National Aeronautics and Space Administration

NASA

TEACHER ACTIVITY MANUAL

FEEL THE NOISE

In this activity, students use everyday metal objects and string to feel sound waves moving through different substances, or mediums. The activity demonstrates vibrations interacting with matter, building fundamentals for further learning about waves, energy and communications.

AGE	SIZE	COST	TIME
7-14	3-22 STUDENTS	<$10	15-30 MIN

LEARNING OBJECTIVES

NEXT GENERATION SCIENCE STANDARDS

Performance Expectation: 1-PS4-1

DCI: PS4.A: Wave Properties

Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1)

A sound wave needs a medium through which it is transmitted.

Performance Expectation: 1-PS4-1

DCI: PS4.C: Information Technologies and Instrumentation

People use a variety of devices to communicate (send and receive information) over long distances.

Performance Expectation: 1-LS1-1

DCI: LS1.D: Information Processing

Animals have body parts that capture and convey different kinds of information needed for growth and survival.

MATERIALS

1. String
2. Metal objects 6-12 inch long ('resonant bodies'): Serving spoons with textured patterns or holes in the handle are ideal
   - Serving forks
   - Tablespoons
   - Box wrenches
   - A wide variety of items work here!
3. Striker objects (hard plastic or wooden rulers work best)
4. Scissors

OPTIONAL

5. Data sheet, writing implements and clipboards *Data sheets on pg. 5.*
6. Wind chimes, bells or similar percussive/ resonant instrument

VOCABULARY

DATA: Important facts or information.

TRANSMIT: To send out or pass on information.

RECEIVE: To hear or 'catch' information.

WAVE: A moving disturbance that transfers energy from one place to another.

VIBRATION: A repeated motion, whether back-and-forth, side-to-side or up-and-down.

MEDIUM: The stuff (matter) that a wave moves through.

WAVELENGTH: The distance between the crest of one wave and the crest of the next.

FREQUENCY: The number of complete waves that pass a given point in a certain amount of time.

ATMOSPHERE: The literal ball of air that is drawn to Earth's surface by gravity.

VACUUM: Empty space with nothing in it.

CORE TAKEAWAYS

- Waves are energy moving through space.
- Sound is a kind of wave that needs matter – 'stuff' – to move through. Without matter, there can be no sound.
- Different types, shapes and sizes of matter interact with sound waves differently. Even applying tension to matter can have an impact.
- Not all waves need matter to move through. Light waves can move through the vacuum of space!

INSTRUCTIONS

FIRST: Demonstrate a wind chime's behavior when hanging freely on a string and compare it to the wind chime's behavior when held firmly (i.e. muffled/dampened). Explain the difference.

1

1. Divide the students into groups of three. Distribute a few metal objects to each group (the wider the variety in size, the better.)
2. Distribute a data sheet to each group. Instruct students to take turns rotating between three roles.

2

Demonstrate the procedure to the entire class:

1. If the objects do not already have strings attached, show the students the right way to tie them on. Make sure the knots are snug for best results.
2. Show that the listener should lean forward slightly so that the object dangles free and is not muffled. *Diagram on pg. 5.*

1. Have a volunteer student tap the dangling object with a striking instrument. Depending on how much independent vs. guided exploration you want, you may hint that hitting harder doesn't always equal louder.
2. Ask the students how it sounded (with air as the medium, it should simply make a faint 'tink').
3. Show how to hold the loose ends of the string to the outside of their ears, pressing the string to the tragus and gently pressing the tragus over the opening of the ear.
   See diagram on pg. 5.
4. With the strings now conveying more vibrations to the ear, have the student strike the object again. Compare the sound as perceived by the listener.

3

Have the students experiment and record their observations. Put away the items; discuss and have the students explain their observations.
Discussion prompts on pg. 4.

ROLES

Striker:
The striker will use the striking instrument (ruler, etc.) to tap the metal object while it is hanging from the listener's ears.

Listener:
The listener will be listening to the sound from the object and reporting their results to the recorder.

Recorder:
The recorder will write down the results gathered by the group.

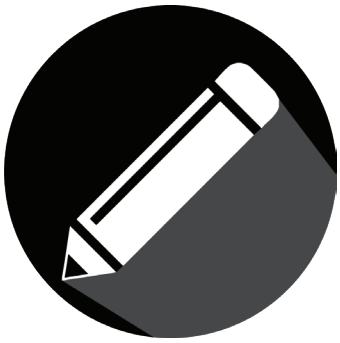
WARNINGS

- *Ensure that none of your metal resonant bodies have sharp edges, and avoid using any object heavy enough to cause damage if dropped on a foot.*
- ***During the activity, emphasize that students should not be placing anything inside the ear canal.***

ASSESSMENT

DISCUSS

- What happens when students strike an object that is held in a hand rather than suspended by a string? What makes the difference in sound?
- What are some other examples of sound traveling through a medium other than air? Would it be possible to communicate like this?
- How can NASA communicate in outer space, where there is no air outside the space station?



DRAW

- Have students draw a 3-part diagram explaining the movement of waves through a medium.

SHOW

- Play slow-motion videos of plucked instruments like an upright bass. How is the movement of the string making noise?

TIPS, TRICKS & FURTHER INVESTIGATION...

- Experiment with different types of string: yarn, cotton string, thread, fine wire, monofilament (fishing line)
- Experiment with different types of metals (copper vs. aluminum pipes)
- Experiment with different lengths of string
- Experiment with different shapes of resonant bodies: bars, tubes, forks, etc.

DIVING DEEPER

- Encourage your students to listen next time they are underwater in a bathtub or a pool. How do noises sound different in air vs. water? Research the transmission speeds of sound in water, air and ice. *(Any immersion in water should be done with adult supervision.)*
- Explore how tension and elasticity play into the transmission of sound waves. Make a 'tin can telephone' and experiment with different levels of tautness in the string. Demonstrate how a completely slack rope will not transmit waves from one end to the other, while a taut rope conveys vibrations along its entire length.
- For more activities related to waves and communications, visit:

esc.gsfc.nasa.gov and ***nasa.gov/SCaN***

DATA SHEETS

7-11 YEARS

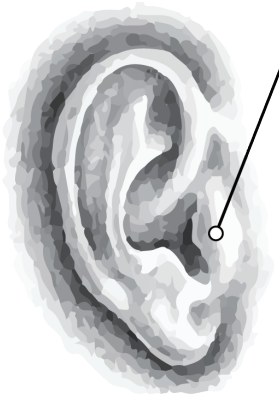
OBJECT	HOW DOES IT SOUND WHEN HELD IN YOUR FINGERS?	HOW DOES IT SOUND WHEN HANGING ON A STRING?	HOW DOES IT SOUND WHEN STRING IS PRESSED TO YOUR EARS?
Small *(key, nail)*			
Medium *(teaspoon, small wrench)*			
Large *(serving spoon)*			

10-14 YEARS

	COTTON STRING		WIRE	
OBJECT	HOW DOES IT SOUND HANGING ON A STRING?	HOW DOES IT SOUND WHEN THE STRING IS PRESSED TO YOUR EAR?	HOW DOES IT SOUND HANGING ON A STRING?	HOW DOES IT SOUND WHEN THE STRING IS PRESSED TO YOUR EAR?
Tiny *(paper clip)*				
Small *(key, nail)*				
Medium *(teaspoon, small wrench)*				
Large *(serving spoon)*				
Extra Large* *(12"+ wind chime, wrench)*				

*Before allowing students to experiment, the teacher should test anything larger than a serving spoon to ensure safety and prevent hearing damage.

DIAGRAMS



TRAGUS

Place string here.

GOOD VIBRATIONS

Ensure neither string nor object are resting against anything which could absorb or dampen the vibrations.

EXPLORATION AND SPACE COMMUNICATIONS PROJECTS DIVISION
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