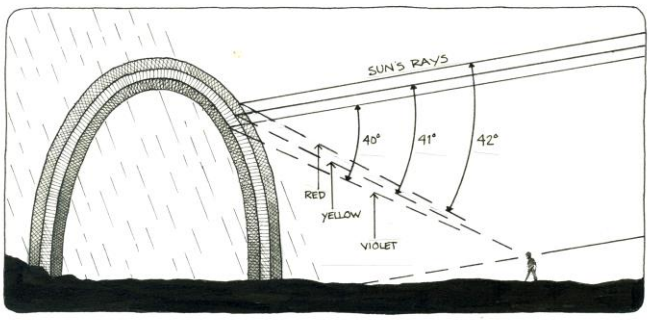
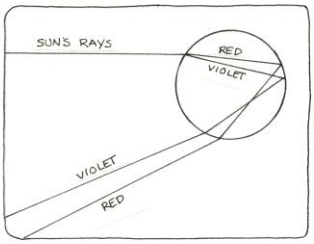
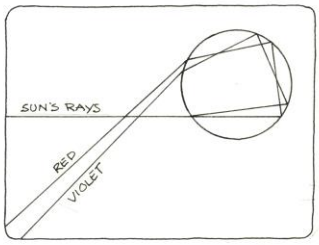
The Outside Story







Inside a Rainbow

By: Susan Shea

After a passing shower, when the sun comes out again, I often see a rainbow in the east behind my house, arching over the trees on the hilltop. Ancient peoples were awed by these multi-colored arcs in the sky and came up with a variety of explanations. To the Norse, a rainbow was a bridge connecting Earth with the home of the gods that could only be used by warriors killed in battle. In Japan, rainbows were the paths used by the original ancestors of humans to descend to earth from the heavens. In Hindu mythology, Indra, the god of thunder and war, uses a rainbow as an archer's bow to shoot arrows of lightning.

Today we understand more of the science behind rainbows. A rainbow forms when sunlight is separated into its spectrum of colors by the refraction (bending) and reflection of water droplets. It's easier to understand the physics if you consider what happens when a ray of sunlight passes through one raindrop suspended in the air. According to the National Oceanic and Atmospheric Administration, as light enters a raindrop, it is refracted, or bent to a different angle. Some of this light is then reflected by the curved, inner surface of the raindrop, and when it hits the other side of the raindrop, is refracted again, back out to the observer.

Light travels in waves, and the colors that make up white light have different wavelengths. The raindrop acts like a tiny prism. As the light is refracted and reflected by the water droplet, it splits into its component colors. The shorter wavelength light refracts slightly more than the longer wavelength light. The colors of a rainbow are always in order of their wavelength, longest to shortest: red, orange, yellow, green, blue and violet. There is also invisible light in a rainbow, including infrared and ultraviolet wavelengths.

Since a raindrop is round, it creates a circular reflection. However, unless you're in an airplane, you won't see the full circular rainbow because the Earth is in the way. Rainbows are an optical illusion — they don't exist in a specific spot in the sky. Each person sees a different rainbow depending on their position. The conditions for seeing a rainbow are very specific, which is why we don't see them more often. In order to see a rainbow, you must be standing with the sun at your back and looking at rain or water droplets suspended in front of you. The sun needs to be less than 42 degrees above the horizon, and the sun's rays must be shining on the raindrops.

There are many variations of rainbows. Not all of the sunlight shining on a raindrop escapes after it is reflected and refracted once. Double rainbows

form when some of that light is reflected again, travels along a different path, and emerges at a different angle. The colors of this secondary rainbow are reversed, a mirror image of the primary rainbow. Twinned bows are two distinct rainbows that emerge from a single point. Rainbows can form anywhere moisture is in the air, such as over waterfalls, breaking ocean waves, or in fog. Fog rainbows are not as colorful as other rainbows since the water droplets in fog are smaller. Sunlight reflected by the moon can produce a lunar rainbow, or moonbow.

Rainbows are more common in Vermont and New Hampshire than in many other states, said Christopher Kurdek, a meteorologist with the Fairbanks Museum and Planetarium, because we have a lot of pop-up showers and thundershowers. Our latitude, the influence of the jet stream, and our mountainous topography all create active, changing weather and a higher chance of passing showers. Rainbows occur here in all seasons of the year, though they are much less frequent and the colors are more muted in winter. Winter precipitation tends to fall more steadily, and snowflakes and sleet, being more solid than raindrops, do not provide the refraction and reflection needed to see a bright uniform rainbow.

Kurdek saw a “super-bright” rainbow just east of his house recently, as the sun was setting. “What was really amazing was that it was still raining and I could also see sunlight twinkling off the water droplets.”

While it’s fascinating to learn the science behind rainbows, let’s not forget to continue to appreciate their beauty and mystery, as did cultures of old.

Susan Shea is a naturalist, conservationist, and freelance writer who lives in Brookfield, Vermont. The illustration for this column was drawn by Adelaide Tyrol. The Outside Story *is assigned and edited by* Northern Woodlands *magazine (www.northernwoodlands.org) and sponsored by the Wellborn Ecology Fund of the New Hampshire Charitable Foundation (wellborn@nhcf.org).*

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