science developed at the Federal Republic of Germany. Print (1993, p.164), some of the evaluation models are often referred to in the literature of evaluation. These models will be discussed below briefly: 1. Tyler's objective-oriented model 2. Societal experimentation model 3. CIPP model and the EIPOL model 4. Countenance evaluation 5. Discrepancy evaluation model 6. Responsive evaluation 7. Transactional evaluation

- **Summary**

The main objectives of the study were as follows. a) To develop an effective sketch of factors those are responsible for the evaluation of curriculum development process. b) To provide support for the development of a continuous system for process evaluation of curriculum development. c) To point out the responsible institutions which can effectively do the job of curriculum development process in future. d) To estimate the performance of the institutions which are involved in curriculum development process. e) To appraise the existing curriculum development process

- **Revision**

Curriculum development is a continuous process and necessary changes are part and parcel of the process, In order to make more responsive to the changing demands and to ensure the relevancy. It is beyond doubt reality that the effective curriculum development process can enhance the learning of the participants. It will be only possible if evaluation with respect to the formulation, implementation, launched in a proper way. If programmed evaluation is needed to judge and perceive in order to improve planning and implementation of current and future activities, this research will be helpful to meet most of the querics regarding curriculum development process.

- **Assignment/Activity**

Questionnaire is more efficient as it requires less time, is less expensive, and permits collection of data from a much larger sample (Best and Khan, 1992). Van Dalen, (1973, p.324) it is quite suitable instrument for the collection of reliable and quantifiable information from all members of a sample. It is easy to fill out, keep respondent on subject, is relatively objective and fairly easy to be tabulated and analyzed. A questionnaire as Likrt rating scale consisting of 84 statements was developed on the basis of related literature, Main features of the curriculum development process in the shape of objectives, content; methodology and evaluation were kept in view while developing the Questionnaire. The questionnaire was validated through expert opinions working at excellence centers, Institute of Education and Research, Punjab University and personnel working at Federal Level involved in process of Curriculum Development.

POINTS FOR DISCUSSIONS / CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

Points for Discussion

Points for Clarification

- References / Further Readings

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UNIT 5: CHALLENGES IN CURRICULAR EVALUATION

- **Introduction**
- **Objectives**
- **Definitions**
- **Summary**
- **Revision**
- **Assignment/Activity**
- **Points For Discussion And Clarification**
- References / Further Readings

- **Introduction**

1.1 Curriculum design and development The Primary School Curriculum was launched and circulated to primary teachers in September 1999. The introduction of the curriculum was a significant development in primary education and was the culmination of an extensive process of collaborative curriculum planning and design by the education partners, under the auspices of the National Council for Curriculum and Assessment (NCCA). Previously, the last revision of the curriculum for primary schools was Curaclam na Bunscoile (1971). The Primary School Curriculum (1999) encompasses the philosophical thrust of Curaclam na Bunscoile (1971), incorporates current educational thinking, and embraces contemporary teaching approaches and methodologies. The curriculum is presented in six areas of learning, some of which are further subdivided into subjects. These are outlined in Fig. 1.1. Each subject area is presented in two booklets: • A curriculum statement, which outlines a range of objectives and learning experiences that pupils will be enabled to undertake. The curriculum for each subject area is presented for four class levels: junior and senior infants, first and second classes, third and fourth classes, and fifth and sixth classes. The objectives are outlined in such a way that pupils will be enabled to develop progressively a wide range of concepts, skills and understandings appropriate to their age and stage of development. • Teacher guidelines, which provide guidance to schools on school planning, organisational aspects associated with each subject area, and classroom planning. Exemplar lessons are provided to assist schools in the exploration of a variety of approaches and methodologies distinctive to each subject. 1.2 Curriculum dissemination and implementation Educational change involves changing teachers' beliefs and understanding as a prerequisite to improving teaching practices. Research indicates that teachers require a thorough understanding of the meaning of educational change before there is an acceptance and adoption of new programmes Language Gaeilge English Mathematics Social, environmental and scientific education History Geography Science Arts education Visual arts Music Drama Physical education Social, personal and health education Religious education Figure 1.1: The structure of the Primary School Curriculum (1999) Introduction 2 Curriculum Implementation and approaches. Curriculum change requires in-school management teams, principals and boards of management to lead the implementation of change in the school as an organisation. Effective curriculum change and implementation requires time, personal interaction, in-service training, and other forms of people-based support (Fullan, 1993). The Department of Education and Science devised a range of initiatives and programmes of professional development to support the phased implementation of change within primary schools nationally. These initiatives were designed to increase the capacity of schools to respond to change and to plan for and implement that change at individual school level.

- **Objectives**

1.2.1 The Primary Curriculum Support Programme The Primary Curriculum Support Programme (PCSP) was established prior to the launch of the curriculum. Its purpose was to mediate the curriculum for teachers and to enable them to implement it in their schools. The core task of the PCSP was to facilitate the professional development of whole-school staffs through in-service seminars and school-based planning days. The seminars provided an introduction to the content and methodologies of each curriculum area. During the seminars teachers were presented with opportunities to engage in activities that illustrated changes in teaching approaches. The Education Centre network supported the provision of the programme and facilitated the organisation of the seminar schedules. As part of its dissemination and support strategy the PCSP developed a web site that provides teachers, parents and boards of management with details of the organisation of professional development support and the content of seminars. The web site also provides templates for planning and exemplars of methodologies that can be downloaded and used in school and classroom contexts. Newsletters informing schools of the in-service provision were circulated to schools nationally. PCSP personnel also responded to the requests of parents' associations and boards of management for information about the curriculum, and seminars for parents were organised. 1.2.2 The Regional Curriculum Support Service The Regional Curriculum Support Service (or Cuiditheoirí Service) was established as a central component of the PCSP. The cuiditheoirí offer their services to schools in a variety of ways, including visiting schools and advising teachers on the implementation of particular areas of curriculum strands, providing teachers with useful sources of information in relation to resources and teaching materials, and facilitating networking between schools. They provide supports for whole-school and classroom planning and organise additional in-service courses for teachers through the Education Centre network. This service provides clarification, reinforcement and reiteration of many of the key messages delivered on the in-service days. Teachers are also encouraged to contact the Primary Curriculum Curriculum Implementation 3 Support Programme directly by telephone, and a Curriculum Advisory Line was established to facilitate direct communication with curriculum support personnel on the implementation of the curriculum. 1.2.3 School Development Planning Support (Primary) The School Development Planning Support (SDPS) initiative was established in 1999 to promote school development planning in primary and post-primary schools. At primary level, SDPS supports schools in the process of formulating a school plan that articulates the educational philosophy of the school, its aims, and how it proposes to achieve them. The promotion of school effectiveness and improvement is the essential purpose of school planning. SDPS facilitators assist principals and class teachers in working collaboratively to develop both organisational and curriculum policies. Facilitators hold meetings with school representatives to explore the schools' annual development planning programmes and also organise seminars in individual schools and in clusters of schools. Planning prompts and templates for each subject area of the curriculum have been designed by the SDPS together with the PCSP, in consultation with the National Council for Curriculum and Assessment. These planning templates are provided to assist schools in recording curriculum planning decisions. 1.2.4 Additional supports Additional grants for English, Mathematics and Visual Arts were provided to schools to enable them to purchase books and materials required for implementing the curriculum. Furthermore, teachers could attend summer courses and evening courses, join primary subject associations and avail of the services of national and local arts, heritage and cultural institutions to assist them in becoming familiar with the curriculum. 1.3 Time frame for implementation 1.3.1 Supporting whole-school planning for the phased introduction of the curriculum Approximately 27.5 days of school closure were sanctioned to accommodate whole-staff attendance at seminars and to convene planning days for the phased introduction of the curriculum from 1999 to 2003. As part of this programme, ten school closures were sanctioned to facilitate teachers in Introduction 4 Curriculum Implementation attending seminars and engaging in whole-school planning for English, Visual Arts, and Mathematics. Further days were sanctioned to assist schools to engage in school development planning during this period. The planning days were school-based and provided staff members with opportunities to develop whole-school plans, reflect on the changes in methodologies or structure of the curriculum, review resources, and plan for the implementation of the curricular area in the school. Table 1.1 outlines the programme of PCSP support for 2001/02 and illustrates the balance between facilitated seminars and school-based planning days provided to schools to support the dissemination and implementation of the curriculum. In general, the implementation of each curriculum area in schools began in the year following the completion of the familiarisation programme, and each new subject was phased in over a two-year cycle. Circular 40/03 (DES, 2003) outlines the schedule for the planning and implementation of the Primary School Curriculum (1999). It states: "During the first year the focus will be on initial implementation and the advancement of planning which began during the period of preparation organised by PCSP. In the second year, the focus will be on substantially completing plans and consolidating implementation." Table 1.2 outlines the support programme devised for the continuing professional development of teachers in relation to familiarisation with the curriculum and provides information about the implementation dates for various subject areas. So far, teachers have received in-service support in English, Visual Arts, Mathematics, Gaeilge, Social, Personal and Health Education (SPHE), and Science. Circular 30/04 (DES, 2004) sets out the Department's expectations in relation to schools' progress in curriculum implementation. It states that "it is expected from the end of the 2002/2003 school year, all schools will be implementing English and Visual Arts and will have substantially completed plans in these two subjects. In relation to Gaeilge and Maths, 2003/2004 will be the second year of the cycle and accordingly, schools will advance their planning in these subject areas with a view to substantially completing plans and consolidating implementation by the end of the school year." In the current school year, 2004/05, teachers are receiving input and support from the PCSP as the curricula in Music and Physical Education are introduced.

- **Definitions**

1.4 Reviewing and evaluating curriculum implementation In the guideline circular to all primary schools, Circular 26/03 (DES, 2003), the DES outlined the strategy adopted, in conjunction with the National Council for Curriculum and Assessment, for reviewing the progress of curriculum implementation and setting targets for further implementation. The strategy included: • a review and evaluation of the implementation of English, Visual Arts and Mathematics in a sample of schools by the DES Inspectorate in the context of conducting whole-school inspections

(Tuairiscí Scoile) • an evaluation of the PSCP, commissioned by the DES and part-funded by the NCCA, undertaken by a research team from Trinity College, Dublin • the collection and analysis by the NCCA of responses to the Review and Reflection Template for Teachers from a representative sample of schools in order to provide information on the progress of curriculum implementation in English, Visual Arts, and Mathematics. This report, An Evaluation of Curriculum Implementation in Primary Schools, concerns the external review undertaken by the Inspectorate to evaluate the quality of curriculum implementation of English, Mathematics, and Visual Arts. The report details the extent of curriculum implementation and draws attention to both the good practice evident in our primary schools and areas where development is required. Curriculum Implementation 7 1.5 The report structure Chapter 1 outlines the context and background to the evaluation undertaken by the Inspectorate. Chapter 2 describes the procedures and methodology employed to gather the data in schools and outlines the process of data analysis. Chapter 3 reflects on the quality of curriculum implementation in English. Chapters 4 and 5 discuss the quality of implementation with regard to Mathematics and Visual Arts. Important priorities and concerns with regard to the quality of implementation are presented in the concluding chapter

- **Summary**

2.1 Evaluation objectives The overall purpose of the evaluation was to report on the quality and extent of curriculum implementation in English, Mathematics and the Visual Arts in a sample of primary schools. The evaluation sought to identify strengths and challenges in the implementation process, both for teachers and for school communities, and to make recommendations aimed at supporting future curriculum implementation. 2.2 Selection of schools Primary schools are inspected on a cyclical basis in line with annual inspection targets. A comprehensive report (often referred by the Irish term, tuairisc scoile) is issued to each school following inspection. The evaluation of the school examines teaching, learning and assessment, as well as school planning, the work of the board of management, and the school's accommodation and resources. This focused evaluation of curriculum implementation in Mathematics, English and Visual Arts was undertaken in conjunction with the annual cycle of school inspection. Eighty-six schools, from the list of schools where it was proposed to furnish a school report, were selected for focused evaluation. These schools were informed that a review of curriculum implementation in English, Mathematics or Visual Arts would occur in tandem with the general school inspection in which all curriculum areas are evaluated. The sample included a variety of school types and locations and involved single-sex, co-educational, junior, senior and full vertical schools. 2.3 Development of the evaluation model In September 2003 a steering group of inspectors, supported by the Evaluation Support and Research Unit (ESRU), developed an evaluation model that incorporated three main components of evaluation activity. These were: • a focused, school-based evaluation of the implementation of the revised curricula of English, Mathematics or Visual Arts in a sample of mainstream classes in eighty-six schools • semi-structured interviews with school principals and classroom teachers • a review of whole-school planning documents, teachers' curriculum plans, assessment policy, information on pupils' engagement and achievement, and programme planning in relation to individual pupils. An orientation seminar was organised for the team of thirty inspectors nominated to undertake the evaluation.

- **Revision**

Structure of whole-school evaluation for each curriculum area In addition to individual classroom evaluation, the inspectors carried out a review of the specific curriculum area in the whole-school context. They examined whole-school planning documents and assessment policy and analysed information on pupils' achievement. School principals were interviewed, and the themes for discussion included whole-school planning policy and practice, curriculum provision, assessment and achievement, and professional development support. The principals commented, where relevant, on the use by the school of external tutors (for example a visiting artist) to assist the class teachers with a specific area of the curriculum. The discussion provided an opportunity for principals to share their insights into what was working well and what remained challenging in the implementation process. 2.5 Feedback to schools and preparation of evaluation reports Following the evaluation, a meeting was held with the school staff, and the contents of the School Report were discussed. The reporting inspector also provided feedback about the curriculum area that had been the focus

- **Assignment/Activity**

POINTS FOR DISCUSSIONS / CLARIFICATION

After going through the unit you may like to have further discussion on some points and clarification. Note down those points:-

Points for Discussion

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Points for Clarification

- References / Further Readings

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