

Rainbows, Rainbows, Everywhere!

Student Objective

The student:

- will identify the colors in the solar spectrum
- will identify the colors that they did not see in the solar spectrum
- will be able to predict what will happen when sunlight is split by a prism or raindrop.

Key Words: indigo light waves rainbow solar spectrum

Time:

1 hour

Materials:

- sunny day
- garden hose
- oil
- cat litter or floor dry
- bubble solution
- wire bubble frames, several inches across (1 per child)
- shallow containers for bubble solution (1 per 4 students)
- glass beads or sparkling jewelry
- prism
- drawing paper (2 sheets per student)
- crayons

Background Information

A rainbow is one of the most spectacular light shows observed on earth. Long ago, people believed that rainbows were magic. Some people believed that a rainbow was a bridge that appeared in the sky when the gods wanted to leave heaven and come to earth. Some believed that there was a pot of gold at the end of the rainbow.

We now know that a rainbow is caused by sunlight shining on raindrops. To see a rainbow, the sun must be behind you and the rain must be falling in front of you. Sunlight in its natural state looks clear (or transparent), but it is really made up of many wavelengths that we see as different colors. When sunlight enters a raindrop, the raindrop bends (refracts) the light which divides it into the various wavelengths (colors) that we see—red, orange, yellow, green, blue, indigo, violet. Many rays of sunlight, being refracted into their colors and reflecting off many other drops of falling rain, make the curved, colored rainbow that we see.

The ‘bow’ shape of the rainbow is caused by the spherical shape of the raindrop. The raindrop shape is symmetrical around the axis that the light source enters, so the light is refracted out at 42° all around the axis of light entry. A rainbow is actually a circle of light being refracted out of the droplets of water; however we don't see a full circle because the earth gets in the way. The lower the sun is to the horizon, the more of the circle we can see; the higher the sun is in the sky, the smaller is the arch of the rainbow.

Procedure

1. Lead a discussion on rainbows. Most children will know that rainbows appear when there is a combination of rain and sunlight. Offer a simplified explanation to the students such as: *The light that we see is actually made up of light waves of different colors all blended together so that we don't see just one color at a time. Some things, like water droplets, can separate the light into its different color waves so that we are able to see them.*
2. Ask the students which colors are in the rainbow. After collecting suggestions, tell them they are going to be scientists and observe and record just what colors they see.
3. Take the students out and have them observe the solar spectrum split with water droplets.
 - have students stand with their backs to the sun
 - with a garden hose, spray a mist of water in the air so that the sunlight is shining on it
 - let the students call out the names of the colors that they see.
4. Pour a little oil on wet asphalt that is in the sun. Have the students observe the rainbow in the oil slick:
 - have students look at the rainbow streaks
 - ask how they are different than the rainbow from the water droplet (*smaller, shaped different*), and how they are the same (*same colors*)
 - pour a little cat litter over the oil that you spread. Explain to the students that oil is a pollutant to the water supply and must be cleaned up. Before returning to the classroom, sweep up the cat litter and dispose of it.
5. Let the students see the rainbow colors in the glass beads or faceted jewelry:
 - ask them how these rainbows are the same and how they are different from the water droplet and the oil rainbows.
6. Let the students make bubbles and observe the rainbows. Encourage them to make some of their bubbles in the shade to see if they see the rainbow colors:
 - ask how are these rainbows the same and how are they different from the water, oil and jewelry rainbows.
7. Show the students a prism and explain that it is used to separate the light into its different waves so it can be studied.
8. Have the students observe the rainbow spectrum.
9. Either outside or indoors (using the light from an overhead and the prism) have the students observe what colors they see and draw the rainbow spectrum on their paper. Challenge them to reproduce the colors and the order that they are in as accurately as possible. (*Red, orange, yellow, green, blue, indigo, violet*)
10. For the older students, write “Solar Spectrum” on the board, and have them write it on

- their paper
11. Ask the students which colors were not in the rainbow. (*black, brown, gold, etc. Let them list pink and various shades of colors at your discretion depending on their previous knowledge of color.*) Have the students draw a picture on the second sheet of paper that uses only colors that are not found in the solar spectrum (rainbow).

Further Activities

1. Plant flowers in a rainbow garden with bands of colors in the order of the colors of the rainbow.
2. Have the students wear a shirt/blouse to school in one of the colors of the rainbow. The students then arrange themselves in 'rainbow order' for a class picture.
3. Create a rainbow dessert. Make a batch of gelatin in each of the rainbow colors and cut into cubes. Arrange the cubes on a large platter in a rainbow shape. If you like, you could use whipped cream around it for the clouds!
4. Older students can play "What color am I?". Pin a color on the back of each student. Hang a sign for each color around the room. When the game starts, the students try to figure out what color they are by asking yes and no questions of the other students. When they think they know what color they are, they stand under that color's sign.

Related Reading

- *A Rainbow of My Own* by Don Freeman (Puffin, 1978)
A little boy runs outside after a rainstorm to try to find a rainbow. After he fails to find it, he imagines that one appears in front of him, swirling and whirling around him, to let him know that it wants to play. They play hide and seek (the rainbow hides in a flower bed), and other games. The boy returns home to find that the sun is making a prism with the goldfish bowl in his bedroom, so that there is a rainbow on his bedroom wall—a rainbow of his very own.
- *All the Colors of the Rainbow* by Allan Fowler (Children's Press, 1999)
Explains how rainbows are formed by the colors in sunlight shining through water. Answers questions such as: Which color is on the top of rainbow and which one is at the bottom? How many colors are in it? What is the shape of a rainbow? Where and when can we see rainbows and why can't we touch them?

EnergyWhiz

Students may submit their rainbow pictures to the EnergyWhiz website, <http://www.energywhiz.com/> If their picture is selected for the site, we will recognize the student (first name), class and school.

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			.1	.2	.3	.4	.5
Nature of Matter	Standard 1	SC.A.1.1-	X				
	Standard 2	SC.A.2.1-					
Energy	Standard 1	SC.B.1.1-	X				
	Standard 2	SC.B.2.1-					
Nature of Science	Standard 1	SC.H.1.1-				X	X
	Standard 2	SC.H.2.1-					
	Standard 3	SC.H.3.1-					
Art Standards:		VA.A.1.1.1					

Benchmark SC.A.1.1.1 - The student knows that objects can be described, classified, and compared by their composition and their physical properties.

Grade Level Expectations

The student:

Kindergarten

- knows that objects have many different observable properties

First

- knows that objects can be grouped according to their physical characteristics

Second

- knows ways objects can be grouped according to similarities or differences of their physical characteristics.

Benchmark SC.B.1.1.1 - The student knows that the Sun supplies heat and light energy to Earth.

Grade Level Expectations

The student:

Kindergarten

- knows the effect of sun and shade on the same object.

Benchmark SC.H.1.1.4 - The student knows that people use scientific processes including hypothesis, making inferences, and recording and communicating data when exploring the natural world.

Grade Level Expectations

The student:

Kindergarten

- poses questions, seeks answers, draws pictures of observations, and makes decisions using information

First

- uses simple graphs, pictures, written statements, and numbers to observe, describe, record and compare data

Second

- understands that, through the use of science processes, people can solve problems and make decisions
- analyzes information to make predictions, makes sketches and diagrams to explain ideas, draws conclusions using information and prior knowledge.

Benchmark SC.H.1.1.5 -The student uses the senses, tools, and instruments to obtain information from his or her surroundings.

Grade Level Expectations

The student:

Kindergarten

- knows that the five senses allow us to take in and respond to information in order to learn about our surroundings

Benchmark VA.A.1.1.1 - The student uses two-dimensional and three dimensional media, techniques, tools, and processes to depict works of art from personal experiences, observation, or imagination.

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electromagnetic spectrum - the whole range of radiation that is emitted by the sun. Includes radio waves, microwaves, infrared waves, visible light, ultraviolet, x-ray and gamma rays.

indigo - in the solar spectrum, a deep blue in hue between blue and violet

light waves - the part of the electromagnetic spectrum that we see as light. It can be split further into the different wavelengths which we see as the different colors in the solar spectrum.

rainbow - the visible light spectrum split by wavelength. We see this as the colors: red, orange, yellow, green, blue, indigo, violet

solar spectrum - the visible light spectrum from the sun