COMBINATION OF THIN LENSES

If two lenses are used to form an image, the system can be treated in the following manner. First, the image of the first lens is calculated as though the second lens were not present. The light then approaches the second lens as if it had come from the image formed by the first lens. Hence, *the image formed by the first lens is treated as the object for the second lens.* The image formed by the second lens is the final image of the system. The overall magnification of a system of lenses is the product of the magnifications of the separate lenses. If the image formed by the first lens is in back of the second lens, then the image is treated as a virtual object for the second lens (that is, p is negative). The same procedure can be extended to a system of three or more lenses.

Compound microscopes use two converging lenses

A simple magnifier, such as a magnifying glass, provides only limited assistance when inspecting the minute details of an object. Greater magnification can be achieved by combining two lenses in a device called a *compound microscope.* It consists of two lenses: an objective lens (near the object) with a focal length of less than 1 cm and an eyepiece with a focal length of a few centimeters. As shown in **Figure 8,** the object placed just outside the focal point of the objective lens forms a real, inverted, and enlarged image that is at or just inside the focal point of the eyepiece. The eyepiece, which serves as a simple magnifier, uses this enlarged image as its object and produces an even more enlarged virtual image. The image viewed through a microscope is upside-down with respect to the actual orientation of the specimen, as shown in **Figure 8.**

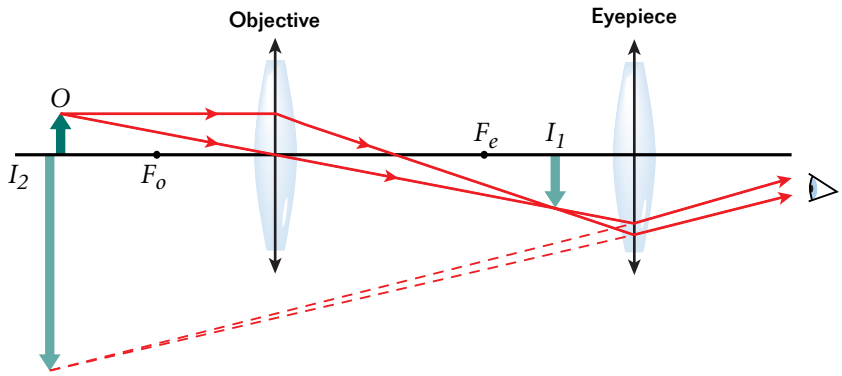

Figure 8
In a compound microscope, the real, inverted image produced by the objective lens is used as the object for the eyepiece lens.

The microscope has extended our vision into the previously unknown realm of incredibly small objects. A question that is often asked about microscopes is, "With extreme patience and care, would it be possible to construct a microscope that would enable us to see an atom?" As long as visible light is used to illuminate the object, the answer is no. In order to be seen, the object under a microscope must be at least as large as a wavelength of light. An atom is many times smaller than a wavelength of visible light, so its mysteries must be probed through other techniques.