Vibrations

Strand Force, Motion, and Energy

Topic Investigating vibrations as a back-and-forth motion and motion-causing force

Primary SOL 1.2 The student will investigate and understand that moving objects exhibit different kinds motions. Key concepts are
b) objects may vibrate and produce sound.

Related SOL 1.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which
d) simple tools are used to enhance observations;
e) length, mass, volume, and temperature are measured using nonstandard units;
g) a question is developed from one or more observations;
h) predictions are made based on patterns of observations;
j) simple investigations and experiments are conducted to answer questions.

1.2 The student will investigate and understand that moving objects exhibit different kinds motions. Key concepts are
a) objects may have straight, circular, and back-and-forth motions.

Background Information

Sound travels by vibrations, which are back-and-forth motions. The faster an item vibrates, the higher the pitch of the sound. The thinner an object (e.g., rubber band, guitar sting) is, the faster it will vibrate and the higher the pitch will be. (Pitch is not a vocabulary requirement for first grade.) Various widths of rubber bands stretched across an object, such as a square plastic food container or a plastic butter container, is an excellent way to demonstrate vibration and different pitches in sound.

Materials

- Ruler
- One round metal cake pan
- One small baking tray
- Wax paper
- Scissors
- Long, strong rubber band
- One tablespoon of sand
- Wooden spoon
- Exit Card (attached)

Vocabulary

back-and-forth motion, sound, vibration

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

Prior to this activity, create a "wax-paper drum" as follows. Center a round cake pan upside down on a sheet of wax paper, and trace around it. Cut a circle out of the wax paper that is larger than the pan by cutting about 1 inch *outside* the traced circle all the way around. Place the wax paper circle over the top of the *upright* cake pan, and fold the 1-inch edge down around the pan all the way around. Secure the paper edge in place by stretching the long, strong rubber band around the periphery of the pan, and pull the paper taut. Be careful not to tear the paper.

Introduction

1. Hold up a ruler, and ask students whether the ruler is making a sound.
2. Then, position the ruler on the edge of a table so that it is half on and half off the table. Hold the ruler on the table and press down on the half that is off the table and quickly release; this will cause a vibration and a sound.
3. Ask whether the ruler is making a sound. Tell students that this type of movement is called a *vibration*, which is a very fast back-and-forth motion.
4. Let several student volunteers make the ruler vibrate.

Procedure

1. Display the question, "Can we see motions caused by vibrations?" Record student responses.
2. Sprinkle a tablespoon of sand on the wax paper surface of the previously made "drum."
3. Measure in nonstandard units how wide the sand is spread out across the surface. Record this measurement on the board for students.
4. Hold the small baking tray directly above the drum but not touching it. Make sure students can see that the second pan is *not* touching the wax paper.
5. Use the wooden spoon to tap lightly on the pan above the drum. "What happens to the sand when I tap on the pan lightly?" (The sand dances, or moves up and down slightly, and also spreads outward a little.) "Why does the sand move?" (The wax paper moves up and down, or vibrates, which causes the sand to move.)
6. Next, tap sharply on the pan above the cake pan. "How does the movement of the sand compare to its first movement?" (It moves more, both up and down and outward.) "Why?" (The wax paper vibrates more.) Measure the width of the sand now, and compare this measurement to the first measurement. Point out that the sand not only danced up and down, it also spread out over a wider space.
7. Finally, ask students what causes the wax paper to move up and down. Lead them to understand that when you tap on the pan, vibrations (very fast back-and-forth motions) travel out into the air. We know this because we hear the sound made by these vibrations. But when these vibrations are close enough and strong enough, they not only make sound, they also make the paper move up and down, or vibrate, which makes the sand move, too. Therefore, we can *see* the effect of the vibrations on the sand, as well as hear the sound they make.

Assessment

- **Questions**
  - What is a vibration?
  - How did you "see" the effect of the sound vibrations?
  - Can a rubber band be used to make sounds? How? If the rubber band is not vibrating, does it make a sound? Is it the rubber band itself that makes the sound, or is it the *vibrations* of the rubber band?
- **Journal/Writing Prompts**
  - Draw a picture of this experiment. Try to include all that you saw.
  - Pretend you are a vibration. Tell how it feels to move back and forth very quickly through the air. What is it like to travel inside an ear?
  - What would the world be like if there were no sounds? How do sounds help us understand the world around us?
- **Other**
  - Take the class on a "Listening Walk." Make a list of various sounds heard at stops along the way. Have students share their findings on a class mural, showing what was vibrating to make the sounds.
  - Have students complete the attached Exit Card. (Note: Cards can be used for later review of the experiment, as well as to gauge students' understanding.)

Extensions and Connections (for all students)

- Invite an audiologist to the classroom to share with students how our hearing is tested and what can be done to help those who may not hear well.
- Tell students that many people who cannot hear at all learn to communicate through sign language. Teach the class simple signs they can use in place of speaking for several days, such as "Hello" or to ask to go to the restroom. Then, reflect on the experience.

Strategies for Differentiation

- Stand together with the students in a tight circle with shoulders almost touching. Tell them that you will be the cause of a "sound vibration" or sound *wave* that they can feel and see. Move gently to push on the shoulder of the student on your right, and tell this student to respond by pushing gently on the shoulder of the student on his/her right. As each student feels the nudge by the student to the left, he/she passes the motion on to the neighbor to the right. After the "vibration" or wave has gone all around the circle, explain you began the motion, and they kept it going through the "air." Demonstrate this several more times, moving to the left and then the right. Finally, have students imagine doing this very fast—right, left, right, left, right, left—to model real sound vibrations.
- Record loud and soft sounds along your walk to replay for students to practice differentiating between them.
- Using interactive software, have students work individually or in small groups to distinguish between loud and soft sounds.
- Have student volunteers demonstrate "inside voice" and "outside voice." Have the class identify which is a loud sound and which is a soft sound. Discuss what vibrates to cause the sound.

Exit Card

Name: _____ Date: _____

Draw an example of each sound from the experiment or the listening walk. Show what vibrates to cause each sound.

Loud Sound

Soft Sound

Which sounds do your ears like best? _____ Why? _____

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