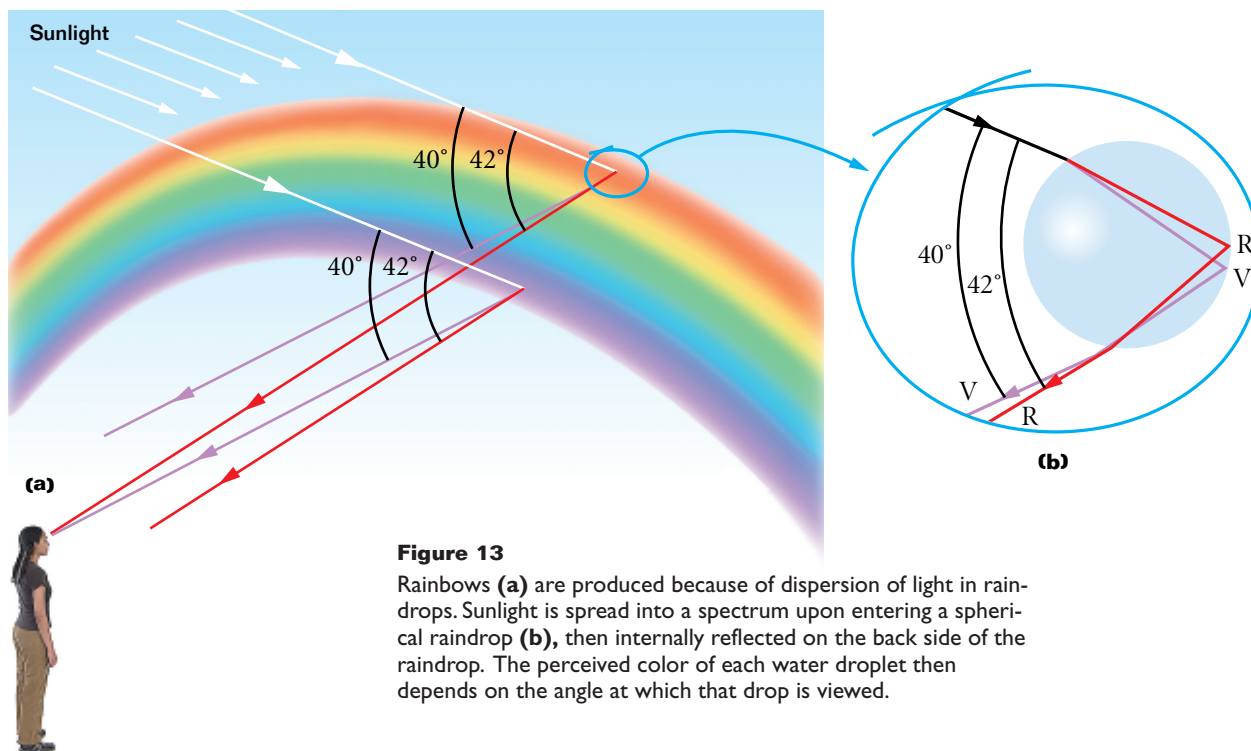


## Rainbows are created by dispersion of light in water droplets

The dispersion of light into a spectrum is demonstrated most vividly in nature by a rainbow, often seen by an observer positioned between the sun and a rain shower. When a ray of sunlight strikes a drop of water in the atmosphere, it is first refracted at the front surface of the drop, with the violet light refracting the most and the red light the least. Then, at the back surface of the drop, the



**Figure 13**

Rainbows (a) are produced because of dispersion of light in raindrops. Sunlight is spread into a spectrum upon entering a spherical raindrop (b), then internally reflected on the back side of the raindrop. The perceived color of each water droplet then depends on the angle at which that drop is viewed.

light is reflected and returns to the front surface, where it again undergoes refraction as it moves from water into air. The rays leave the drop so that the angle between the incident white light and the returning violet ray is  $40^\circ$  and the angle between the white light and the returning red ray is  $42^\circ$ , as shown in **Figure 13(b)**.

Now, consider **Figure 13(a)**. When an observer views a raindrop high in the sky, the red light reaches the observer, but the violet light, like the other spectral colors, passes over the observer because it deviates from the path of the white light more than the red light does. Hence, the observer sees this drop as being red. Similarly, a drop lower in the sky would direct violet light toward the observer and appear to be violet. (The red light from this drop would strike the ground and not be seen.) The remaining colors of the spectrum would reach the observer from raindrops lying between these two extreme positions.

Note that rainbows are most commonly seen above the horizon, where the ends of the rainbow disappear into the ground. However, if an observer is at an elevated vantage point, such as on an airplane or at the rim of a canyon, a complete circular rainbow can be seen.

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Topic: Dispersion of Light

Code: HF60416