ATMOSPHERIC REFRACTION

We see an example of refraction every day: the sun can be seen even after it has passed below the horizon. Rays of light from the sun strike Earth's atmosphere and are bent because the atmosphere has an index of refraction different from that of the near-vacuum of space. The bending in this situation is gradual and continuous because the light moves through layers of air that have a continuously changing index of refraction. Our eyes follow them back along the direction from which they appear to have come.

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Refracted light produces mirages

The *mirage* is another phenomenon of nature produced by refraction in the atmosphere. A mirage can be observed when the ground is so hot that the air directly above it is warmer than the air at higher elevations.

These layers of air at different heights above Earth have different densities and different refractive indices. The effect this can have is pictured in **Figure 11.** In this situation, the observer sees a tree in two different ways. One group of light rays reaches the observer by the straight-line path *A*, and the eye traces these rays back to see the tree in the normal fashion. A second group of rays travels along the curved path *B*. These rays are directed toward the ground and are then bent as a result of refraction. Consequently, the observer also sees an inverted image of the tree by tracing these rays back to the point at which they appear to have originated. Because both an upright image and an inverted image are seen when the image of a tree is observed in a reflecting pool of water, the observer subconsciously calls upon this past experience and concludes that a pool of water must be in front of the tree.

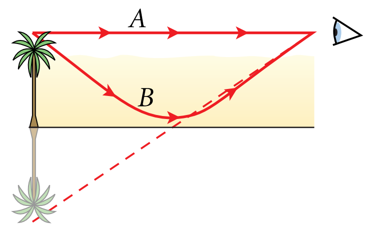

Figure 11
A mirage is produced by the bending of light rays in the atmosphere when there are large temperature differences between the ground and the air.

DISPERSION

An important property of the index of refraction is that its value in anything but a vacuum depends on the wavelength of light. Because the index of refraction is a function of wavelength, Snell's law indicates that incoming light of different wavelengths is bent at different angles as it moves into a refracting material. This phenomenon is called **dispersion.** As mentioned in Section 1, the index of refraction decreases with increasing wavelength. For instance, blue light ($\lambda \approx 470$ nm) bends more than red light ($\lambda \approx 650$ nm) when passing into a refracting material.

dispersion

the process of separating polychromatic light into its component wavelengths

White light passed through a prism produces a visible spectrum

To understand how dispersion can affect light, consider what happens when light strikes a prism, as in **Figure 12.** Because of dispersion, the blue component of the incoming ray is bent more than the red component, and the rays that emerge from the second face of the prism fan out in a series of colors known as a *visible spectrum*. These colors, in order of decreasing wavelength, are red, orange, yellow, green, blue, and violet.

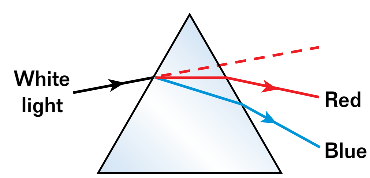

Figure 12
When white light enters a prism, the blue light is bent more than the red, and the prism disperses the white light into its various spectral components.