THE SCIENCE OF SOUND

Est. Time: 60-90 minutes
Subjects: Science
Age Range: Middle School
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TEACHROCK

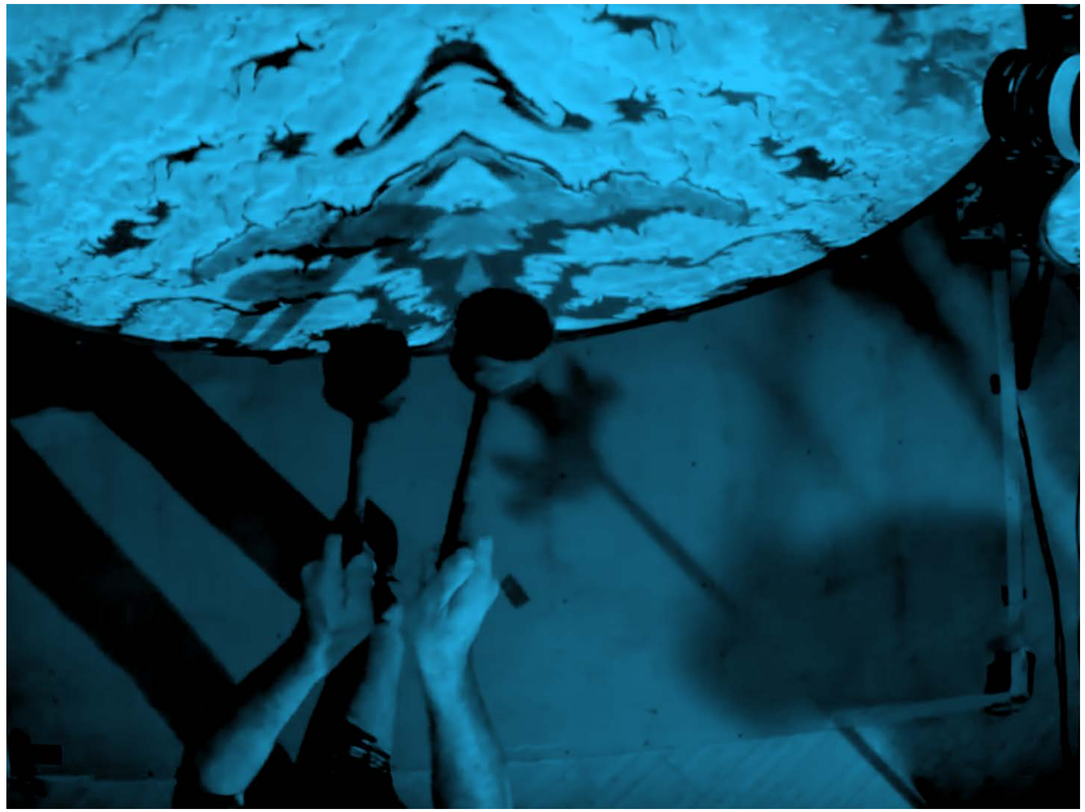
What is sound, and how are its characteristics explained scientifically?

In this lesson you will:

- Examine the science of sound as a phenomenon
- Explore the physical properties and behavior of sound waves
- Identify the difference between longitudinal and transverse waves
- Explore the role of compression and rarefaction in wave mechanics

Materials needed for this lesson:

- 2 medium sized bowls
- Plastic wrap
- A metal coil, such as a Slinky
- 1 cup of sugar, salt, or sand
- A tuning fork (the larger the better)
- A large baking pan
- A large wooden spoon
- Water
- A small piece of string or yarn



Watch **this video** showcasing musicians playing in percussionist Mickey Hart's band. Pay close attention to the instruments in the video and the ways they are performed.

Create a list of the instruments featured in the video and describe how each instrument is “activated” (played). Then consider or ask a partner:

- How are these instruments being “activated” to produce sound? Were they all “activated” in the same way, or a different way?

- Using physics or motion, how could you describe how each instrument is “activated” to make sound?

After reading the definition of “sound” and reviewing your instrument list with descriptions, consider or ask a partner:

- How did each of the instruments create vibration?

If needed, watch the* **Mickey Hart band video *again.*

SOUND

Vibrations that travel through the air or another medium and can be perceived by the ear.

To better understand the science of sound, you first have to understand the physical principles of sound.

Examine **this handout**, and take notes on it as you conduct the following activities.

SOUND

Vibrations that travel through the air or another medium and can be perceived by the ear.

Now, follow the instructions in these three handouts to conduct “Science of Sound” activities and answer questions:

- **Coil Spring Wave Simulation**
- **Drum/Vibrating Membrane Activity**
- **Tuning Fork and Water Activity**

If you do not have the materials needed for these activities, you can watch video demonstrations here:

- **Coil Spring Wave Simulation**
- **Drum/Vibrating Membrane Activity**
- **Tuning Fork and Water Activity**

With the answers you gave for the handout questions in mind, consider or ask a partner:

- What do you think these activities say about the nature of sound waves, or waves in general?

- Now that you've seen waves in operation, what might be some ways to measure waves? What variables exist that change the effects of sound waves?

Summarize what you learned from the “Science of Sound” activities using the **Longitudinal Vs. Transverse Wave Graphic Organizer handout**.

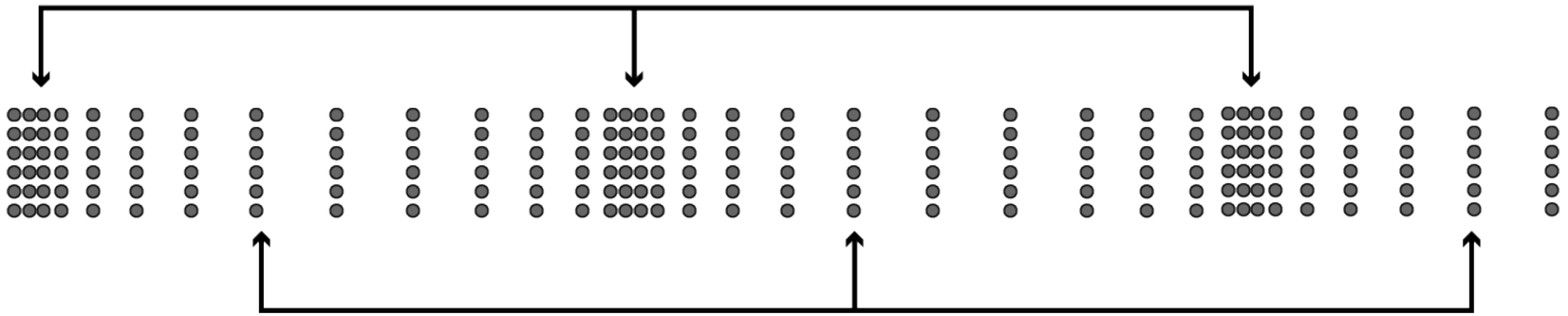
Jot down notes in the organizer as you learn more about the science of sound.

Sound waves operate as longitudinal waves, with characteristics you observed in the “Science of Sound” activities.

Examine the image below from the handout. Consider or ask a partner:

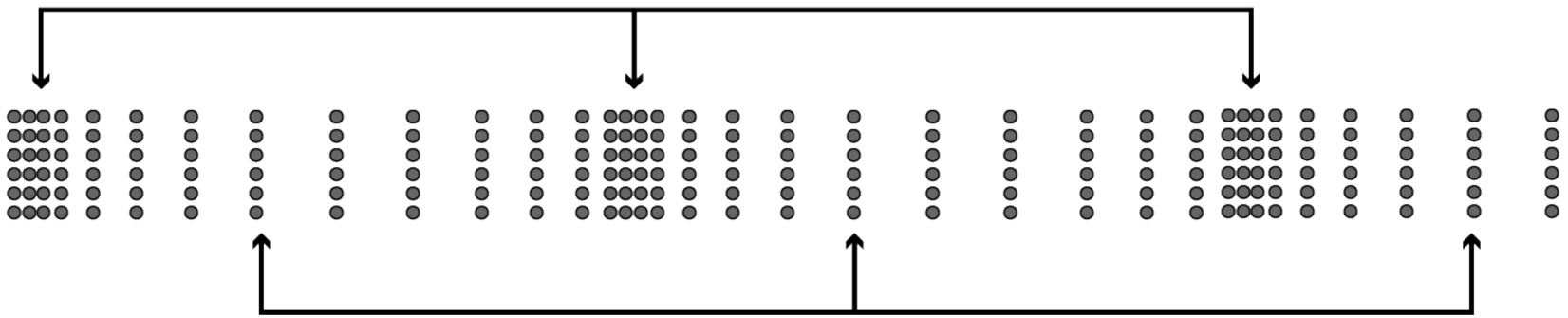
- When striking the bowl rhythmically, what did you notice about the sugar/salt/sand? Did the sugar/salt/sand continuously move in one direction, or did it move back and forth?

- At what point were the sugar/salt/sand grains close together, and at what point were they separated?



As you observed when conducting the earlier “Science of Sound” activities, the sugar/salt/sand reacts in a similar way as air molecules react when producing sound waves.

Like the sugar/salt/sand moving up and down, air molecules are not pushed out at a constant rate, but “pumped” according to how rapidly the material is vibrating.

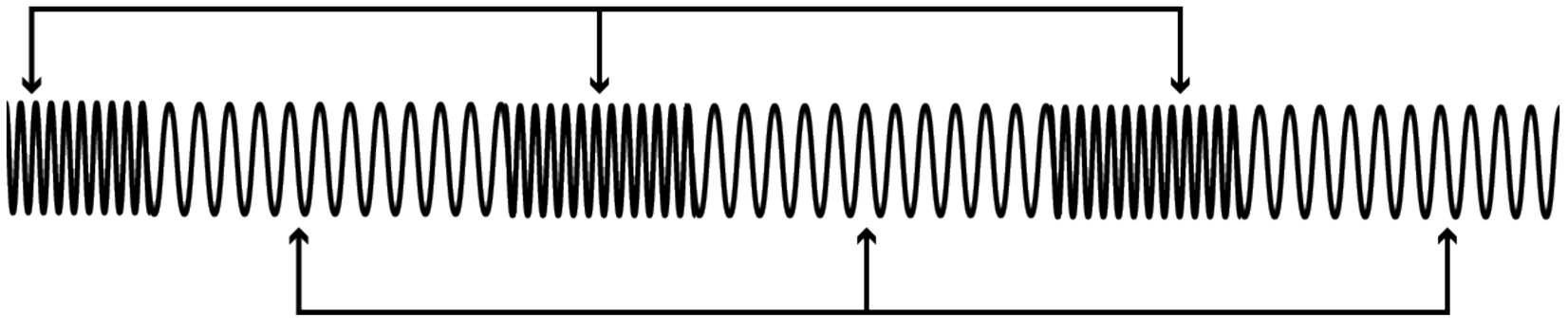


Examine the image below from the handout. Consider or ask a partner:

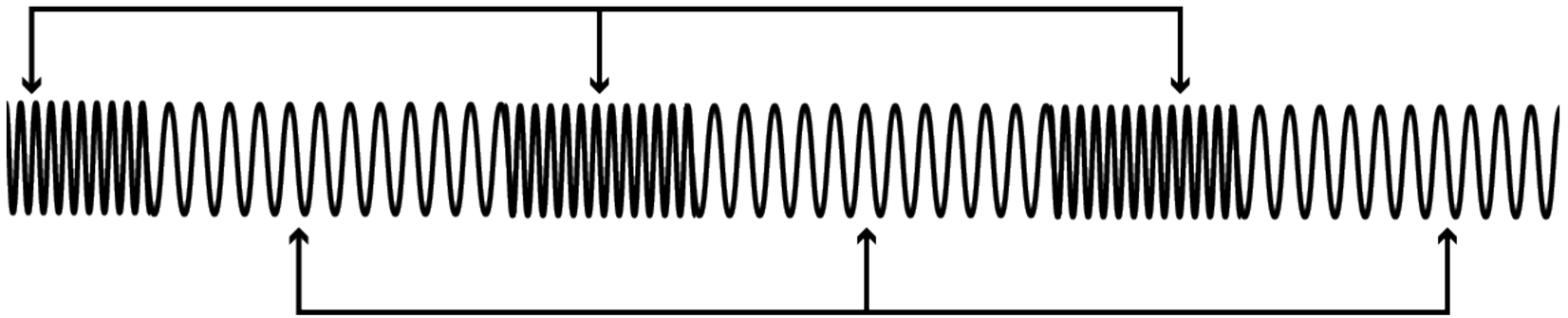
- Is the image similar to what you observed when doing the coil activity?

Much like the sugar/salt/sand in the membrane activity and air molecules in a sound wave, the coils in the coil expanded and contracted. The point at which the coils are farthest apart is called rarefaction. When the coils are closest together, it is called compression.

Now, label the moments of compression and rarefaction in Figures 1 and 2 on the graphic organizer.



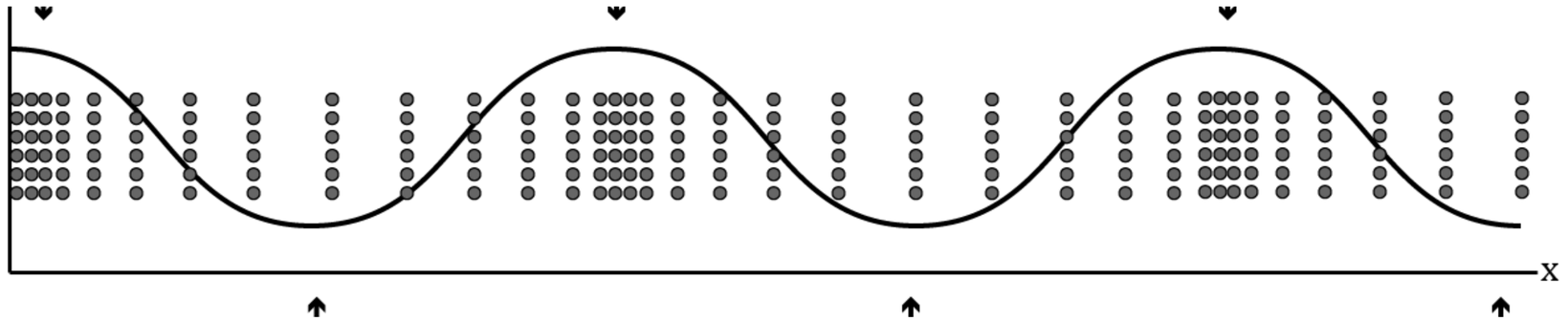
The coil activity revealed another characteristic of longitudinal waves: that the molecules move in parallel with the energy source. The piece of string in the middle of the coil moved in parallel with the energy source (the energy source was the participant's moving hand).



Examine the image above from the handout.

The **longitudinal** waves produced by the tuning fork created **transverse** waves. Transverse waves move perpendicular to the energy source. The classic example of transverse waves are water waves, which move up and down. When the tuning fork was placed in the water, ripples appeared.

While longitudinal waves operate differently than transverse waves, they are mathematically represented as transverse waves. Modeling longitudinal waves like this makes it easy to mathematically represent the measurable variables of any wave.



SUMMARY

- **Sound** is defined as vibrations that travel through the air or another medium and can be perceived by the ear
- **Rarefaction** is when soundwaves are farthest apart
- **Compression** is when they are closest together
- Sound waves operate as **longitudinal waves** but they are mathematically represented as **transverse waves** due to the practicality of measuring soundwaves in an “up/down” motion

BE CREATIVE

Watch **this video about Mickey Hart's paintings**. Notice he creates his paintings using sound!

Create your own work of art (a painting, drawing, writing, music, etc.) inspired by sound. It doesn't have to be created "using" sound like Mickey Hart does. It can be inspired by all sorts of sounds, like the sounds of nature (wind blowing, thunder claps), the sounds of human-made technology, or maybe the sound of a conversation with a friend.

Share your work or art with a partner, your class, or TeachRock!

BE CURIOUS

Explore the **Ancient Theories of Sound handout**. Write a paragraph or two summarizing the handout.

CONNECT

Share it with us! Either you or an adult in your life can share your work with TeachRock on **Instagram** or **Facebook**, email to **info@teachrock.org**, or Tweet it to **@TeachRock**

Visit us at **teachrock.org** for hundreds of other free arts-rich resources for every age range and classroom.

Please check back to **teachrock.org/distancelearning** frequently as we will update the material weekly!