

# Comparison of microscopic techniques/application

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## Introduction

Microscopes are instruments used for examining objects that are too small to be seen distinctly by the human eye. One of the main differences between the various types of microscopes is their application.

## Optical microscopy

The optical or light microscope uses visible light and a system of lenses for the magnification of image samples. Medical applications include tests on free cells or tissue fragments ("smear tests") such as in most fields of histology.

The reflected light-microscope is used for opaque substances as well as in fluorescence microscopy.

In medicine low power optical microscopes are used in form of dermatoscopes for the examination of skin lesions. Ophthalmologists use this technique in form of a binocular slit lamp to examine the anterior and posterior segments of the human eye.



Dermatoscope used by dermatologists

## Fluorescence microscopy

Fluorescence microscopy is an optical microscope that uses fluorescence and phosphorescence to analyze the properties of organic or inorganic substances.

This microscopic technique is widely used in biology. The most important applications of this technique are based on the specific staining of individual cell components. From the resulting image the cell components can be visualized due to the application of specific proteins. The observation of interactions between proteins as well as the tracking of individual processes in living cells is possible.

## Confocal microscopy

Confocal microscopy is an imaging technique that allows an increased optical resolution and contrast of a digital image. Today commonly used are confocal laser scanning microscopes (CLSM; point scanners).

In medicine confocal microscopy is widely used in studies in the field of neurophysiology, neuroanatomy and for morphological studies including a broad spectrum of tissues and cells.

It is a non-invasive technique that enables studying the corneal structure of the eye by mapping the conjunctiva and cornea.



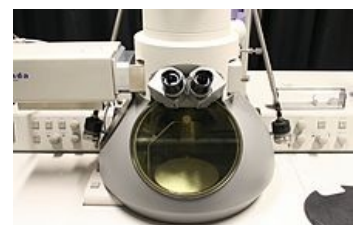
Confocal microscope used in neuroscience

## Electron microscopy

Electron microscopes use a beam of electrons to create an image of a given sample with much higher resolution than optical microscopes. There are two types, the transmission electron microscope and the scanning electron microscope.

In life science electron microscopes are applied for the visualization of 3D architectures of cells and tissues and for the observation of individual viruses as well as macromolecular complexes shown in their natural biological context. Electron microscopes are used to explore the molecular mechanisms of diseases and for cancer research. SEMs are also used in forensic science for microscopic analysis of clothing fibers or blood samples. Worldwide TEMs are used by nanomedicine centers, research laboratories or universities, affecting the daily life in many areas due to the immense magnification and resolution possibilities.

The application in medicine and biology include the localization of proteins, analysis of particles and the electron tomography (detailed 3D structure of cellular macromolecular objects). It is also used in toxicology and cryobiology. The latter includes



Transmission electron microscope (TEM)

the study of organisms that were rapidly frozen at cryogenic temperatures (below -150 °C). The aim of cryopreservation is to bring these organisms back to life after a long-term storage with minimal damage.

## Atomic force microscopy

Atomic force microscopy (AFM) is a high resolution type of scanning which uses Van-der-Waals forces to produce a surface image.

In chemistry it is used to explain the interactions of chemical substances.

A important application of AFM is the force spectroscopy. By measuring the forces directly at the interactions between the tip of the cantilever and the surface of the sample, a digital image can be created.

This technique enables the measurement of atomic boundings and shows the interactions of Van-der-Waals forces. In biophysics this technique is used for the measurement of mechanical properties of living material.

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