Unit 1: Sound Waves
8th Grade Science

12 Class Meetings
Revised May 2024

Essential Questions

- How can sound make something move?

Enduring Understandings with Unit Goals

EU 1: A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.
- Apply the simple mathematical wave model to a physical system or phenomenon to identify how the wave model characteristics correspond with physical observations.
- Calculate that the energy of the wave is proportional to the square of the amplitude.
- Describe that the amount of energy transferred by waves in a given time is proportional to frequency.

EU 2: A sound wave needs a medium through which it is transmitted.
- Investigate and develop a logical conclusion based on evidence for how waves interact with surrounding matter.
- Investigate and develop a logical conclusion based on evidence for how waves affect objects at a distance.

Standards

Next Generation Science Standards:
- **MS-PS4-1:** Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
- **MS-PS4-2:** Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

Common Core State Standards:
- **CCSS.MATH.8.F.B.5:** Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.
- **CCSS.MATH.8.F.A.2:** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
- **CCSS.MATH.6.RP.A.2:** Understand the concept of a unit rate a/b associated with a ratio a:b with b $\neq 0$, and use rate language in the context of a ratio relationship.
- **CCSS.MATH.6.SP.B.5:** Summarize numerical data sets in relation to their context.
- **CCSS.MATH.7.RP.A.2:** Recognize and represent proportional relationships between quantities.
- **CCSS.MATH.8.F.A.3:** Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.
- **CCSS.ELA-LITERACY.RST.6-8.1:** Cite specific textual evidence to support analysis of science and technical texts.
- **CCSS.ELA-LITERACY.RST.6-8.1:** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- **CCSS.ELA-LITERACY.RST.6-8.9:** Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

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ISAAC Vision of the Graduate Competencies

Competency 1: Write effectively for a variety of purposes.
Competency 2: Speak to diverse audiences in an accountable manner.
Competency 3: Develop the behaviors needed to interact and contribute with others on a team.
Competency 4: Analyze and solve problems independently and collaboratively.
Competency 5: Be responsible, creative, and empathetic members of the community.

Unit Content Overview

1. **Objects vibrate when they make sounds.**
   - Determine that patterns of differences in vibrations are tied to differences in characteristics of the sounds being made.

2. **Characteristics of sound waves.**
   - Gather data on how objects vibrate when making difference sounds.
   - Characterize how a vibrating object's motion is tied to the loudness and pitch of the sounds they make.

3. **Sound needs matter to travel.**
   - Conduct experiments to support the idea that sound needs matter to travel through.
   - Use models and simulations to explain how sound travels through matter at the particle level.

Interdisciplinary Connection:

- Language Arts- Students compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. Students cite specific evidence to draw conclusions about the properties of sound waves.
- Math- Students collect and analyze data in the form of distance vs. time graphs showing the motion of a vibrating stick over time. Students characterize the shape of these graphs as wave patterns, and describe differences in properties. Students discuss and use mathematical methods of finding the average of data sets, including calculating mean and median. Students use data to describe and graph functions that represent the relationships between energy and frequency and energy and amplitude.

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Daily Learning Objectives with *TWPS*

Students will be able to…

- Develop a model to explain how a sound source can make another object move. Ask questions about the patterns in observations that can be investigated to figure out how sound travels and causes movement in other objects.
  - *Students create a T-chart in their science notebooks to record what they notice and wonder about in the video the class will be watching together. Discuss their observations.*
- Analyze and interpret data to identify patterns in the motion/vibration of an instrument. Develop a model to describe how a force applied to an instrument causes its shape to change, leading it to repeatedly deform above and below its initial position.
  - *How do you think sound sources like instruments and speakers make all those different sounds? What would you expect to see if you looked closely at these sound sources while they are making sounds?*
- Use mathematical representations of position vs time graphs to describe wave patterns and support scientific conclusions about how objects move when they make louder or softer sounds.
  - *Demonstrate the motion detector with a student. Why does the graph have the shape it does? What do you think the graph would look like if the student walked away more slowly from the motion detector? What do you think the graph would look like if a student walked toward the motion detector instead of away?*
- Use mathematical representations of position vs time graphs to describe wave patterns and support scientific conclusions about how objects move when they make higher-pitch and lower-pitch sounds.
  - *Take a moment to play the small music boxes at your table. What do you notice about the instrument? Other than loudness, how else can sounds be different?*
- Construct an argument using evidence from graphs that patterns of frequency and amplitude are characteristics of sounds that we can hear.
  - *Analyze a distance vs time graph for a harp string playing a music note. What is the graph communicating to you?*
- Demonstrate mastery of the unit goals so far. (Mid-Unit Quiz)
- Use evidence from investigations to compare and critique competing claims and argue that something (medium) is needed to hear sound or move an object at a distance.
  - *Air is not moving all the way from the sound source to our ears. If the air isn't moving, then what is moving?*
- Develop and use a model to describe how sound is traveling through a solid, liquid, or gas.
  - *Draw an initial model of different states of matter after sound has moved through it. Explain your model to your partner.*
- Apply data from a simulation model to determine how changing the frequency and amplitude of the sound source affects the patterns in wavelength and particle compression as energy moves across a medium.
  - *How might using a computer simulation help us better visualize and understand what*

exactly is traveling across the medium when sound is produced from a sound source?

- Critically read scientific texts to describe what goes on in people's ears so they can detect certain sounds.
  - *Watch a video of an otoscope ear exam. What did you notice during this video? What structures in the ear remind you of anything we've already investigated?*
- Apply mathematical concepts to analyze patterns in data and graphs used to determine which transfers more energy, waves of bigger amplitude or waves of greater frequency.
  - *(1) Why might louder sounds do more damage than quieter sounds? Why would they transfer more energy? (2) Why might high-pitched sounds do more damage than low-pitched sounds? Why would they transfer more energy?*
- Demonstrate mastery of the unit goals. (Unit task following last lesson's investigation. End of unit assessment)

Instructional Strategies/Differentiated Instruction

- Whole group instruction
- Guided notes
- Student-led instruction
- Independent problem-solving
- Collaborative problem-solving
- Graphic Organizers
- Cross-curricular problem solving (independent and collaborative)
- Accountable Talk
- Homework
- Word walls with visuals
- Small group instruction
- Investigations/labs

EL Differentiated Instruction:

- Sentence starters
- Simplified directions
- Prompting and questioning
- Alternate responses when needed
- Explicit modeling
- Key vocabulary
- Visuals
- Graphic organizers
- KWL charts
- Venn diagram
- Glossary

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Assessments

FORMATIVE ASSESSMENTS:

- Do Now
- Notebook checks
- Mid-class check-ins
- Exit Slips
- Accountable Talk Discussions- TWPS
- Homework
- NGSS Interim Assessment

SUMMATIVE ASSESSMENTS:

- Quiz – EU 1 & EU 2
- Unit Task- Following lab investigation- How does the energy of a vibration change when we change the amplitude or frequency of the vibration?
- Unit Test

Unit Task

Unit Task Name: The Sonic Fire Extinguisher

Description: Students will watch a video of an invention called a "sonic fire extinguisher". Students are asked to simulate the work of the inventors by first filling in a data set using what they learned from the lab investigation to figure out what kind of sound would transfer enough energy to put out fires (EU 1). Students will identify patterns in how the energy of a vibration changes when we change the amplitude or frequency of the vibration (EU 2). Students will then construct an explanation for how they selected the numbers they filled in the data table with. Lastly, using the evidence from the sets of data, as well as the patterns they saw in the lab investigation they did, students will make a claim, evidence, reasoning response to answer the question: *Which type of sound do you think would be best to transfer enough energy to put out a fire, a louder sound or a higher-pitch sound?*

Evaluation: Problem Solving Rubric and claim, evidence, reasoning response rubric

Unit Resources

- Open Sci Ed unit resources
- Science notebooks
- Laptops
- NGSS Interim Assessments