A drop of water acts like a prism.
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Rainbow in the Room

The Science of Global Atmospheric Change: Activity 2

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Rainbow in the Room

The objectives of this activity are aligned with the National Science Education Standards, specifically those related to Science as Inquiry and Physical Science. "Rainbow in the Room" uses guided inquiry to provide introductory instruction related to Earth's energy and resources. Students will explore the properties of light and observe the mixture of colors (displayed as a rainbow) that comprise visible light.

Concepts

- Visible light is composed of many different wavelengths of radiation.
- We can see different wavelengths of light as the colors of the spectrum.

Student Worksheets

Student pages in the teacher's guide are provided in English and in Spanish.

Reference

Moreno N., and B. Tharp. (2011). *The Science of Global Atmospheric Change Teacher's Guide.* Third edition. Baylor College of Medicine. ISBN: 978-1-888997-76-7.
Development of this student activity was supported, in part, by grant numbers R25 ES06932 and R2510698 from the National Institute of Environmental Health Sciences of the National Institutes of Health to Baylor College of Medicine.

Image Reference

Photo © Mariano Ruiz. Licensed for use.

Key Words

lesson, energy, light, spectrum, visible light, rainbow,

Rainbow in the Room © Baylor College of Medicine.

Materials

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Materials

Teacher Materials

• 2 cups, 9-oz clear plastic jars or glasses (or glass)

• Clear beaker, 1,000-mL size (or quart-sized glass jar, water bottle, or other clear container)

• Overhead projector

Materials per Student

•Crayons or colored markers

•Sheet of white paper

Reference

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Image Reference

Photo by Christopher Burnett © Baylor College of Medicine.

Key Words

materials list, materials needed,

Science Safety Considerations

Students always must think about safety when conducting science investigations. This slide may be used to review safety with your class prior to beginning the activity.

Safety first!

•Always school district and school science laboratory safety guidelines.

•Have a clear understanding of the investigation in advance.

•Practice any investigation with which you are not familiar before conducting it with the class.

•Make sure appropriate safety equipment, such as safety goggles, is available.

•Continually monitor the area where the investigation is being conducted.

References

1.Dean R., M. Dean, and L. Motz. (2003). *Safety in the Elementary Science Classroom*. National Science Teachers Association.

2.Moreno N., and B. Tharp. (2011). *The Science of Global Atmospheric Change Teacher's Guide*. Third edition. Baylor College of Medicine. ISBN: 978-1-888997-76-7.

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Key Words

science, classroom, safety, lab, laboratory, rules, safety signs,

Colors of a Rainbow

- When can rainbows typically be seen outside?
- How are rainbows formed?
- What are the colors of the rainbow?

- Do the colors always appear in the same order?

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Colors of a Rainbow

A rainbow forms when white light passes at an angle from one transparent material (such as air) into another (such as water or glass). The waves corresponding to different colors of light travel at different frequencies, so they are dispersed differently by the second material.

Begin the activity by asking students, *When do you usually see rainbows outside?* Remind students that rainbows are normally seen just after a rainstorm. Continue the class discussion by asking students why they think rainbows form after rain and what they think rainbows are made of. Encourage students to consider what the sky around a rainbow usually looks like. (Typically, there are both clouds and sunlight.)

Ask students, *What are the colors of the rainbow? Do those colors always appear in the same order?*

The colors of the rainbow always appear in the same order, because they correspond to different wavelengths of light. You may have learned the acronym, “ROY G. BIV,” to help you remember the colors of the rainbow from longest to shortest wavelengths: red, orange, yellow, green, blue, indigo and violet.

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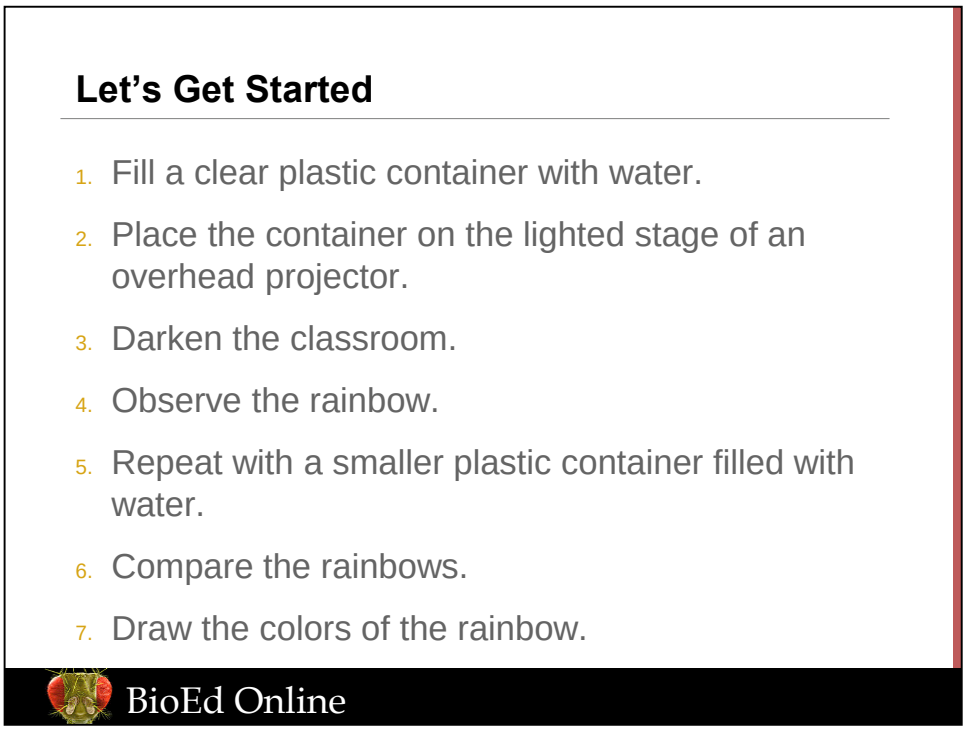
Image Reference

Photo of rainbow in Yellowstone National Park courtesy of the U.S. National Park Service. http://www.nps.gov/features/yell/slidefile/celestialatmospheric/Weather/Images/02616.jpg

Key Words
rainbow, rainbow colors, energy, light, spectrum, visible light, electromagnetic spectrum,



Let's Get Started

In this activity, students will observe a rainbow, and will learn that white light is separated into colors as it passes through water in a plastic container, and will predict whether every rainbow has the same colors, and whether the colors always appear in the same order. Students will make their own rainbow drawings that incorporate the sequence of colors observed in the classroom rainbow.

Conduct this activity as a discovery lesson with the entire class. Ask students to observe as you place a water-filled plastic container on the lighted stage of an overhead projector. Turn out the lights and have students observe the circular rainbow being projected around the classroom. Allow a few minutes for students to observe the rainbow. Then ask, *Have you ever seen anything like this before?* Follow by asking, *Do you think the colors are the same in every rainbow?*

After students have shared their predictions, place another, smaller container or cup filled with water on the overhead. Have students observe the sequence of colors in the rainbow produced by the second cup and compare that rainbow to the one produced by the first, larger container. Once again, ask, *Do you think the colors are the same in every rainbow?* Make sure that students understand the sequence of colors in a rainbow always follows the same predictable pattern. When teaching older students, explain that the colors of light represent energy of different wavelengths.

Have students identify the source of light for the rainbow (white light from the overhead projector). Have all students draw their own rainbows that incorporate the sequence of colors they observed in the classroom rainbow. Display the rainbow drawings in the

classroom.

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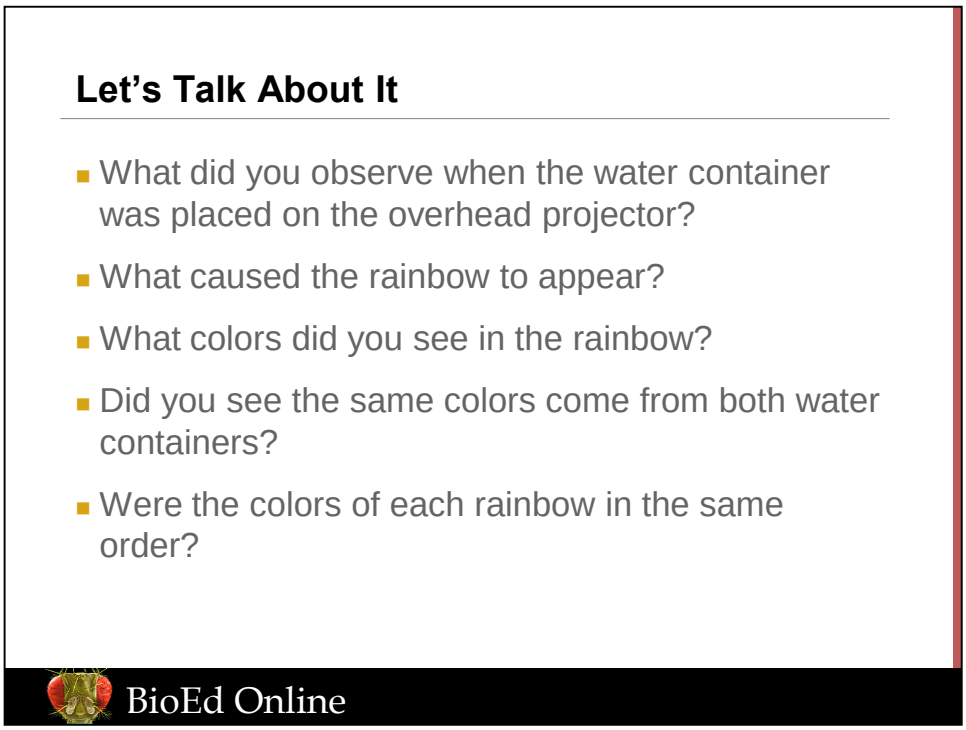
Key Words
lesson, energy, light, spectrum, visible light, rainbow, rainbow colors,



Let's Talk About It

This activity provides a basic introduction to the properties of light. Students will discover that visible light consists of a mix of colors that represent only part of the spectrum of radiation produced by the sun.

Begin a class discussion about what happened when the water in the plastic container was placed on the overhead projector. Challenge students to think about what caused the rainbow to appear. Expect a variety of answers and observations, and pose questions that encourage students to think. Then, help them understand that the light is being separated into its constituent colors as it passes through the water in the container.

Reference

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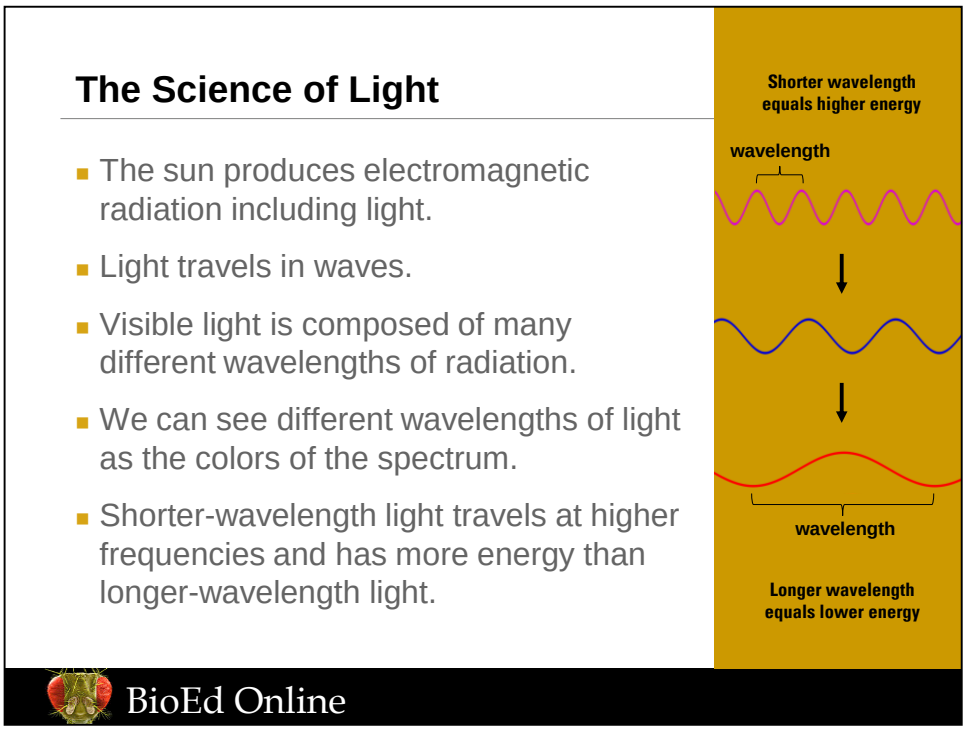
Key Words

lesson, energy, light, spectrum, visible light, rainbow, rainbow colors, electromagnetic spectrum, wavelength,



The Science of Light

Light that we can see is only a part of the electromagnetic spectrum. In addition to visible radiation (light), the sun emits infrared (IR) and ultraviolet (UV) radiation, x-rays, and gamma rays.

In this activity, students observed the following properties of light.

- **Visible light is composed of many different wavelengths of radiation.** Electromagnetic radiation, including light, travels in waves, similar to the waves on the surface of a lake. The distance measured between the peaks, or crests, of two successive waves is known as the wavelength. The longest wavelengths correspond to television and radio signals (1-1,000 meters), while the shortest wavelengths correspond to gamma rays (0.000,000,000,000,01 meters).

- **We can see different wavelengths of light as the colors of the spectrum**. Visible light consists of a mix of wavelengths that we detect as different colors. We can see these colors when white light (light as we usually see it) passes through a prism – or drops of water – and forms a rainbow. The components of visible light represent a small portion of the entire electromagnetic spectrum, and ranges from the longer wavelength of infrared radiation and the shorter wavelength of ultraviolet radiation.

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Image Reference

Graphic courtesy of G.L. Vogt, EdD., Baylor College of Medicine.

Key Words

lesson, energy, light, spectrum, visible light, rainbow, rainbow colors, electromagnetic spectrum, waves, visible light, wavelengths, frequency, frequencies,

Extensions

- Use a prism to form a rainbow.
- Model the motion of waves by moving one end of a Slinky® or rope from side to side.

Glass prisms split white light into a color spectrum.

- Measure the lengths of wavelengths of light and display them in the classroom.
- Examine color photographs and identify the combinations of colors dots used to create orange, green, and purple.

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Extensions

A prism is a transparent optical element with flat, polished surfaces that refract light. At least two of the flat surfaces must have an angle between them. Prisms can be made from any material that is transparent to the wavelengths for which they are designed. Typical materials include glass, plastic and fluorite. When white light passes at an angle from one transparent material (such as air) into another (such as water or glass), a rainbow forms. The colors of the rainbow always appear in the same order, because they correspond to different wavelengths of light. Conduct further explorations of the spectrum by using prisms outside with sunlight and/or indoors with light from incandescent or fluorescent bulbs.

Help students understand waves by modeling wave motion with a spring toy ("Slinky®"). Lay the spring on a tabletop and wave one end from side to side. Students will be able to see waves move along the length of the spring.

Explore the vast differences among wavelengths in the electromagnetic spectrum by measuring out (or creating a scale model of) some of the following kinds of waves and displaying them in the classroom. Alternately, you can measure out the actual lengths on the playground.

AM radio waves: 100m
FM radio waves: 10m
Television waves: 1m
Microwaves: 1 cm

Infrared waves (felt as heat): less than 1 mm

Printers use cyan, magenta, yellow and black inks to create all of the colors in a printed document. Have students examine color photographs, comics or advertisements printed in the newspaper using a hand lens or magnifier. Have them identify the combinations of colored dots used to create colors such as orange, green and purple.

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Image Reference

Key Words

lesson, extension, prism, rainbow, wave, wave action, color, colors, ink, spectrum, white light, visible light,