BRIGHT ART CHALLENGE

SCIENCE LESSON

LIGHT ENERGY (COLOR & LIGHT)

Light is a form of energy made up of electromagnetic waves. Some of these waves can be seen, like the colors of a rainbow while others cannot, like the energy the microwave uses to cook. The entire range of light is called the electromagnetic spectrum.

FOR THE CLASSROOM

POSSIBLE APPROACH FOR THE CLASSROOM

LESSON LENGTH	OBJECTIVE	MATERIALS
50-60 MINUTES	LEARN ABOUT LIGHT ENERGY AND WAVES	SEE BELOW

VOCABULARY:

- Light
- Light Wave
- Crest
- Trough
- Amplitude
- Wavelength
- Electromagnetic Spectrum
- Frequency

MATERIALS

Slide Deck, Worksheet, Computer, Internet, Flashlight, Cardstock, Tape, Ruler, Holepuncher/Sharp Pencil, Clay (Optional), Clothespins (Optional)

PROCEDURE

1. Download and teach the PROPERTIES OF LIGHT SLIDE DECK.
2. Student Activity: Have your students complete the “Transverse Wave Simulator” worksheet while using the Wave Simulator Tool created by PhET of UC Boulder: https://phet.colorado.edu/sims/html/wave-on-a-string/latest/wave-on-a-string_en.html

BACKGROUND INFORMATION

ELECTROMAGNETIC SPECTRUM

The electromagnetic spectrum is much more than the colors of the rainbow. It is the range of all types of electromagnetic energy that travels and spreads out as it goes. For example, the visible light that comes from a laptop screen or the radio waves that come out of your cell phone speaker are two types of radiation. Other types of radiation include microwaves, X-rays, infrared light and ultraviolet light.

WAVES

Light waves can be represented on paper as transverse waves. The length and frequency a light wave that bounces off a material can tell us its color and in some cases what substance the object is made of.

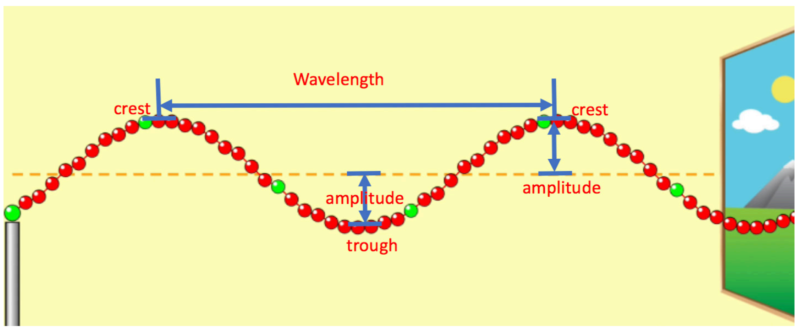
LESSON PLAN CONTINUED

LIGHT ENERGY (COLOR & LIGHT)

BACKGROUND INFORMATION

WAVES (Continued)

Before we can fully understand the differences in light waves we need to take look at the basic parts of a wave.



Crest: The point on the wave with a maximum value of upward displacement.

Trough: The point on the wave maximum value of downward displacement.

Amplitude: The height of the of the wave from the crest to the midline. Or the height of the wave from the trough to the midline.

Wavelength: Distance between two consecutive crests of a wave.

LIGHT & COLOR

Light is made up of wavelengths of light and each color is a specific wavelength. The colors we see are a direct result of which wavelengths are reflected to our eyes. The visible light spectrum ranges from dark red at 700nm (high frequency shorter wavelength) to violet at 400nm (low frequency longer wavelength). Objects appear different colors because they absorb some specific wavelengths of light and reflected or transmit others. The colors we see are the wavelengths that are reflected or transmitted. For example, a red shirt looks red because the dye molecules in the fabric have absorbed the wavelengths of light from the violet/blue end of the spectrum. Red light is the only light that is reflected from the shirt. White objects appear white because they reflect all wavelengths of visible light (all the colors). Black objects absorb all wavelengths of visible light so, no light is reflected.

ADDITIONAL LIGHT ENERGY TEACHING RESOURCES:

- Electromagnetic Spectrum & Light: https://pmm.nasa.gov/education/websites/tour-electromagnetic-spectrum
- Electromagnetic Spectrum: https://www.youtube.com/watch?v=cfXzwh3KadE
- Light Waves: https://www.youtube.com/watch?v=O0PawPSdk28
- Electromagnetic Spectrum: https://www.sciencelearn.org.nz/image_maps/63-the-electromagnetic-spectrum

LESSON PLAN CONTINUED

LIGHT ENERGY (COLOR & LIGHT)

NEXT GENERATION SCIENCE STANDARDS

MS-PS4-2 Waves and their Applications in Technology for Information Transfer: Develop and use a model to describe that waves are reflected, absorbed or transmitted through various materials.

- PS4.B Electromagnetic Radiation: When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the objects material and frequency (color) of the light. The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bend. A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. However, because light can travel through space, it cannot be a matter wave, like sound or water waves.
- Crosscutting Concepts: Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used

SCIENCE LESSON WORKSHEET

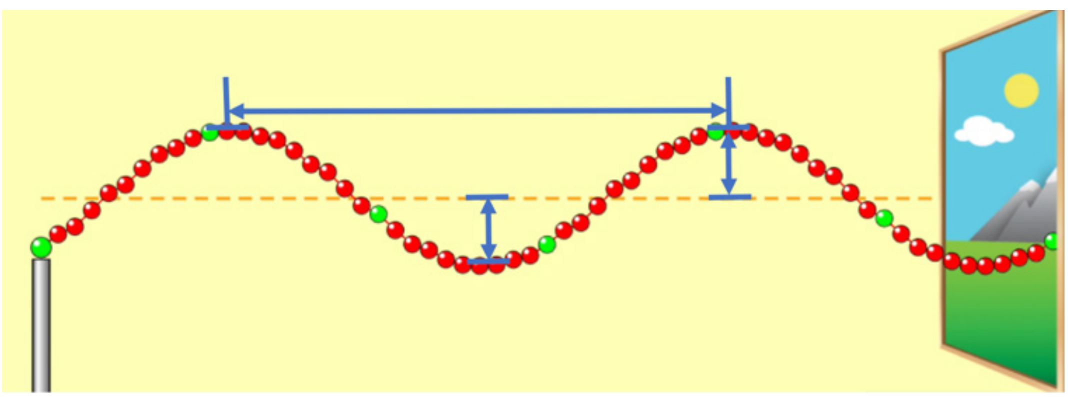
TRANSVERSE WAVE SIMULATOR

Light is made up of transverse waves. Transverse waves transfer energy in a motion perpendicular to the direction the wave is travelling. Check out the wave simulator link to learn more about how waves work!

PARTS OF A WAVE

Crest: The highest point on the wave with a maximum value of upward displacement.
Trough: The lowest point on the wave with a maximum value of downward displacement.
Amplitude: The height of the of the wave from the crest or trough to the midline (dotted line in diagram below).
Wavelength: Distance between two consecutive crests of a wave.

Label the **crest**, **trough**, **amplitude** and **wavelength** of the wave in the diagram below.



Use the Wave Simulator tool created by PhET of UC Boulder to answer the questions below:
https://phet.colorado.edu/sims/html/wave-on-a-string/latest/wave-on-a-string_en.html

1) Set your wave simulator to oscillate. Record your observations.

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2) The amplitude of a wave directly correlates to the brightness/intensity of the light relative to other light waves with the same wavelength. The higher the amplitude the brighter and more intense the light appears.

Set the amplitude to 0.5cm. Describe how the wave changes.

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3) Set the amplitude to 1.25 cm. Describe how the wave changes.

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If this is a light wave, would it be brighter than a light wave with an amplitude of 0.5cm? Explain.

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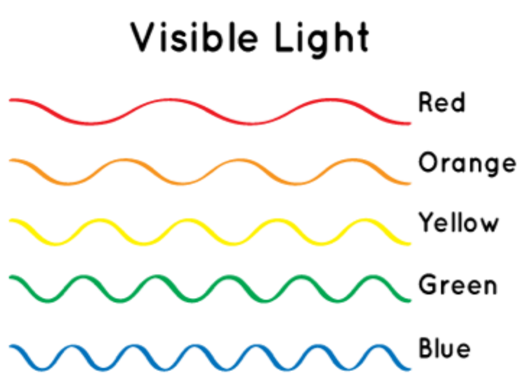
The color of an object is based on what frequency of light is reflected from that object to our eyes. Visible light waves with lower frequencies fall into the red and yellow range. Visible light waves with medium frequencies are green and blue and high frequency visible light waves are blue and violet.



4) Set the frequency of the wave to 0.5Hz. Describe the wave.

How fast (the frequency) a wavelength travels can tell us what color it is. For example, green travels at frequencies between 526-606 Tera Hertz (THz) this equates to 526,000,000,000,000 Hz to 606,000,000,000,000 Hz.

SCIENCE LESSON WORKSHEET

LIGHT DIRECTION

The direction of light waves is often represented as rays. Light rays travel super-fast and clock in at 186,282 miles per second. If you ran at this speed, you could circle the Earth 7.5 times in one second. Learn more about light by conducting the light direction demonstration and answering the questions below.

- Punch a hole in the center of each index card with a hole puncher or sharp pencil.
- Use a small piece of modeling clay or clothespin to create a “stand” for each card. Or use the ruler to fold the card ¼ inch from the bottom and tape it to a desk. The important thing is to place the cards so that they stand vertically and at an equal distance from each other.
- Turn off the lights in the room and place the flashlight at one end of the index cards and arrange the cards so that light can be seen through all the holes.
- Observe and record your observations.

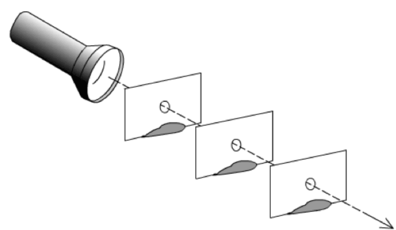


Image courtesy of NASA

1) Shine your flashlight through the holes in the cardstock and record your observations.

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2) What does the experiment prove about the path light travels?

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3) What do you think would happen if the holes were smaller?

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