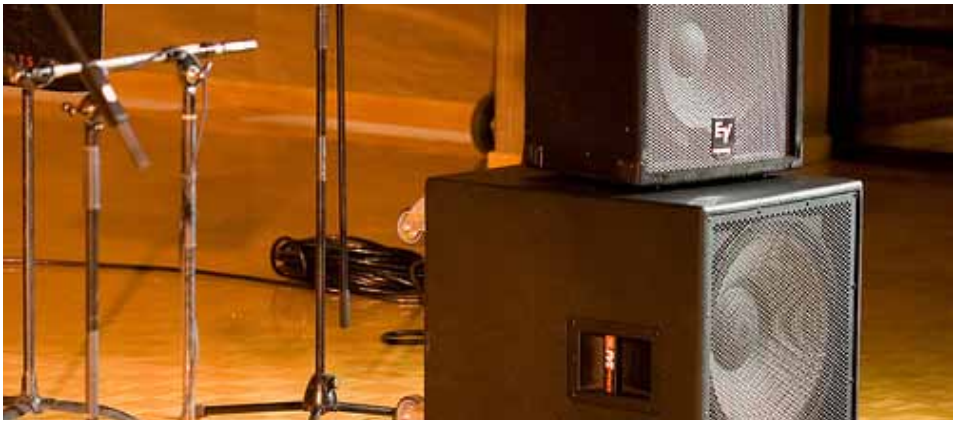
EXHIBIT: **VISUALIZING SOUND**

ACTIVITY: # Exploring Sound

How does sound travel? How can we "see" sound?



DISCOVER

Students will explore three stations, each of which demonstrates different properties of sound. The "big ideas" of each station are: 1) force affects sound waves; 2) sound waves have certain characteristics; 3) sound travels differently in liquids, solids, and gases.

MATERIALS

- 1 metal or plastic container (any shape or size)
- Plastic wrap (enough to cover the top of the tin or container)
- 2-3 teaspoons of sand
- 1 plastic lid (any size)
- 1 plastic spoon
- 1 rubber band (big enough to fit around the edge of the tin or container)
- 1 Slinky
- 1 meter stick or tape measure
- Music box (or cell phone with a musical ringtone or anything that makes noise)
- 2 sandwich zip lock bags
- Towel (optional, just in case)
- 2 pan lids or other pieces of metal
- 1 metal spoon
- Student worksheets (attached)
- Worksheet answer key (attached)

PREPARE

1. Make copies of the student worksheet (attached) or create your own.
2. Prepare station 1: Force & volume
   a. Cover the container with the plastic wrap and secure it with a rubber band.
   b. Put the sand on top of the plastic wrap.

Grades: 2nd-9th

Group Size: 10-30 students in 3 groups of 3-10 students each.

Time: 45 minutes (10 minutes at each station, plus a short introduction and concluding discussion)

Utah Core Curriculum:

- 6th Science 6.3 a, c
- 8th Science 4.1 a, b, c
- Physics 4; 5.1 a, f

Process Skills & Higher Level Thinking Skills:

- Hypothesizing
- Investigating
- Communicating
- Observing
- Questioning

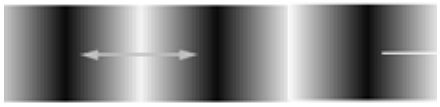
Related Activities/ Exhibits:

- The Leo on Wheels Voice Print & Whisper Dishes
- Digital Commons Sound Booth
- Materials Science

WHAT'S GOING ON?

Wave Types

There are two main types of waves: longitudinal and transverse. Sound waves are longitudinal waves, as illustrated by the Slinky. Another example of longitudinal waves is seismic primary waves (P-waves).



Sound moves through longitudinal or compression waves, with the vibration in the same direction as the travel.

Examples of transverse waves (up and down movement perpendicular to the direction of energy) are electromagnetic waves (light) and seismic secondary waves (S-waves). Moving a rope up and down creates transverse waves.

Light moves through transverse waves; the oscillations are perpendicular to the direction of travel.

Wave Characteristics

- The **crest** of the wave is where the particles are crowded, or compressed.
- The **trough** of the wave is where the particles are less crowded.
- **Amplitude** is the distance the wave oscillates (the size of the wave).

c. Place the metal spoon, one of the metal lids, the plastic spoon, and the plastic lid next to the tin or container.

3. Prepare station 2: Wave characteristics
   a. No preparation needed. You will be using the Slinky and meter stick or measuring tape.
4. Prepare station 3: Transfer of sound through various objects
   a. Fill the zip lock bag water water. (you may want to double-bag it so it doesn't leak). Have a towel close by in case it leaks.
   b. Set out the music box, metal lid, and drinking glass.
   c. Print the sound speed chart or prepare it to display on a projector.

PONDER

- How does sound travel?
- What professions need to know how sound travels through various materials?
- Is there sound in outer space? Why or why not?
- Do animals hear sound the same as humans?

EXPERIMENT

Divide the students into three groups and assign them each a station to begin with. Each group should spend about 10 minutes at each station.

Station 1: Force & volume

1. Beat the metal lid with the metal spoon very softly close to the tin. Notice the sound and enter your observations on the worksheet.
2. Beat the metal lid with the metal spoon very hard close to the tin. Notice the sound and enter your observations on the worksheet.
3. Do the same with the plastic lid and spoon. Record what you notice on the worksheet.

Station 2: Wave characteristics

1. Two students should extend the Slinky 120 cm (~48"). While one student holds one end still, the other should push their end at 2-second intervals. Record what you notice.
2. Two students should extend the Slinky 30 cm (12") While one student holds one end still, the other should push their end at 2-second intervals. Record what you notice.

- **Frequency** is the number of waves in a certain time period.
- **Period** is the time of one cycle, or wavelength.
- A **wavelength** is the distance between a point on the first wave and the same point on the second.

Station 1: Force & volume

Sound waves are caused by matter's vibration. The greater the force, the greater the wave amplitude, the more the object vibrates, and the louder the sound. Volume is the amount of sound energy reaching your ears.

Station 2: Wave characteristics

The shorter the space, the more the waves were compressed. The waves also moved out from the vibration source - your hand. See the definitions and diagram above and on the previous page for more information on specific wave characteristics.

Station 3: Transfer of sound through various objects

Sound travels through moving particles. If there are no particles, there is no sound, so there is no sound in outer space. In hard, solid materials, sound waves can move very fast because the particles in solids are close together and bump into each other often. In liquid, sound waves don't move as fast as in solids, because the particles are farther apart and don't bump into each other as much. In gas (air), sound waves move even more slowly because the particles in gas are farther apart and don't bump into each other very often.

Station 3: Transfer of sound through objects

1. Play the music box in the air, about 3" from your ear.
2. Put the plastic bag of water next to your ear. Have a friend place the music box against the other side of the plastic bag and play the music.
3. Put the metal lid next to your ear. Have a friend place the music box against the other side of the metal and play the music.
4. Record the differences in sound on your worksheet.
5. Look at the sound speed chart. Through which medium does sound travel the fastest? The slowest?

Reflection

Have the students discuss what they have learned about sound. Encourage them to share ideas of how these principles might be applied to other subjects (music, architecture, etc.) and share questions they have about how sound travels. This discussion can take place in small groups, with the whole class, or as a writing assignment.

EXPAND

Newton's Laws: The characteristics of sound waves can be related to Newton's laws of motion. The principles that govern forces and movement also govern the behavior of sound.

Acoustics: When designing rooms and buildings, architects and engineers take into account the principles of sound and use materials that will create the desired effects. For example, a concert hall is designed specifically to amplify sound while a library or classroom may be designed to muffle sound.

Animals: Different animals perceive sound in different ways. You may want to discuss these differences with your students.

Communicating: Discuss how technology enhances our hearing. Talk about how different communication methods work (cell phones, satellites, etc.) as well as how hearing aids, speakers, and ear plugs can help us.