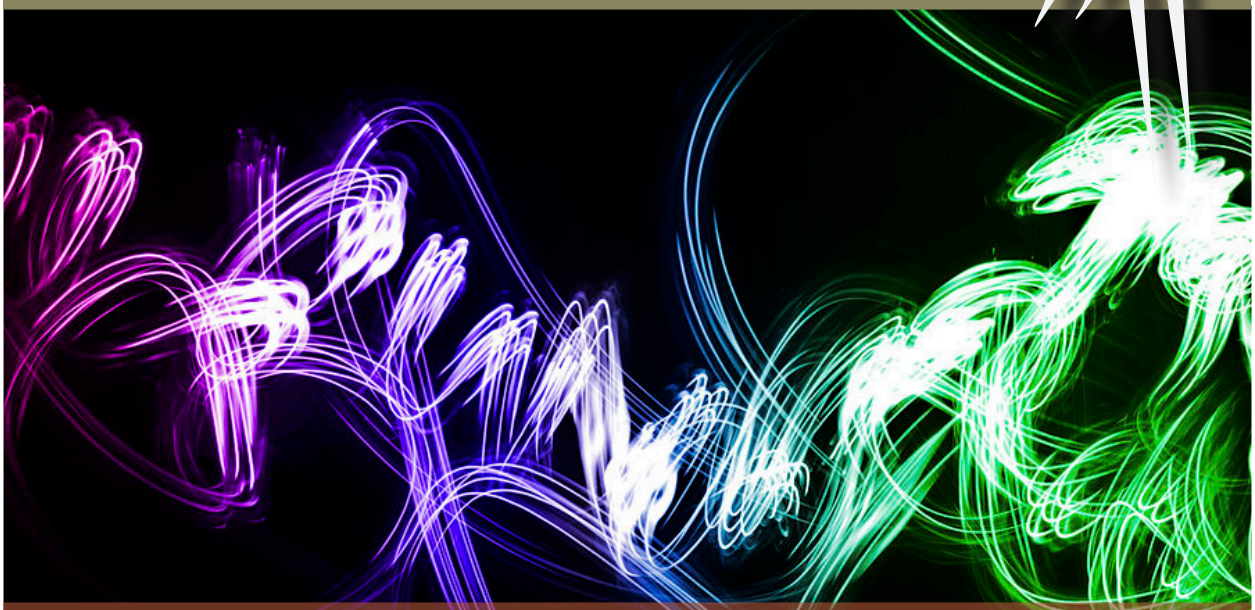
Five Stars Pathway
Afterschool Science Curriculum



Rainbows of Light: The Visible Light Spectrum

Multiverse

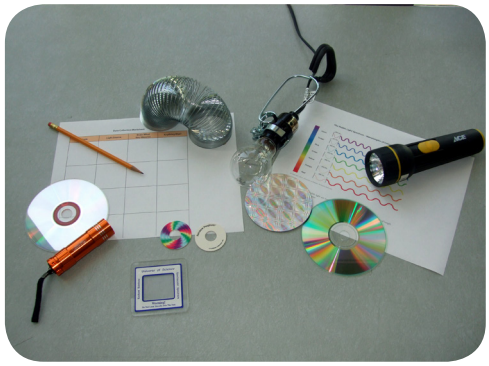
girls inc.®

Rainbows of Light: The Visible Light Spectrum

Age Range
Ages 10+

Duration
45 minutes

Participants
~ 15



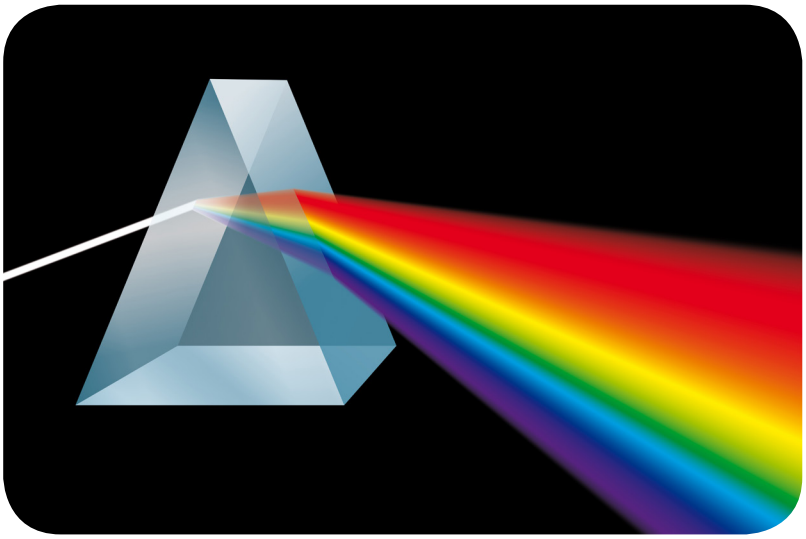
Overview

Participants explore with a variety of tools to observe some of the characteristics of visible light. By using prisms, CDs, and diffraction gratings, participants discover the rainbow spectrum that makes up white light and by using slinkies and ropes, participants learn about the way light travels. Participants act as scientists by making observations and recording their data.

Activity Goals

In this activity, participants will learn that:

- White light can be separated into a rainbow of colors.
- Light is made of waves of different lengths.
- Scientists make observations to learn about phenomena such as light.



"Prism rainbow schema". Licensed under Creative Commons Attribution-Share Alike 3.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Prism_rainbow_schema.png#mediaviewer/File:Prism_rainbow_schema.png

Multiverse

Rainbows of Light: The Visible Light Spectrum

Materials

One set of the following materials per each group of 3-4 participants:

- CD—(use old CDs so you don't mind if they get damaged)
- Prisms and diffraction gratings – several different kinds
- Several different kinds of white-light lights (e.g., regular flashlight, LED flashlight, incandescent light bulb, florescent lights, sunlight)
- Rope—individual jump ropes work well
- Slinky—one that stretches to 5'+ is easier to see
- Data sheet (see at end of lesson or on website - http://bit.ly/19nYUGS)
- Pencils and colored pencils/crayons
- Graphic of visible light spectrum wavelengths (see end of lesson or on website http://bit.ly/1BsLnVj)

NOTE: Prisms and diffraction gratings can be purchased online from sources such as Edmund Scientifics (www.scientificsonline.com) or Educational Innovations (www.teachersource.com).

Lesson Plan

1. Divide participants into small groups of 3 or 4 members each and give each group a set of the supplies listed above. If you have a class of 15 participants, we recommend dividing them into five groups of three members each.
2. Tell the participants to take time to explore and play with all of the materials in any way. Allow at least 15 minutes for free exploration. If necessary, suggest to participants that they try looking at the light sources through the non-light materials (i.e. CDs, prisms, diffraction gratings). As participants appear to need more instruction, go around to the different groups and ask them the following guiding questions (without providing answers):
   - What colors do you notice?
   - What do you notice about the order of the colors?
   - How do using different light sources change what you see?
   - What would happen if you go outside and shine sunlight on the CD and prisms? (Encourage them to go outside and check.)
3. After sufficient play time with the supplies, give each group or pair of participants a data sheet and have them record their observations, including drawing what they observed and writing down any questions that arise.
4. After each pair or group has completed their data sheet, come together as a whole group and ask each pair to share one observation or question they discovered from playing with the materials with the class. Address questions and validate observations. Explain that the CD and prism break up visible light into the rainbow colors called the visible light spectrum.
5. Most participants will observe and find the rainbows of light in the CDs, prisms, and diffraction gratings during the exploration time. But fewer will figure out what to do with the slinkies and ropes, so use these materials to guide participants through a wavelength demonstration together:
   - Have two participants hold each end of a jump rope and instruct them to make it wave like a snake. (It works best to do this on the ground or other horizontal surface. Gather the other participants around so that they can see the movement.)

lesson plan continued on next page...

Multiverse

Rainbows of Light: The Visible Light Spectrum

lesson plan continued from previous page...

- Ask participants to characterize what they see. For example: When you look at how the rope moves, what does it remind you of? Point out how the rope's movement is like a wave. Have the participants move the rope with more energy, then with less energy. Ask the group to notice what happens to the waves when the participants move the rope with more and less energy (higher energy = shorter wavelength; less energy = longer wavelength).

6. Conceptually connect the colors of rainbow with differing wavelengths by giving each pair/group of participants the graphic of the visible light wavelengths. Tell participants that each color of the visible light spectrum has a different wavelength. Explain that light moves in waves, similar to ocean waves. Point out the crests (tops) and troughs (bottoms) of the wavelength. Ask participants:
   - What do you notice about the length between each crest and trough for different colors of the visible light spectrum? [Possible responses include: the length of the red waves is shorter than the length of violet waves; wavelength is measured from crest-to-crest (or trough-to-trough); wavelength of visible light is measured using nanometers or nm.]
   - Which visible light color has the highest energy? [violet] Which has the lowest energy? [red]
7. Have the participants look again at the rainbow colors in the prisms/CDs. Point out that each of the colors represent a different wavelength of light.

Background Information

Visible light is the small part of the electromagnetic spectrum that human eyes can detect. When visible light travels through a prism or diffraction grating, it becomes separated into the colors of the rainbow. Each color of visible light has a different wavelength. All wavelengths of light move at the same speed, but different wavelengths have different energy. Within the visible spectrum, red light has the longest wavelength and is the least energetic while violet light has the shortest wavelength and is the most energetic. The study of light is extremely important to astronomy because it is the means by which we learn about the Universe. More background information available at http://multiverse.ssl.berkeley.edu/FiveStars#sciencebackground.

Further Resources

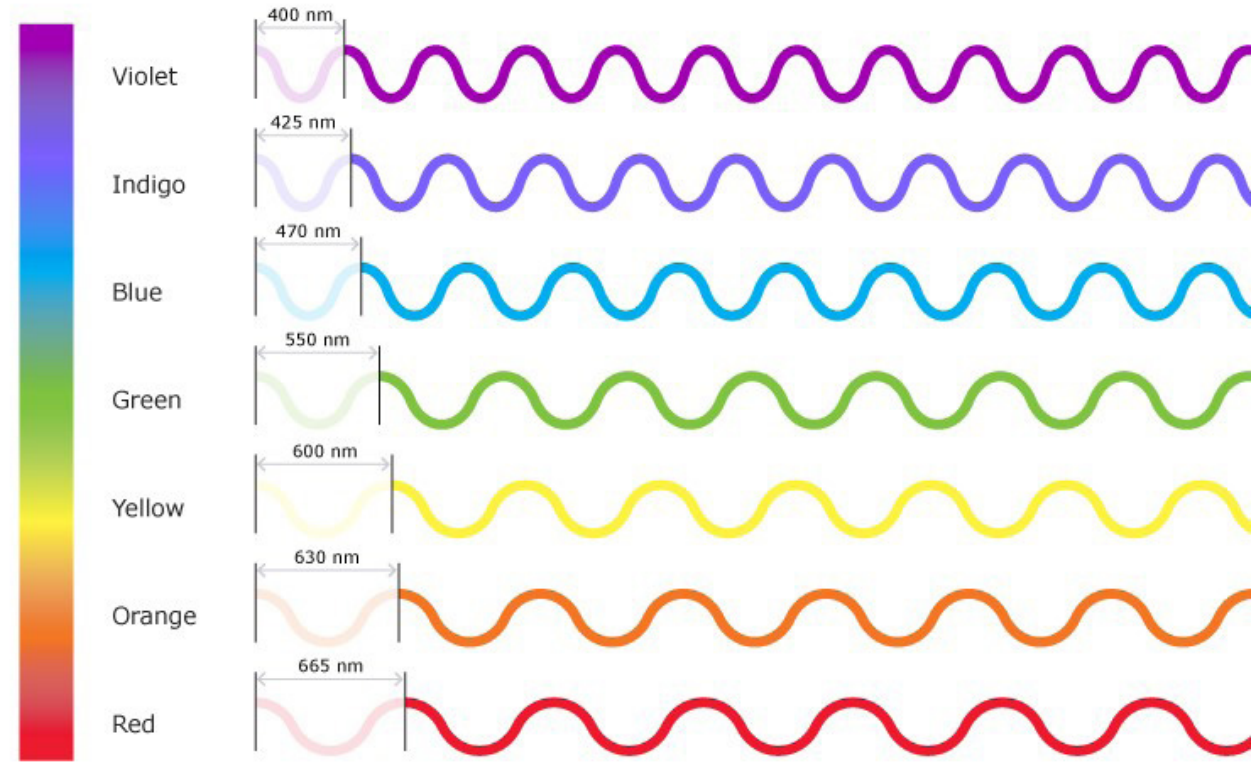
- **Science at NASA** video on visible light—http://www.youtube.com/watch?v=PMtC34pzKGc
- **NASA's Mission Science, Visible Light**—http://missionscience.nasa.gov/ems/09_visiblelight.html
- **NASA The Electromagnetic Spectrum Visible Light**—http://science.hq.nasa.gov/kids/imagers/ems/visible.html

Multiverse

Data Collection Worksheet

Tools	Light Source	Draw What You Observe	Anything Else?

The Visible Light Spectrum – Wavelengths of Colors



NOTE: Wavelengths of visible light are measured in nanometers (nm). A nanometer is a unit of length equal to one billionth of a meter.

The Five Stars Pathway project was funded by an EPOESS grant from NASA Science Mission Directorate under award #NNX12AE26G.

Multiverse

Space Science Laboratory
UC Berkeley
MC 7450
Berkeley, CA 94706
www.multiverse.ssl.berkeley.edu

Special thanks go to Girls Inc. of Alameda County, Girls Inc. of the Island City and the Five Stars students from UC Berkeley.