Two other types of microscopes are important in the study of cells. The scanning electron microscope (SEM) and the transmission electron microscope (TEM) can produce images of objects as small as 0.002 micrometers. The light microscope can be used only for objects that are larger than 0.2 micrometers. Therefore, although a light microscope can be used to see many of the parts of a cell, only the SEM and TEM can be used for looking at the details of those parts.

In both the SEM and the TEM, tiny particles called electrons, not light, are used to produce images. The advantage of these microscopes is that they can magnify objects up to a million times. The disadvantage is that they cannot be used to study live specimens.

To be viewed with an SEM, a cell sample is coated in a heavy metal, such as gold. Then a beam of electrons is run back and forth over the surface of the cell. The electrons bounce off the coating and are read by a detector that produces a three-dimensional image of the surface.

A cell viewed with a TEM is sliced extremely thin. Electrons pass through a section. Images produced by a TEM appear two-dimensional.

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**Electron Microscopes**

**SEM**

1. An infected bacterial cell is coated with a heavy metal.
2. Beams of electrons bounce off the surface of the coated cell.
3. Images produced by an SEM appear three-dimensional.

**TEM**

1. An infected bacterial cell is sliced into very thin sections.
2. Beams of electrons pass through the thin section.
3. Images produced by a TEM appear two-dimensional.