narrowed, the light eventually begins to spread out and produce a *diffraction pattern,* such as that shown in **Figure 11.** Like the interference fringes in the double-slit demonstration, this pattern of light and dark bands arises from the combination of light waves.

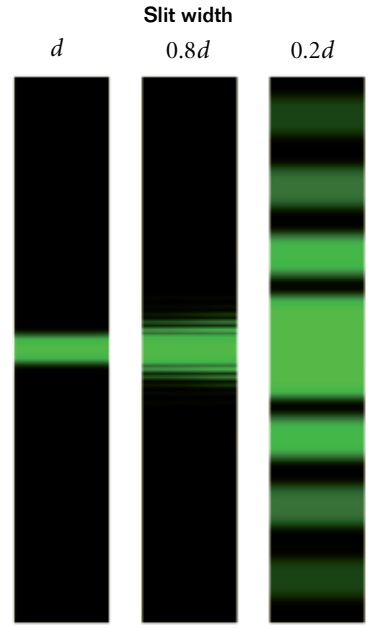

Figure 11
Diffraction becomes more evident as the width of the slit is narrowed. (Note: The wavelength of this light is 510 nm.)

Wavelets in a wave front interfere with each other

Diffraction patterns resemble interference patterns because they also result from constructive and destructive interference. In the case of interference, it is assumed that the slits behave as point sources of light. For diffraction, the actual width of a single slit is considered.

According to Huygens' principle, each portion of a slit acts as a source of waves. Hence, light from one portion of the slit can interfere with light from another portion. The resultant intensity of the diffracted light on the screen depends on the angle, θ, through which the light is diffracted.

To understand the single-slit diffraction pattern, consider **Figure 12(a),** which shows an incoming plane wave passing through a slit of width *a.* Each point (or, more accurately, each infinitely thin slit) within the wide slit is a source of Huygens wavelets. The figure is simplified by showing only five among this infinite number of sources. As with double-slit interference, the viewing screen is assumed to be so far from the slit that the rays emerging from the slit are nearly parallel. At the viewing screen's midpoint, all rays from the slit travel the same distance, so a bright fringe appears.

The wavelets from the five sources can also interfere destructively when they arrive at the screen, as shown in **Figure 12(b).** When the extra distance traveled by the wave originating at point 3 is half a wavelength longer than the wave from point 1, these two waves interfere destructively at the screen. At this same time, the wave from point 5 travels half a wavelength farther than the wave from point 3, so these waves also interfere destructively. With all pairs of points interfering destructively, this point on the screen is dark.

For angles other than those at which destructive interference completely occurs, some of the light waves remain uncanceled. At these angles light appears on the screen as part of a bright band. The brightest band appears in the pattern's center, while the bands to either side are much dimmer.

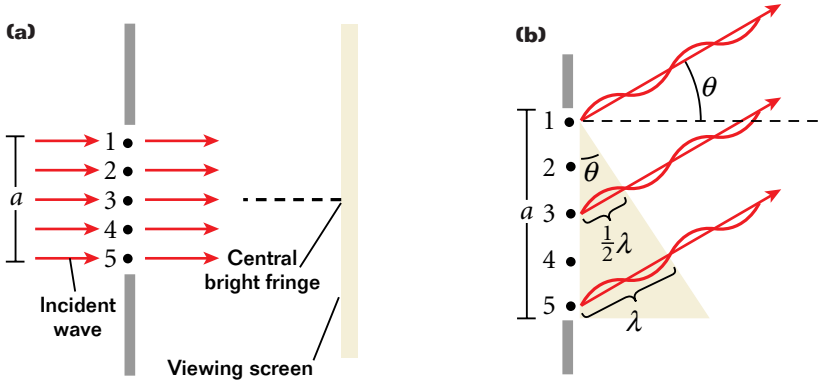

Figure 12
(a) By treating the light coming through the slit as a line of infinitely thin sources along the slit's width, one can determine **(b)** the conditions at which destructive interference occurs between the waves from the upper half of the slit and the waves from the lower half.