

Chapter 4 – Microscopes

1. Identify the two primary metric units used to measure the diameters of microbes

- Micrometers and nanometers

2. List the metric units of length in order, from meter to nanometer

- Meter → Decimeter → Centimeter → Millimeter → Micrometer → Nanometer
- (1 → 1×10^{-1} → 1×10^{-2} → 1×10^{-3} → 1×10^{-6} → 1×10^{-9})

3. Explain the relevance of electromagnetic radiation to microscopy

- The electromagnetic spectrum includes visible light and UV light.
- Depending on the wavelengths, different colors are interpreted by the human eye.
- Radiation of smaller wavelengths enhances microscopy.

4. Define empty magnification

- Empty magnification is combining lenses to augment an image millions of times, but the image remains faint and blurry, thus useless.

5. List and explain the two factors that determine resolving power

- Resolving power, or resolution, is the ability to distinguish objects that are close together.
 - **Wavelength of electromagnetic radiation** - the shorter the wavelength, the higher the resolving power.
 - **The aperture of the lens** - the ability of a lens to gather light.

6. Know how to calculate resolving power

- Resolving Power = wavelength / (2 x numerical aperture)

7. Discuss the relationship between contrast and staining in microscopy

- **Contrast**: the difference in intensity between two objects or between an object and its background.
- A way to increase the contrast between microorganisms and their background is to **stain** them.

8. Contrast simple and compound microscopes

- Simple and compound microscopes are both types of bright-field microscopy
- **Simple microscopes** contain a single magnifying lens.
- A **compound microscope** uses a series of lenses for magnification.

9. Compare and contrast bright field, dark field, phase, and fluorescence microscopy

- **Bright field microscopy** involves an illuminated background as light travels through the specimen.
- **Dark field microscopy** involves scattered light reaching the objective lens making the specimen appear illuminated against a dark background (high contrast).
- **Phase microscopy** is used on living organisms that would be altered or damaged by attaching them to slides or staining them.
 - *In phase* when the crests and troughs are aligned, producing a brighter image.
 - *Out of phase* when the crests and troughs are not aligned, producing a darker image.