TEACHING UNIT: What is a Sound?

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O. IMPORTANCE OF THE TOPIC

Sound is one of the most important methods of communication for living things.

One of the first things a newborn baby learns to do is to recognise the voice of his or her mother.

1. KEY TOPIC IDEAS

- Sounds can be high or low, loud or soft.
- Sound can be detected with appropriate instruments, which includes the human ear.
- Sound travels in all directions.
- Sound can bounce off a surface.
- Sound travels through space and we can measure the time it takes to do so.
- Sound travels through solids, liquids and gases.
- Sounds are made from vibrations of objects.

2. WHAT SHOULD TEACHERS KNOW?

- **What is a sound?**

A sound is a vibration which travels through an elastic medium (gas, liquid or solid).

- **What do you need to create a sound?**

A source of vibration and a medium through which it can travel.

- **When is a sound made?**

Sounds are made when objects move, such as when we hit something with a ruler or when we stretch an elastic band.

- **How is a sound made?**

When an object vibrates, the gas particles in the air experience a disturbance which is transmitted from one particle to another, causing some areas to have more particles than others. This, in turn, produces wave movements which our eardrums are capable of receiving. Sound waves, therefore, are created as a result of having areas with more particles and others with less.

- **What is a sound wave like?**

A sound wave is a "longitudinal" wave which travels in the same direction in which the vibration is produced.

- **Can we make a sound if we remove the air around us?**

No, sound needs a medium through which to travel.

- **Where does sound travel better - through solids, liquids or gases?**

Sound travels better through solids than liquids, and travels the slowest through gases.

- **How was the speed of sound first measured?**

The speed of sound was first measured in the 17th century. A cannon was fired a long distance away and observers measured the time between the flash and the moment the sound was heard. The distance travelled was then divided by the time it took observers to hear the sound. The result was 340m/s.

- **What does the speed of sound depend on?**

The speed of sound depends on two factors: the medium through which it travels and the temperature of the medium.

The speed of sound in air at 0 degrees Celsius is 331.46 m/s
The speed of sound in distilled water at 0 degrees Celsius is 1,484 m/s
The speed of sound in sea water at 15 degrees Celsius is 1,509.7 m/s
The speed of sound in aluminium at 20 degrees Celsius 6,400 m/s

- **How can a sound be altered?**

Sounds can be altered by changing the length, thickness or tension of the vibrating object.
Sounds can be made higher by increasing the movement of the object, for example, by hitting the object harder.

- **How is human voice produced?**

Voice is produced by vibration of the vocal cords. Air is expelled from the lungs and flows through the larynx. This makes the vocal chords vibrate and then comes out past the mouth. Different sounds can be created by changing the shape of the mouth.

- **What is sound "intensity"?**

Sound intensity is a quality used to classify sounds into loud or soft.
The energy carried by sound waves is measured by intensity. Strong sounds carry more energy than soft sounds, which is why sounds produced from an explosion can shatter nearby glass windows.
If the volume of a sound system is too low, we will not be able to hear the sound. This is because it is below the minimal sound level, called the absolute threshold of hearing.
If we turn the volume up, it can reach the most intense sound humans can hear without immediate damage to the ear, called the threshold of pain.
Sound intensity is measured in decibels.
Leaves rustling in a breeze- 10 db
Quiet conversation – 20 db
A moving car – 40 db
Heavy traffic – 80 db
Drill – 100 db – threshold of pain
Thunder -110 db
Discotheque – 120 db
Formula 1 – 180 db
High levels of sound have dangerous physical and psychological effects. This is what we call noise pollution.

- **What do "pitch" and "frequency" mean?**

"Pitch" is a sound property that enables us to distinguish between high-pitched sounds and low-pitched sounds.
"Frequency" is the physical magnitude of the pitch. Frequency is measured by the number of pulses (compressions and expansions) per second generated by the sound wave.
A high frequency sound wave corresponds to a high-pitched sound, whereas a low frequency sound wave corresponds to a low-pitched sound. It is measured in cycles per second or hertz (Hz).
In sound systems, the pitch is adjusted through bass and treble controls or equalizers.
An average ear can detect sounds in the range of 20 to 20,000 herts. As we get older, the range of sounds we can hear is reduced, especially when it comes to high-pitched sounds.
Sound waves with frequencies below 20 hertz are called infrasonics (some can only be perceived through touch), while those with frequencies above 20,000 hertz are called ultrasonic.
Elephants and whales can hear very low frequency sounds, such as shock waves, which is why these animals tend to be restless prior to earthquakes.

Dogs and bees can hear ultrasonic sounds above 30,000 hertz.
Dolphins and bats can hear sounds above 100,000 hertz, which allows them to rely on sound signals to find their way around.
Bats emit sound signals and then listen to the sound waves that bounce off other obstacles. They can estimate the distance of an object by studying the time it takes for the sound to reach their ears.
Ultrasonic sounds are applied in medical science to alleviate tendinitis and lumbago and are also used during pregnancies.
An ultrasound scan projects an ultrasound beam through the body of a pregnant woman. Sound waves bounce off the body's tissues and are analysed on the ultrasound machine to create a picture of the baby.

- **What is "timbre"?**

"Timbre" is the property of a sound that enables us to distinguish sounds that have the same intensity and pitch. Vocal timbre allows us to recognise different people's voices, even when they have the same intensity and pitch.

- **What is "sound reflection"?**

"Sound reflection" occurs when a sound wave hits an obstacle that is blocking its path, causing the sound to change direction.
The same thing happens when light is reflected in a mirror or when a ball bounces on the floor.

An echo is a type of sound reflection which consists of hearing the direct sound first and then its return from the reflecting surface.
Our ears are able to distinguish two different sounds if there is a time difference of 0.1 seconds between them. An echo, therefore, is heard when the time difference between the initial sound and its return from the reflecting surface is at least a tenth of a second.
The speed of sound is 340m/s (at 15 degrees Celsius), which means that sound travels 34 metres in a tenth of a second. For an echo to occur, the reflecting surface must be at least 17 metres away from the source of the sound. If the reflecting surface is exactly 17 metres away, the sound will travel 17 metres to the obstacle and 17 metres back.

- **What is "reverberation?"**

If the time difference between the initial sound and its return from the reflecting surface is less than 0.1 seconds, our ears will only perceive one prolonged sound. This is what we call "reverberation". The reflecting surface must be at least 17 metres away. The two sounds overlap, which

makes it difficult to detect the repeated sound. This is what happens when we talk in an empty room, which is why we use materials that absorb sound waves, such as curtains, carpets and cork. Curtains absorb 50 to 75% of sound waves, wood absorbs 45%, cork absorbs 30% and walls absorb 2%.

- **How does our auditory system work?**

The human auditory system has three main parts: the outer ear, the middle ear (which consists of small bones that help the sound to travel) and the inner ear.
The cells in the inner ear transform the sound vibrations into nerve impulses. These impulses are carried by various nerves to the brain. We would not be able to hear if the sound information failed to reach our brains.

3. CHILDREN'S PRIOR KNOWLEDGE

We suggest carrying out the following activities to find out children's ideas about sound:

a. **Use different objects in the classroom**

- Gather various objects that make a noise and put them in a large box. Encourage the children to guess what is in the box. Take out the objects one by one and let them touch them.
- Then ask them the following questions:

What is it made of?
How do you think it makes that sound?
How do you know it is making a noise?
Can you classify the sounds into different groups?
Which object makes the loudest / softest sound?
Can you make the noise louder / softer?

b. **Listen to sounds**

- Ask the children to draw the different sounds they can hear in the classroom or in the school playground. Prior to this, give the children the opportunity to listen to different sounds by taking them on a walk around the school.

Then ask them the following questions: *How do you think sounds are made?*
How can you hear sounds?

The children may hint that sound travels when drawing their pictures. You can get them to clarify this idea by asking them the following question:
How do you think sound travels?

c. **Listen to an echo**

Find out what children think an "echo" is by asking them the following questions:
Have you ever heard an echo?
How does an echo occur?
Can you make a picture that represents how you can tell there is an echo?
Can you draw what happens with sound?

CHILDREN'S IDEAS

Ideas about how sound is produced:
Children often say that they have heard a sound but can't explain how it happened. They don't feel the vibration that takes place.
Children usually say that sound is produced because they have banged or shaken the object.
They describe the characteristics of the object. For example, they can identify the importance of metal in the production of sound.
"The drum makes a noise. If you bang it, it makes a very loud noise"
Ideas about how they can hear sounds:
Children usually say that it is important to listen in order to hear a sound.
They sometimes draw big ears to illustrate that they are listening and a line that goes from the object to their ear to show that the sound is travelling towards it.
Children often suggest that sound reaches our ears as long as there is nothing in its way that prevents it from doing so.
They sometimes think it only travels towards one person.
Ideas about echoes:
Most children are able to list places where you can hear echoes: caves, tunnels, empty rooms, ...
They can't explain how echoes occur.

4. OBJECTIVES

WHAT IDEAS CAN WE TEACH CHILDREN?

The objectives will depend on the children's prior knowledge. We suggest three levels:

Level 1:

- To describe and distinguish different sounds.
- To learn that we hear things when the sound enters our ears.
- To make sounds.

Level 2:

- To describe how objects produce different sounds.
- To learn how sounds become softer as we move away from their source.
- To analyse the characteristics of the best sound they have made.

Level 3:

- To understand that something needs to vibrate if we want to produce a sound.
- To predict what needs to happen in order for a sound to be produced.
- To analyse an echo.

5. MIND MAP

link

6. SEQUENCE OF ACTIVITIES

1st SEQUENCE: HOW ARE SOUNDS CREATED?

Objective: To understand that sounds can be produced with a wide variety of objects.

1. Do our bodies make noises?

Encourage the children to make noises with different parts of their bodies.

Follow a particular order: hands, feet, nose, mouth, …

Ask the children the following questions to encourage them to analyse the sounds they make:

- *How did you make that noise?*
- *Did anything move when you made that noise?*

2. What noises can you hear when you go for a walk?

Help the children to develop their ideas by going on a walk around the school.

They can record the different sounds they hear.

Encourage them to listen carefully by asking them the following questions:

- *What noises can you hear in the school playground?*
- *What noises can you hear in the secretary's office?*
- *What noises can you hear in the kitchen?*
- *What noises can you hear in the classroom?*
- *Can you hear the noise the bird is making?*
- *Can anyone else hear that noise?*

Can you draw the different sounds you hear?

Get the children to make a book of sounds.

Can you hear any particular noises in different places?

- Ask the children to analyse the sounds they have heard in different places. Make a poster of places and sounds.

- Listen to the sounds you have recorded and discuss what or who makes them.

3. What noises can you hear at home?

- With the help of their parents, ask the children to write down the sounds they hear at home.

- Discuss their notes in class.

4. Can you make a musical instrument?

- Give the children different types of materials and ask them to make a musical instrument that sounds like:

Rain
A horse
A bird
The sea
The wind
A frog

2nd SEQUENCE: <u>WHAT DO YOU NEED TO CREATE A SOUND?</u>

Objective: To understand that a sound is made from the vibrations of an object and that it needs a medium though which it can travel.

1. **How do different instruments create sound?**

   Get the children to play percussion, string and wind instruments. Get them to identify which instruments produce sound through banging, touching and blowing.

2. **What can you feel when you play a musical instrument?**

Get the children to play the different musical instruments you have in the classroom and ask them if they can feel anything in their fingers.

Place bits of paper on top of a drum and watch how they move when the instrument vibrates and creates a sound.

You can also show the children a tuning fork and get them to feel how it vibrates when you bang it.

Get them to notice the same feeling by touching their throats when they talk.

In pairs, ask the children to hold a spring and put pressure on one of its ends. Explain that the resulting movement is a vibration.

Ask them to cover one end of different tubes at a time and to blow into it.

Finally, get them to stretch an elastic band around a plastic box.

3. **How can we prove that sound travels?**

Get the children to put pressure on one end of a spring and watch how it eventually arrives at the other end.

Place a candle a short distance away from a loudspeaker. Play music through the loudspeaker and ask the children to feel the vibration on the loudpspeaker's membrane. Then look at how that movement eventually reaches the candle's flame, making it move back and forth or even blowing it out.

Get the children to listen to the sound of a spoon banging against a table. Attach a piece of string to the spoon and get them to put the edges to their ears.

3rd SEQUENCE: CAN THE SAME SOUND BE HEARD IN DIFFERENT PLACES?

Objective: To understand that sound travels in all directions.

1. Can we hear the same sound in different rooms?

Ask three children to stand in three different places in the classroom. Make a noise and ask them whether they heard it.

Then ask one of the children to stand in the hall, get another to go into the classroom on the right and the other to go into the classroom on the left, and do the same thing.

Get the children to answer the following questions at home:

- *How do you know that the doorbell is ringing when you are at home?*
- *Where are you when the doorbell rings?*
- *Can you hear the doorbell from different rooms in the house?*
- *Can other people in other rooms hear the doorbell too?*

Make the children aware of the fact that the sound of the clock in the square, the church bell and the school bell can be heard by different people in different places.

3. Does a noise sound the same everywhere?

Get the children to stand at varying distances from the source of the noise in order to notice the difference in the intensity.

4th SEQUENCE: DOES SOUND TRAVEL THROUGH AIR, WATER AND GROUND?

OBJECTIVE: To understand that sound can travel through three mediums.

1. Can we hear sounds through solids?

Get the children to put their ear against a door and ask them to try to listen to sounds on the other side. Do the same thing with a table, a wall, an iron bar and the classroom floor.

2. Can we hear sounds through water?

Use a documentary to show the children how some animals (such as whales) can hear through water.

Use two glasses, one empty and one full of water, to illustrate the difference between listening through air and listening through water:

- Place your ear on the edge of the empty glass. Bang a knife against the glass and listen to the sound.
- Place your ear on the edge of a glass full of water. Bang a knife against the glass and listen to the sound.
  Did you notice a difference in the two sounds?
  Which glass transmits the clearest sound?

3. Can we hear sounds through the air?

The children should already be aware that there is something around us, a series of gases called air. Explain that we can hear sounds through the air because there is something around us which we can't see that carries sound.

4. Can we hear a sound if there is nothing between the source of the noise and us?

There is no way of showing that a bell cannot make any noise when in an airtight container, but you can use a documentary to illustrate what happens.
You can also exaggerate the point by asking one of the children to come into the classroom and pretend to remove all of the air from the room. Then get two other children to simulate that they are talking but cannot hear each other.

5th SEQUENCE: <u>DO ALL NOISES SOUND THE SAME?</u>

OBJECTIVE: To analyse the different sounds in our environment.

1. Do you like to create rhythms to accompany a poem or a song?

In groups, get the children to make up a rhythm to accompany a poem and then share it with the rest of the class.

2. Can you classify sounds according to how they are made? This is an extension of the first exercise.

- Ask the children to classify sounds according to how they are made.
Through banging
Through blowing
Through shaking

3. Can you distinguish between loud and soft sounds?

- Ask the children to classify sounds into:
Loud sounds
Soft sounds

4. How can we change noises?

- Ask the children to think about how they can make their instrument's noise sound louder or softer.
Encourage them to experiment by asking them the following questions:
  - *Can you make that noise sound louder or softer?*
  - *What happens if you use a different elastic band?*
  - *Does it make a sound even if you can't hear it?*
  - Get the children to analyse the new sounds they have produced and what changes they have had to make to their instrument.

4. Shall we play "guess the sound"?

Ask one of the children to choose an instrument and, without showing anyone else, get him or her to make a noise with it. The rest of the class has to guess which instrument he/she has used.
Ask them the following questions to aid their thought process:

- *What did you notice about the sound?*
- *Is it loud or soft?*
- *How do you think he/she has made the sound?*
- *What do you think is inside the instrument?*

Ask the children to listen to different noises you have recorded previously, such as running water, a conversation, a vacuum cleaner, a mixer and a television.
Ask them the following questions to help them guess what they are:

- *What sounds can you hear?*
- *What sounds are easy to identify?*
- *What sounds are difficult to identify?*
- *How did you hear that sound?*

5. What sounds attract our attention?

Ask the children to name different sounds used to attract our attention.
Show them pictures of:
A fire engine
An ambulance
A telephone
A church bell
A school bell
A doorbell

The aim is for children to link sounds with the objects that make them and to understand what they are used for.

6. What sounds do you like and which do you dislike?

Show the children pictures of different sounds heard around us: a fried egg, birds, a drill, a crying baby, ...
- Ask them to make a collage with sounds they like and dislike.
- Get them to research sounds they like and dislilke at school.

Ask them the following questions to help them analyse what they like and dislike:

- *What sounds make you feel happy?*
- *What sounds make you feel angry?*
- *What do people do to stop a noise they don't like?*

Ask the children to share their conclusions with the rest of the class. Get them to use a table showing pictures of different sounds and the number of people who like or dislike them.

7. What sounds do animals make?

Get the children to listen to the noises heard on a farm or in the park and ask them to imitate them.
Play a computer game to listen to different animal sounds.
Get the children to link different animals to different sounds.
Ask the children to imitate animal noises.

6th SEQUENCE: <u>WHAT IS INSIDE OUR EARS?</u>

OBJECTIVE: To understand that we can hear because we have an organ that catches sound – the ear.

1. What part of the body allows us to hear?

Get the children to cover their ears and ask them whether they can hear you.
Can you hear me if you cover your ears?
Do things sound the same?

Ask the children to make a face on a plate made of cardboard – get them to draw two eyes, a mouth and a nose. Then ask them to draw the ears on a separate piece of cardboard and attach them to the face.

2. What is the relation between the shape of the ear and sound?

Get the children to put their hands behind their ears to make them bigger. Then ask them the following questions:
Does my voice sound the same as before?
What shape are your ears?

Ask the children to collect pictures of animals and compare their ears. Ask them the following questions to help them with their research:

- *Are all animals ears the same shape and size?*
- *Are all animals ears in the same place?*
- *In what way do ears help animals?*

In groups, get the children to make a mural. Each member of the group must add one animal.
Then, in one large group, discuss the relation between sound and the type and size of animals ears.

5. What is inside our ears?

Use a documentary to help you research how sound reaches the brain.
Make a poster of the different parts of an ear.

6. How do deaf children communicate?

Study the different problems deaf children may have.

Ask them the following questions to aid your discussion:

- *Can you understand the television if you turn the sound off?*
- *How can we communicate with someone if we can't hear properly?*
- Read a story about the day-to-day life of a child with hearing difficulties.

Look at hearing aids for deaf people.
If possible, ask a deaf person to explain how sign language works.

7. Which telephone is better?

Show the children a telephone made from two cups and a piece of string. Let them use it to speak to one of their classmates.

Encourage them to carry out a small experiment:

How can we build a good telephone?

Show the children different types of cups and string. In pairs, ask them to build a number of telephones following your instructions.

Option 1:

- Choose a particular type of cup and string.
- Cut the string into three different lengths and decide which one works the best.
- Share the results with the rest of the class.

Option 2:

- Establish the same distance for everyone.
- Give them all the same type of cup.
- Give them all three different types of string.
- In one large group, decide which material works the best.

Option 3:

- Establish the same distance for everyone.
- Give them all the same type of string.
- Give them all different types of cups (ranging from small to very big).
- Share the results with the rest of the class.

7th SEQUENCE: <u>WHAT IS AN ECHO?</u>

OBJECTIVE: To learn that sound can be reflected and produce an effect called "echo".

1. In which parts of your school can you hear an echo?

Look for places in your school where you can hear a sound reflection.
Discuss the places where you have heard an echo.
Make a picture of how sound travels there and back.
Get the children to draw the places where you can hear an echo or show them pictures of different situations in which this occurs.
Ask them the following questions:

- *What is special about the places where you can hear an echo?*
- *What do you think produces the echo?*
- *Does the echo sound the same as the sound you made?*
- *What do you think happens to the sound?*
- *How does the sound come back to you?*

7. ASSESSMENT

As mentioned above, the suggested activities have been designed as a progressive approach to understanding the phenomenon of sound, which children usually achieve at the age of 7.
Taking into account the children's prior knowledge, teachers should plan activities that are just one step ahead and avoid those that entail more advanced concepts and comprehension.

Teachers need to assess the children in two areas: scientific procedures and scientific concepts.

Assessment of procedures:

There are three levels of progress with regards to scientific procedures:
Level 1. The children are able to make observations about things that produce sound and about different types of sound, both as part of a group discussion and in drawings.
Level 2. They can suggest how to compare different sounds – using a recorder or musical instruments.
Level 3. They can make predictions about what they think will happen to a particular sound if they make changes to the object and are able to collect information to prove their predictions. They are able to make changes to the object, predict how it will sound and take notes of what has happened in order to make comparisons.

Assessment of concepts:

There are three levels of progress with regards to understanding what sound is and how it is made:
Level 1. The children can identify a large number of sounds in their environment and are able to recognise where they come from.
Level 2. They are able to recognise differences between sounds and can link them to their different sources. They are aware of the fact that sound travels and that we can hear it when it enters our ears.
Level 3. They understand that sound is made from the vibrations of an object. They are able to explain that some sounds are louder than others, depending on their source and our location (i.e. they understand that sound can travel through different materials).

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