

# Transmission Electron Microscope (TEM): Quick Notes

**Definition:** The Transmission Electron Microscope (TEM) uses a beam of high-energy electrons to visualize thin specimens at molecular and subcellular levels. It provides extremely high resolution compared to light microscopes.

**Principle:** TEM works on the interaction of electrons with matter. Electrons have shorter wavelengths than visible light (de Broglie principle), giving higher resolving power.

## Key Components:

- Electron source – emits high-energy electrons.
- Electromagnetic lenses – focus the electron beam.
- Vacuum column – prevents scattering of electrons by air.
- Fluorescent screen/camera – records the image.

## Specimen Preparation Steps:

- Fixation – preserves structures (glutaraldehyde, osmium tetroxide).
- Dehydration – removes water using ethanol or acetone.
- Embedding – stabilizes with resin.
- Sectioning – ultrathin sections (50–100 nm).
- Staining – heavy metals (lead, uranium) enhance contrast.

## Applications:

- Cell Biology – visualize organelles (mitochondria, ER, ribosomes).
- Virology – study virus morphology.
- Microbiology – examine bacterial cell walls, flagella.
- Pathology – detect ultrastructural tissue changes.
- Molecular Biology – observe protein complexes and macromolecules.

## Advantages:

- High resolution (0.1–0.2 nm).
- Detailed intracellular visualization.
- Can analyze viruses and macromolecules.

## Limitations:

- Complex and time-consuming sample preparation.
- Samples must be in a vacuum (non-living).
- Expensive and requires expert operation.

**Conclusion:** TEM provides detailed visualization of biological structures beyond the limits of light microscopy. It is a fundamental tool for studying cellular and molecular ultrastructure despite its

limitations.