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Wave Research and Demonstrations by Expert Groups

You will only have five minutes to research and prepare your presentation. Use your textbook (Sound and Light, pp. 6–15) or other research to address the concept(s) assigned to your team. As the expert(s), you will then share your research using a demonstration to explain the concepts so others understand them as well as you do. You will also need to be prepared to answer clarifying questions.

Complete the **Review** section on your own to check for your understanding.

What is a Wave?

A *wave* is a _____ that transfers _____from place to place.

Energy is the ability to do_____.

Demonstration: Place a rubber duck (or other floating object) in the center of a tub of water and tap on the water at one end with a pencil twice a second for 30 seconds. Point out how the object goes up and down with the waves but does not travel with the wave. This is showing that the energy of the wave is moving the object, or doing work.

Explain how the demonstration is related to the statements above it.

What Carries Waves?

_____waves need something to travel through.

The _____ that a wave travels through is called a _____.

Waves that require a _____ are called _____ waves.

Demonstration: Say a phrase so a partner can hear you. Ask: *What medium is the wave traveling through?* Ask students to place an ear to the desk, and then to tap on the desk with a hand. Ask: *What is the medium that the wave traveled through?* Gently tap the water surface. Ask: *What is the medium the wave traveled through?*

Explain how the demonstration is related to the statements above it.

How Do Waves Transfer Energy?

The wave _____ _____ carry the medium with it. The medium is made of tiny particles. The wave _____ _____ to the medium's particles. The particles bump into each other. This causes the _____ to _____ from one particle to the next.

Demonstration: Form a line with five or more students and model "the wave." Emphasize how the energy (up and down movement) moved through the medium, but that the students (particles) stayed where they were. Describe how this demonstration relates to the first demonstration.

Explain how the demonstration is related to the statements above it.

What Causes Waves?

Mechanical waves are produced when a source of energy causes a medium to_____.

A *vibration* is a repeated _____ and _____ or up and down motion.

Demonstration: Gently strike a tuning fork on your hand. Touch it gently with a finger. Repeat procedures with students in the class, providing all students in the class an opportunity to feel the vibrations.

Explain how the demonstration is related to the statements above it.

Transverse Waves

A *transverse* wave in which the direction that the _____ is traveling is _____ to the direction the _____ is moving.

A _____ _____is an example of a transverse wave.

Draw and label diagram of a transverse wave and label the direction the wave moves the medium compared to the direction the wave travels. (Source: Sound and Light, p. 10)

_____

Rest Position

Demonstration: With a partner, lay out a rope on the floor (leave some slack) and then have one partner flick it (move it to the left and right) one time per second. Point out the direction the wave moves the medium (rope) compared to the direction that the wave travels along the rope.

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(*Continued from* **Transverse Waves** *on previous page*)
Explain how the demonstration on the previous page is related to the statements above it. Explain any new terms needed to understand the concept.

Longitudinal Waves

In a *longitudinal* wave, the wave is traveling in a direction that is _____ to the direction of the medium.
A _____ is an example of a longitudinal wave.

Draw and label diagram of a longitudinal wave and label the direction the wave moves the medium compared to the direction the wave travels. (Source: Sound and Light, p. 10)

_____
Rest Position

Demonstration: With a partner, stretch out and hold a spring. Gently have one partner push the spring straight forward repeatedly one time per second. One partner could also gently pull a few coils toward one end and then let them go. Point out the direction the wave moves the medium (spring) compared to the direction that the wave moves along the spring.
*Be careful not to overstretch and tangle the spring.

Explain how the demonstration is related to the statements above it. Explain any new terms needed to understand the concept.

All Groups: Review Parts of a Wave

1. *Crest*: The _____ part of a transverse wave.
2. *Trough*: The _____part of a transverse wave.
3. *Rest Position*: The position of the medium_____ it is disturbed. It is usually drawn as a horizontal line through the entire wavelength, half-way between the crest and the trough.
4. *Compression*: Part of a longitudinal wave where the particles are _____together.
5. *Rarefaction*: Part of a longitudinal wave where the particles are_____.
6. Draw a labeled diagram of each type of wave. (Source: Sound and Light, p. 10)

Challenge: What are the four properties that all waves share? (*Hint: You are given the first letter.*)

- A_____
- F_____
- W_____
- S_____

Amplitude

Amplitude is the maximum distance the particles of a medium move _____ from their_____ position.

In a transverse wave, the amplitude is the _____ of the wave from the _____ _____.

Demonstration: With a partner, stretch out a rope (leave some slack) by its ends and then have one partner flick it (move it to the left and right, or up and down) one time per second. Increase the distance the end moves from the rest position to increase the amplitude. Do not increase the rate.

In a longitudinal wave, the amplitude is measured by how_____ or _____ the medium becomes.

Demonstration: With a partner, stretch out and hold a spring and then gently pull a few coils toward one end and then let them go. Point out where the springs are compressed along the spring to show where the wave has the greatest amplitude.

*Be careful not to overstretch and tangle the spring.

Draw and label two *transverse* waves and two *longitudinal* waves with different amplitudes.

_____

Rest Position

_____

Rest Position

Wavelength

A *wavelength* is the _____ from one point on a wave to the same point on the _____ wave. It is the distance from _____ to _____ on a transverse wave, or the distance from the beginning of one _____ to the beginning of the next _____ on a longitudinal wave.

Demonstration: With a partner, arrange a rope on the floor to represent a transverse wave and point out one wavelength. With a partner, arrange a spring on the floor to represent a longitudinal wave and point out one wavelength. This may require one partner "pulling" on part of the spring and another compressing it.

*Be careful not to overstretch and tangle the spring.

Draw and label two *transverse* waves and two *longitudinal* waves with different wavelengths but the same amplitude.

_____

Rest Position

_____

Rest Position

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Frequency

Frequency is the number of_____ that pass a given point in a certain amount of_____. Frequency is measured in hertz (Hz), which are the units describing the number of waves passing a point each second: Hertz = waves/ second.
For example, 1 wave/1second = 1Hz, 2 waves/1 second = _____ Hz

Demonstration: With a partner, stretch out a rope (leave some slack) by its ends and then have one partner gently and slowly flick it (move it to the left and right, or up and down) one time per second. To increase the frequency, increase the rate at which the end moves from the rest position to increase the frequency to two times per second, but do not increase the amplitude. Repeat, but decrease the rate.

What is the frequency if 4 crests pass you in one second? _____

Draw and label <u>two</u> *transverse* waves and <u>two</u> *longitudinal* waves with <u>different frequencies</u> but the <u>same amplitude</u>.

_____
Rest Position

_____
Rest Position

Describe what happened to the wavelength as you increased the frequency.

Speed

Speed is the _____ it takes a wave to travel a certain _____.
The speed of a wave will _____ when it passes through a different _____.
Speed = _____ x _____

Demonstration: Repeat the demonstration from above and point out how when the frequency is increased, the speed increases. Keep the amplitude unchanged. Repeat, but decrease the rate.

Describe what happens to the speed of a wave if the frequency remains the same, but the wavelength increases.

Summary Questions

1. Describe the relationship, if any, between the energy a wave has and its amplitude (*Hint: The distance that you needed to move your hand from the rest position*).

2. Describe the relationship, if any, between wavelength and amplitude. Include a labeled diagram to support your answer. (*Hint: Is it possible to change one but not the other?*)

3. Describe the relationship, if any, between frequency and amplitude. Include a labeled diagram to support your answer. (*Hint: Is it possible to change one but not the other?*)

4. Describe the relationship, if any, between frequency and wavelength. Include a labeled diagram to support your answer. (*Hint: Is it possible to change one but not the other or is it more complicated than that?*)