FYI Breaking Up Light with a Diffraction Grating

In 1666 (published in 1704), Sir Isaac Newton discovered that a thin beam of sunlight will produce a color spectrum (like a rainbow) when passed through a prism. Light travels more slowly in glass than in air, causing the beam of light to bend when it enters the glass. Moreover, each wavelength travels at a slightly different speed in the glass, such that each color is bent by a different amount. This has the effect of spreading out the light so that each color can be viewed individually. This process is called **refraction**.

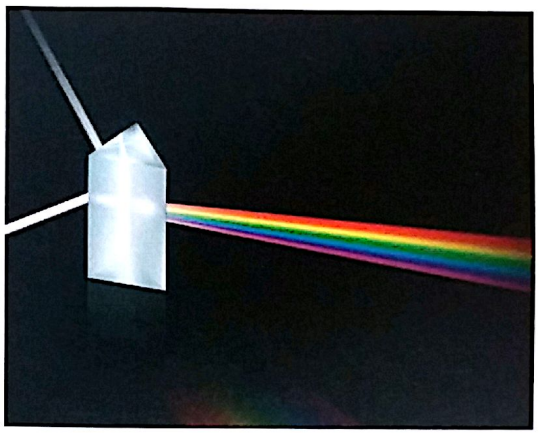

Figure 4-7: Drawing showing white light passing through a prism and breaking into colors

Astronomers use devices called diffraction gratings to produce the same spreading effect through the process of **diffraction**. Diffraction is the bending and spreading of waves as they pass by an obstruction or through a gap. A **diffraction grating** is typically a thin sheet of glass or plastic with hundred to thousands of closely spaced parallel lines etched onto its surface. The space between the lines and the wavelength of light determine how much the light is bent as it passes through the grating. The angle by which each color of light is bent is directly proportional to the wavelength. This means that longer wavelengths are bent more than shorter wavelengths are.

Figure 4-8: The grooves in a CD can diffract light

A **spectroscope** uses a diffraction grating to spread out white light into its component colors while also providing a ruler to determine the corresponding wavelengths for each color. This is the instrument astronomers use to decode the hidden messages carried by the light from distant objects. By using the technique of **spectroscopy**—interpreting the pattern and brightness of wavelengths present in an object's spectrum—astronomers can learn about the color, temperature, and chemical composition of that object.