

Introduction to Botany

Alexey Shipunov

Minot State University

Lecture 12

Outline

1 Questions and answers

- Quiz

2 Plant cell

- Cells in cells: mitochondria and chloroplasts
- Cell boundaries

Outline

1 Questions and answers

- Quiz

2 Plant cell

- Cells in cells: mitochondria and chloroplasts
- Cell boundaries

Questions and answers

Quiz

Quiz question (2 points)

...

Quiz question (2 points)

...

● ...

Plant cell

List of cell structures

- *Cell membrane*
- *Cytoplasm*
- *Nucleus, nuclear pore, chromosomes*
- *Chloroplast, thylakoids*
- *Mitochondrion, cristae*
- ER (endoplasmatic reticulum/network)
- Golgi apparatus (AG)
- **Vacuoles**, lysosomes, peroxisomes
- Ribosomes
- **Cell wall**

Chloroplasts and mitochondria are both results of symbiogenesis

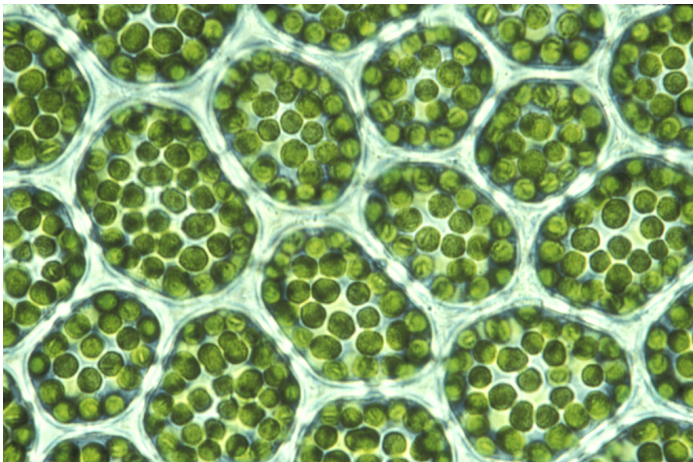
Plant cell

Cells in cells: mitochondria and chloroplasts

Symbiogenesis

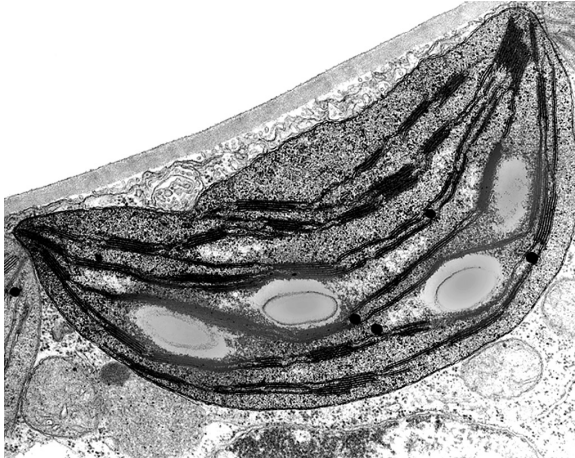
- Small, rigid procaryotic cells became larger to escape from predators
- To keep all parts of larger cell communicable, they developed cytoplasm motility based on **actin** protein
- Cytoplasm motility allowed for **phagocytosis** so they became predators
- These predator cells captured many bacteria and digested them in lysosomes; they also developed nucleus to (a) guard DNA and (b) prevent the horizontal transfer of genes from alien organisms
- Some of prey were not digested (probably, by mistake) but were still useful because they provide ATP
- This condition were naturally selected, and these prey became mitochondria; mitochondria originated from purple bacteria
- Some mitochondrial eukaryotes also captured cyanobacteria (plants₁) and became **algae** with chloroplasts

Plastids



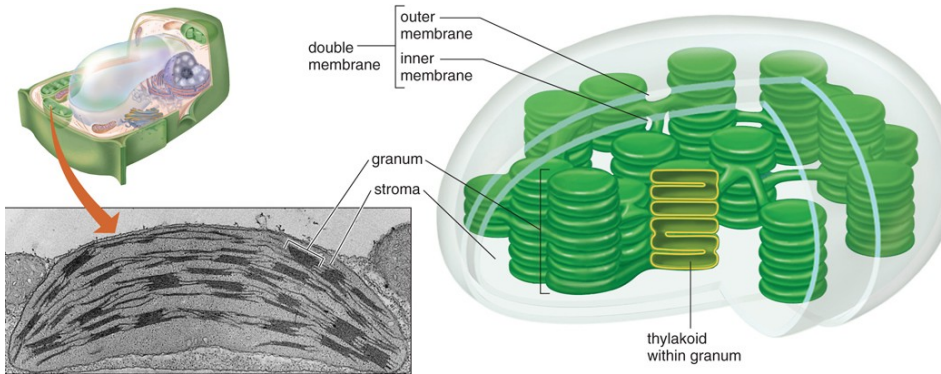
Green plastids (chloroplasts) in leaf cells of *Rhizomnium pseudopunctatum* (LM $\times 500$)

Plastid structure

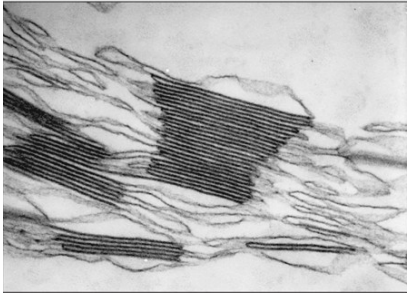


Thylakoids, stroma and starch granules (TEM $\times 37,500$)

Scheme of plastid



Grana



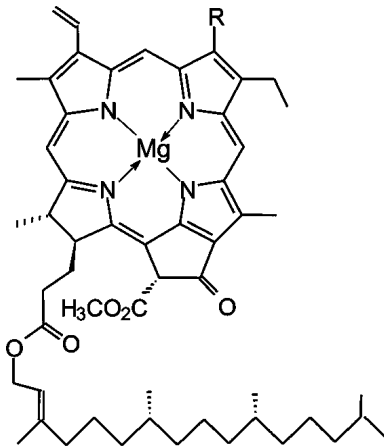
interconnecting thylakoids

Grana is plural, **granum** singular.

Pigments

- Chlorophylls (*a* and *b*) are photosynthetic lipids, including magnesium (Mg)
- Carotenoids facilitate photosynthesis, responsible for autumn colors

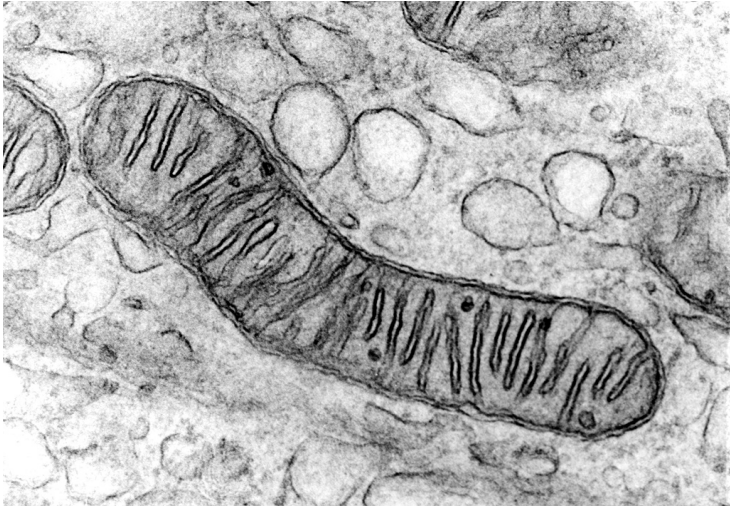
Chlorophylls *a* and *b*



chlorophyll *a* (R = CH₃)

chlorophyll *b* (R = CH=O)

Mitochondria

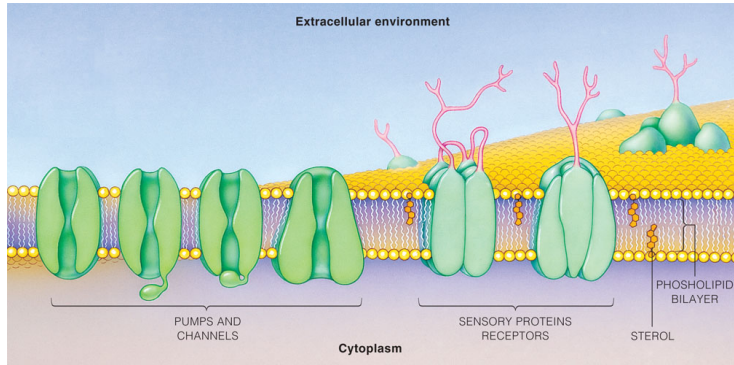


Mitochondrion showing foliate *cristae* and matrix granules. Mitochondria are the main energy source (in form of ATP) of the cell (TEM)

Plant cell

Cell boundaries

Plasma membrane



© 2005 Brooks/Cole - Thomson

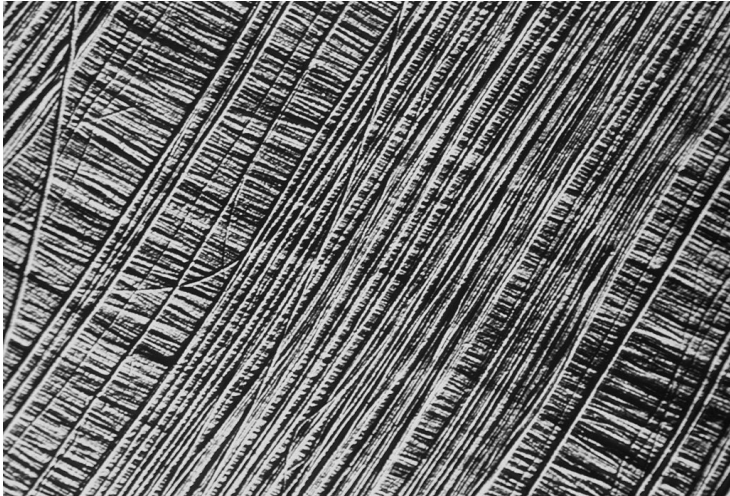
Phospholipids, sterols, proteins: pumps, receptors, channels

Cell wall



Root cells of an onion showing the cell wall (TEM $\times 47,000$)

Fibers

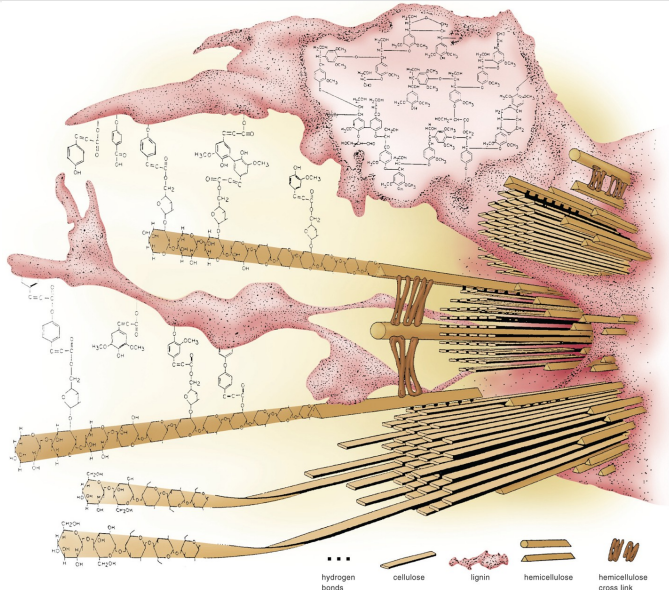


Cellulose fibers in the plant cell wall (SEM)

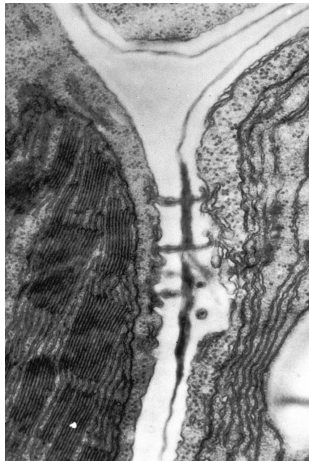
Primary and secondary cell walls

- **Primary cell wall** consists mostly of cellulose and proteins, they are thin and flexible
- **Secondary cell wall** includes hydrophobic lignine and suberine; this inclusion leads to the death of cell. However, dead cells are very useful for plants

Secondary cell wall: molecules

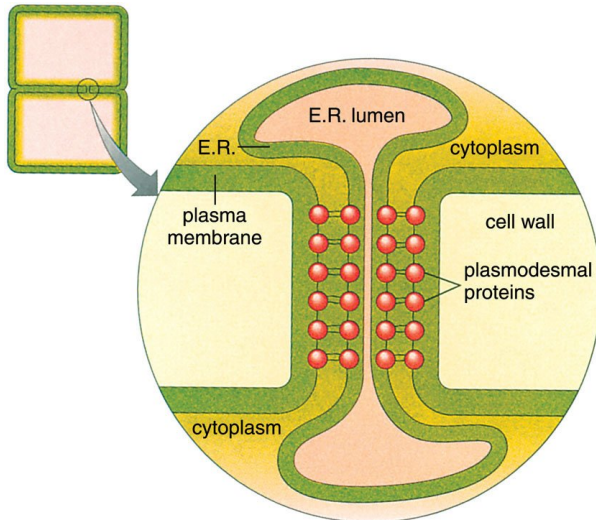


Plasmodesmata



Plasmodesmata in a corn leaf between a mesophyll cell and a bundle sheath cell (TEM)

Plasmodesmata: schematic view



E.R. = endoplasmic reticulum (endoplasmic network)

Quiz question (2 points)

Quiz question (2 points)

...

Summary

- Eukaryotic and prokaryotic cells are cells of different levels of organization
- Eukaryotic cell is a “second-level” cell, cell from cells, ecosystems
- Chloroplasts and mitochondria are both results of symbiogenesis
- Secondary cell walls cover dead cells

For Further Reading



A. Shipunov.

Introduction to Botany [Electronic resource].

Mode of access:

http://ashipunov.info/shipunov/school/biol_154