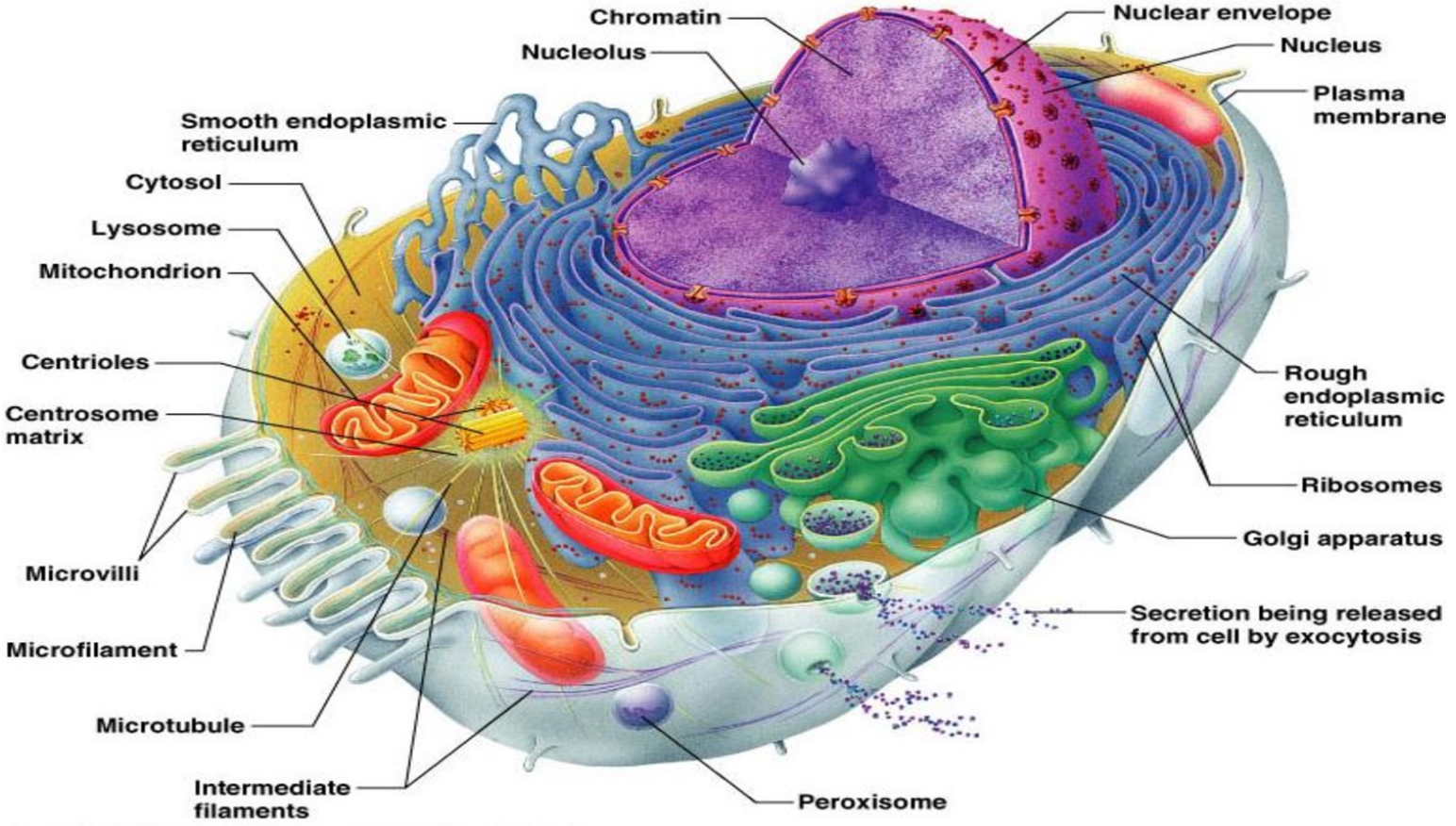
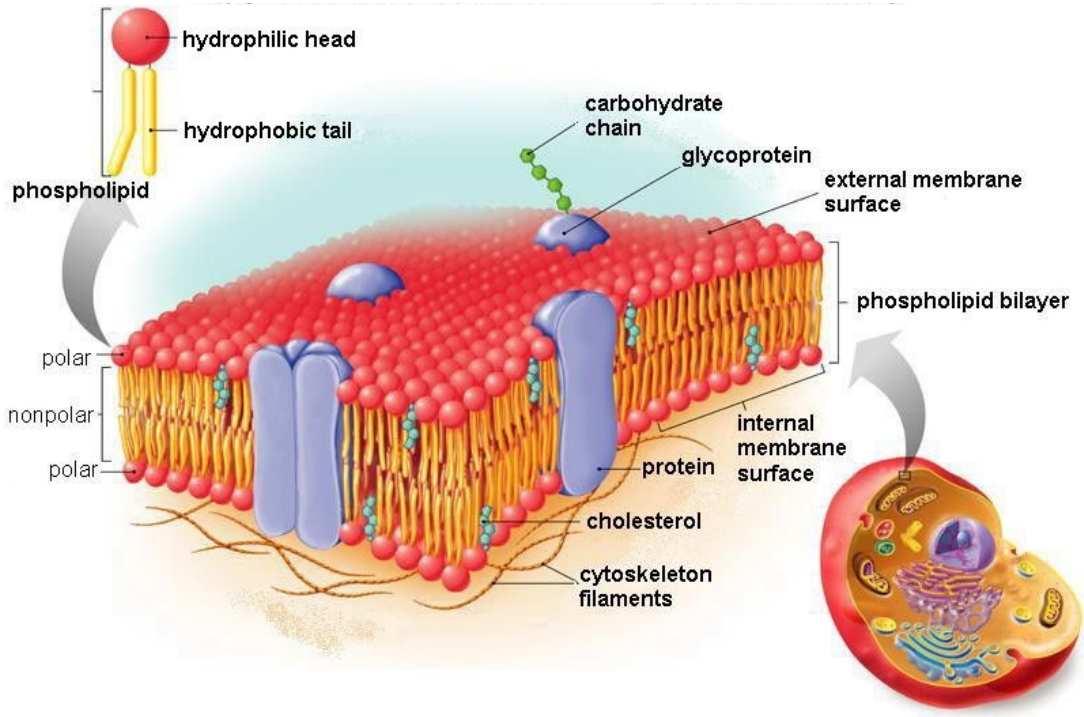
Lesson 7
Cellular organization



Cell membrane

- Cells are building blocks of life
- Cells are surrounded (protected) by a **plasma (or cell) membrane = highly hydrophobic amphipathic lipid bilayer**



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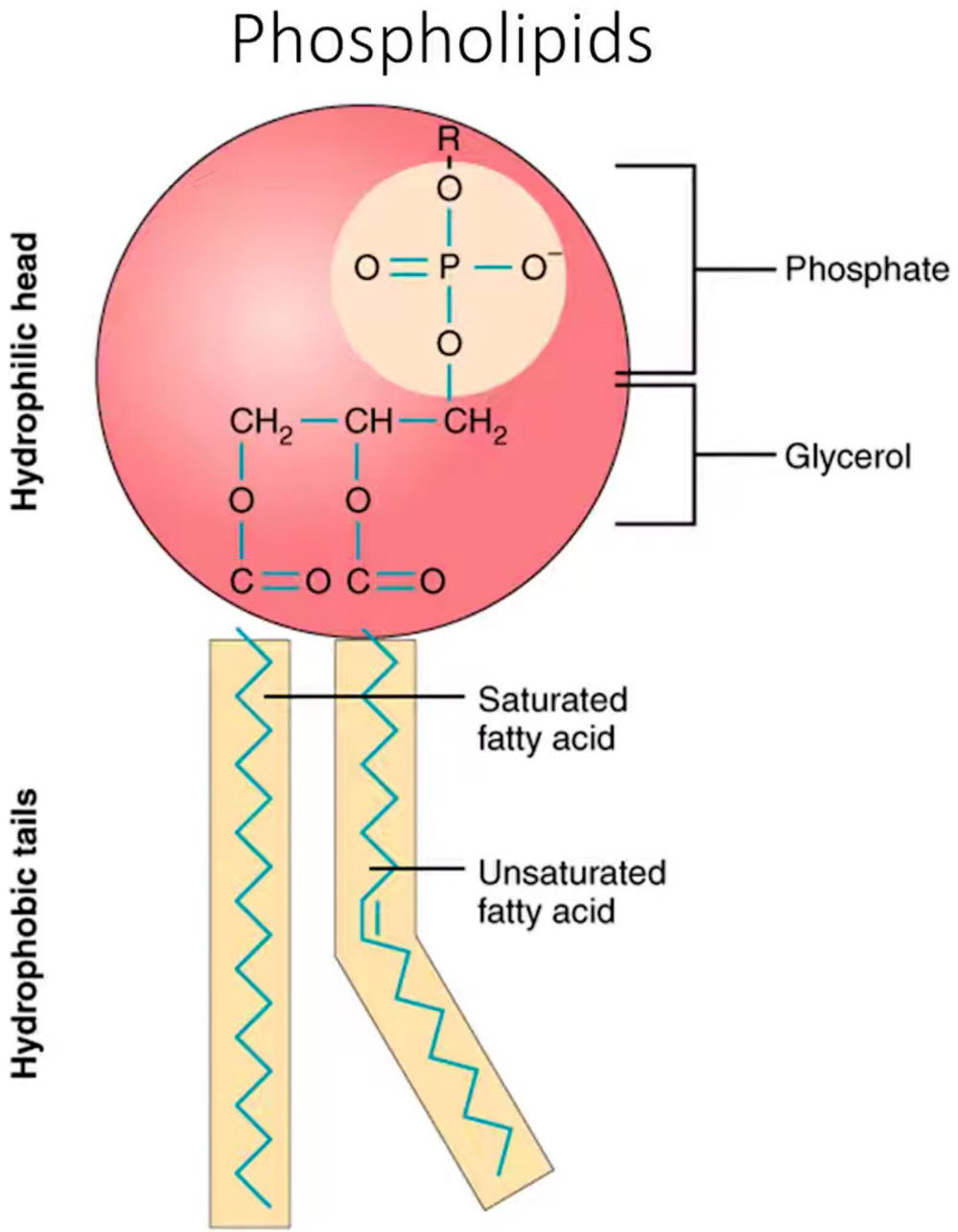

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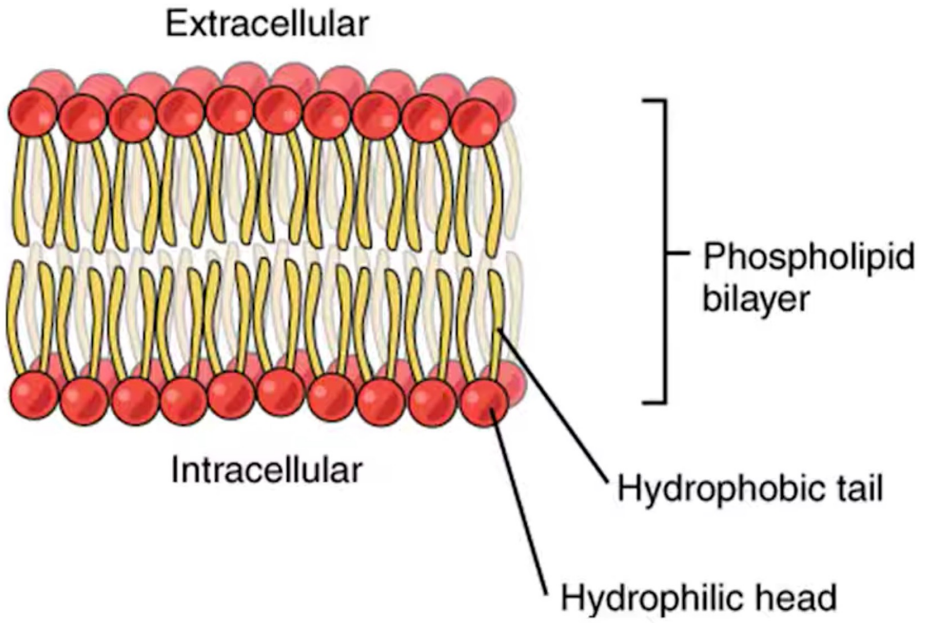

Phospholipid membrane (lipid bilayer)

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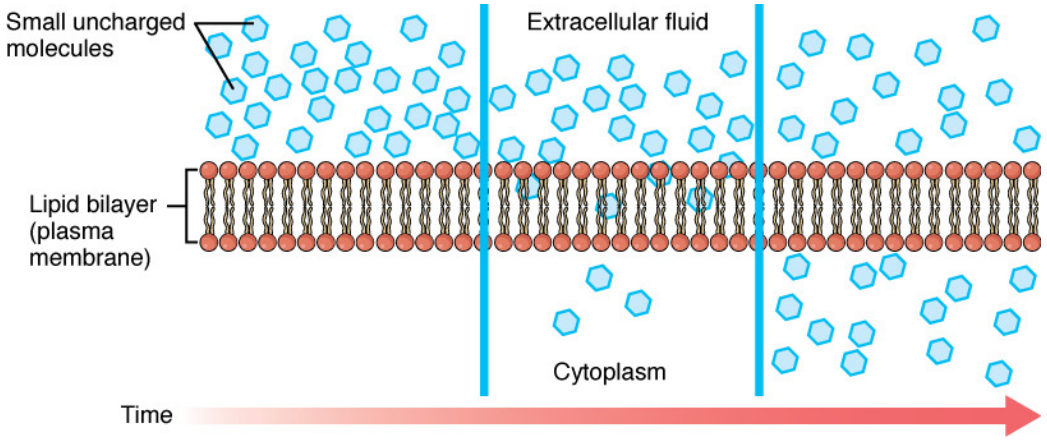

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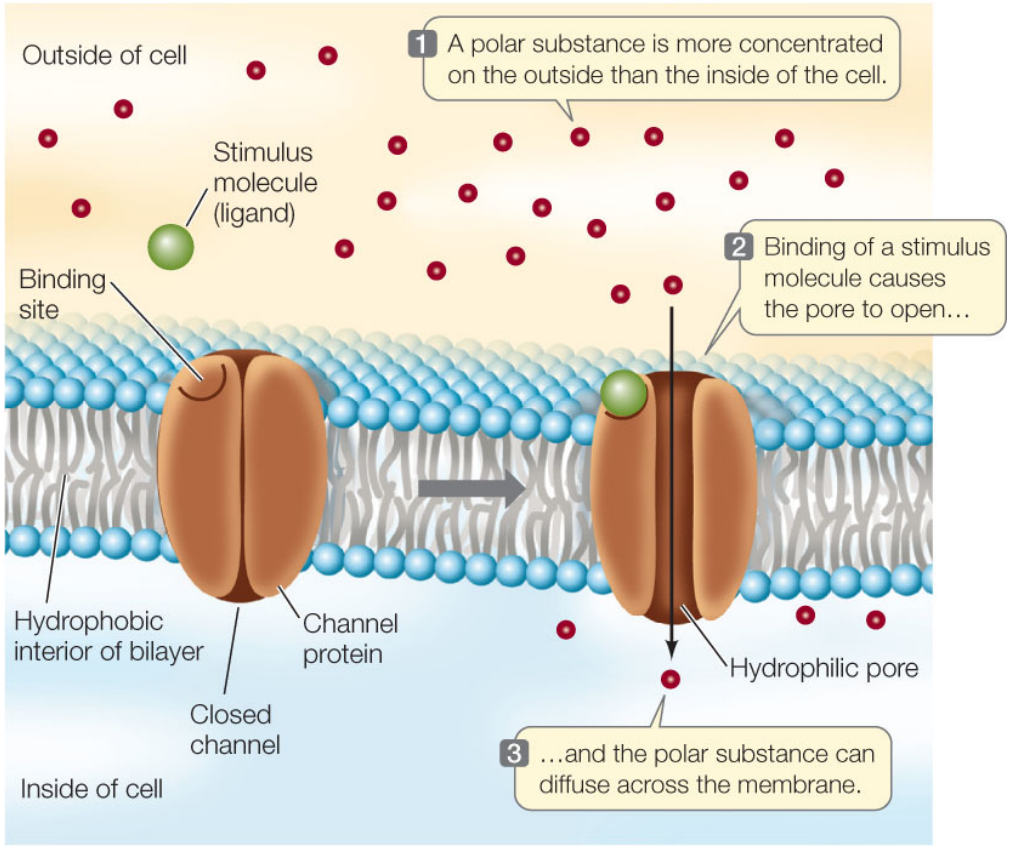
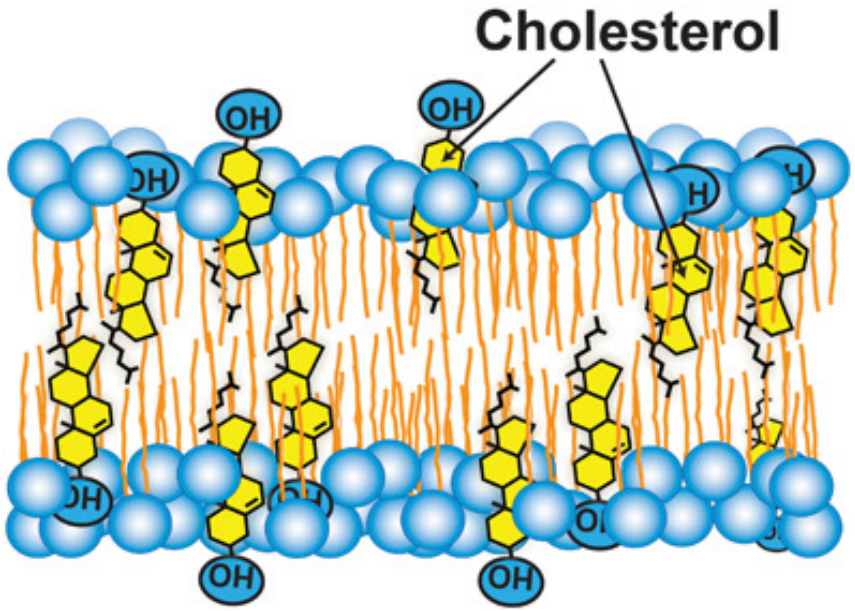
- Hydrophobic molecules can diffuse in & out the plasma membrane
- Particular structures like **channels or pores** allows polar molecules in & out the plasma membrane



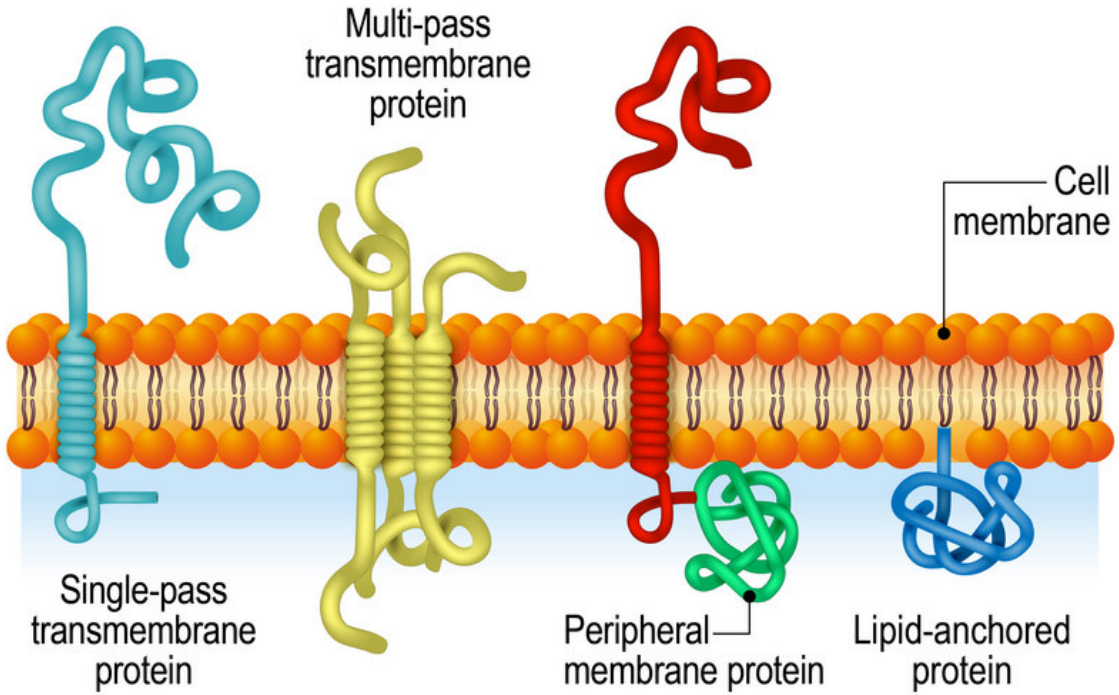
Cell membrane

- Cholesterol – a steroid (lipid)
  → membrane fluidity



Cell membrane

- Cholesterol – a steroid (lipid) → membrane fluidity
- Membrane proteins
  - **Integral proteins** = span the entire width of the phospholipidic bilayer
  - **Peripheral proteins** = loosely bound to the exterior or interior membrane surfaces
- Both integral and peripheral proteins may serve as:
  - Enzymes
  - Structural attachments for the fibers of the cytoskeleton
  - Part of the cell's recognition sites



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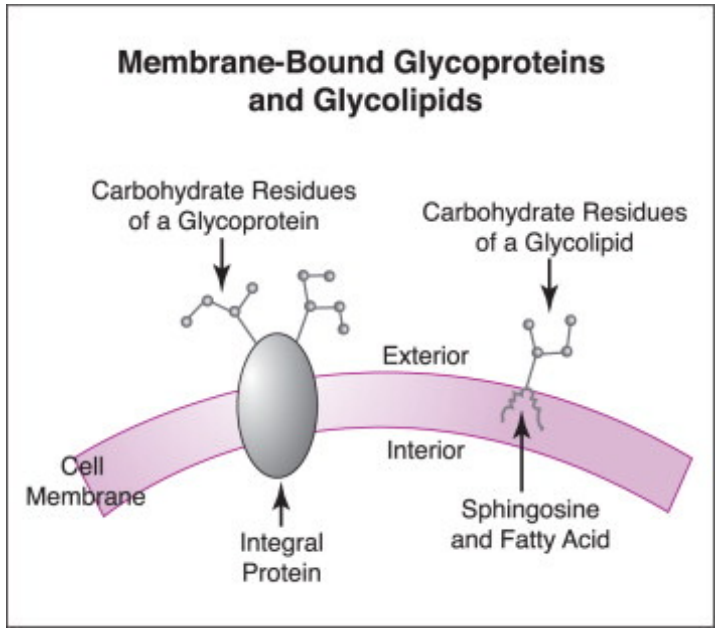
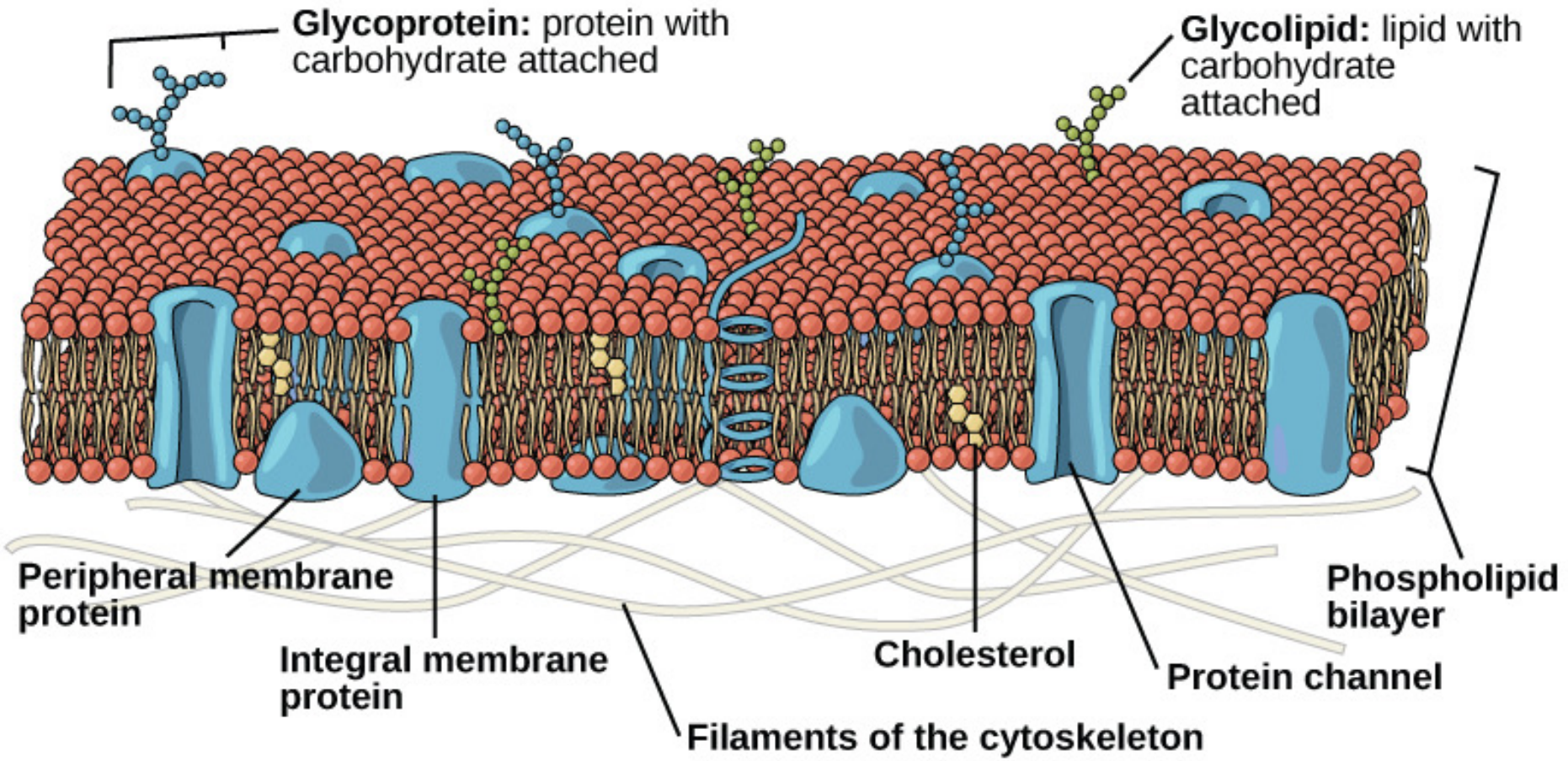
- **Carbohydrates**
  - always found on the exterior surface of cells
  - always bound to:
  - proteins → glycoproteins
  - lipids → glycolipids
- Along with peripheral proteins, carbohydrates form specialized sites on the cell surface that allow cells to recognize each other

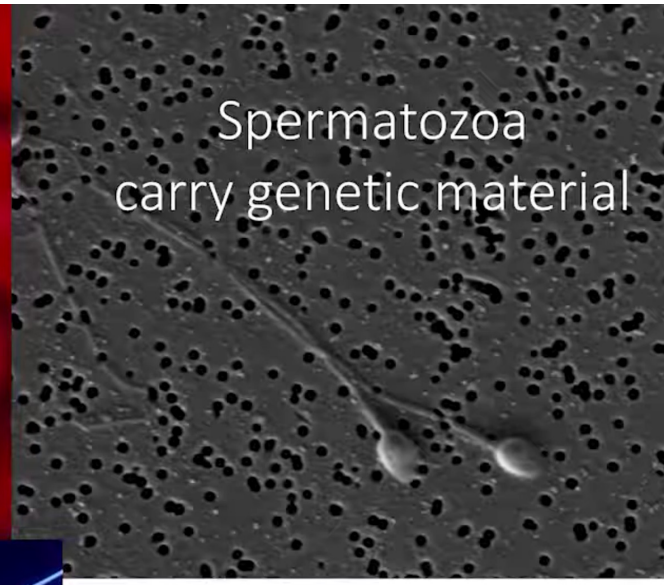


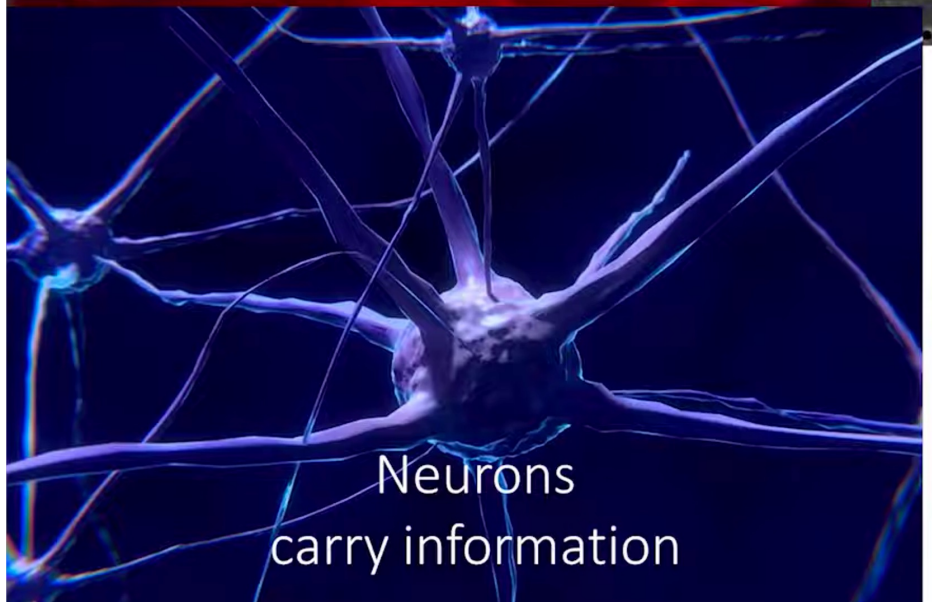
The fluid mosaic model



Cell types

- There are about 200 different types of cells in a human body
- Each human cell type has a different
  - structure
  - size
  - shape
  - function (and organelles)

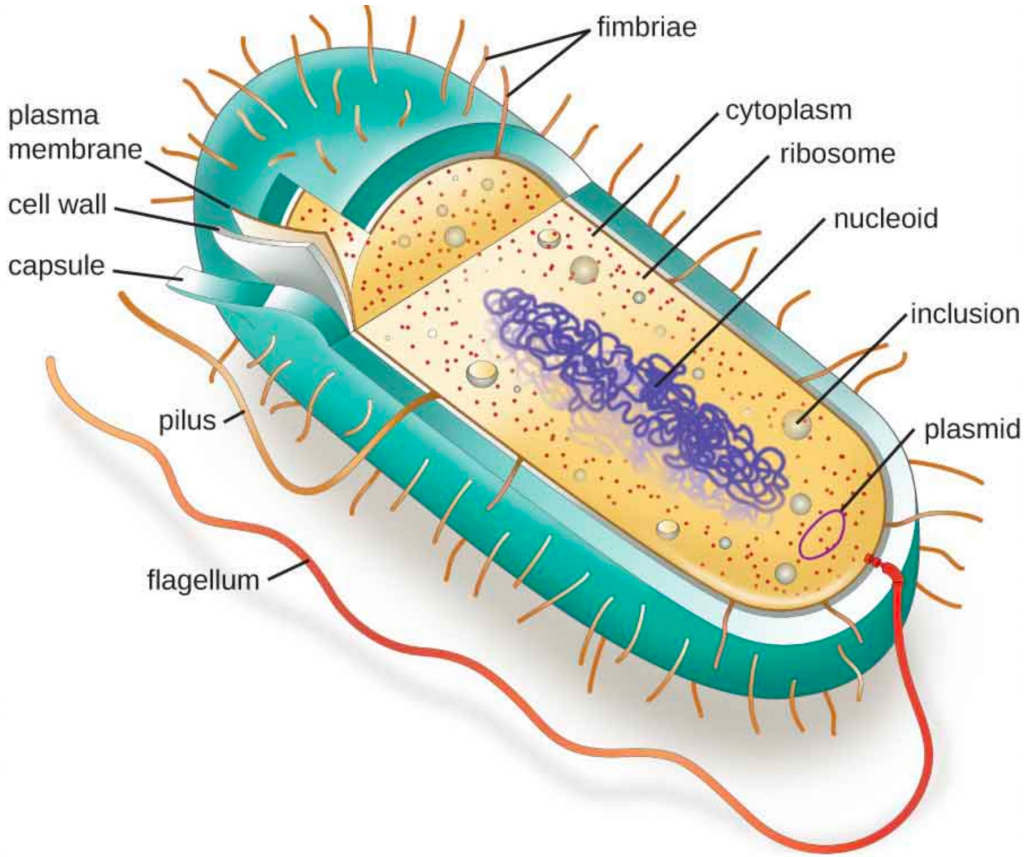




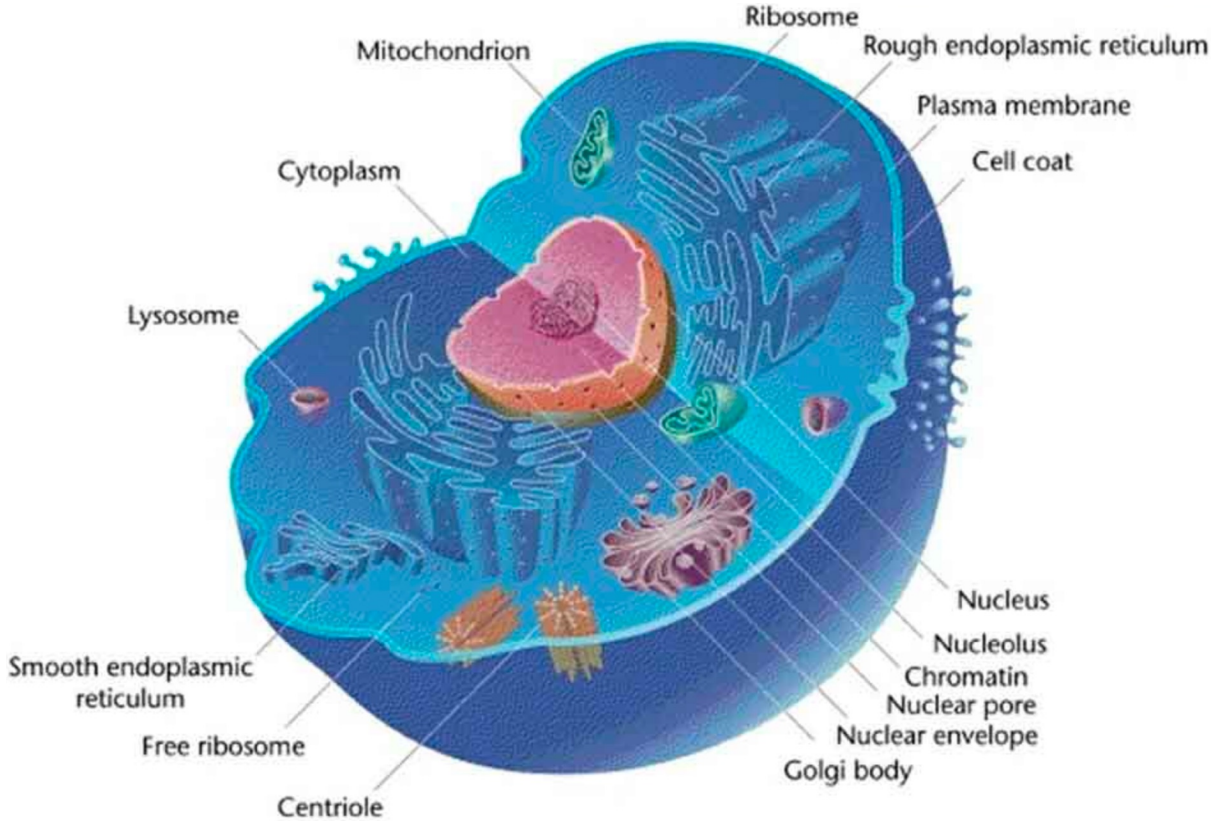
Many different
cell types
with
different functions

Inside a cell

Prokaryotic cell



Eukaryotic cell

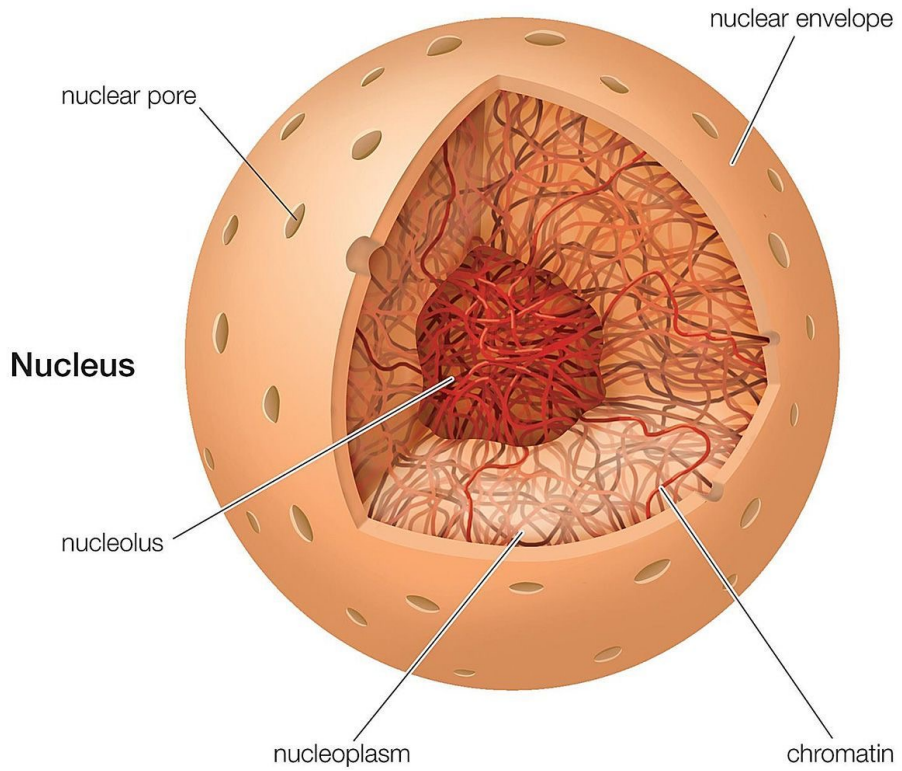


Inside a cell

- Cells are replicating, membrane-bound factories
- **Organelles** = subcellular structures with specific functions
  - May be membrane-bound themselves

Cellular organelles (eukaryotes)

- **Nucleus** = repository for genetic information, cell control center
- **Nucleolus** = r-RNA synthesis, ribosome construction
- **Nuclear envelope** = an inner and an outer membrane which run parallel to each other
- **Nuclear pores** = gaps in nuclear envelope
  - ~ 100 nm in real diameter (however due to the presence of central regulatory proteins, the true size of the gap is around 9 nm)
    - control the passage of molecules in&out of the nucleus
    - larger molecules (e.g., big proteins and nucleic acid are unable to pass through these pores → nuclear envelope works to selectively separate the contents of the nucleus from that of the cytoplasm



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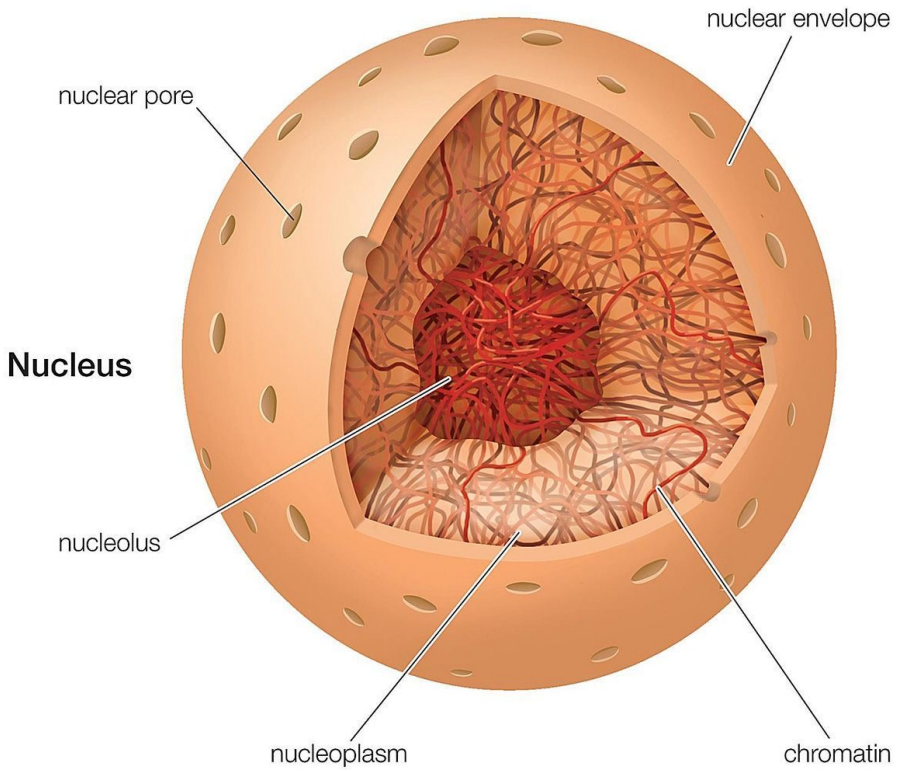
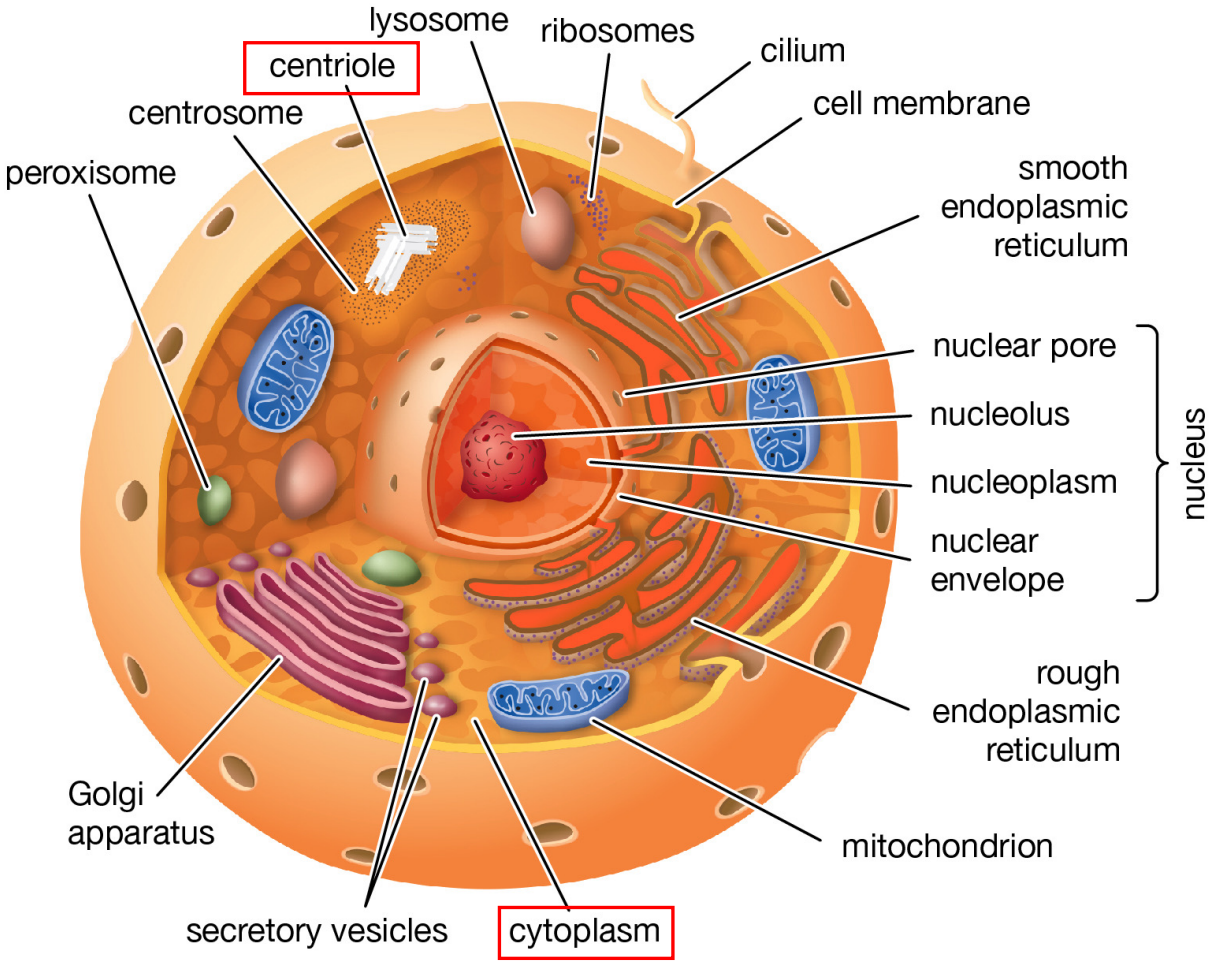
- **Chromatin =** DNA complexed with proteins (histones)
  - Histones combined with DNA form **nucleosomes**
    - a nucleosome describes a segment of DNA associated with **8** histone proteins
    - by associating with histones, DNA is more compact and able to fit into the nucleus



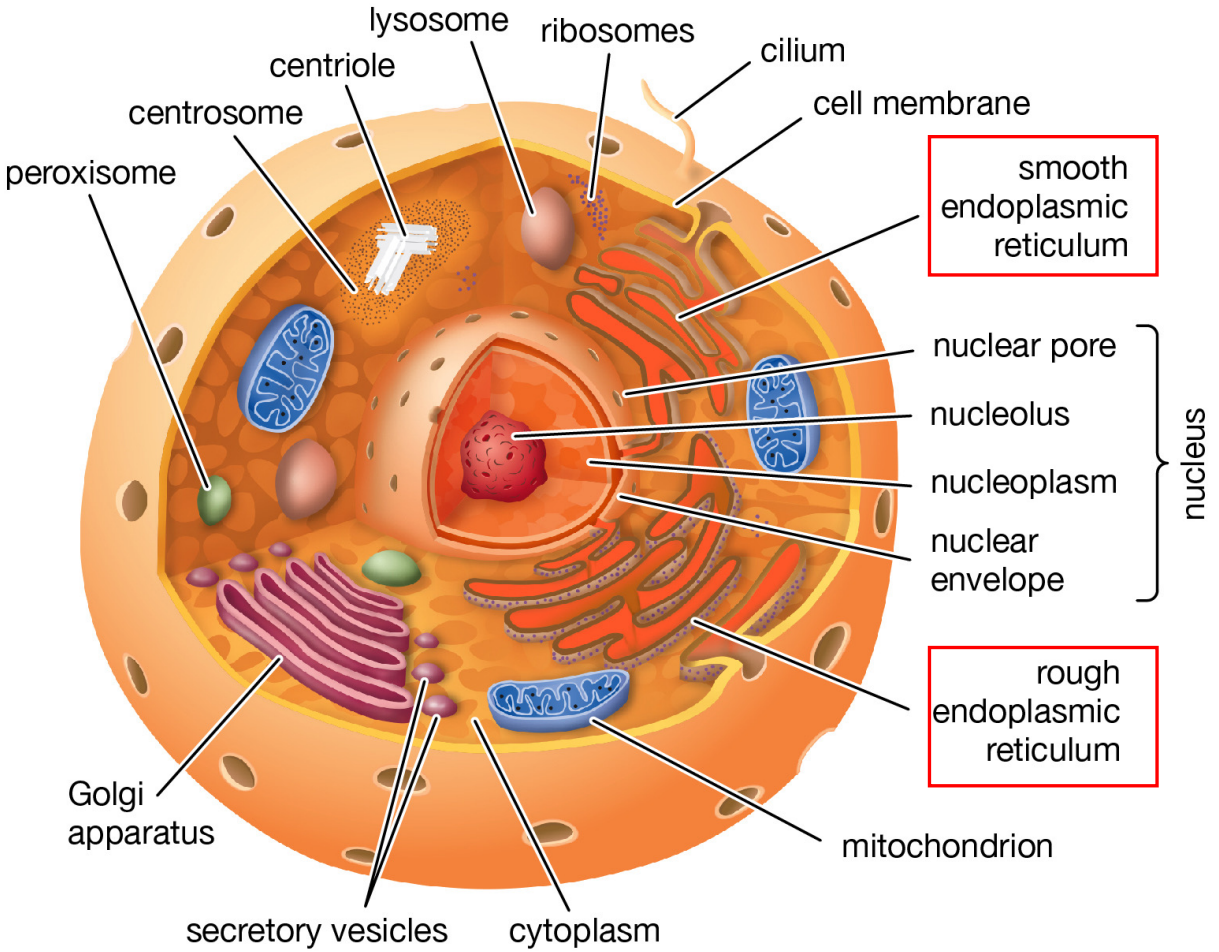
Cellular organelles (eukaryotes) – fly-by view

- Everything non-nuclear = **cytoplasm**
- **Centrioles** = organize structural components of the cell involved in moving the cell's components during cell division



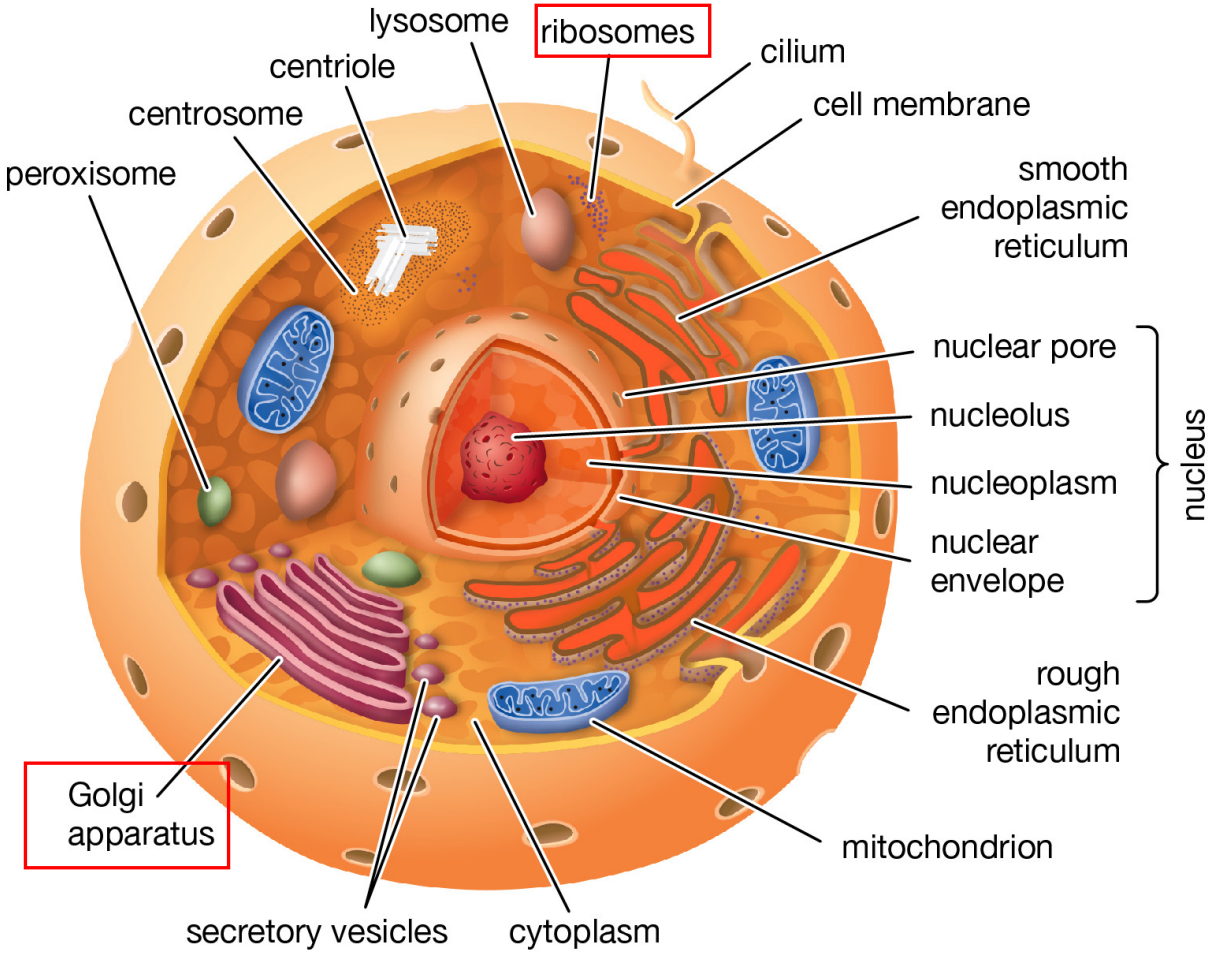
Cellular organelles (eukaryotes) – fly-by view

- **Endoplasmic reticulum (ER)**
- **Rough ER (RER)**
  - Contains the ribosomes (the protein synthesis machinery)
    - The cell's factory assembly line
- **Smooth ER (SER)**
  - Shuttles the cell's reaction products to the Golgi apparatus
    - The cell's factory shipping department



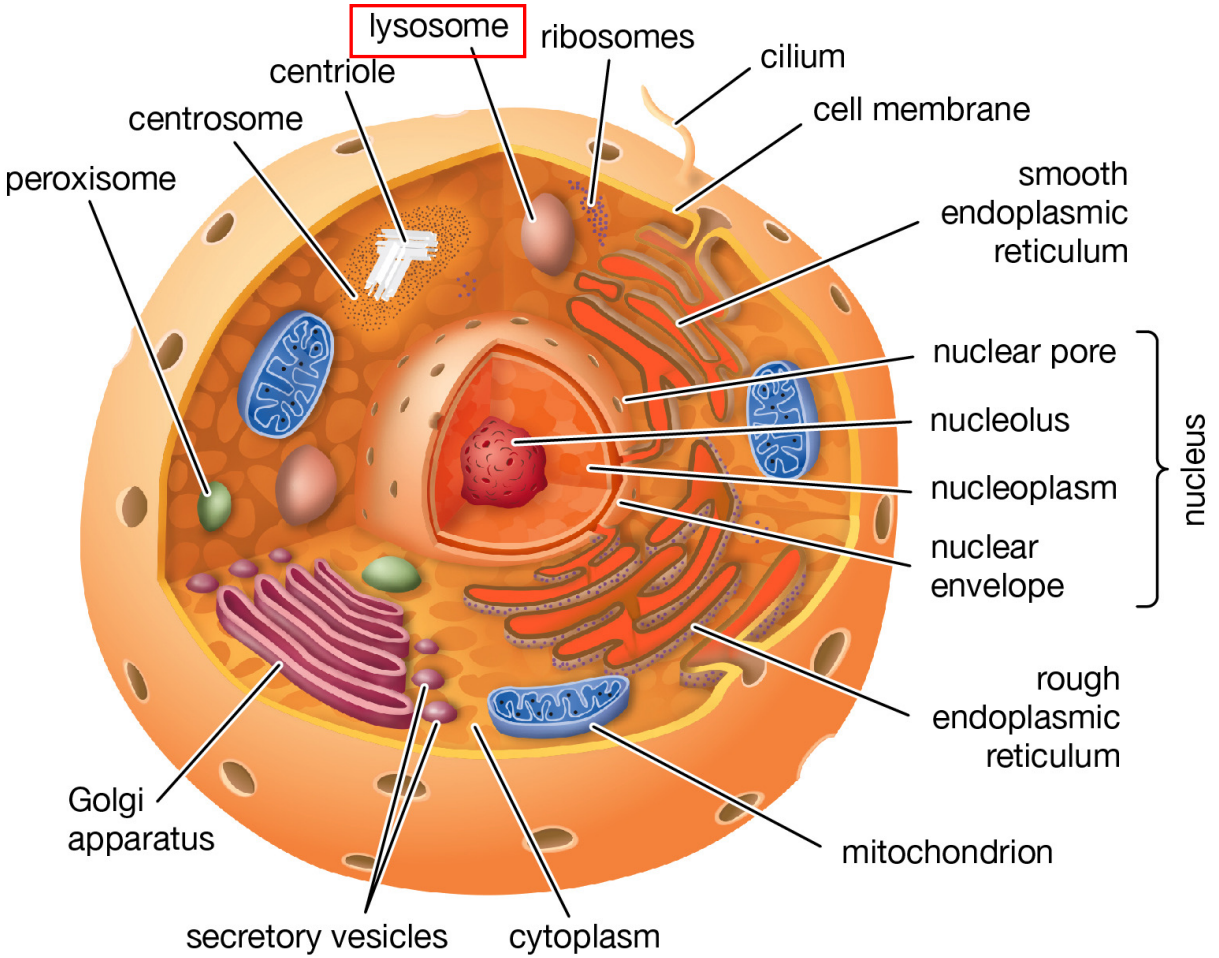
Cellular organelles (eukaryotes) – fly-by view

- **Ribosomes** = cell's organelles in which amino acids are assembled into proteins
  - Contain proteins and nucleic acid subunits
  - Cell factory's strategic department
- **Golgi apparatus** = Materials produced by the cell are packed into vesicles and sent to other organelles (for metabolism) or to cell membrane (for excretion)
  - Cell factory's postal system



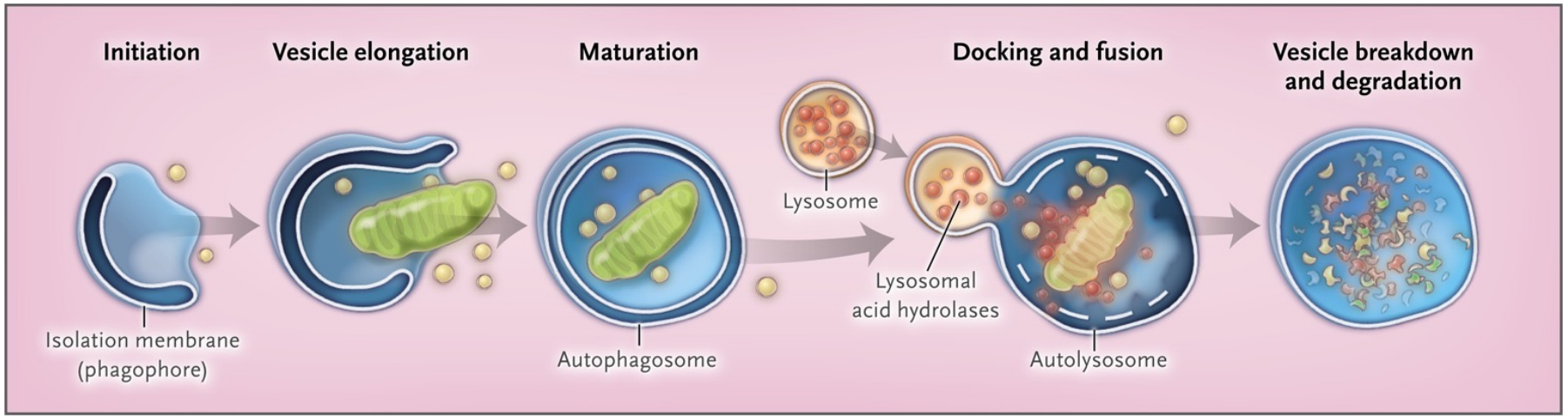
Cellular organelles (eukaryotes) – fly-by view

- **Lysosomes** = breaking down cellular components no longer needed/unwanted substances
  - They also digest dead organelles (autophagy or autodigestion)
  - Can be though of as the call factory's landfill



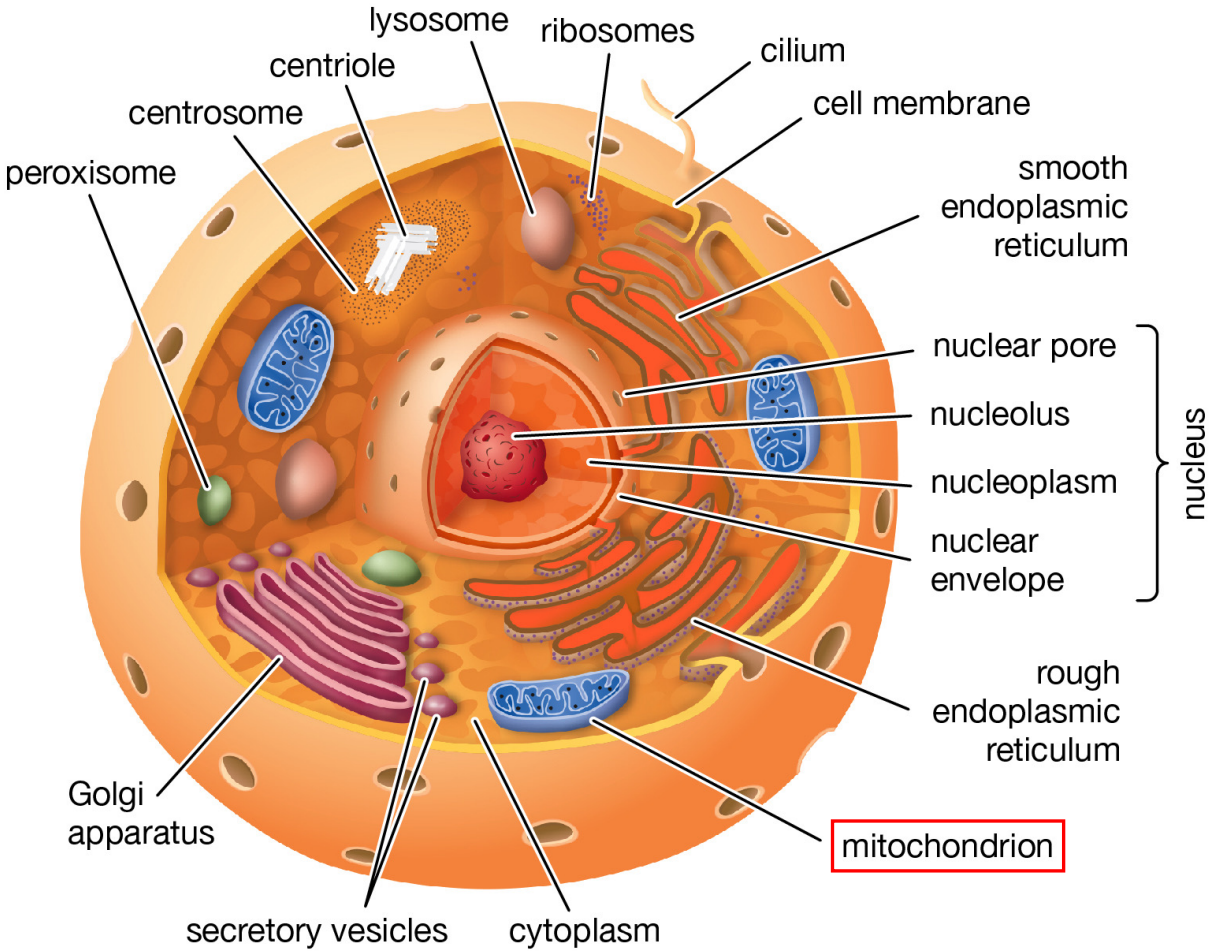
Autophagy

- A cellular self-degradative process fundamental in:
  - balancing sources of energy at critical times in development and in response to nutrient stress
  - housekeeping in removing
    - misfolded or aggregated proteins
    - clearing damaged organelles (mitochondria, ER…)
    - eliminating intracellular pathogens
- **Autophagy is generally thought of as a cellular survival mechanism**



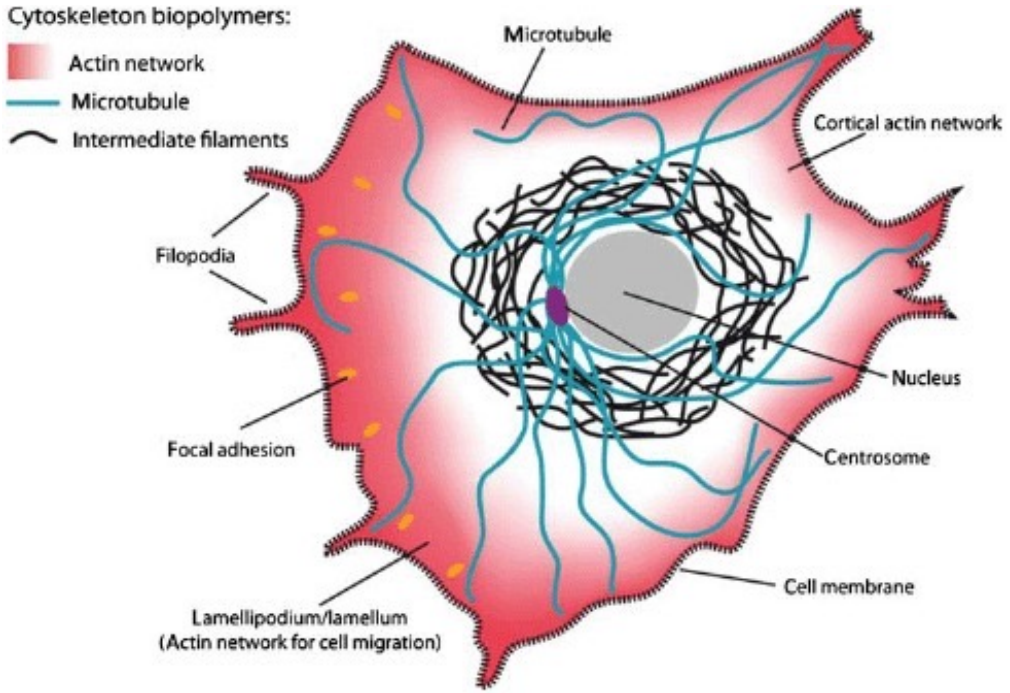
Cellular organelles (eukaryotes) – fly-by view

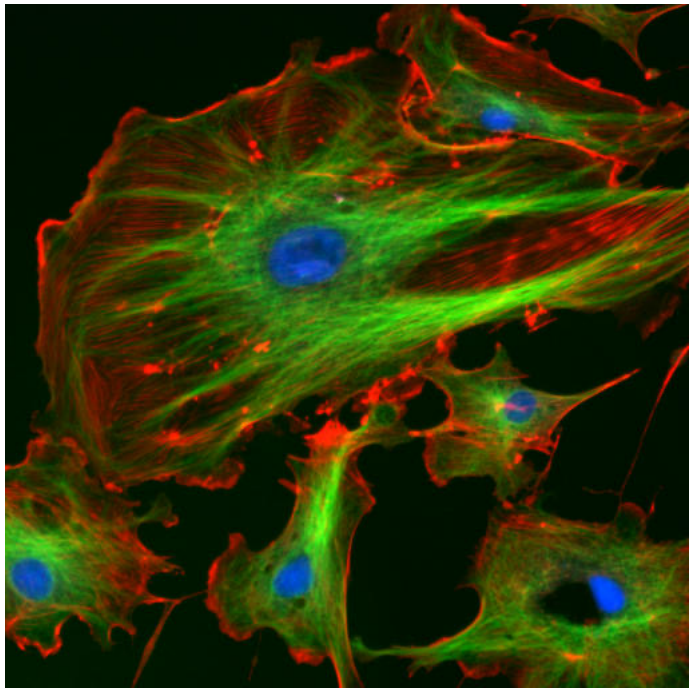
- **Mitochondria** = the cellular power plants where energy is produced
  - They use food components (mainly carbohydrates) to produce highly energetic molecules (ATP)
    - ATP hydrolysis = energy



Cellular organelles (eukaryotes) – fly-by view

- **Cytoskeleton** = mechanical support, shape, and strength





Cellular organelles (eukaryotes) – fly-by view

- **Celia**, **flagella** = cellular movement, sensory organelles