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| 1. Name of the lesson | <i>HOW TO SEE THE SOUND?</i> |
| 2. Target group | 8-9 years old |
| 3. Duration | 45 minutes |
| 4. STEAM Skills/ 21st Century Skills | Critical Thinking Tech Literacy Creative Thinking Problem Solving |
| 5. Expected learning outcomes | By the end of this unit, students will: <ul style="list-style-type: none"> ● Know how the sound waves propagate ● Understand ability of the acoustic waves to spread in gas, liquid or solid ● Understand how analogue phone works |
| 6. Subjects and topics covered | Topics covered: Science, Technology, Art In particular, students will learn about: <ul style="list-style-type: none"> ● What is sound propagation ● Features of sound waves ● Propagation of sound waves ● Mechanism of analogue phone ● Building own analogue phone and making experiment on it |
| 7. Methodologies | Design Thinking Inquiry Based Learning |
| 8. Integration of the Arts | Arts are integrated in the activity as students will build their tube made of paper or other materials to diffuse and propagate the sound, so they can practice creatively with different materials and discover their characteristics. Furthermore, many artists have also worked on the concept of sound to create beautiful works of art. Many of them have also played with the sound elements or with specific colours (colours associated to specific feelings and sounds) within their paintings such as Kandinskij and Mirò. |
| 9. Learning Environment | Classroom |
| 10. Required resources | <ul style="list-style-type: none"> ● 4-5 bowls (one per group) made of metal, aluminum, glass ● Food wrap foil ● Sugar or grains (e.g. couscous) ● A paper card in A4 format for each student; ● Paper cups (2 pcs per pair) ● Rope string (approx. 3 m per pair) ● Guitar strings or lines (two types, different thickness) - all must be of the same length <p>The classroom must be prepared in described way:</p> <ul style="list-style-type: none"> ● Arrange the tables in the room so that children can work in groups. Also leave free space for the exercises. |



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| | <ul style="list-style-type: none"> • Place 2 chairs facing each other on the side of the classroom. Tie strings or lines to their legs (only from one side of the string; leave the other one unattached) - Prepare a membrane bowl for each group: Stretch the foil and place it over the bowl opening so that it is tightly stretched. Put grains or sugar on the taut foil - Prepare the cups and cords for students to use for building the phone. |
| <p>11. Prior knowledge a. teacher b. students</p> | <p>In order to deliver this lesson, the teacher will need to have the following knowledge and skills set:</p> <ul style="list-style-type: none"> - knowledge about basic features of sound waves - good communication skills - ability of explaining tasks and experiments and encouraging students to draw conclusions <p>In order to be able to participate and contribute to this lesson, the students will have achieved the following standards:</p> <ul style="list-style-type: none"> - making simple experiments - having knowledge about functionality of a phone - drawing conclusion with help of a teacher |
| <p>12. Detailed description of the step-by-step sequences of the unit, incl. specific activities to support the learning experience</p> | <p>STEP 1: Can you hear that? EXPERIMENT NUMBER 1.</p> <ul style="list-style-type: none"> - Ask students to cover their mouth with both hands and say their names. Afterwards ask them to create a “tube” with their hands, place it around their mouth and say their name again. - Ask them those questions: <ul style="list-style-type: none"> ➤ Which way does make the sound louder and clearer? ➤ How did the “tube” work? ➤ When was it difficult to understand the spoken words and why? <p>ANSWER: If you cover your mouth with your hand the sound is muffled, if you use a "tube" it is amplified. The sound is louder and more audible in the direction the “tube” is facing.</p> <p>STEP 2: What is “sound”? EXPERIMENT NUMBER 2.</p> <ul style="list-style-type: none"> - Ask students to put the fingers on their larynx and make sounds: they can murmur, sing, make a low sound and a high sound. - Now give them piece of food wrap foil (or paper). Ask them to stretch it, put it over their mouths and do the same again. - Ask them those questions: <ul style="list-style-type: none"> ➤ What did you feel under your fingers when you made the sound? ➤ What did you feel on your lips when you placed the foil on them? ➤ Why is this happening? <p>ANSWER: The vibration under your fingers and the tickling on your lips are the result of the sound wave propagation.</p> |

STEP 3: How to generate sound?

EXPERIMENT NUMBER 3.

- Divide students into pairs and ask them to come to tables / chairs with strings attached to them (preparation for this experiment you can find in the section "Required resources")
- The students will make the experiment in this way:
 - One student must hold the unattached part of the string in his hand. Ask him to pull it as strong as he can.
 - The second student strikes or hits a string like during playing guitar.
 - After that they exchange the roles.
 - Ask students to try pull the string harder or more delicate and hit the string.
 - Ask students to use the whole length of a string or roll it on their hands to make it shorter and hit it.
 - Ask them to try all of those exercises on each kind of string – thick and thin ones.
 - After experiment ask those questions:
 - What did you have to do to hear sound?
 - Why did the string have to be taut?
 - What sound was created when you didn't tighten the string enough?
 - Were the sounds made on both strings (thick and thin) the same?
 - What was the difference?
 - What sound did you hear when you made the string longer or shorter?

ANSWER: The longer the string, the lower the sound. The heavier the string the lower the sound. The tighter the string is pulled, the higher the sound.

This is because the pitch of a sound depends on the frequency of the sound waves - the number of oscillations in a certain time, for example 1 second. The unit of frequency is the Hertz. The higher the frequency, the higher the sound.

STEP 4: How to see the sound?

EXPERIMENT NUMBER 4.

- Ask students to seat at the table with their own groups. Give to each group a membrane bowl (preparation for this experiment you can find in the section "Required resources")
- Give to each student a piece of A4 paper card. Ask them to roll it to make a tube.
- Ask them to place one end of the tube close to bottom of the bowl and make loud sounds through the tube. Be careful not to touch the bowl with it.
- Ask them to observe what is happening with the grains or sugar within the bowl.
- After finishing the experiment ask them those questions:
 - What did you notice?
 - Why did the grains move?

ANSWER: The foil acts as a membrane vibrating under the influence of sound waves. The sound wave coming out of the tube vibrates the bowl. The foil, by vibrating, moves the grains, which bounce.

STEP 5: Sound propagation

EXERCISE NUMBER 1

- Students stand in big circle and hold hand of students standing next to them. First student is asked to tilt on the left side to touch with his arm other student's arm. After that he returns to his original position. The touched student does the same to other student on his left side and returns to his original position. The exercise is finished when the last student in the circle touches with his arm the first one.
- After the exercise ask students those questions:
 - What role did you have in this exercise?
 - Why did you move like this?
 - What is this movement like?
 - Remember how the guitar string moved, did you move similarly?

ANSWER: The first student plays the role of the sound source. The next pupils are air molecules that lean towards the next molecule. Their movements resemble the propagation of a sound wave.

The propagation of sound in a medium is based on the propagation of vibrations according to the direction of the wave. You can find some examples [here](#)

The grey line on the left is a source of sound. Black and red dots are the gas molecules, e. g. air in which the sound propagates. You can see the densification and dilution of air molecules. Those are the sound waves. The red dots show how air molecules move when a sound wave propagates. This is swinging movement.

STEP 6: Energy precipitation

EXPERIMENT NUMBER 5.

- Ask students to whisper something to the ear of their colleague sitting next to them.
- Afterwards ask them to whisper the same sentence to the colleague sitting in front of them.
- At the end ask them to whisper the same sentence to a person sitting at the opposite side of the classroom.
- Ask students those questions:
 - What is happening to the sound?
 - Does the sound disappear as the distance increases?

ANSWER: Every sound wave carries a certain amount of energy. The energy of the wave becomes less and less as it moves away from the sound source. This is because energy is absorbed by other physical bodies, such as air molecules. The longer distance the wave has to travel, the more of its energy will be absorbed.

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| | <p>STEP 7: Building our own phone EXERCISE NUMBER 2.</p> <ul style="list-style-type: none"> - Students are matched in pairs; each pair has two paper cups and string from which they make a phone. - Ask them to make their own phones. Instruction: Make a hole in the bottom of each cup with a pen. Pull the rope string through them. - Students can talk on that phone. Make sure the rope string between the cups is taut as they do that. - Ask them those questions: <ul style="list-style-type: none"> ➤ Did you hear your voices on that phone? ➤ What is the working principle of this simple phone? ➤ In what material was the sound transferred? <p>ANSWER: The sound makes the cup vibrate. The bottom of the cup vibrates and transmits the vibration to the rope string. The string transfers the vibration to the other cup. Its bottom acts as a speaker's diaphragm.</p> |
| <p>13. Gender-inclusive strategies and activities planned</p> | <p>All of the girls in the group will participate in all of the activities in the same way as boys. Teacher will ask the questions and choose equally male and female students to answer them.</p> |
| <p>14. Assessment & Evaluation</p> | <p>Thanks to this activity students can:</p> <ul style="list-style-type: none"> - Understand how the sound “looks” – it’s a wave. - Check what is the effect of sound wave – vibration. - Explain what is frequency of the sound and how can it be modified by using some materials (for example string). - Understand how the sound waves propagate in the environment - Understand ability of the acoustic waves to spread in gas, liquid or solid and connect it with energy which each acoustic wave has, e. g. why acoustic waves become weaker when the distance between source of the sound and a person is bigger and bigger - Build their own simple phone |