

SOUND

Overview of the module-

This CLIX module has been designed for class 8 students. The aim of this module is that students learn basics of sound by following the process of science.

Teacher handbook would provide a guideline to a teacher. It will help a teacher to implement the module in the classroom.

Key Objectives of the module:

- To develop questioning ability
- Constructive learning
- Learning science using things around us; sophisticated equipment could be replaced with easily available materials
- Leading towards answer through investigation
- Collaborative learning

Content Mapping with State Textbook-

The sound unit has been divided into separate conceptual lessons. The following diagram will help you see the concept flow of the concepts covered in the module.

The title of the Lesson	Concepts covered	Total number of activities	Total time required
Introduction	Introduction of the module	1	10 min
Lesson 1: Sounds around us	Identification of various sound sources, production of sound, and visualization of vibration	5	100 min

Lesson 2: Knowing more about sound	Amplitude, frequency and their relation with loudness and pitch respectively	3	135 min
Lesson 3: Sound travels	Propagation through solid, liquid and air, and vibrations in the medium while sound is propagating	6	115 min
Lesson 4: How does sound travel?	Elasticity of air, and behaviour of particles of the medium while sound is traveling through the medium	5	95 min
Lesson 5: Solve the Puzzle	Pitch, loudness, frequency, amplitude, motion of the particle of the medium through which sound is propagating, and elastic property of matter	1	30 min

Description of Lessons- Introduction

It's a brief introduction of the module. Since we are talking about sound, so we started with a few examples of sounds. Let the students read it and add more examples of sounds from their surroundings.

Below is the activity wise description of the lesson and specific learning objective(s).

Lesson 1: Sounds Around us

Learning Objective(s):

After going through this lesson, student will -

1. Know various kinds of sources of sound
2. Be able to understand mechanism of production of sound
3. Be able to visualize vibration

Description of activities of lesson 1:

Activity	Mode (Hands-on/Digital)	Duration
1.1 Where are these sounds coming from?	Digital- An Audio + Classroom Discussion	15 min
1.2 A science classroom like yours	Digital- A video + Classroom Discussion	25 min
1.3 Make sound(s)	Hands-on + Classroom Discussion	10 min
1.4 Sound is vibration	Classroom Discussion	10 min
1.5 Seeing vibrations	Hands-on + Classroom Discussion	25 min
1.5 Seeing vibrations (continued)	Classroom Discussion	15 min

1.1 Where are these sounds coming from?

It's an ice breaking activity to engage students. Let the children sit in group and listen to the audio. Once they listen to the audio, ask them to identify the sound sources.

You may also ask them to mimic different kinds of sounds like sounds of animals, birds etc. Or ask them to go around and collect sample of different kinds of sounds by themselves.

1.2 A science classroom like yours

We want students to ask questions and classroom environment lively and fear free. Asking questions make us think, reason out. Motivate students to ask questions.

Let the children sit in the group and watch video. After watching video let them discuss their queries or questions in group. Give them around 5 minute for the group discussion.

Then ask children to type their questions about sound, "What they want to learn/know about sound?" in the assessment toolbox. They can type more than one question.

You as a facilitator, categorize the recorded questions in the three categories- Production of sound, Characteristics of sound, Propagation of sound. Take the discussion forward by picking up production of sound first.

It is possible that children would come up with varied and wide questions, and the syllabus of textbook and this module do not cover up them.

Do not discourage children to ask questions just because the text book does not provide the answer or we do not know the answer. We can always explore the ways to find out the answer. At this stage, for the children it is more important to involve in the process of finding answer rather than just knowing/got the answer.

1.3 Make sound(s)

(i) Make sound(s) with things around you

This activity is to make sound with things around, as quick as possible. You should motivate children to come up with their own idea. For example,

children can make sound using cap of pen, by banging on the table, etc. Please ensure that they do the activity in group.

(ii) Make sound(s) with things given to you

In this activity you should provide a few commonly available materials such as rubber bands, plastic straw, paper cup, pebbles, empty box, plastic bottles and bags, string/thread etc. These materials should be kept in the class or can be given in groups. Please ensure that they do the activity in group.

At the end, you should also present at least one design in the class showing blowing, hitting or plucking. For example, you can show vibration in string while plucking, vibration of pieces of chalk-put some pieces of chalk on table and hit the table with duster or some other thing. With the help of your design or students design try to demonstrate or introduce "vibration".

Ask children to visualize vibrations in air.

1.4 Sound is vibration

The production mechanism of sound is described and explicitly said that the sound is vibration only. Help students to contextualize it.

Here we also touched the concept of damping without being explicitly used the term damping. We believe that students have experience of damping though they might not know the term "Damping". Our intention is not that they learn terminology but to understand that vibrations can be damped because of the that we cannot feel or observe them.

Damping means amplitude of the vibration becomes lesser. The amplitude become so less, that sound wave cannot reach to us. Because of that we cannot hear sound even though the frequency is in audible range.

Discuss the questions given in the box for further exploration with the children. Allow children to explore them by themselves. Children can work in group or individually. You can guide them.

1.5 Seeing vibrations

In the previous topic we concluded that sound is vibration and vibration is sound. But do we really see any vibration in an object which make sound? For example vibration in flute, whistle etc.

In fact, vibrations could be felt and hard to see (because of low amplitude and high frequency), in a sound making object. Therefore, this activity "dancing ring on the base of paper" will be a direct experience to see the vibrations caused due to the sound produced.

Instructions to perform the activity are provided in the student module. You make sure that every group perform this activity and discuss the question given. You can also suggest examples or alternatives to this activity, which give direct evidence of the vibrations of the sounds.

1.5 Seeing vibrations (continued)

This is somewhat contradictory to what is described in previous activity. We realized while writing that in daily life, we actually cannot see vibrations except few cases like vibrations of mobile phone (when phone is ringing on vibrating mode), vibration of speaker.

Constituent particles of matter vibrate around its mean position at normal conditions. But it is beyond our limit of vision and frequency is not in human audible range.

Sound waves when propagate through medium exerts pressure on the particles of the medium.

If it is in audible range of human ear then we can hear sound.

If it is in within the limit of vision of human eyes, then we can observe vibrations, still it is hard to tell the exact frequency of a vibrating object just by observing it.

Let the children read the text and write the examples where two things are not hitting each other or they do not see the vibration but could hear the sound. It would be good if children do this exercise in group so that they can discuss with each other and help each other.

There is an activity in a box for further exploration. Let the children do it and discuss their findings. You can give it as homework and discuss their experience and cause of production of sound in each case in classroom.

Lesson 2: Knowing more about sound

Learning Objective(s):

After going through this lesson, students will-

1. Be able to build a relation between amplitude and loudness
2. Be able to identify low pitch and high pitch sound
3. Develop an understanding about frequency

Description of activities of lesson 2:

Activity	Mode (Hands-on/Digital)	Duration
2.1 Loudness	Digital- A video + Classroom Discussion	15 min
2.1 Loudness (continued)	Digital- Audacity Tool + Classroom Discussion	60 min
2.2 Pitch	Digital- A video + Classroom Discussion	20 min
2.3 World of music	Digital- Audacity Tool + Classroom Discussion	40 min

2.1 Loudness

Loudness and shrillness are the characteristics that we usually attached to the voice or sound in social life.

We tried to associate these parameters (loudness and shrillness) with the scientific concepts amplitude and frequency.

We focused on the visualization of the amplitude and frequency and its relation with the sound's loudness and shrillness, using digital tool and by doing hands-on activity.

Ask them to watch the video which shows the amplitudes of three balls. Displacement from the mean position is shown by an arrow. Discuss the displacement with the students, if required. Tell them explicitly that amplitude is the maximum displacement from mean position, either up or down.

2.1 Loudness (continued)

You are aware that sound from different sources are different (loud/ shrill). They are different because they are produced in different manner and even if they have produced in same manner, they have different frequencies and amplitudes.

For that we used a tool "Audacity" to analyze the sound. Students can see sound signal using this tool.

A tutorial video is given in this section. You should get familiar with the Audacity prior to conducting this session.

We used the term "wiggle" for the waveform of sound wave formed on the screen.

Horizontal spread of the wiggle shows the distance traveled by the sound, height of the wiggle shows the amplitude of the sound.

Let them do the activity in group. Ask them to watch the tutorial video first so that they can use the tool with ease. Ask them to record the sound sample in low voice or volume and in high voice or volume and compare the height of wiggle. Height of the wiggle corresponds to amplitude of sound wave.

Instructions for how to save audio file or open the recorded sample is given in the student module. Please refer the student module for the same.

Make sure that students get the idea that loudness and amplitude are related to each other. Allow enough time to students to spend on the tool to explore it and analyze sound.

Discuss the question given for further exploration with children. Elaborate it if needed.

Note down the responses of children. This discussion might also be useful for their biology classes when they learn about nervous system of human body.

2.2 Pitch

We described shrillness in terms of frequency. There is a video of straw flute, where students can compare the shrillness in the sound as the length of the straw varies.

You can also ask them to categories sound of the basis of shrillness and loudness. You can use audio clip 1.2 for that.

Discuss the question given for the further exploration with the children. You can do it as thought experiment, as what to do if we want to know the frequency of running ceiling fan.

2.3 World of music

Let student read this activity. Give them some time to work with Audacity and record their song (it could be different sounds also).

Ask them to complete the project work and provide their analysis of recorded sound sample(s).

Lesson 3: Sound Travels

Learning Objective(s):

After going through this lesson, students will:

1. Be able to know that sound propagates through solid, liquid and air
2. Be able to show/feel vibration while sound is propagating

Description of activities of lesson 3:

Activity	Mode (Hands-on/Digital)	Duration
3.1 Paper cup telephone	Hands-on + Classroom Discussion	15 min
3.1 Paper cup telephone (continued) - A	Hands-on + Classroom Discussion	15 min
3.1 Paper cup telephone (continued) - B	Hands-on + Classroom Discussion	15 min
3.2 Singing spoon	Hands-on + Classroom Discussion	15 min
3.3 Do walls have ears?	Hands-on + Classroom Discussion	15 min
3.4 Hitting spoons inside the bucket	Hands-on + Classroom Discussion	15 min
3.5 Vibrating balloon	Hands-on + Classroom Discussion	15 min
3.6 Sound travels: as vibrations through different media	Classroom Discussion	10 min

3.1 Paper cup telephone

You would be familiar with the paper cup toy telephone and so the children. It is fun playing with the toy telephone but we can have much more. You can discuss amplification of sound, effect of tension of the medium on sound, sound in different material-string of different materials, cup of different material etc.

Few questions given with the activity which can be discussed with the children as -Cup help to amplify the sound, so if we change the cup size we will get different sound (loud/low). Stretched string has more tension than loose, which allows particles to vibrate from one end to other. While if we keep string slack, vibrations lost in the way and we could not hear the sound.

Assist every group to perform the activity. Ask them to write the answers of the questions asked.

3.1 Paper cup telephone (continued) - A

Ask student to read the instructions and follow it. One can feel the vibrations of the voice by touching the thread at any place when it is taut. This would provide evidence that when sound propagates, particles of medium vibrate.

3.2 Singing spoon

When you do the activity, you will listen an enchanting voice similar to a temple bell which vibrates for longer time. The vibrations of spoon can be heard for longer time because sound wave with small amplitude travels to our ear via string. We won't be able to listen the small amplitude sound if there is no string. String provide a pathway to send sound wave of small amplitude to us.

This activity is mainly to show that sound travels through solids (here string). But enchanting singing of spoon make it very interesting. Let the student have fun with this activity.

Ask them to answer and discuss the questions asked.

3.3 Do walls have ears?

Generally, Students have notion that sound does not travel through solid medium and it cannot travel through a thick wall or any solid material. In contrast, this activity will help them to find it out that sound can travel through a solid medium like the activities 3.1 and 3.2.

Take care that while doing the activity sound should not come directly through air.

3.4 Hitting spoons inside the bucket

You know that sound also travel through liquid medium but this may not be easy to convince the students. Therefore, students can learn through direct experience that sound also travel through the sound. Ask the students to go through this activity as per the instructions.

Take two or three buckets in the class, filled with water. Ask children to perform the activity one by one.

You can also do the same activity with different liquids.

3.5 Vibrating balloon

This activity helps student to feel vibrations of on the balloon which is caused by the vibrating particles in the air. There could be a good discussion with students. Like, you can ask them- "How does the vibrations reaches to balloon?". After listening their answer, you can tell them that sound forces the

particles around us in vibrational motion. Furthermore, these vibrating particles put the balloon in vibration.

3.6 Sound travels: as vibrations through different media

This section is the gist of all the activities done above in lesson 4. After doing hands-on activities and direct experiences of this which are said about the propagation of sound in different media (gas/liquid/solid). Ask students to read this section carefully.

Lesson 4: How does sound travel?

Learning Objective(s):

After going through this lesson, students will:

1. Be able to develop an understanding about the behavior of particles of the medium while sound is traveling the through the medium
2. Be able to know the elastic property of air

Description of activities of lesson 4:

Activity	Mode (Hands-on/Digital)	Duration
4.1 A speaker	Digital- A video + Classroom Discussion	10 min
4.2 A slinky spring	Digital- A video + Classroom Discussion	15 min
4.3 Is air like a spring?	Hands-on + Classroom Discussion	30 min
4.4 Does the medium move with the sound?	Classroom Discussion	10 min
4.5 Is this true in other cases too?	Digital- A video + Classroom Discussion	30 min

4.1 A speaker

There are two videos given in this section. Discuss the question related to vibrating diaphragm of speaker with the children.

There is a simple pendulum attached with the vibrating speaker, for comparing the speed of the slow-motion video with the normal speed video.

4.2 A slinky spring

Slinky spring provides us clue about how sound travels through medium.

One can see the compression and rarefaction while the wave is passing through the slinky spring.

Ask student to watch the video of slinky spring.

Video 4.2 (a) shows a single wave pulse traveling in slow motion in a golden colored slinky spring.

Video 4.2 (b) shows consecutive waves traveling so many times, one can also see reflection of the wave.

You can demonstrate or ask students to do it, if slinky spring is available.

4.3 Is air like a spring?

There is analogy between the compression and rarefaction of slinky spring and air particles. This activity shows the elastic property of the air.

You have to arrange some syringes for the activity. One syringe per group is enough. Assist the children to do this activity.

4.4 Does the medium move with the sound?

Waves do not carry matter with it i.e. particle of the medium does not move with the wave, it vibrates about its mean position and passes energy to the neighboring particles.

Students might need to revisit the activities done previously. Help them to recall and revisit.

Ask the student to read the section carefully and their experiences and learning.

4.5 Is this true in other cases too?

(1) Make sure that students have good quality nylon rope for the activity given.

Nylon rope shows better wave on string.

While doing the activity ask them to observe the position of the coloured mark.

Do the activity in group and assign role to the members of the group like two will hold the ends of the rope, one will observe the coloured mark, other one will make a note.

(2) Ask students to observe the motion of the paper boat with the propagation of the ripples on the water.

In the activity 2, while shooting the video we taken care of the other disturbances which could affect it e.g. wind, our movement of foot near by the bucket, and any high amplitude sound source.

You can also demonstrate the activity but do take the necessary precautions.

Lesson 5: Solve the puzzle

Learning objective(s):

After going through this lesson, students will:

1. Be able to recall the concepts discussed in the previous lessons
2. Be able to relate the concepts with real world problem

Description of activities of lesson 5:

Activity	Mode (Hands-on/Digital)	Duration
5.1 Let's explore; Friends discussing a question	Digital- A video + Classroom Discussion	30 min

5.1 Let's explore; Friends discussing a question

Ask children to watch the video in group. Let them discuss in group and solve the puzzle. Do not assess them on the basis of wrong or right answer. You may give some hint and help them to revisit concepts related to sound learned in previous lessons.