**Sound Investigations**

**Organizing Topic**  Investigating Sound

**Overview**  Students investigate how sound travels through different media.

**Related Standards of Learning**  5.2b

**Objectives**
The students should be able to
- explain why sound waves travel only where there is matter to transmit them;
- compare and contrast sound traveling through a solid with sound traveling through the air;
- investigate how different media affect the transmission of sound;
- explain how different media (solids, liquids, and gases) transmit sound.

**Materials needed**
- Copies of the attached activity sheet
- Long table
- Babywipes
- 2 pieces of string, each about 2 feet long
- Large metal serving spoon
- Large rectangular pan (metal, if possible, like a deep aluminum baking pan)
- Water
- 2 windup, ticking clocks
- Thin rubber tube or hose
- 2 large funnels

**Instructional activity**

**Content/Teacher Notes**

Sound is a form of energy produced and transmitted by vibrating matter. Sound waves caused by such vibrations move through a material medium (a solid, liquid, or gas) in all directions from their source. However, the medium just 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. Students should know the following terms:

- **Wave.** A disturbance moving through a medium (solid, liquid, or gas)
- **Sound.** A compression wave moving outward from its source through a material medium
- **Wavelength.** The distance between two sound waves
- **Frequency.** The number of sound waves in a given unit of time, such as a second
- **Pitch.** The property of sound that is determined by the frequency of the waves producing it; the higher the frequency, the higher the pitch, and vice versa

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.
Introduction

1. Review with the students what they learned in the “Sound Vibrations” lesson. Remind them that the tuning fork vibrations caused the ripples in the water. Be certain that students understand that during the process of vibrations being transferred from air molecule to air molecule, it is energy, not matter, that is being transferred.

2. Ask each student to hold one hand against his/her throat, high up under the chin, and then hum. Ask them what they feel and what conclusions they can make about their voice and vibrations. (They should feel vibrations and should conclude that in order make sound, the throat must produce vibrations.) 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.)

3. Review with students the three types of media (solids, liquids, and gases) through which sound travels, and that these correspond to the three states of matter (solid, liquid, and gas). The point is that for a sound wave to happen, there must be matter in some form through which the wave can travel.

4. Review SOL 5.4c and the motion of molecules in the three states of matter. Explain that sound travels at different speeds through the three media: it travels most 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; it travels most slowly through gases because the molecules of a gas are farthest apart.

Procedure

1. Set up four stations, labeled A through D, as described on the attached activity sheet.

2. Put the students into pairs, and hand out a copy of the activity sheet to each pair. Allow the pairs to rotate among the various stations to investigate and compare how sound travels through the three media. Instruct students to record in their science journals 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 Conclusions

1. Randomly select student pairs to share their answers to questions. Students will have learned that 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. Sound traveling through the air travels at a much slower rate because the molecules in a gas are farther apart.

Sample assessment

Assess students’ participation in the activity and answers to the questions.

Ask students to describe why sound travels faster in a solid than it does in a gas.

Resources

“The Case of the Barking Dogs.” NASA SciFiles™
Sound Waves and Music. The Physics Classroom.
http://www.physicsclassroom.com/Class/sound/soundtoc.html, or
## Sound Travel Through Media

### Directions
You and your partner will go to each of four stations to investigate how sound travels through 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 the answers in your science journals.

### Station A
You will find a long table and babywipes.

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 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 babywipe 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 babywipes.

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 babywipe 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.

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 babywipe to clean the funnel that touched your ear, and reverse roles to repeat steps 1–3.