

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).

Key Words & Definitions

- **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

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 the 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?

- ***Chasing Rainbows (Dr. Seuss/Cat in the Hat)*** by Tish Rabe (Random House, 2012)
Sally and Nick want to paint rainbows, but they don't know what colors to use, or what order to put the colors. The Cat in the Hat is not quite sure himself, but he knows someone who will know—King Kaleidoscope, ruler of Colorgalore! So it's off to visit the King! The book features 3D artwork on every page and comes with a pair of 3D glasses.
- ***Light and Color*** by Lawrence Lowery (NSTA Kids, 2014)
This book unfolds as a series of observations about light, including where it comes from, how it bounces off of people and objects, and what we mean when we say the colors of a rainbow are the colors in light. By the end of the book, students will have a useful foundation to learn about energy, wavelengths, and the electromagnetic spectrum.

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Florida NGSS Standards & Related Subject Common Core

			.1	.2	.3	.4	.5	.6
Grade K								
The Practice of Science	Big Idea 1	SC.K.N.1		X	X	X	X	
Grade 1								
The Practice of Science	Big Idea 1	SC.1.N.1	X	X	X			
Grade 2								
The Practice of Science	Big Idea 1	SC.2.N.1	X					
Visual Arts Standards:	Kindergarten: VA.K.C.1.1, VA.K.O.3.1, VA.K.H.3.1							

Kindergarten Benchmarks

Science--Big Idea 1: The Practice of Science

- SC.K.N.1.2 - Make observations of the natural world and know that they are descriptors collected using the five senses.
- SC.K.N.1.3 - Keep records as appropriate -- such as pictorial records -- of investigations conducted.
- SC.K.N.1.4 - Observe and create a visual representation of an object which includes its major features.
- SC.K.N.1.5 - Recognize that learning can come from careful observation.

Visual Arts--Critical Thinking and Reflection

- VA.K.C.1.1 - Create and share personal works of art with others.

Visual Arts--Organizational Structure

- VA.K.O.3.1 - Create works of art to document experiences of self and community.

Visual Arts--Historical and Global Connections

- VA.K.H.3.1 - Express ideas related to non-art content areas through personal artworks.

First Grade Benchmarks

Science--Big Idea 1: The Practice of Science

- SC.1.N.1.1 - Raise questions about the natural world, investigate them in teams through free exploration, and generate appropriate explanations based on those explorations.
- SC.1.N.1.2 - Using the five senses as tools, make careful observations, describe objects in terms of number, shape, texture, size, weight, color, and motion, and compare their observations with others.
- SC.1.N.1.3 - Keep records as appropriate - such as pictorial and written records of investigations conducted.

Second Grade Benchmarks

Science–Big Idea 1: The Practice of Science

- SC.2.N.1.1 - Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations.

National Next Generation Science & National Core Art Standards

Kindergarten Standards

Science–Energy

- K-PS3-1 - Make observations to determine the effect of sunlight on Earth’s surface.

Visual Arts–Creating

- Cr.2.3.K - Create art that represents natural and constructed environments.

First Grade Standards

Visual Arts–Creating

- Cr.1.2.1a - Use observation and investigation in preparation for making a work of art.