Lesson Topic: Wave Model of Light

Objective:
Students will be able to:

1. Recognize that light travels as waves.
2. Explain the relationship between wavelength, frequency, and color.
3. Describe how changes in amplitude affect brightness.
4. Discuss how light waves are affected by interaction with certain materials.

Time Required: 75 minutes

Materials Needed:

- Plain white paper (6 to 8 pieces)
- Drinking glass (Approximately 6” tall)
- Water (enough to fill drinking glass completely)
- Tape (2”-3” blue painters’ tape or similar tape)
- Flashlight
- Scissors
- Ruler
- Pencil or Pen
- Teacher computer with internet access
- Projector/interactive whiteboard
- 1 computer/laptop/iPad per student with internet access
- Wave Model of Light Worksheet (attached)

Teacher Preparation:

- Assign a Legends of Learning Instructional Quick Play playlist for the day(s) you will be teaching the lesson.
    - Instructional - Middle School - Wave Model of Light
- Assign a Legends of Learning Content Review Quick Play playlist for the day(s) you will be teaching the lesson.
    - Content Review - Middle School - Wave Model of Light
- Make copies of Wave Model of Light Worksheet (1 per student)
- Construct water prism (see attached diagram)
    - Cut a 4”x4” piece of paper with a vertical, rectangular slit in the center. (This opening will allow a beam of light to pass through the water)
    - Tape the paper to the back of the glass.
    - Place white pieces of paper beneath the glass and surrounding the glass.
    - You may add water at the beginning of the lesson. Be sure to fill the glass completely.

Engage (10 minutes):

1. Display the visible spectrum for the students. (see attached)
2. Ask students for observations based on the illustration. (the wavelengths change as

colors change; light is a wave)
3. Explain to students that you will be constructing and demonstrating a water prism.
4. Show the flashlight to the students and explain that the flashlight will act as the sun in this demonstration.
5. Explain that the white light emitted by the sun and the flashlight is a wave and composed of the colors of the visible spectrum.
6. Ask students if they remember learning ROYGBIV in a previous science class.
7. Show students the water-filled glass and explain that the wave of light will change as it passes through the water prism.
8. Have a student dim the light and begin the demonstration.
9. Allow students to gather around to view the demonstration.
10. Ask students to describe what they see. (a rainbow, colors, the spectrum)
11. Explain to students that the glass of water causes the wave of light to slow and bend as it passes through it.
12. Explain to students that the white light is separated into different wavelengths, each moving at different frequencies, which appear as the colors we see.
13. Remind students that waves have additional properties, including amplitude, which affects the brightness of light, and they will learn more about the wave model of light during the lesson.

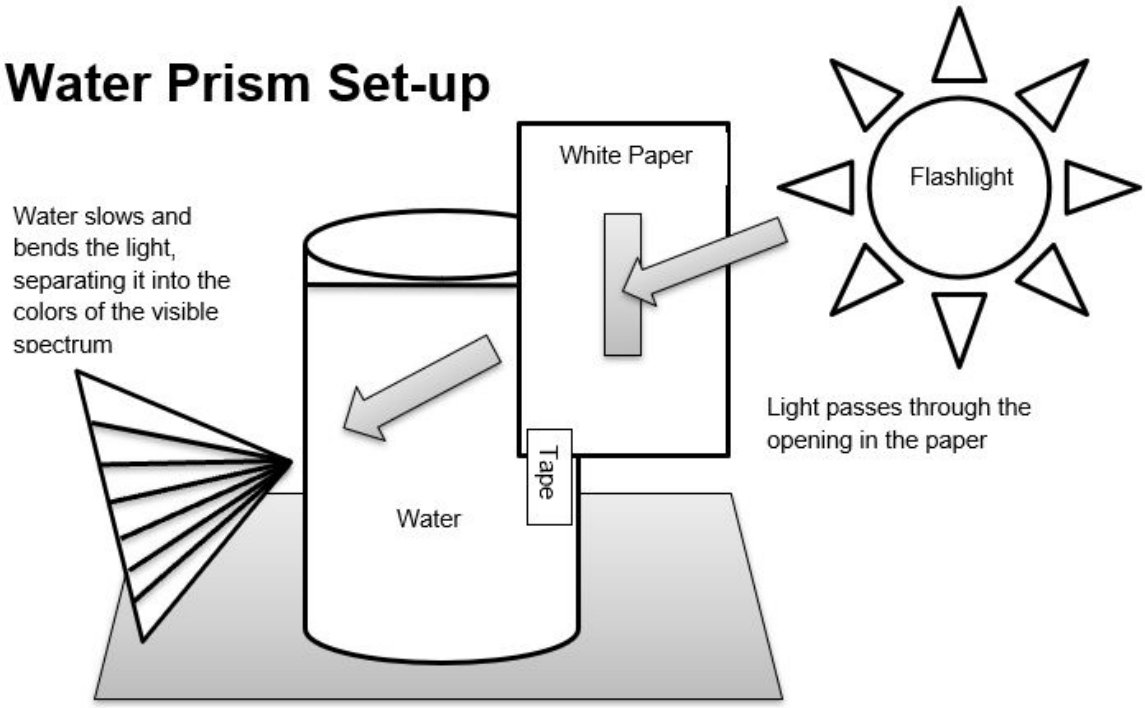
Explore (30 minutes):

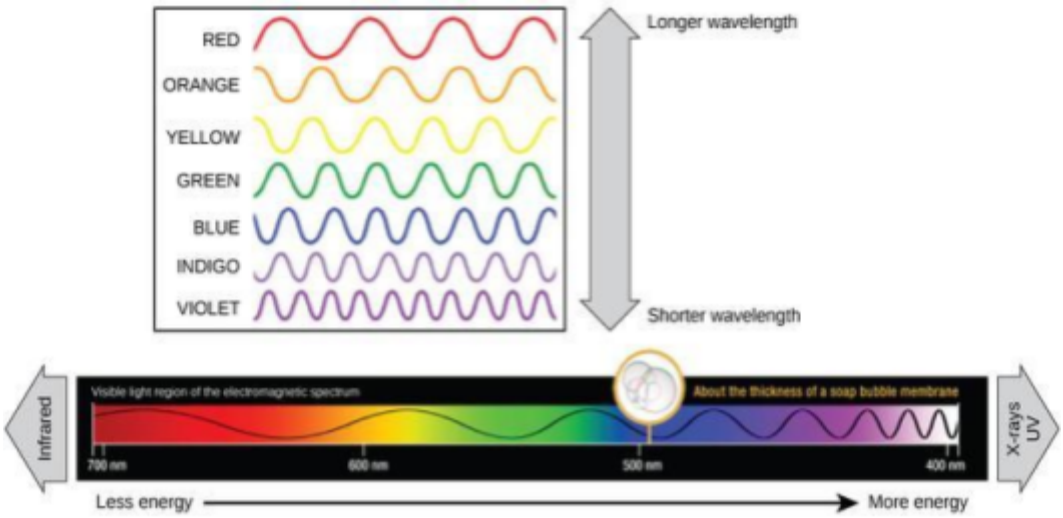
1. Have your students sign in to Legends of Learning. Instruct students to complete the Instructional playlist.
2. As students complete the assigned games, students will complete the Wave Model of Light Worksheet.
3. Circulate as students work through the playlist and complete the handout. Listen for evidence of understanding and use this opportunity to correct any misconceptions.

Explain (20 minutes):

1. Review answers to the Wave Model of Light Worksheet by asking for a student volunteer to read each situation and give the solution. Complete the review by drawing the illustration from the handout, using a red and purple marker, if possible, to highlight the correct answers.
2. Relate student knowledge to the demonstration at the beginning of the lesson.
    a. Why did the white light separate when it passed through the glass of water? (interaction caused the light to slow and bend, different wavelengths left the water prism at different angles)
    b. Which color had the shortest wavelength? (violet)
    c. Which color had the longest wavelength? (red)
    d. How would the demonstration be different if only blue light passed through the water glass and why? (only blue light, only one wavelength, so nothing to separate)
    e. Who can draw an example of a light wave with increasing amplitude?
        i. Answer: The student draws a wave with increasing taller peaks.
    f. Who can draw an example of a light wave with a long wavelength?

i. Answer: The student selects the red marker and draws elongated wavelengths.
Elaborate (5 minutes): 1. Explain to students that understanding the wave model of light helps to study characteristics of distant stars. By observing the color of a star, a scientist can determine the temperature of the star. Hotter stars have more energy and a higher frequency, so they emit blue light. Cooler stars have less energy and a lower frequency, so they emit red light. 2. Show this video of the Messier 47 Star Cluster, which includes both blue and red stars. Messier 47 Star Cluster 3. Ask students to describe what they see in the video. a. Answer: Some blue stars, some red, stars with different wavelengths, different temperatures.
Evaluate (10 minutes): 1. Have your students sign in to Legends of Learning. Instruct students to complete the Content Review playlist. 2. Analyze student results to determine what concepts need to be a focus for reteaching.
Additional Lesson Strategies: ● To use Legends for additional instruction, create a custom playlist with an instructional game and pre and post assessment. ● To use Legends for a quick formative assessment, create a 5-question assessment in a playlist. ● To use Legends for a student-directed experience, create a targeted freeplay playlist. ● Encourage students to play on their own at home in Legends of Learning: Awakening for a student-driven experience including avatars, battling, and quests all centered around topics they are covering in class.


Water Prism Set-up
White Paper
Flashlight
Water slows and bends the light, separating it into the colors of the visible spectrum
Light passes through the opening in the paper
Tape
Water



Wave Model of Light

Name:_____

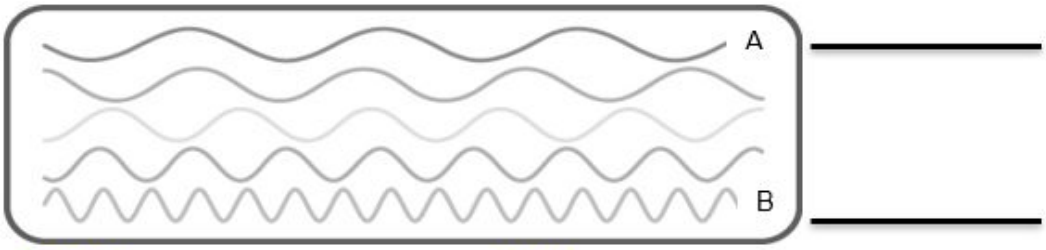
Directions: While playing the games in Legends of Learning, use what you learn to answer the questions below.

Part 1: Problem Solving. Write your answer in the space given.

Situation 1.
A stage manager is using a new computer program to control lights for a show. They need to increase the brightness of the lights. What property of the light wave should they adjust, and how should they change it?

Situation 2.
The stage manager is grateful for your help. Now they would like to change the color from blue to red. Explain how they can solve this problem using your knowledge of the wave model of light.

Part 2. Label wavelengths A and B with the correct color based on their wavelength. Your color choices are red and violet.



Wave Model of Light

Name:_____KEY_____

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Situation 1.
A stage manager is using a new computer program to control lights for a show. They need to increase the brightness of the lights. What property of the light wave should they adjust, and how should they change it?

They can increase the amplitude. Increasing amplitude increases the brightness of light.

Situation 2.
The stage manager is grateful for your help. Now they would like to change the color from blue to red. Explain how they can solve this problem using your knowledge of the wave model of light.

They can increase the wavelength. Red has a longer wavelength than blue light. They could also decrease the frequency. Red has a lower frequency than blue light.

Part 2. Label wavelengths A and B with the correct color based on their wavelength. Your color choices are red and violet.