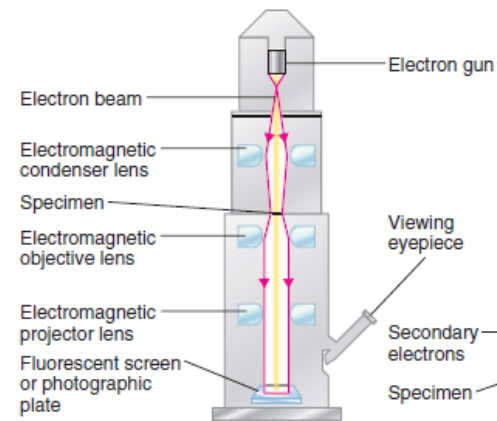


## Transmission Electron Microscopy

In the **transmission electron microscope (TEM)**, a finely focused beam of electrons from an electron gun passes through a specially prepared, ultrathin section of the specimen (**Figure 3.10a**). The beam is focused on a small area of the specimen by an electromagnetic condenser lens that performs roughly the same function as the condenser of a light microscope—directing the beam of electrons in a straight line to illuminate the specimen.

Electron microscopes use electromagnetic lenses to control illumination, focus, and magnification. Instead of being placed on a glass slide, as in light microscopes, the specimen is usually placed on a copper mesh grid. The beam of electrons passes through the specimen and then through an electromagnetic objective lens, which magnifies the image. Finally, the electrons are focused by an electromagnetic projector lens (rather than by an ocular lens as in a light microscope) onto a fluorescent screen or photographic plate. The final image, called a *transmission electron micrograph*, appears as many light and dark areas, depending on the number of electrons absorbed by different areas of the specimen.

The transmission electron microscope can resolve objects as close together as 10 pm, and objects are generally magnified 10,000 to 100,000 $\times$ . Because most microscopic specimens are so thin, the contrast between their ultrastructures and the background is weak. Contrast can be greatly enhanced by using a “stain” that absorbs electrons and produces a darker image in the stained region. Salts of various heavy metals, such as lead, osmium, tungsten, and uranium, are commonly used as stains. These metals can be fixed onto the specimen (*positive staining*) or used to increase the electron opacity of the surrounding field (*negative staining*). Negative staining is useful for the study of the very smallest specimens, such as virus particles, bacterial flagella, and protein molecules.



**A Read the text and find the synonyms for these words:**

- 1 very thin (1)
- 2 approximately (1)
- 3 to shine light on sth (1)
- 4 to make look larger (2)
- 5 last (2)
- 6 to start to be seen (2)
- 7 to determine (3)
- 8 to improve the quality (3)

**B Read the text and answer the questions:**

- 1 Which part of the electron microscope is used to direct the beam of electrons onto the specimen?
- 2 Which part of the EM controls focus?
- 3 Where usually is the specimen placed in the EM?
- 4 Does the beam of electrons pass first through the specimen or the objective lens?
- 5 How do we call the picture obtained by the EM?
- 6 What is the resolution and the magnification of the EM?
- 7 How do we improve the contrast?
- 8 What is the difference between positive and negative staining?