GENERATIONGENIUS
ALWAYS QUESTION. ALWAYS WONDER.

TEACHER GUIDE

WAVE REFLECTION, ABSORPTION, AND TRANSMITTANCE • GRADES 6–8

COMMON MISCONCEPTIONS

- **Sound waves are visible.**
  Sound waves are not visible because waves move energy, not matter. However, some students believe sound waves are visible because they can vibrate in matter causing them to move. Examples of this are visible vibrations in water or glass breaking from high-pitch sounds.

- **All visible light has the same wavelength.**
  Each color of light has a specific wavelength. White light contains all colors and when the visible wavelength is reflected, that color is seen. For example, when all other colors are transmitted and green is reflected, the eye sees the visible wavelength of green, and the leaf appears the color it is.

- **Not all waves have all properties.**
  All waves have the properties of amplitude, wavelength, and frequency. Sometimes the amplitude of a sound wave is so low that the sound wave cannot be heard, but the wave still exists. All waves can be described using their properties as wavelength and frequency combine to determine the color of light waves.

PROPERTIES OF WAVES

Waves are repeating patterns of motion that transfer energy from one place to another. All waves have properties of amplitude, wavelength, and frequency. Amplitude is the height of the wave from its resting point, and higher amplitude light waves are brighter. Similarly, higher amplitude sound waves are louder. Wavelength is the length of one wave. Frequency is how many waves occur in 1 second. The combination of wavelength and frequency of light waves are what make up color.

ABSORPTION, REFLECTION, AND TRANSMITTANCE

Sound waves need matter to travel through, but light waves do not. Waves can be absorbed, reflected by, or transmitted through matter, including solids, liquids, and gases. When light waves pass through matter, such as water, some colors are transmitted while others are absorbed. This is the reason your eyes can see a green leaf—white light is hitting the leaf, green is being transmitted, and all other colors are being absorbed. When sound is absorbed, the amplitude of the wave lessens until it dissipates completely. When a sound wave strikes an object that it cannot be transmitted through, it will be partially absorbed and partially reflected. The sound waves reflected will cause an echo until the energy dissipates and the reverberation ends.

WAVES MOVE ENERGY, NOT MATTER.

A wave itself is NOT matter. Waves *transfer energy* from place to place. A simple wave has a repeating pattern of specific wavelength, frequency, and amplitude. The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which for each type of wave depends on the medium through which the wave is traveling. Energy can be transferred from one medium to another; for example, energy transferred by sound waves can be absorbed, reflected, and transmitted just like light can. The energy of a wave is measured in terms of wavelength and frequency. In the case of light, this is what produces color. Different colors have different wavelengths that are measured in nanometers. Higher wavelengths display colors like red, whereas lower wavelengths display colors like violet. The frequency of waves is measured in hertz—that is, how many waves that occur in 1 second. The higher the frequency of a wave, the more energy it has to be absorbed, reflected, or transmitted by something else.

TEACHER TIPS

Encourage students to discuss what they understand to be true of waves, including concepts from previous grade levels. Students should know that energy can move from place to place by moving objects or though sound, light, or electrical currents. They should also know that energy is present wherever there are moving objects, sound, light, or heat. These concepts can be used as pre-assessment as you engage students in explanations of their past learning experiences.

ABOUT THIS LESSON

This lesson was created by the National Science Teaching Association (NSTA) to pair with the Generation Genius video and support *NGSS*.

They have requested we provide the following background with this lesson:

The Next Generation Science Standards (NGSS) are the national standards on how students learn science, and they are based on contemporary research presented in *A Framework for K–12 Science Education (the Framework).* The shift in science teaching and learning required by the Framework is summarized in this infographic: A New Vision for Science Education.

At the start of each Generation Genius lesson, students are presented with a phenomenon, then they try to explain it. Students will notice they have gaps in their knowledge and ask questions, which motivates them to build ownership of science ideas they need in order to explain how or why the phenomenon occurred. The way students build ownership of science and engineering ideas is through active engagement in the science and engineering practices (SEPs). This process of sensemaking, or doing science to figure out how the world works, is one of the major shifts the *Framework* encourages.

To engage in the SEPs, students should be part of a learning community that allows them to share their ideas, evaluate competing ideas, give and receive critiques, and reach consensus. Students can start by sharing ideas with a partner, then with a small group, and finally, with the whole class. This strategy creates opportunities for all students to be heard, build confidence, and have something to contribute to whole-class discussions. Each Generation Genius lesson provides conversational supports to facilitate such productive student discussions to contribute to sensemaking.

Excited to continue your shift toward the new vision for science education? Check out the Generation Genius Teacher Guide page on the NSTA website for resources and strategies to engage every student in your classroom in **doing** science.