Splashing Light

Summary

Introduce the color spectrum, and experiment with diffraction glasses and lasers to demonstrate colors are ordered by wavelength.

Time Frame

1 class periods of 60 minutes each

Materials

Diffraction glasses
laser pointers (red and green)
string of multicolored lights
white paper and marker, OR SmartBoard with pens
powerpoint (Light)

Background for Teachers

When white light is transmitted through a prism, a rainbow of colors is visible on the other side as the light exits the prism. These colors appear in a very specific order which is based on their wavelength or the length from the top of one wave to the top of the next wave. Red light has the longest wavelength, while violet has the shortest wavelength. The prism is actually slowing down the light proportionally. What this translates to is that the shorter wavelengths of light are slowed down more. Thus, the prism bends violet light the most and red light the least.
All light travels in waves and reacts differently when it hits different surfaces. Imagine a pool or a rocky beach in the summer. As the waves move, they often hit the pool walls or big rocks. This sends the water in different directions, with one big wave splitting into multiple smaller waves. Light can "splash" like water, since light also travels in waves. When light "splashes," scientists call it diffraction. This exercise uses glasses with specific grating in the lenses to demonstrate diffraction. Unlike the prism which slows down light, the grating in the diffraction glasses spread out light as it interacts with the molecules in the lenses. And just as wavelengths matter when bending light, wavelengths matter when diffracting or splashing light. Red light splashes or spreads out the most and violet light spreads out the least.

Student Prior Knowledge

Students should know that light travels in waves and is a form of energy. Students should also have general knowledge that light can reflect (bounce off) or transmit (pass through) different objects.

Intended Learning Outcomes

ILOs: 1. Use Science Process and Thinking Skills
- a. Observe simple objects, patterns, and events, and report their observations.
- d. Compare things, processes, and events.
- i. Use data to construct a reasonable conclusion.
- 3. Understand Science Concepts and Principles.
- a. Know and explain science information specified for grade level.
- c. Solve problems appropriate to grade level by applying science principles and procedures.
- 4. Communicate Effectively Using Science Language and Reasoning
- b. Describe or explain observations carefully and report with pictures, sentences, and models
- c. Use scientific language in oral and written communication.

Instructional Procedures

(1) Start powerpoint and lead discussion about light. Ask students where light comes from, what properties does light have, etc. Be sure to stress that light travels in waves. Steer the discussion towards prisms and the spectrum (e.g. rainbows). Define spectrum and introduce the concept that colors are ordered based on their wavelengths (e.g. ROY G BIV). This should take 15-20 minutes.
(2) Present the question, "How do we know that light actually has different colors based on wavelengths? If light travels in waves, should it act like a wave when it hits an obstacle? We are going to try to answer those questions / test these ideas today."
(3) Introduce the tools we will use to answer these questions -- laser pointers and cool glasses. Explain that the diffraction glasses have small and tight grids in their lenses, creating barriers that the light hits (like the big rocks on the beach). Demonstrate with the red laser pointer what happens to light. Be sure to note that not only are there more dots, but they are all less bright.
(4) Hand out the glasses, and allow students to explore by looking at different objects around the classroom. Be sure to have a lamp with a single light bulb ready for the students to look at. Call on students to explain what they see. Explore with the laser pointer as students put on and take off their glasses. Notice what two layers of diffraction glasses result in.
(5) Experiment -- will the red and green lasers react in the same way when shone through the diffraction glasses? Have students predict what will happen, and have them explain their reasoning. Using a marker and large white paper, or the SmartBoard, shine the red laser through the glasses. Ask a volunteer to draw the red dots that appear. Ask another volunteer to remember where you stood, and explain since this is an experiment it is important to keep as many things the same as possible. Next, get the green laser and shine it through the glasses, making sure the central point is in line with the previous red laser pointer. Ask another volunteer to draw the green dots as they appear. Discuss with the class what they see or notice about the dots on the board. Is there any pattern? What order are the color dots? What do you think this means? What else do you know about colored light? Make a connection between colors and wavelength. Ask the students to predict where a blue laser would go.
(6) After the experiment, have the students put on their diffraction glasses again and look at the lamp again. What do they notice now?
(7) If there is time, plug in the multicolored lights and have students look at the lights. Ask them what they notice about the different colored light bulbs and the "rainbows" that appear with the glasses.

Assessment Plan

In the last 5-10 minutes of class, have the students write a reflection about what they learned about light. Make sure they use complete sentences and certain key words including light, wavelength, color, ROY G BIV, defraction, etc.

Bibliography

- Blog by Ian Glenn

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