SOUND AND MOTION

Performance Standard 12C/11B/13A.A

Students will apply the process of technological design to examine sound energy accordingly:

- *Knowledge*: Know that sound is produced by vibrating objects.
- *Application*: Demonstrate how a vibrating tuning fork can make sound and can cause another object to move and/or make sound.
- *Communication*: Explain how a vibrating object can cause another object to move or make sound.

Procedures

1. ***In order to know and apply concepts that describe properties of matter and energy and the interactions between them (12C), know and apply the concepts, principles and processes of technological design (11B) and know and apply the accepted practices of science (13A),*** students should experience sufficient learning opportunities to develop the following:
   - Identify various properties of sound.
   - Demonstrate how sound energy is produced by vibrating objects.
   - Propose ideas for testing this science concept.
   - Select, construct and test their design.
   - Communicate their results.
   - Apply appropriate principles of safety and scientific habits of mind.

   Note to teacher: This activity relates to knowledge associated with standard 12C, while addressing the performance descriptors for stage A within standard 11B. Applying scientific habits of mind noted in standard 13A are foundational to these activities.

   Safety note: To cause the tuning fork to vibrate, hold it loosely by the handle and strike it against a rubber object or strike it with a hard rubber object. Do not strike the tuning fork with or against any solid object other than rubber as the tuning fork can be chipped or dented causing a change in frequency from its listed frequency.
2. Provide each student a copy of the "Sound and Motion" task sheet. Have students review and discuss the assessment task and how the rubric will be used to evaluate their work.
3. Lead the students through each of the first three tasks. Ask the students to complete each item on the task sheet after you give them the following instructions. Do these demonstrations with small groups, if time permits.
   - Vibrate a tuning fork a 256cps which is the frequency of Middle C on a piano. Tell students to draw an arrow to the part of the tuning fork that moves the most when producing a sound. You may have to move around the room initially, letting students touch the tuning fork. Promote questioning about what happens if the tuning fork itself is touched in different places and how its volume can change. Students may ask to touch the vibrating tuning fork to different objects. If you touch it to a desk, ask the students to place an ear to the desk to hear the vibration.
   - (Demonstration by teacher first and then by student groups, if time permits.) Place a Styrofoam cup upright on a flat surface. Vibrate a tuning fork and <u>gently</u> touch it to the lip of the Styrofoam cup causing the cup to vibrate back and forth. The students should be encouraged to ask questions about variations in the placement of the tuning fork on the cup. "Was the tuning fork moving when it touched the cup? Circle YES or NO on your task sheet." "Explain why you thought it was moving."
   - (Demonstration by teacher first and then by student groups, if time permits.) Vibrate the tuning fork. Holding a Styrofoam cup horizontally in one hand, <u>gently</u> touch the tip of the tuning fork to the center of the outside bottom of the cup, causing the cup to produce a sound. Tell students to draw a line from the part of the tuning fork that caused the cup to make a sound. After the entire task sheet is done say, "explain how the cup made a sound."

4. In order to incorporate the challenge of technological design (as referenced from standard 11B), ask students to think of ways that they could test how sound energy travels. If specific materials (Styrofoam cups, plastic wrap, rubber bands, salt particles and tuning forks) are provided, the students are asked to design a way to determine how sound energy travels (technological design question). Encourage the students to collaboratively test for locating the sound using the given materials. A possible solution is to vibrate the tuning fork and hold it about 1/2 inch above some salt particles that have been sprinkled on plastic wrap that has been spread and held tightly

over the top of a Styrofoam cup by a rubber band. (See teachers' guide page.) Successful implementation of this procedure will cause the salt particles to jump up and down. Ask the students to diagram their technological design and label the parts. "Draw a circle around the name of the object that is the source of the energy that made the salt move." (You might want to write the words on the chalkboard and point to each one and say, for example, "was it the salt?") After the entire task sheet is done say "explain how the salt moved."

5. After the task sheet activity and the technological design activity are completed, ask students to orally explain their answers. Preferably, do this individually, but if time does not permit, do it in small groups or with the whole class.
   (1) Explain how you knew which part of the tuning fork was vibrating and how it makes sound.
   (2) Explain why you thought the tuning fork was moving when it touched the cup.
   (3) Explain how the cup made a sound when I brought the tuning fork near it.
   (4) Explain how the salt moved.
   (5) What are some other possibilities for how to test how sound travels?
6. Evaluate each student's work using the Science Rubric as follows and add the scores to determine the performance level:
   - *Knowledge*: The description and identification of the vibrating tuning fork making the objects move or make sound was complete and correct.
   - *Application*: The items on the task sheet were complete and correct and the diagram for their technological design was labeled correctly.
   - *Communication*: The explanations and sketches were thorough, well-reasoned, and well-detailed.

Examples of Student Work not available

Time Requirements

- 30-45 minutes

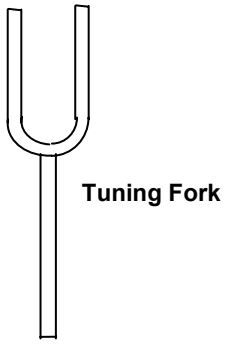
Resources

- Copies of "Sound and Motion" task sheet
- Classroom supply 8 ounce Styrofoam cups (1-2 per student or group)
- Classroom supply of plastic wrap (approximately 6-8 square inches per student or group)
- Classroom supplies of rubber bands to hold plastic wrap tightly on cup
- One tuning fork (256 cycles per second frequency) for each grouping of students
- Salt
- Science Rubric

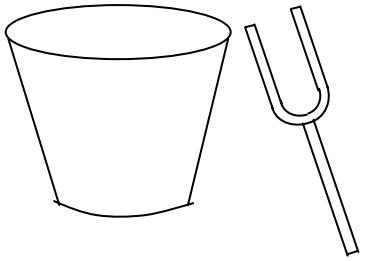
Name _____ Date _____

SOUND AND MOTION

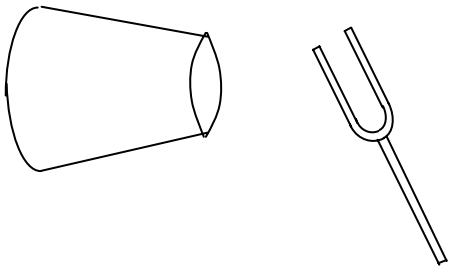
1. Draw an arrow. ⟶



2. Yes No



3. Draw a line.



SOUND AND MOTION – TEACHER'S GUIDE

1. After striking the tuning fork, which part of it was moving (vibrating)? (The tines were vibrating. If the tuning fork was a 'Middle C' tuning fork, it was vibrating 256 cycles per second. If it is held in the air, the sound energy is traveling through the air which is a less "efficient" media for sound transmission. If it is touched into a cup of water, the vibrations can be seen as concentric waves. If the tuning fork is touched to the student's desk, the sound energy is transferred to a solid (desk) and the sound is amplified.)

2. Was the tuning fork moving when it touched the cup? Circle yes or no (YES). (What differences were observed when the tuning fork was touched to different areas of the cup? The sound energy is transferred into the solid of the cup. Did the vibrations speed up or slow down? How can you tell?)

3. Draw a line on the diagram shown from the part of the tuning fork to the part of the cup that made the sound (from the tip of the tuning fork to the bottom of cup). (What observations could be recorded about the sound now? What if a different cup is used? What if two cups are put together?)

4. The technological design activity: Draw a circle around the name of the object that is the source of the energy that causes the salt to move (the tuning fork). (What other ideas could be tested to determine how sound travels?)