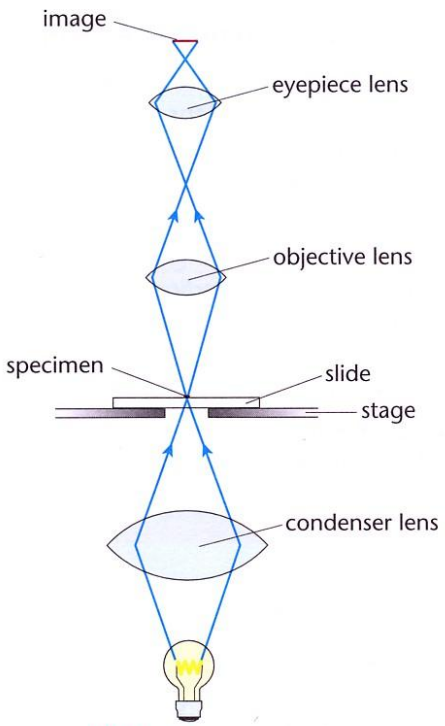
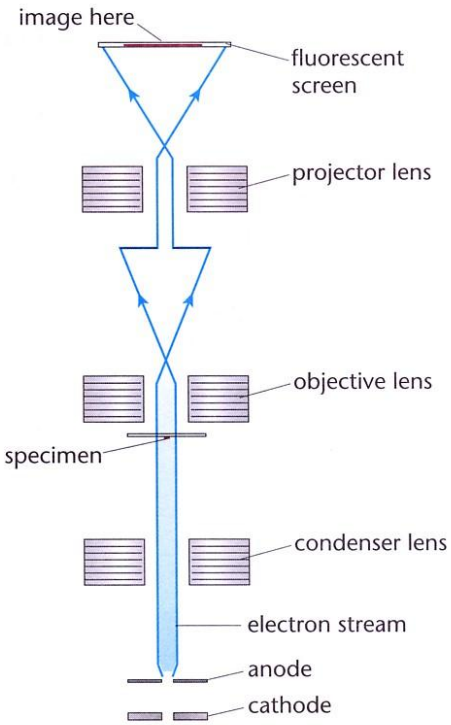
Worksheet: Date:

Electron microscopy

Microscopes magnify the image of a specimen to enable the human eye to see minute [winzig] objects not visible to the naked eye. Resolution [Auflösung] of a microscope is the ability to distinguish between two objects as separate entities [Einzelheiten, Ganzheiten]. At low resolution only one object may be detected. At high resolution two distinct objects are visible. At high resolution the image of such a specimen would show considerable [beträchtlich] detail.
The light microscope has limited resolution (0.02 (µm) due to the wavelength of light so that organelles such as mitochondria, although visible, do not have clarity. Electron microscopes have exceptional resolution. The transmission electron microscope has a high resolution (0.2 to 0.3 nm). This enables even tiny organelles to be seen.



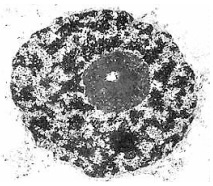
light microscope

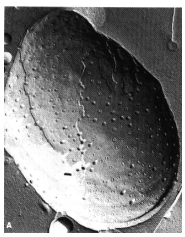


transmission electron microscope

Many specimens need staining [Anfärben] with chemicals so that tissues and, perhaps, organelles can be seen clearly, e.g. methylene blue is used to stain nuclei. Sometimes more than one stain is used, e.g. in differential staining, so that sub-cellular parts contrast against each other.

The electron microscope uses an electron stream which is directed at the specimen. The transmission electron microscope (TEM) has extremely high magnification and resolution properties. Specimens are placed in a vacuum within the microscope, to ensure the electrons do not collide with air molecules and distort [verzerren] the image. Stains ["Färbemittel"] such as osmium and uranium salts are used to make organelles distinct. These salts are absorbed by organelles and membranes differentially, e.g. some parts absorb more of the salts than other parts. In this way certain structures become visible: When the electron beam hits the specimen, electrons are unable to pass through dense [dicht] structures. The membrane, for example, shows up as a dark shadow area on the image. Cytoplasm (see photo on the right) allows more electrons to pass through. When these electrons hit the fluorescent screen visible light is emitted [aussenden] and the area is lighter.





The Scanning electron microscope (SEM) produces images of the surface of the specimen — so SEM can produce images that are a good representation of the 3D structure of the sample (see on left).

Artefacts

When microscopic specimens are prepared there are often several chemical and physical procedures. Often the material is dead so changes from the living specimen are expected. Microscopic material should be analysed with care because there may have been some artificial change in the material during preparation, e.g. next to some cells a student sees a series of small circles. They look like eggs but are merely air bubbles. These are artefacts; structures alien [fremd] to the material which should not be interpreted as part of the specimen.