Chapter 10

Sound

Points to Study:

10.1 Origin of sound
10.2 Vocal sound produced by human
10.3 Transmission of sound
10.4 Loudness and pitch
10.5 Audible , infra-audible, ultra-audible sound
10.6 Human ear
10.7 Air polhution

With birth We started to hear different types of sound. The various - different sound are enter in our ears at every moments like- coo-coo of cuckoo, cock of crow, moo of cow, tweet of birds, bells in temple, music of harmonium and sitar, etc. and also do not know many others sounds. Sound is intergral part of our life. Do you know scientific cause of sound production? Let find out.

10.1 Origin of sound

Activity - 1

Make 2-3 small balls from piece of papers and put on inverted plate. Now hit the plate with steel spoon. What do you see? Why do pieces of paper do up-down motion?

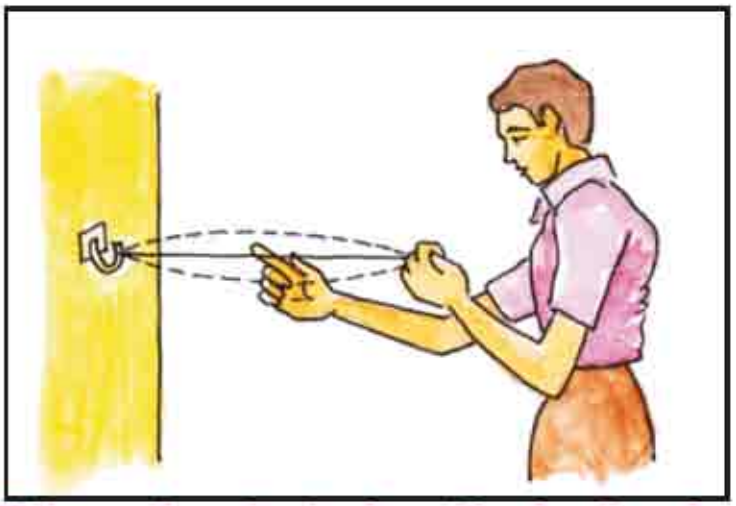

Fig. 10.1 High sound production by rubber band up-down motion.

According to fig 10.1, clamp one end of rubber band on wall with nail and tense it. With the second hand , pull the rubber band from mid and release it. What does sound appear. Observe the motion of rubber band?

If motion of rubber band is stopped. Do you hear sound ?

It is clear from the above activity that after releasing the strained rubber band. It is vibrating up and down. It is called vibrational motion.

The objects produce sound due to vibration.

Similarly, ringing the, drum, tabla, dholak, school bell, etc. and touch it. Does the vibration occur ?

10.2 Vocal sound produced in human:

When we speak then sound generated from our vocal. How does vocal sound generate? Let see by doing.

Activity -2

Take two rubber balloon's strips of size 4 cm long and 3 cm wide. Place these two pieces one above the other and stretch them tight. Now, try to blow quick air through the gap between them from mouth and sound is produced. You may say your friends to see it. Ask to your friend to perform the same activity and you observe it. Strips are continuously opening and closing by blowing the air and sound is producing.

Fig. 10.2 Strips are continuously opening and closing and producing sound with air blowing in these.

Fig. 10.3 Vocal system of human.

In human's throat, there are exist two vocal cords bounded to each other. It is called vocal-fibre. Its structure is shown in fig. 10.3. Our vocal-fibre is natural musical instrument.

When we speak, vocal fibre is stretched in such a way that it becomes think slit. When the lungs force air through the slit, the vocal cords starts vibrating and producing sound. The process is same as in above activity. The Vibrations are produced in rubber strips as shown in fig 10.2.

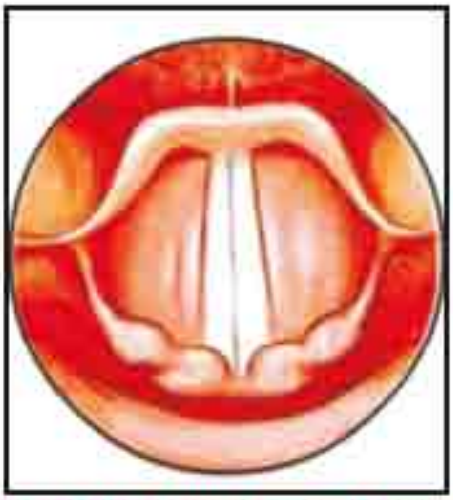

Fig. 10.4 (A) closed vocal system

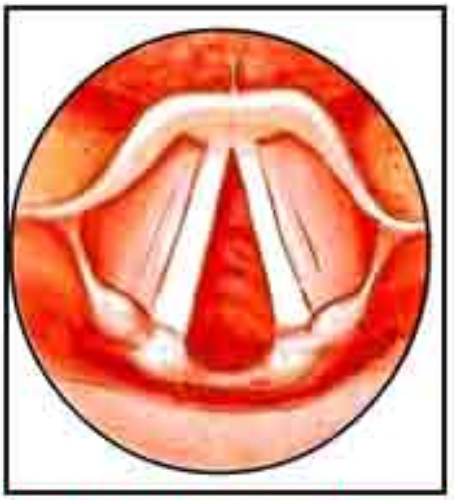

Fig. 10.4 (b) open vocal system

10.3 Transmission of sound

How does sound transmission into different- medium.

(A) Sound transmission in air:

Sound reaches to our ears by transmission through air from location of generation. Sound transmission in air through vibration. When an object is doing vibration then air nearby it also vibrates. Each vibrating particle transmission these vibrations to other particles which comes into contact of these. Similarly, sound vibrations reach to our ears through one air molecule to another air molecules. Air molecules nearby ear-drum vibrate. These oscillating air molecules collide with ear-drum. The ear-drum starts oscillating and we listen sound.

Does sound transmission in solids and liquid ?

(B) Sound Transmission in solid

Activity - 3

Take a metre scale or approximately 2 meter long metal wire and same length thread. Hold one end of meter scale near to your ear and ask your friend to gently scratch the other end of the scale. Can you hear the sound of the scratches? Similarly repeat the same activity for stretched metal wire and thread. Vibrations is produced in solids due to scratching at one end and forwarded to other particle till reached the second end. It is clear that sound propagates in solids also.

In laboratory, we hear sound after putting a vibrating tuning fork near to ear.

Activity - 4

Take two empty match box and make an hole in its inner part. knot a long thread in these holes. Two students hold these match box and move apart to each other. One student hold the match box near to ear and other student speaks in box slowly. This is a toy telephone.

Fig. 10.5 Toy telephone.

(C) Sound Transmission in liquid

Activity - 5

Take a bucket or a bath tub. Fill it with clean water. Take two small piece of stone and scratch these to each other in bucket. Does sound hear to nearby person. Certainly, You will be able to hear this sound. It is clear that sound is transmission in liquids also.

It is straightforward from above discussion that sound propagates in solid, liquid, and gas (air) medium. Sound can not transmission in vaccum. Sound needs a medium to transmission.

Do you know it.

1. Speed of sound is highest in solid, high in liquid and lowest in gas (air).
2. Speed of sound in air at 0°C is 331 m/sec.
3. The two space travellers can not talk to each other at moon. Because, there is no air at moon.

Amplitude, frequency and periodic time

According to fig. 10.6, the vibrating objects displaced form its mean position O' to upper side maximum displacement position A and come back to 'O' and goes lower side maximum displacement position B and again come upward to O. In this way, it completes one oscillation which can be represented as following.

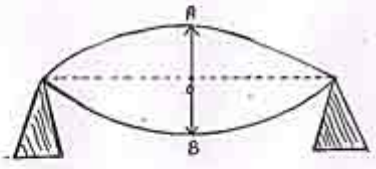

Fig. 10.6 Amplitude of vibration.

$$A \rightleftharpoons O \rightleftharpoons B$$

Amplitude: Maximum displacement from mean position for a vibrating object is called amplitude. Amplitude OA=OB in as shown in fig.10.6.

Frequency : The data related to three vibrating objects are given in table. Fill in the blank by make easy calculation.

Table 10.1

Sr. No.	Object	Number of oscillation completed by an object	Time taken in oscillations	Number of vibrations in one second
1	A	500	10 sec	.....
2	B	400	10 sec	.....
3	C	100	5 sec	.....

Which is the object do maximum number of oscillation in one second? It is apparent that object A does maximum number of oscillation and objects C does minimum.

"Number of oscillation executed in one second is called frequency."

In above table, you find the number of oscillation by division of number of oscillations to time taken in these oscillations. So we can say that frequency can be calculated by following formula-

The international unit of frequency is vibration per second which ia also called Hertz.

Unit of time period is second

$$\text{Frequency} = \frac{\text{Total number of oscillations}}{\text{total time taken}}$$

Periodic time or time period:

Time taken to complete one oscillation is called periodic time. Periodic time and frequency are reverse to each other.

$$\text{Periodic time} = \frac{1}{\text{Frequency}}$$

10.4 Loudness and pitch

Sounds are different from each person, animal, musical instruments. We can recognise the sound through ears on the basis of three characteristics elements. These are three as- loudness, pitch and quality. Here, we discuss only loudness and pitch. Regarding the quality you will read in higher classes. How you define pitch? Let us understand.

(A) Loudness:

Activity -6

Take plate or metal plate other. Hit it with a spoon first slowly and then hardly. In which position you will hear high sound or loudness and in which position softness? You may also have seen the ringing the drum or Tambour. When these hit hardly, then intense or more strong sound will be heared. Whereas when it hit softly then the soft or low intense sound is produced.

Table 10.2

Sr. No.	Pair	Soft sound (low intense)	Loud sound (high intense)
1	Tong and bell	tong	
2	Roar of lion's and buzzing of mosquito		
3	Drum and Sitar		
4	Flute and band-baza		
5	Tasha, anklete		

Identify the group of soft and loud sounds in next table 10.2.

When you speak slowly then low intense or loudness sound come outs. But when you speak strongly then sound comes out high loudness which has high intensity of loudness.

The loudness of sound depends upon amplitude. So we can say that loudness of sound increases as amplitude increases. The international unit of sound is decibel (dB).

Search the examples of soft and loud sound using additional experience of daily life and discuss on it.

(B) Pitch

Activity -7

Ring a tong and a bell . Which has fine or sharp sound and which does it have thick or heavy? Classify the the pair of sound systems into sharp(fine) and heavy (thick) sound based on experience. Search the examples of soft and loud sound using additional experience of daily lifes. In the case of man and woman, normally woman has fine sound whereas a man had heavy sound.

The sound's characteristics of sharpness (fineness) or thickness (heavy) is called pitch. The pitch of sound depends upon the frequency.

The sound of woman's and children's is melodious and fine compared to man's sound due to its high frequency or pitch.

It is clear that high pitch sound has high frequency and low pitch sound has low frequency.

Search reason:

1. Sitar's sound is more melodious than Tambour.
2. Nightingale's (Cuckoo) sound is more melodious between the sound of cuckoo and crow.

Find out the various sounds nearby you and know by comparing these sounds. Which does sound has high pitch and which does sound has low pitch?

Till now discussion, you may able to find the difference between the loudness

and pitch of sound. We can classify the objects on the basis of loudness and pitch e.g the loudness in sound roaring of loin is more compared to buzzing of mosquito but the pitch in sound roaring of loin is less compared to buzzing of mosquito.

You feel also it:

A musical instrument generates varied pitch sounds. You may feel it by pressing the different buttons on harmonium . It generates different pitch (frequency) sound. Is the pitch of sound generated by opening the different holes in flute same?

Try to get feel to change the pitch of musical instrument does you have nearby.

How do you classify the sound on the basis frequency ? Let us know.

10.5 Audible, infra-sonic, ultra-sonic

Our ears are only capable to hear the sound of minimum frequency 20 vibration per seconds (Hertz) and maximum frequency 20,000 vibration per second. The sound having frequency 20 hertz to 20,000 (20 kg hertz)hertz can only heared by us is called audible sound.

What do you call the sounds of frequency less then 20 hertz and more than 20 kg hrtyz?

The sounds of of frequency less then 20 hertz is called infra-audible (infra-sonic) and more than 20,000 hertz is called ultra-audible (ultra-sonic).

Ultrasonic sounds are used in diagnose the diseases through ultrasonography. It is called sonography in normal language.

Infrasonic waves sre used in 'SONAR' device to measure the depth of sea and submarine's position and speed.

Warning : Sonography is used to check the health and growth of infant child in the womb of pregnant woman. Few people are identifying the sex of child during checking and make abortion if the infant child is girl. It is called embryo death. In our country, it is legal crime to check an embryo for sex determination and help in this activities. In society, girl child has equal right to live .

Lets know it

Some animals can hear ultra-audible sound like - dogs, bats, rats, whale, etc. Police uses the ants which generate ultra-audible to train the investigating dogs. The bat generates ultra-audible sound and hear the reflecting ultra-audible sound and get information about the obstacle. That is why, the bats can easily fly in dark night

10.6 Human ear

The shape of the outer part of the ear is like a funnel. It is called Pinna. When sound enters in it, it travels down a canal . It is called hearing cavity. At the

end of hearing cavity a thin membrane is stretched tightly. It is called the ear-drum. It is also called tympanum in normal language.

When the vibration of sound vibrates ear drum then ear dumsends vibration to the inner ear. It performs an important function. To understand what the eardrum does, let us build a tin can model of the eardrum. From there, the signal goes to the brain. That way we hear.

Let do it also.

Activity - 8

To understand the process of eardrum vibration. Let perform the following activity. Take a paper glass. Cut its ends. Stretch a piece of rubber balloon across one end of the glass and fasten it with a rubber band. Put four or five small pieces of ther mocol on the stretched rubber. Now ask any student to speak few words from the open end Observe what happens to the pieces. Why do the grains jump up and down?

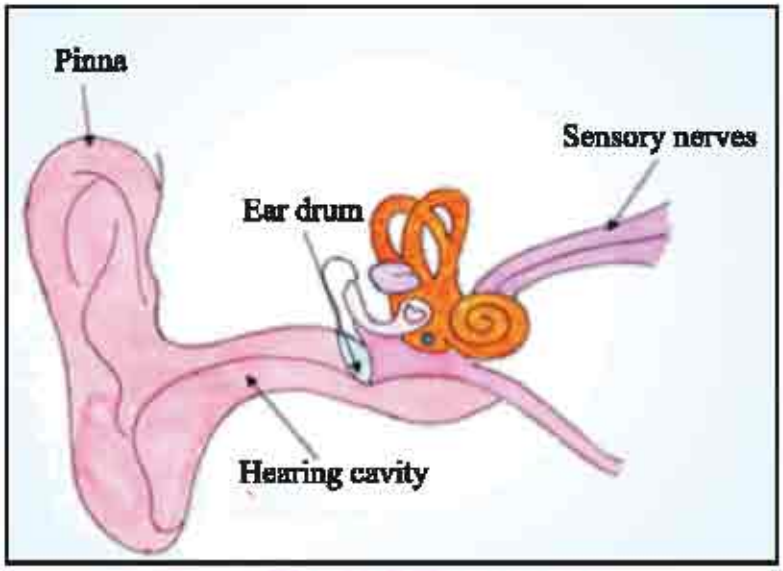

Fig. 10.7 Human ear

10.7 Sound Pollution

Classify the sounds heared in daily experience by you into pleasant and non-pleasent catagories.

Melodious sounds are pleasent to ear. Musical sound is one which is pleasing to the ear. The sounds which are unpleasant to ear are called noise e.g. sounds produced by transports vehicles, music with high loudness, sounds coming from the construction, etc.

Low sounds as normal breathing has loudness upto 10 decibel, soft whisper has loudness 20 -30 decibel, radio music (normal form) has loudness 50 -60 decibel.

The loudness of sound is upto 50 decibel then we feel it as pleasant sound. We can bear 50-80 loudness sound e.g. light vehicles, noise by students, normal music. The loudness of sound is more then 80 decibel then it becomes unbearable sound even though, it is melodious music.

The sound pollution is occurred due to continuously high noise by motor vehicle sounds, rail engine sound, factories, loud speakers, etc. The daily

routine activities are affected by noise pollution. The lot of health related problems are generated e.gmoreseness, sleeplessness, high blood pressure, temporary or permanent loss of hearing capacity and becomes deaf rarely.

Measures to limit noise pollution

1. The silencing devices must be installed in transport vehicles, industrial machines and home appliances.
2. The noisy operations must be conducted away from any residential area.
3. Television and loudspeaker should be run at low volumes.
4. Trees must be planted along the roads and around buildings to observe the sounds

let you know also it.

Indian music system is purely scientific. It has seven musical surs - Sa, Re, Ga, Ma, Pa, Dha, Ni. Musicians are used these swaras to produce melodious sound /music. Indian music system has different which are based on these tones surs.

□□□

What you have learnt

- Sound is produced by vibrating objects.
- In human beings, the vibration of the vocal cords produces sound.
- Sound travels through a medium (gas, liquid or solid).the speed of sound is highest in solids, high in liquids and lowest in gases.
- Sound cannot travel in vacuum.
- The number of vibrations per second is called the frequency of oscillation.
- The time taken to complete one oscillation is called the time period or vibration period.
- The loudness of sound depends on amplitude of vibration. Larger the amplitude of vibration, louder is the sound.
- The properties of sounds like Sharp (fine) or heavy (think) are called pitch of sound. Higher the frequency of vibration, the higher is the pitch.
- We can hear the sound from 20Hz to 20000Hz. It is called audible sound.
- The sounds having frequency less than 20Hz is called infra-sonic and more than 20000Hz (20 kilo hertz) is called ultra-sonic.
- Sound produces vibration in eardrum. It send to brain through ear – cavity by which we feel sound.
- Unpleasant sounds are called noise.
- Noise pollution may create many problems. So we should attempt to minimise noise polhution.

□□□

Exercises

Choose the correct answer.

1. In which medium, the Transmission of sound is not possible?
   (A) Iron rod (B) water
   (C) air (D) vaccum ( )
2. The up-down motion around the mean position of an object is called -
   (A) Vibration (B) Amplitude
   (C) Frequency (D) Periodic time ( )
3. Speed of sound at 0 °C in air is -
   (A) 350 m/sec (B) 200 m/sec
   (C) 400 m/sec (D) 331 m/sec ( )
4. Time taken to complete one vibration is called -
   (A) frequency (B) time period
   (C) amplitude (D) non of these ( )

In the following statements, tick T against those which are true, and F against those which are false:

1. sound generates due to vibration in objects. True/false
2. The sound waves do not need medium to Transmission. True/false
3. The sound has maximum velocity in solids. True /false
4. The unit of loudness of sound is decibel (dB). True / false

Fill in the blanks with suitable words.

1. Main source of sound in human is.....
2. The sound wave of having frequency more than 20000 hertz is called.....
3. The international unit of frequency is .....
4. The loudness of sound depends on .....
5. The pitch of sound depends on.....

Short answer questions

1. A musical instruments takes 2 seconds to complete 200 oscillations then calculate frequency of it ?
2. The ringing bell in a temple has frequency 400 vibration/sec, then calculate the periodic time of it.

3. What are differences in audible, infra-audible, ultra-audible.
4. Define frequency and periodic time ? Represent the relation of them by a formula.

Long answer questions:

1. Draw an human vocal system diagram and explain its working principle.
2. What is noise pollution. How does it affect us ? How can it controlled? Explain it in detail.
3. Explain the process of receiving the sound signals to brain with labelled diagram of human ear.
4. How does sound Transmission in solids, liquids and gases? Explain it.

Activity work:

1. Prepare a chart of human ear and hang in class room.
2. Prepare the charts for representation of sound pollution and its effects and to control it. Develop the awareness in school and villages by showing the charts.
3. Take a flute and produce different sounds by closing 1,2,3 ...hole by finger and compare its pitch.
4. Prepare the charts by knowing about musical instruments of Rajasthan.

◆◆◆