



MAKE A RAINBOW

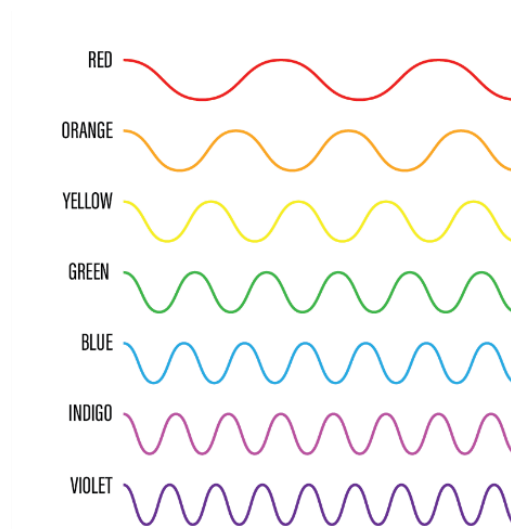


Most people would agree; a rainbow is a beautiful sight! Did you ever wonder how these beautiful arcs of color form in the sky?



Sunlight is considered white light, only a part of which can be seen by the human eye. White light is actually made up of all the colors of the rainbow blended together. The scientist Sir Isaac Newton identified the colors of the **visible light spectrum** that make up white light. Have you ever heard of ROYGBIV? If you can remember this **acronym** (an abbreviation formed from the first letters of other words), you can remember all the colors of the rainbow in order: **red**, **orange**, **yellow**, **green**, **blue**, **indigo**, and **violet**!

Light travels in waves that have both a **wavelength** and **frequency**. **Wavelength** is the distance between the crests of the waves. **Frequency** is a measure of the number of wave crests that pass a stationary point each second. Longer wavelengths have a lower frequency. Shorter wavelengths have a higher frequency. Each color in the visible light spectrum has a different wavelength, as you can see in the illustration below.



When light enters glass, it slows down and is bent or **refracted**. You can see the full spectrum of colors in white light if you shine a bright light, or focus sunlight, through a **prism**. A prism is a specially shaped crystal that separates light into all of its colors. The different wavelengths that make up white light bend at different angles, which is why the colors appear in a specific order.





An illustration of the separation of white light passing through a prism.

Similar to a prism, raindrops **reflect** (cast back from a surface) and **refract** (bend) sunlight to separate the colors in white light. This is what forms a rainbow. Most people are familiar with rainbows when it is raining, but they can also form in mist and fog, wherever there are water drops with light shining from behind. Even though rainbows appear as arcs in the sky, they are actually full circles of light. Because we view them from the ground, we only see half circles. If a rainbow forms while you are looking out of an airplane window, you may be lucky and see a full circle rainbow.



A full circle rainbow.

A double rainbow occurs when a second arc of color appears outside the primary rainbow. This happens when the light bends and reflects off the water droplets two times. Usually the secondary rainbow is not as bright as the primary rainbow. The next time you see a double rainbow, look closely and you will see that the colors are reversed in the secondary rainbow! As you can see in the picture below, the red is on the inside rather than on the outside of the secondary rainbow.



The image below is called a parhelion or “sun dog”, which is a bright spot in the sky that appears on either side of the sun. The spots are formed by the sun passing through ice crystals in clouds. You can sometimes see all of the colors of a rainbow in a parhelion.



Parhelion or “sun dog”



A very cool, canine version of a “sun dog”!

ACTIVITIES: Two simple ways to make your own rainbow

Method # 1:

- garden hose with a sprinkler head that will create a mist
 - sunlight
1. Stand with the sun at your back
 2. Turn on the water to create a spray
 3. Point the spray slightly upward
 4. A rainbow will appear before you just like one that you can see during a rainstorm.

Method # 2:

- drinking glass made of clear glass
 - water
 - sunlight
1. Fill your glass with water
 2. Take your glass of water outdoors
 3. Hold it up in front of a wall so that the sunlight can pass through the glass and onto the wall.
 4. Move the glass up and down and try tilting it at different angles.
 5. You will see the colors of the rainbow form on the wall. This may not form a bow, but you can see colors of the rainbow, much as you would see them if you had a prism.



Facts about light and rainbows:

- ☀ The Sun is part of an array of energy known as the **electromagnetic radiation spectrum**. This spectrum includes **visible light, ultraviolet light, infrared, radio waves, x-rays, and gamma rays**.
- ☀ **Physics** is the branch of science that studies light. The study of light is known as **optics**.
- ☀ The **speed of light** in a **vacuum** (a space that's entirely empty of matter) is **186,282 miles per second**. It takes approximately 8 minutes for light from the sun to reach the Earth.
- ☀ Most rainbows we see are primary rainbows, with red on the outer edge and violet on the inner edge.
- ☀ The process of light refracting through droplets to make a rainbow is called **Rayleigh scattering**.
- ☀ To see a rainbow, the sun always has to be behind you. You can't see a rainbow if you are facing the sun.
- ☀ No two people see a rainbow the same way. Someone standing next to you sees the rainbow from a set of water drops that are different from the drops forming the rainbow that you see!
- ☀ Rainbows are very bright when water droplets in the sky are large. They will be brighter if there is a big rainstorm.

ADDITIONAL RESOURCES

Books available from the Washoe County Library System:

[*Amazing Light*](#) by Sally Hewitt

[*Let's Make a Rainbow!: Seeing the Science of Light with Optical Physics*](#) by Chris Ferrie

[*The Rainbow and You*](#) by E. C. Krupp and Robin Rector

[*Rainbows Never End: And Other Fun Facts*](#) by Laura Lyn DiSiena and Hannah Eliot

[*Tell Me Why I See Rainbows*](#) by Kathryn Beaton

Videos:

PBS, It's Okay to be Smart, "What are Rainbows?" <https://www.pbs.org/video/its-okay-be-smart-rainbows/>

PBS, Learning Media, "Light and Color"

<https://thinktv.pbslearningmedia.org/resource/lps07.sci.phys.energy.lightcolor/light-and-color/>

PBS, Science Trek, "Light: Let There Be Light – Science Trek"

<https://thinktv.pbslearningmedia.org/resource/light-color-science-trek/light-color-science-trek/>

SciShow Kids, "How to Make a Rainbow" <https://youtu.be/Cm9ZkYTnCNE>



Websites:

Canadian Broadcasting Corporation, CBC Kids, Why Don't We See Rainbows All the Time?

<https://www.cbc.ca/kidscbc2/the-feed/why-dont-we-see-rainbows-all-the-time>

Met Office, How are Rainbows Formed?

<https://www.metoffice.gov.uk/weather/learn-about/weather/optical-effects/rainbows/how-are-rainbows-formed>

