LESSON 3 | Understanding Sound

Objective
Students will use mathematical representations (graphs) to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.

Time
45–60 minutes (over two class periods)

Materials
- Tuning fork, glass bowl full of water
- Be a Sound Detective! activity sheet

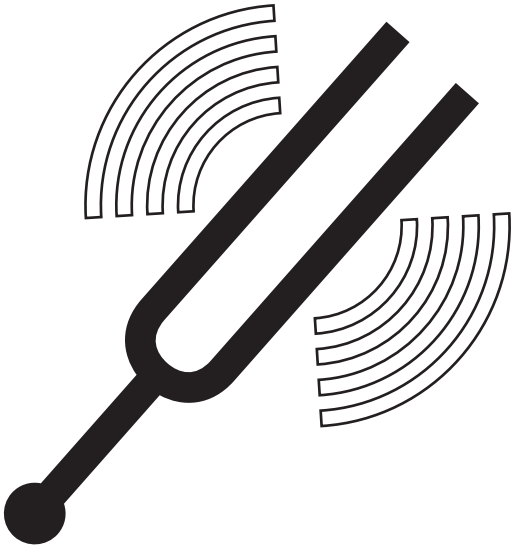
Extension Material
- This lesson is part of the "Science in Action" program. You can implement the lessons as standalone experiments or use them sequentially. Elevate experiments by using Google's free Science Journal app on classroom tablets or Chromebooks to measure and record observations; experiment data will be stored on Google Drive so you can access it across devices. To get more info and to download the app, go to **sciencejournal.withgoogle.com**.

Instructions
1 Place a glass bowl full of water on a table. Hit a tuning fork to make a sound and place the prongs into the water. Have students observe what happens. What does that tell them about sound? Explain that sound is a vibration that can travel through air and water.

2 Draw a model of a simple wave on the board. Label the different properties of the wave, including amplitude (wave height), wavelength (distance between two wave peaks), and frequency (how often the wave repeats in a certain time; the higher the frequency, the shorter the wavelength). Ask for volunteers to draw a wave model that has a higher amplitude than your sound wave, and one that has a shorter wavelength. Explain that the properties of a sound wave affect what you hear. A wave with a high amplitude sounds loud, like a vacuum cleaner or car engine. High-pitched sounds, like a mouse's squeak, are made by waves with short wavelengths and high frequencies.

3 Explain that students will conduct observations of everyday sounds they hear at school (e.g., lunchroom conversations, lockers slamming shut, music played on their headphones, crowded hallways between classes, whispering in class, etc.). Hand out the activity sheet and have students complete it in class or as homework.

4 In the next class period, discuss the students' observations. Explain that studies have shown that exposure to sounds with a loudness level of 85 decibels or more can cause hearing damage. Were they exposed to any dangerous sounds during the day?

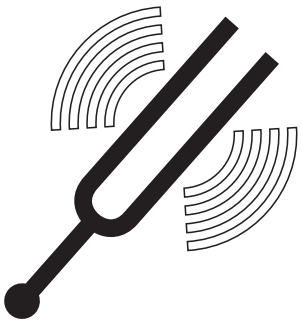


5 Have students consider what they've learned about the properties of sound and think about why loud sounds can be hazardous to your ears. Direct them to write a 50- to 100-word explanation and turn it in. (Answer: Loud sounds are made by high-amplitude waves, which can cause damage by strongly vibrating structures in the ear.)

Science Journal Extension

After students conduct their own observations, have them use the Sound Intensity and Pitch tools in the Science Journal app to collect accurate measurements of the pitch and loudness of the same sounds at school. How do their results compare with their observations?

Name _____



Be a Sound Detective!

Write observations about everyday sounds you hear at school.

Step 1 Estimate the decibel level of each sound, using the chart at the bottom as a guide. Is it loud or soft? High- or low-pitched?

Step 2 Draw a model of a wave that could represent each sound. Your sketches should reflect how the wave shapes of each observed sound would compare to one another.

WHAT I HEAR	ESTIMATED DECIBEL	WAVE MODEL

How Loud Are Common Sounds?

SOUND	DECIBELS
Rustling leaves	20
Bird calls	44
Restaurant conversation	60
Vacuum cleaner	70

SOUND	DECIBELS
Car driving at 65 mph	77
Garbage disposal	95
Rock concert	110
Ambulance siren	120