

MICROSCOPES

Microscopes

- **Definition:** Microscopes are instruments that help to magnify microorganisms in order to make them visible. The lenses produce magnified images that allow us to visualize the form and structure of the microorganisms
- **Types of microscopes**
- There are two major types which are further divided into subtypes
- **1. Light microscopes:**
 - Use visible light or ultraviolet rays to illuminate specimens
 - Use lenses to observe specimens
- **2. Electron microscopes:**
 - Use electron beams instead of light rays
 - Use magnets instead of lenses to observe specimens.

- **Light microscopes**
- They are further divided into two major groups
- a. Simple microscopes: use one lens
- b. Compound microscopes: use two lenses
- **Electron microscopes**
- They are further divided into two groups:
- a. Scanning electron microscopes
- b. Transmission electron microscopes
- **Simple microscope**
- It uses natural light
- No condenser lens and only one lens
- Very low magnification of up to x300.

- **Compound microscope**
- A compound microscope is a type of light microscope that uses two sets of lenses to obtain high magnification of up to 2000x
- **Lenses used:**
 - the ocular lens in the eyepiece and
 - the objective lens located in the nose-piece
- **The most common compound microscopes are:**
 - 1. Bright-field microscope
 - 2. Dark-field microscope
 - 3. Fluorescence microscope
 - 4. Phase-contrast microscope

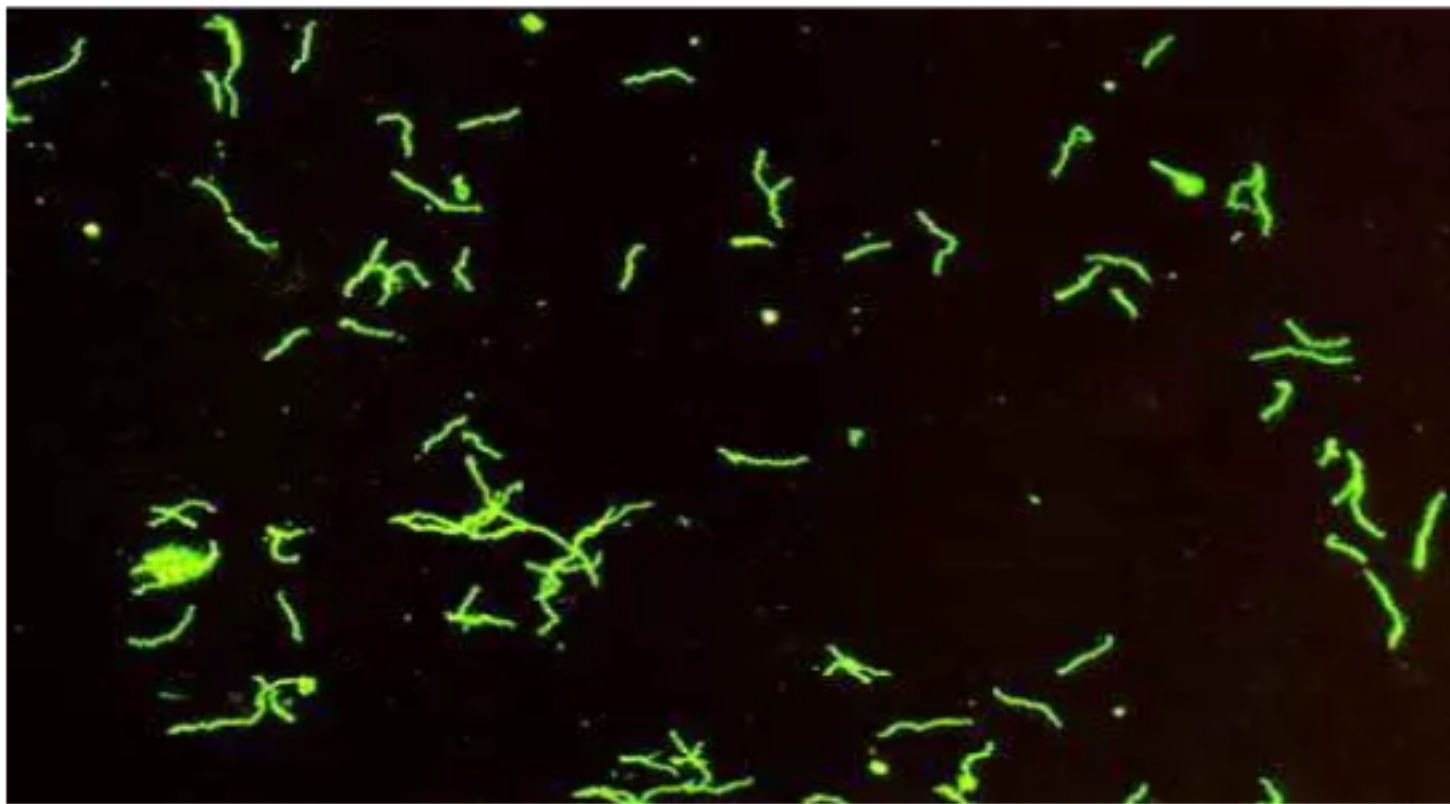
- **Bright-field microscope**
- The specimen is illuminated by a beam of tungsten light focused on it by a sub-stage lens called a condenser
- The specimen appears dark against a bright background
- **Limitation:** Absence of contrast between the specimen and the surrounding medium, which makes it difficult to observe living cells
- Therefore, stained specimens of nonviable cells are often required to increase contrast and color differentiation



Bright-field light microscope

- **Dark-Field Microscope**

- It is used to examine living microorganisms that are invisible in bright-field microscopy,
- Living microorganisms do not stain easily, or
- are distorted by staining
- For example, in suspected cases of syphilis, chancre fluid is examined by dark-field microscopes to detect *Treponema pallidum*
- A dark-field microscope uses a dark-field condenser instead of the normal condenser
- An opaque disk of this condenser blocks the light that would enter the objective lens directly
- The only light that is reflected or refracted by the specimens enters the objective lens and forms an image
- The field surrounding a specimen appears dark and the specimen appears brightly illuminated so the name dark-field microscope



Dark field of a microscope

- **Phase-Contrast Microscope**
- Phase-contrast microscope is a bright field-light microscope with the addition of a special phase-contrast objective and a phase contrast condenser
- **Uses:**
 - To study living cells without staining.
 - To study microbial motility.
 - To observe endospores and inclusion bodies

- **Fluorescence Microscope**

- A fluorescence microscope is much the same as a conventional light microscope but it uses light of higher intensity as a light source instead of visible light.
- It uses ultraviolet or blue light
- A specimen is stained with a fluorescent dye (fluorochrome) and then exposed to light of a shorter wavelength (ultraviolet or blue light)
- The light is absorbed by the specimen stained with fluorochrome and releases fluorescent (or green) light of a longer wavelength
- This produces a bright image on a dark background.

- **Electron microscopes**

- They use electron beams as an illumination source and
- examine structures too small to be resolved with light microscopes such as viruses or objects or molecules having sizes smaller than $0.2\text{ }\mu\text{m}$
- The resolving power of the electron microscope is far greater than that of the light microscopes
- Due to the use of a shorter wavelength of electrons, better resolution is obtained
- The wavelengths of electrons are about 100,000 times smaller than the wavelengths of visible light
- **Transmission electron microscope**
- It is used to examine cells and cell structure even nucleic acid molecules (that is, morphology and internal composition) can be visualized