

Advanced Cell Biology. Lecture 2

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Outline

Questions and answers

Introduction to cells

Microscopy

Prokaryotic and eukaryotic cells

Model organisms

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Previous final question: the answer

What is that?

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What is that?

- ▶ Synapse—the contact between two neural cells (neurons)

Introduction to cells

Microscopy

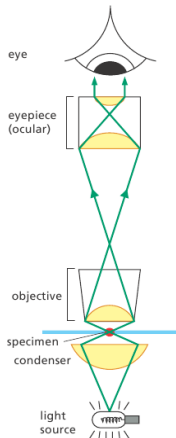
Miscroscopes

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” (dissectiscopes) 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

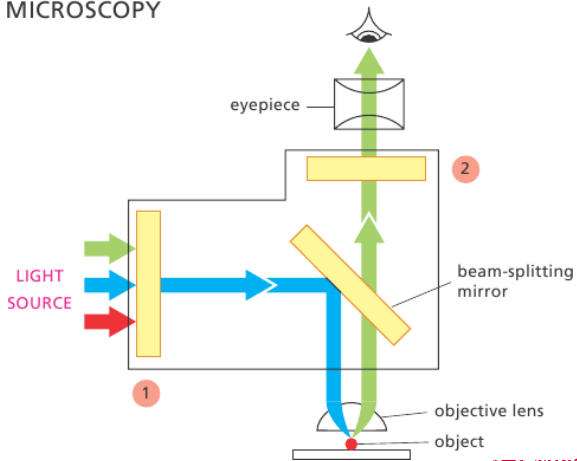
Scanning electron microscopy (SEM) based on the electronic reflection from the surface covered with metals (typically, gold, **Au**) and provides an image of the surface of cells and organisms

Light microscopy



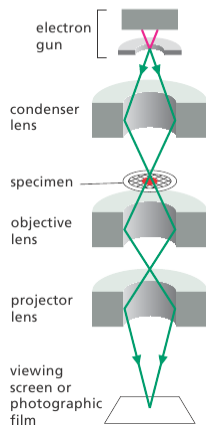
the light path in a light microscope

FLUORESCENCE MICROSCOPY

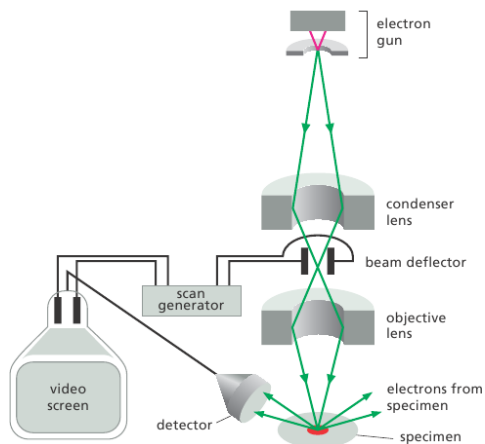


Electron microscopy

TRANSMISSION ELECTRON MICROSCOPY



SCANNING ELECTRON MICROSCOPY



Introduction to cells

Prokaryotic and eukaryotic cells

Organelles in prokaryotic and eukaryotic cells

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

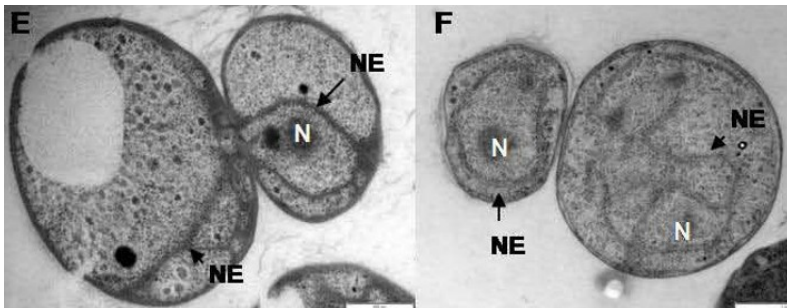
Comparison of prokaryotic and eukaryotic cells

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

PVC 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 PVC bacteria (hypothesis of Forterre, 2010)
- ▶ Mitochondria were first symbionts, probably proteobacteria
- ▶ Chloroplasts appeared later, from cyanobacteria

Diversity of life and model organisms

- ▶ *Escherichia coli*, or *E. coli*: proteobacteria
- ▶ *Saccharomyces cerevisiae*: fungal protist
- ▶ *Arabidopsis thaliana*: flowering plant from cabbage family
- ▶ *Drosophila melanogaster*: fly (Diptera) insect
- ▶ *Caenorabditis elegans*: round worm (Nematoda)
- ▶ *Mus musculus*: common mouse (rodent mammal)

Less common model organisms

- ▶ *Gallus gallus*: chicken (Aves, birds)
- ▶ *Danio rerio*: zebrafish (Pisces)
- ▶ *Strongylocentrotus purpuratus*: purple sea urchin (Echinodermata)
- ▶ *Hydra vulgaris*: freshwater hydra (Cnidaria)
- ▶ *Trichoplax adhaerens*: basal animal (Placozoa)
- ▶ *Neurospora crassa*: orange bread mold (fungal protist)
- ▶ and many others

Zebrafish, *Danio rerio*



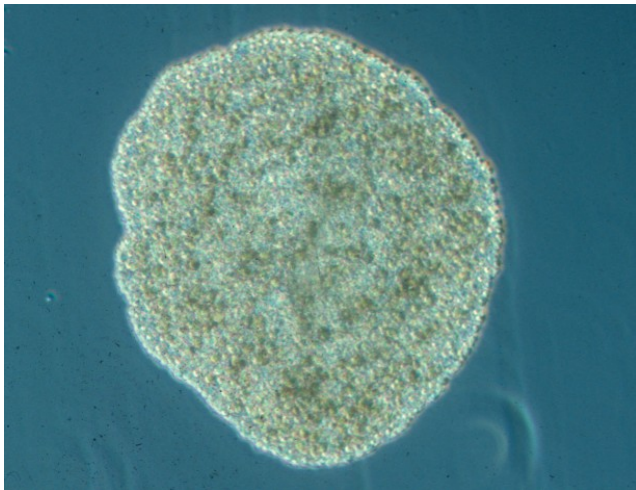
Sea urchin, *Strongylocentrotus purpuratus*



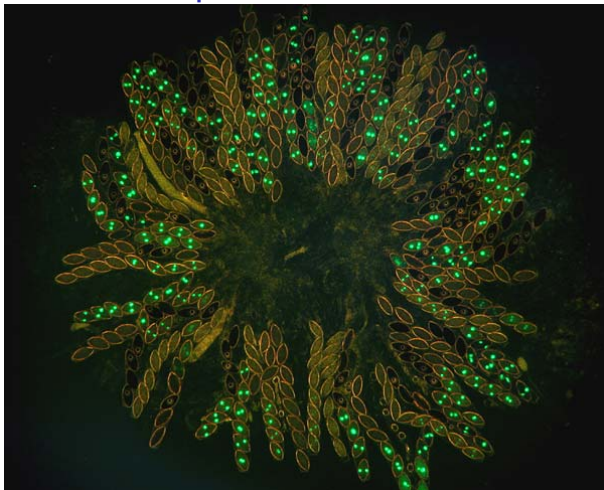
Hydra, *Hydra vulgaris*



Trichoplax adhaerens



Orange bread mold, *Neurospora crassa* under fluorescent microscope



Final question (2 points)

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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:](http://)

[//ashipunov.info/shipunov/school/biol_250](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.