

Introduction to Botany. Lecture 10

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Outline

1 Questions and answers

2 Cell

- Cells from cells: mitochondria and chloroplasts
- Cell boundaries
- Protein synthesis



1 Questions and answers

2 Cell

- Cells from cells: mitochondria and chloroplasts
- Cell boundaries
- Protein synthesis



Previous final question: the answer

Name main differences between animal and plant cell.

- Chloroplasts
- Vacuole(s)
- Cell wall



Cell

Cells from cells: mitochondria and chloroplasts

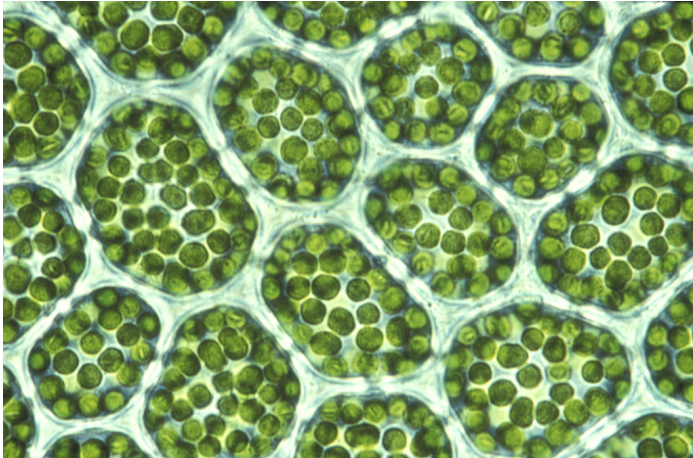


Symbiogenesis

- 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



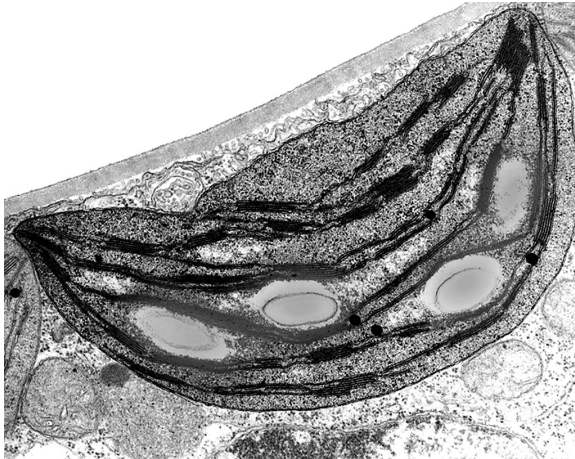
Plastids



Chloroplasts in leaf cells of *Rhizomnium pseudopunctatum* (LM $\times 500$)



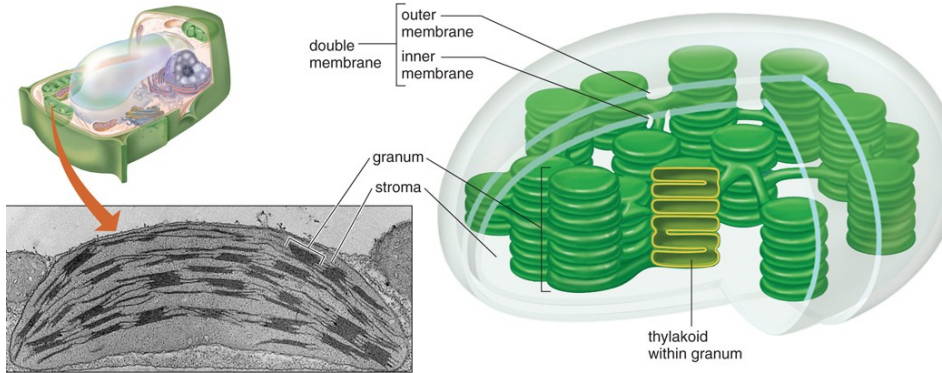
Plastid structure



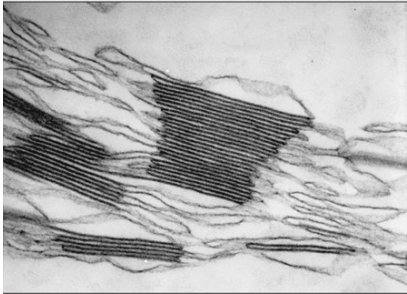
Tylacoids, stroma and starch granules (TEM $\times 37,500$)



Scheme of plastid



Grana



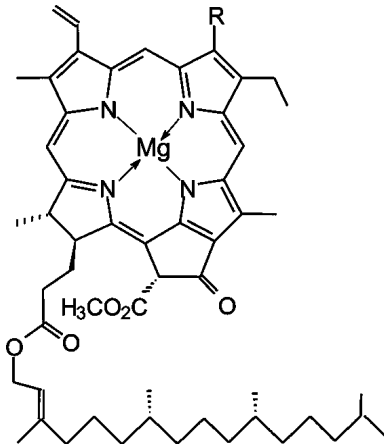
interconnecting thylakoids

Pigments

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



Chlorophylls *a* and *b*



chlorophyll *a* ($R = \text{CH}_3$)

chlorophyll *b* ($R = \text{CH=O}$)



Mitochondria



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



Cell

Cell boundaries



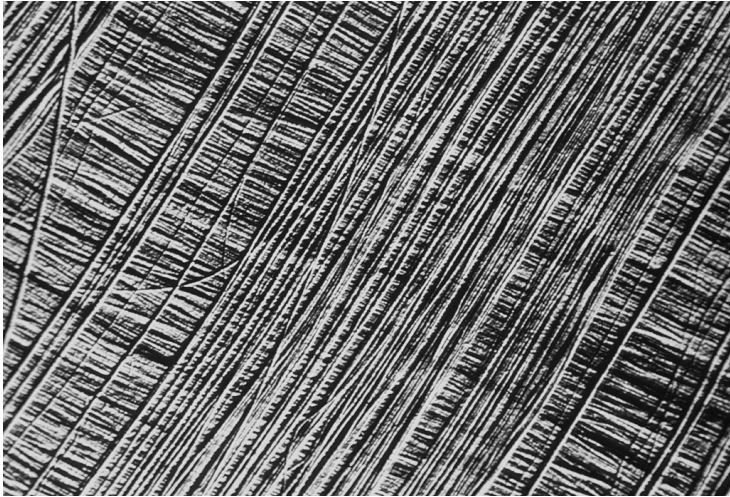
Cell wall 1



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



Cell wall 2



Cellulose fibers in the plant cell wall (SEM)

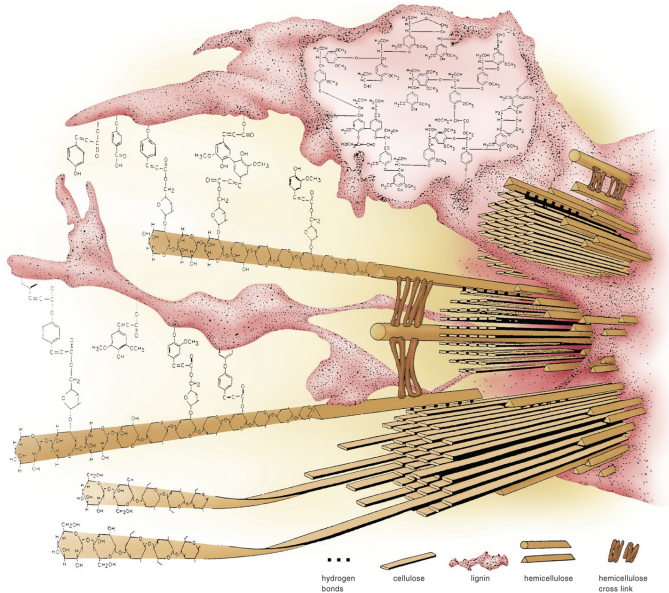


Primary and secondary cell walls

- **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



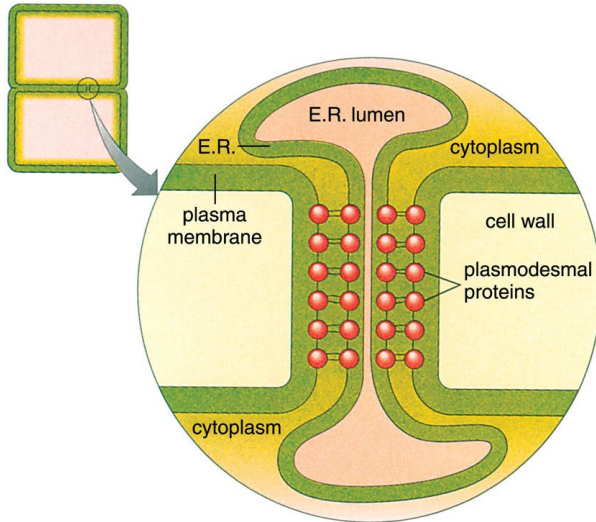
Plasmodesmata 1



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



Plasmodesmata 2



E.R. = endoplasmic reticulum (endoplasmic network)



Vacuoles, osmosis and turgor pressure

- If cell vacuoles contain more concentrated solution of salts then water surrounding cell (i.e., water outside is *hypotonic*), water will flow inside a cell. It is called **osmosis**
- Cell wall prevents cell from explosion due to high **turgor pressure**
- When water flows outside a cell, cell content will shrink: this is **plasmolysis**

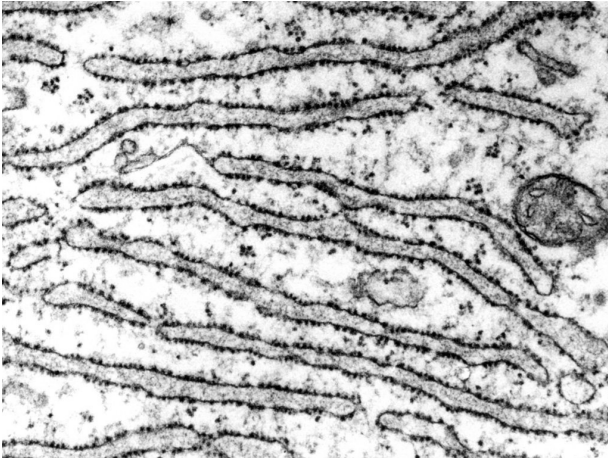


Symplast and apoplast

- **Symplast** — name for continuous cytoplasm in set of cells
- **Apoplast** — space outside cell; area of considerable metabolic activity



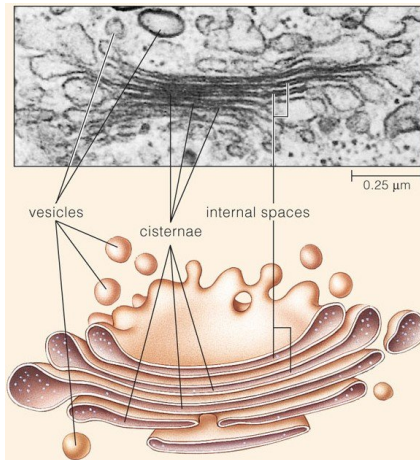
Endoplasmic reticulum (network), ER



Rough endoplasmic reticulum with ribosomes along outer surface. Manufactures many proteins destined for secretion or for incorporation into membranes (TEM)



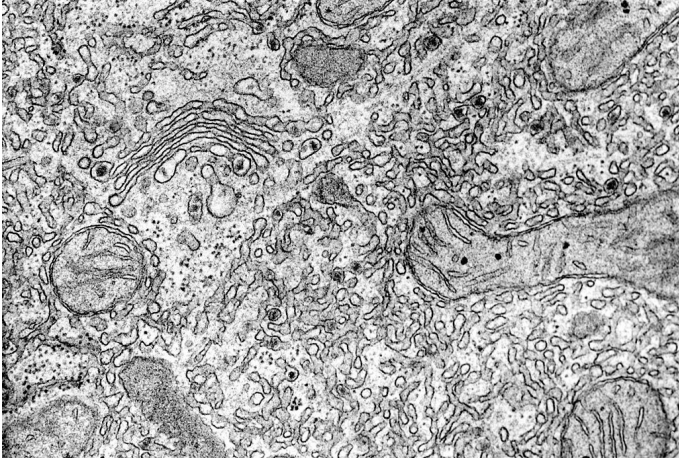
Golgi apparatus (dictyosomes) 1



The Golgi is an organelle composed of stacks of flattened, membranous sacs mainly responsible for modifying, packaging, and sorting proteins that will be secreted or targeted to other organelles of the internal membrane system or to the plasma membrane



Golgi apparatus (dictyosomes) 2



Golgi complex and smooth endoplasmic reticulum in a liver cell (TEM)



Cell

Protein synthesis



Nucleus structure

Nuclear envelope Double layered membrane, filaments of protein lamin line inner surface and stabilize structure, inner and outer membranes connect to form pores

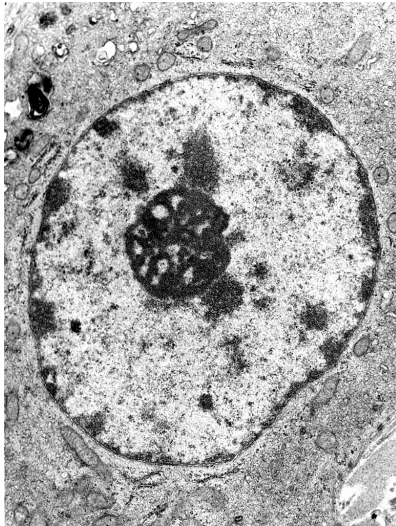
Nucleoplasm Portion inside the nuclear envelope

Nucleoli Dark staining bodies within nucleus, site for ribosome synthesis

Chromosomes Store genetic information in nucleotide sequences, each chromosome consists of chain of nucleosomes (long DNA molecule and associated histone proteins)



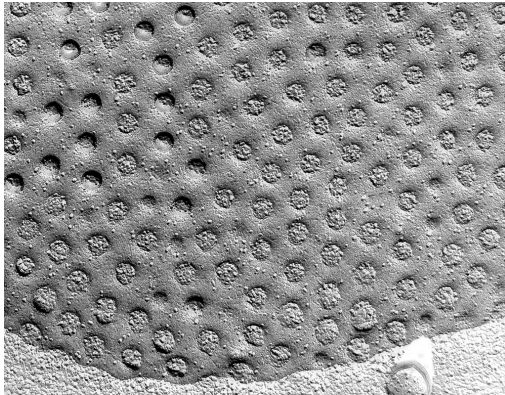
Nucleus



A typical nucleus with a prominent nucleolus (TEM).



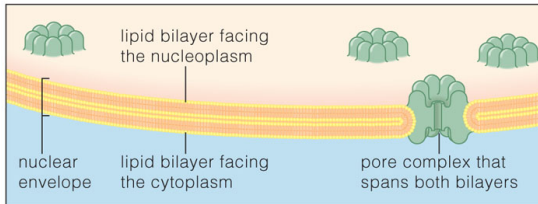
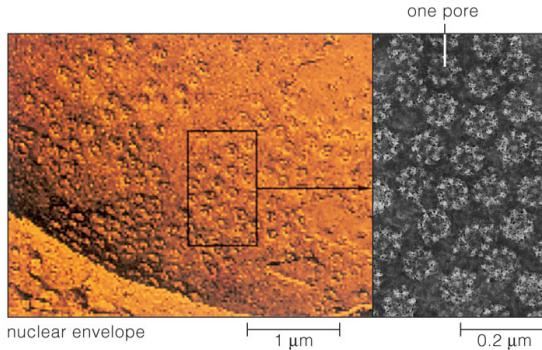
Nuclear pores



Freeze-fracture technique used to show nuclear pores. Nuclear pores are structures in the nuclear envelope that allow passage of certain materials between the cell nucleus and the cytoplasm (TEM $\times 100,000$)



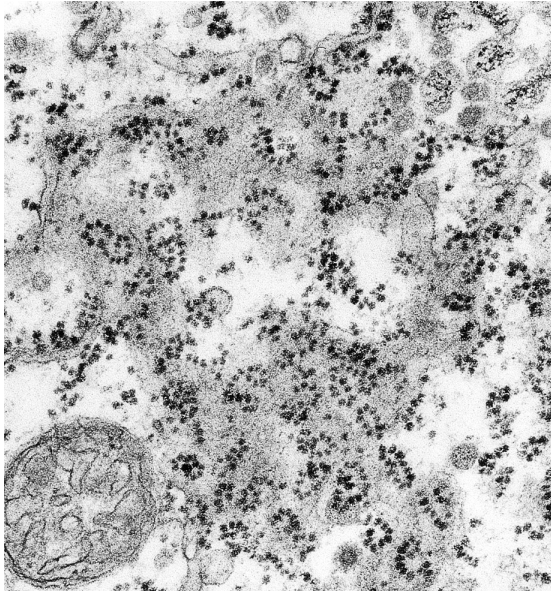
Nuclear pores and envelope



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Ribosomes



Final question (2 points)



Final question (2 points)

What is the difference between primary and secondary cell walls?



Summary

- Chloroplasts and mitochondria are both results of symbiogenesis
- Vacuole, chloroplasts and cell wall are three most important cell parts specific to plants.
- There are **two ways** of moving things between plant cells: through symplast or through apoplast
- **ER** handles ribosomes and packages proteins
- **Golgi apparatus** guides the movement of proteins
- **Nucleus** stores and expresses genetic information



For Further Reading



A. Shipunov.

Introduction to Botany [Electronic resource].

2015.

Mode of access:

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

