

Introduction to Botany. Lecture 12

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1 Questions and answers

- Quiz

2 Plant cell

- Cell structure
- Cells in cells: mitochondria and chloroplasts
- Cell boundaries



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Questions and answers

Quiz



Final question (2 points)

How to avoid photorespiration?



Final question (2 points)

How to avoid photorespiration?

- Decrease photosynthesis (foolish solution)
- Pump oxygen out (does not really work – why?)
- Pump carbon dioxide in (C₄ pathway)



Plant cell

Cell structure



Plant cell



List of cell structures

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

Chloroplasts and mitochondria are both results of symbiogenesis



Plant cell

Cells in cells: mitochondria and chloroplasts

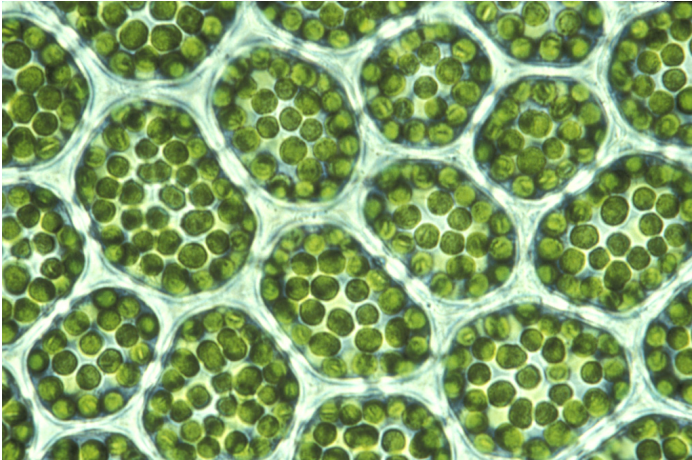


Symbiogenesis

- 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



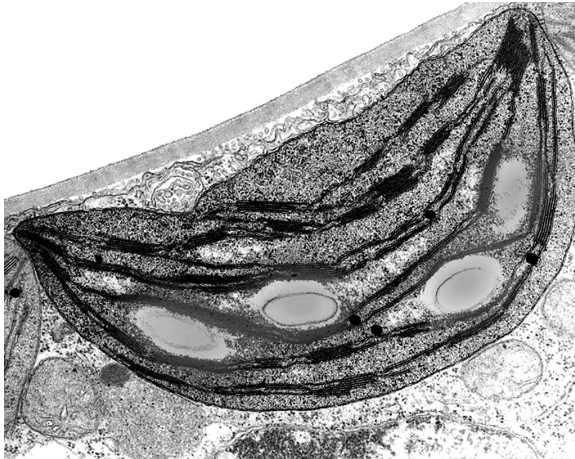
Plastids



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



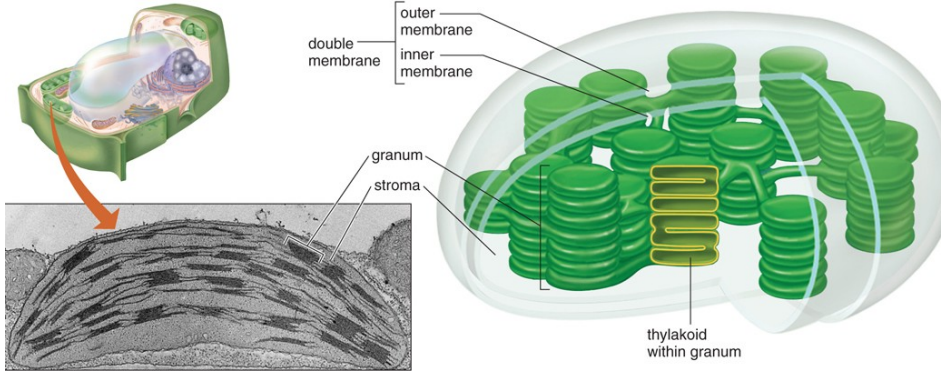
Plastid structure



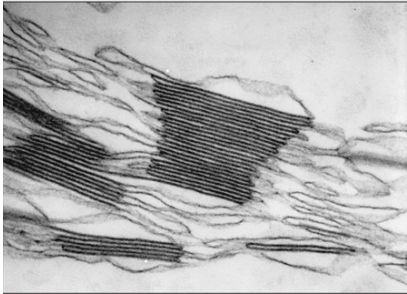
Thylakoids, stroma and starch granules (TEM $\times 37,500$)



Scheme of plastid



Grana



interconnecting thylakoids

Grana is plural, **granum** singular.

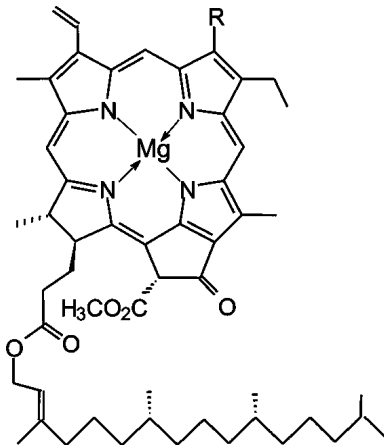


Pigments

- 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)

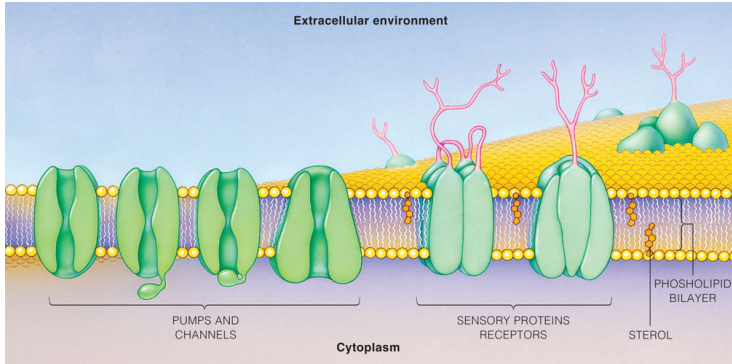


Plant cell

Cell boundaries



Plasma membrane



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Phospholipids, sterols, proteins: pumps, receptors, channels



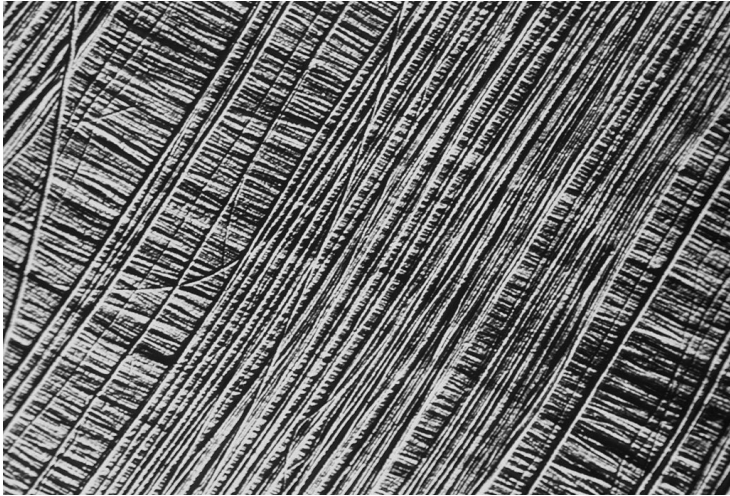
Cell wall



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



Fibers



Cellulose fibers in the plant cell wall (SEM)

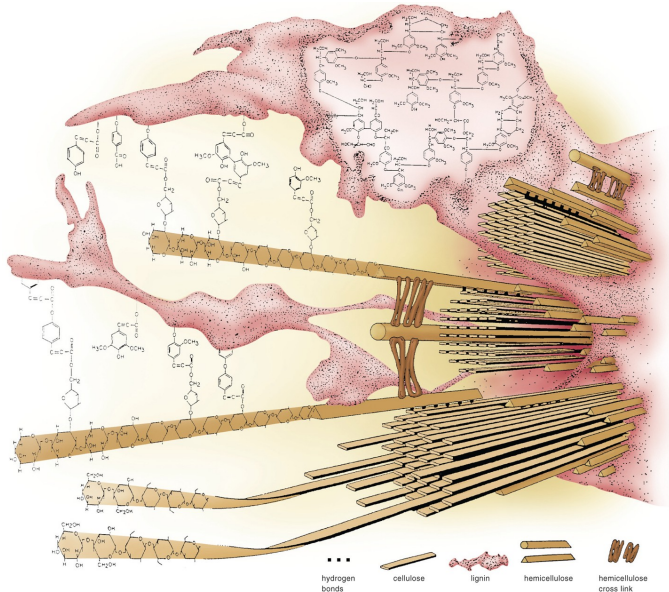


Primary and secondary cell walls

- **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



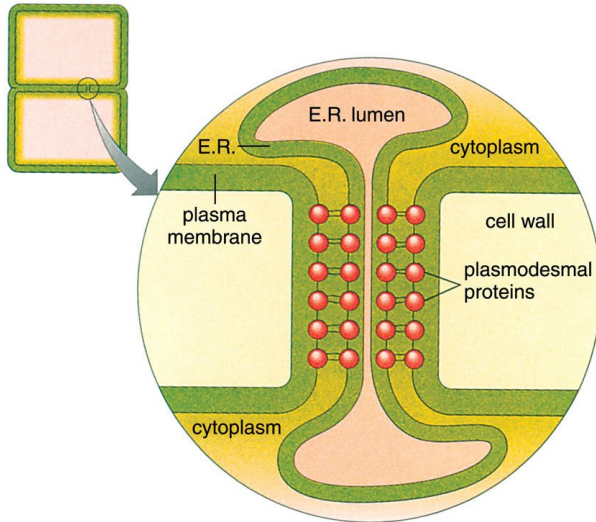
Plasmodesmata



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



Plasmodesmata: schematic view



E.R. = endoplasmic reticulum (endoplasmic network)



Final question (1 point)



Final question (1 point)

What is the difference between primary and secondary cell walls?



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



For Further Reading



A. Shipunov.

Introduction to Botany [Electronic resource].

2016.

Mode of access:

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

