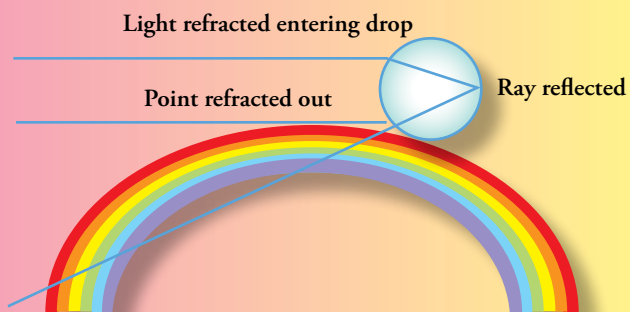


RAINBOWS

One of the world's most breathtaking natural beauties is the sight of a rainbow. Used throughout proverbs and childhood stories, rainbows have a mystical and magical appeal. Although this spectrum of light is inspiring to many, its explanation is rather simple. The formation of a rainbow was first studied and documented by Rene Descartes in 1637. He conducted an experiment studying how light reacts when shone upon a drop of water. He discovered that when a ray of light goes through a raindrop, that light is refracted or bent, reflected back by the arc or mirror-like surface of a droplet, and then refracted back out of the drop. This is the point at which we view the division of light or rainbow.



Since most raindrops are spherical in nature, the rainbow is most often seen as an arc or semicircle. The rainbow is in fact also spherical in nature, but due to the earth and other objects' blocking of the sunrays, we can only view part of the light's reflection. The closer to sunset, the more rainbow is visible. If it is near noon, we cannot view much of a rainbow because the sun is directly overhead. The sun's location also affects the visibility of rainbows. When viewing a rainbow, you will notice that the sun is always behind you and that the arc or middle of the rainbow is always in the opposite direction of the sun, with rain falling in the same direction as the rainbow.

Sunlight appears white to the eye but is actually made up of a range of colors. When light is refracted through a raindrop, the amount of the refraction is the deciding factor as to which color is viewed by the naked eye. The band of colors seen in a rainbow is actually the reflection and refraction of many raindrops.

The rainbow normally seen is called the primary rainbow. However, it is possible for two internal reflections to appear causing a second or double rainbow. This occurs when the rays from light exit the raindrop at a greater angle, causing a second, mirror image rainbow. Light can be reflected from the same drops more than twice, but this is rarely seen.

If you examine a rainbow, you will discover that there is always more light within the arc than the outside of the arc. This effect is because many small light refractions are being produced that are not rainbow-ray strength. These smaller rays fall underneath or inside the rainbow, leading

to more light in that location. Beyond the rainbow there is not as much reflection of light, which causes a darker sky. During a double rainbow, rainbow strength rays reflect through the water at a greater angle as well as at the normal angle. This results in a darkened area between the two rainbows.

The quality of the rainbow (color definition) depends on the size of the raindrops. The larger the raindrops, the brighter and more pure the colors of the rainbow. When light hits smaller drops, the rays are scattered and become weaker. More reflections are produced, which when overlapping produce a nearly white or clear vision to the eye. This also lends to the explanation of why we mainly see rainbows in the spring and summer versus the winter. During the winter, raindrops freeze into ice particles, which still scatter light but in a different way.

Because of the distribution of light and the angles involved in producing and viewing a rainbow, the same rainbow can never be seen by two different people. If the conditions causing the rainbow to appear produce enough reflection, that is close to the same location (angle), two people will be able to see similar rainbows. The only known means to see the exact same rainbow is through photography.

Reference:

The National Center for Atmospheric Research & the UCAR Office of Programs www.eo.ucar.edu/rainbows/

