5 Sound

Sound, we hear constantly in the environment is produced by vibrating various things. Instruments, that produce sound are called **sources of sound.**

It can be concluded that various musical instruments produce sound in various ways.

Sources of sound can be divided into three categories according to the part that vibrates when producing sound.

Figure 5.1

Some of the sounds we hear in the environment occur naturally while some others occur artificially.

Birds call

Cats mew

Figure 5.2 ▲ Several natural sounds

Sound of machines in factories

Sound of vehicles

Figure 5.3 ▲ Several artificial sounds

Artificial sounds, as well as natural sounds are produced by vibrating strings/ bars, membranes or air columns.

Assignment 5.1

- List out separately some naturally produced sounds and artificially produced sounds in the environment.
- Identify and name the part that vibrates when those sounds are produced.

Humming of bees comes from fast motion of their wings. Grass hoppers and cicadas generate their characteristic sound by rubbing the bristles on their legs

Assignment 5.2

- Make a list of some animals that generate sounds.
- Investigate the methods that they generate sounds and make a report.

Frequency of vibrations

Let us do Activity 5.1 to study further, the nature of sounds.

Activity 5.1

You will need:- An organ, a piano or a xylophone

Method:-

- Play two keys of the organ, the piano or xylophone, which are apart from each other.
- Listen to the sound and you will realise that the two sounds are different to each other.
- Now play the seven relevent keys to seven notes, which are close to each other.
- Listen to the sound and you will realise that there is a slight difference between each note.
- Discuss the reason for that difference, you observed.

The difference in the sound you realised in the above activity is due to a quantity called frequency of vibration.

The number of vibrations of an object per unit time is referred to as the frequency of that object.

If an object vibrates 50 times a second, then it is said that, the frequency of that object is 50 Hz.

Frequency of vibrations is measured by the international (SI) unit Hertz (Hz).

Let us do Activity 5.2 to study further, the frequency of vibrations.

Activity 5.2

You will need:- Two tuning forks of long arms and short arms

Method:-

- Vibrate the tuning fork of long arms and listen to the sound carefully.
- Then vibrate the tuning fork of short arms and listen to that sound carefully. (Both tuning forks should be vibrated in the same manner. Get the support of your teacher for this purpose.)
- Repeat vibrating the tuning forks several times and identify the difference of sounds.
- Record your observations.

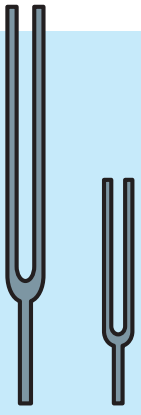

Figure 5.4
Tuning forks

Now it is clear to you that, the sound generated by a tuning fork differs according to its arm length. It is the frequency of sound that changes here.

Observe the tuning forks of different length. The frequency differ according to the length of them. The longest tuning fork has the mechanisms frequency. Frequency increases gradually with decreasing length. There are mechanisms in every musical instrument to change the frequency. The seven notes in music are produce with the frequency manipulation.

5.1 Musical instruments that produce sound by vibrating membranes

Let us construct a simple instrument that produce sound by vibrating membranes.

Activity 5.3

You will need:- A large balloon, a small plastic cup, rubber bands

Method:-

- Cut the neck of the balloon as shown in the Figure 5.5.
- Insert the plastic cup into the balloon and make it like a drum as shown in the figure. Use rubber bands where necessary to tighten the balloon membrane. Strengthen the upper edge of the cup also with a rubber band.
- Tap the drum, thus made and listen the sound produced.
- Tighten the balloon membrane by pulling the balloon down. Tap again and listen to the sound. (Tapping should be done in the same manner at each instance.)
- Listen to the sound produced by increasing the tightness of the balloon membrane.

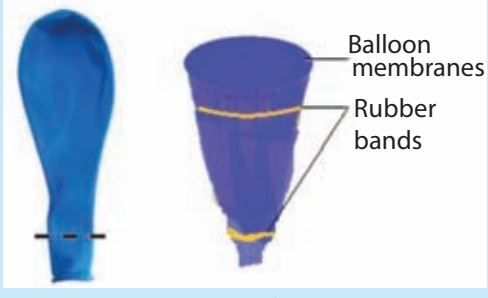

Figure 5.5

It is clear that the sound is sharp and high when the tightness of the balloon membrane is increased. The frequency of the sound produced has increased when the membrane is stretched more.

Assignment 5.3

- Make an instrument that produce sound by vibrating membrane.
- Design a suitable way to adjust its sound and present it to the classroom.

Let us find out how the sound of a membrane vibrating instrument can be adjusted.

Activity 5.4

You will need:- A thabla

Method:-

Figure 5.6

- Play the thabla that you are provided with.
- Listen to the sound of it carefully.
- Tighten the thabla strap well by tapping gently to the piece of wood fitted for that purpose. This will stretch the membrane to the thabla. (Get the music teacher's assistance for this)
- Play the thabla again and listen to the sound well.
- Notice the difference of sound in two instances.
- Identify the change of sound by playing the thabla several times, while changing the tension of its membrane.
- Record your observations.

Stretching of the membrane of thabla can be adjusted by tightning or loosening its strap. You may understand that the sound produced by the thabla is different when its skin is stretched and not stretched. It is the frequency of the sound that changes here. When the membrane is stretched, the frequency of the sound produced is high.

Assignment 5.4

- Find another instrument which produces sound when a membrane is vibrated.
- Plan and present a method to adjust its sound.

5.1 Musical instruments that produce sound by vibrating air columns

Let us do Activity 5.5 to study about the instruments that produce sound by vibrating an air column.

Activity 5.5

You will need:- Three pen tubes in different length with a close end
Method:-

- First blow the shortest pen - tube (A) and listen to the sound carefully.
- Then, blow the longer one (B) and listen. Finally, blow the longest one (C). Listen and identify the difference of sounds.
- Repeat this activity several times to identify the difference of sounds well.

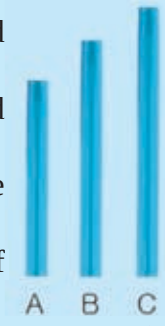

Figure 5.7

You may hear that the sound produced by pen tubes of different lengths are different. Thus, it is clear that the frequency of the sound produced differs according to the length of air column vibrated.

Assignment 5.5

- Make a whistle using six one end closed pen tubes as shown in Figure 5.8.
- Blow the whistle, you made, rhythmically.

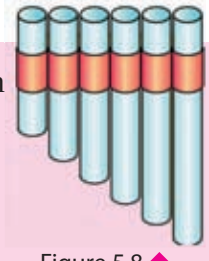
Figure 5.8

Activity 5.6

You will need:- Six tall glass tumblers of the same size, a metal spoon, water
Method:-

- Fill the six glass tumblers with water to varing heights as shown in the figure.
- Tap the edge of the tumblers with a spoon gradually, starting from the one with less water.
- Listen the sound carefully.

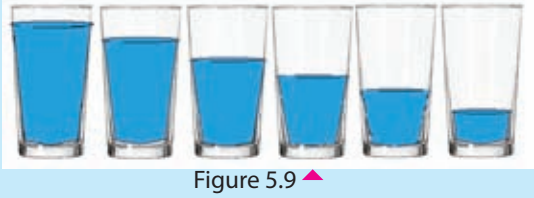
Figure 5.9

Assignment 5.6

- Make a whistle using a tender coconut leaf. Blow it while changing the length of its reeds and listen to the sound carefully.
- Record the change of sound according to change of length of the reed.

Let us find some more facts about the instruments that produce sound by vibrating a column of air.

Activity 5.7

You will need:- A flute

Method:-

- Close all the holes of the flute provided to you and play it.
- Listen to the sound carefully.
- Then, open the holes B,C,D,E,F and G gradually one at a time and blow the flute.
- Listen carefully to find whether there is a change in the sound when each hole is opened and closed.
- Record your observations

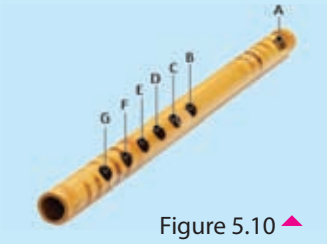

Figure 5.10

When the holes B,C,D,E,F and G are opened gradually one at a time, the length of the air column vibrated is increased.

Thus, flute is a musical instrument that changes the sound with the change of the length of air column vibrated. It is played with the blow of air that vibrates the air colomn in the flute. The air pores are closed and opened with the fingers to produce different sounds in music.

5.3 Musical instruments that produce sound by vibrating strings/rods

Let us construct a musical instrument that produces sound by vibrating strings.

Activity 5.8

You will need:- A piece of plank which is about 2 feet long and 6 inches wide, empty fish can, 4 iron nails, 4 bolts, a small thin plastic sheet, 4 pieces of wire of the same metal which are 45 cm long and have different diameters.

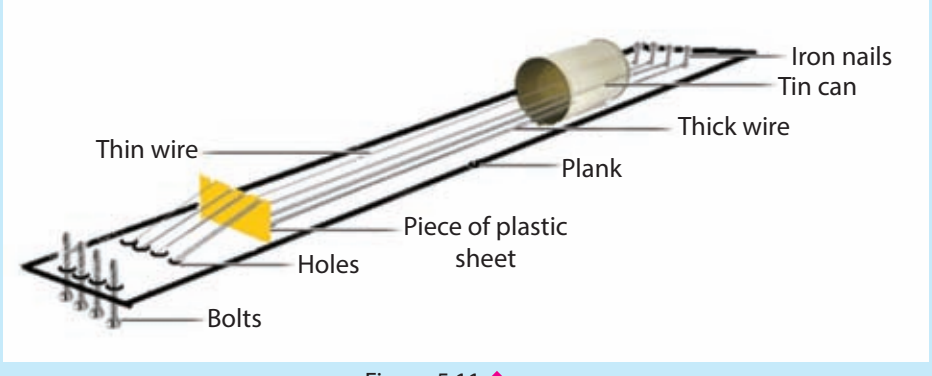

Figure 5.11

Method:-

- Fix the iron nails to the plank as shown in Figure 5.6 and tie the wires to them. Take the other ends of the wires through the holes of the tin can, fixed to the plank.
- Pass the wires through the slots made on the plastic sheet, which is placed on the plank. Send the wires through the holes, made on the plank.
- Wind the wires around the bolts which are fixed to the plank. (Ask the assistance of your teacher for this)
- Make sure that the lengths of the vibrating part of the wires and their tension can be adjusted.
- Play the instrument, you made adjusting wires and identify the change of sound.
- Record your observations.

Let us do Activity 5.9 to investigate the methods of changing the sound produced by the musical instruments with strings.

Activity 5.9

You will need:- A guitar

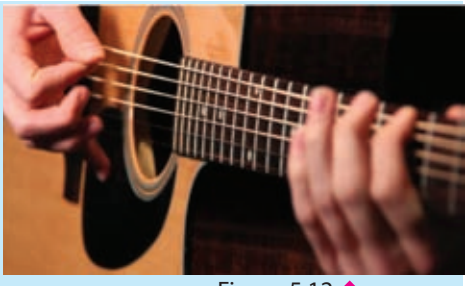

Figure 5.12

Method:- (Get the assistance of your teacher for the activity)

- Observe well, the way that wires are fixed in a guitar and the thickness of those wires.
- Then, vibrate the wires one by one starting from the thick wire.
- Listen carefully, the sound produced, when each wire is vibrated.
- Listen to the sound produced, when length and the tension of wires are gradually changed. Identify the differences.
- Repeat this procedure several times.
- Record your observations.

A sharp (high) sound is produced when short, tight, thin wires are vibrated. Sound produced by the vibration of long, loose and thick wire is not that sharp. When a guitar or a violin is being tuned, the length and the tension of the wires are changed. Sound may also be changed by the way and the speed of vibrating the strings.

Assignment 5.7

- Plan to construct a musical instrument that produces sound by vibrating strings.
- Construct the instrument planned, and play it.

Assignment 5.8

- Investigate the methods of tuning some other musical instruments that produce sound by vibrating strings.
- Tune those instruments, identify the change of sound and record the methods of tuning.

Xylophone is a musical instrument with vibrating bars. Let us study more about the sound produced by a xylphone.

Assignment 5.9

- Make a flute using a piece of PVC pipe or a piece of bamboo. Use a cork stopper to close the end of the flute.
- Try to play it rhythmically by opening and closing the holes.

Activity 5.10

You will need:- Xylophone

Method:-

- Tap gradually, one by one on the plates of the xylophone, you are provided with, (starting from the longer plate to the shorter one). Listen the sound carefully.
- Repeat playing the xylophone by tapping the plates.
- Record your observations.

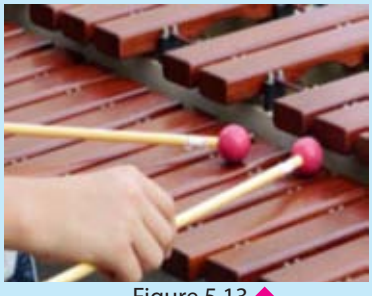

Figure 5.13

Xylophone produces sound because of the vibration of plates. Here, tapping to the shorter plates, gives higher (intense) sound than tapping to the longer plates. It is clear that the sound produced by tapping shorter plates is different to the sound produced by tapping longer plates. The frequency is changed by the change of the length of plates. As in the set of tuning forks, in the xylophone also, the frequency is highest in shortest plate and it is lowest in the longest plate.

Assignment 5.10

- Try to construct a xylophone and play it.
- Prepare a list of musical instruments that produce sound by vibrating bars or plates.
- Find and record how the sound is produced in them.

Figure 5.14

Assignment 5.11

- Construct various musical instruments with your class mates.
- Adjust the sound of those musical instruments well.
- Present a group display, using those musical instruments in your science or literary society.

Musical tones and noises

Figure 5.15 ▲ Instances where noises are produced

It is joyful to listen playing guitar or violin or to listen singing a song. Such sounds are pleasant to our ears. But the sounds coming from factories and vehicles are not pleasant. Such sounds are a nuisance to our ears.

Rhythmical sounds which are pleasant to our ears are musical tones. Such sounds are produced by methodical or formal vibrations of objects. Sounds which are unpleasant to our ears are called noises. They are produced by non formal vibrations of objects.

Even a musical tone may be unbearable to our ears, when the sound of which is very high. It depends on the relevant person.

High and noisy sounds may harmful to ears. They disturb our day-to-day activities. It is our duty to use instruments that produce sounds without disturbing others.

Assignment 5.12

- List out some instances, where noises are produced.
- Mention the source of noise, infront of the instances you identified.
- Investigate and record the part of the source which vibrate to produce the noise.

Ancient, traditional and modern musical instruments

It is said that musical instruments had been used for the services in religious places in ancient Sri Lanka. Large drum ('daula'), double drum ('tammattama'), and trumpet are prominent among those instruments. From the ancient times, till today, those instruments are in use for the life activities of common folk, like devil dancing, chanting good will and religious worships.

Figure 5.16 ▲ Several ancient musical instruments

Low country drum, up country drum 'udekkiya', large drum ('daula'), double drum ('tammettama'), trumpet and "geta beraya" are main items in traditional musical instruments. These are used in cultural festivals.

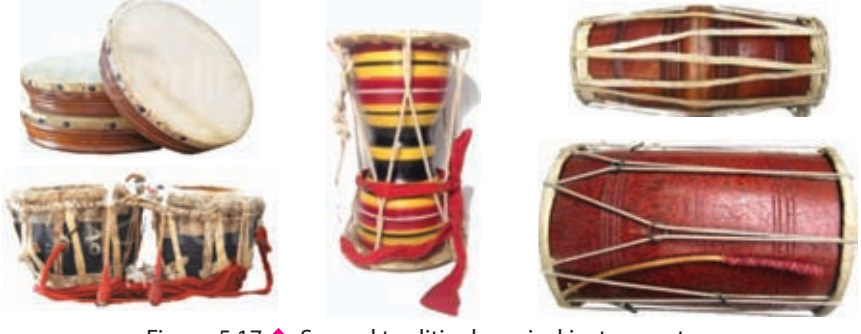

Figure 5.17 ▲ Several traditinal musical instruments

Guitar is a very popular musical instrument among younger generation. It is used in local popular music as well as in North Indian "Ragadari " music.

There are instances in the modern world that ancient and traditional musical instruments are used along with instruments like electric organ, guitar and thabla.

Figure 5.18 ▲ Several modern musical instruments

Special importance of modern musical instruments is that a single person can fulfil the necessity of a full orchestra or a number of instruments by using a computer and a keyboard. Octopad is commonly used for rhythm playing and organ is used as a permanent keyboard instrument.

Assignment 5.13

- Collect information on ancient traditional and modern musical instruments and prepare a booklet.

Musical therapy

Music can be used to improve the quality of life. Music has an ability to heal the mental stress and give spiritual happiness to the people spending busy life. Thus, the treatment given using music is known as musical therapy. Musical therapy can be used as a method of treatment to improve physical fitness and mental intergrity. It is discovered that diseases and disorders of brain and nervous system, heart failures, mental depression so on, can be cured by using this therapy.

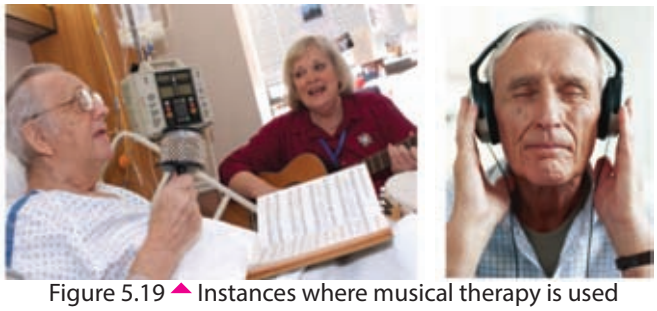

Figure 5.19 ▲ Instances where musical therapy is used

So, training a person from his childhood to enjoy music will be helpful to develop a healthy mind.

For extra knowledge

Nowadays musical therapy is used in many countries of the world to coordinate muscle movements in sport activities like running and cycling to prepare patients for surgeries and as a healing method after surgeries.

Assignment 5.14

- Prepare a letter to a wall paper on musical therapy which can be used to develop the quality of life.

Limits of hearing

Can we hear a vibration of any frequency?

Let us do Activity 5.11 to find out about this.

Activity 5.11

You will need:- A long hacksaw blade, a G-clamp

Method:-

- Clamp the hacksaw blade to the table. Keep the free end of the blade longer. (Figure 5.20)
- Vibrate the blade and listen.
- Then re-clamp the blade making its free end shorter.(Figure 5.21)
- Vibrate it again and listen.
- Discuss your observations with the teacher.

Figure 5.20

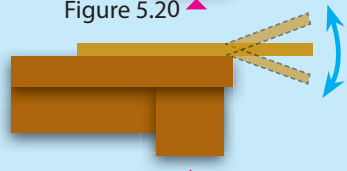

Figure 5.21

You may have experienced that no sound is heard though the longer blade is vibrating. The reason is that the human ear is not sensitive to the sound produced by the vibration of that blade.

We can not hear the sound of any frequency. We can hear only the sound of a certain range of vibrations. That range we can hear is known as the **limits of hearing**.

The limits of hearing or the range of frequency of sound that human ear can hear is 20 Hz to 20 000 Hz. Man can not hear the sounds of the frequency which is less than 20 Hz or more than 20 000 Hz.

Dog can hear the sounds of the frequency which is less than 20 Hz or more than 20000Hz. Bat can hear the sounds of higher frequencies up to 70 000 Hz.

Summary

- Instruments that produce sound are called sources of sound.
- All natural and artificial sounds are produced by the vibrations of strings/rods, membranes, bars or air columns.
- Number of vibrations of a sound source, produced in unit time is called the frequency.
- International (SI) unit of frequency is Hertz.

- Man cannot hear the sound of any frequency. There is a limited range of frequency of sound that man can hear.
- The limits of hearing of human is 20 Hz - 20 000 Hz.
- There are three categories of musical instruments, according to the part that vibrates when producing sound.
- Sound produced can be changed by adjusting the vibrating parts of musical instruments.
- Sound can be used to improve the quality of life.

Exercise

1. Select the appropriate words from those given in the brackets to fill in the blanks.

   I. Sound of high frequency can be obtained, when the wires of a violin are ..... (longer/ shorter).

   II. Sound of high frequency can be obtained, when the membrane of a drum is ..... (thinner/ thicker).

   III. Human ear is ..... (sensitive/ not sensitive) to any range of sound.

   IV. Vibrations of an object is ..... (regular/ irregular) when musical tones are produced.

2. Categorize the musical instruments given below, into three groups according to the way they produce sound.

   Double drum ('Tammattama'), 'Udekkiya', 'Horanewa', 'Sitar', 'Trumpet', 'Conch shell' ('Hak gediya'), 'Violin', 'Chello', 'Mandolin', 'Large drum' ('Daula').

1. If the statements given below are correct, put a (√) and if they are wrong put a (×) in the brackets.

   I. When the wires of a violin are tightly stretched, it gives a low tone. ( )

   II. When the length of the vibrating air column is less, it gives a sound of low frequency. ( )

   III. Xylophone is an instrument that produces sound by vibrating bars. ( )

   IV. Some mental depressions/conditions of patients can be cured by musical therapy. ( )

Technical Terms

Sources of sound	-	ධ්වනි ප්‍රභව	-	ஒலி முதல்
Vibration	-	කම්පනය	-	அதிர்வு
Artificial sounds	-	කෘත්‍රිම ශබ්ද	-	செயற்கை ஒலி
Natural sounds	-	ස්වාභාවික ශබ්ද	-	இயற்கை ஒலி
Adjusting	-	සීරුමාරු කිරීම	-	சுரத்தை மாற்றுதல்
Limitation of hearing	-	ශ්‍රව්‍යතා සීමාව	-	கேள்தகு எல்லை
Tuning fork	-	සරසුල	-	இசைக்கவை
Musical sounds	-	සංගීත නාද	-	சங்கீத ஒலி
Noises	-	ඝෝෂා	-	இரைச்சல்
Musical therapy	-	සංගීත චිකිත්සාව	-	இசைச் சிகிச்சை