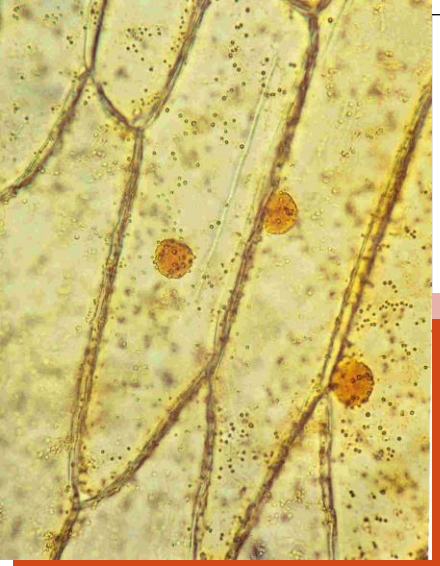
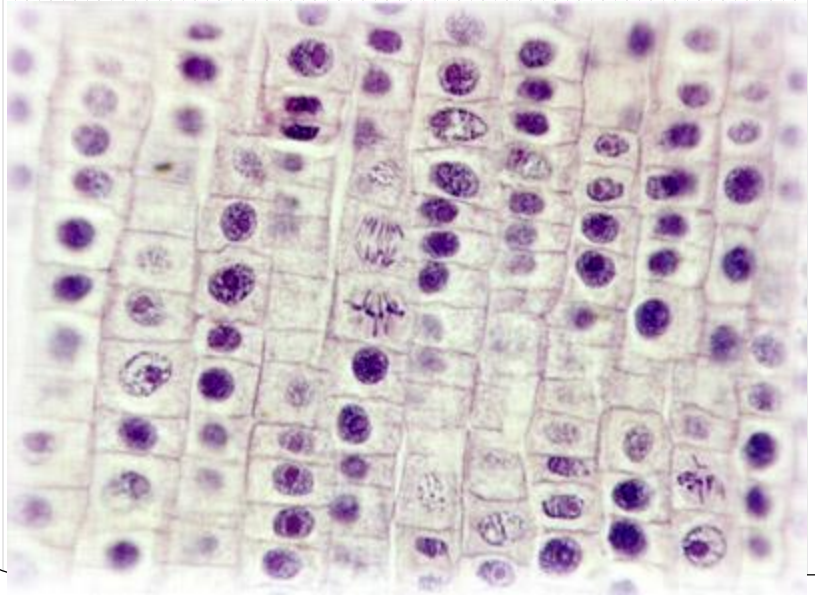
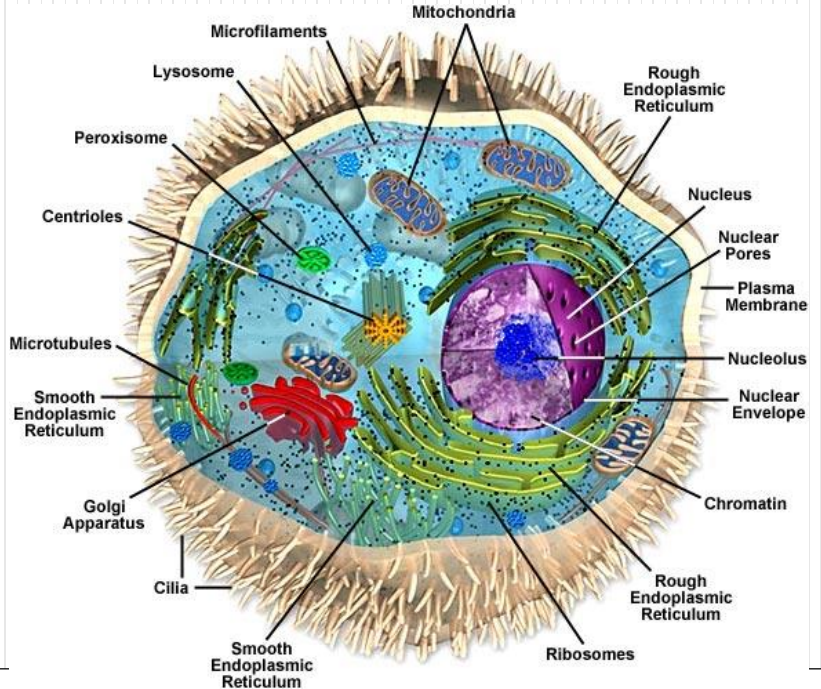


# Chapter 4 - CELLS





# Cell Lab

For each prepared slide

1) Draw each cell – remember to draw the field of view and label any structures you know.
2) Record the magnification of each
3) Make observations of the cells. Include items such as color, structures, size, etc….
4) Conclusion: Write a conclusion paragraph stating similarities and differences in cells. Why do you see the similarities and differences?

# 4.1 Cell Theory

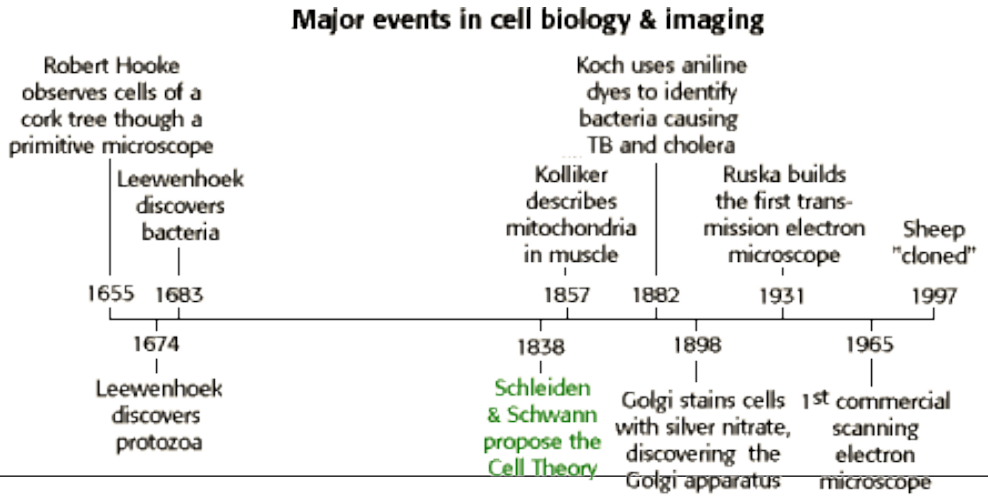
- Review Chapter 1 for History of the Microscope
- In 1839, Schleiden and Schwann proposed the basic concepts of the modern **cell theory**

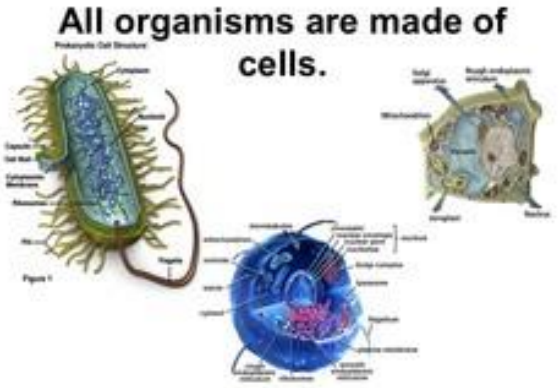
1) All organisms consists of one or more cells

2) A cell is the smallest unit with the properties of life

3) Each new cell arises from division of another, preexisting cell

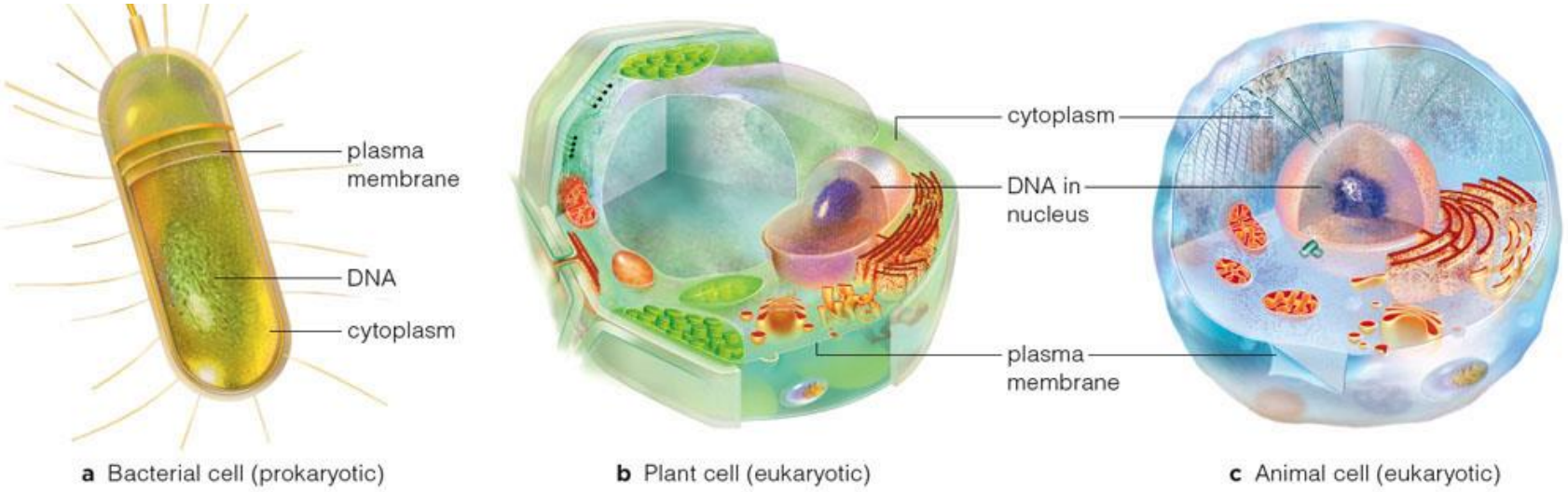
4) Each cell passes its hereditary material to its offspring



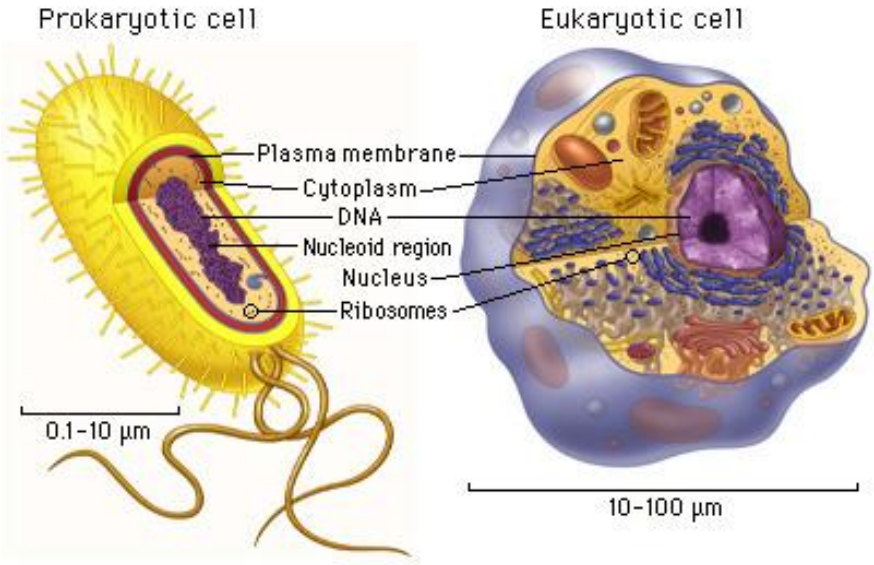
# 4.2 Prokaryote vs. Eukaryote

- **Eukaryotic cell**
  - Cell interior is divided into functional compartments, including a nucleus
- **Prokaryotic cell**
  - Small, simple cells without a nucleus




YOU ARE A EUKARYOTE!!!

# 4.2 What is a cell?

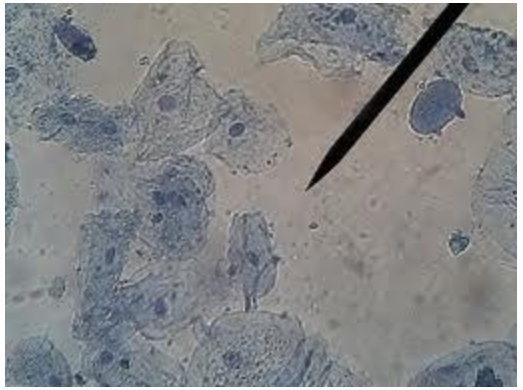



- "Smallest unit of life"
- All cells have

  **1) Plasma membrane** = Controls substances passing in and out of the cell

  2) DNA containing region
  - **Nucleus** in eukaryotic cells
  - **Nucleoid** region in prokaryotic cells

  3) **Cytoplasm** = A semifluid mixture containing cell components

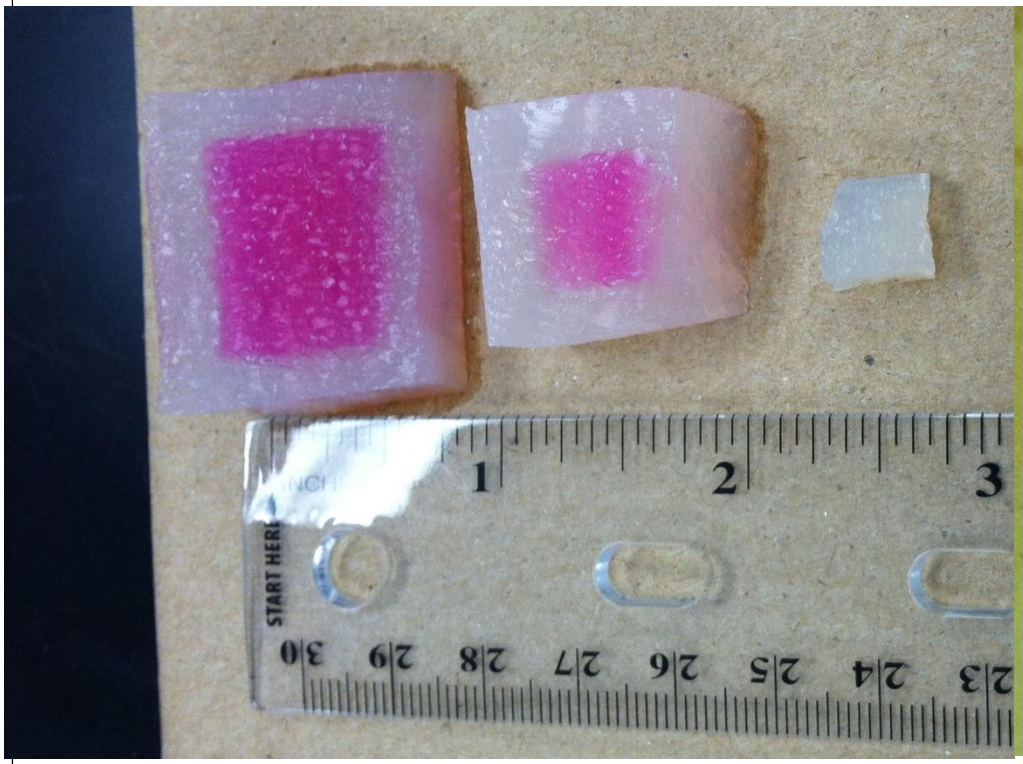


# Cell Size

- **Surface-to-volume ratio** restricts cell size by limiting transport of nutrients and wastes

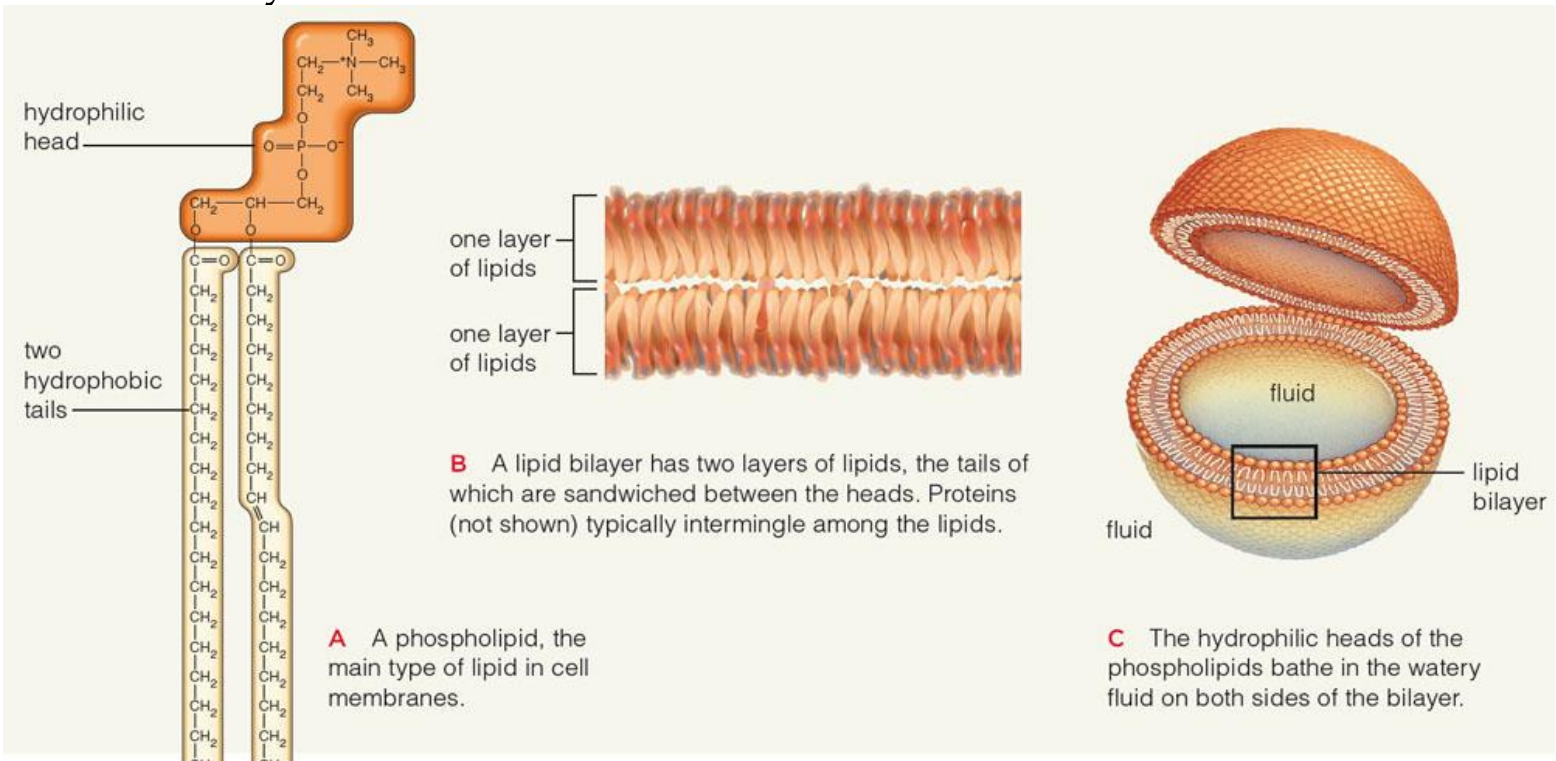
| | | | |
|---|---|---|---|
| Diameter (cm) | 2 | 3 | 6 |
| Surface area ($cm^2$) | 12.6 | 28.2 | 113 |
| Volume ($cm^3$) | 4.2 | 14.1 | 113 |
| Surface-to-volume ratio | 3:1 | 2:1 | 1:1 |

# Diffusion and Cell Size Lab!




# Lipid bilayer – MORE IN CHAPTER 5!!!!

- **Lipid bilayer**
  - A double layer of phospholipids organized with their hydrophilic heads outwards and their hydrophobic tails inwards
  - Many types of proteins embedded or attached to the bilayer carry out membrane functions

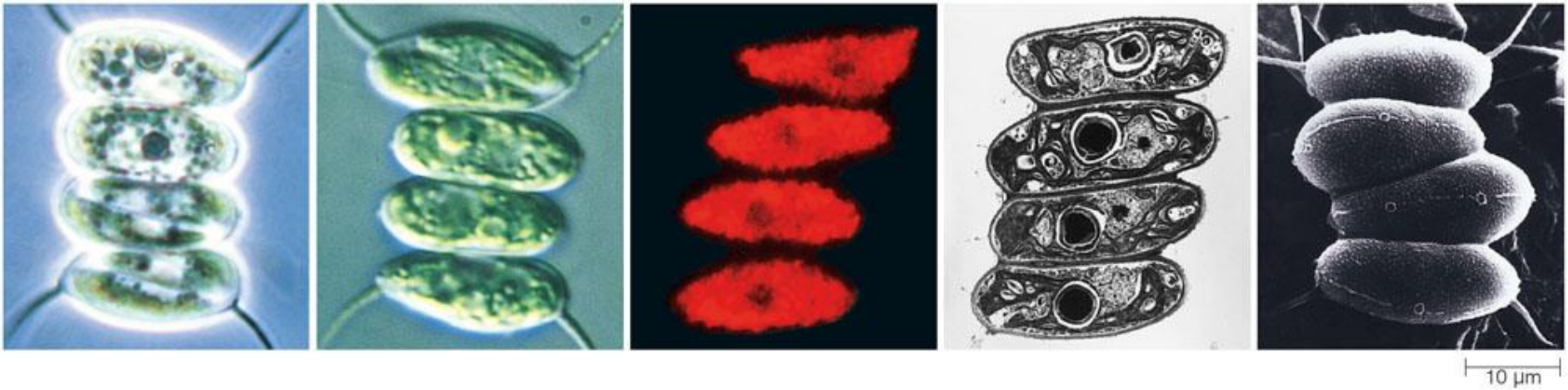



A A phospholipid, the main type of lipid in cell membranes.

B A lipid bilayer has two layers of lipids, the tails of which are sandwiched between the heads. Proteins (not shown) typically intermingle among the lipids.

C The hydrophilic heads of the phospholipids bathe in the watery fluid on both sides of the bilayer.

# 4.3 How do we see cells – see Ch 1 for review!




**a** Light micrograph. A phase-contrast microscope yields high-contrast images of transparent specimens, such as cells.

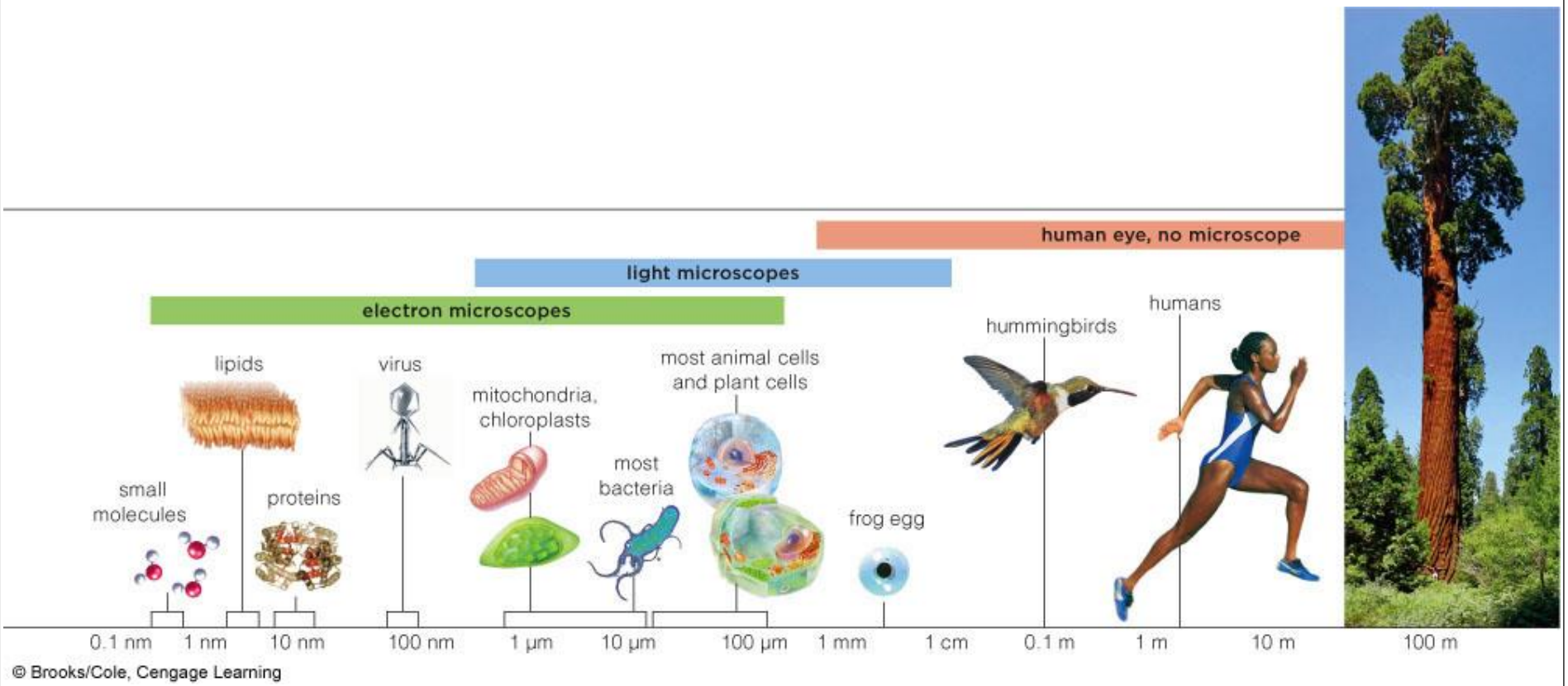
**b** Light micrograph. A reflected light microscope captures light reflected from opaque specimens.

**c** Fluorescence micrograph. The chlorophyll molecules in these cells emitted red light (they fluoresced) naturally.

**d** A transmission electron micrograph reveals fantastically detailed images of internal structures.

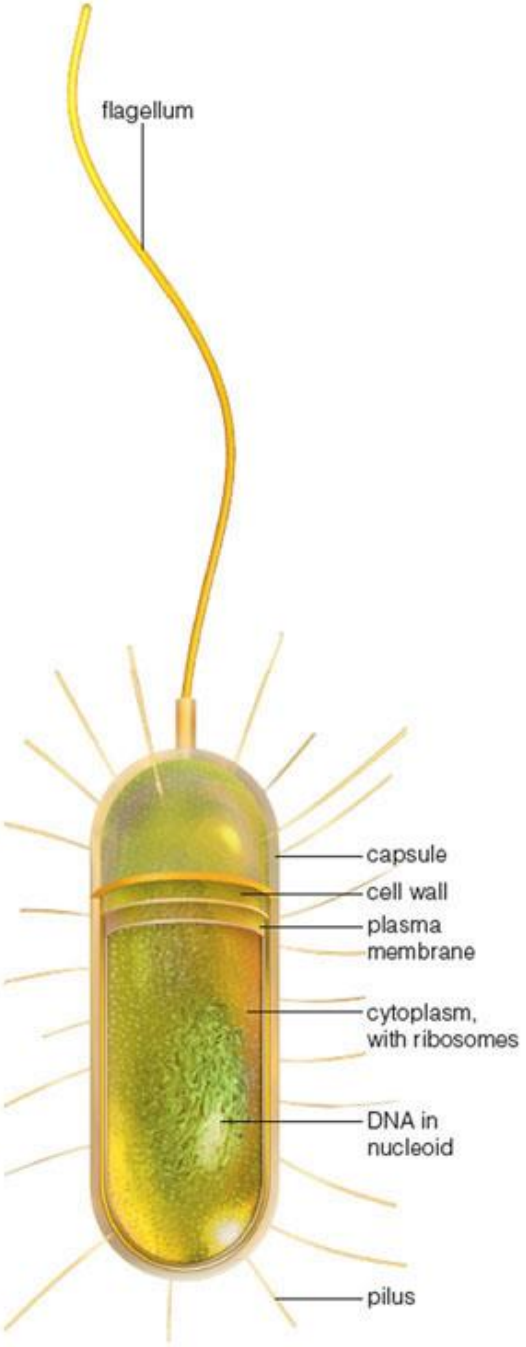
**e** A scanning electron micrograph shows surface details of cells and structures. Often, SEMs are artificially colored to highlight certain details.

# Sizes of structures!



# 4.4 Prokaryote

- **Cell wall** surrounds the plasma membrane
  - Made of peptidoglycan (in bacteria) or proteins (in archaea) and coated with a sticky **capsule**
- **Flagellum** for motion
- **Pili** help cells move across surfaces
  - Sex pilus aids in sexual reproduction



# 4.5 Microbial mobs

- Although prokaryotes are all single-celled, few live alone
- **Biofilm**
  - Single-celled organisms sharing a secreted layer of polysaccharides and glycoproteins
  - May include bacteria, algae, fungi, protists, and archaeans

# 4.6 Eukaryotic Cells

The Cell Song - you know you will love it!

- Eukaryotic ("true nucleus") carry out metabolism inside membrane-enclosed organelles
- **Organelle** = structure that carries out a specialized function within a cell

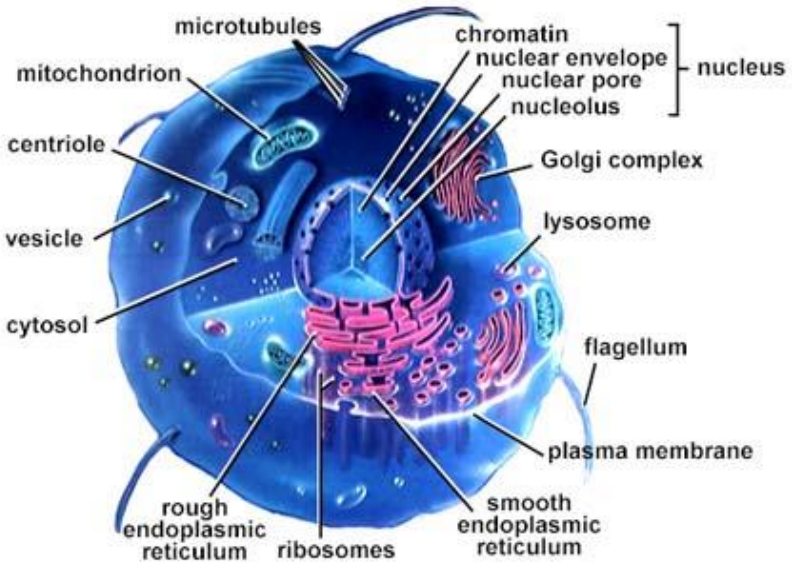
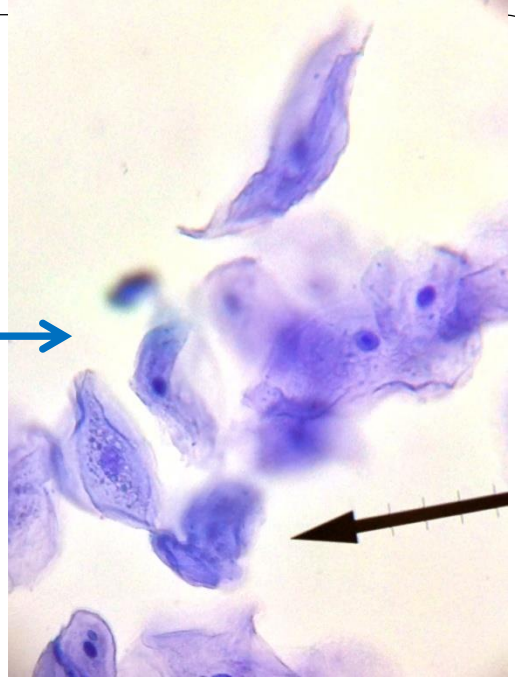


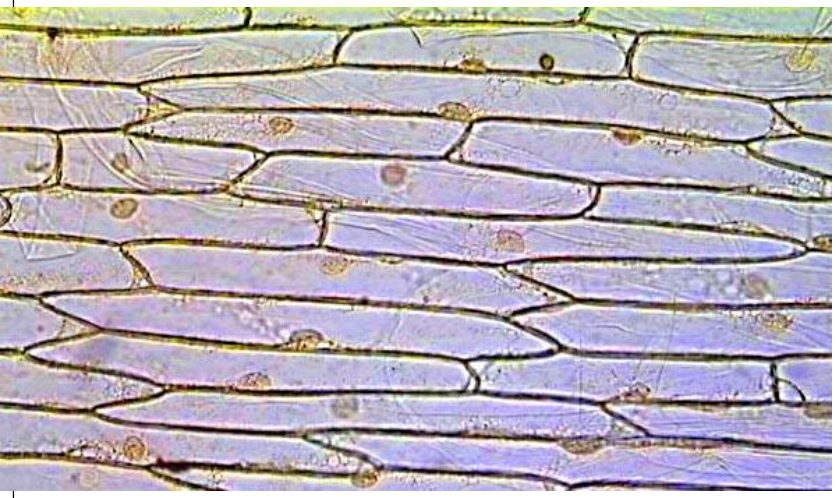

**Table 4.1 Organelles of Eukaryotic Cells**

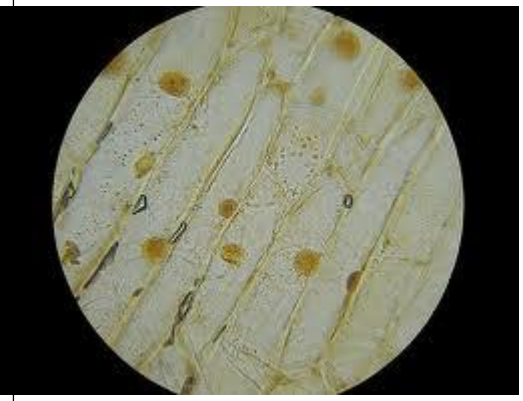
| Name | Function |
|---|---|
| *Organelles with membranes* | |
| Nucleus | Protecting, controlling access to DNA |
| Endoplasmic reticulum (ER) | Routing, modifying new polypeptide chains; synthesizing lipids; other tasks |
| Golgi body | Modifying new polypeptide chains; sorting, shipping proteins and lipids |
| Vesicles | Transporting, storing, or digesting substances in a cell; other functions |
| Mitochondrion | Making ATP by sugar breakdown |
| Chloroplast | Making sugars in plants, some protists |
| Lysosome | Intracellular digestion |
| Peroxisome | Inactivating toxins |
| Vacuole | Storage |
| *Organelles without membranes* | |
| Ribosomes | Assembling polypeptide chains |
| Centriole | Anchor for cytoskeleton |

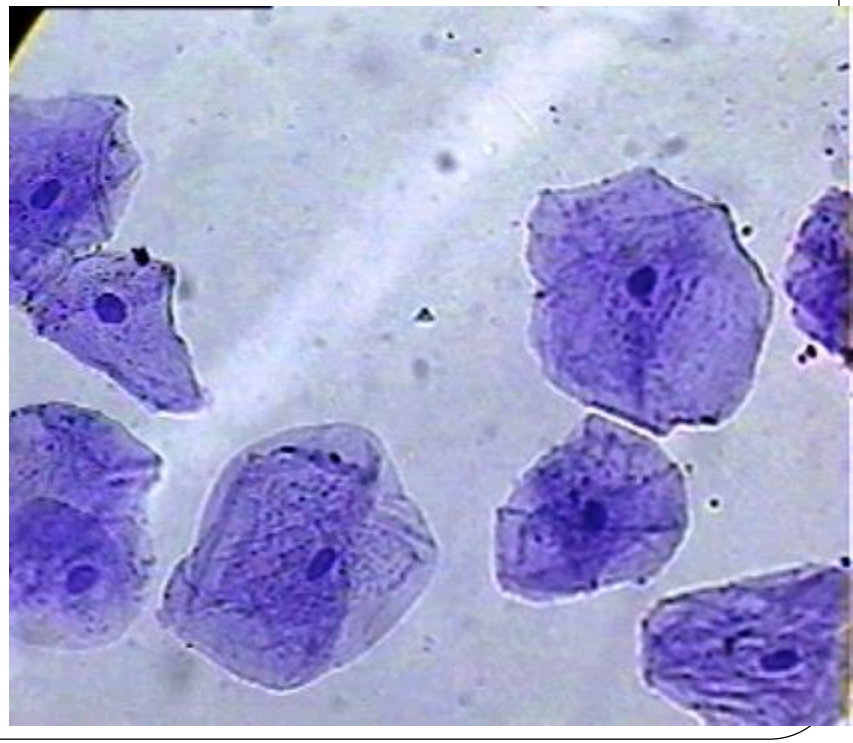
# Cheek and Onion Cell

4th period 2013

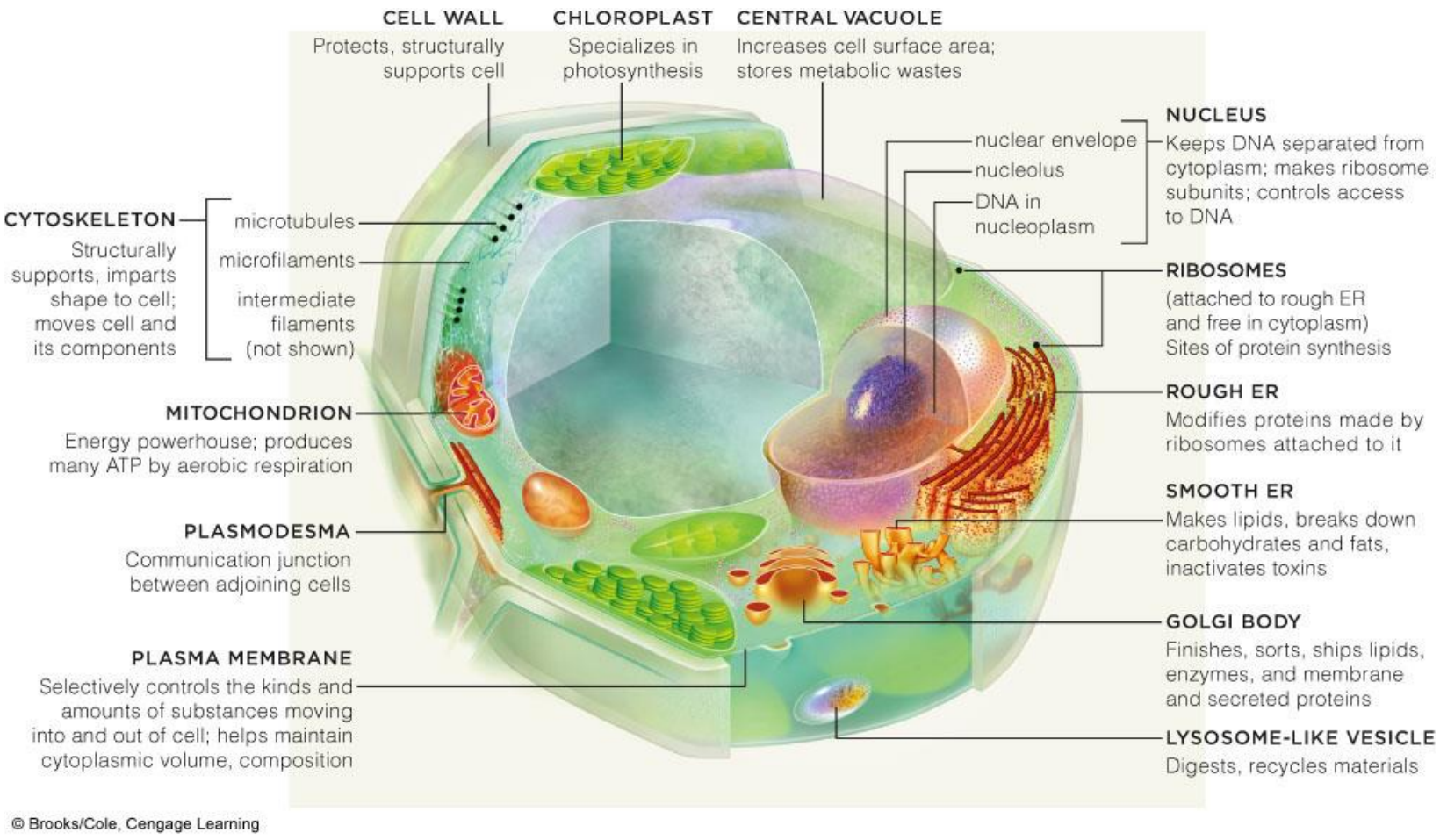




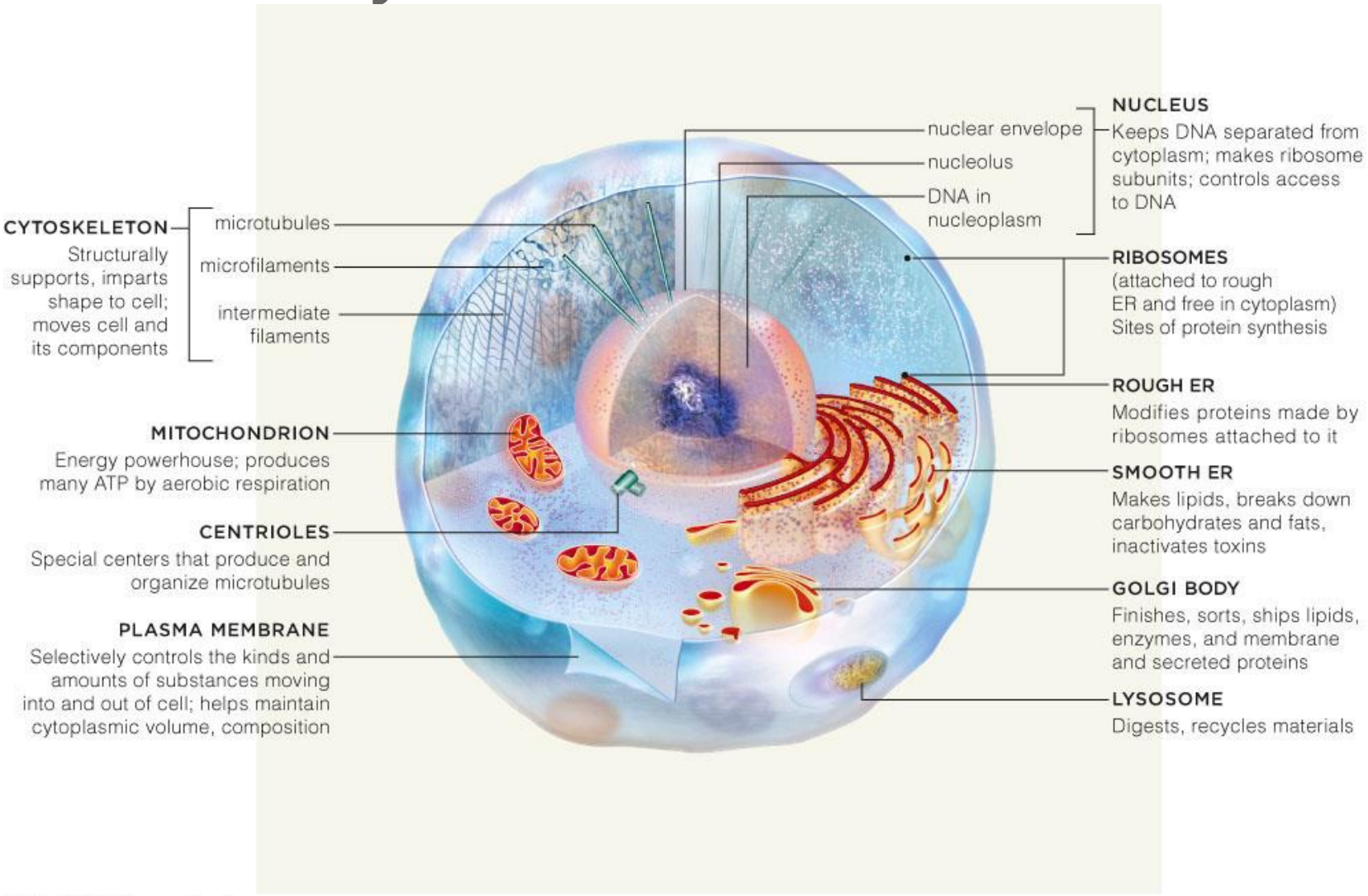




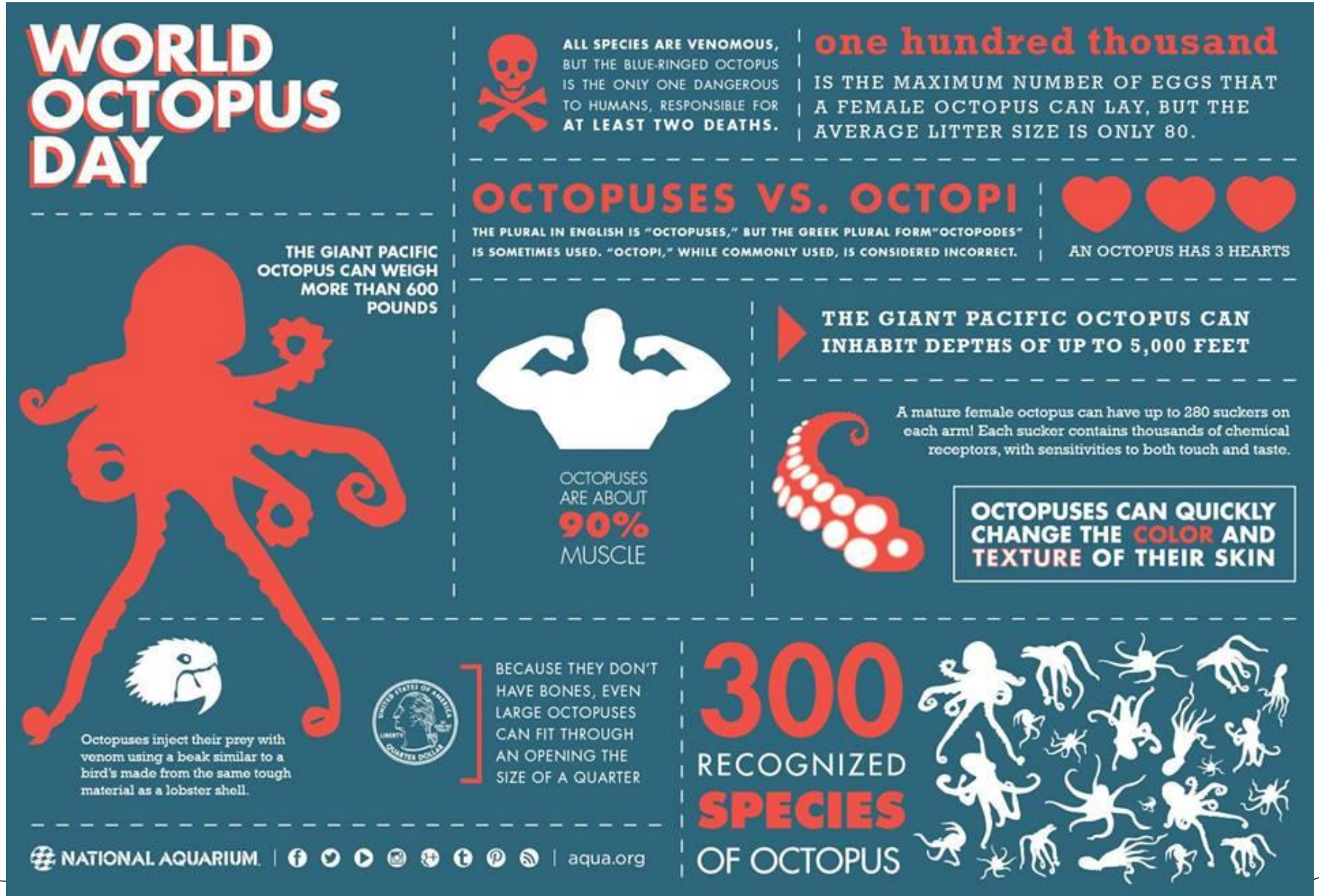
# 4.7 A Eukaryote – plant cell pg. 63



# A Eukaryote – animal cell



# It's October 9th…don't forget to be awesome and that it is World Octopus Day!




## Protect yourself from Airborne

# Ebola Outbreak

use these powerful antimicrobial oils:

**THIEVES** **CINNAMON BARK**
**CLOVE** **OREGANO** **THYME**

**Cinnamon Bark -** 99.9% effective against all viruses. Ebola virus cannot survive in the presence of pure unadulterated cinnamon.

**Thieves -** A 15th century recipe that protected a group of thieves from the black plague even as they robbed the highly contagious bodies of the plagues dead victims.

**Cloves -** High protective & anti-infectious properties include: anti-viral, anti-bacterial & anti-fungal.

**Oregano -** Very aggressive & highly effective against all microbes.

**Thyme -** A very powerful oil on viruses and has demonstrated protective properties for liver, kidneys and the heart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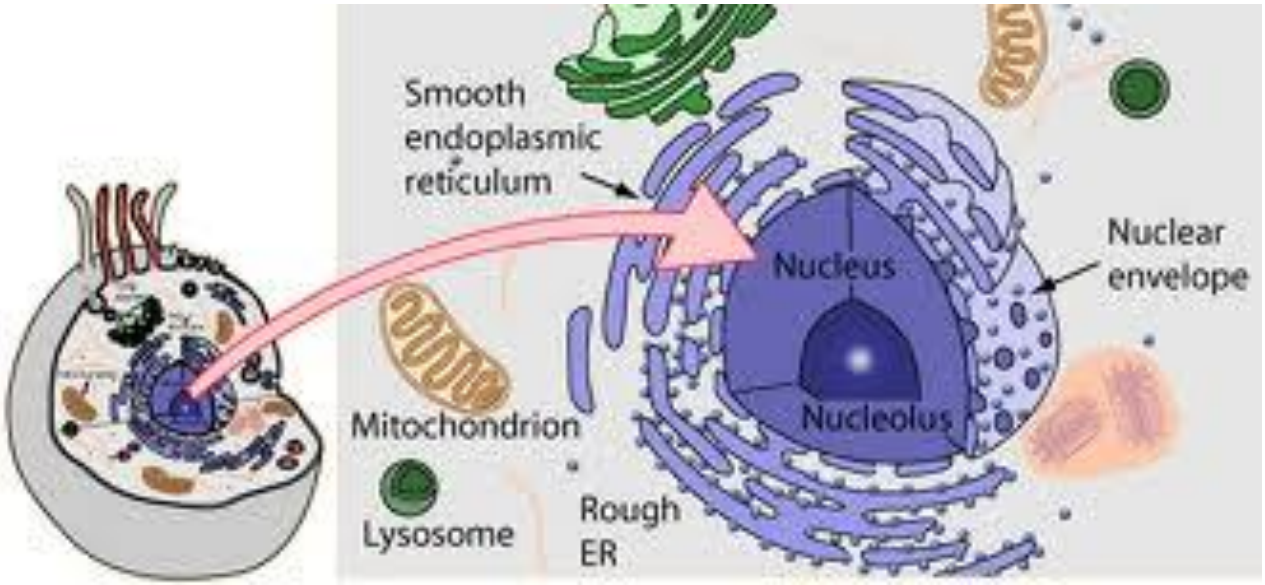
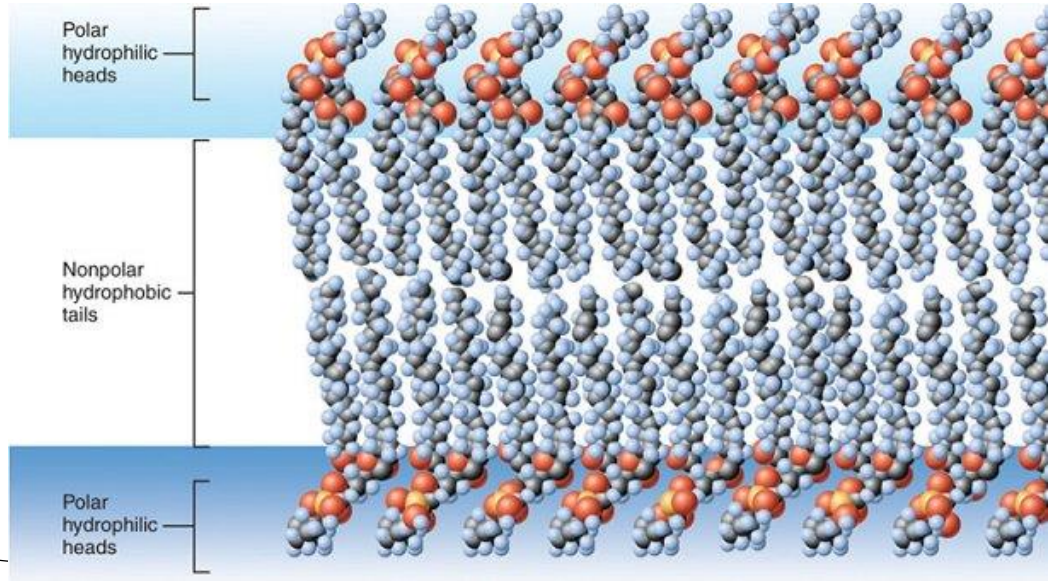
# 4.8 The nucleus – the control center!

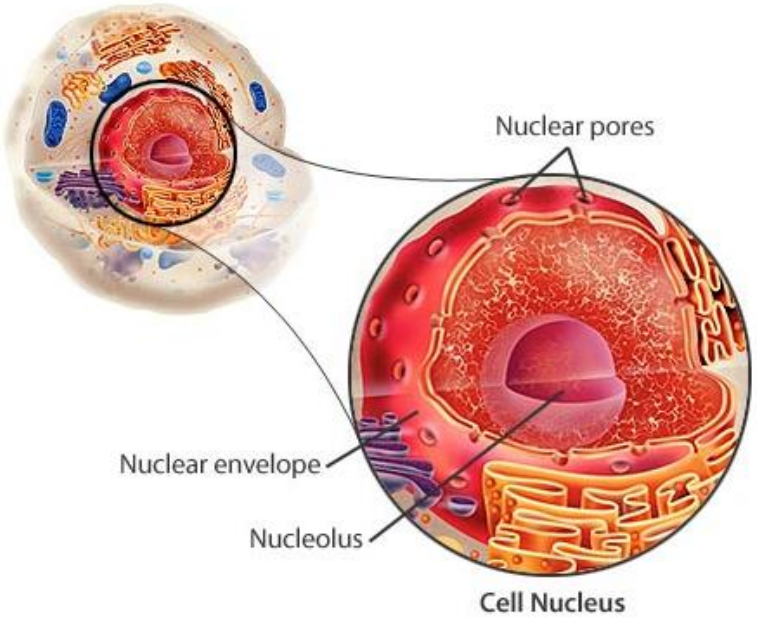
- The nucleus keeps DNA away from damaging reactions in the cytoplasm



# Holding the nucleus together

- **Nuclear envelope**
  - Two lipid bilayers pressed together as a single membrane surrounding the nucleus
  - Outer bilayer is continuous with the ER
  - Nuclear pores allow certain substances to pass through the membrane

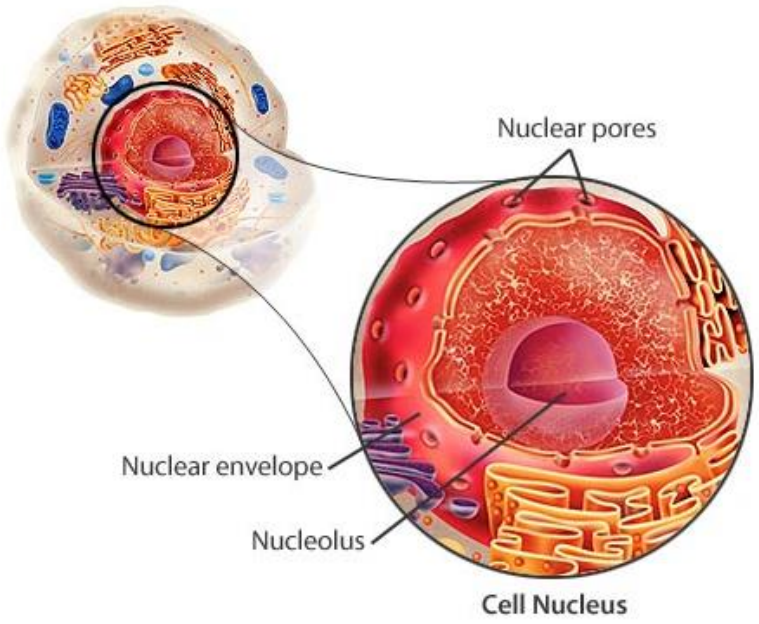


# What is in the nucleus?

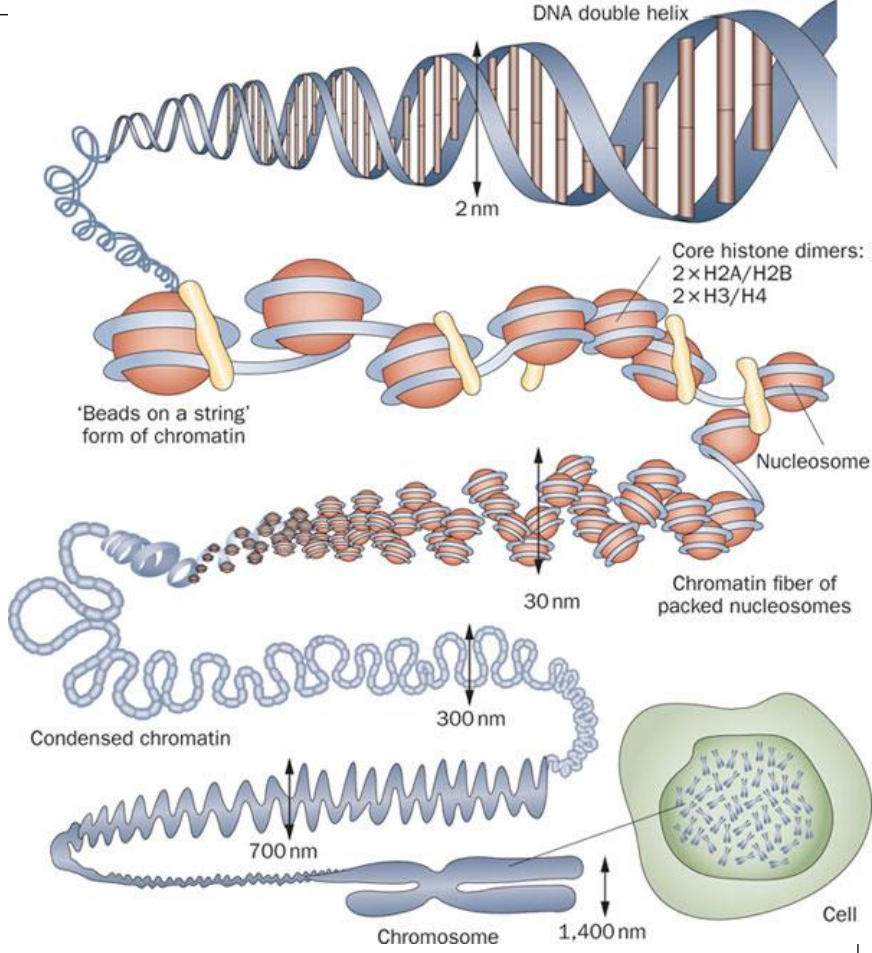
- **Nucleoplasm =** Viscous fluid inside the nuclear envelope, similar to cytoplasm

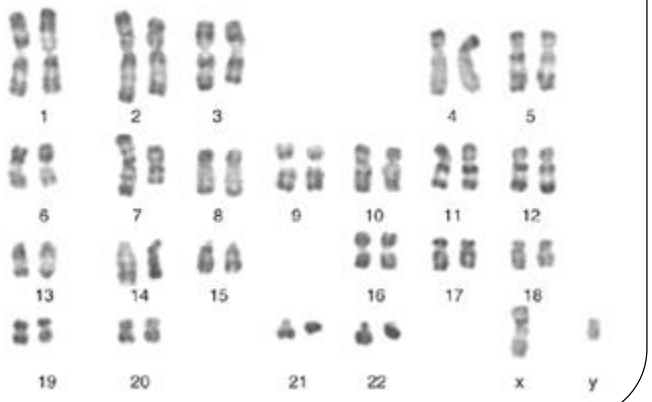
- **Nucleolus =** A dense region in the nucleus where subunits of ribosomes are assembled from proteins and RNA



# DNA in the Nucleus

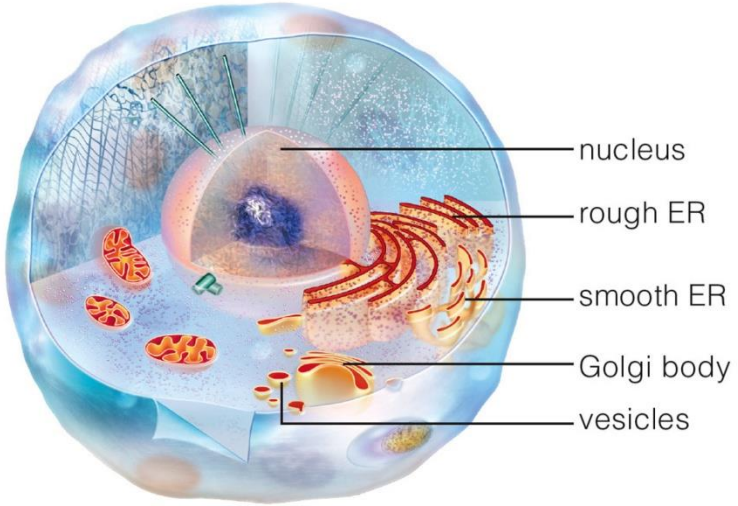
- **Chromatin** = All DNA and its associated proteins in the nucleus
- **Chromosome** = A single DNA molecule with its attached proteins
  - During cell division, chromosomes condense and become visible in micrographs
  - Human body cells have 46 chromosomes



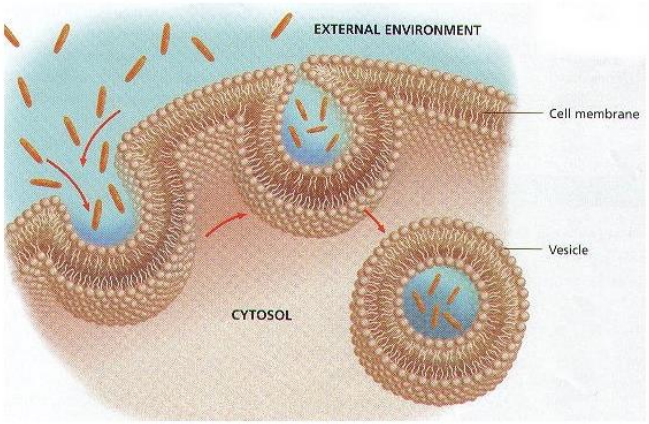
# 4.9 The Endomembrane System

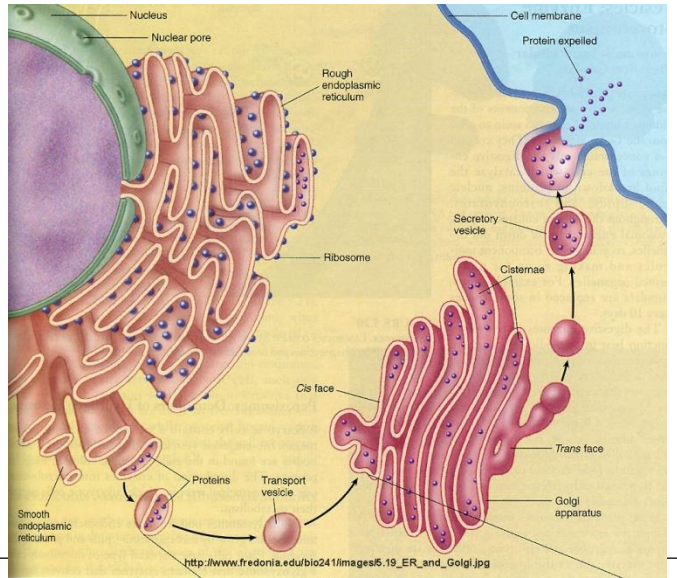
- **Endoplasmic reticulum (ER)** = An extension of the nuclear envelope that forms a continuous, folded compartment
  - Rough ER (with ribosomes) makes proteins and folds them into their tertiary form
    - RIBOSOMES – small organelles that are the site for protein synthesis
    - Cells that make proteins have lots of rough ER – ex. Pancreas makes digestive enzymes
  - Smooth ER (no ribosomes) makes lipids, breaks down carbohydrates and lipids, detoxifies poisons



# Vesicles – transport and breakdown

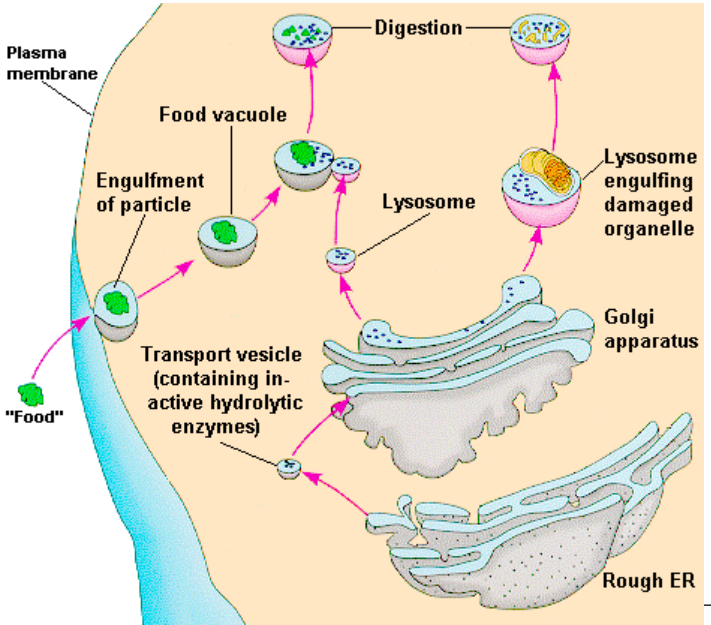
- **Vesicles =** Small, membrane-enclosed saclike organelles that store or transport substances
  - **Peroxisomes =** Vesicles containing enzymes that break down fatty acids, amino acids, hydrogen peroxide, alcohol, and other toxins
  - **Vacuoles =** Vesicles for waste disposal/storage

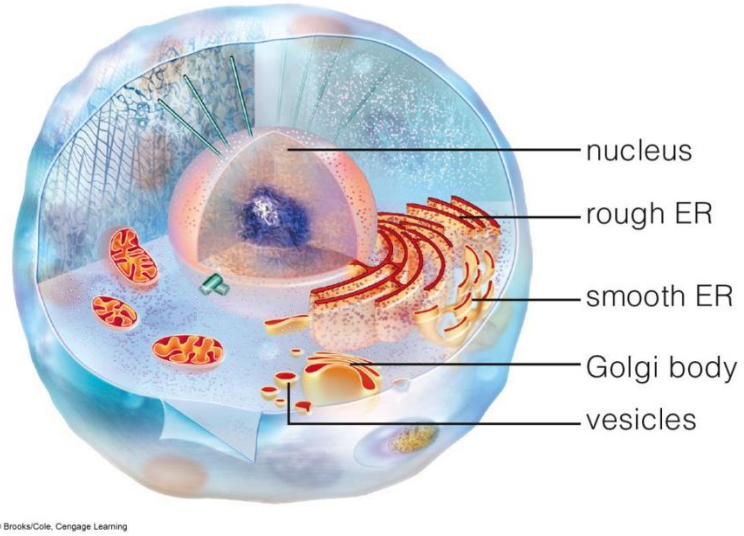


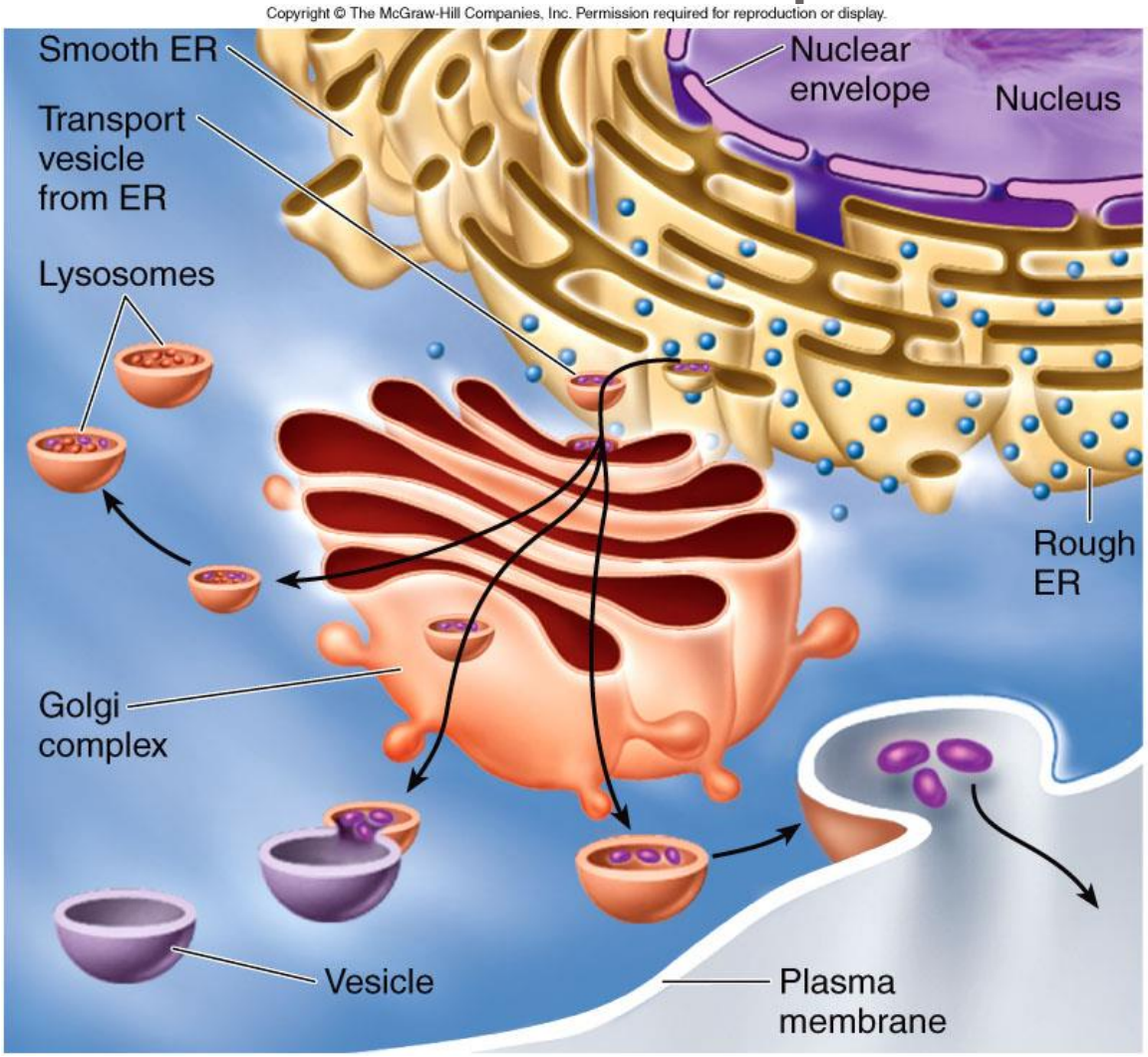
# Endomembrane system: cont.

- **Golgi body** = A folded membrane containing enzymes that finish polypeptides and lipids delivered by the ER
  - Packages finished products in vesicles that carry them to the plasma membrane or to lysosomes
- **Lysosomes** = Vesicles containing enzymes that fuse with vacuoles and digest waste materials



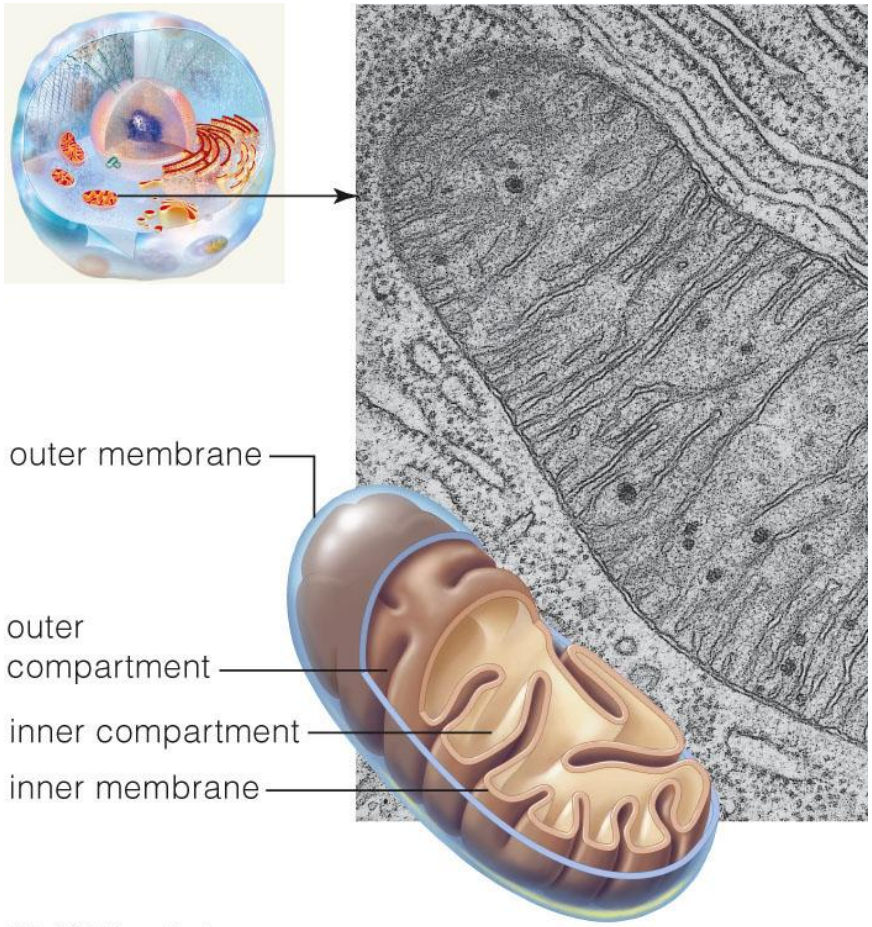
# Endomembrane transport



# 4.10 Lysosome malfunction – for your info

- When lysosomes do not work properly, some cellular materials are not properly recycled, which can have devastating results
- Different kinds of molecules are broken down by lysosomal enzymes
- There are more than 40 known lysosomal storage diseases:
  - Fabry disease - causes kidney and heart problems, pain and a skin rash
  - Gaucher disease - causes the spleen to enlarge, anemia and bone lesions if untreated
  - Pompe disease - an often fatal storage disease in which glycogen builds up in the liver, heart and muscle, especially during infancy (also known as acid maltase deficiency)
  - Tay-Sachs disease - a lysosomal storage disease that causes degeneration of the brain in infants because cells can't break down a specific lipid – (die by age 5) Nathan - a boy with Tay Sachs

# 4.11 More Organelles



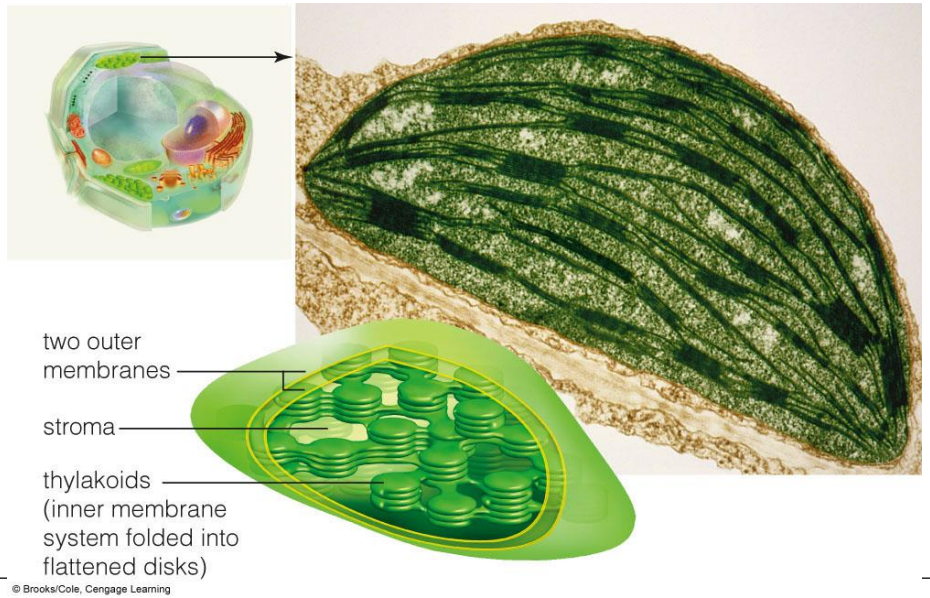

- **Mitochondrion**
  - **Makes the energy molecule ATP through aerobic respiration (Ch 6)**
  - Contains two membranes and an inner and outer compartment
  - Has its own DNA (inherited from mother) and ribosomes
  - Resembles bacteria; may have evolved through endosymbiosis

What types of cells would have lots of mitochondria?

Muscles cells, etc

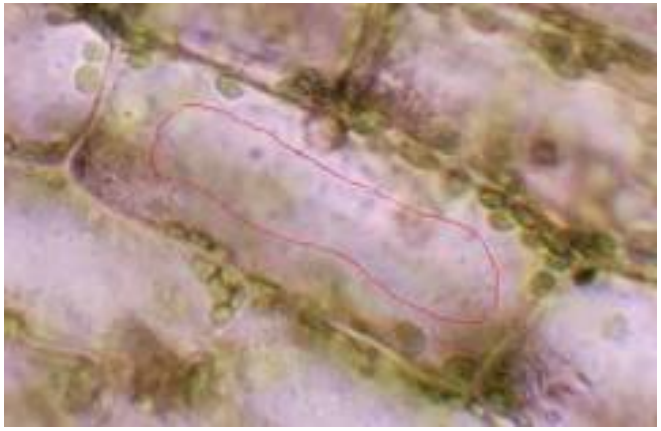
# Plastids

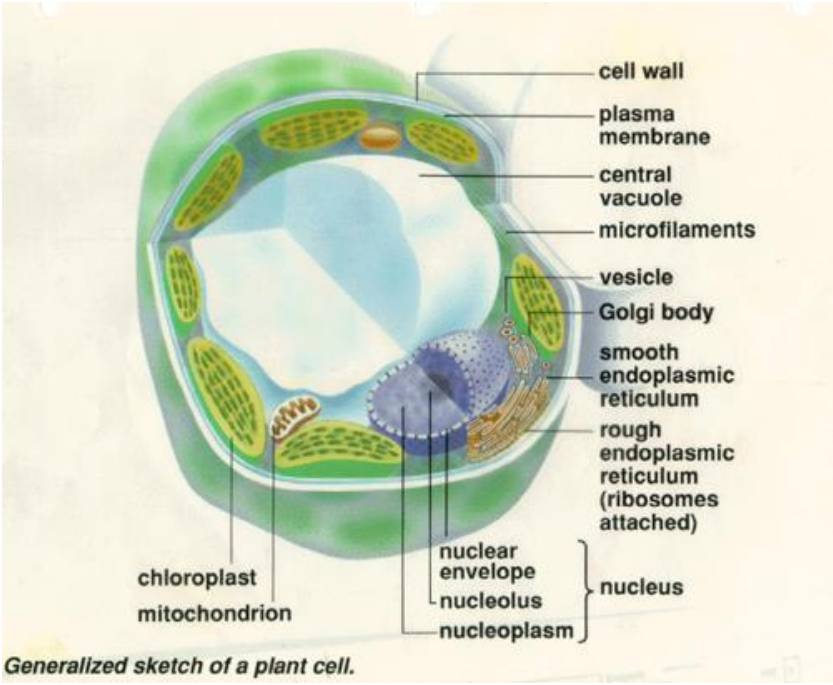
- Plastids function in storage and photosynthesis in plants and some types of algae
- **1) Chloroplasts**
  - Plastids specialized for photosynthesis
  - Resemble photosynthetic bacteria; may have evolved by endosymbiosis
- 2) Chromoplasts – make/store other plant pigments
- 3) Amylolasts – colorless, store starch grains



# The Central Vacuole – plants!!!!

- **Central vacuole**
  - A plant organelle that occupies 50 to 90 percent of a cell's interior
  - Stores amino acids, sugars, ions, wastes, toxins
  - Fluid pressure keeps plant cells firm

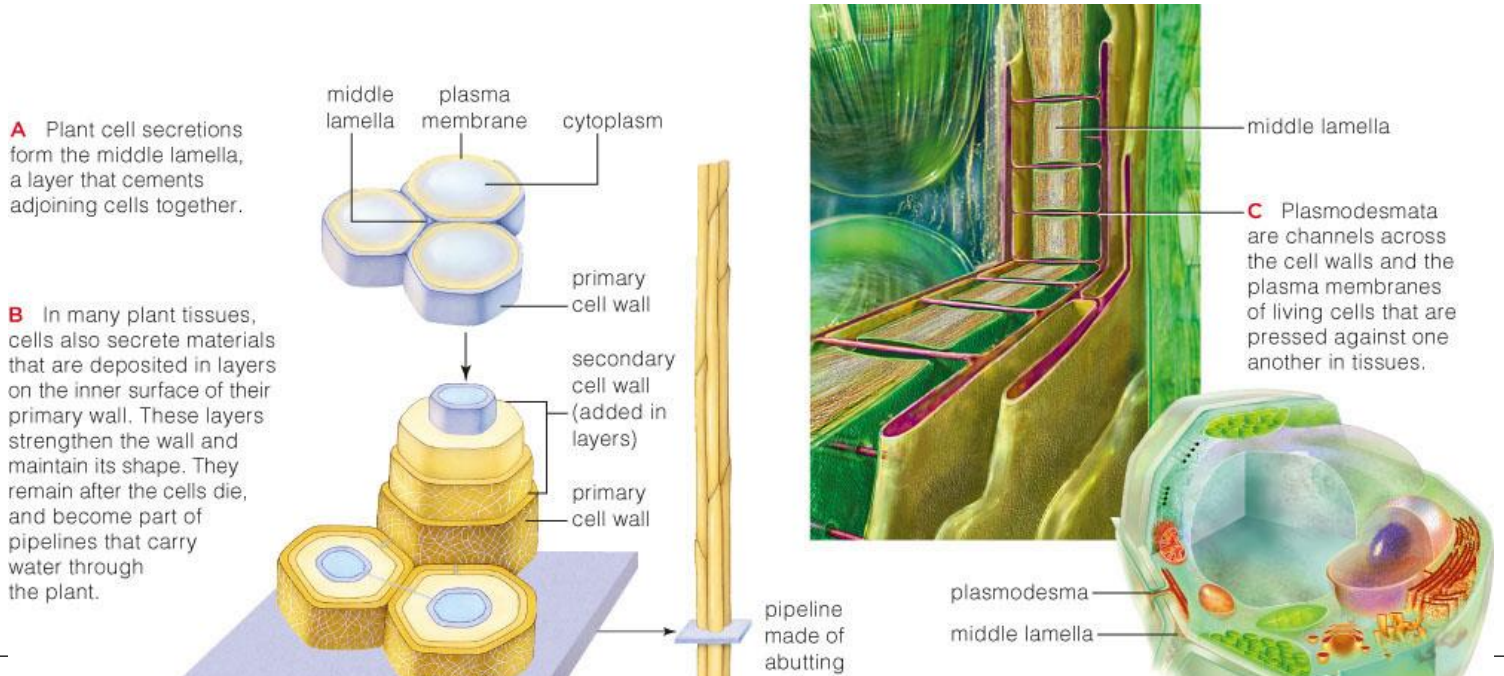




Generalized sketch of a plant cell.

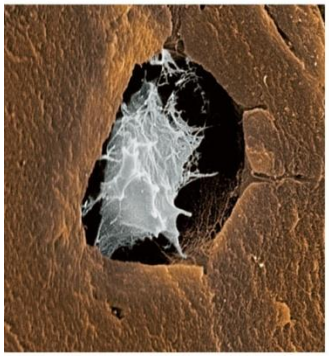
# 4.12 Cell Wall

- Found in plant cells and many protist and fungal cells
- **Primary cell wall**
  - A thin, pliable wall formed by secretion of cellulose into the coating around young plant cells
- **Secondary cell wall**
  - A strong wall composed of **lignin** (polymer of alcohols), formed in some plant stems and roots after maturity



# Matrixes

- **Extracellular matrix (ECM)**
  - A nonliving, complex mixture of fibrous proteins and polysaccharides secreted by and surrounding cells; structure and function varies with the type of tissue
  - *Example:* Bone is mostly ECM, composed of collagen (fibrous protein) and hardened by mineral deposits

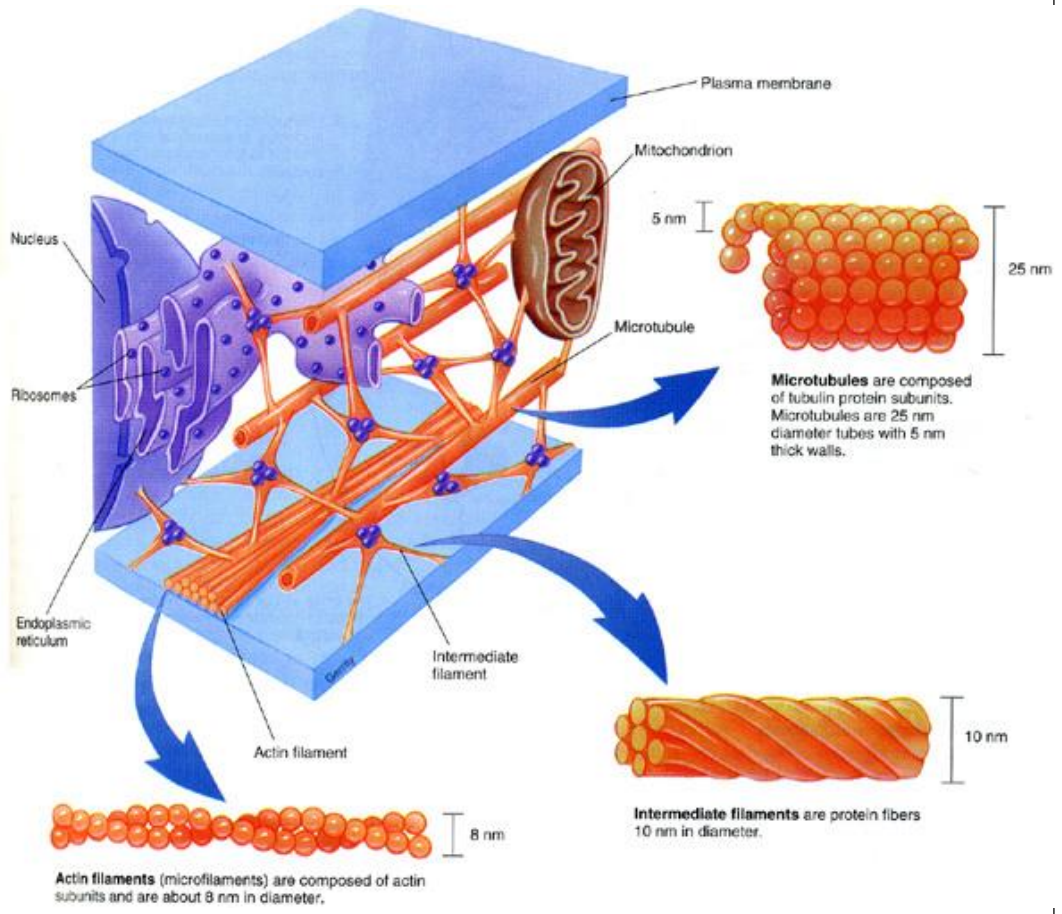


# Cell Junctions

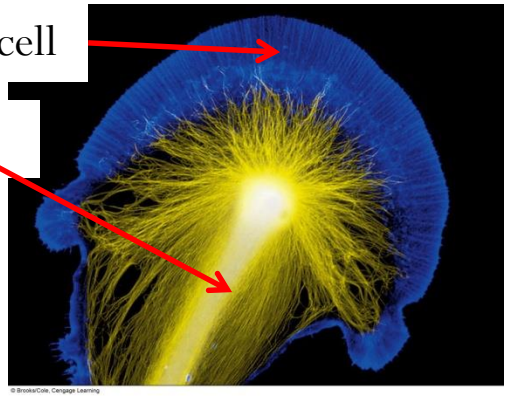
- **Cell junctions** allow cells to interact with each other and the environment
- In plants, **plasmodesmata** extend through cell walls to connect the cytoplasm of two cells
- Animals have three types of cell junctions:
  - **tight junctions – seal cells tightly (gastrointestinal)**
  - **adhering junctions – anchor cells (strengthen heart muscles)**
  - **gap junctions – open channels that connect cytoplasm of adjoining cells (allow heart muscles to contract as a unit)**

# 4.13 – THE END OF CHAPTER 4

- **Cytoskeleton**
  - An interconnected system of many protein
  - Reinforce, organize, and move cell structures, or even a whole cell

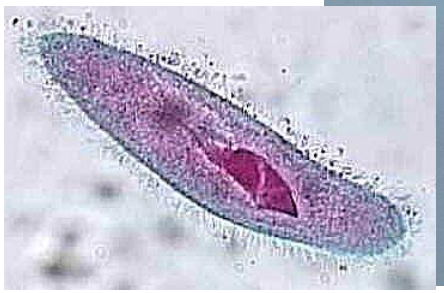


# Microtubules

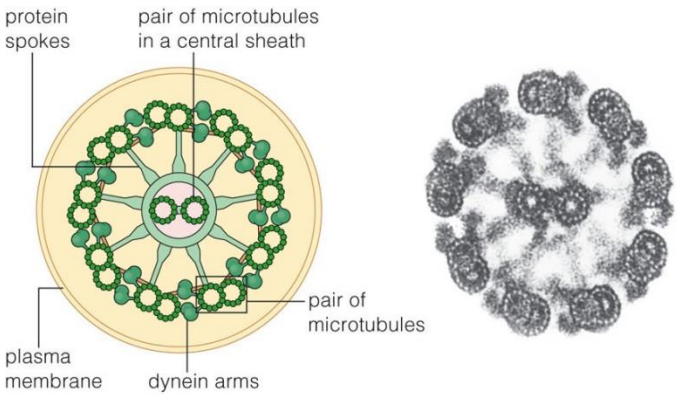



- **Microtubules**
  - Long, hollow cylinders made of tubulin
  - Form dynamic scaffolding for cell processes (directing nerve cells, separating chromosomes in cell division)
- **Eukaryotic flagella** and **cilia**
  - Whiplike structures formed from microtubules organized into 9 + 2 arrays
  - Grow from a **centriole** which remains in the cytoplasm as a basal body

# Flagella and cilia



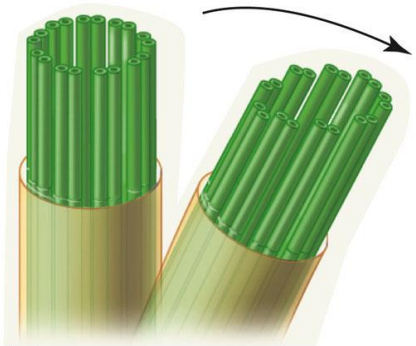
- **Eukaryotic flagella** and **cilia**
  - Whiplike structures formed from microtubules organized into 9 + 2 arrays




A Sketch and micrograph of one eukaryotic flagellum, cross-section. Like a cilium, it contains a 9+2 array: a ring of nine pairs of microtubules plus one pair at its core. Stabilizing spokes and linking elements that connect to the microtubules keep them aligned in this radial pattern.



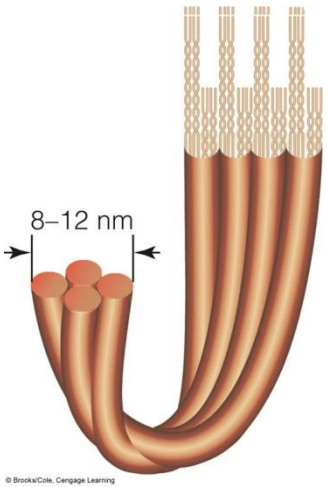
C Short, sliding strokes occur in a coordinated sequence around the ring, down the length of each microtubule pair. The flagellum bends as the array inside bends:



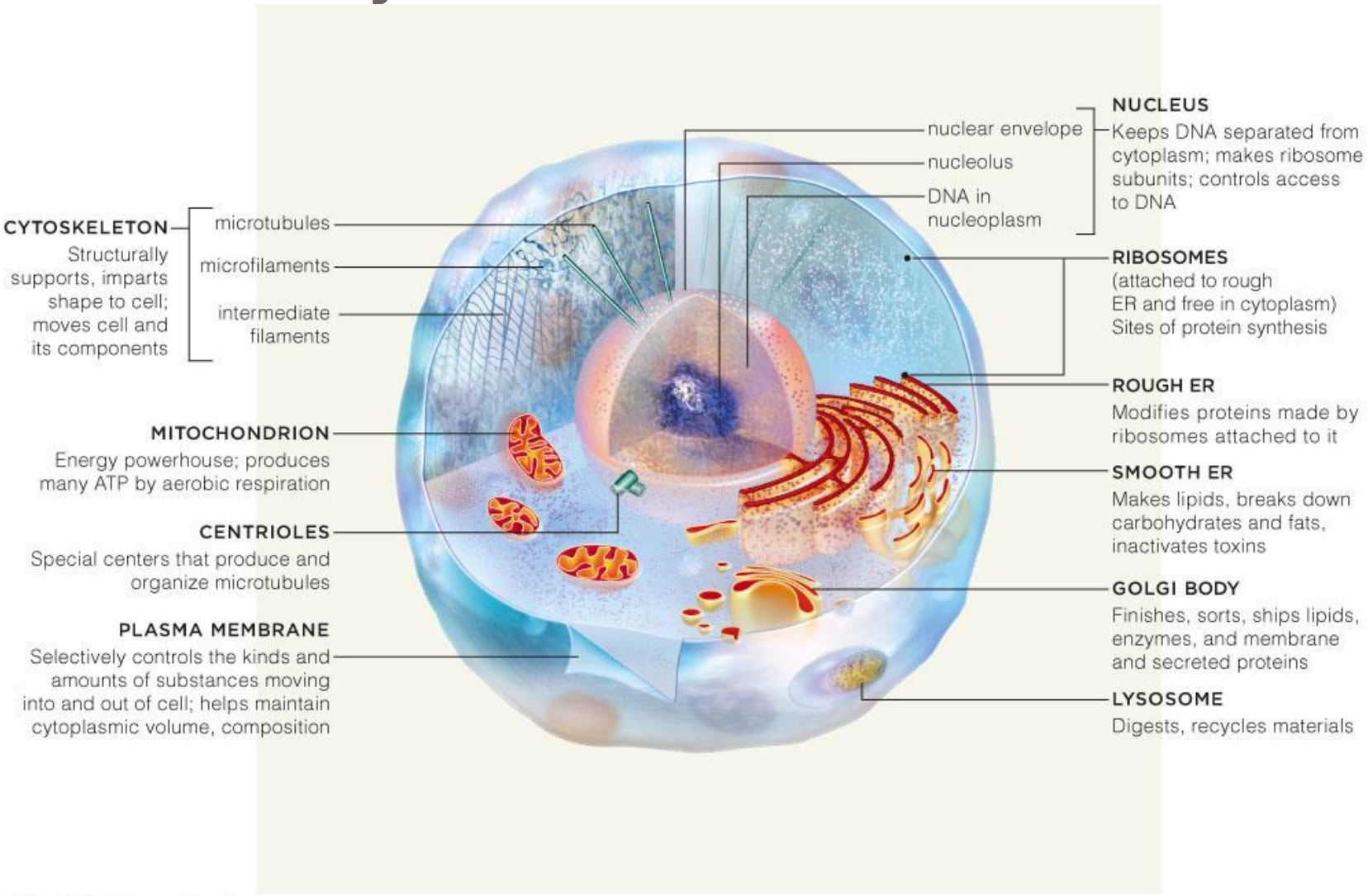
# Cytoskeleton

- **Microfilaments**
  - Consist mainly of the globular protein actin
  - Strengthen or change the shape of cells
- **Intermediate filaments**
  - Maintain cell and tissue structures

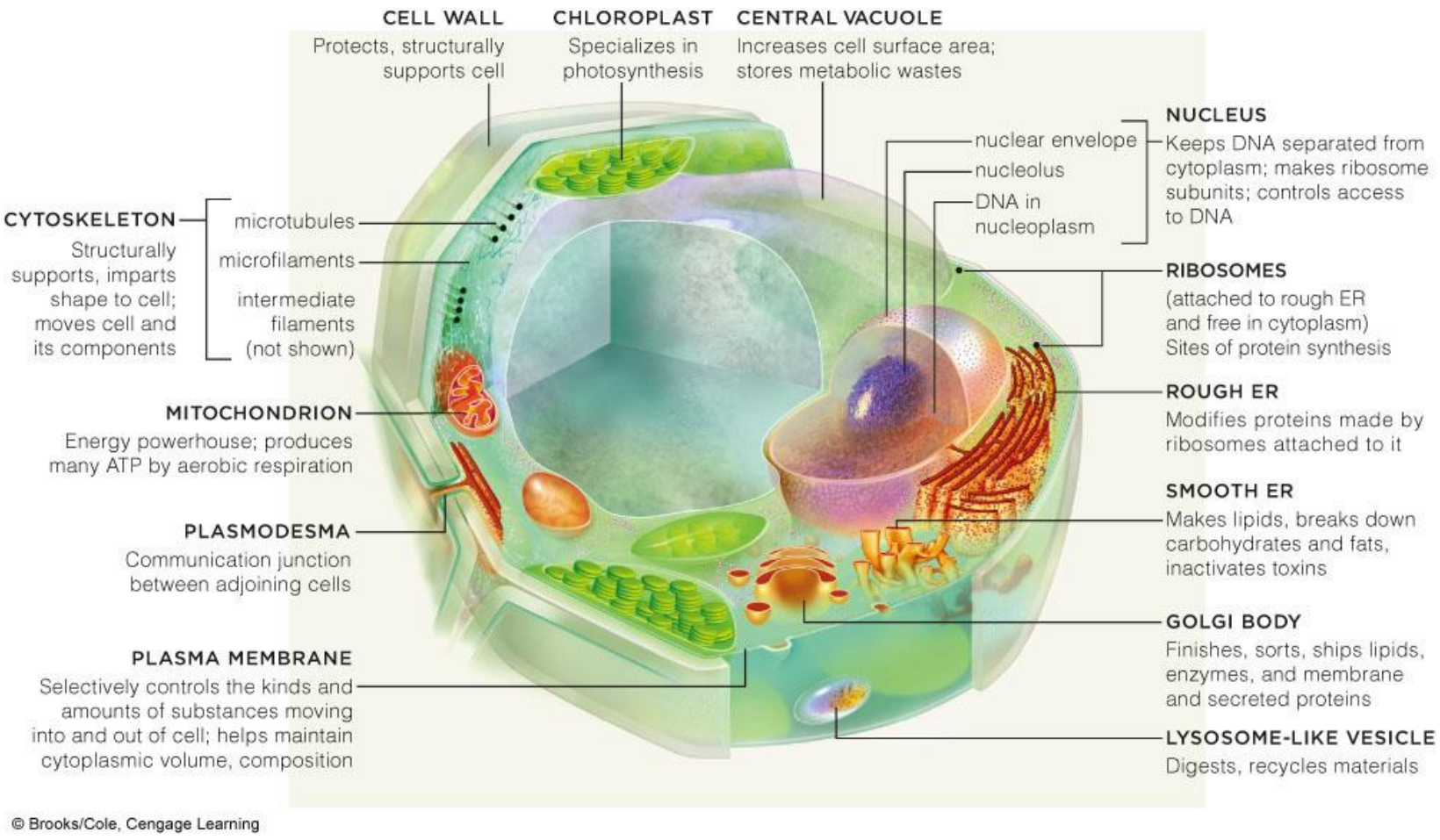
(supports inner surface of nuclear membrane)




# A Eukaryote – animal cell



# 4.7 A Eukaryote – plant cell pg. 63



# The most helpful table you have ever seen!!!

**Table 4.3 Summary of Typical Components of Prokaryotic and Eukaryotic Cells**

| Cell Component | Main Functions | Prokaryotic | Eukaryotic | | | |
|---|---|---|---|---|---|---|
| | | Bacteria, Archaea | Protists | Fungi | Plants | Animals |
| Cell wall | Protection, structural support | ✻ | ✻ | ✓ | ✓ | — |
| Plasma membrane | Control of substances moving into and out of cell | ✓ | ✓ | ✓ | ✓ | ✓ |
| Nucleus | Physical separation of DNA from cytoplasm | —* | ✓ | ✓ | ✓ | ✓ |
| DNA | Encodes hereditary information | ✓ | ✓ | ✓ | ✓ | ✓ |
| Nucleolus | Assembly of ribosome subunits | — | ✓ | ✓ | ✓ | ✓ |
| Ribosome | Protein synthesis | ✓ | ✓ | ✓ | ✓ | ✓ |
| Endoplasmic reticulum (ER) | Synthesis, modification of membrane proteins; lipid synthesis | — | ✓ | ✓ | ✓ | ✓ |
| Golgi body | Final modification of membrane proteins; sorting, packaging lipids and proteins into vesicles | — | ✓ | ✓ | ✓ | ✓ |
| Lysosome | Intracellular digestion | — | ✓ | ✻ | ✻ | ✓ |
| Centriole | Organization of cytoskeletal elements | ★ | ✓ | ✓ | ✻ | ✓ |
| Mitochondrion | ATP formation | — | ✓ | ✓ | ✓ | ✓ |
| Chloroplast | Photosynthesis | — | ✻ | — | ✓ | — |
| Central vacuole | Storage | — | — | ✻ | ✓ | — |
| Bacterial flagellum | Locomotion through fluid surroundings | ✻ | — | — | — | — |
| Flagellum or cilium with 9+2 microtubule array | Locomotion through or motion within fluid surroundings | — | ✻ | ✻ | ✻ | ✓ |
| Cytoskeleton | Cell shape; internal organization; basis of cell movement and, in many cells, locomotion | ★ | ✻ | ✻ | ✻ | ✓ |

✓ Present in at least part of the life cycle of most or all groups.
✻ Known to be present in cells of at least some groups.
★ Occurs in a form unique to prokaryotes.
* Some planctomycete bacteria have a double membrane around their DNA.

# HeLa cells

- Video on HeLa cells