Sound Vibrations

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
a) compression waves;
b) vibration, compression, wavelength, frequency, amplitude;
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
d) hypotheses are formed from testable questions;
e) independent and dependent variables are identified;
g) data are collected, recorded, analyzed, and communicated using proper graphical representations and metric measurements;
h) predictions are made using patterns from data collected, and simple graphical data are generated;
i) inferences are made and conclusions are drawn.

Background Information

The source of all sound is movement. Movement causes vibrations, which in turn can cause molecules surrounding the source of the movement to vibrate. These vibrations move outward from the sound in a wave-like pattern. In sound waves, individual molecules do not move very far. They move as the mechanical energy is transferred from one molecule to the next. *Energy* is transferred.

We hear sound after these vibrations enter our ears. The sound vibrations cause a super-sensitive membrane in our ears, the eardrum, to vibrate. The eardrum transfers the vibrations to three tiny bones — the hammer, anvil, and stirrup. These bones, called *ossicles*, amplify and transmit the vibrations to the inner ear where they are changed into nerve impulses. The nerve impulses are then carried to the brain, where they are perceived as sounds.

This activity is useful for introducing the important concept that sound waves are *energy* moving from one place to another through a medium, but that the molecules of the medium — for example, the air or water molecules — do not move with the wave but merely vibrate to transfer the energy along.

Materials

- Tuning forks
- Bowls
- Water
- Copies of the attached worksheet “Make Some Waves!”

Vocabulary

wave, frequency, vibrations, pitch, sound, wavelength, medium

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

Introduction

1. Tell students that they will be investigating sound vibrations.
2. Give each student a copy of the attached worksheet, "Make Some Waves!" Ask if they know what a tuning fork does when it is struck. Have the students make a prediction about what will happen if you strike a tuning fork and then the tuning fork touches the water.
3. Have students record the predictions on their worksheets.
4. Put the students into groups, and give each group a bowl of water and some tuning forks. Tuning forks can be different sizes, or you can choose one size.
5. Instruct the students in the proper way to strike the tuning fork softly on a soft object, such as their palm or knee. Stress that it should never be struck against a hard surface, such as metal, stone, or wood, because such an impact could damage the tuning fork.
6. Have students practice striking the tuning forks.

Procedure

1. Inform the students that when the water in their bowl is perfectly still, students in each group should take turns striking the tuning fork and very carefully placing the tips of the prongs in the water while the other group members observe what happens to the water. They should record their observations on their worksheets.
2. The students will take turns striking the tuning fork, listening to it, and recording their observations on their worksheets.
3. They will complete the handout by explaining how sound travels, what it is, and whether it exists in outer space.
4. Discuss with the students that when the tuning fork is struck, the prongs begin to vibrate. The vibrating prongs cause the surrounding air to vibrate. These vibrations are transmitted through the air from molecule to molecule until the air molecules near your eardrum vibrate and, in turn, cause your eardrum to vibrate.
5. Point out that the tuning fork vibrations also caused the water to vibrate (ripple) in every direction. The ripples are visible if the vibrations are strong enough. Remember, during this process, energy, not matter, is transferred. Sound waves are energy moving from one place to another through a medium, but the molecules of the medium — for example, the air or water molecules — do not move with the wave but merely vibrate to transfer the energy along.

Conclusion

1. Lead the class through a short discussion of what sound is and how it travels.
2. Have a representative from each group share some of their discoveries during the investigation.
3. Continue the discussion by turning to the issue of sound in outer space. Ask the students whether they could hear a spaceship explode in space. (No. In space, there is no medium through which sound vibrations can travel since space is a vacuum.) Include in this discussion the mention of movies that depict huge explosions in outer space. Should these fictional explosions be shown as silent?

Assessment

- **Questions**
  - How does sound travel? *(vibrations)*
  - What is sound? *(energy)*
  - What role does the water play in this experiment? *(provides a way to see the vibrations)*
  - Identify the variables in the investigation.
- **Journal/writing prompts**
  - How is sound made?
  - How does sound travel?
  - Explain how sound occurs.
- **Other**
  - Use the worksheet "Make Some Waves!" to assess student understanding of sound vibrations.

Extensions and Connections (for all students)

- Have each student place one finger gently in his/her ear. Strike the tuning fork on a soft object and touch the handle of it to each student's elbow. Sound vibrations will travel up the arm and be heard. (Note: If students are wearing thick clothing, such as a heavy sweater, this will not work very well.)
- Have students put an ear to a table. Strike the tuning fork on a soft object and gently touch the handle of the tuning fork to the table. The sound vibrations will travel through the table and be heard by the students.

Strategies for Differentiation

- Introduce pitch with a pitch instrument to show varying pitches (e.g., xylophone, recorder, piano).
- Complete a picture word sort with pitch instruments.
- Show the musical scale for Every Good Boy Does Fine and FACE.
- Model the variance in pitch through using your voice, playing an instrument, or creating variance in pitch using audio software. Explain the differences in pitch and how they occur.
- Have the music teacher reinforce pitch concepts with the students.
- Place a ruler on the desktop. Hold it with one hand and pluck the opposite end. Listen to the sound and watch the vibration of the ruler.
- Use a Venn diagram to compare and contrast two instruments and how they produce sound.

Make Some Waves!

Name: _____ Date: _____

PREDICT

What will happen if you strike the tuning fork and then place the tips of the prongs in the water?

_____

_____

CAUTION! Never strike a tuning fork on a hard surface, as this could damage the fork. Always strike it on a soft surface like the palm of your hand or your knee.

PROCEDURE

1. Strike the tuning fork gently on your palm or knee, and then hold it close to your ear. Do you hear a sound? _____If so, what is it like? _____

   What are the prongs doing?_____ What is the air around the prongs doing?_____ What is your eardrum doing?_____

2. Strike the tuning fork again, and place the tips of the prongs in the water.

   What happens? _____

   Why? _____

THINK

1. After seeing what happened in step 2 of your experiment, how do you think sound travels? _____

   _____

   _____

2. What do you think sound is? _____

   _____

APPLY YOUR KNOWLEDGE

1. Does sound exist in outer space? _____Why, or why not?_____

2. Could you hear a spaceship explode in outer space? _____Why, or why not?