Investigating Sound

Strand Force, Motion, and Energy
Topic Investigating sound
Primary SOL 5.2 The student will investigate and understand basic characteristics of sound and how it behaves. Key concepts include
c) the ability of different media (solids, liquids, and gases) to transmit sound.
Related SOL 5.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which
h) predictions are made using patterns from data collected, and simple graphical data are generated;
i) inferences are made and conclusions are drawn.
5.4 The student will investigate and understand that matter is anything that has mass and takes up space; and occurs as a solid, liquid, or gas. Key concepts include
a) distinguishing properties of each phase of matter.

Background Information

Sound is a form of *energy* produced and transmitted by vibrating matter. Sound waves caused by such vibrations move through a medium (a solid, liquid, or gas) in all directions from their source. However, the medium vibrates back and forth and transfers the *energy*; the medium is not carried along with the sound wave.

Sound waves can be described by the wavelength and frequency of the waves.

Sound travels more quickly through solids than through liquids and gases because the molecules of a solid are closer together and, therefore, can transmit the vibrations (energy) faster. Sound travels most slowly through gases because the molecules of a gas are farthest apart. Some animals make and hear frequencies of sound vibrations (pitches) that humans cannot make nor hear. Musical instruments vibrate to produce sound.

Materials

- Copies of the attached activity sheet "Sound Travels through Media"
- Long table
- Baby wipes for each station setup
- Two pieces of string, each about two feet long for each setup of Station B
- Large metal serving spoon for each setup of Station B
- Large rectangular pan (metal, if possible, like a deep aluminum baking pan) – one for each setup of Station C
- Water
- Windup, ticking clocks – one for each setup of Station C and one for each setup of Station D
- Thin rubber tube or hose – one for each setup of Station D
- Two large funnels – for each setup of Station D

- Science journals or loose leaf paper

Vocabulary

wave, frequency, vibrations, pitch, sound, media, wavelength

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

Introduction

1. Review with the students that sound is caused by vibrations. Be certain that students understand that during the process of vibrations being transferred from air molecule to air molecule, it is *energy* being transferred.
2. Ask students to hold one hand against his/her throat, high up under the chin, and then hum.
3. Ask the students what they *feel*. Have them to either draw or write a description of what they think is happening. Have the students share their descriptions, making sure that students understand what is happening. *(They should feel vibrations and should conclude that in order to make sound, there must be vibrations. The vocal cords are vibrating, causing their throat to vibrate.)*
4. What does this investigation teach us about sound? What causes sound? *(Vibrations cause sound. Vibrating objects transmit sound waves to other media, such as air, and they travel in all directions.)*
5. Ask students through which types of matter sound can travel and ask them to give examples. *(Solids, liquids, and gases.)* Explain to the students that these are called the three types of media through which sound travels. For a sound wave to occur there must be matter in some form through which the wave can travel.
6. Ask students if sound travels at different speeds through different materials. For instance, does sound travel faster through a solid than a gas? Plan and conduct an investigation to test this motion.

Procedure

1. Set up the four stations labeled A through D as described on the attached activity sheet "Sound Travels through Media." You will need to set up multiple stations of each of the four stations so that students can work in groups of two.
2. Put the students into groups of two.
3. Pass out a copy of the activity sheet "Sound Travels through Media" to each group and explain the directions for each station.
4. Have students rotate through the stations to investigate and compare how sound travels through the three media. Remind them that each team should go to one of the Station A's, one of the Station B's, one of the Station C's, and one of the Station D's.
5. Ask students to record in their science journals or on loose leaf paper their observations and the answers to the questions that accompany each station. *(Safety Note: Be sure that students are instructed not to place the funnel in their ears. It is best to use a large funnel so that it will not fit into an ear.)*

Observations and Conclusion

1. Randomly select students to share the answers to their questions.
2. Ask, *"Which medium did you find the sound traveled the best through? Explain your answer."*(Sound travels best (fastest) through solids. Emphasize the reason for this:

because the molecules in a solid are closer together, and, therefore, the sound wave can transfer from one molecule to another faster.) *Through which medium did you find that the sound was the weakest? Explain why."* (Sound traveling through the air travels at a much slower rate and is weaker because the molecules in a gas are farther apart.)

Assessment

- **Questions**
  - What causes sound? *(Vibrations cause sound. Vibrating objects transmit sound waves to other media, such as air, and they travel in all directions.)*
  - How does medium the sound waves are traveling through change the sound?
- **Journal/writing prompts**
  - Reflect on the different experiences you have had with the sound experiments today. Provide three examples of sound traveling through different media from your experience and how it was generated.
- **Other**
  - Create your own sound experiment testing how media changes sound.
  - Create a three-flap flipbook or Venn diagram to compare the differences in sound through the different mediums (solid, liquid, gas).

Extensions and Connections (for all students)

- Encourage students to think of and discuss real-life experiences or things they have experienced or read about that illustrate transmission of sound (i.e. talking underwater, jobs requiring ear protection, sound moving in outer space, etc.).
- Invite an audiologist to discuss hearing loss and the development of hearing aids.

Strategies for Differentiation

- In lieu of journal writing, allow students to draw pictures or take pictures with captions through word processing software.
- Have higher-level learners explore other mediums, which will produce varying sounds and explain why the sounds occur or connections that they can make to these sounds: e.g., underwater pool water talking versus whales communicating underwater.
- Model the action of the molecules in a solid, liquid and gas and explore how that affects sound.
- Model the walking spring toy as a wave passing through the mediums.
- Arrange dominoes, or direct students to stand up and use their bodies to represent the spacing of molecules in solids, liquids, and gases. Gently push one domino or student at the end of the line to illustrate how sound would travel through the medium.
- Direct students to create and use "tin can telephones."

Sound Travels Through Media

Directions: You and your partner will go to each of four stations to investigate how sound travels though a certain medium — a solid, a liquid, or a gas. As you do the experiment at each station, discuss the questions listed below, decide on the answers, and write them in your science journals.

Station A

You will find a long **table** and **baby wipes**.

1. Put your ear on one end of the tabletop (a solid) and plug your exposed ear with a finger. Have your partner tap lightly or scratch on the *underside* of the other end of the table. What do you hear? How strong (loud) is the sound?
2. Remove your ear from the table, but keep your other ear plugged. Have your partner tap or scratch the table in exactly the same way as before. What do you hear this time? How did the sound coming to your ear *through the table* compare to the sound coming *through the air*? Which of the two sounds was louder? Why?
3. Use a baby wipe to clean the spot where you put your ear, and then reverse roles to repeat steps 1–3.

Station B

You will find a **spoon** with two equal lengths of **string** tied to one end of it.

1. Wrap the end of one of the strings (a solid) around a finger of one hand and the end of the other string around a finger of the other hand. Plug your ears with your wrapped fingers. Have your partner bang the spoon against the table. How would you describe the sound you hear?
2. Remove your fingers from your ears, and have your partner bang the table with the spoon in exactly the same way as before. What do you hear this time? How did the sound coming to your ears *through the string* compare to the sound coming *through the air*? Which of the two sounds was louder? Why?
3. Reverse roles to repeat steps 1 and 2.

Station C

You will find a windup ticking **clock**, a large **pan** (a solid) filled with **water** (a liquid), and **baby wipes**.

1. Place your ear against one end of the pan, and plug your exposed ear with a finger. Have your partner place the clock against the other end of the pan. Can you still hear the ticking sound through your ear that is against the pan? How strong is the sound?
2. Remove your ear from the pan, but keep your other ear plugged. Listen carefully to the ticking sound coming through the air. What do you hear this time? How did the sound coming to your ear *through the water and pan* compare to the sound coming *through the air*? Which of the two sounds was louder? Why?
3. Use a baby wipe to clean the spot where you put your ear, and then reverse roles to repeat steps 1–3.

Station D

You will find a ticking **clock** and a rubber **tube** (a solid and a gas) with a **funnel** attached to each end, and **baby wipes**.

1. Place one funnel against your ear, and plug your exposed ear with a finger. Have your partner place the other funnel against the ticking clock. Can you hear the ticking sound coming through the tube, which is filled with air? How strong is the sound? (Safety Note: Be sure that you do not place the funnel *in* your ear!)
2. Now, remove the funnel from your ear, but keep your other ear plugged. Listen carefully to the ticking sound coming through the air. What do you hear this time? How did the sound coming to your ear *through the tube and the air in it* compare to the sound coming to your ear *through the air alone*? Which of the two sounds was louder? Why?
3. Use a baby wipe to clean the funnel that touched your ear, and reverse roles to repeat steps 1–3.