

# Introduction to Botany. Lecture 5

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August 31, 2012

# Outline

## 1 Questions and answers

## 2 Cell

- Cell boundaries
- Cellular transport
- Protein synthesis
- Organelles of energy metabolism
- Other cell structures

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## 2 Cell

- Cell boundaries
- Cellular transport
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## Previous final question: the answer

Give at least three differences between plant and animal cells.

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- Chloroplasts
- Vacuole
- Cell wall
- Plasmodesmata
- Almost no phagocytosis

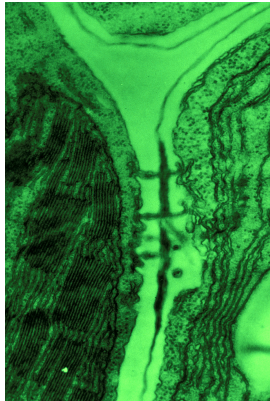


# Cell

## Cell boundaries



# Plasmodesmata 1



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

# Vacuoles, osmosis and turgor pressure

- If cell vacuoles contain more concentrated solution of salts than 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

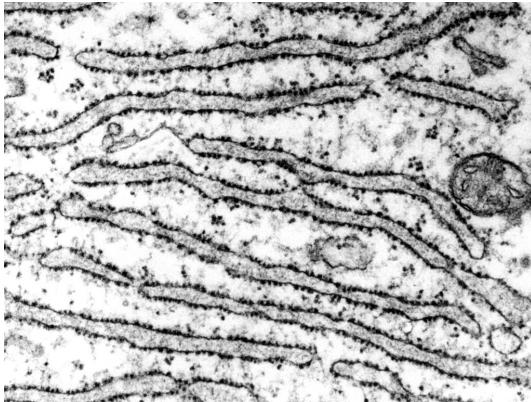
- **Symplast** — name for continuous cytoplasm in set of cells
- **Apoplast** — space outside cell; area of considerable metabolic activity



# Cell

## Cellular transport

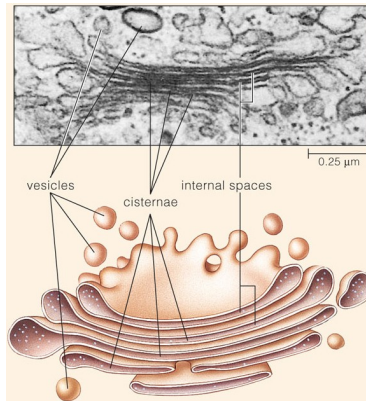
# Endoplasmatic reticulum (network), ER



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

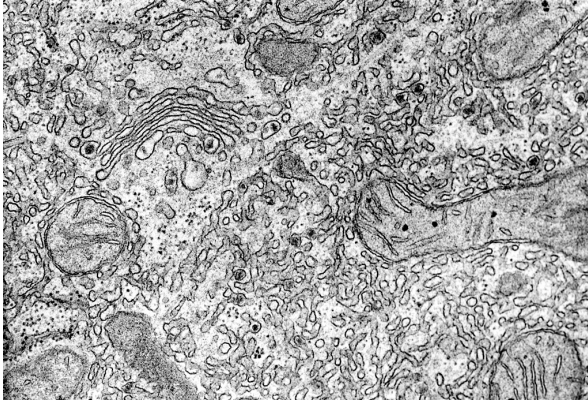


# Goldgi apparatus (dictyosomes) 1



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

## Goldgi 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

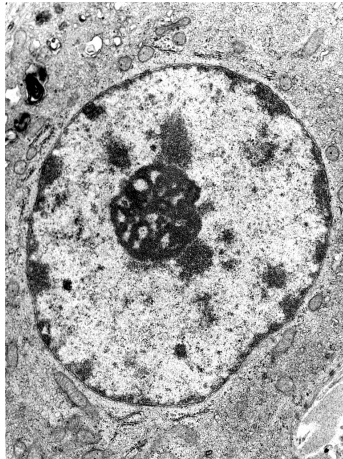
**Nucleoplasm** Portion inside the nuclear envelope

**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)



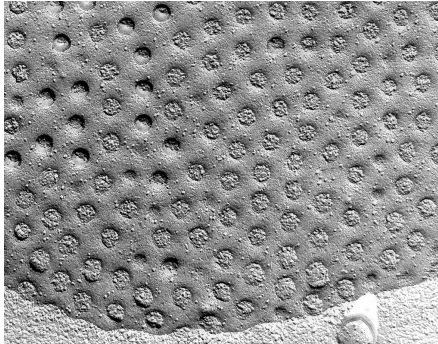
# Nucleus



A typical nucleus with a prominent nucleolus (TEM).

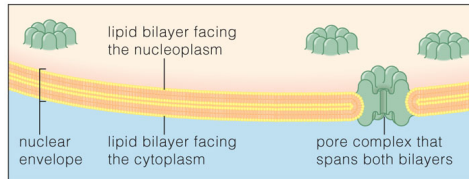
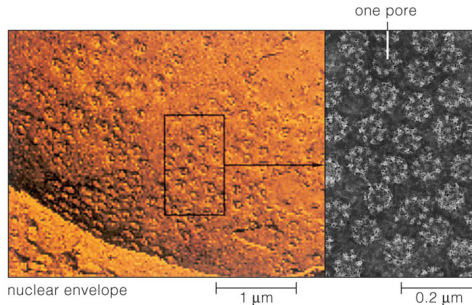


# Nuclear pores

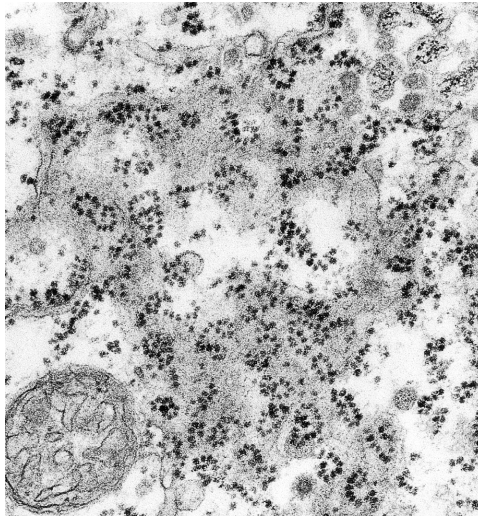


Freeze-fracture technique used to show nuclear pores. Nuclear pores are structures in the nuclear envelope that allow passage of certain materials between the cell nucleus and the cytoplasm  
(TEM  $\times 100,000$ )

# Nuclear pores and envelope



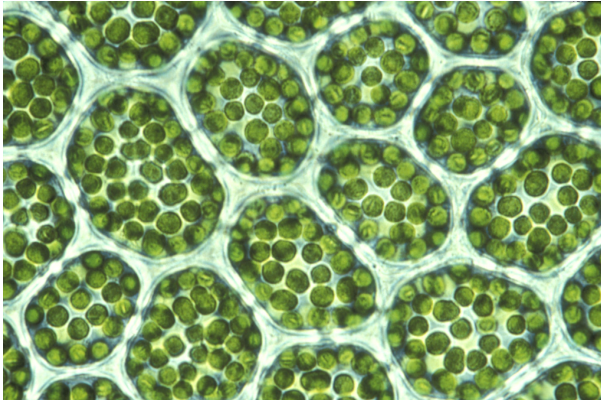
# Ribosomes



# Cell

## Organelles of energy metabolism

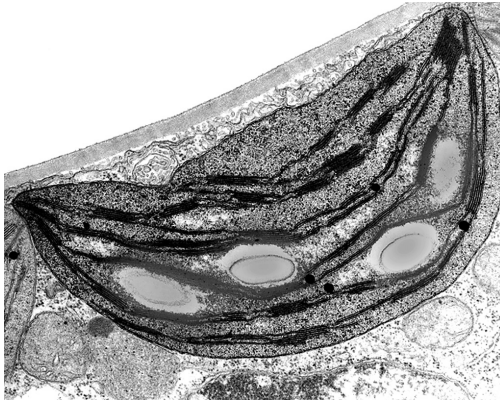
# Plastids



Chloroplasts in leaf cells of *Rhizomnium pseudopunctatum* (LM  
×500)

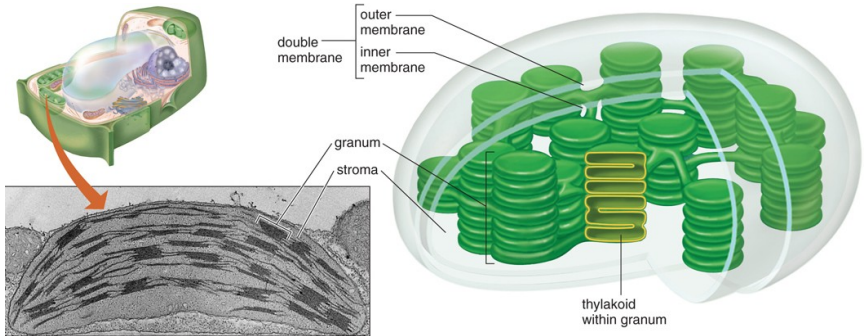


# Plastid structure

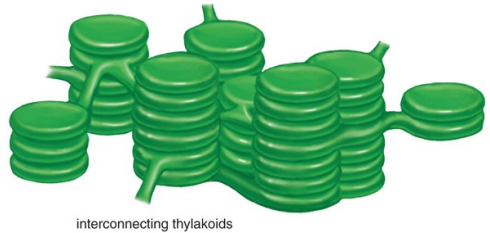
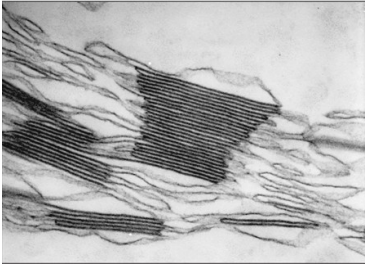


Tylacoids, stroma and starch granules (TEM  $\times 37,500$ )

# Scheme of plastid



# Grana



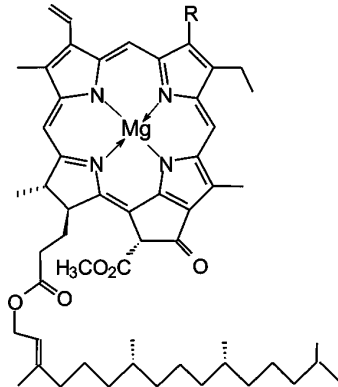


# Pigments

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



# Chlorophylls *a* and *b*



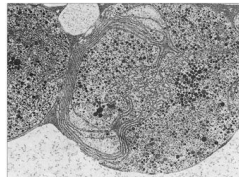
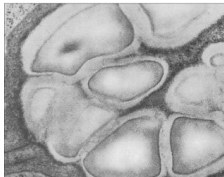
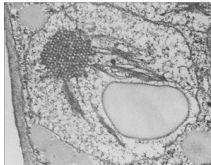
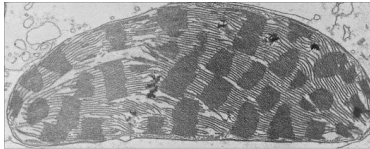
chlorophyll *a* ( $R = \text{CH}_3$ )  
chlorophyll *b* ( $R = \text{CH}=\text{O}$ )

# Plastid types

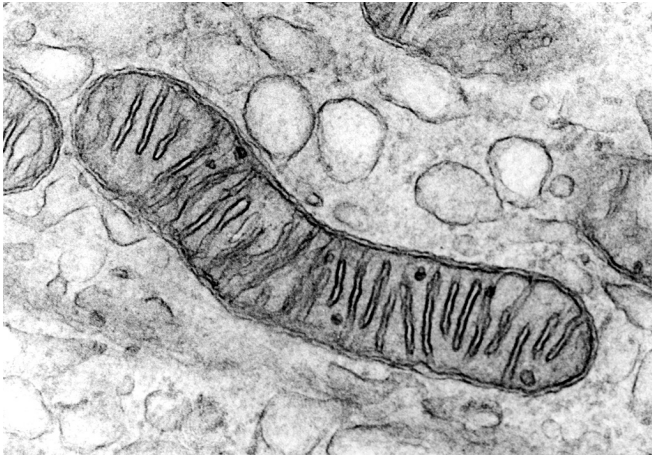
- **Chloroplast** (from “chloro-” = “yellow-green”). Photosynthesis, convert light energy into chemical energy, store carbohydrates as starch grains
- **Leukoplast** (from “leuko-” = “white”). Store carbohydrates in form of starch
- **Amyloplast** (from “amylo-” = “starch”). Leukoplasts that contain large granules of starch
- **Chromoplast** (from “chromo-” = “color”). Stores carotenes and xanthophylls, give orange-to-red color to certain plant tissues.



# Plastid types: chloro-, leuco-, amylo- and chromo-



# Mitochondria



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



# Cell

## Other cell structures

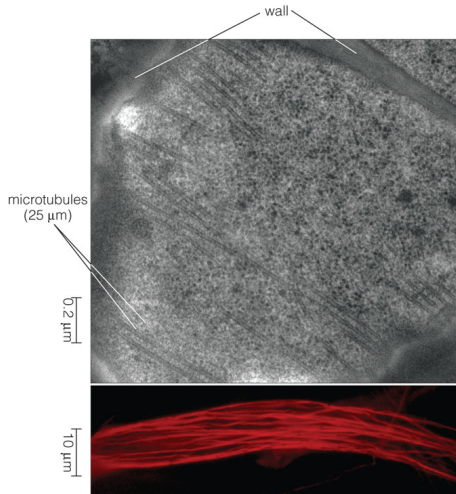
# Cellular skeleton

*Collection of long, filamentous structures within cytoplasm:*

- **Microtubules.** Movement based on tubulin-kinesins interactions. They are key organelles in cell division, form basis of cilia and flagella, serve as guides for the construction of cell wall
- **Microfilaments.** Movement based on actin-myosin interactions. Serve as guides for movement of organelles within cell



# Cytoskeleton





## Final question (2 points)

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What is the difference between symplast and apoplast?

# Summary

- 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
- **Plastids** convert energy of light to chemical energy and store starch
- **Mitochondria** make useful forms of chemical energy



## For Further Reading



J. E. Bidlack, Sh. H. Jansky.  
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McGraw-Hill, 2011.  
*Chapter 3.*



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.  
*Plant Biology*. 2nd edition.  
Thomson Brooks/Cole, 2006.  
*Chapters 3.1–3.6.*

