Advanced Cell Biology. Lecture 2

Alexey Shipunov

Minot State University

January 14th, 2011

Outline

Introduction to cells

- Microscopy
- Prokaryotic and eukaryotic cells

Previous final question: the answer

What is that?

Sinapsis—the contact between two neural cells

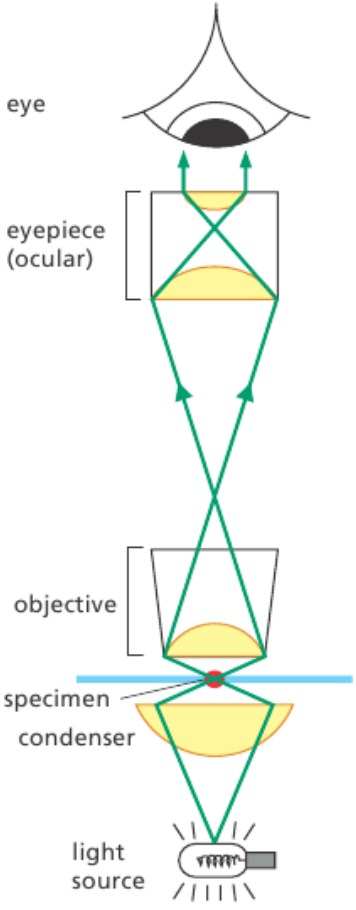
Miscroscopes

Light microscopy based on visible light rays and glass optics, most common are “transparency” microscopes where light goes through object (stained with specific **dyes** or not stained); there are also “reflection” (dissectoscopes) and fluorescent microscopes

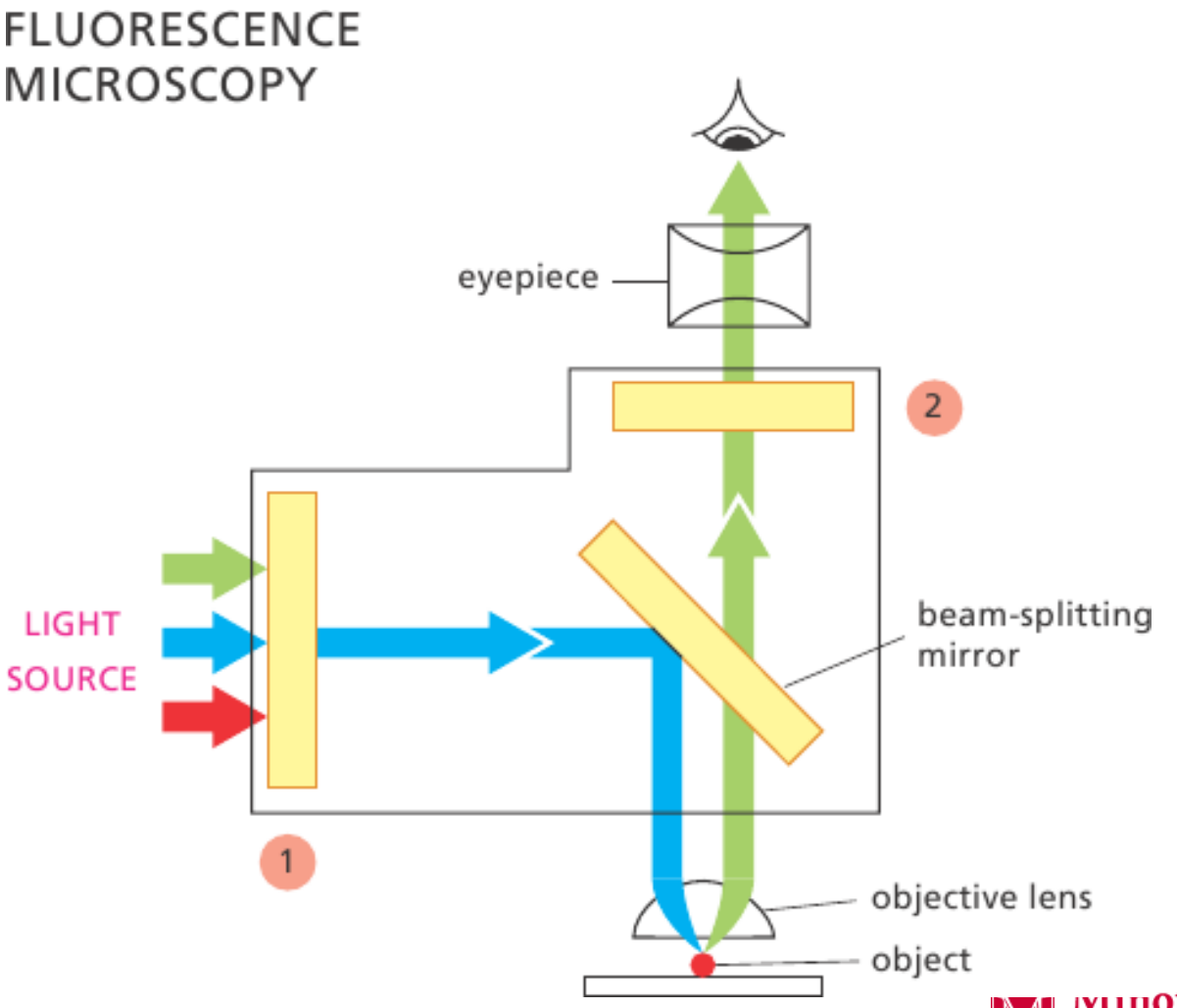
Transmission electron microscopy (TEM) based of the flow of electrons through specially prepared (usually stained with osmium, **Os**), extremely thin object; allows to see the internal organization of cells and organelles

Scanning electron microscopy (SEM) based on the electronic reflection from the surface covered with metals (typically, gold, **Au**) and provides an image of the surface of cells and organisms

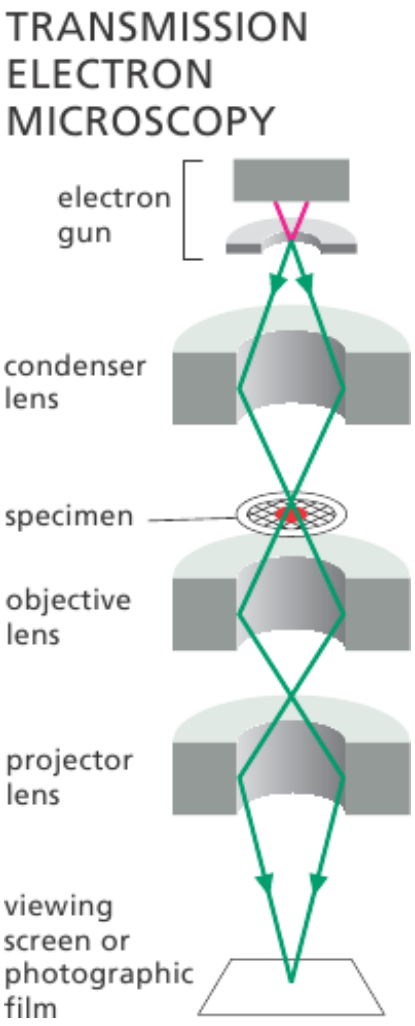
Light microscopy

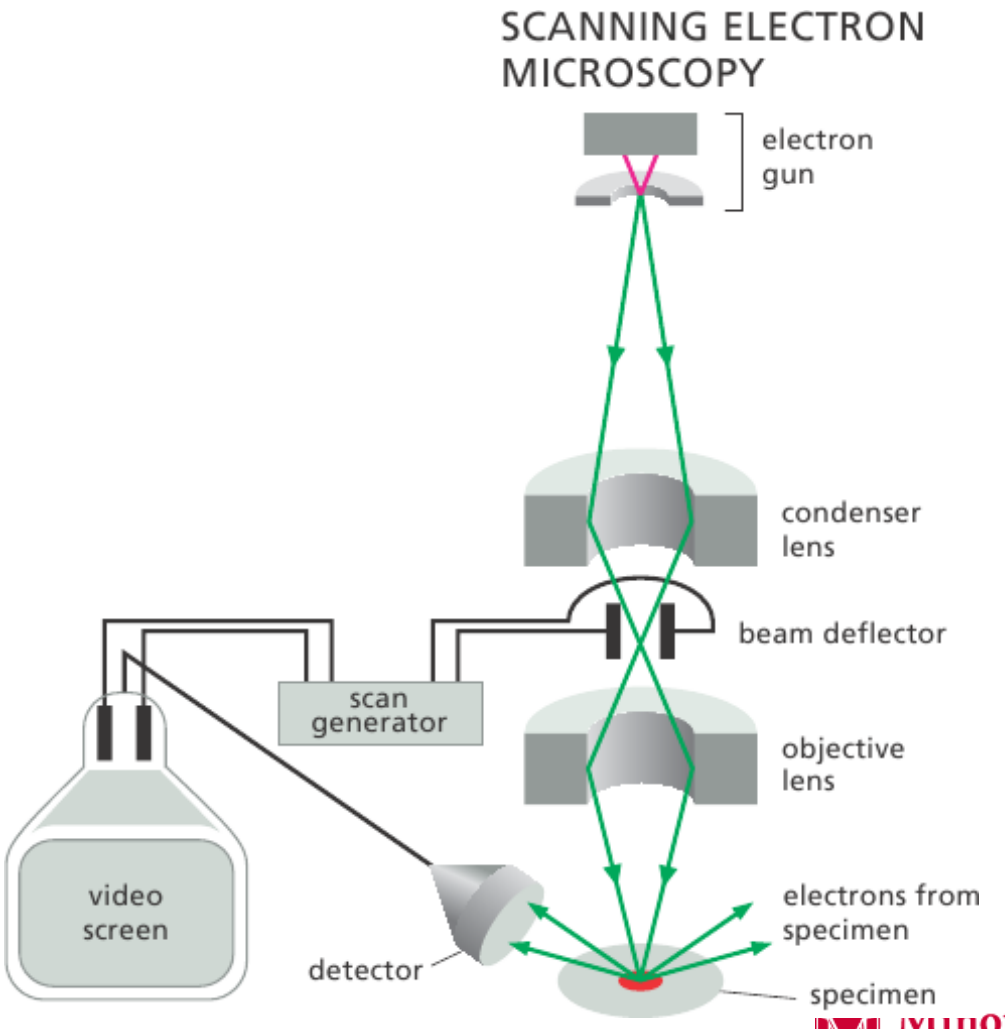


the light path in a light microscope



Electron microscopy





Organelles in prokaryotic and eukaryotic cells

- Prokaryotic: [cell wall], plasma membrane, cytosol, [vacuoles], [prokaryotic flagella], nucleoid, [tylacoids]
- Eukaryotic: [cell wall], plasma membrane, cytosol, nucleus, mitochondria, [chloroplasts], endoplasmatic reticulum, [Goldgi apparatus], vesicles (vacuoles, lysosomes etc.), cytoskeleton, [eukaryotic flagella]

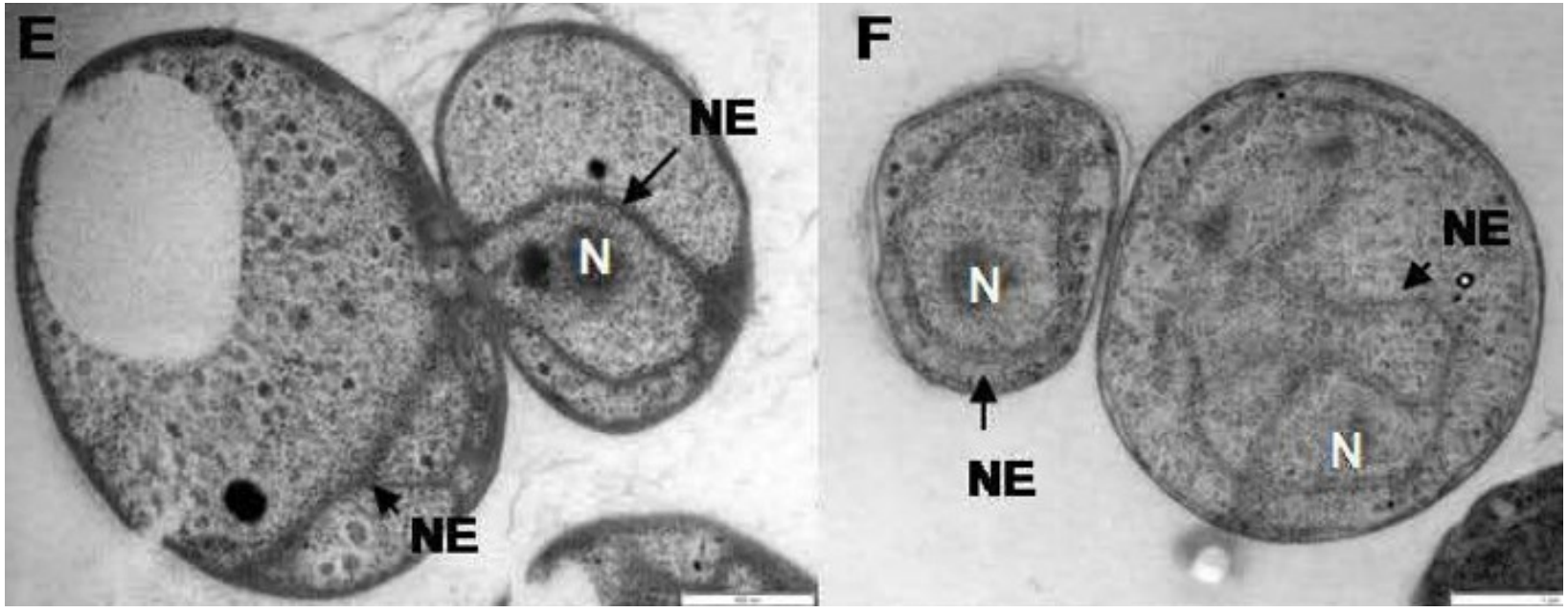
Comparison of prokaryotic and eukaryotic cells

Please copy drawings from a board

Comparative biology of prokaryotic and eukaryotic cells

- Eukaryotic cells are 10–100 times bigger than prokaryotic*
- Eukaryotes have cell motility and capable to endo- and exocytosis*
- Prokaryotes have combined RNA and protein synthesis
- Prokaryotes are more diverse chemically, whereas eukaryotes are more diverse morphologically

PCV bacteria have nucleus-like structures



From Lee et al., 2010

Symbiotic origin of eukaryotic cell

- Double membrane and own DNA are unique features of mitochondria and chloroplasts
- Originally, endosymbiosis was an idea of Russian scientists (Konstantin Merezhkovsky and Boris Kozo-Poljansky), it was revived in 60s by Lynn Margulis (UMass Amherst).
- The host cell was probably predatory archaeon (belongs to Archaea domain) or PCV bacteria (hypothesis of Forterre, 2010)*
- Mitochondria were first symbionts, probably proteobacteria
- Chloroplasts appeared later, from cyanobacteria

Final question (1 point)

Final question (1 point)

Which organelle is present in most prokaryotic cells and absent in all eukaryotic?

Summary

- Electron microscope can only work with dead cells
- Eukaryotic cells are “cells of second level” where part of organelles (mitochondria, chloroplasts) originated from different prokaryotic cells.

For Further Reading

A. Shipunov.
Advanced Cell Biology [Electronic resource].
2011—onwards.
Mode of access: `http://ashipunov.info/shipunov/school/biol_250`

B. Alberts et al.
Essential Cell Biology. 3rd edition.
Garland Science, 2009.
Chapter 1: Cells under the microscope; The prokaryotic cell; The eukaryotic cell.