

BIOLOGICAL TOOLS AND TECHNIQUES

The microscope is a very important biological tool. The invention of the microscope revealed a whole new world to biologists. They were able to extend the limits of what could be seen. The microscope made it possible to make observations, ask questions, and find answers like never before! It was a major development in science that was essential to the development of cell theory.

There are several different types of microscopes, but the two major types are classified according to the method used to produce an image:

1. THE LIGHT MICROSCOPE

- This is a device that consists of a lens, or series of lenses that produce an enlarged image of small objects.
- It was invented in the 1500s and used by such early scientists as Hooke and Leeuwenhoek to study cells.

Disadvantage of the light microscope:

- Light is used to focus. The nature of visible light limits resolution. Resolution is the ability to distinguish between objects that are close together.
- Resolving power of light microscopes is limited to $0.2 \mu\text{m}$, which is actually quite poor.
- It doesn't matter what the magnification of the lenses may be, it is the resolution that determines the effectiveness of the instrument.

2. THE ELECTRON MICROSCOPES

- There are two basic types of electron microscopes, the TEM and the SEM.
- Both operate not on light, but by using a beam of electrons to focus the image, which is then viewed on a television monitor or directly on a photographic plate.
- The earliest electron microscopes weren't any better than light microscopes, until Canadian scientists at the University of Toronto improved on the technology.

A. The TEM - Transmission Electron Microscope

- These can magnify up to a million times, but are best at magnifications up to 500 000x.
- Their resolution is 0.0002 μm (a thousand times better than the light!).

Disadvantage of the TEM:

- Specimens must be frozen and sliced very thinly
- Freezing the specimen may distort it
- Only two-dimensional(2D) view is possible

B. The SEM - Scanning Electron Microscope

- The SEM scans the surface so whole organisms may be used.
- Specimens are coated with a metal, usually gold, which holds the contours and shape of the specimen to produce a three- dimensional image on a television monitor

Disadvantage of the SEM:

- SEM has lower resolution than the TEM
- SEM has lower magnification than TEM
- Since specimens are often coated with gold, it may be expensive to operate

(FOR OTHER TOOLS AND TECHNIQUES, REFER TO YOUR WORKSHEET ENTITLED *Other Tools and Techniques of the Biologist*).