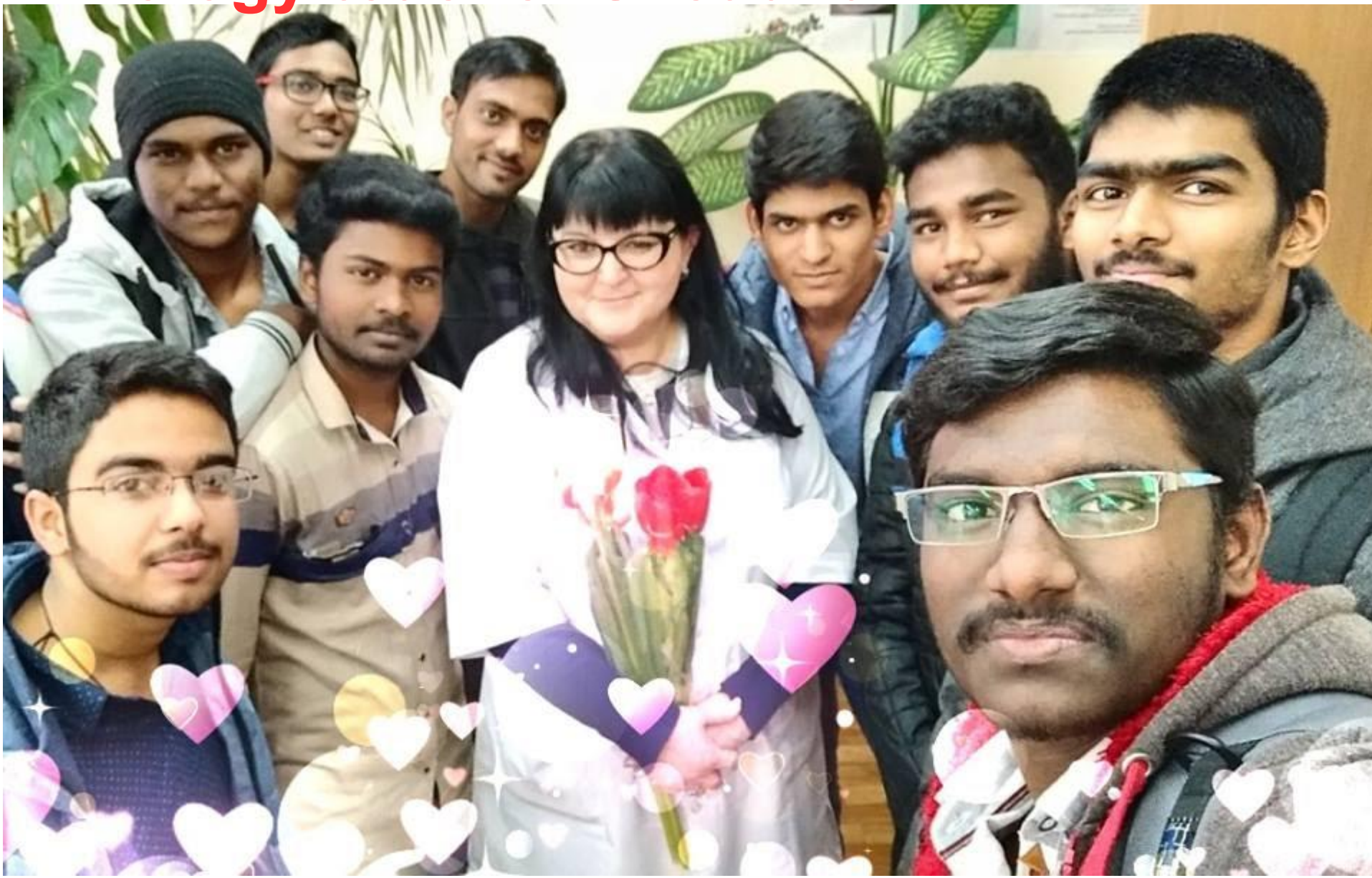
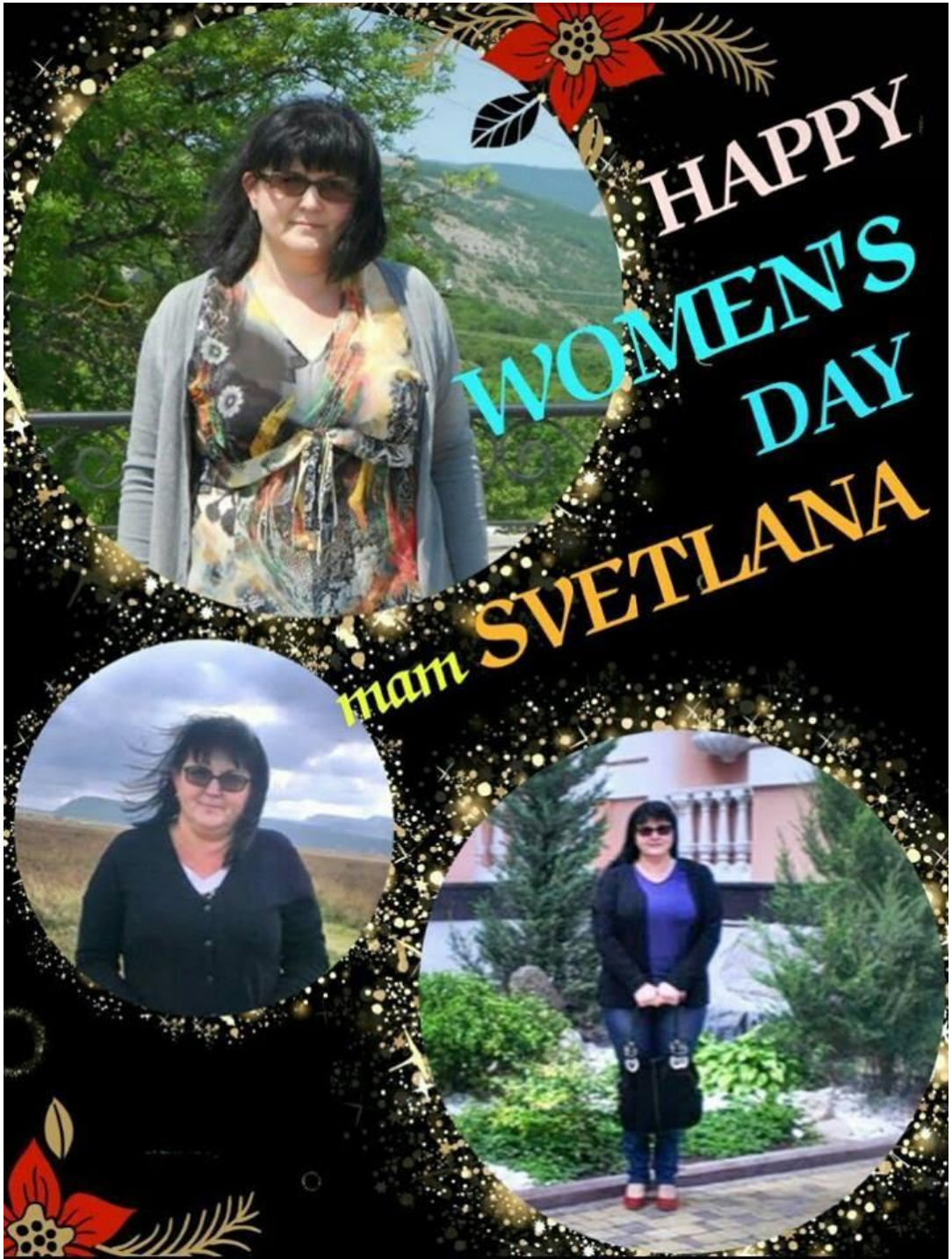

Introduction to Biology.
Forms of life.
Biology of the cell.

Department of Medical Biology

Biology teacher Svetlana

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Medical Biology 1 course MA Crimea

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Информация | Свежие новости

Medical biology is a field of biology that has practical applications in medicine, health care and laboratory diagnostics. It includes many biomedical disciplines and areas of specialty that typically contain the "bio-" prefix such as: molecular biology, biotechnology, cell biology, embryology, nanotechnology, biological engineering, laboratory medical biology, cytogenetics, genetics, gene therapy, bioinformatics, biostatistics, systems biology, parasitology, pathology,toxicology, and many others that generally concern life sciences as applied to medicine.

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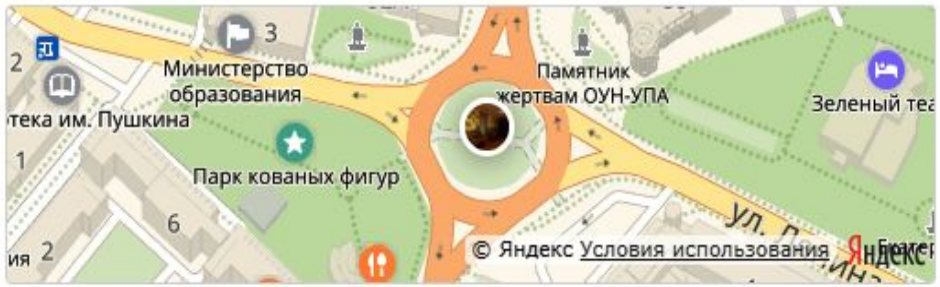

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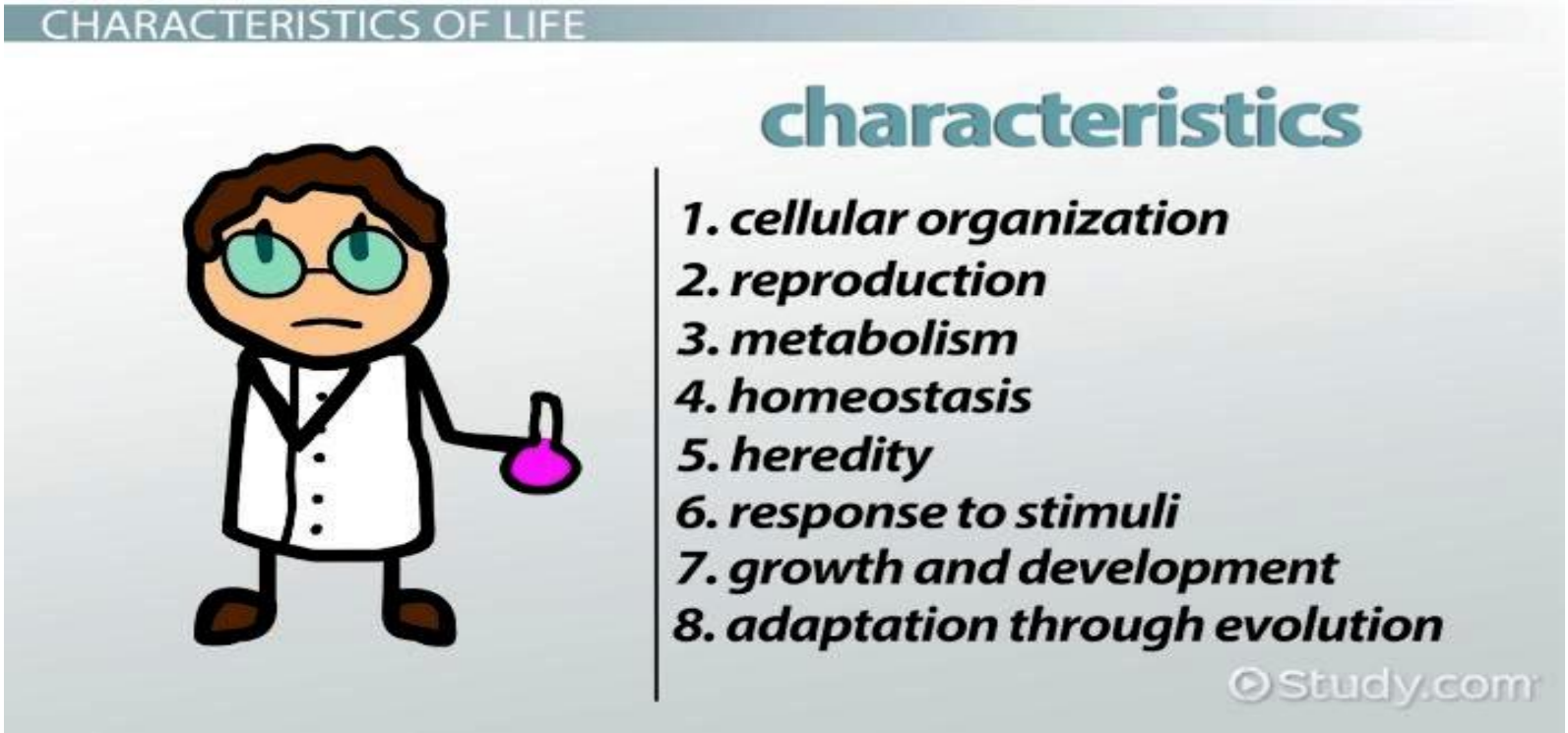
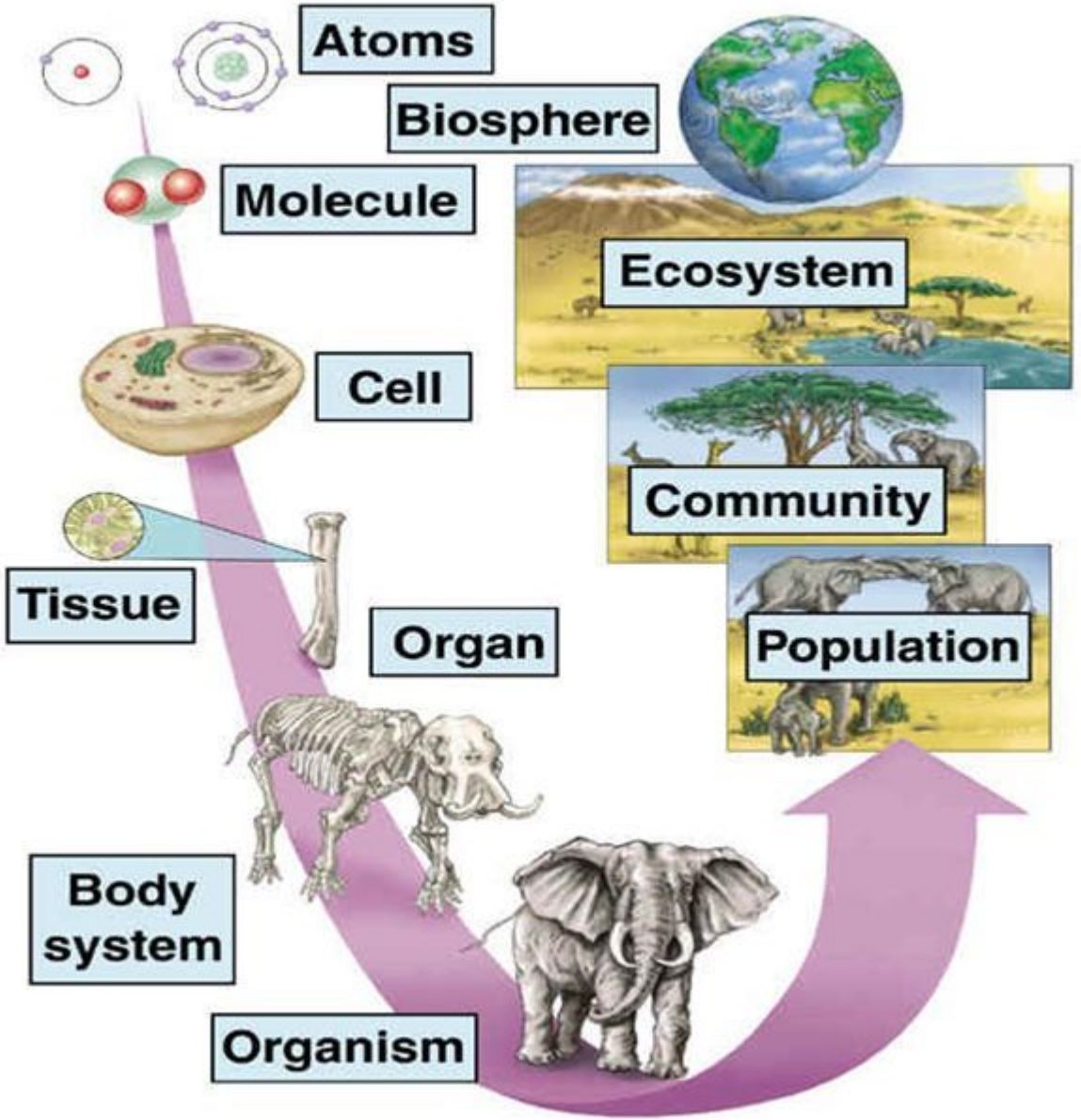
Characteristics of Life

Biology examines the structure, function, growth, origin, evolution, and distribution of living things. It classifies and describes organisms, their functions, how species come into existence, and the interactions they have with each other and with the natural environment. Four unifying principles form the foundation of modern biology: cell theory, evolution, genetics and homeostasis.

Biological life, as contrasted with death or with nonliving objects, is an evident fact but difficult to characterize precisely.



Organizational Levels of Life

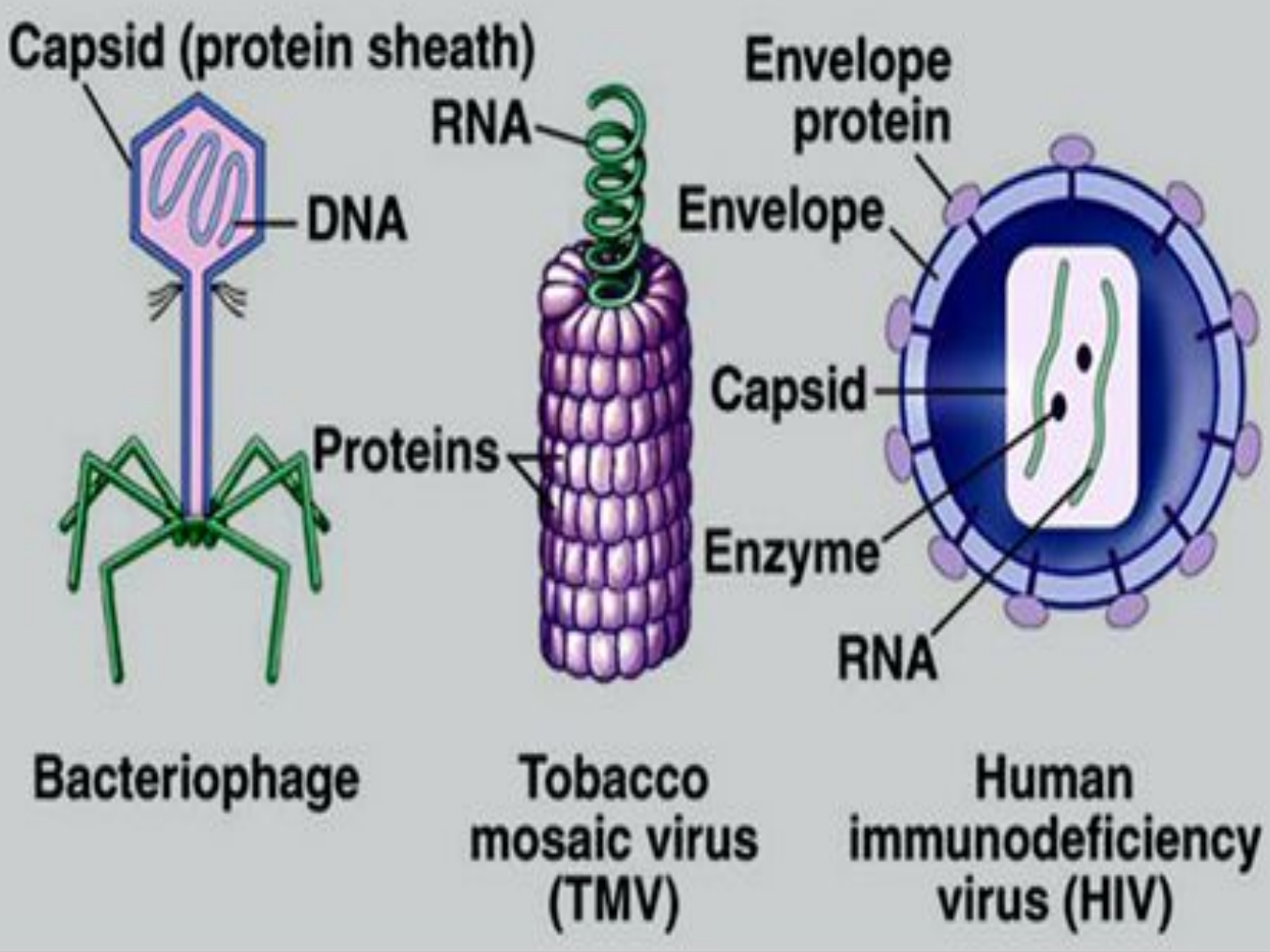


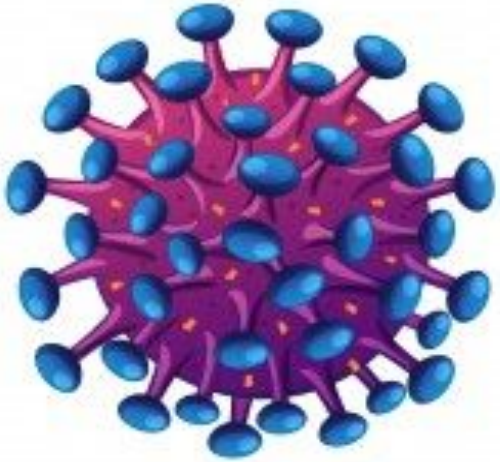
Forms of life - non-cellular and cellular organisms.

Virus

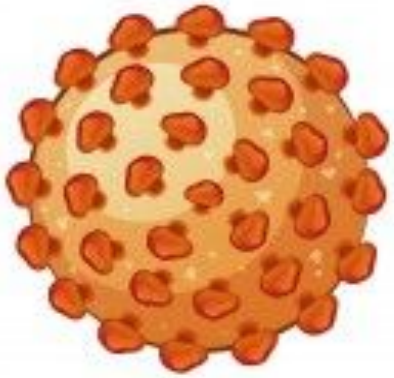
- A **virus** is a small infectious agent that replicates only inside the living cells of other organisms. Viruses can infect all types of life forms, from animals and plants to bacteria and archaea.
- Viruses are non-cellular entities whose properties have been identified through technological advances in microscopy and tissue culture. Viruses are infectious particles that invade every known type of cell. They are not alive, yet they are able to redirect the metabolism of living cells to reproduce virus particles.
- Viral replication inside a cell usually causes death or loss of function of that cell.

Viral Structure



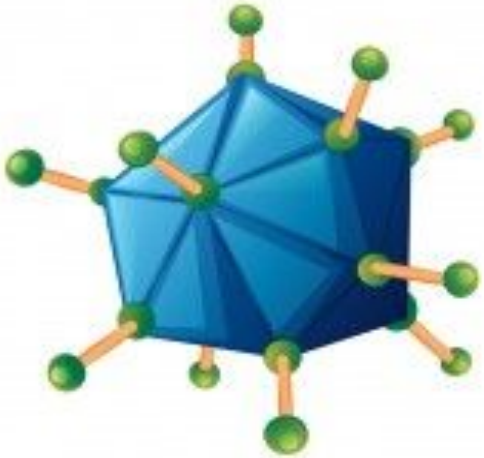


HIV

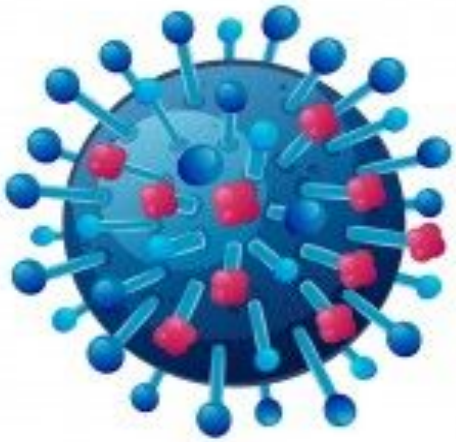


Hepatitis B

Ebola Virus

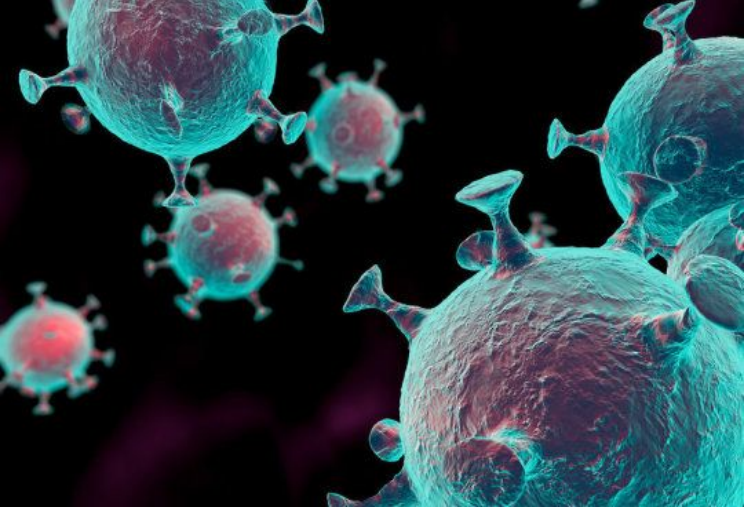


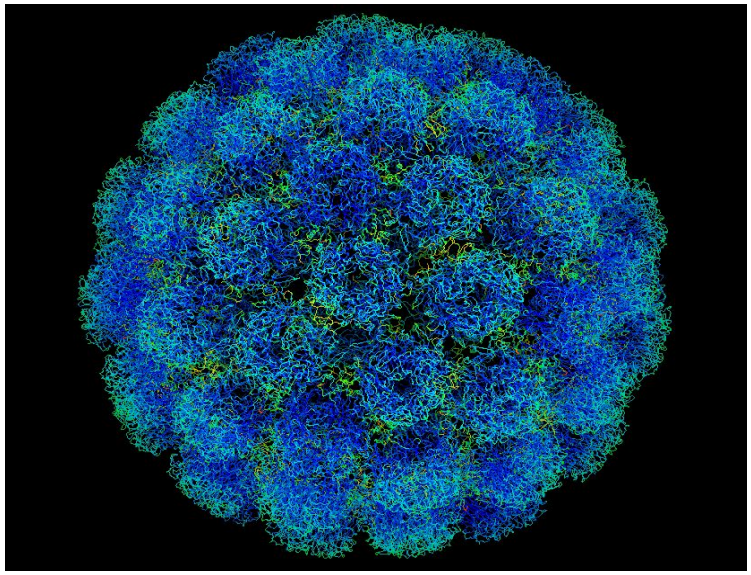
Adenovirus

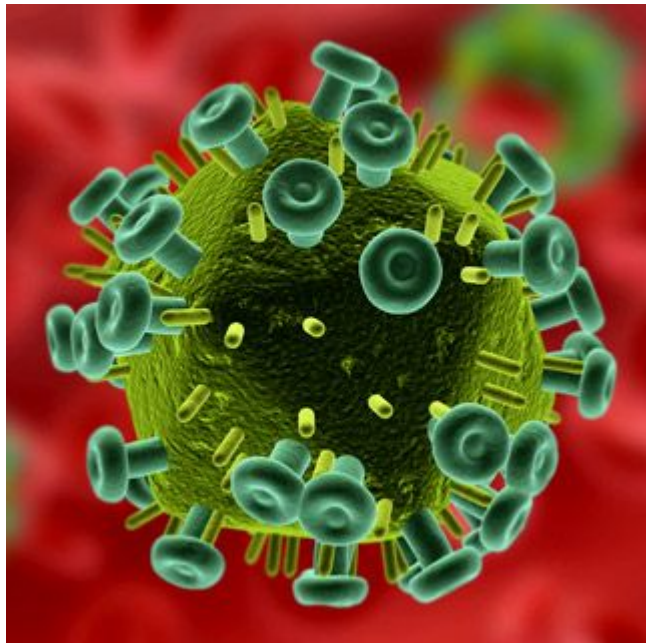


Influenza

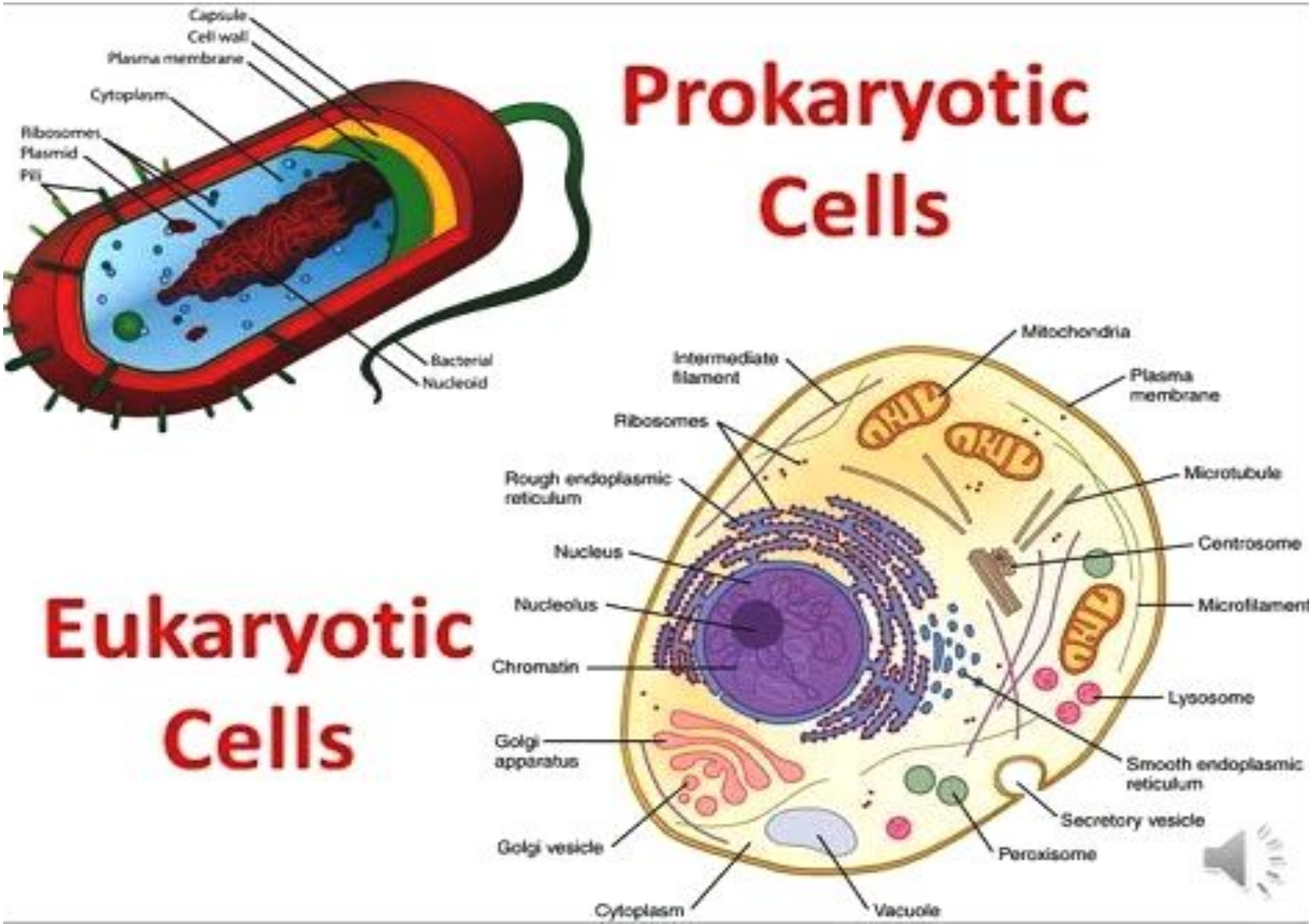
Bacteriophage





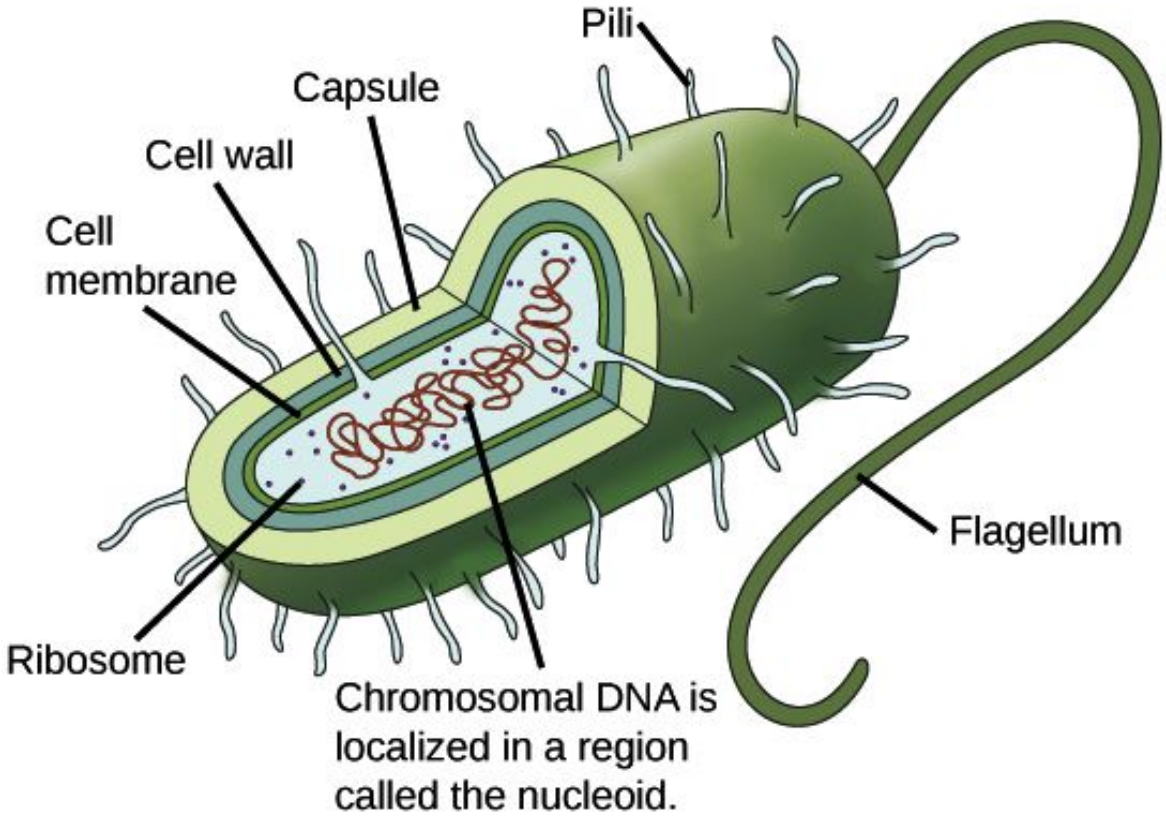


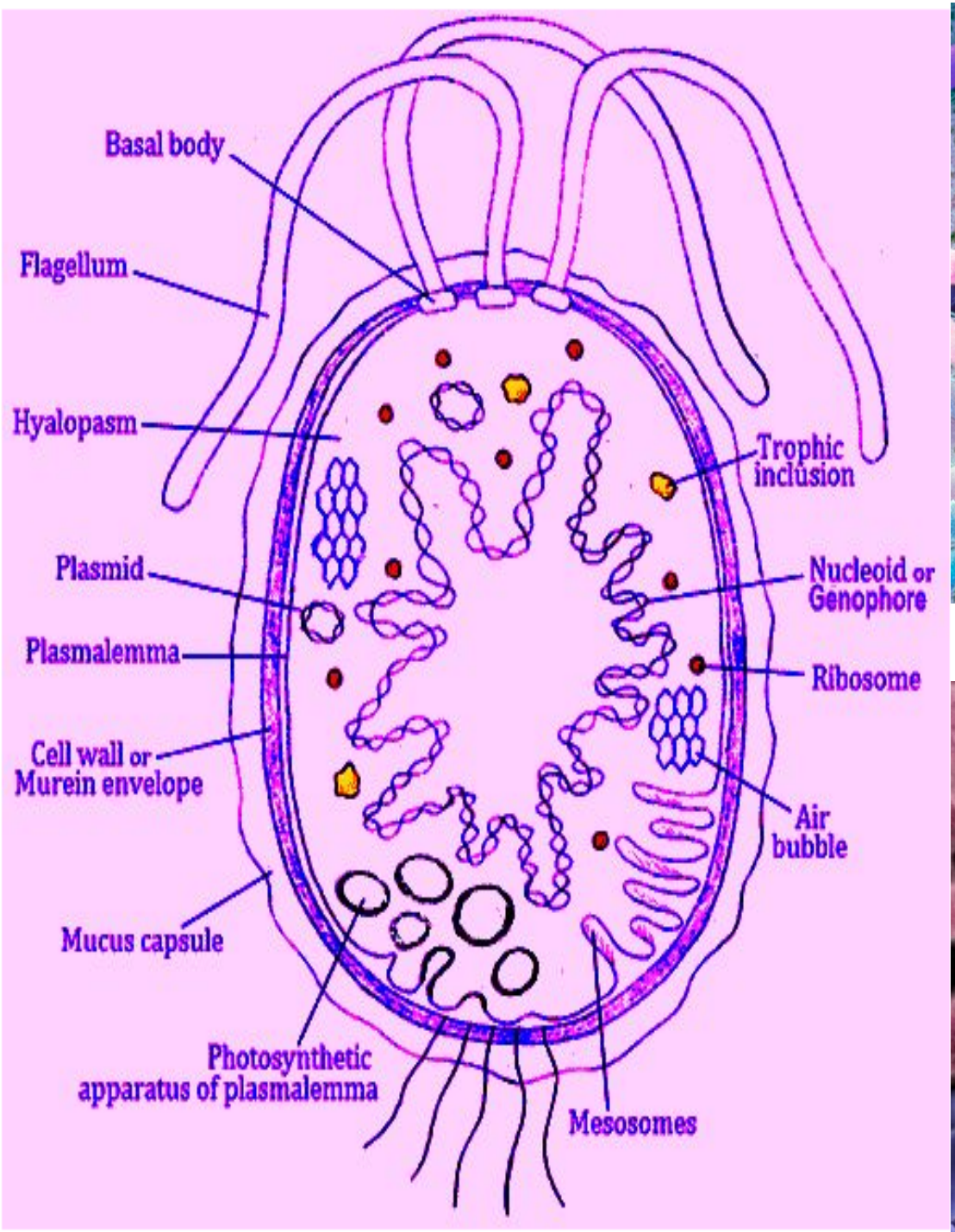
A cell is chemical system that is able to maintain its structure and reproduce. Cells are the fundamental unit of life. All living things are cells or composed of cells.

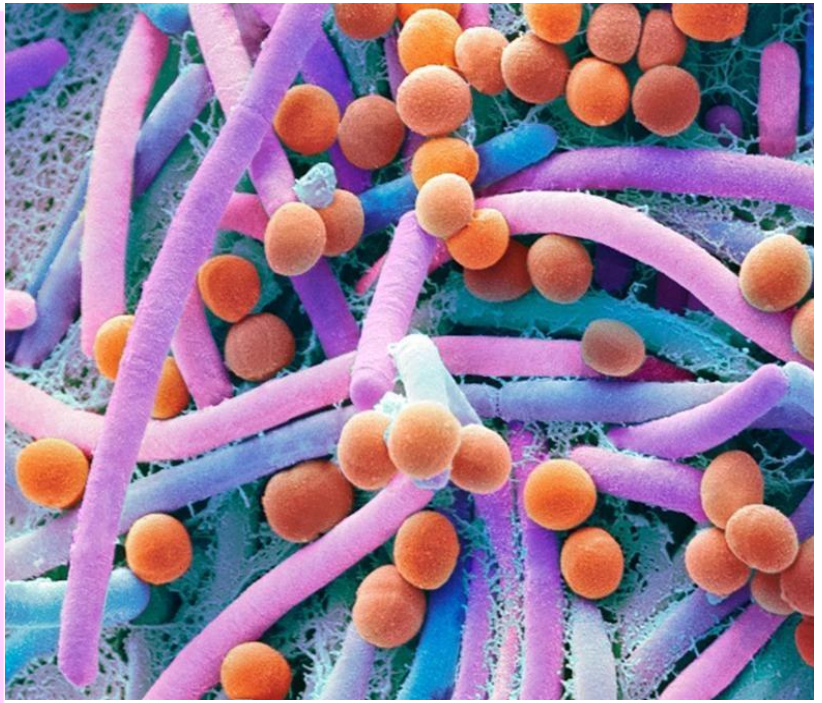


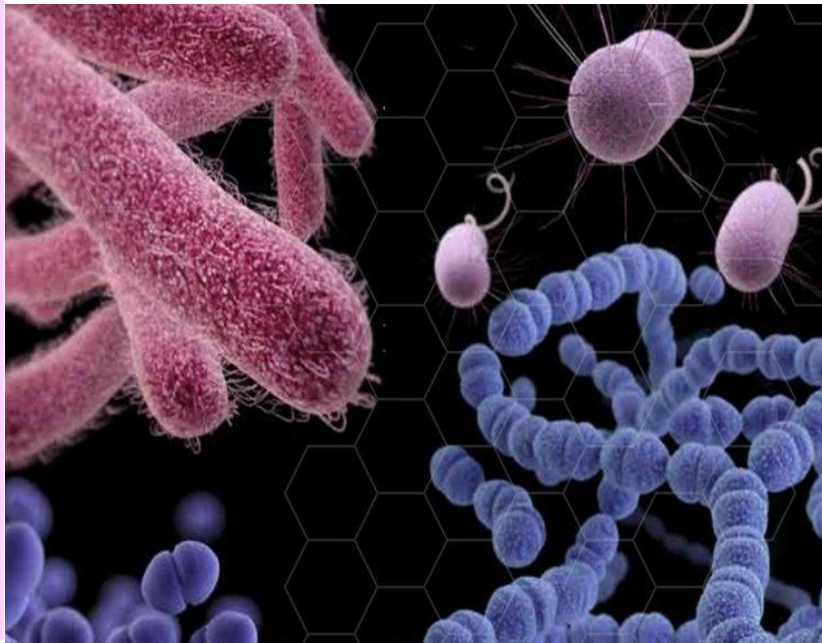
The first life on Earth came in the form of a prokaryotic cell. For two billion years prokaryotic cells were the only living things on Earth and spread to almost every corner of the planet. Today they are still the most abundant and diverse organisms on Earth and more prokaryotes are found in one handful of soil than all the humans that have ever existed.

A prokaryotic cell is one of the two types of cells that make up all the trillions of organisms that live on Earth, the other type being eukaryotic cells. Although prokaryotic cells appear far less advanced than eukaryotic cells, prokaryotic organisms outperform eukaryotes in many ways.

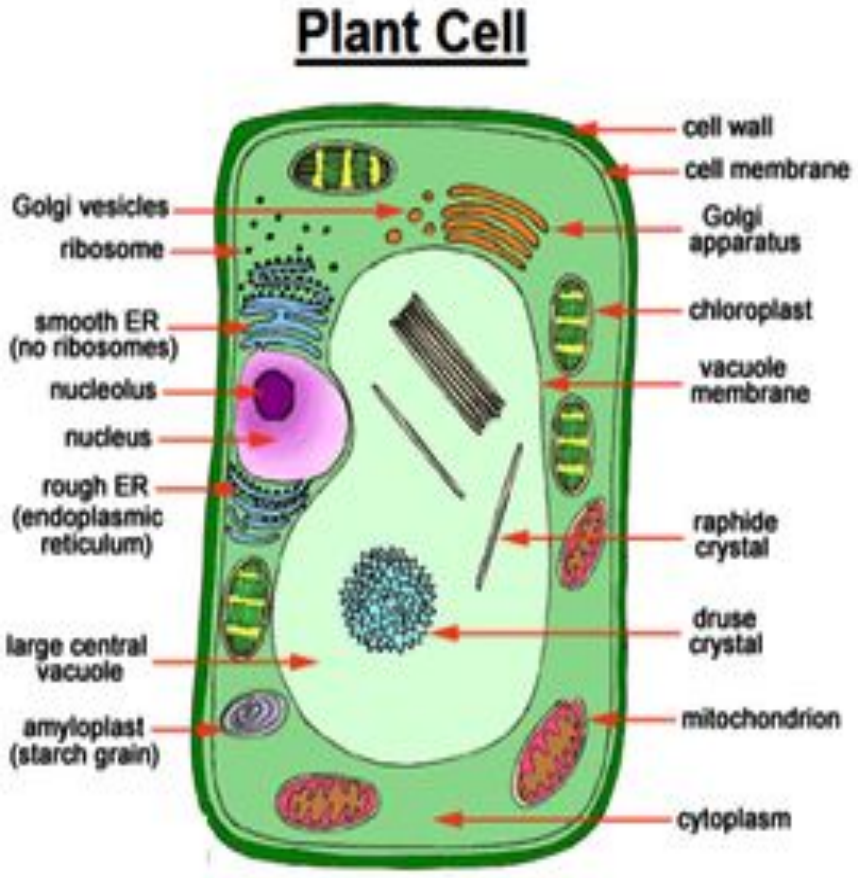


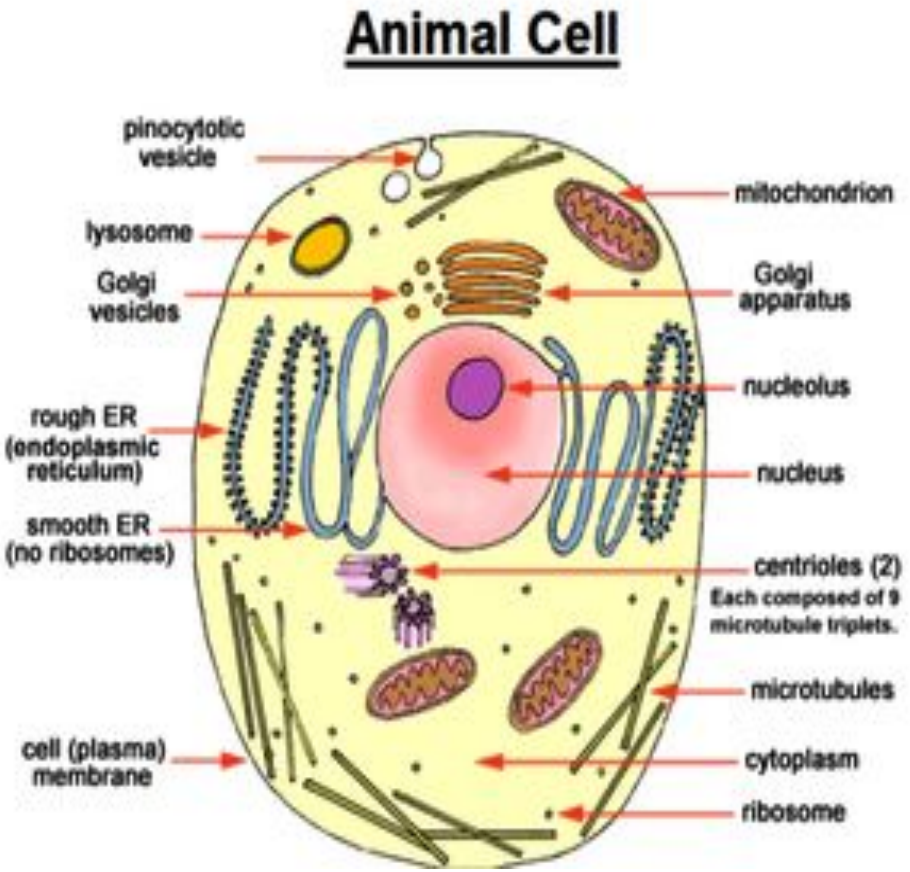

Basal body
Flagellum
Hyalopasm
Trophic inclusion
Plasmid
Nucleoid or Genophore
Plasmalemma
Ribosome
Cell wall or Murein envelope
Air bubble
Mucus capsule
Photosynthetic apparatus of plasmalemma
Mesosomes



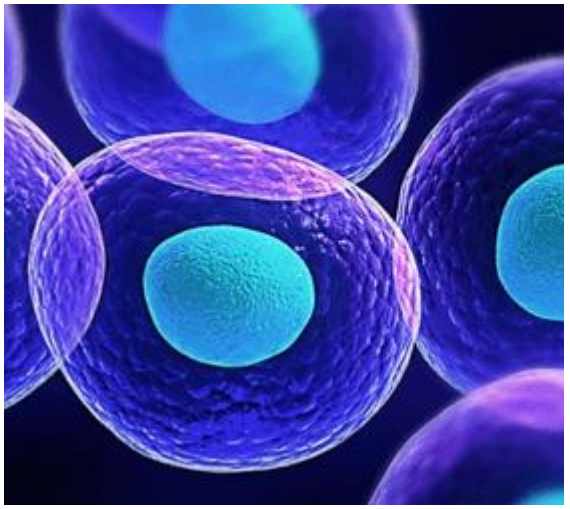


Eukaryotic cells are cells that contain a nucleus and organelles, and are enclosed by a plasma membrane. Organisms that have eukaryotic cells include protozoa, fungi, plants and animals. These organisms are grouped into the biological domain Eukaryota. Eukaryotic cells are larger and more complex than prokaryotic cells, which are found in Archaea and Bacteria, the other two domains of life.





The cell theory developed in 1839 by microbiologists Schleiden and Schwann describes the properties of cells. It is an explanation of the relationship between cells and living things.

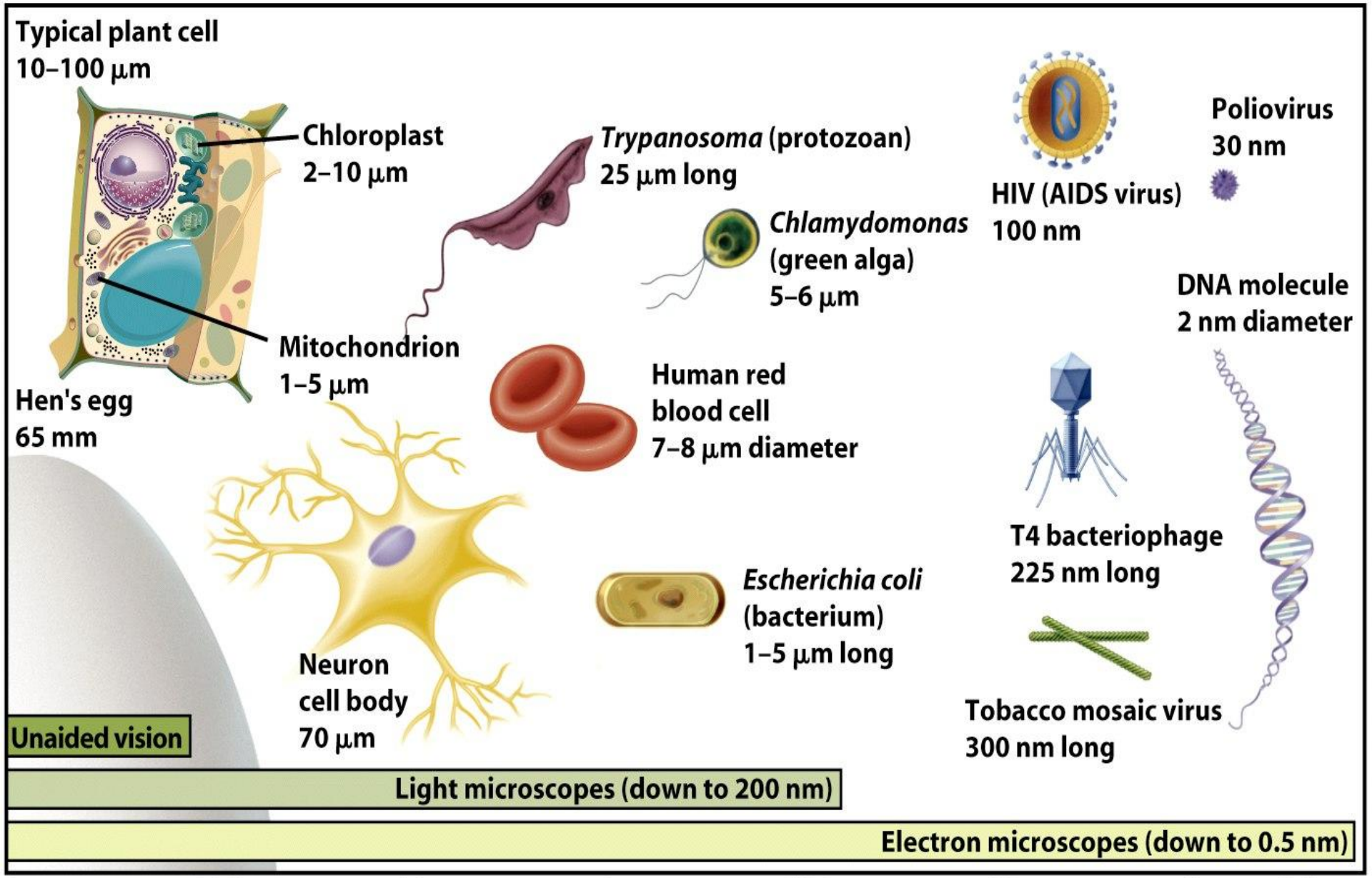


The theory states that:

- all living things are made of cells and their products.
- new cells are created by old cells dividing into two.
- cells are the basic building blocks of life.

Modern Cell Theory

- Modern Cell Theory contains 4 statements, in addition to the original Cell Theory:
- The cell contains hereditary information(DNA) which is passed on from cell to cell during cell division.
- All cells are basically the same in chemical composition and metabolic activities.
- All basic chemical & physiological functions are carried out inside the cells.(movement, digestion,etc)
- Cell activity depends on the activities of sub-cellular structures within the cell(organelles, nucleus, plasma membrane)


Typical plant cell
10–100 μm
Chloroplast
2–10 μm
Mitochondrion
1–5 μm
Hen's egg
65 mm
Trypanosoma (protozoan)
25 μm long
Chlamydomonas
(green alga)
5–6 μm
Human red
blood cell
7–8 μm diameter
Neuron
cell body
70 μm
Escherichia coli
(bacterium)
1–5 μm long
HIV (AIDS virus)
100 nm
Poliovirus
30 nm
DNA molecule
2 nm diameter
T4 bacteriophage
225 nm long
Tobacco mosaic virus
300 nm long
Unaided vision
Light microscopes (down to 200 nm)
Electron microscopes (down to 0.5 nm)
1 mm
100 μm
10 μm
1 μm
100 nm
10 nm
1 nm
0.5 nm

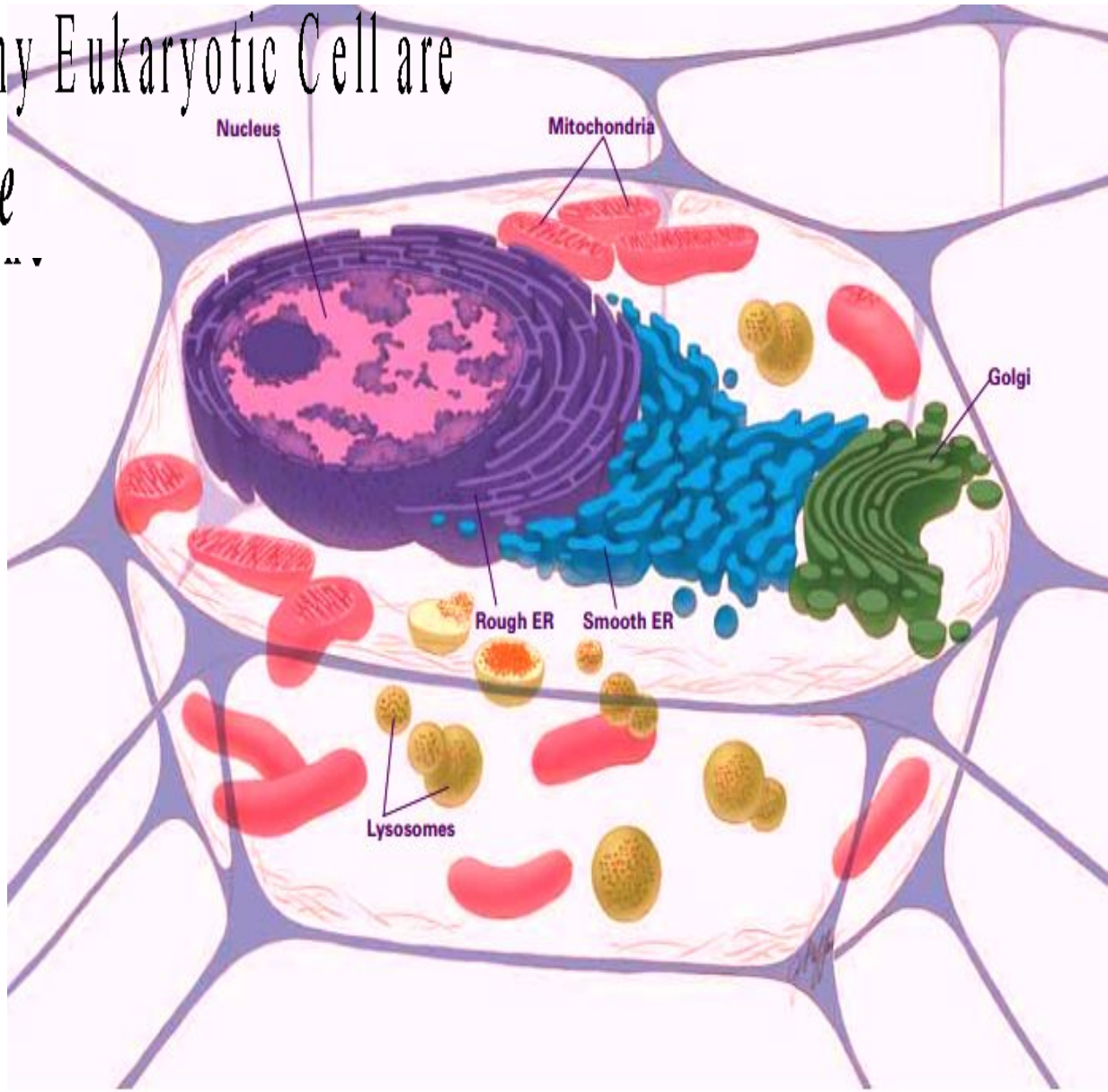
EUKARYOTIC CELL

The Main Components of any Eukaryotic Cell are

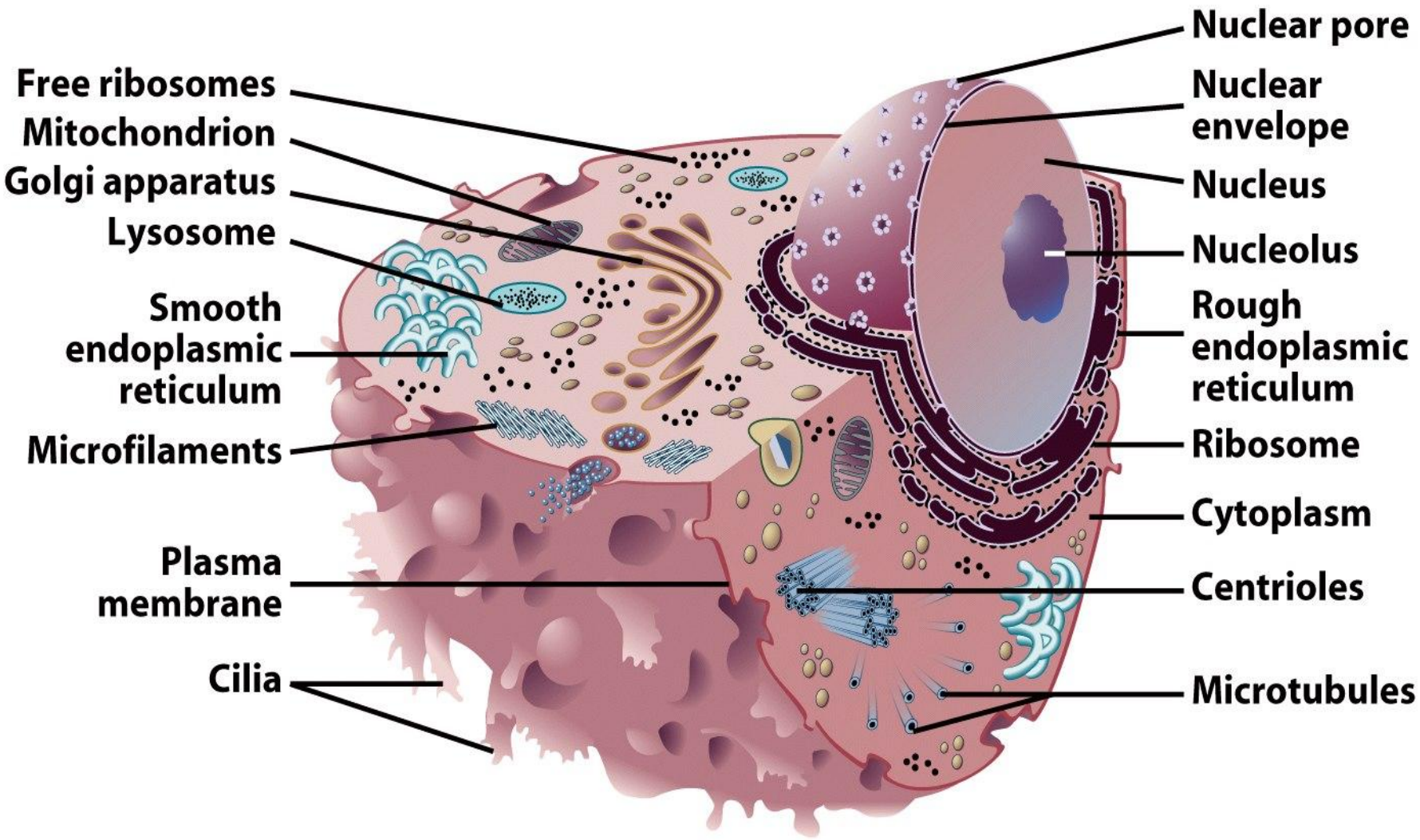
1) *Plasma membrane*

2) *Nucleus*

3) *Cytoplasm*



Representative Animal Cell

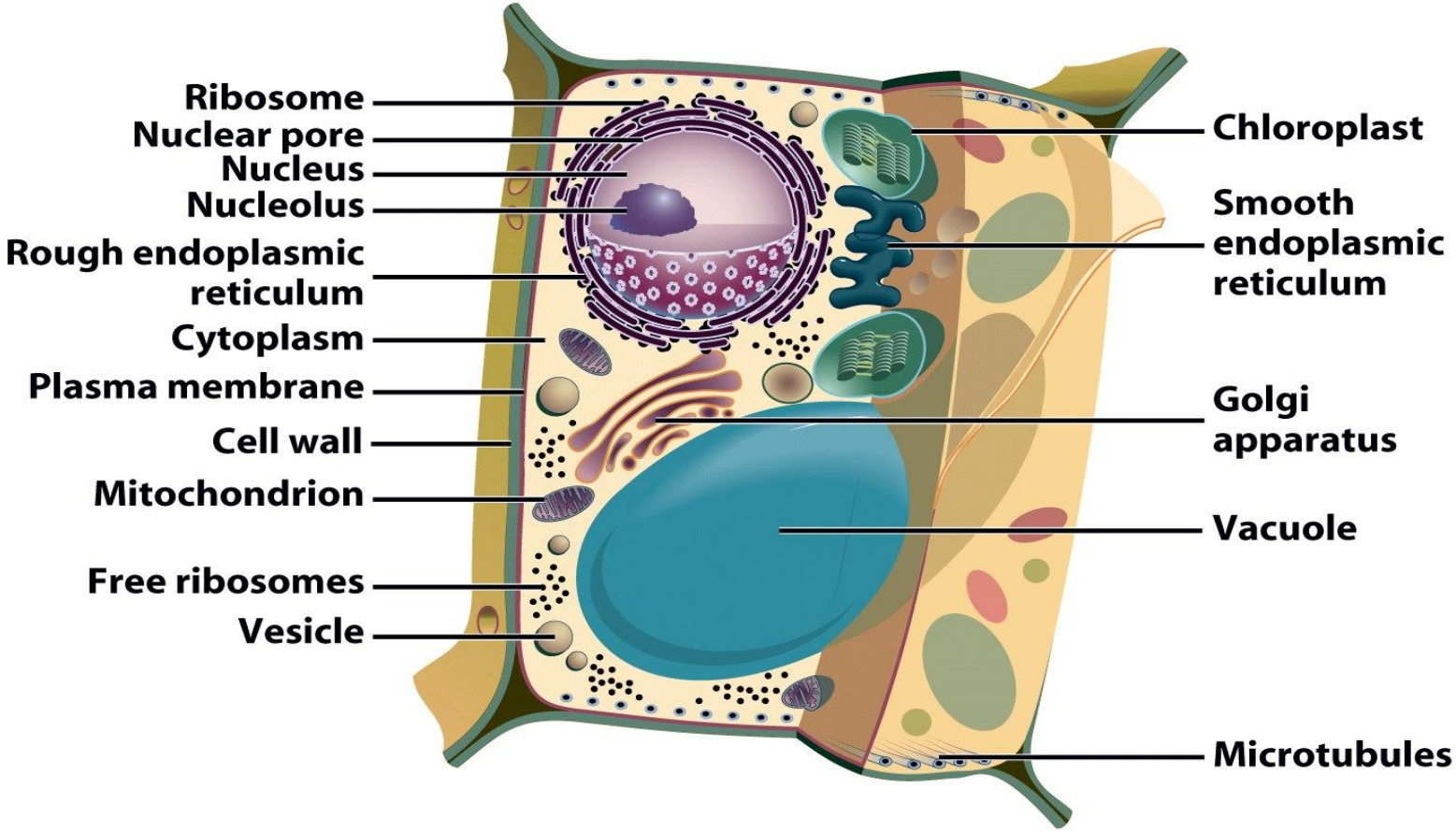


DISTINCTIONS ANIMAL FROM PLANT CELL:

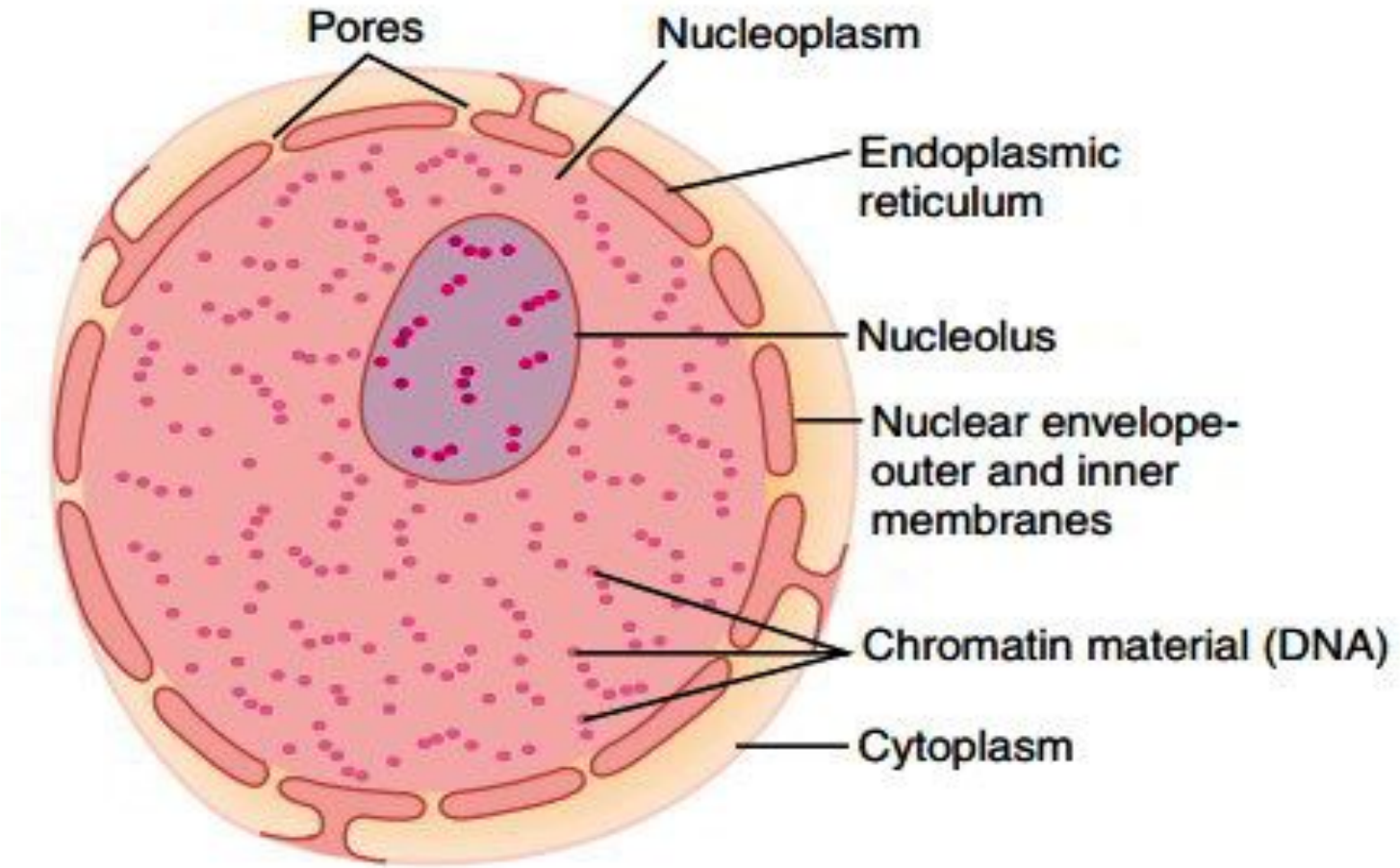
The plant cells include:

1) Cell wall (or cellulose envelope)
2) Plastids: chloroplasts, chromoplasts, and leykoplasts
3) Vacuoles.

In animal cell these structures are absent.



The nucleus is a highly specialized organelle that serves as the information processing and administrative center of the cell. This organelle has two major functions: **it stores the cell's hereditary material, or DNA**, and **it coordinates the cell's activities, which include growth, intermediary metabolism, protein synthesis, and reproduction (cell division)**.



Nucleus

- Control center of the cell
- Contains **DNA**
- Surrounded by a double membrane
- Usually the easiest organelle to see under a microscope
- Usually one per cell

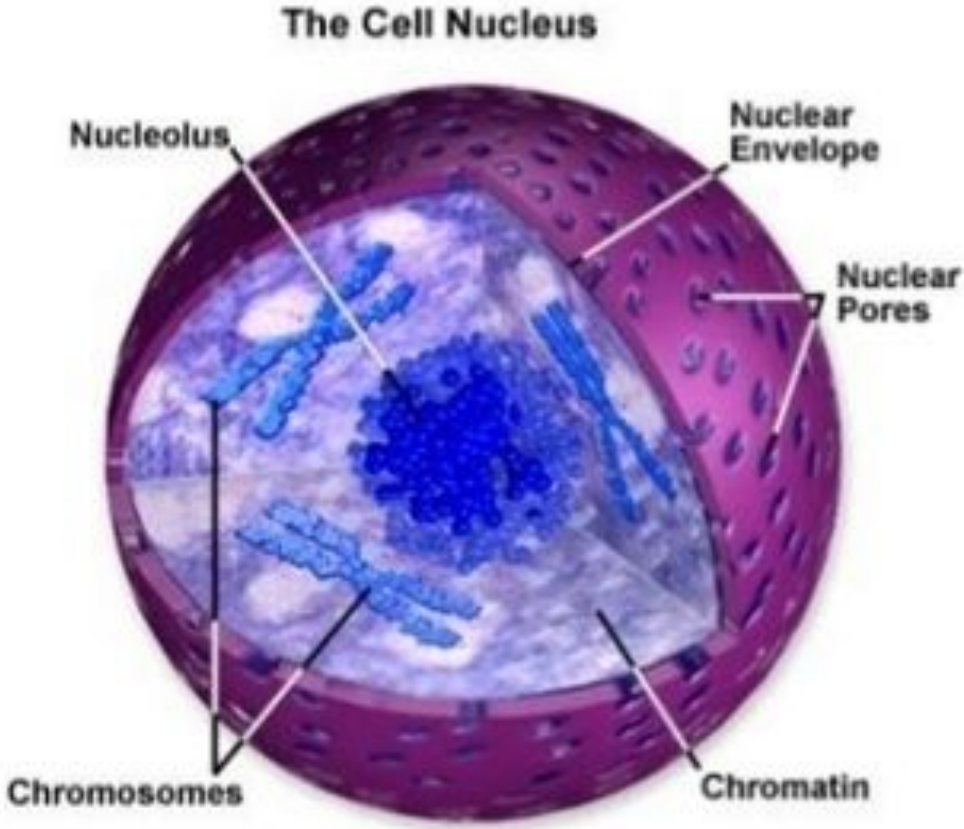
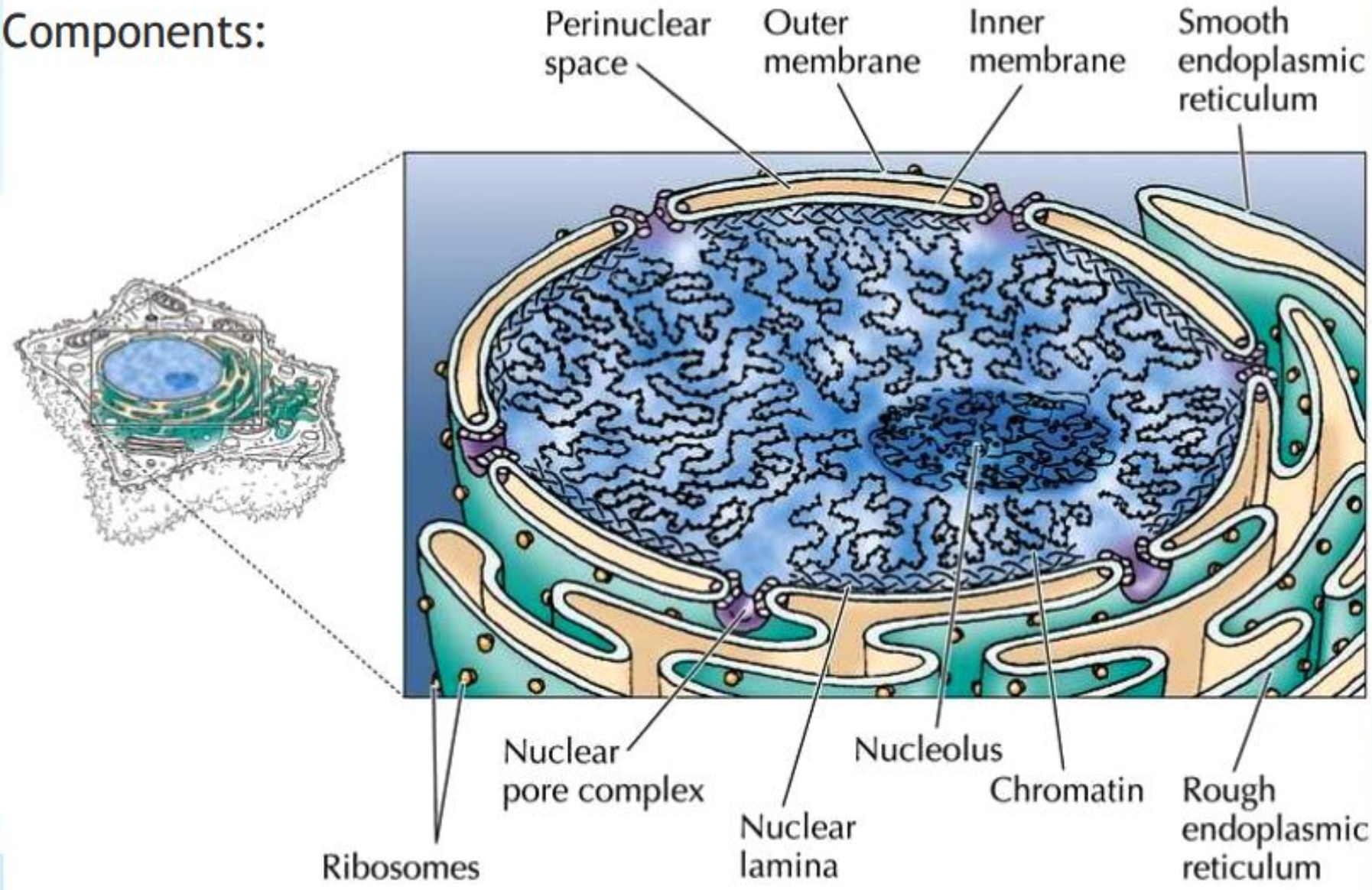


Figure 1

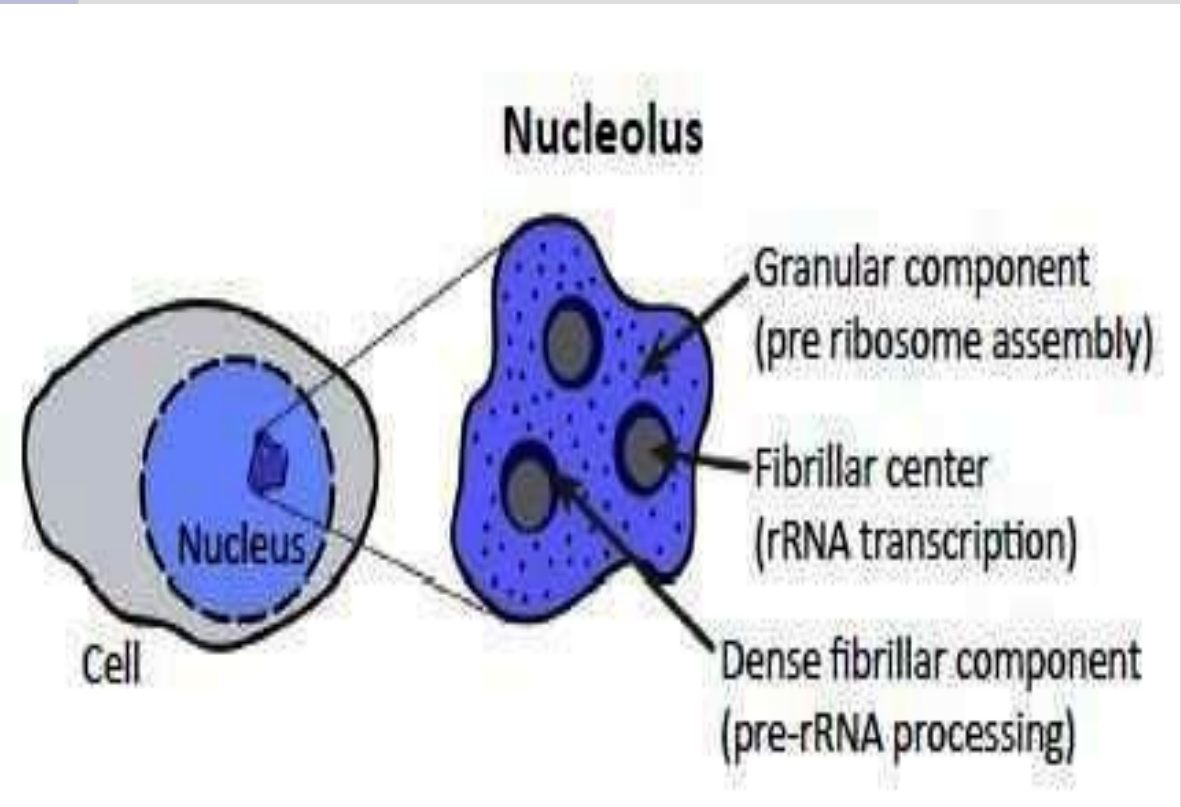
Eukaryotic Nucleus - Structure

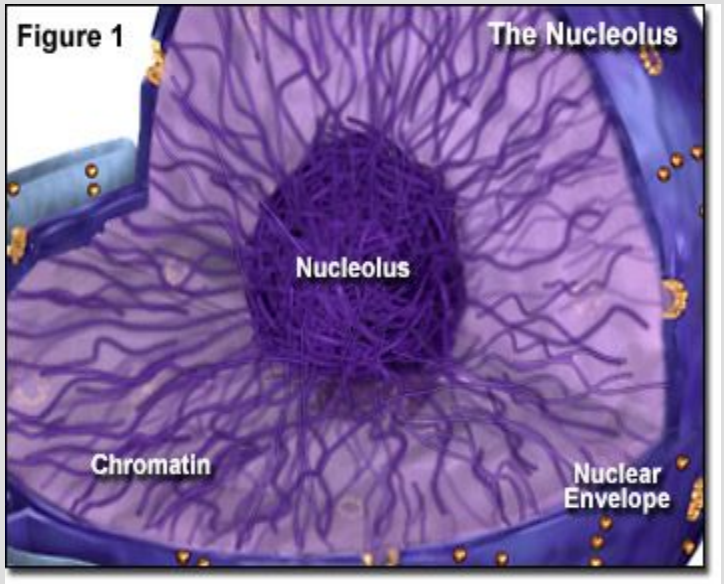
* The nuclear envelope
  * Components:

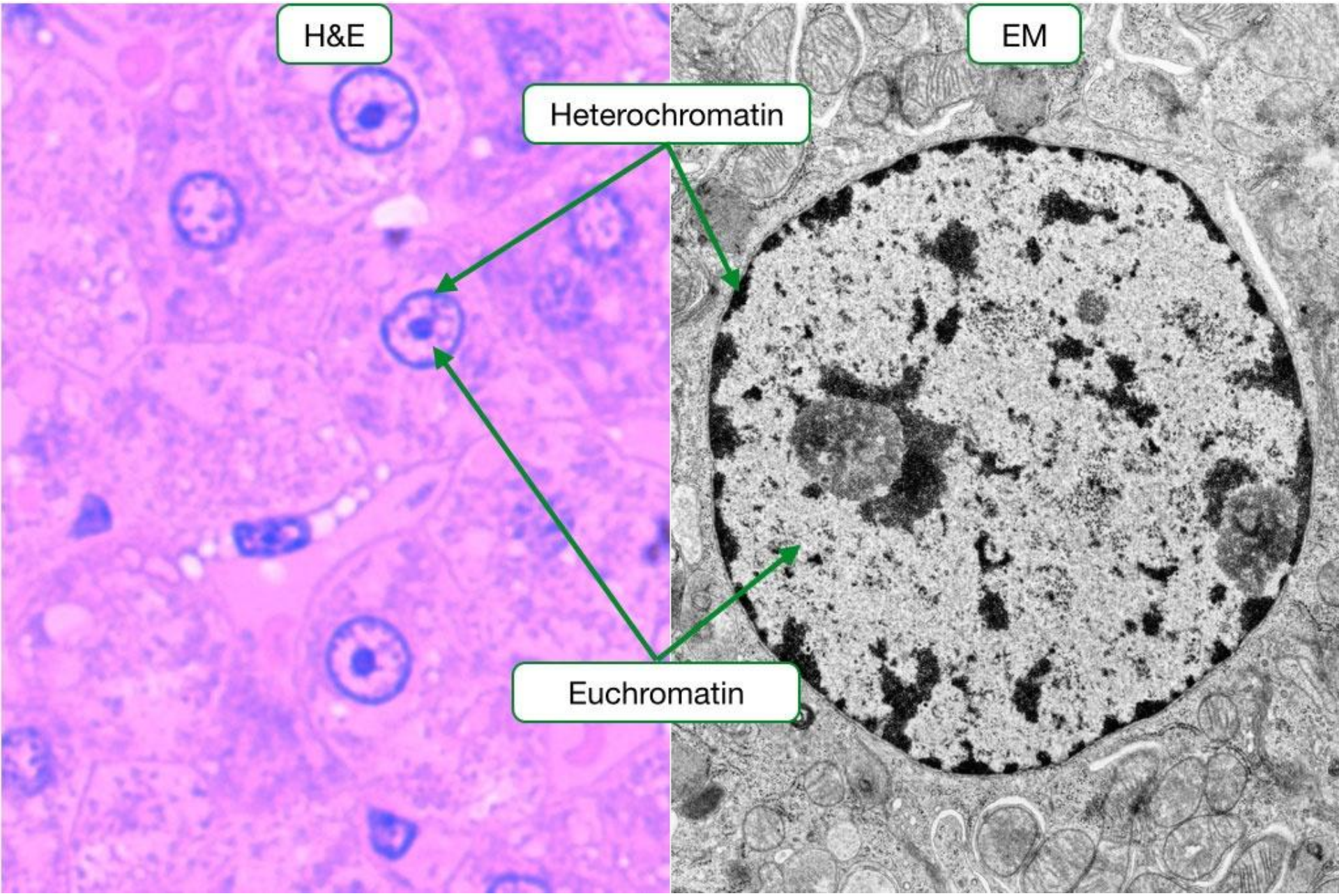


Nucleolus

Within the nucleus is a small subspace known as the nucleolus. It is not bound by a membrane, so it is not an organelle. This space forms near the part of DNA with instructions for making ribosomes, the molecules responsible for making proteins. Ribosomes are assembled in the nucleolus, and exit the nucleus with nuclear pores.

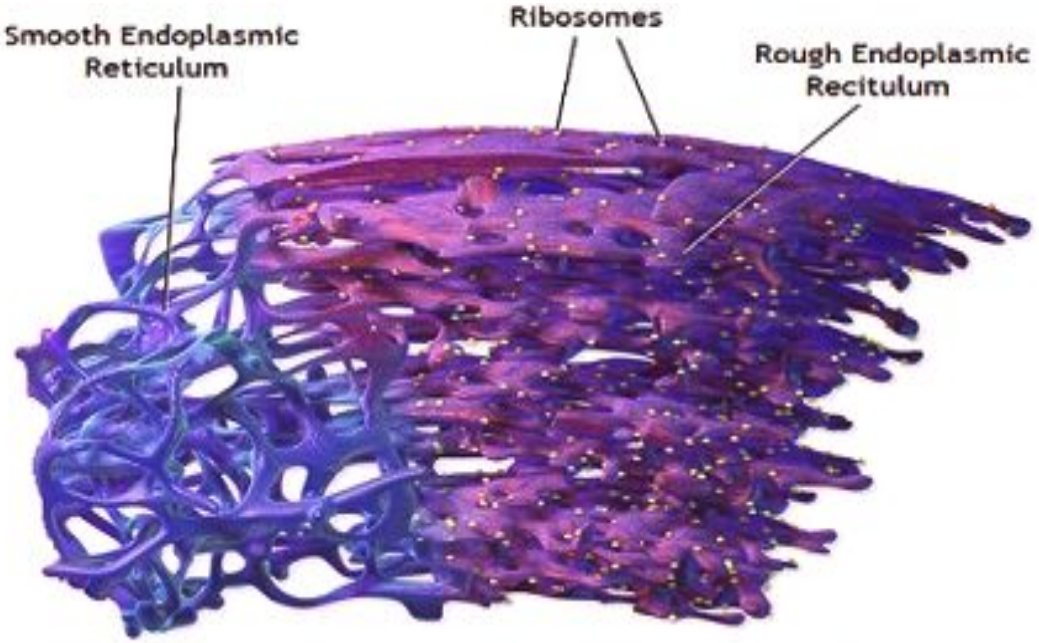





H&E
EM
Heterochromatin
Euchromatin

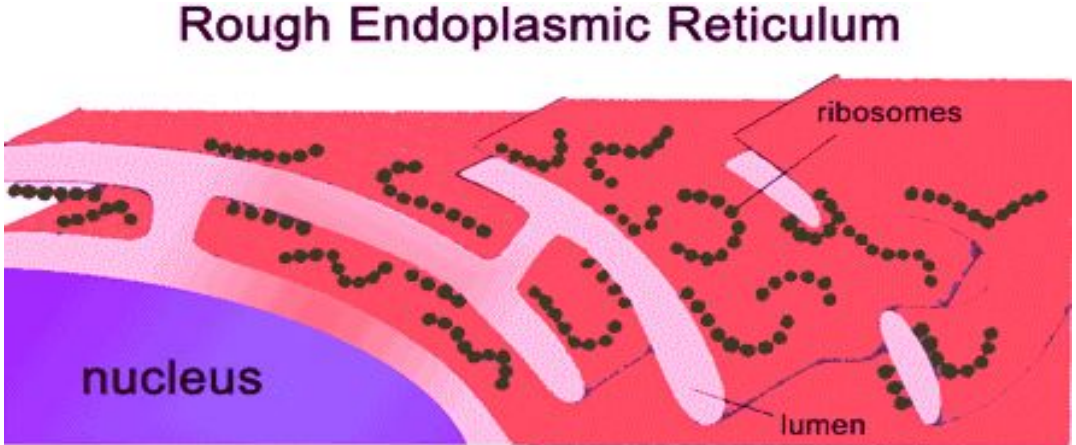
Endoplasmic Reticulum

Endoplasmic means inside (endo) the cytoplasm (plasm). Reticulum comes from the Latin word for net. Basically, an endoplasmic reticulum is a plasma membrane found inside the cell that folds in on itself to create an internal space known as the lumen. This lumen is actually continuous with the perinuclear space, so we know the endoplasmic reticulum is attached to the nuclear envelope. There are actually two different endoplasmic reticuli in a cell: the smooth endoplasmic reticulum and the rough endoplasmic reticulum. The rough endoplasmic reticulum is the site of protein production, while the smooth endoplasmic reticulum is where lipids (fats) are made.



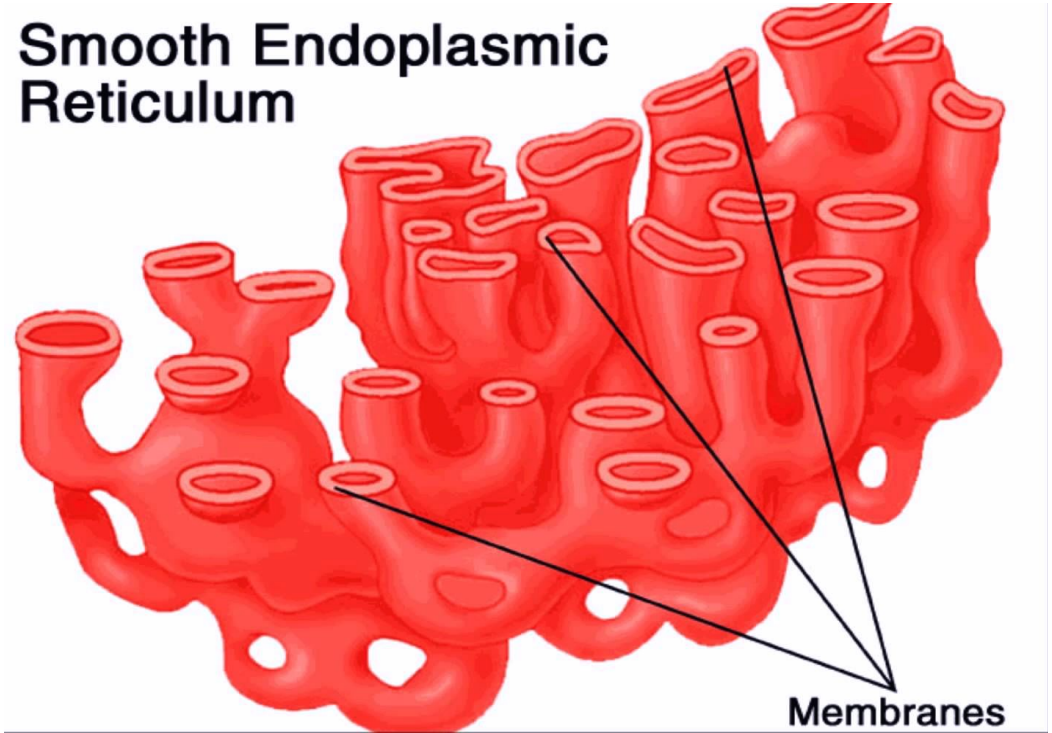
Rough Endoplasmic Reticulum

The rough endoplasmic reticulum is so-called because its surface is studded with ribosomes, the molecules in charge of protein production. When a ribosome finds a specific RNA segment, that segment may tell the ribosome to travel to the rough endoplasmic reticulum and embed itself. The protein created from this segment will find itself inside the lumen of the rough endoplasmic reticulum, where it folds and is tagged with a (usually carbohydrate) molecule in a process known as glycosylation that marks the protein for transport to the Golgi apparatus. The rough endoplasmic reticulum is continuous with the nuclear envelope, and looks like a series of canals near the nucleus. Proteins made in the rough endoplasmic reticulum as destined to either be a part of a membrane, or to be secreted from the cell membrane out of the cell. Without an rough endoplasmic reticulum, it would be a lot harder to distinguish between proteins that should leave the cell, and proteins that should remain. Thus, the rough endoplasmic reticulum helps cells specialize and allows for greater complexity in the organism.



Smooth Endoplasmic Reticulum

The smooth endoplasmic reticulum makes lipids and steroids, instead of being involved in protein synthesis. These are fat-based molecules that are important in energy storage, membrane structure, and communication (steroids can act as hormones). The smooth endoplasmic reticulum is also responsible for detoxifying the cell. It is more tubular than the rough endoplasmic reticulum, and is not necessarily continuous with the nuclear envelope. Every cell has a smooth endoplasmic reticulum, but the amount will vary with cell function. For example, the liver, which is responsible for most of the body's detoxification, has a larger amount of smooth endoplasmic reticulum.



Ribosome:

Situated in two areas of the cytoplasm.

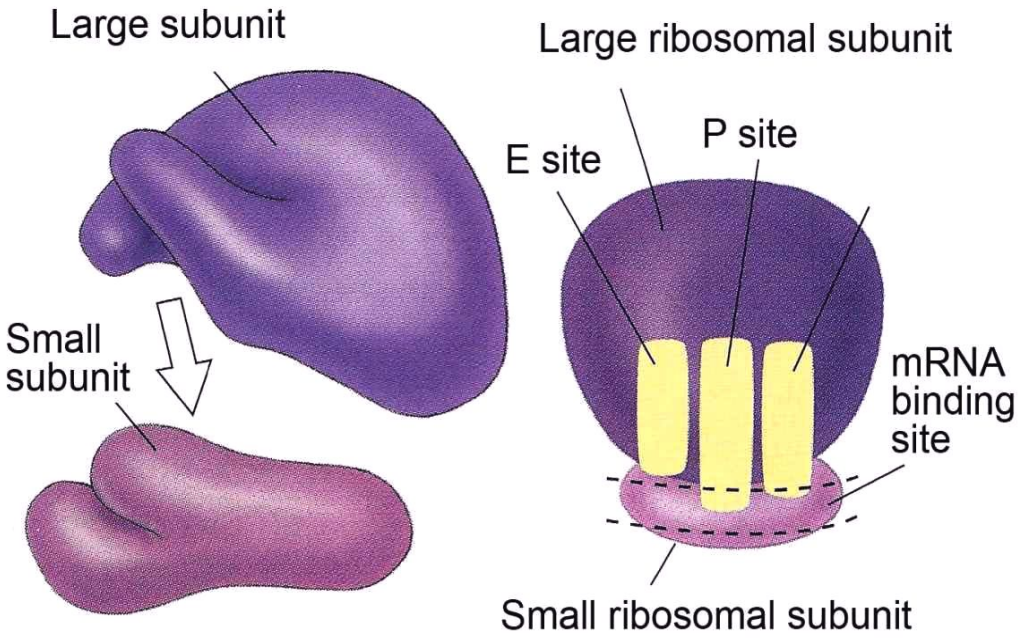
They are seen scattered in the cytoplasm and a few are connected to the endoplasmic reticulum.

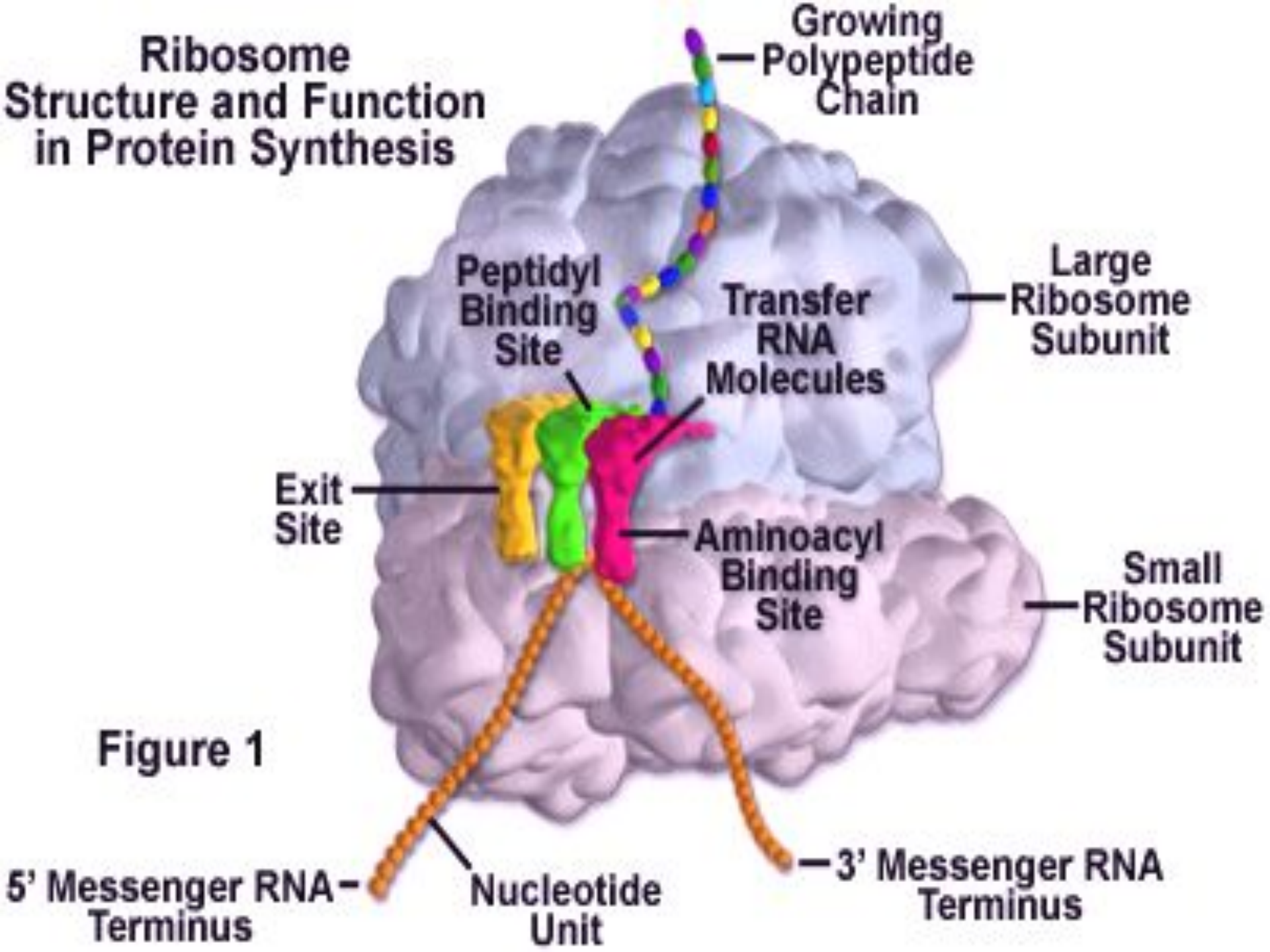
Whenever joined to the ER they are called the rough endoplasmic reticulum.

The free and the bound ribosomes are very much alike in structure and are associated with protein synthesis.

Around 37 to 62% of ribosome is comprised of rRNA and the rest is proteins.

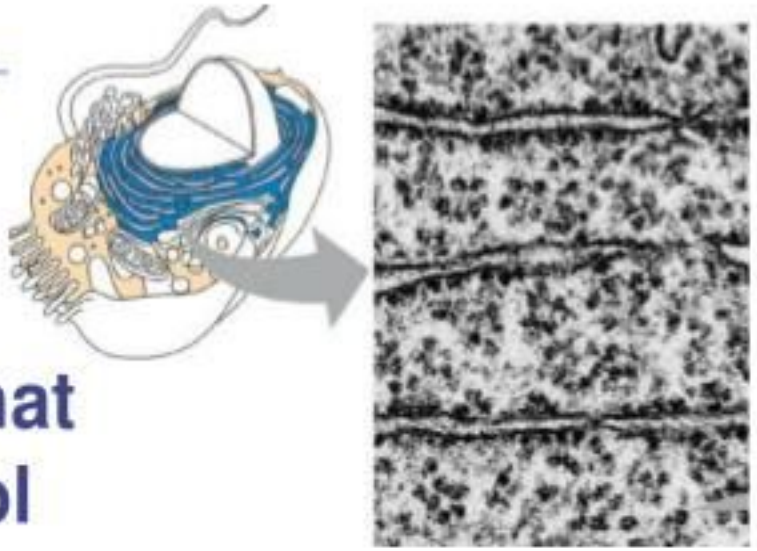
Prokaryotes have 70S ribosomes respectively subunits comprising the little subunit of 30S and the bigger subunit of 50S. Eukaryotes have 80S ribosomes respectively comprising of little (40S) and substantial (60S) subunits.

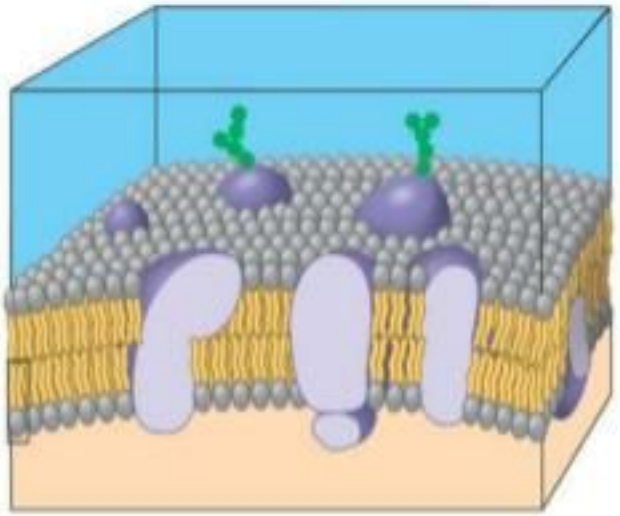



Ribosome
Structure and Function
in Protein Synthesis
Growing
Polypeptide
Chain
Peptidyl
Binding
Site
Transfer
RNA
Molecules
Large
Ribosome
Subunit
Exit
Site
Aminoacyl
Binding
Site
Small
Ribosome
Subunit
Figure 1
5' Messenger RNA
Terminus
Nucleotide
Unit
3' Messenger RNA
Terminus

Types of Ribosomes

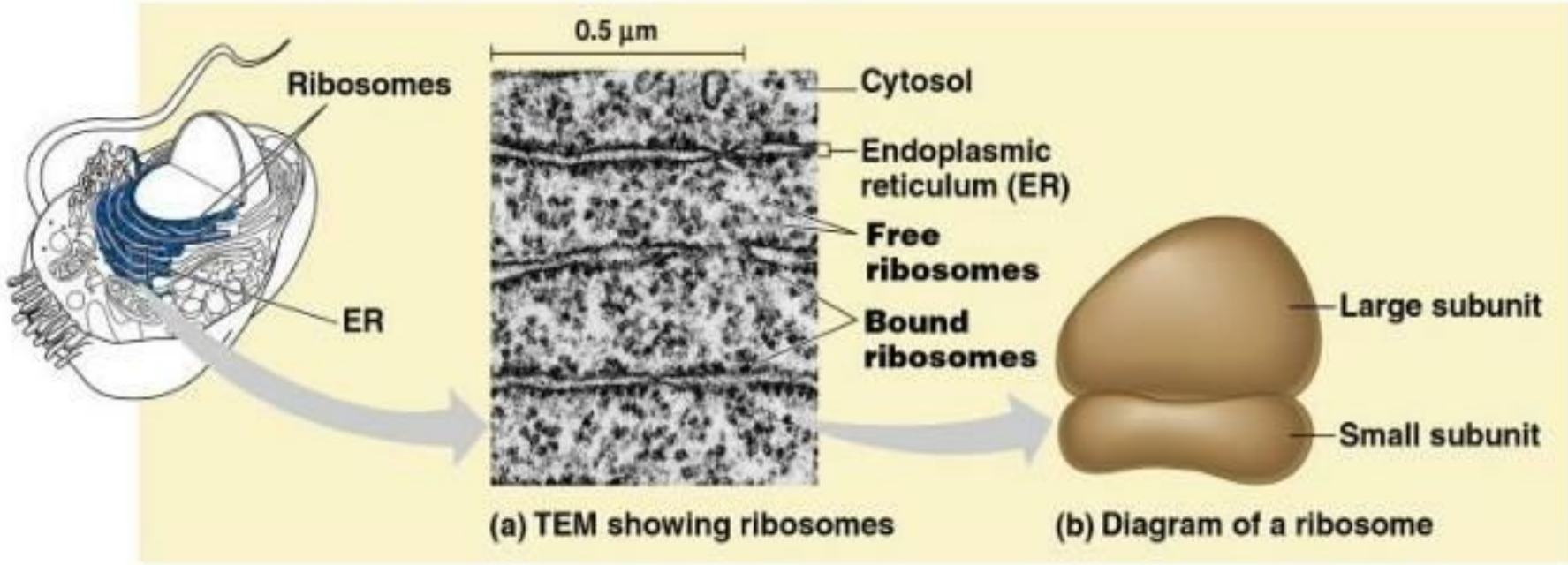
- **Free ribosomes**
  - suspended in cytosol
  - synthesize proteins that function within cytosol
- **Bound ribosomes**
  - attached to outside of endoplasmic reticulum
  - synthesize proteins for export or for membranes





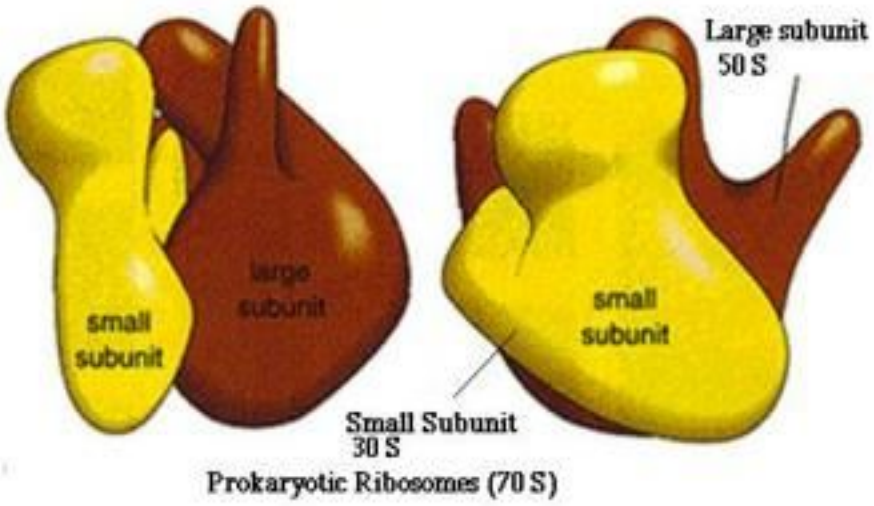
Ribosomes

- **Function**
  - protein production
- **Structure**
  - ribosomes contain rRNA & protein
  - composed of 2 subunits that combine to carry out protein synthesis

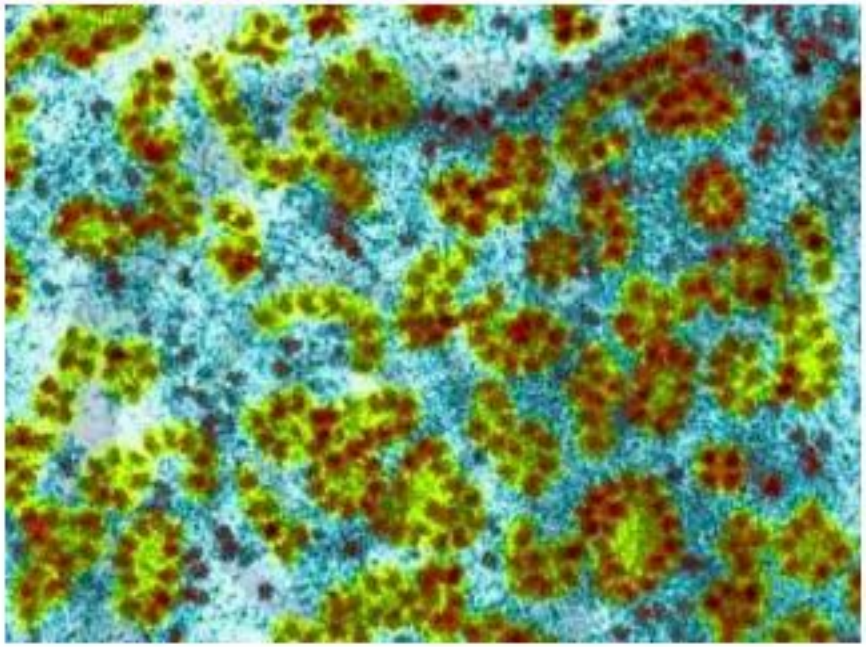


Ribosomes

- Prokaryotes & eukaryotes have different ribosomes
  - different size subunits
  - different proteins
  - can this difference be useful?



Prokaryotic Ribosomes (70 S)



Golgi apparatus (aka Golgi body aka Golgi)

We mentioned the Golgi apparatus earlier when we discussed the production of proteins in the rough endoplasmic reticulum. If the smooth and rough endoplasmic reticula are how make proteins. Golgi is responsible for packing proteins from the rough endoplasmic reticulum into membrane-bound vesicles (tiny compartments of lipid bilayer that store molecules) which then translocate to the cell membrane. At the cell membrane, the vesicles can fuse with the larger lipid bilayer, causing the vesicle contents to either become part of the cell membrane or be released to the outside.

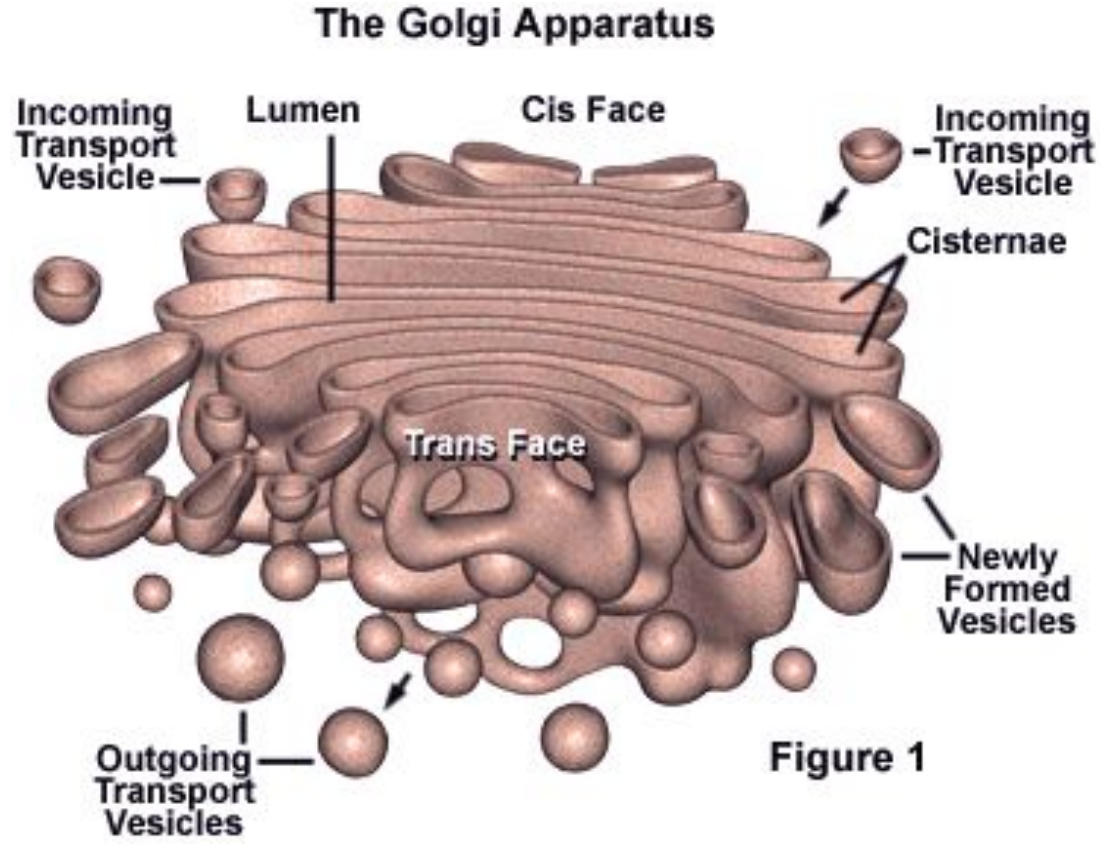
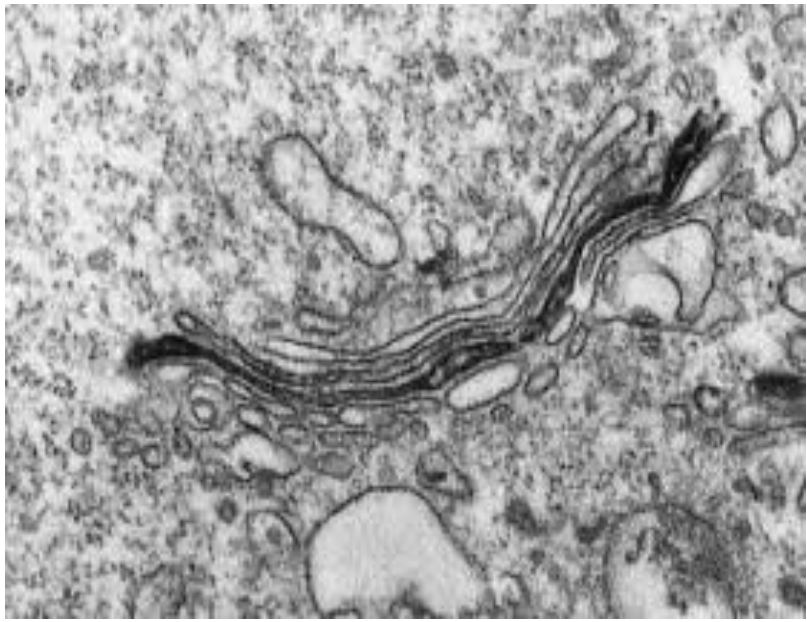


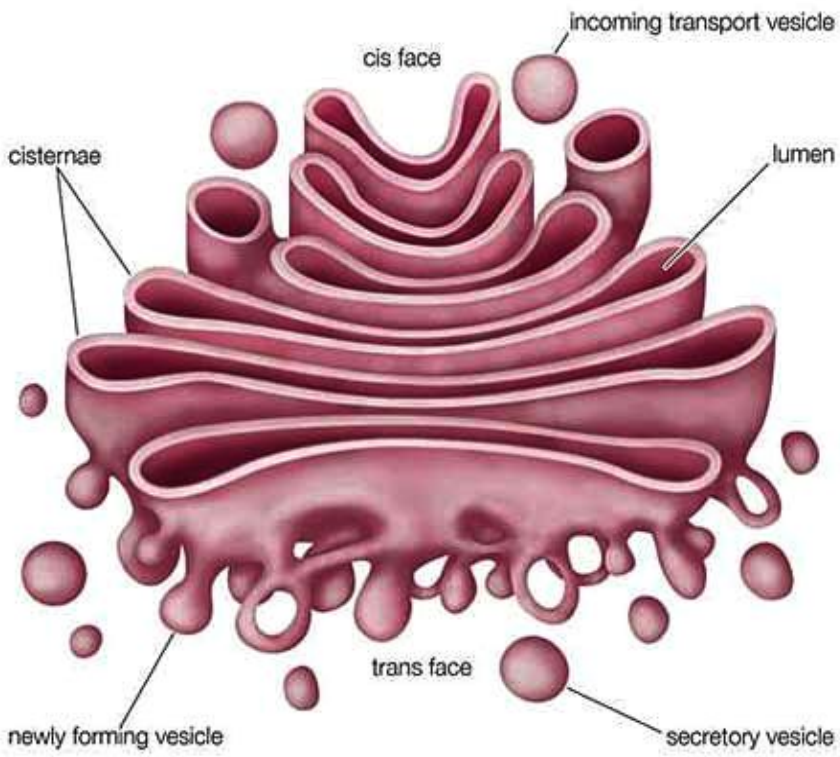
Figure 1



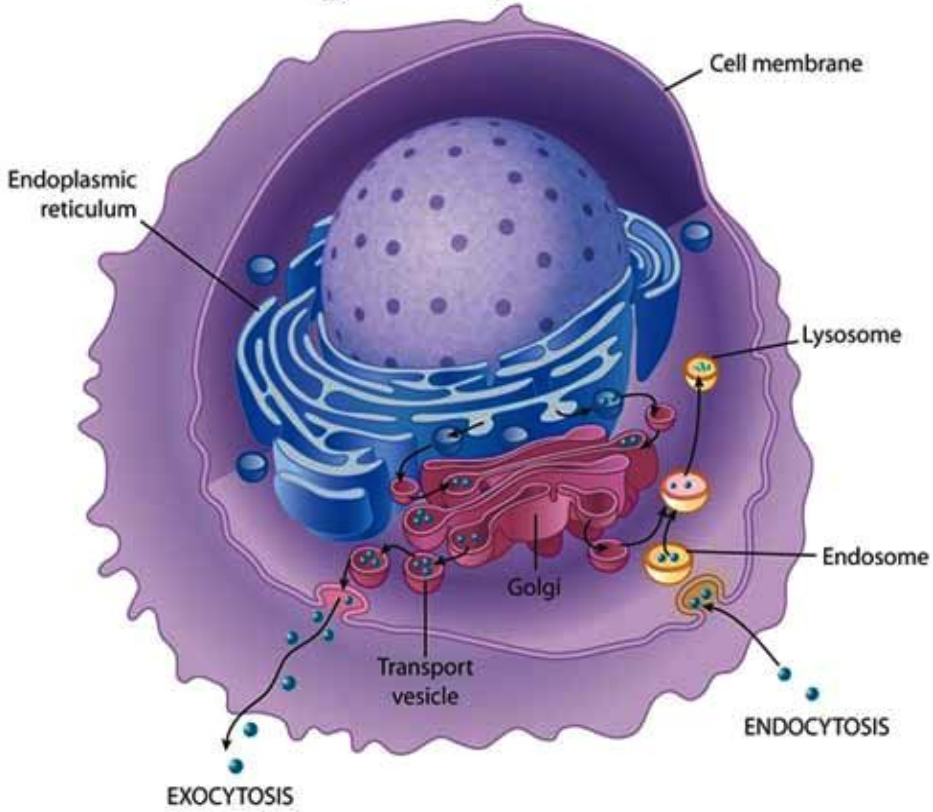
Different molecules actually have different fates upon entering the Golgi. This determination is done by tagging the proteins with special sugar molecules that act as a shipping label for the protein. **The shipping department identifies the molecule and sets it on one of 4 paths:**

- **Cytosol**: the proteins that enter the Golgi by mistake are sent back into the cytosol (imagine the barcode scanning wrong and the item being returned).
- **Cell membrane**: proteins destined for the cell membrane are processed continuously. Once the vesicle is made, it moves to the cell membrane and fuses with it. Molecules in this pathway are often protein channels which allow molecules into or out of the cell, or cell identifiers which project into the extracellular space and act like a name tag for the cell.
- **Secretion**: some proteins are meant to be secreted from the cell to act on other parts of the body. Before these vesicles can fuse with the cell membrane, they must accumulate in number, and require a special chemical signal to be released.
- **Lysosome**: The final destination for proteins coming through the Golgi is the lysosome. Vesicles sent to this acidic organelle contain enzymes that will hydrolyze the lysosome's content.

Golgi Apparatus

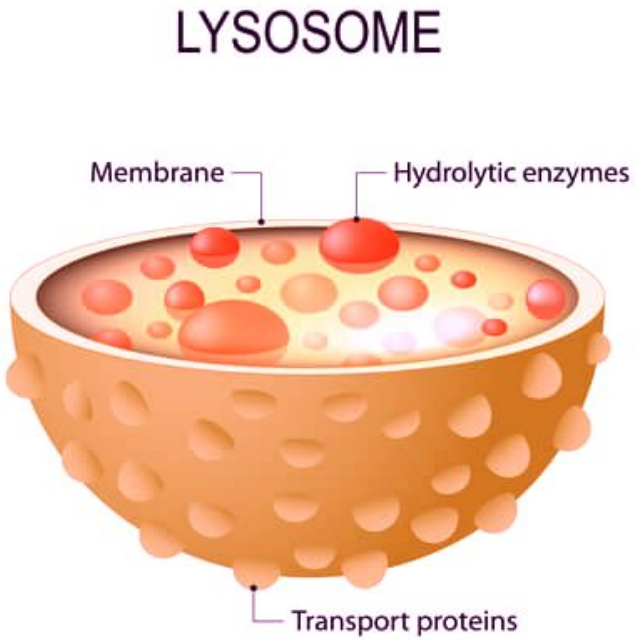


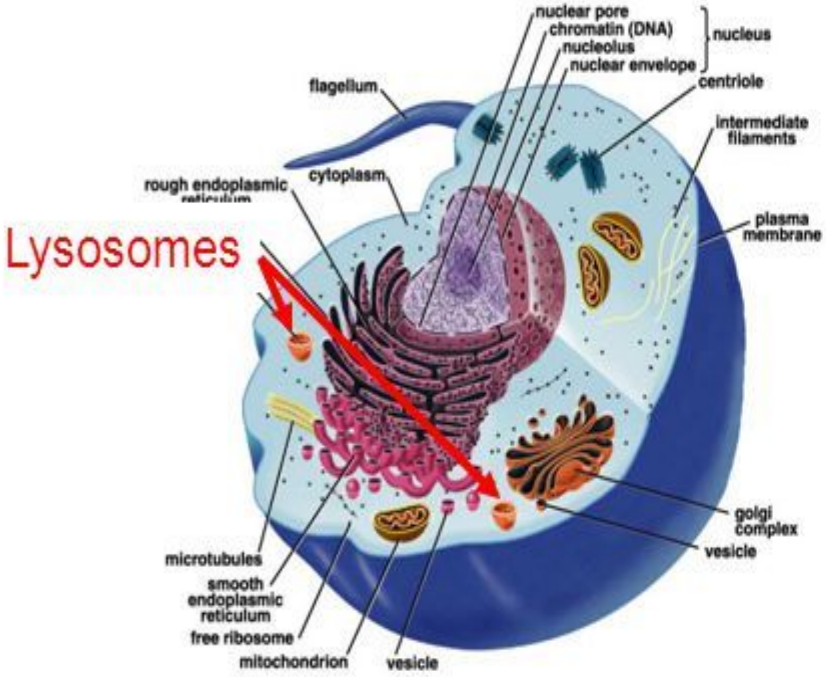
Golgi Body in a Cell

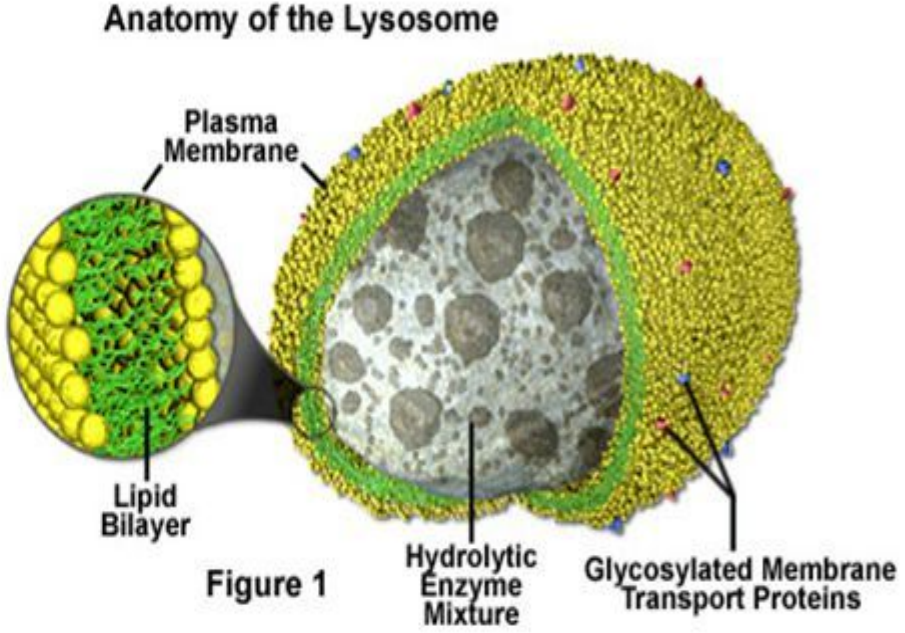


Lysosome

The lysosome is the cell's recycling center. These organelles are spheres full of enzymes ready to hydrolyze (chop up the chemical bonds of) whatever substance crosses the membrane, so the cell can reuse the raw material. **These disposal enzymes only function properly in environments with a pH of 5, two orders of magnitude more acidic than the cell's internal pH of 7.** Lysosomal proteins only being active in an acidic environment acts as safety mechanism for the rest of the cell - if the lysosome were to somehow leak or burst, the degradative enzymes would inactivate before they chopped up proteins the cell still needed.





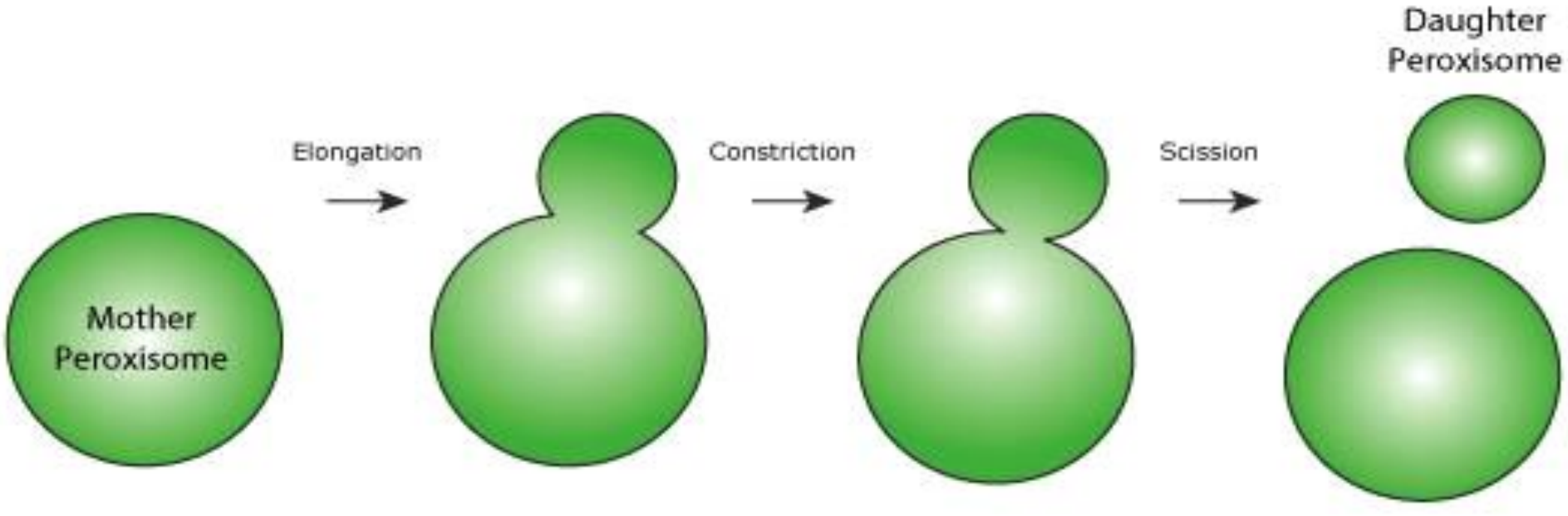


1. **Function**: packets of enzymes that break down materials in a cell.
2. **Structure**: Small membrane-bound organelles

Analogy – Recycling center

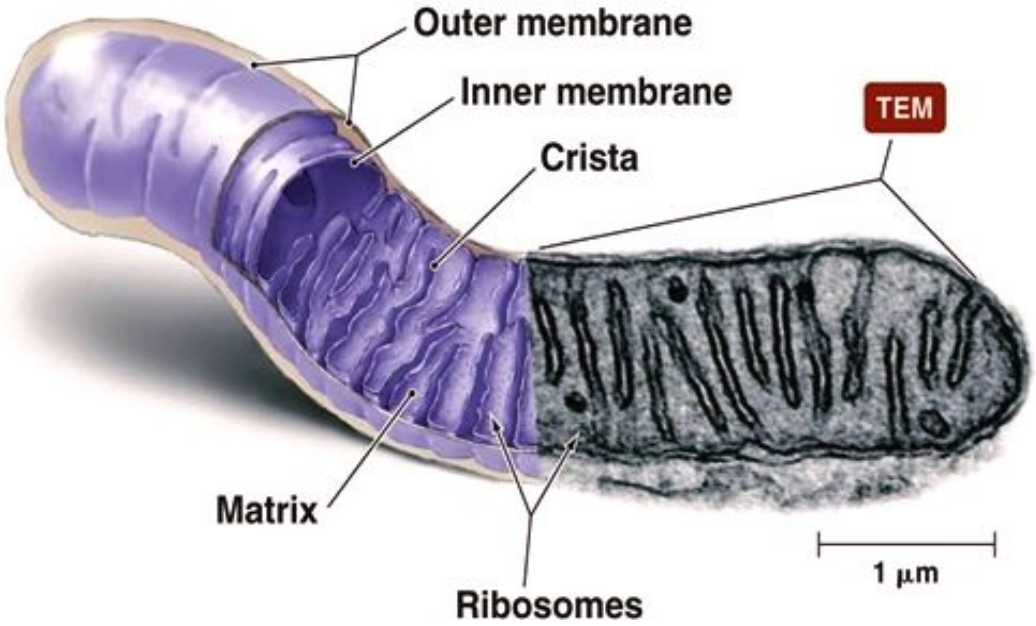
Peroxisome

Like the lysosome, the peroxisome is a spherical organelle responsible for destroying its contents. Unlike the lysosome, which mostly degrades proteins, **the peroxisome is the site of fatty acid breakdown.** It also protects the cell from reactive oxygen species (ROS) molecules which could seriously damage the cell. ROSs are molecules like oxygen ions or peroxides that are created as a byproduct of normal cellular metabolism, but also by radiation, tobacco, and drugs. They cause what is known as oxidative stress in the cell by reacting with and damaging DNA and lipid-based molecules like cell membranes. These ROSs are the reason we need antioxidants in our diet.



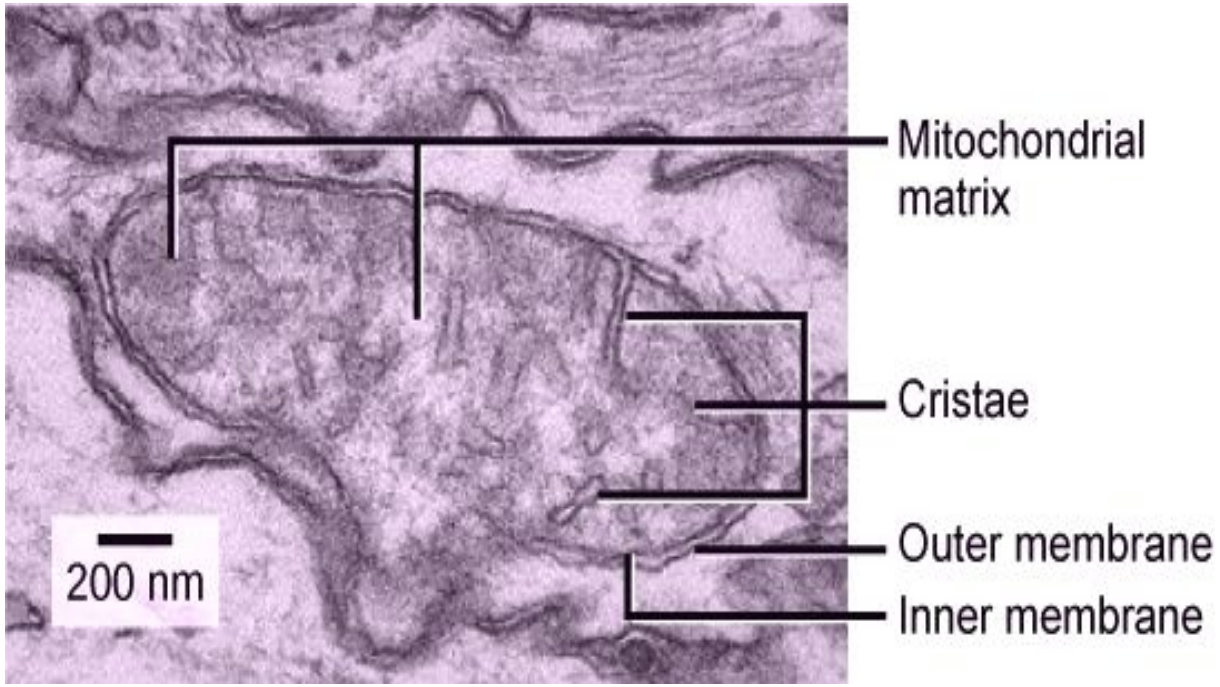
Key Concepts

- Mitochondria are semi-autonomous organelles that are descendants of endosymbiotic bacteria.
- Mitochondria play a pivotal role in cellular energy production through the mitochondria-housed pathways of citric acid cycle, fatty acid oxidation, respiration and oxidative phosphorylation (OXPHOS).
- Mitochondria have an important anabolic role in cellular metabolism, as they are fundamental for the synthesis of several amino acids, nucleobases and enzymatic cofactors such as haem and Fe-S clusters.
- Mitochondria are membrane-bound organelles. They have two distinct membranes: the outer and the inner membrane. The inner membrane is highly impermeable to ions and forms an extensive series of invaginations called cristae.



In the cell, **mitochondria** form a continuous and highly dynamic network. In addition, they intimately interact with other cellular structures, such as the cytoskeleton and the endoplasmic reticulum.
Mitochondria retain their own hereditary material, the mitochondrial DNA (mtDNA), and their own translation apparatus or mitoribosomes.
mtDNA is present in ~1000–10 000 copies per cell and encodes for a handful of proteins, all subunits of the OXPHOS system.

In humans, defects of the OXPHOS system are associated with devastating diseases, known as **mitochondrial disorders**, which are multisystemic, although mainly affecting highly energy-demanding tissues such as *brain, heart and muscle.*



MITOCHONDRIA

- Structure
  - Double membrane
  - Have own DNA
  - Very numerous in high requirement cells (muscles)
- Function
  - Powerhouse of the cell (energy)
  - Transfers energy into ATP to be used as energy for life functions
- Cell Type
  - Eukaryotic Cells
  - Plant and Animal Cells

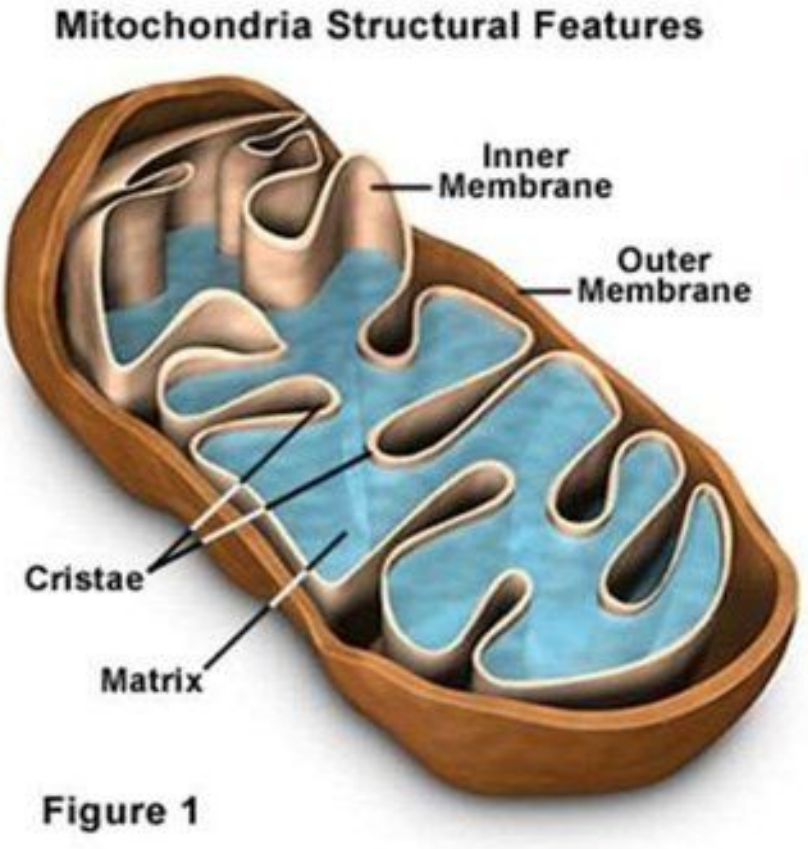
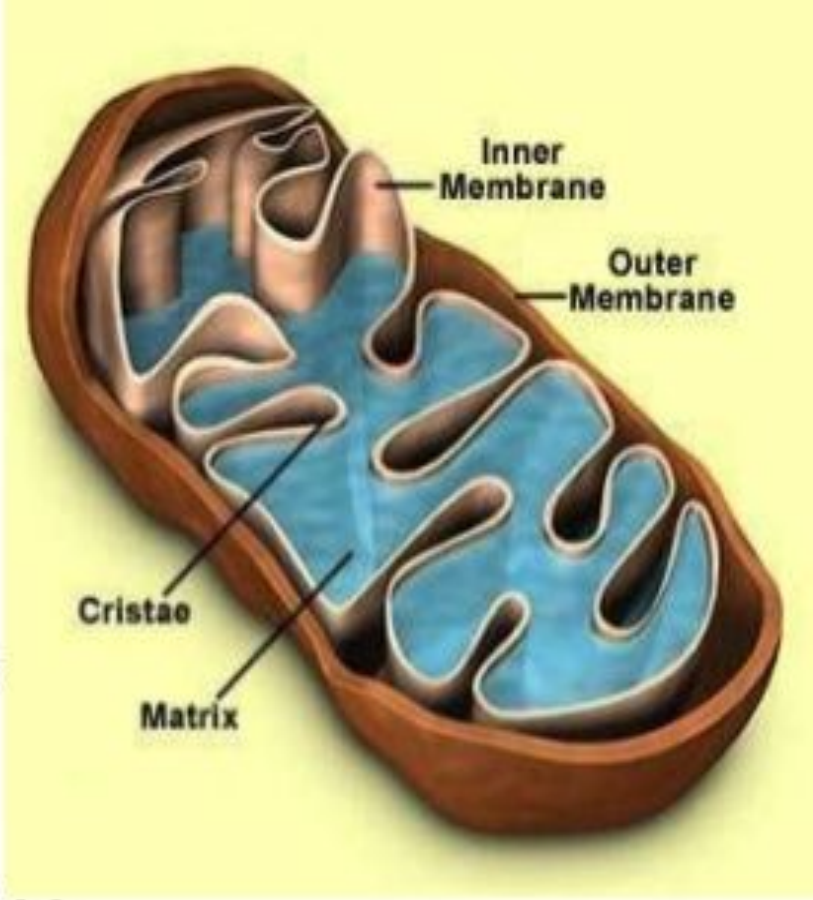


Figure 1

Mitochondria

- Function
  - cellular respiration
  - generate **ATP**
    - from breakdown of sugars, fats & other fuels
    - in the presence of oxygen
    - break down larger molecules into smaller to generate energy = catabolism
    - generate energy in presence of O_2 = aerobic respiration



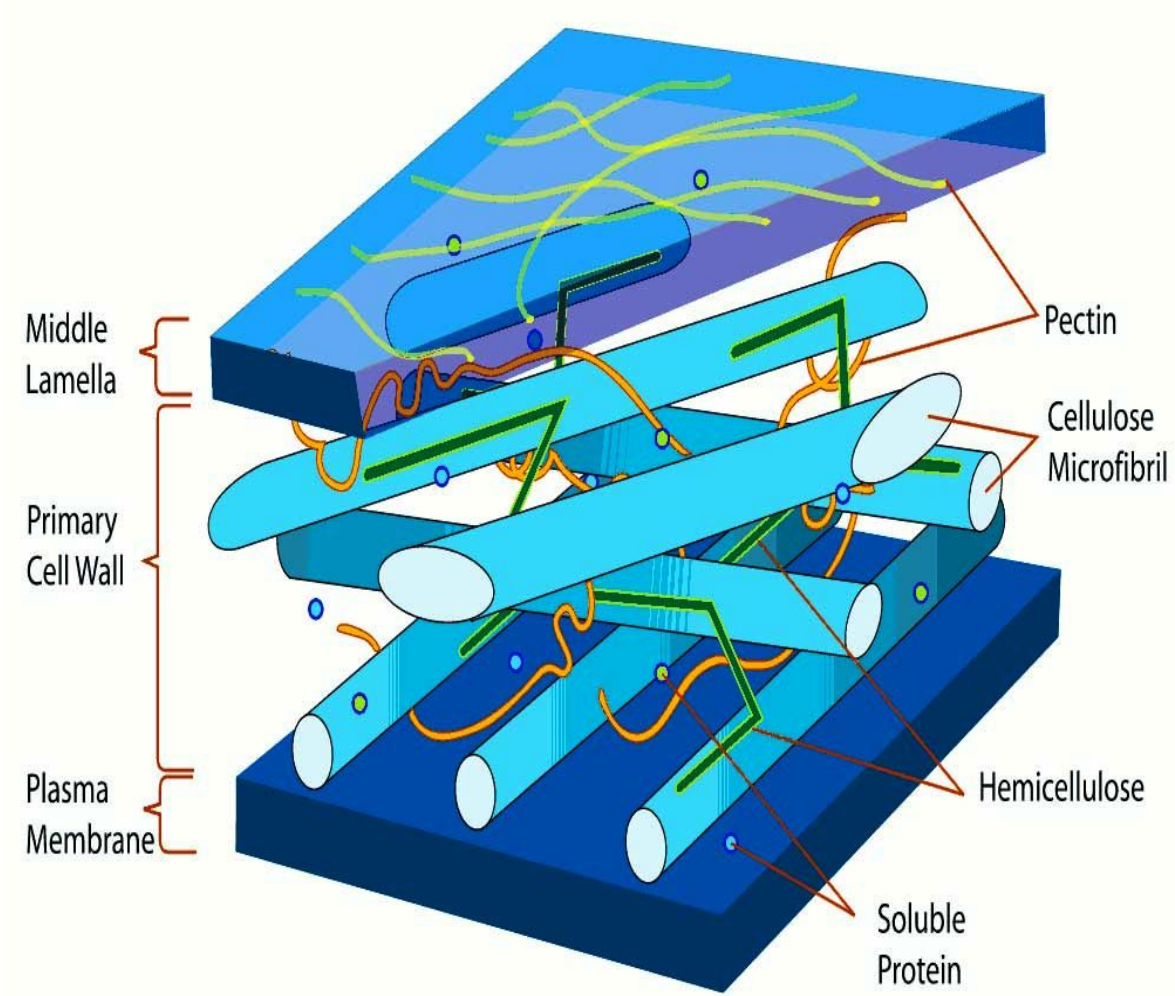
Cell Walls

- Found in plants, fungi, & many protists
- Surrounds plasma membrane

Cell Wall Differences

Plants – mostly cellulose

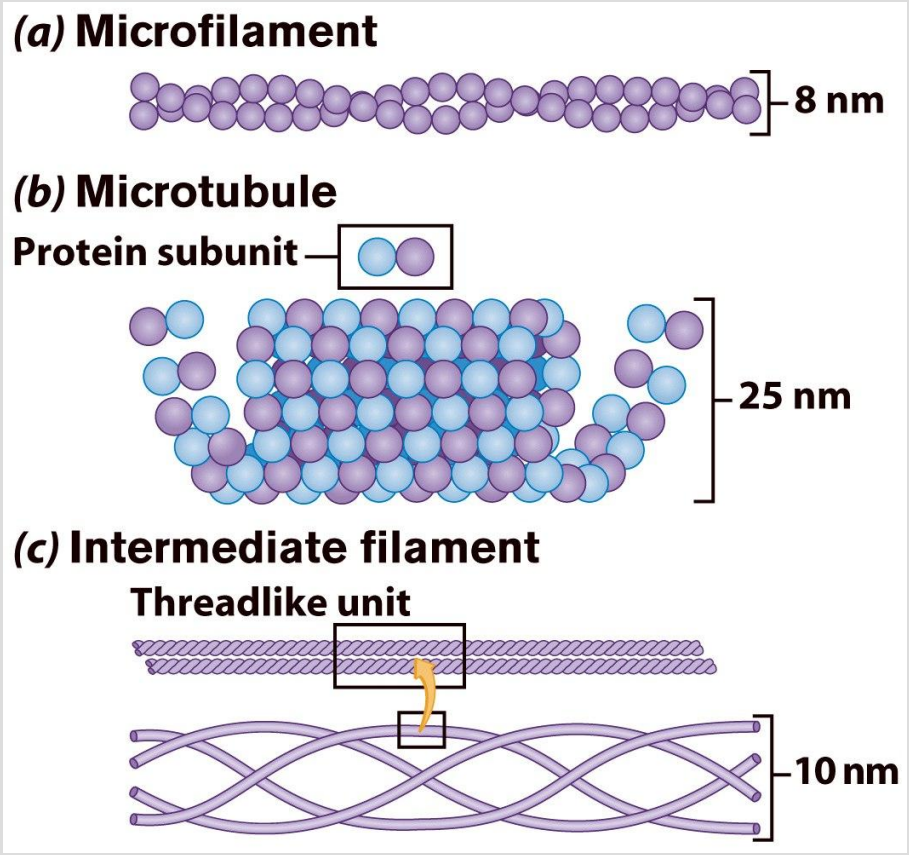
Fungi – contain chitin



Cytoskeleton

- Filaments & fibers

- Made of 3 fiber types
  - Microfilaments
  - Microtubules
  - Intermediate filaments
- 3 functions:
  - mechanical support
  - anchor organelles
  - help move substances

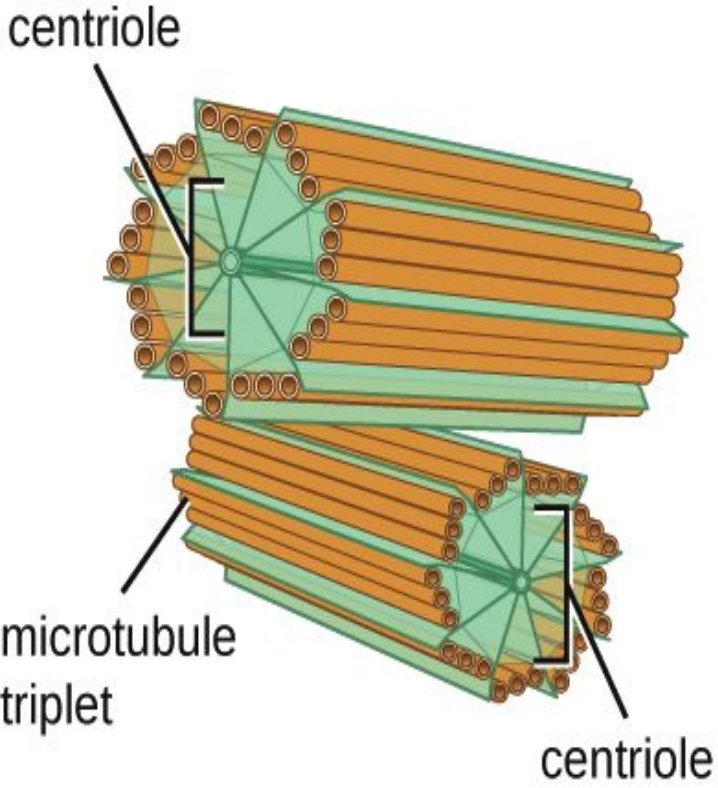


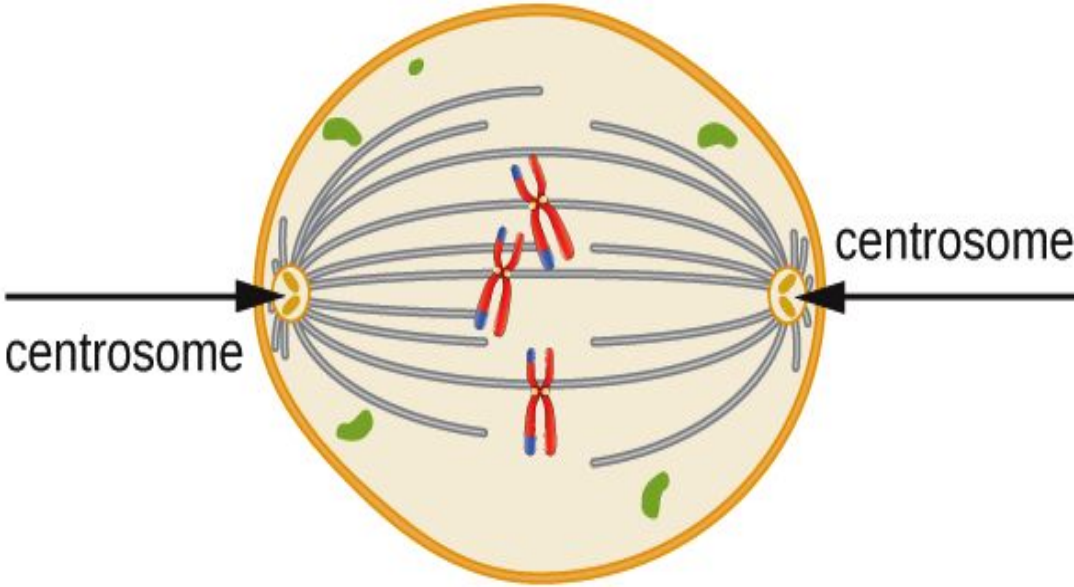
Cilia & Flagella

- Provide motility
- Cilia
  - Short
  - Used to move substances outside human cells
- Flagella
  - Whip-like extensions
  - Found on sperm cells
- Basal bodies like centrioles

Centrioles

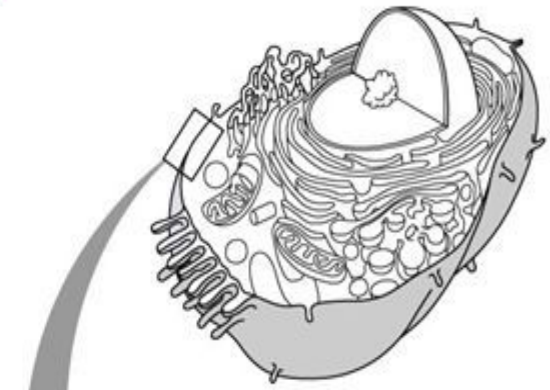
- Pairs of microtubular structures
- Play a role in cell division

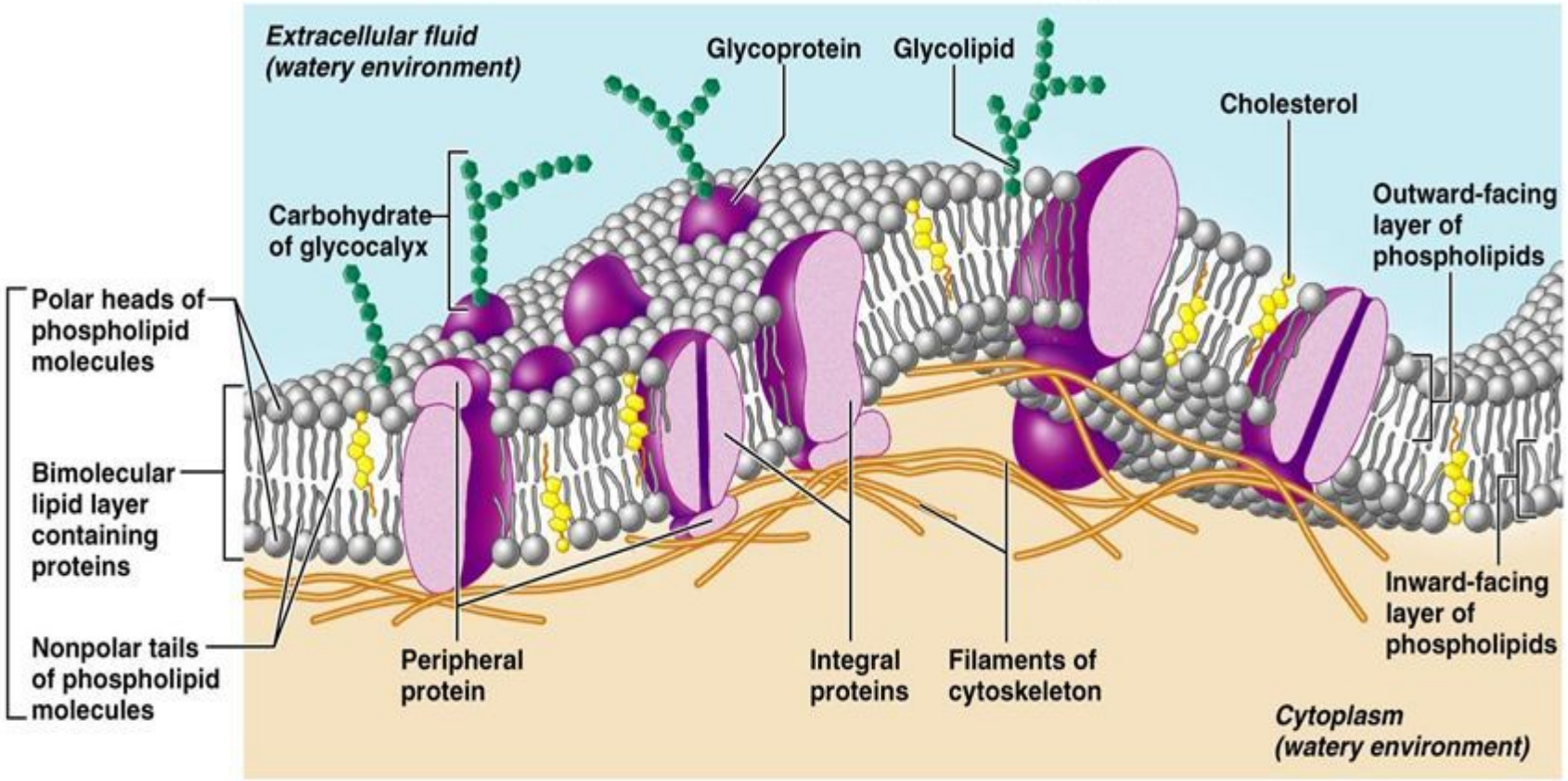




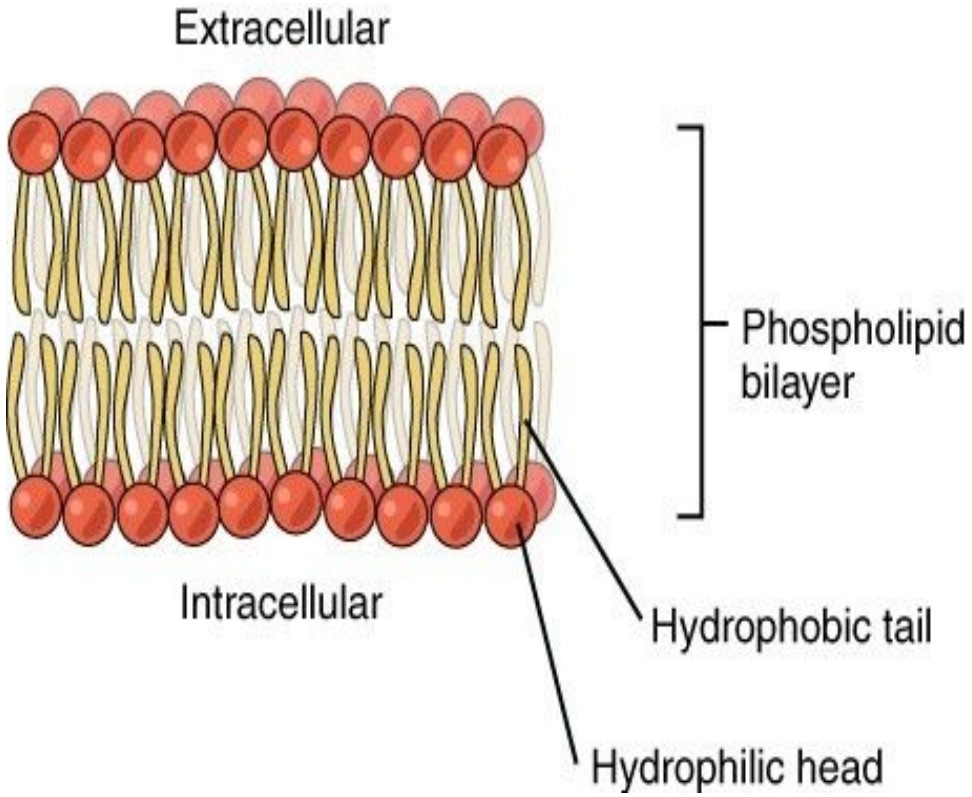
Fluid mosaic model of membrane structure

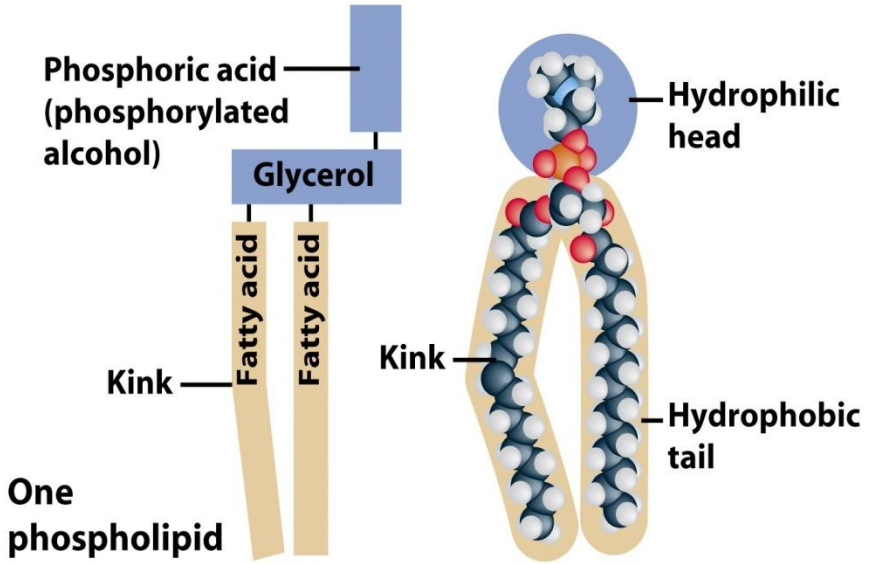
Plasma membrane - defines extent of cell; fragile, selective, **semi-permeable** barrier





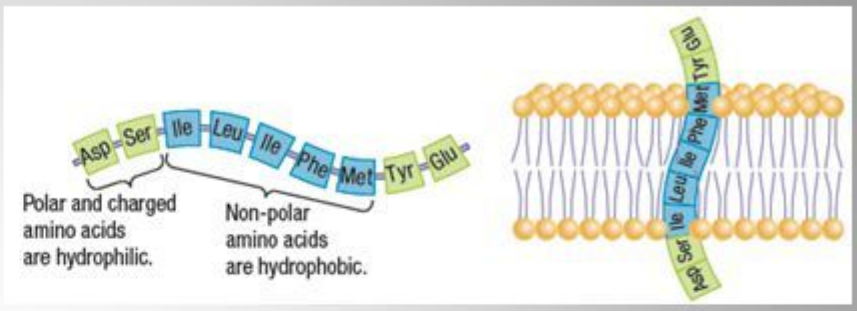
Plasma membrane can be defined as a biological membrane or an outer membrane of a cell, which is composed of Plasma membrane can be defined as a biological membrane or an outer membrane of a cell, which is composed of two layers of phospholipids and embedded with proteins. It is a thin semi permeable membrane layer, which surrounds the cytoplasm and other constituents of the cell.

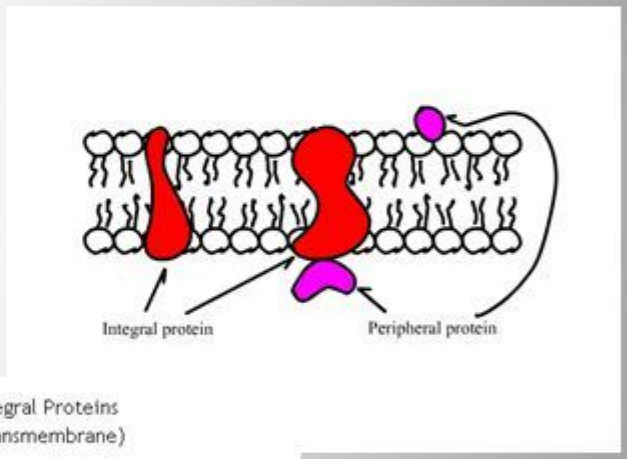


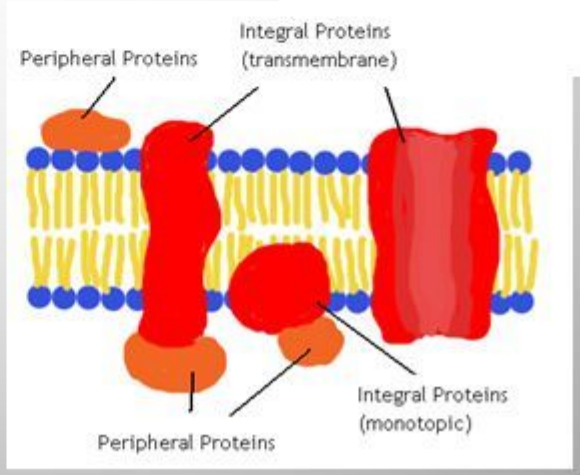


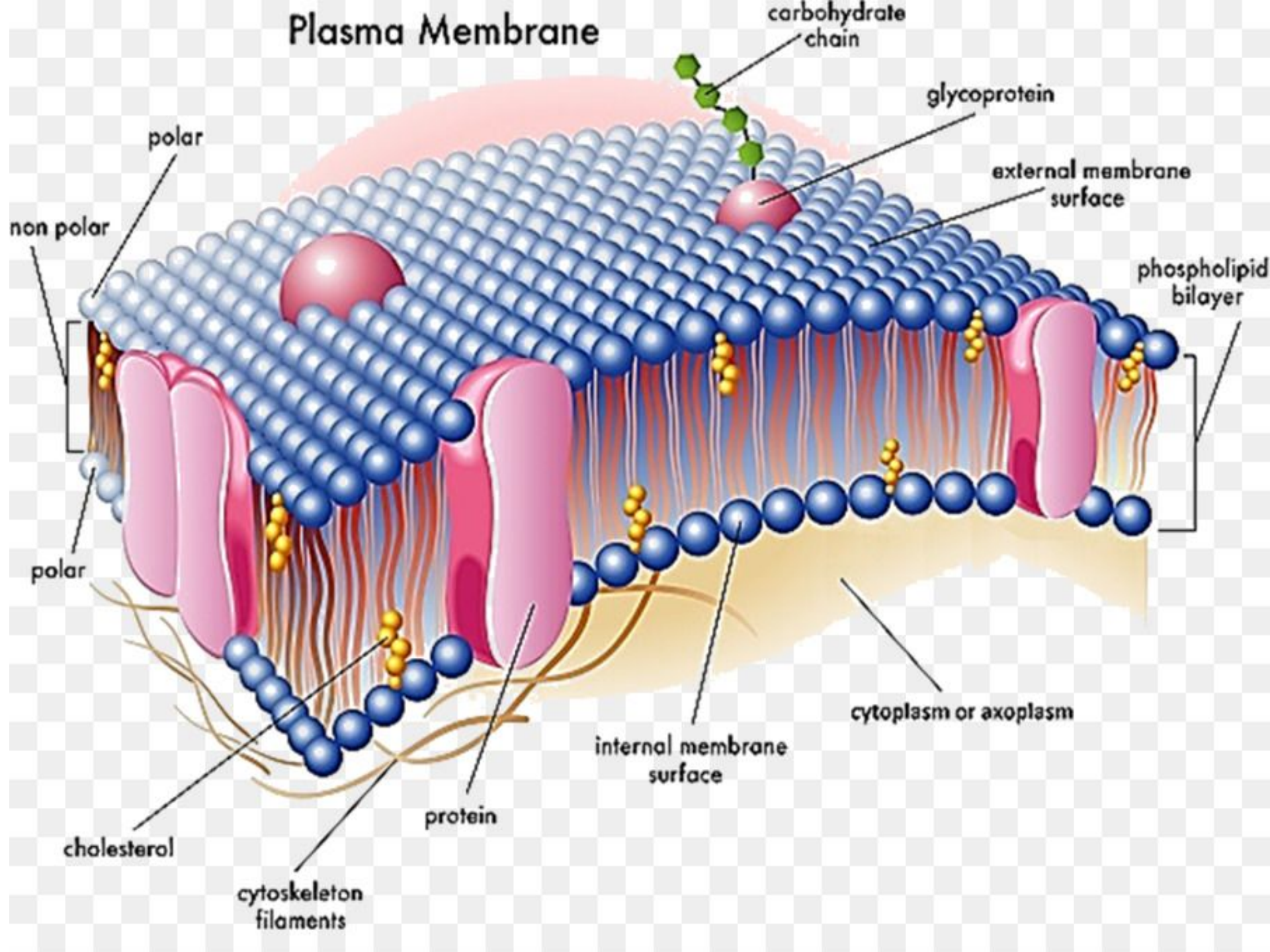
Membrane Protein : Integral/Peripheral

- Integral Membrane Proteins (transmembrane)
  - Exposed to aqueous environment on both sides of the membrane
  - Used to transport molecules across membrane
- Peripheral Membrane Proteins
  - Located on surface of a membrane
  - Eg. Cytoskeleton







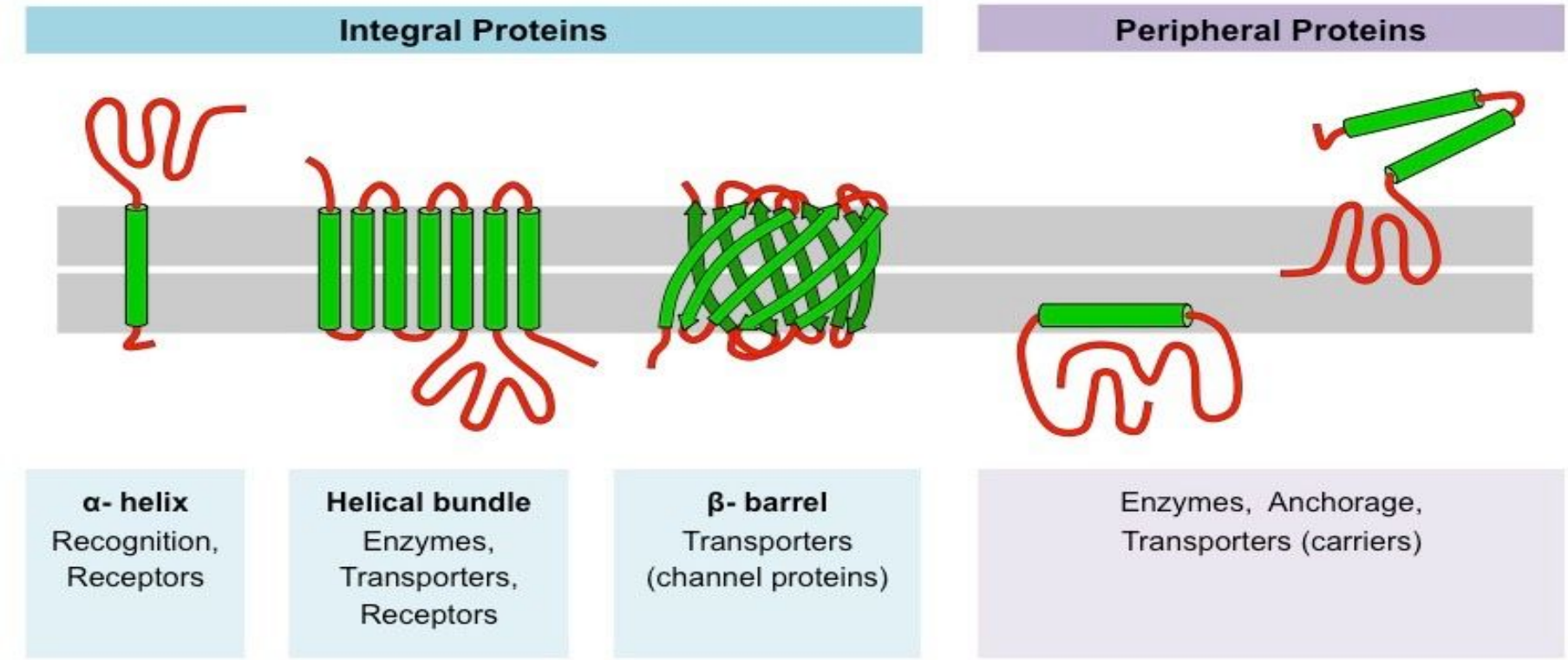

Plasma Membrane
carbohydrate chain
glycoprotein
external membrane surface
phospholipid bilayer
polar
non polar
polar
cytoplasm or axoplasm
internal membrane surface
protein
cholesterol
cytoskeleton filaments

Cell Membrane Function

1. **Maintenance**
2. **Identification-** protein molecules are unique on the membrane surface.
3. **Communication-** hormones and neurotransmitters bind to receptor proteins that start changes in the cell's activities.
4. **Transportation-** Most substances move through the membranes.
5. **Defense-** antibodies are located on the membrane surface and bind to harmful substances.

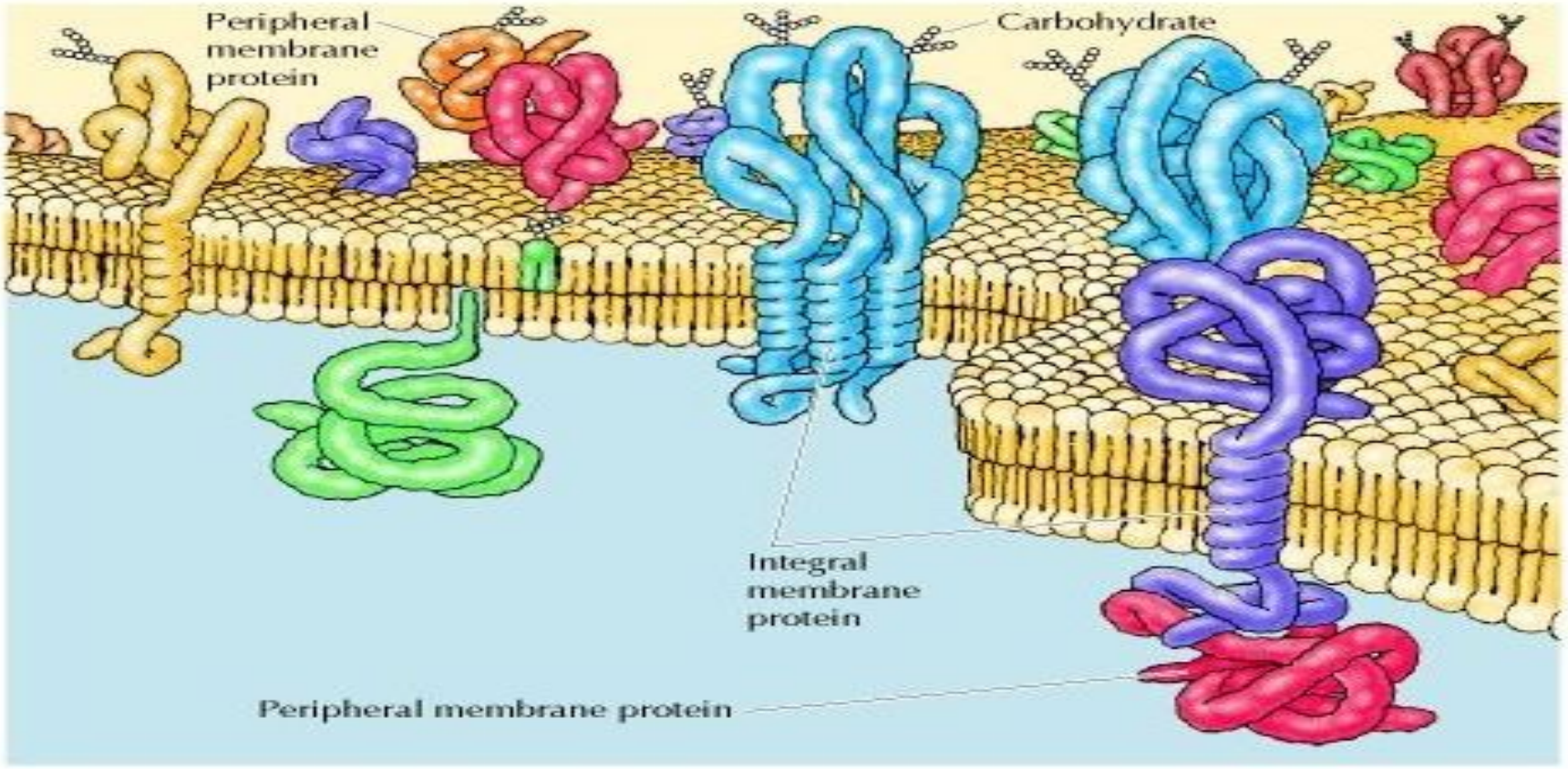
Membrane Proteins

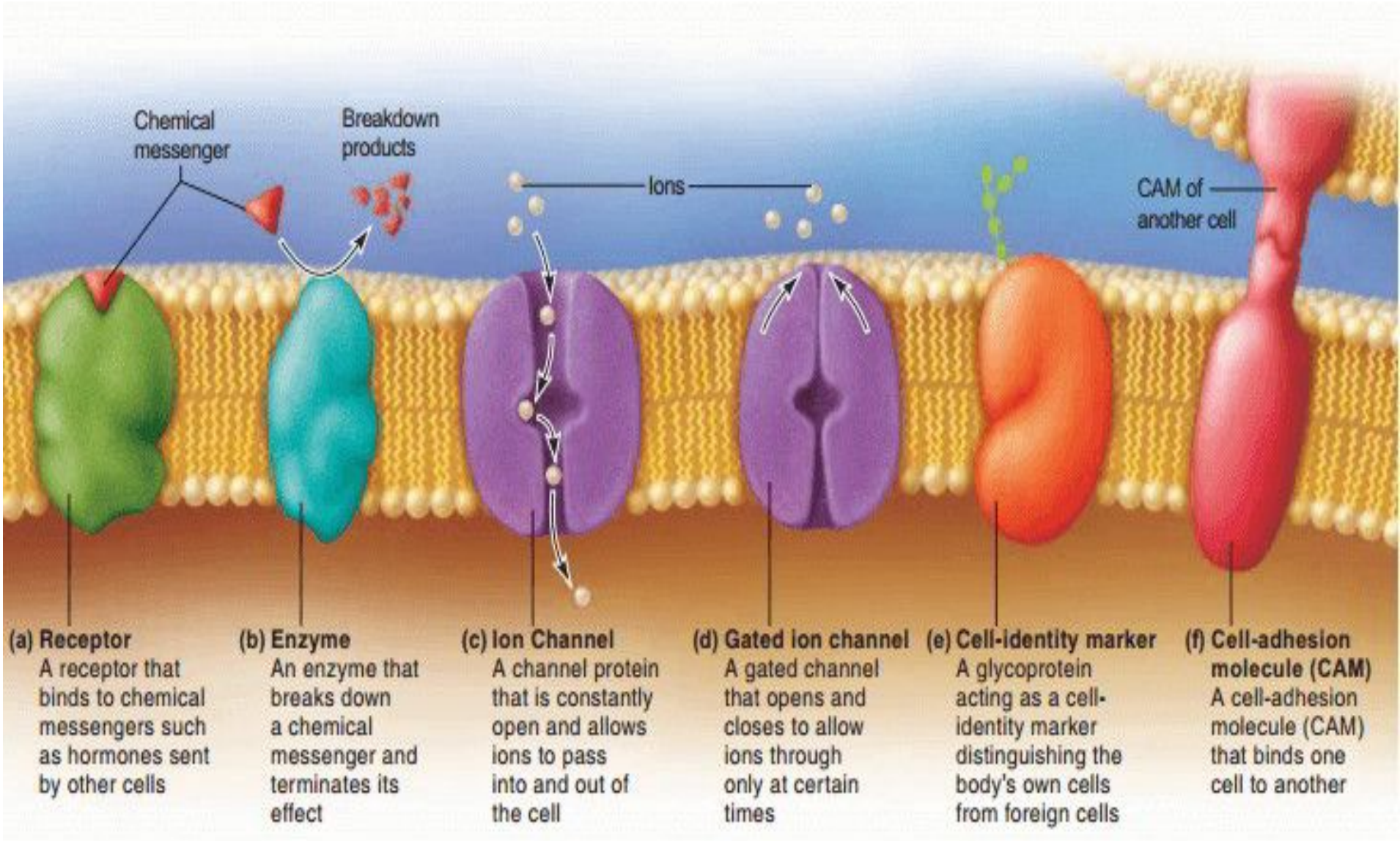
1. Channels or transporters
   - Move molecules in one direction
2. Receptors
   - Recognize certain chemicals

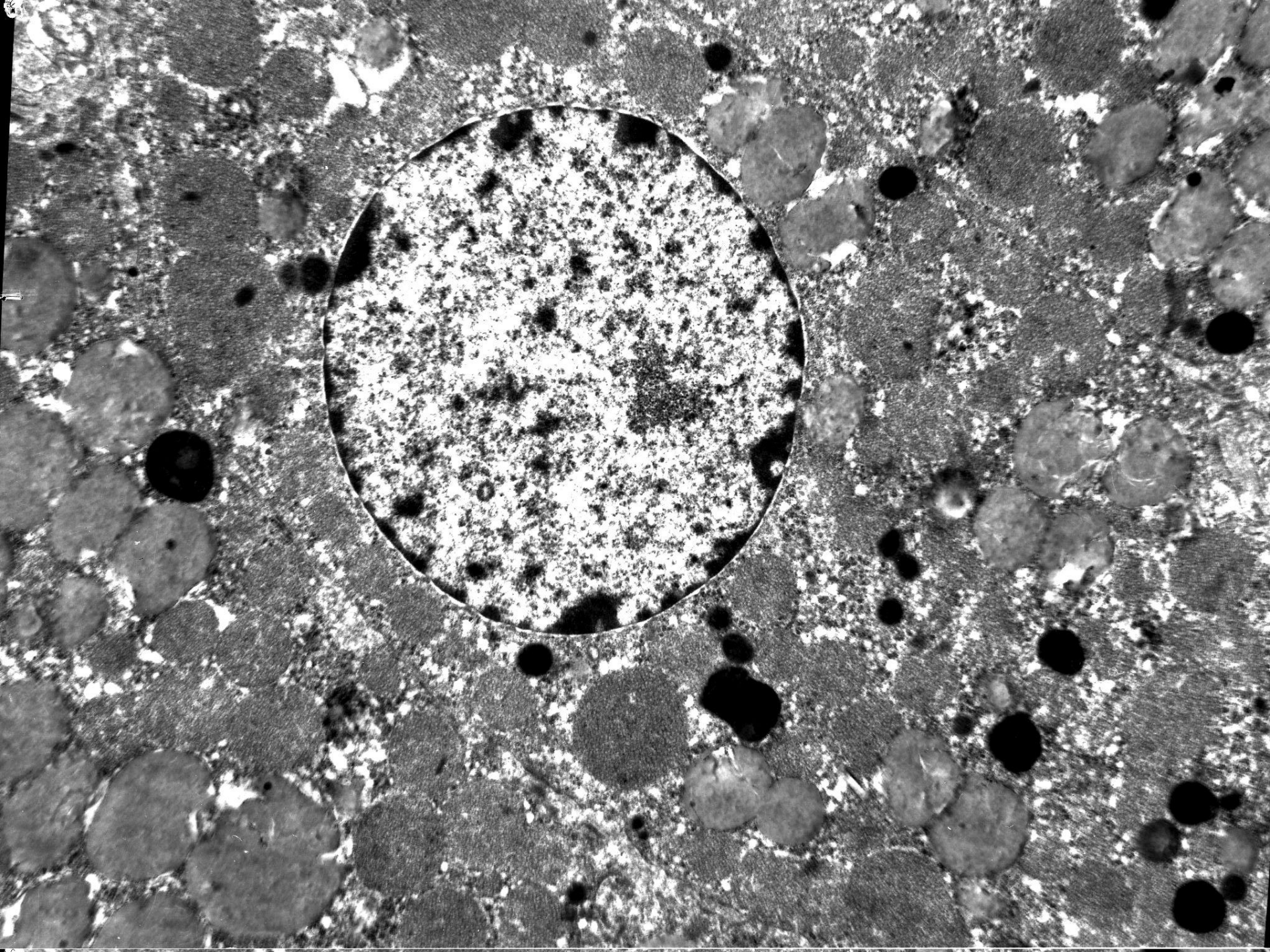


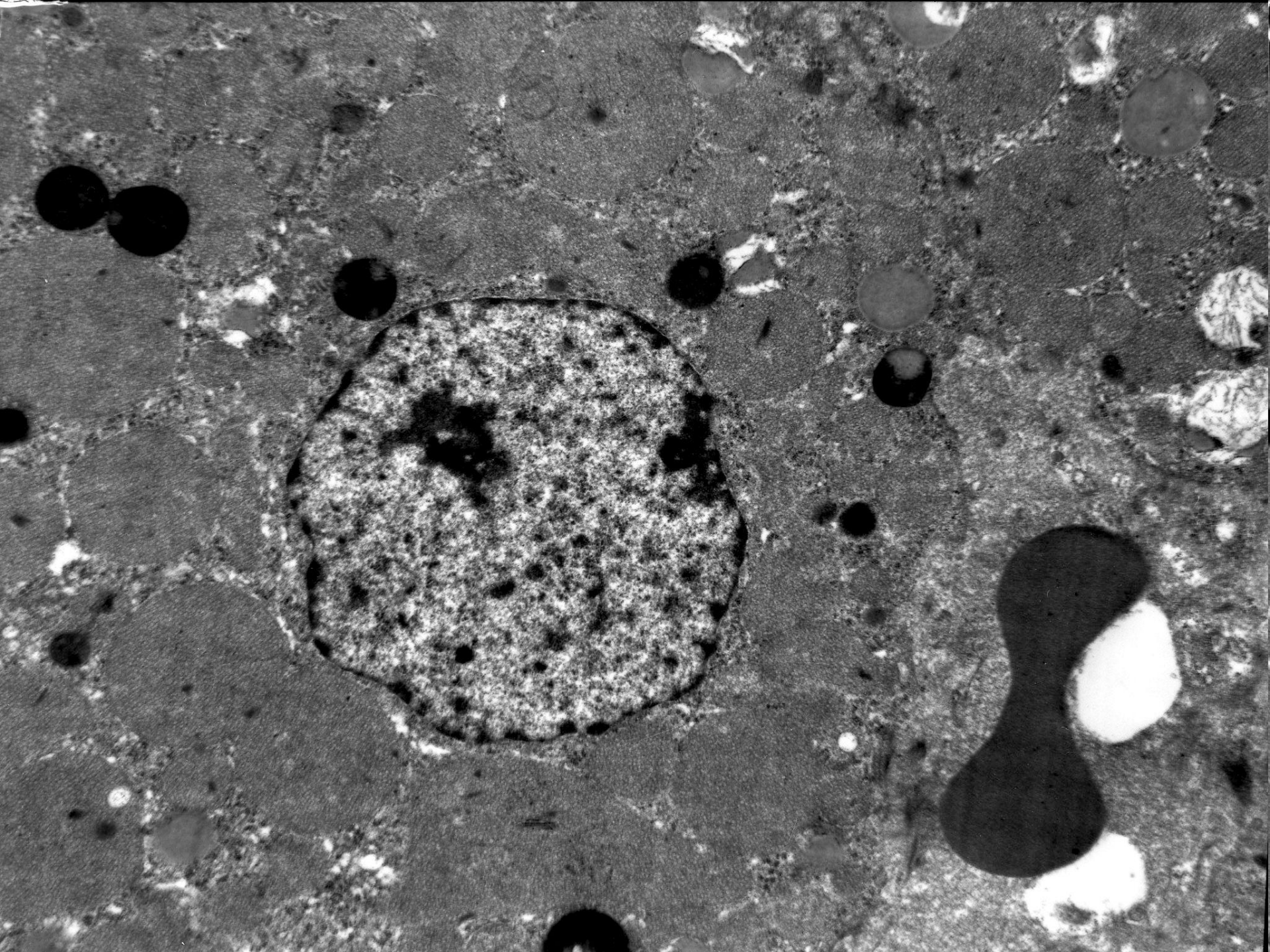
Membrane Proteins

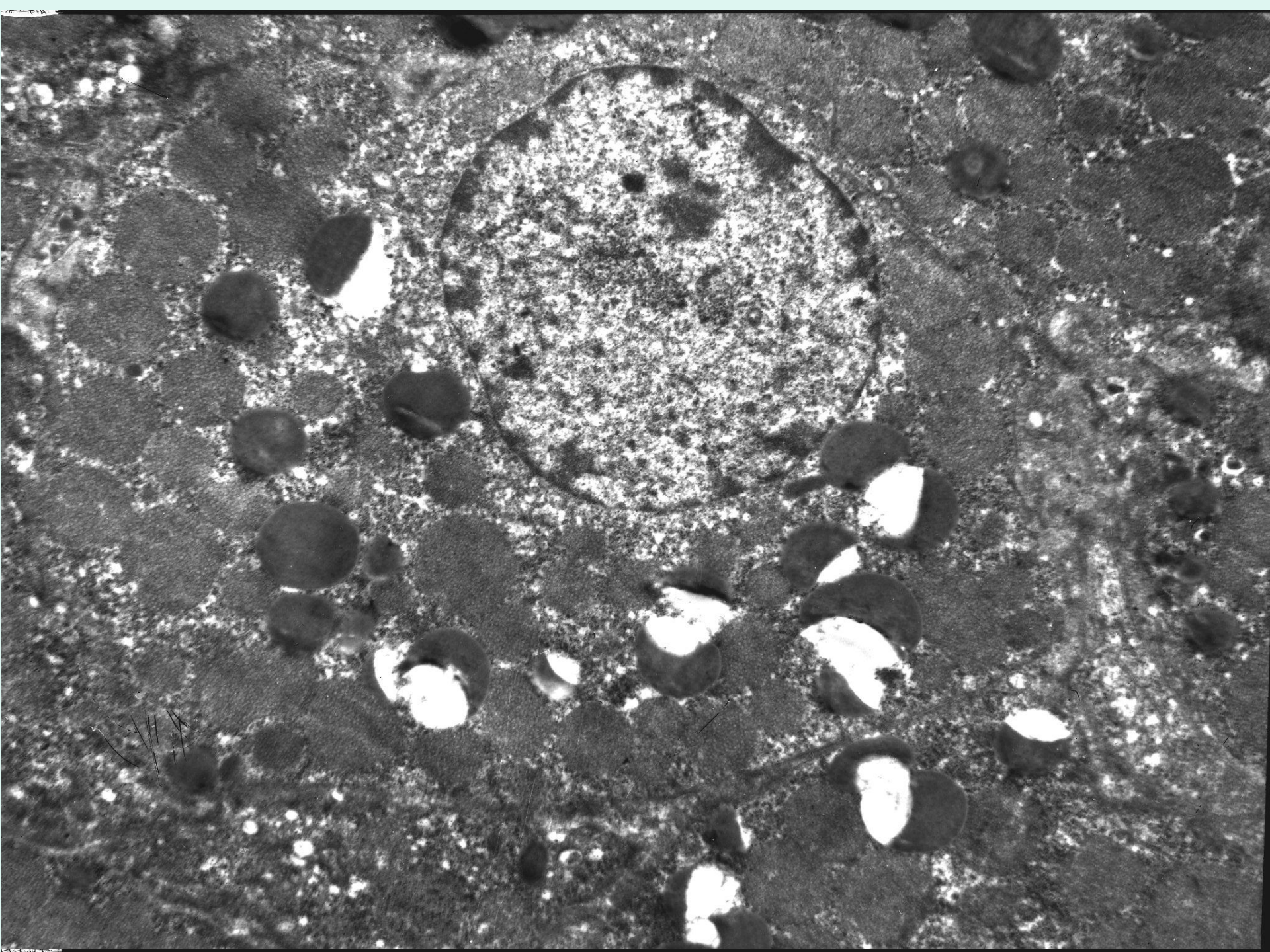
3. Glycoproteins
   - Identify cell type
4. Enzymes
   - Catalyze production of substances

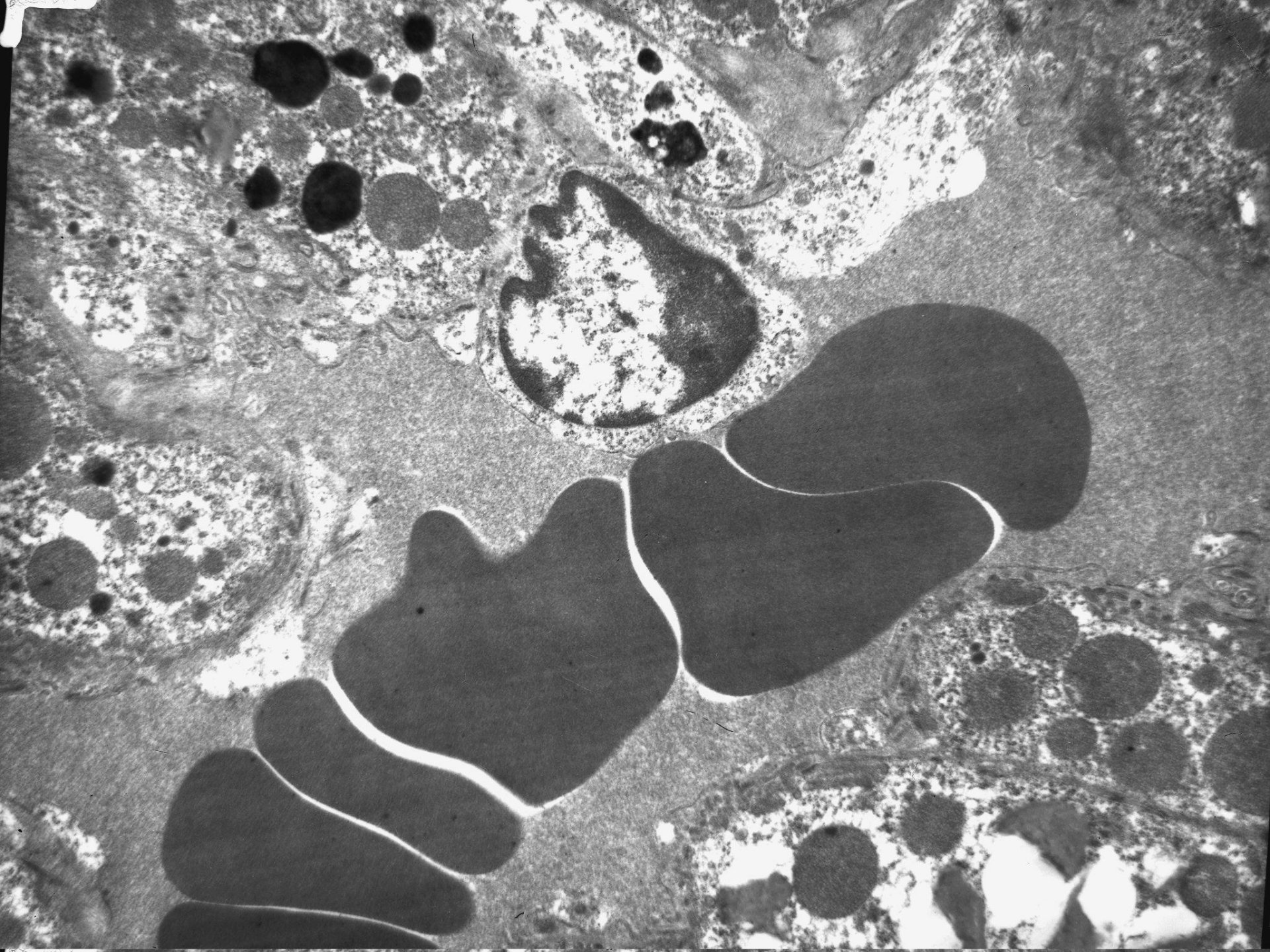


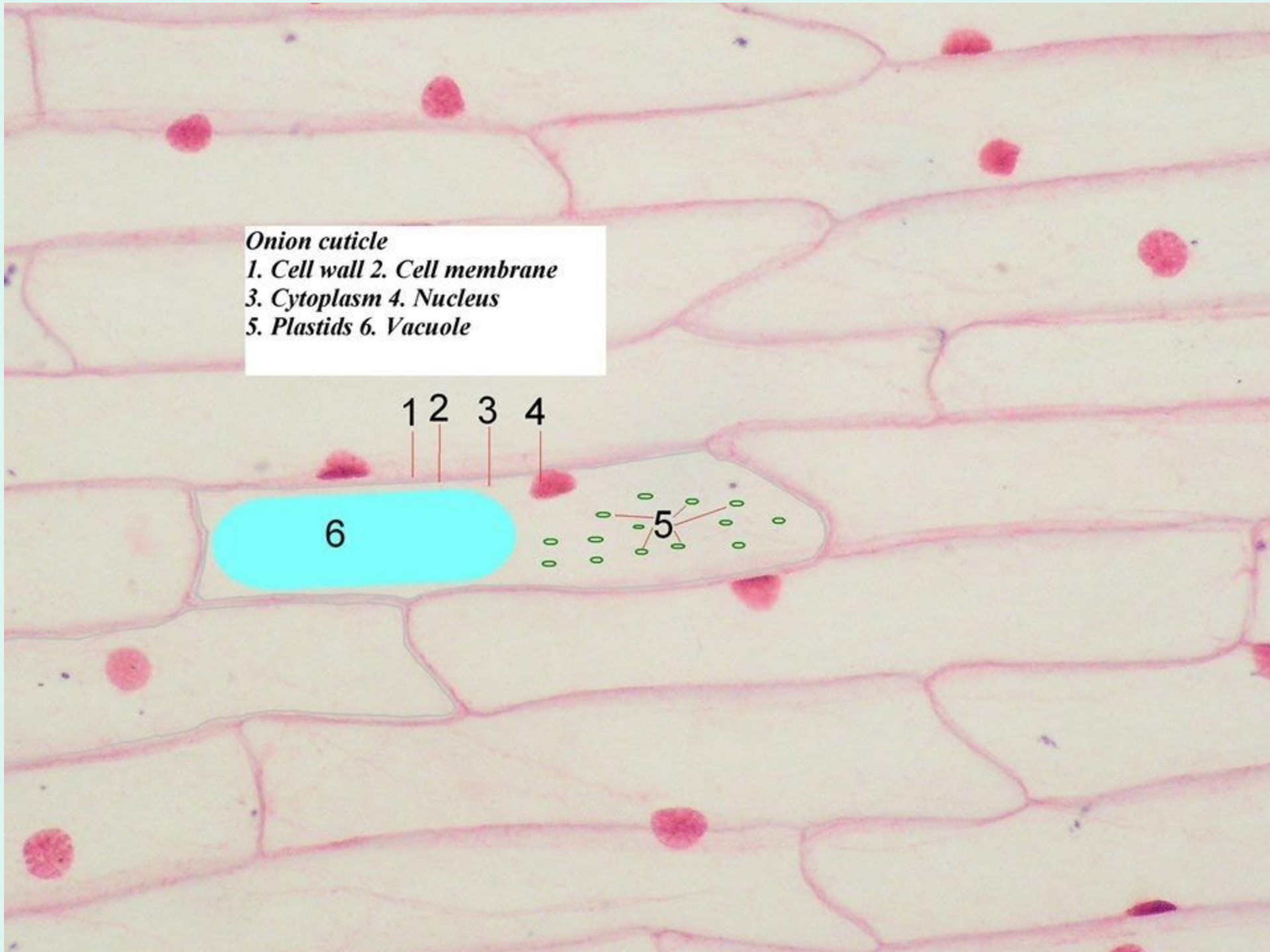

Chemical messenger
Breakdown products
Ions
CAM of another cell
(a) Receptor
A receptor that binds to chemical messengers such as hormones sent by other cells
(b) Enzyme
An enzyme that breaks down a chemical messenger and terminates its effect
(c) Ion Channel
A channel protein that is constantly open and allows ions to pass into and out of the cell
(d) Gated ion channel
A gated channel that opens and closes to allow ions through only at certain times
(e) Cell-identity marker
A glycoprotein acting as a cell-identity marker distinguishing the body's own cells from foreign cells
(f) Cell-adhesion molecule (CAM)
A cell-adhesion molecule (CAM) that binds one cell to another

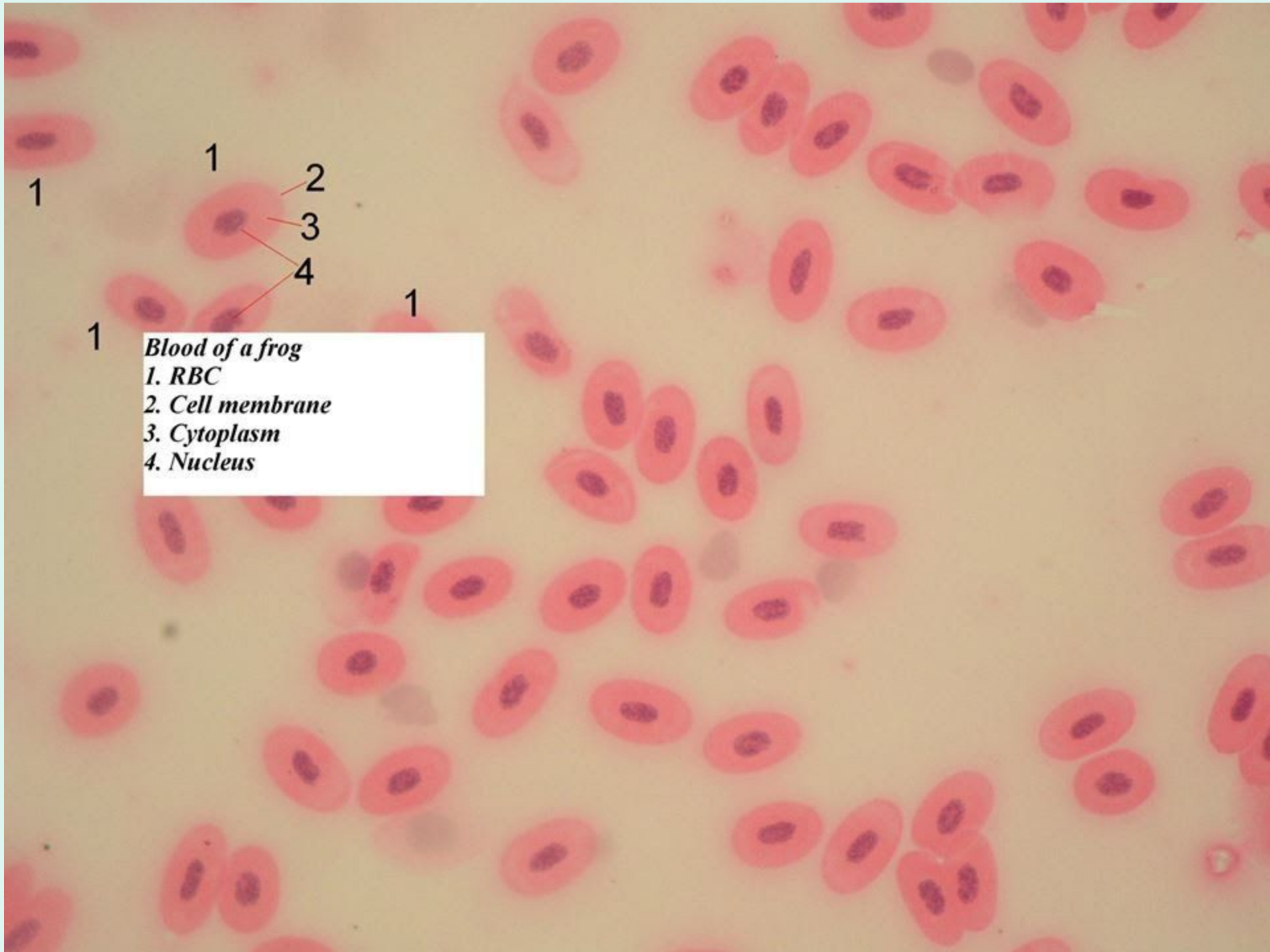




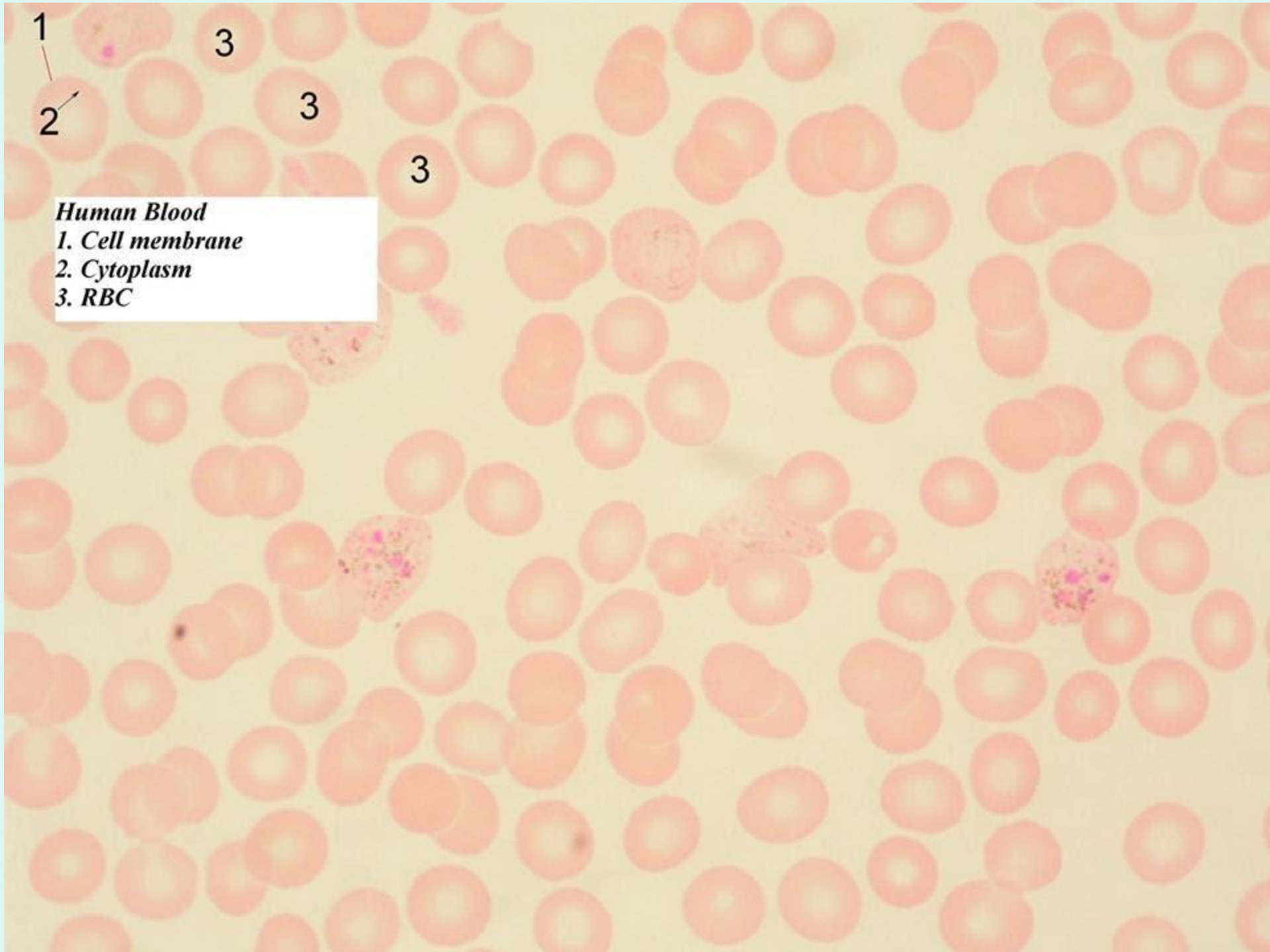


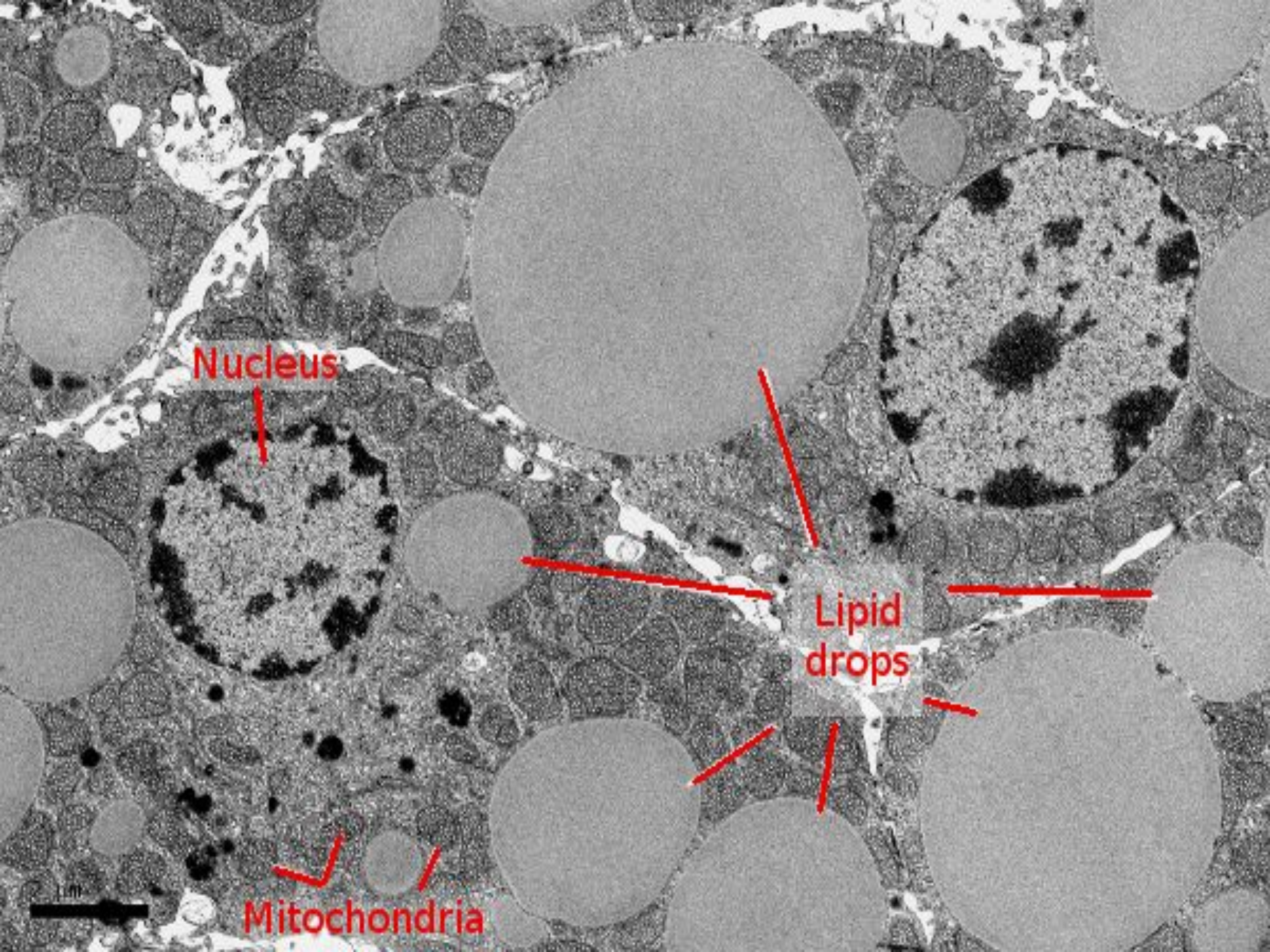


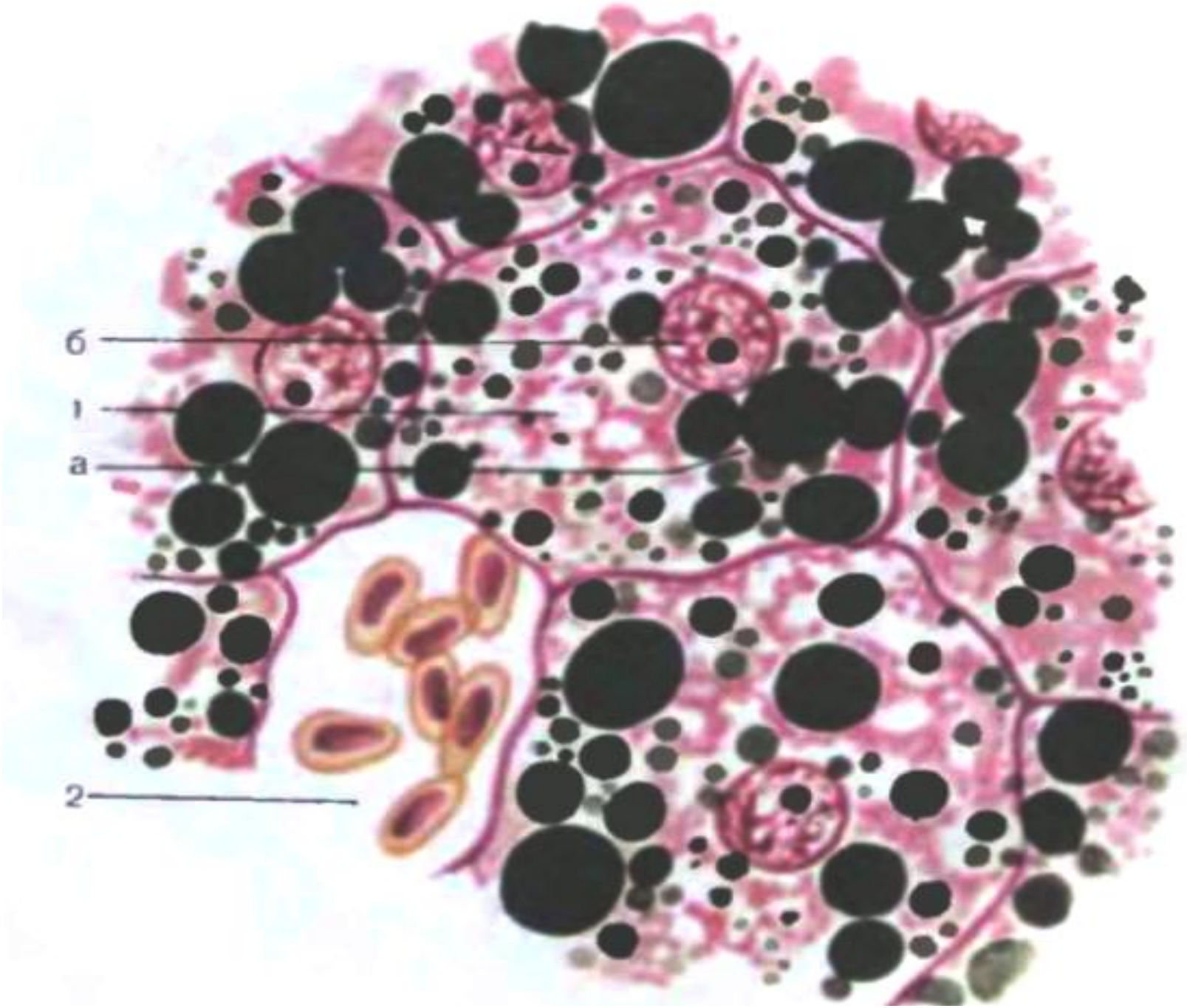

Onion cuticle
1. Cell wall 2. Cell membrane
3. Cytoplasm 4. Nucleus
5. Plastids 6. Vacuole
1
2
3
4
5
6

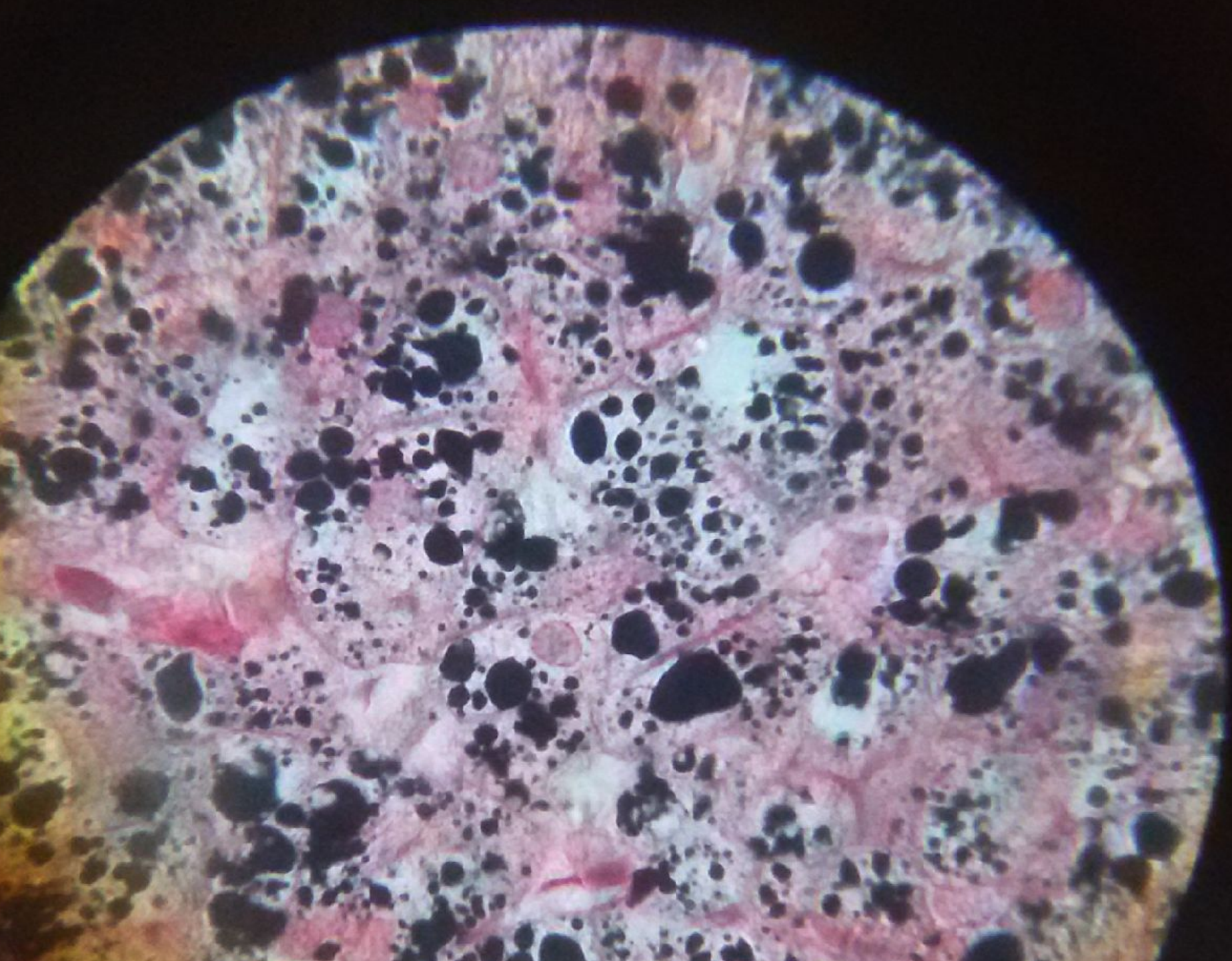


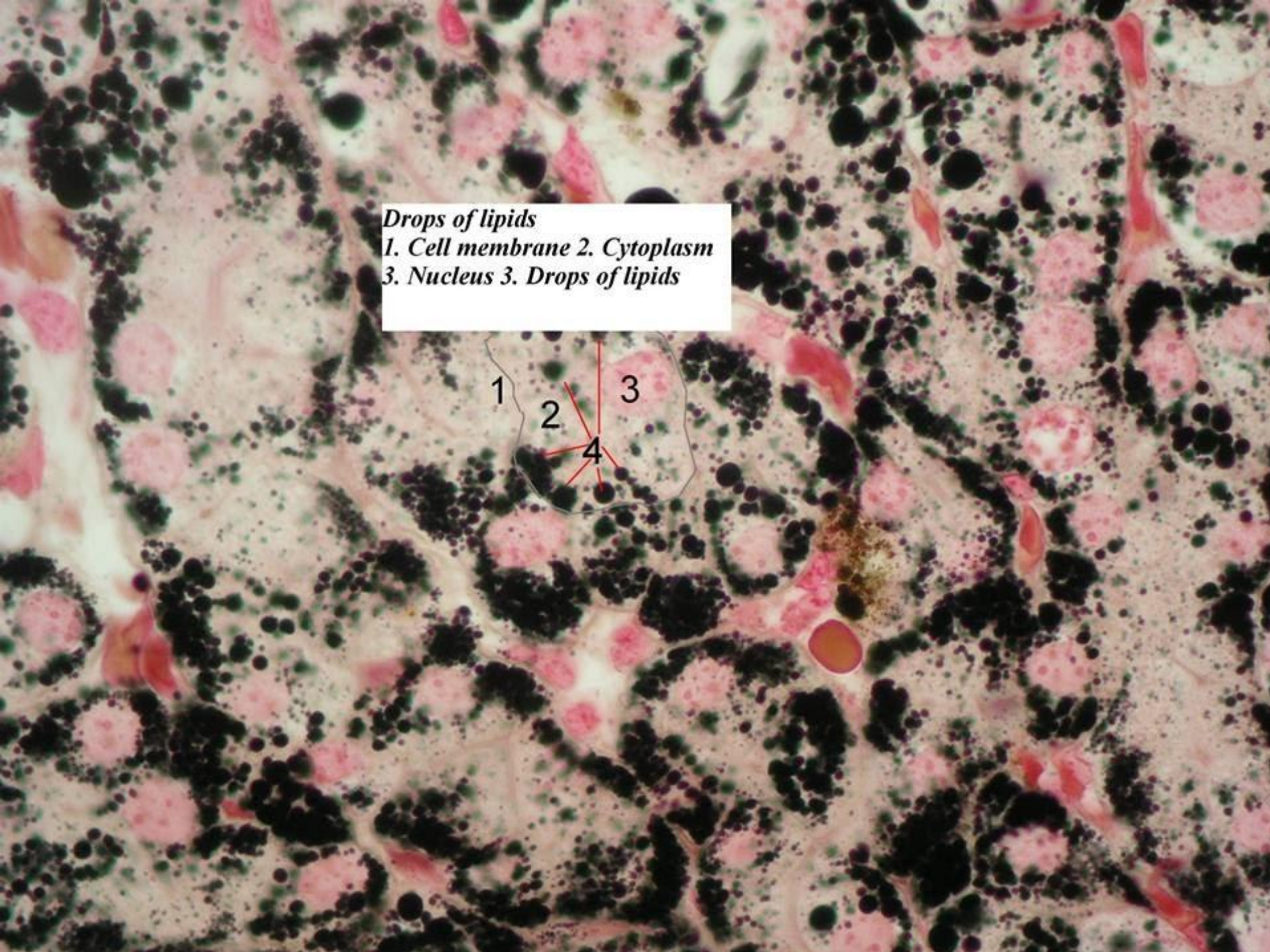
Blood of a frog
1. RBC
2. Cell membrane
3. Cytoplasm
4. Nucleus

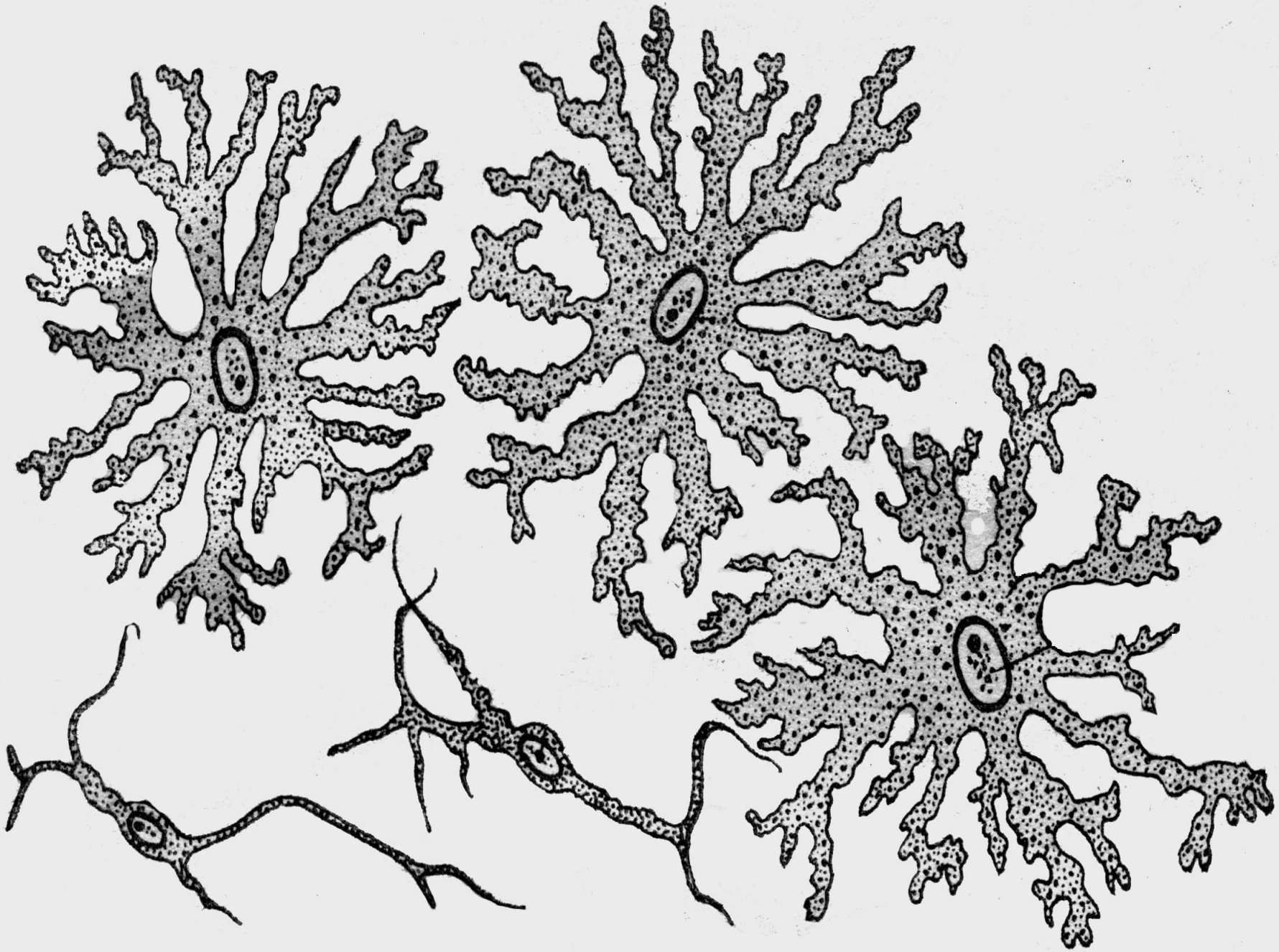

1
2
3
3
3
Human Blood
1. Cell membrane
2. Cytoplasm
3. RBC

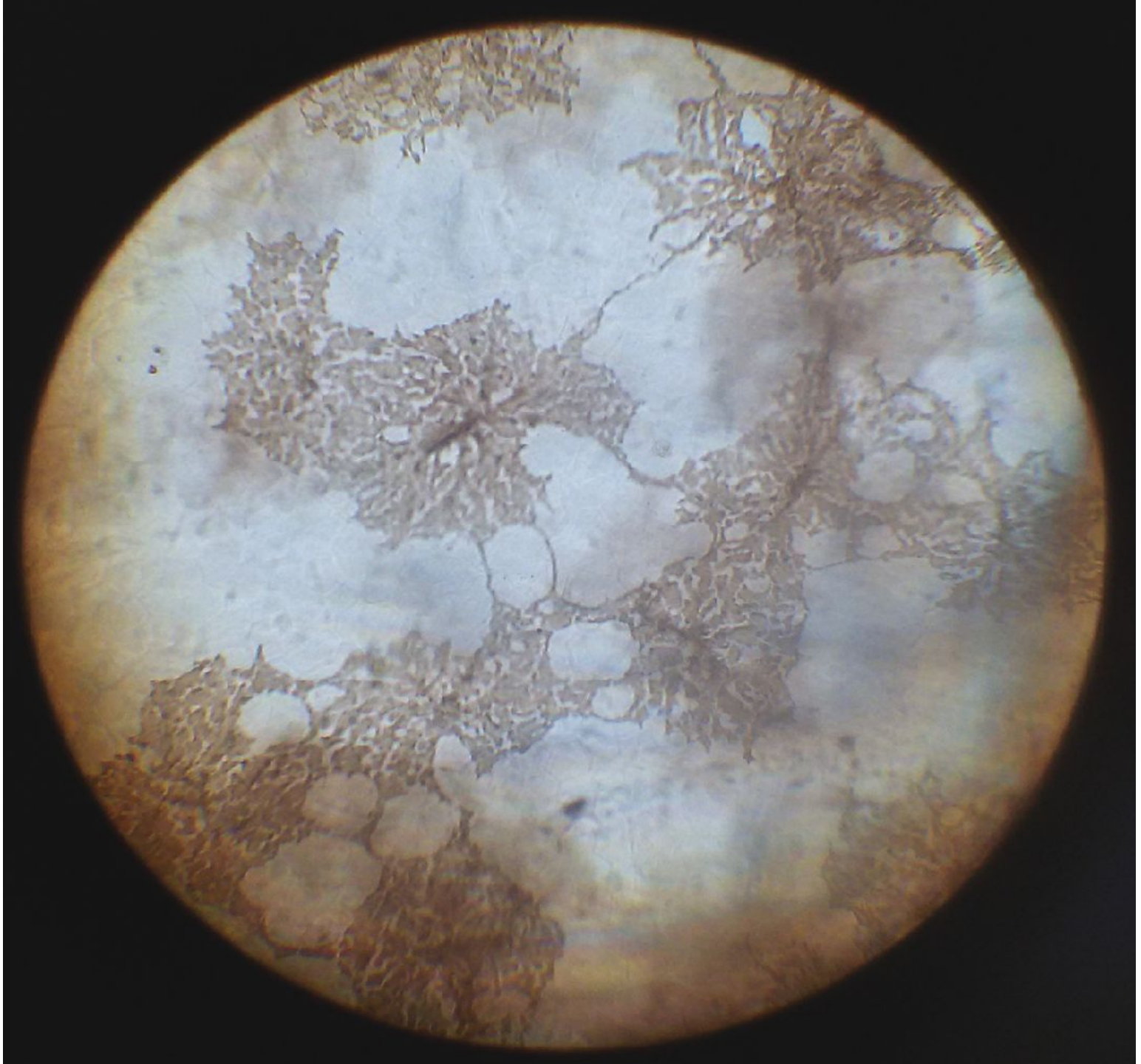

Nucleus
Lipid drops
Mitochondria
1 µm

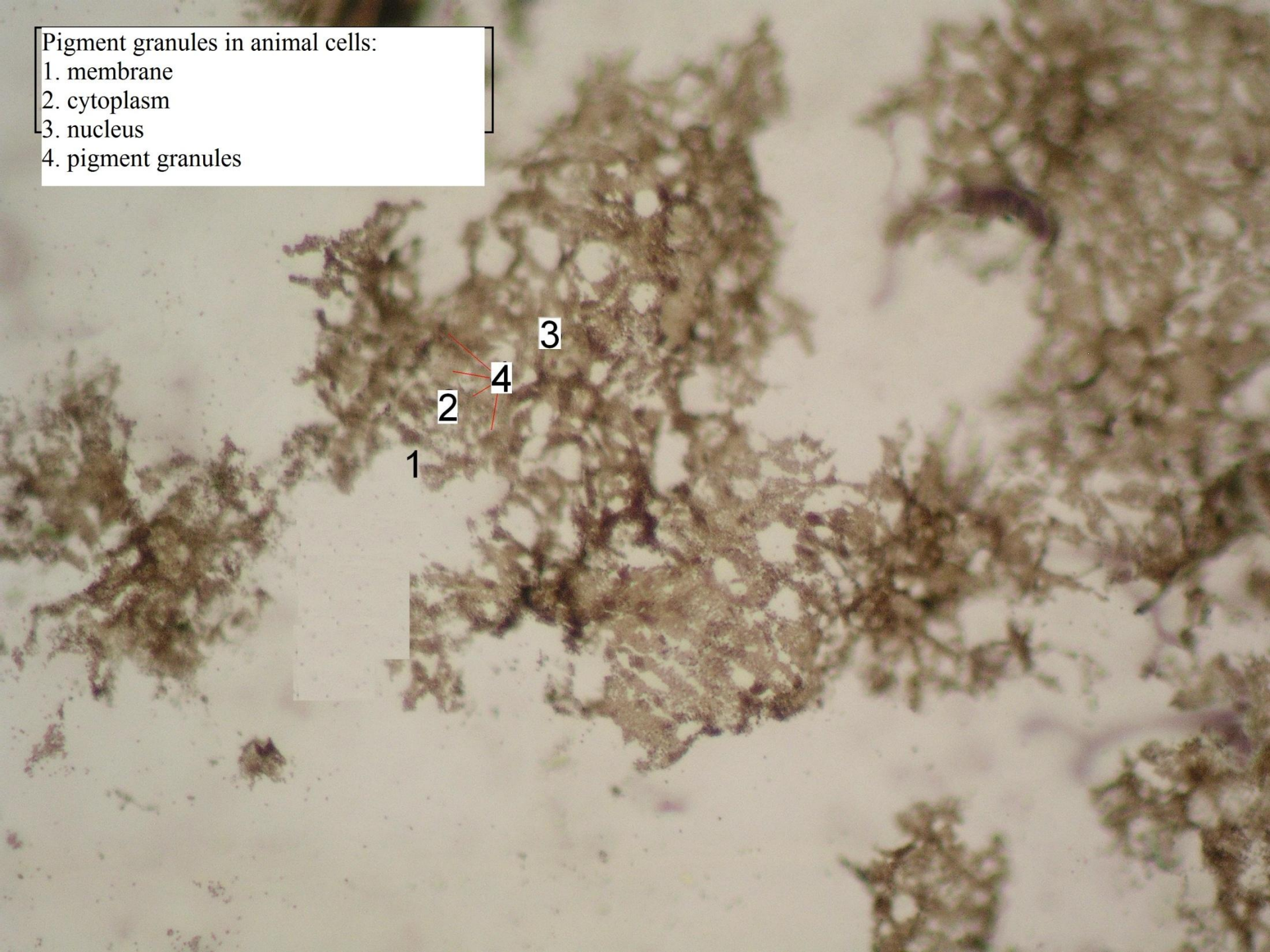

б
1
а
2




Drops of lipids
1. Cell membrane 2. Cytoplasm
3. Nucleus 3. Drops of lipids
1
2
3
4






Pigment granules in animal cells:
1. membrane
2. cytoplasm
3. nucleus
4. pigment granules
3
4
2
1

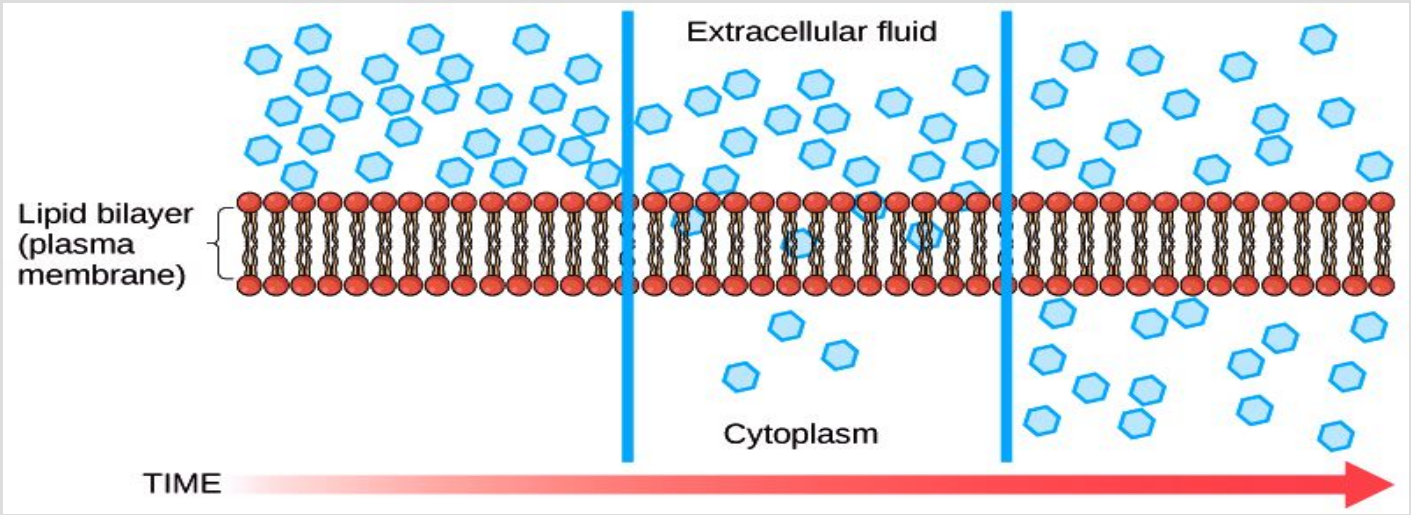
All 3 types are passive transport

- **Passive Transport**: movement of substances without any energy input by a cell.

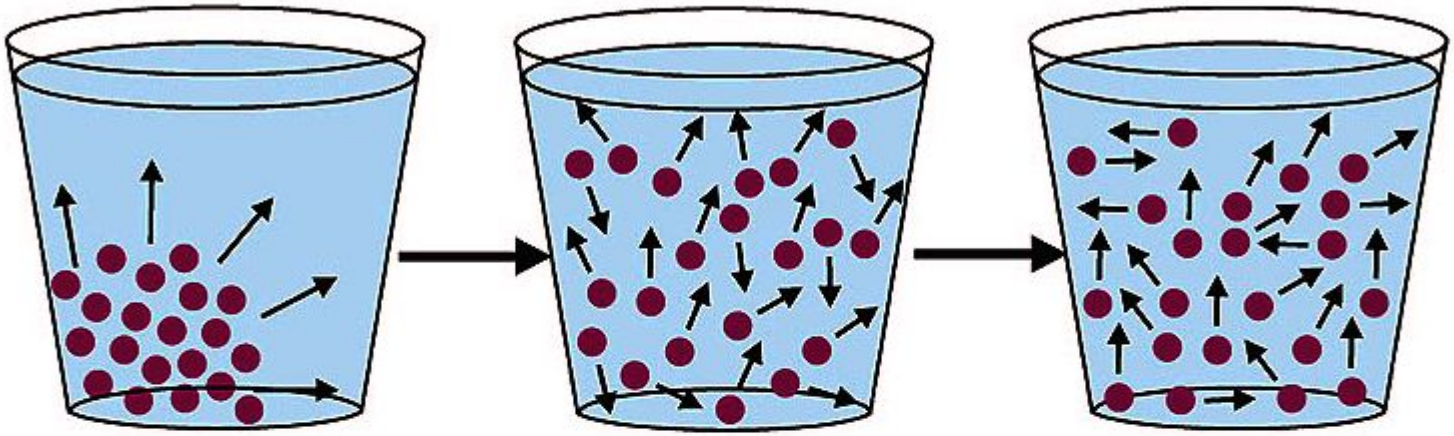
1. **Diffusion**: molecules move straight through the membrane.
2. **Facilitated diffusion**: molecules or ions move through channel proteins embedded in the membrane.
3. **Osmosis**: water molecules move through the membrane (mostly through protein channels).

Diffusion

Diffusion is a passive process of transport. A single substance tends to move from an area of high concentration to an area of low concentration until the concentration is equal across the space. You are familiar with diffusion of substances through the air. For example, think about someone opening a bottle of perfume in a room filled with people. The perfume is at its highest concentration in the bottle and is at its lowest at the edges of the room. The perfume vapor will diffuse, or spread away, from the bottle, and gradually, more and more people will smell the perfume as it spreads. Materials move within the cell's cytosol by diffusion, and certain materials move through the plasma membrane by diffusion. Diffusion expends no energy. Rather the different concentrations of materials in different areas are a form of potential energy, and diffusion is the dissipation of that potential energy as materials move down their concentration gradients, from high to low.



Diffusion



Molecular movement during diffusion. Although molecules move in every direction, the overall direction of movement is outward to areas of lower concentration. The colored circles in these figures represent molecules of dye.

concentrated, high energy molecules

[High] ⟶ [Low]

diffuse, low energy molecules

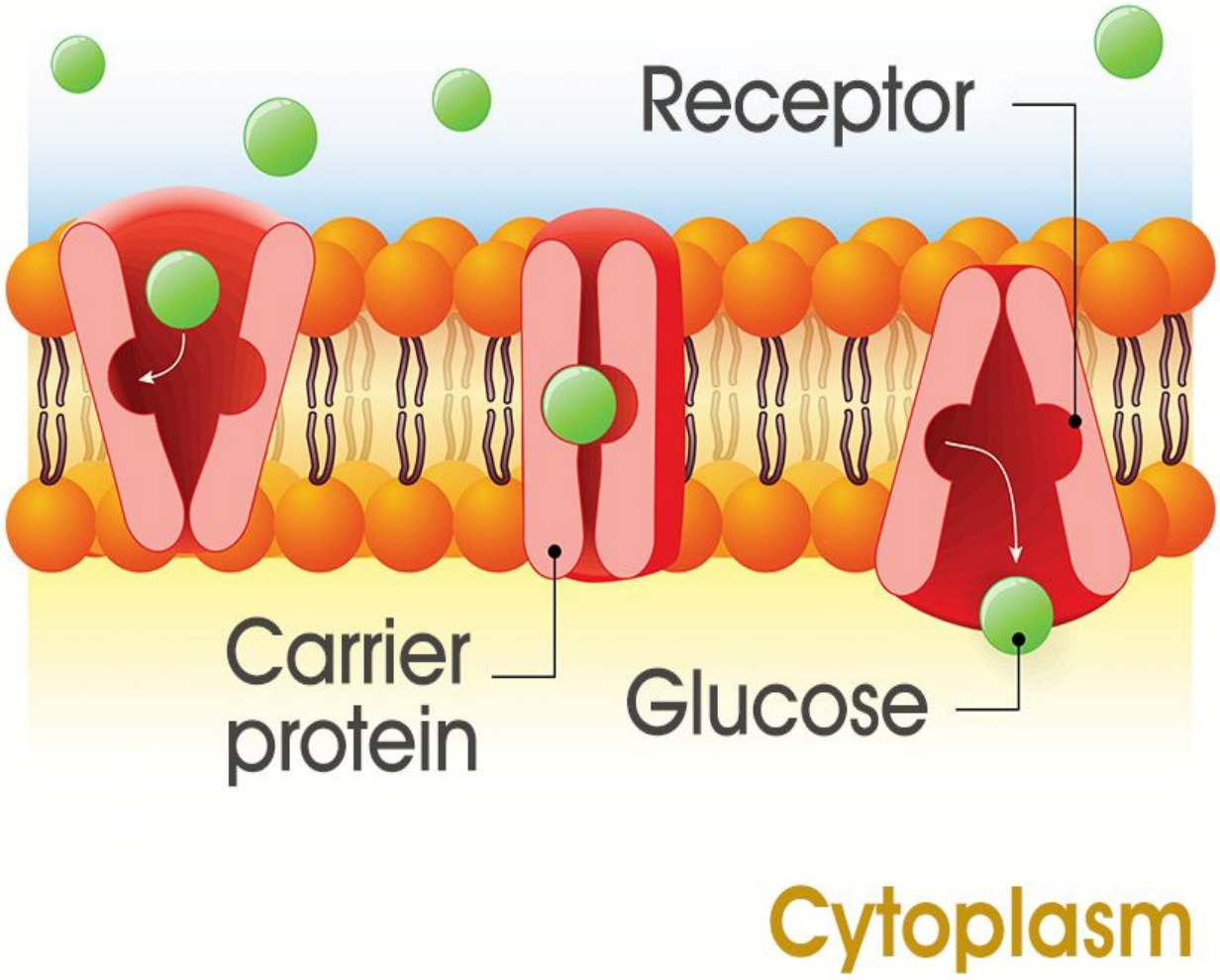
Several factors affect the rate of diffusion.

- Extent of the concentration gradient: The greater the difference in concentration, the more rapid the diffusion. The closer the distribution of the material gets to equilibrium, the slower the rate of diffusion becomes.
- Mass of the molecules diffusing: More massive molecules move more slowly, because it is more difficult for them to move between the molecules of the substance they are moving through; therefore, they diffuse more slowly.
- Temperature: Higher temperatures increase the energy and therefore the movement of the molecules, increasing the rate of diffusion.
- Solvent density: As the density of the solvent increases, the rate of diffusion decreases. The molecules slow down because they have a more difficult time getting through the denser medium.

Facilitated transport

In *facilitated transport*, also called **facilitated diffusion**, material moves across the plasma membrane with the assistance of transmembrane proteins down a concentration gradient (from high to low concentration) without the expenditure of cellular energy. However, the substances that undergo facilitated transport would otherwise not diffuse easily or quickly across the plasma membrane. The solution to moving polar substances and other substances across the plasma membrane rests in the proteins that span its surface. The material being transported is first attached to protein or glycoprotein receptors on the exterior surface of the plasma membrane. This allows the material that is needed by the cell to be removed from the extracellular fluid. The substances are then passed to specific integral proteins that facilitate their passage, because they form channels or pores that allow certain substances to pass through the membrane. The integral proteins involved in facilitated transport are collectively referred to as transport proteins, and they function as either channels for the material or carriers.

Facilitated diffusion—the process that allows selective movement in and out of the **cell membrane**.



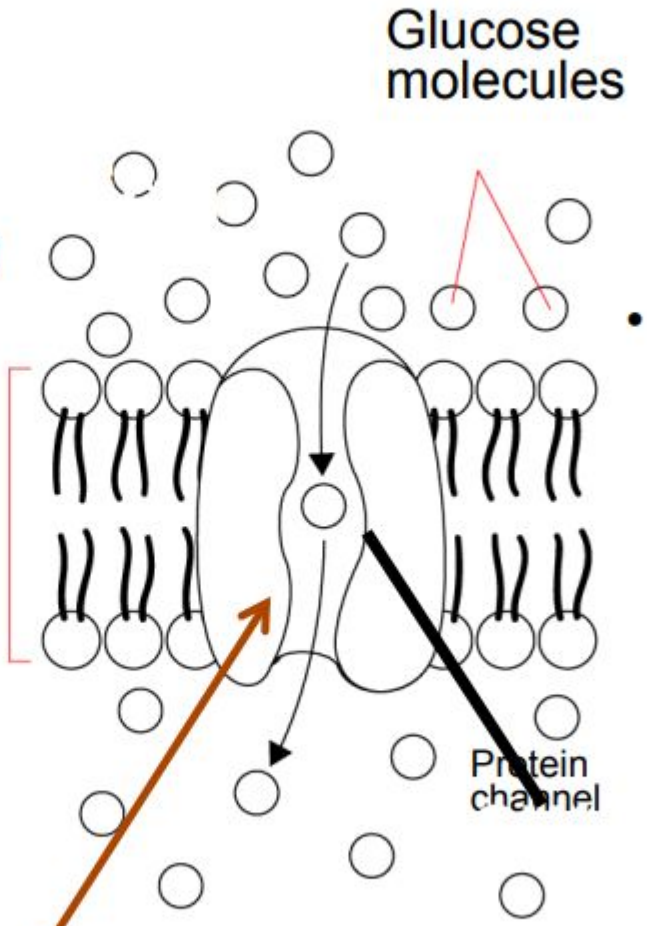
Passive Transport: 2. Facilitated Diffusion

Cellular Transport From a-

High Concentration

Cell Membrane

Low Concentration

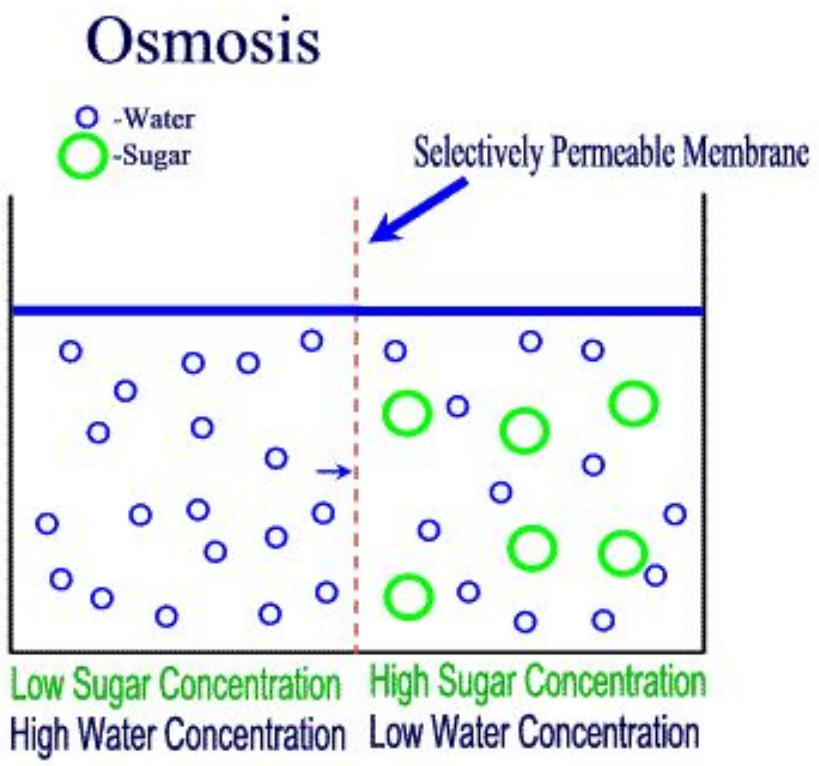


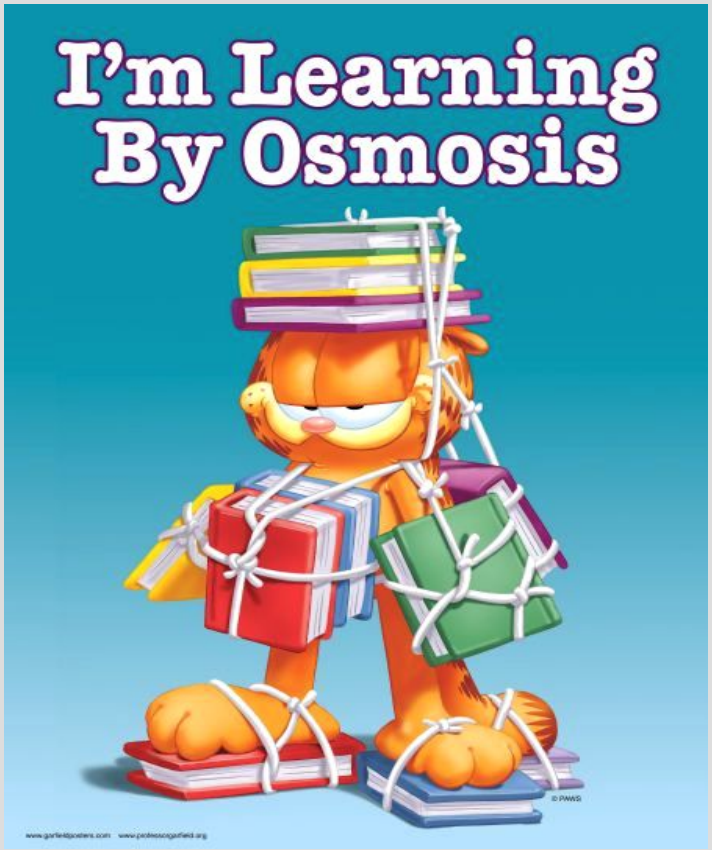
- Channel Proteins animations

Through a → Transport Protein

Osmosis

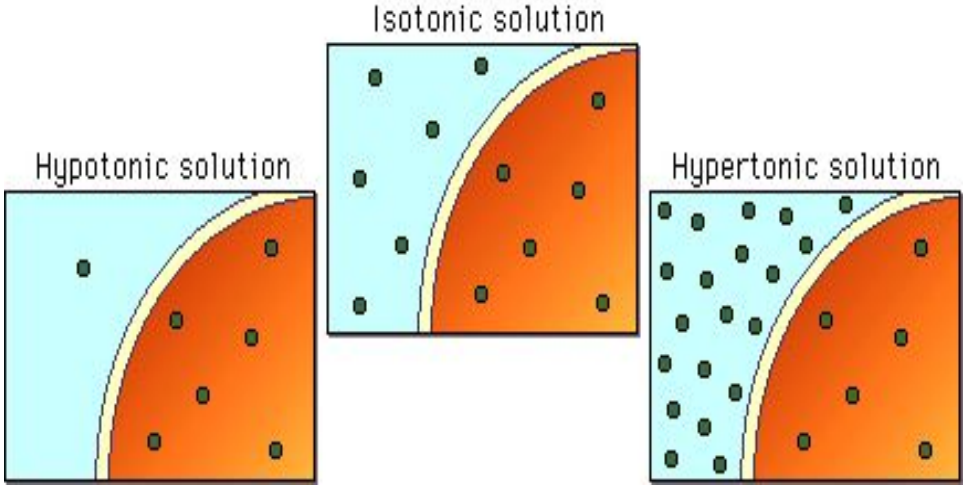
Osmosis is the diffusion of water through a semipermeable membrane according to the concentration gradient of water across the membrane. Whereas diffusion transports material across membranes and within cells, osmosis transports only water across a membrane and the membrane limits the diffusion of solutes in the water. Osmosis is a special case of diffusion. Water, like other substances, moves from an area of higher concentration to one of lower concentration.





Solution Differences & Cells

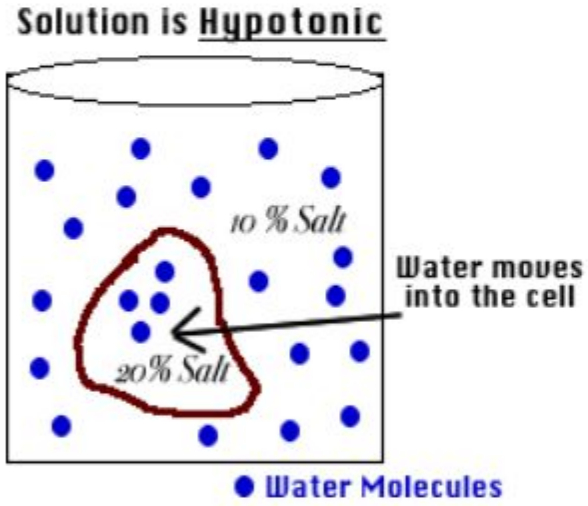
- solvent + solute = solution
- Hypotonic
  - Solutes in cell more than outside
  - Outside solvent will flow into cell
- Isotonic
  - Solutes equal inside & out of cell
- Hypertonic
  - Solutes greater outside cell
  - Fluid will flow out of cell

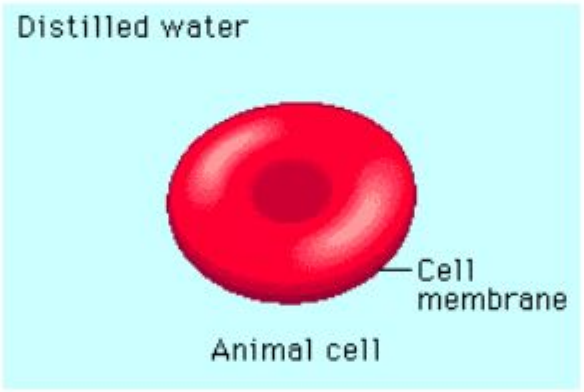


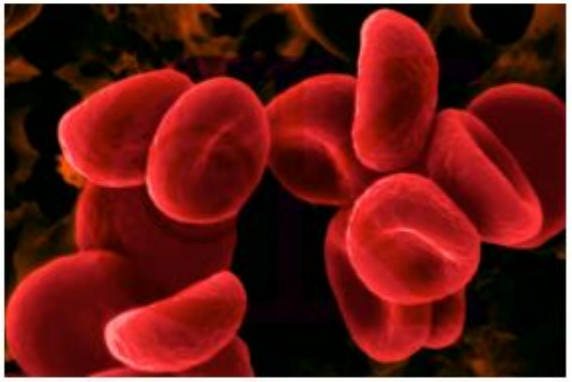
- Osmosis Animations for isotonic, hypertonic, and hypotonic solutions

Hypotonic Solution

Hypotonic: The solution has a lower concentration of solutes and a higher concentration of water than inside the cell. **(Low solute; High water)**





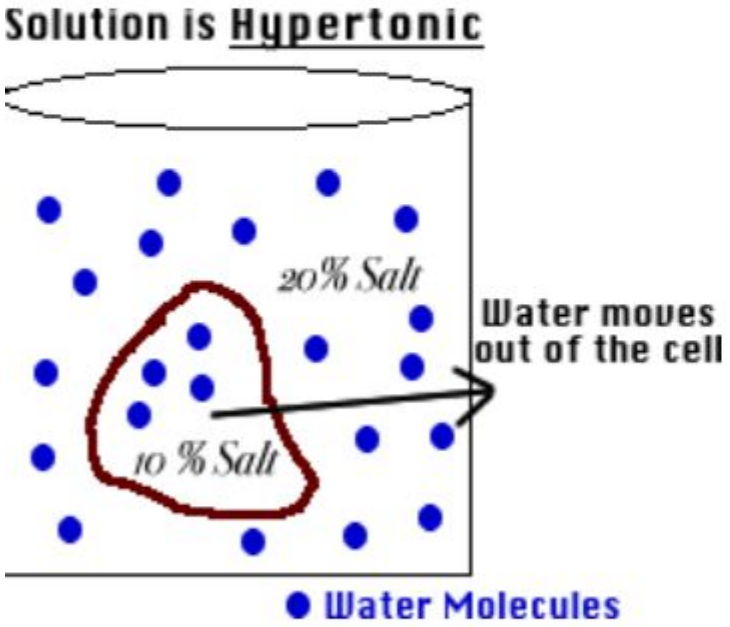


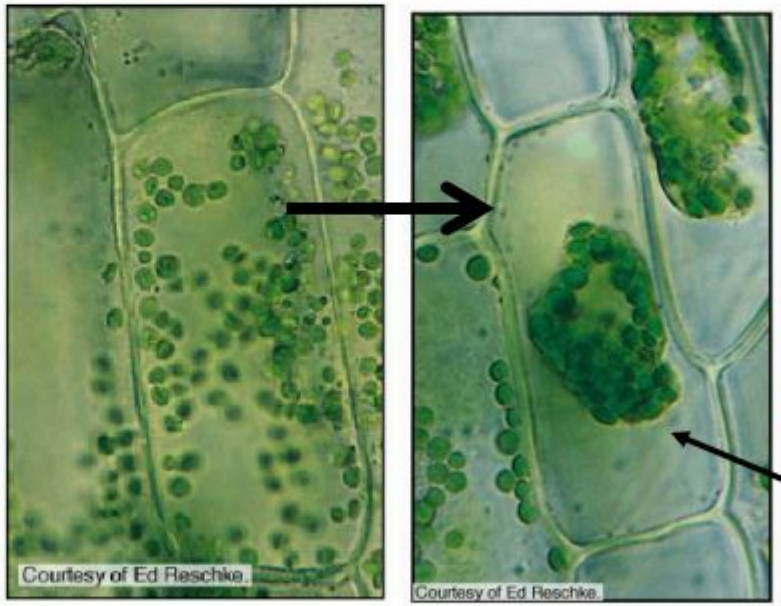
Result: Water moves from the solution to inside the cell): Cell Swells and bursts open (*cytolysis*)!

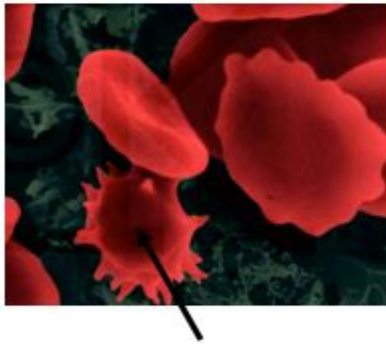
- Osmosis Animations for isotonic, hypertonic, and hypotonic solutions

Hypertonic Solution

Hypertonic: The solution has a higher concentration of solutes and a lower concentration of water than inside the cell. **(High solute; Low water)**







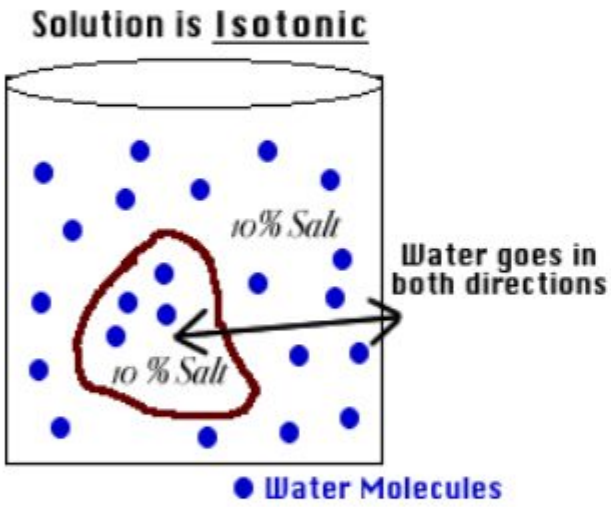
shrinks

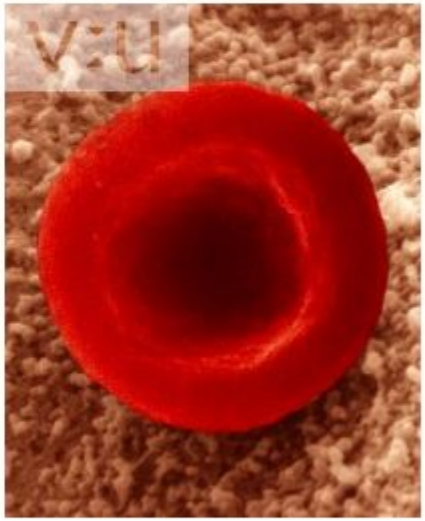
Result: Water moves from inside the cell into the solution: Cell shrinks (*Plasmolysis*)!

- Osmosis Animations for isotonic, hypertonic, and hypotonic solutions

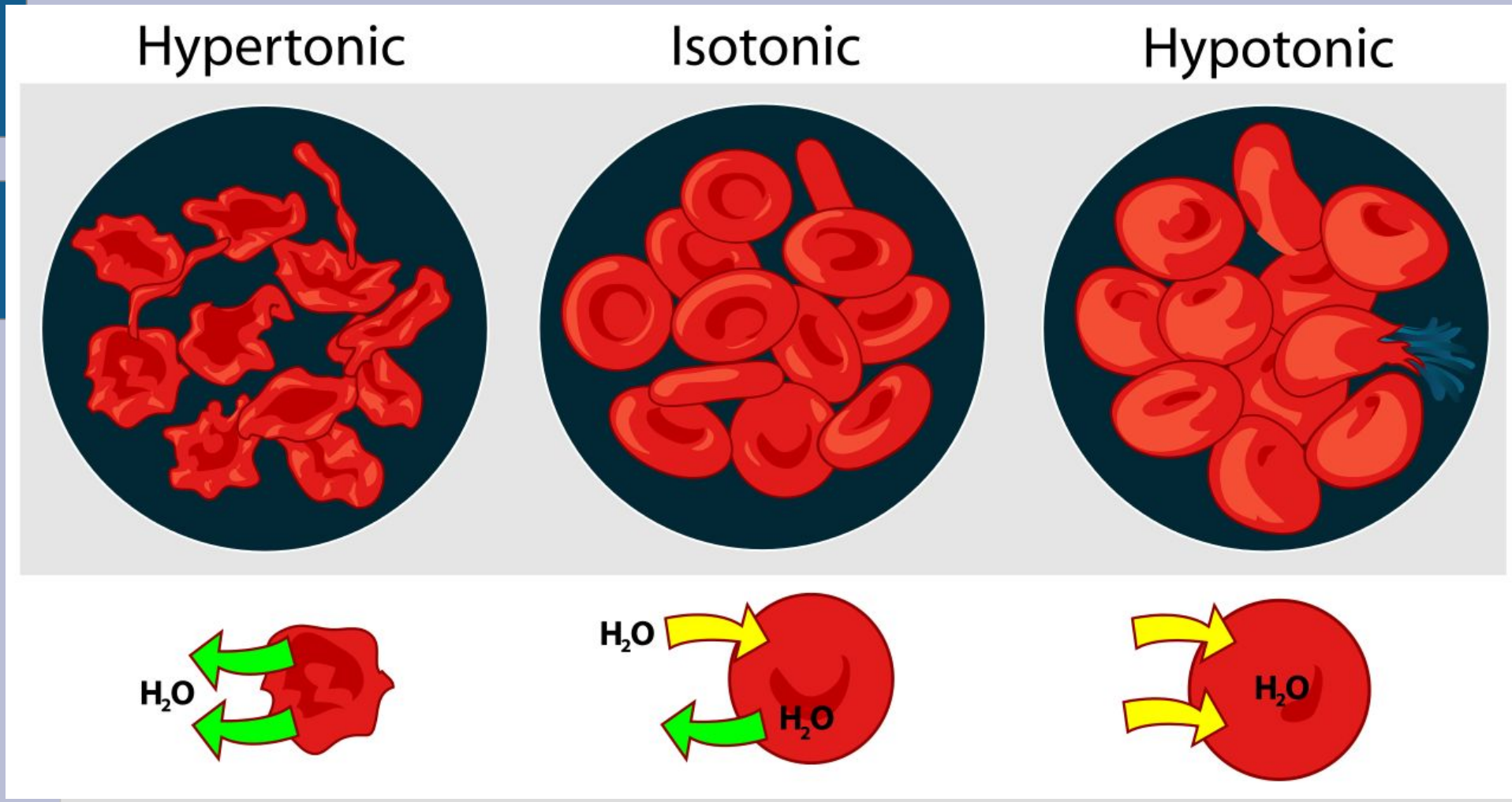
Isotonic Solution

Isotonic: The concentration of solutes in the solution is equal to the concentration of solutes inside the cell.



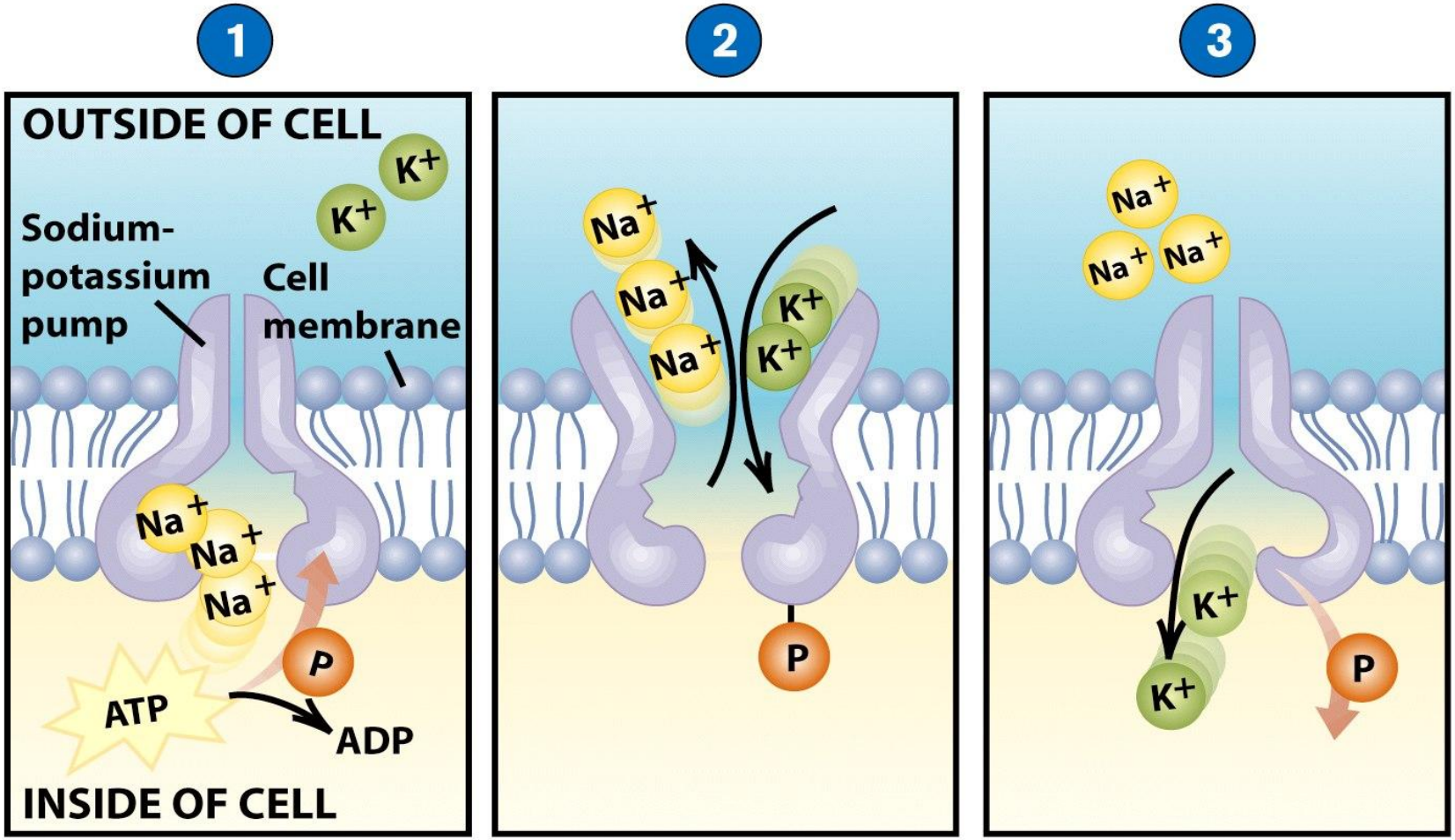


Result: Water moves equally in both directions and the cell remains same size! (Dynamic Equilibrium)


Hypertonic
Isotonic
Hypotonic
H_2O
H_2O
H_2O
H_2O

Active Transport

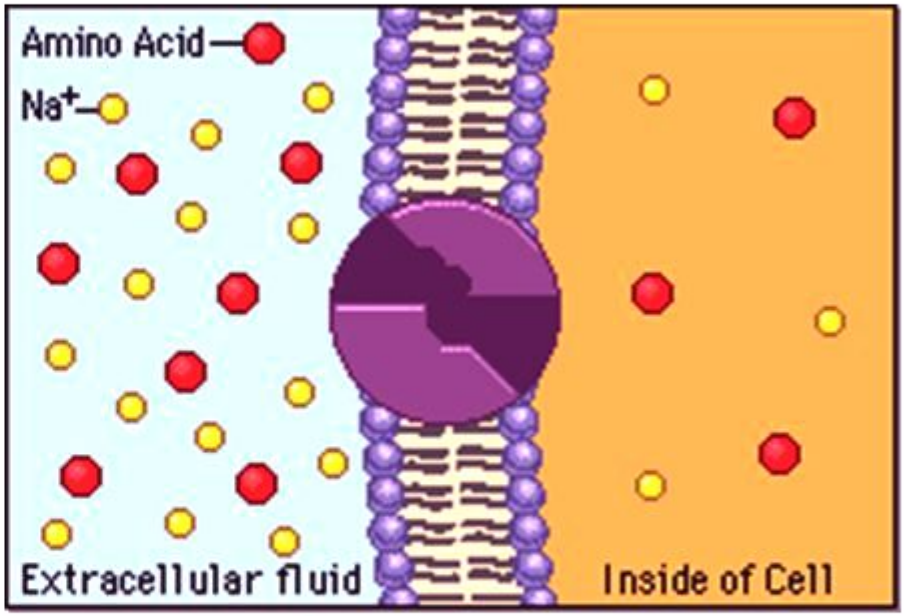
- Molecular movement
- Requires energy (against gradient)
- Example is sodium-potassium pump



Types of Active Transport

1. Protein Pumps - transport proteins that require energy to do work

- **Example: Sodium / Potassium Pumps are important in nerve responses.**



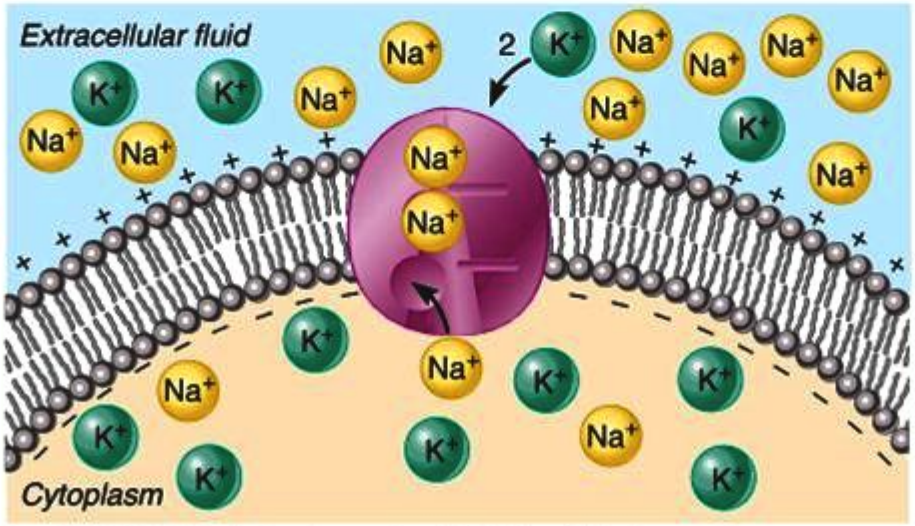
Protein changes shape to move molecules: this requires energy!

ACTIVE TRANSPORT- PUMPS

Pump- a special type of carrier protein that is used to push molecules from lower to higher concentration

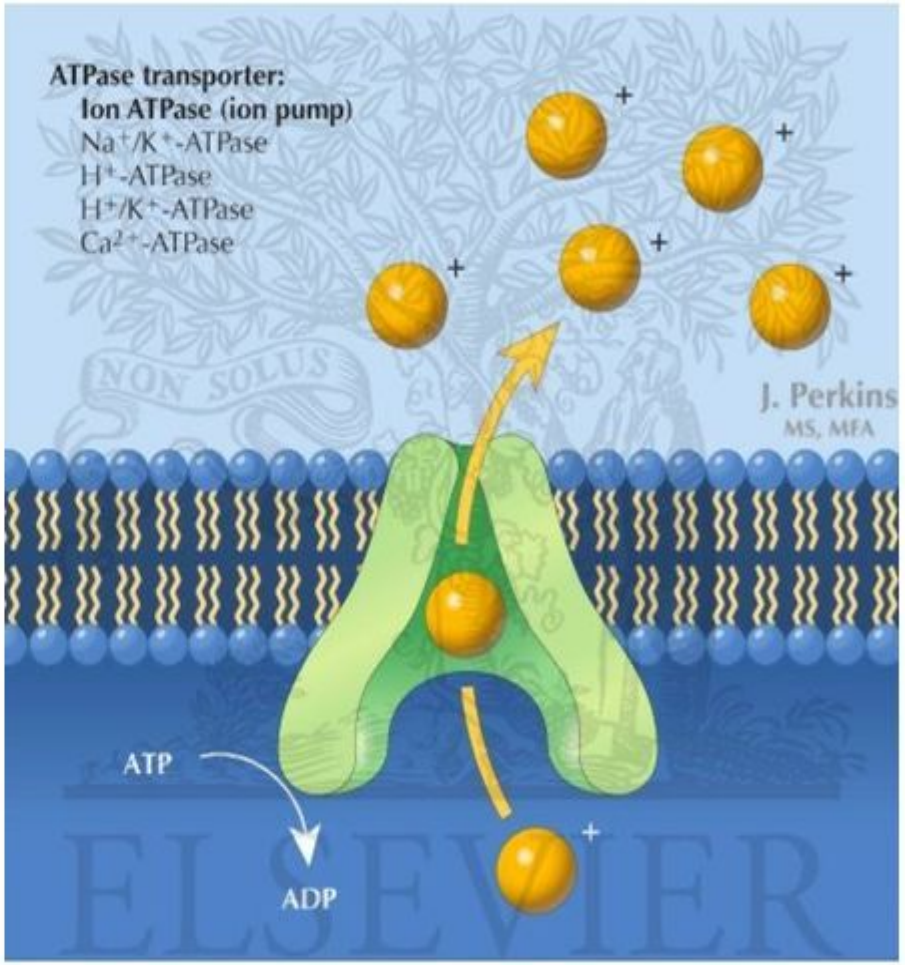
Ex. Sodium (Na^+) and Potassium (K^+) pumps

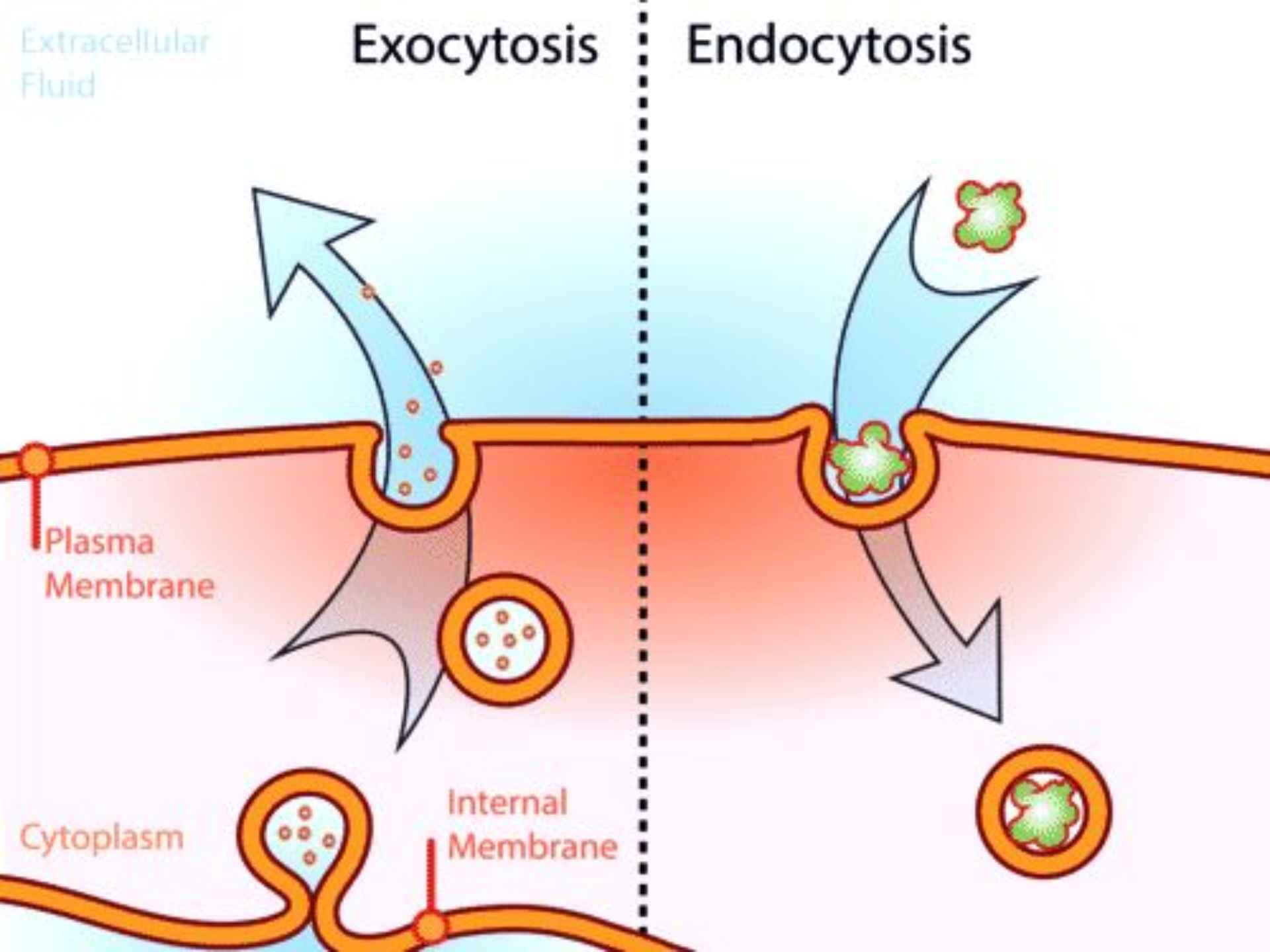
- Energy is **required** for pumps
- The carrier will take three Na^+ ions out of the cell and pick up two K^+ to pump into the cell.
- This unequal exchange of ions creates a **charge** on the cell. The cell uses this charge to send signals to other cells.



Types of Pumps

- Na+/K+ pump
- H+ pump
- H+/K+ pump
- Ca++ pump



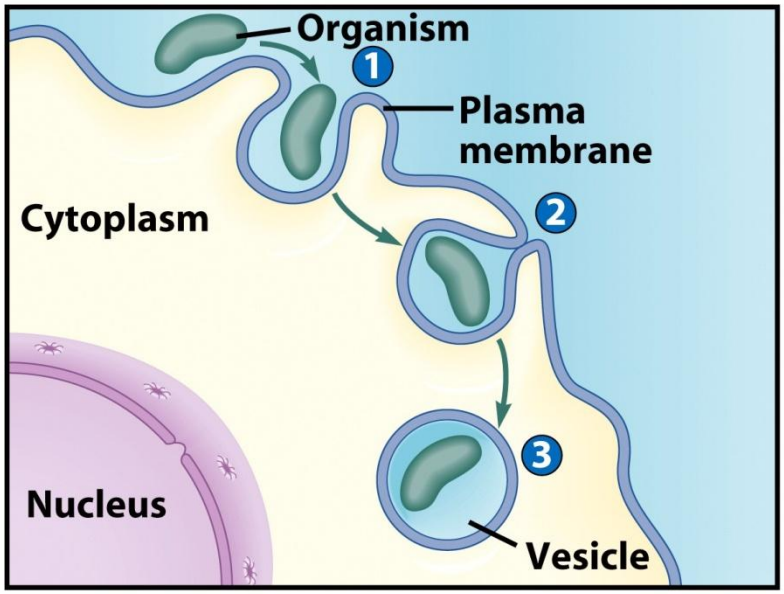

Extracellular Fluid
Exocytosis
Endocytosis
Plasma Membrane
Cytoplasm
Internal Membrane

Endocytosis

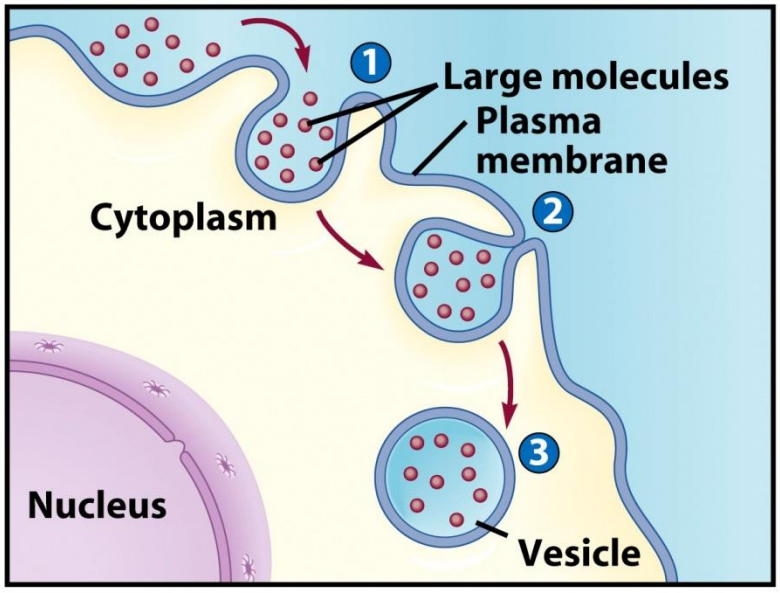
- Movement of large material
  - Particles
  - Organisms
  - Large molecules
- Movement is into cells
- Types of endocytosis
  - bulk-phase (nonspecific)
  - receptor-mediated (specific)

Process of Endocytosis

- Plasma membrane surrounds material
- Edges of membrane meet
- Membranes fuse to form vesicle



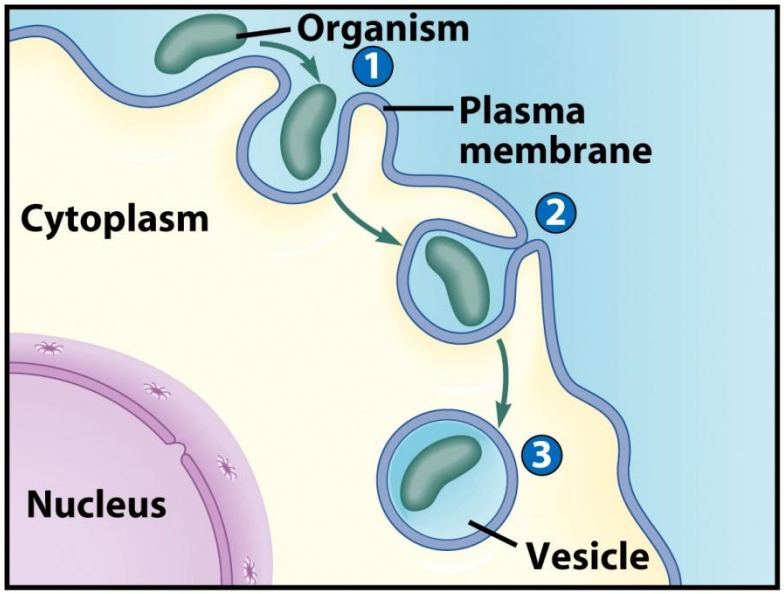
PHAGOCYTOSIS



PINOCYTOSIS

Forms of Endocytosis

- Phagocytosis – cell eating
- Pinocytosis – cell drinking



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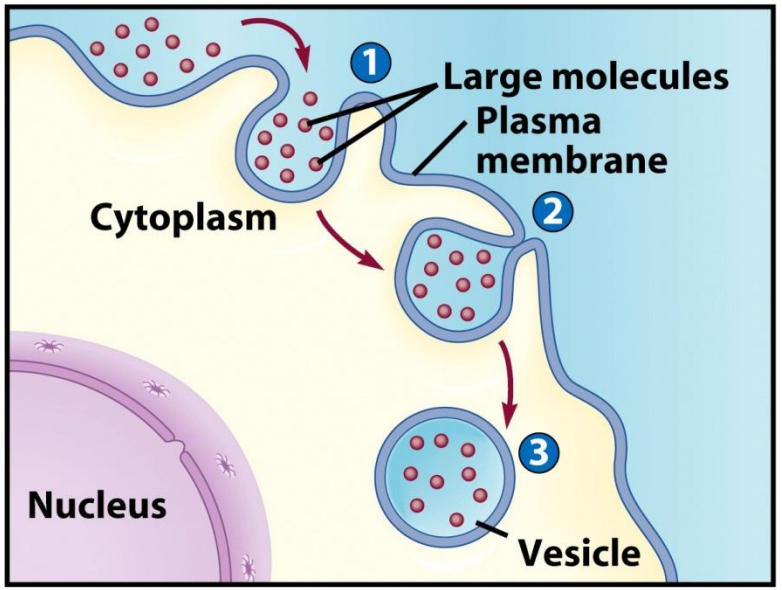
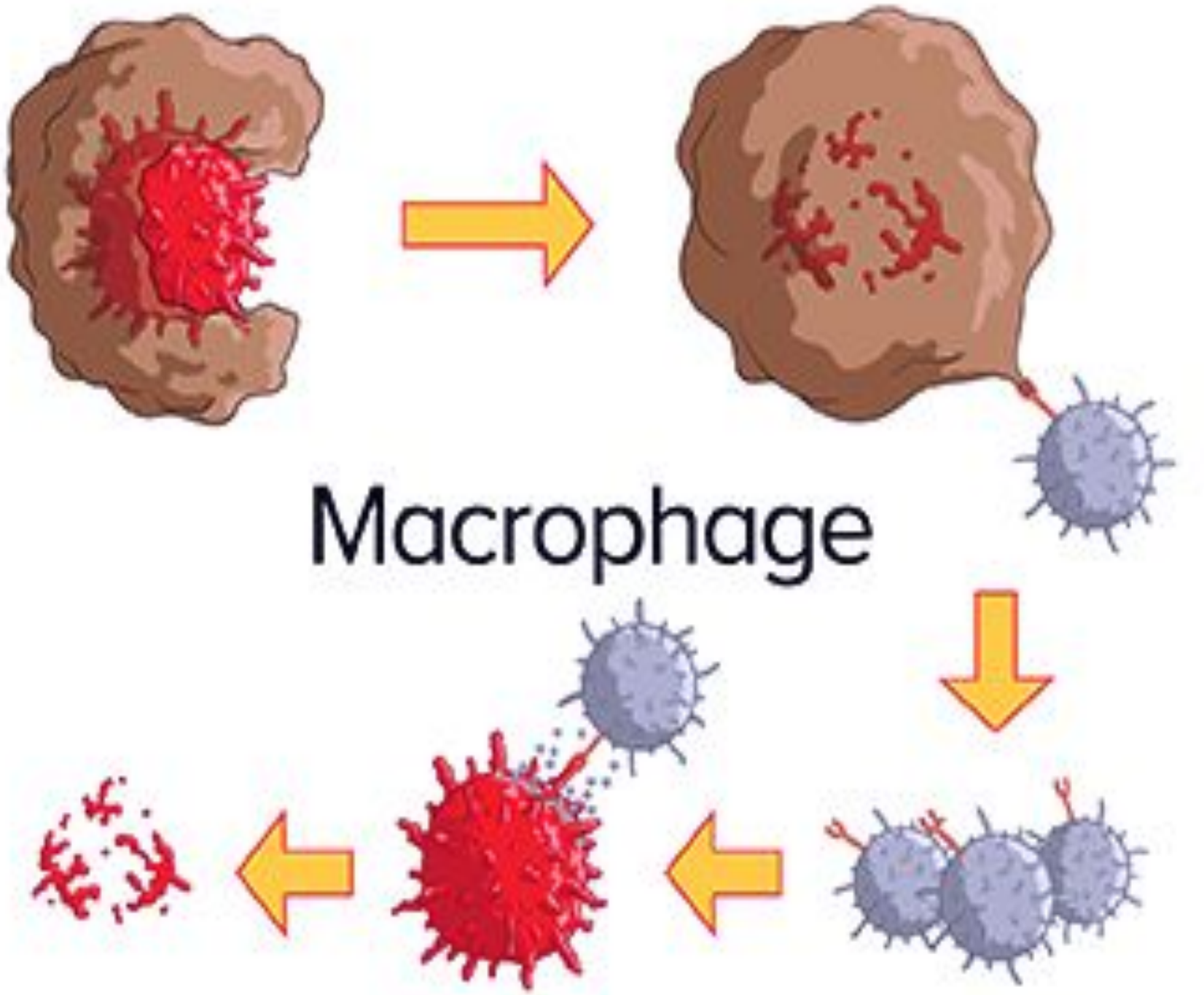
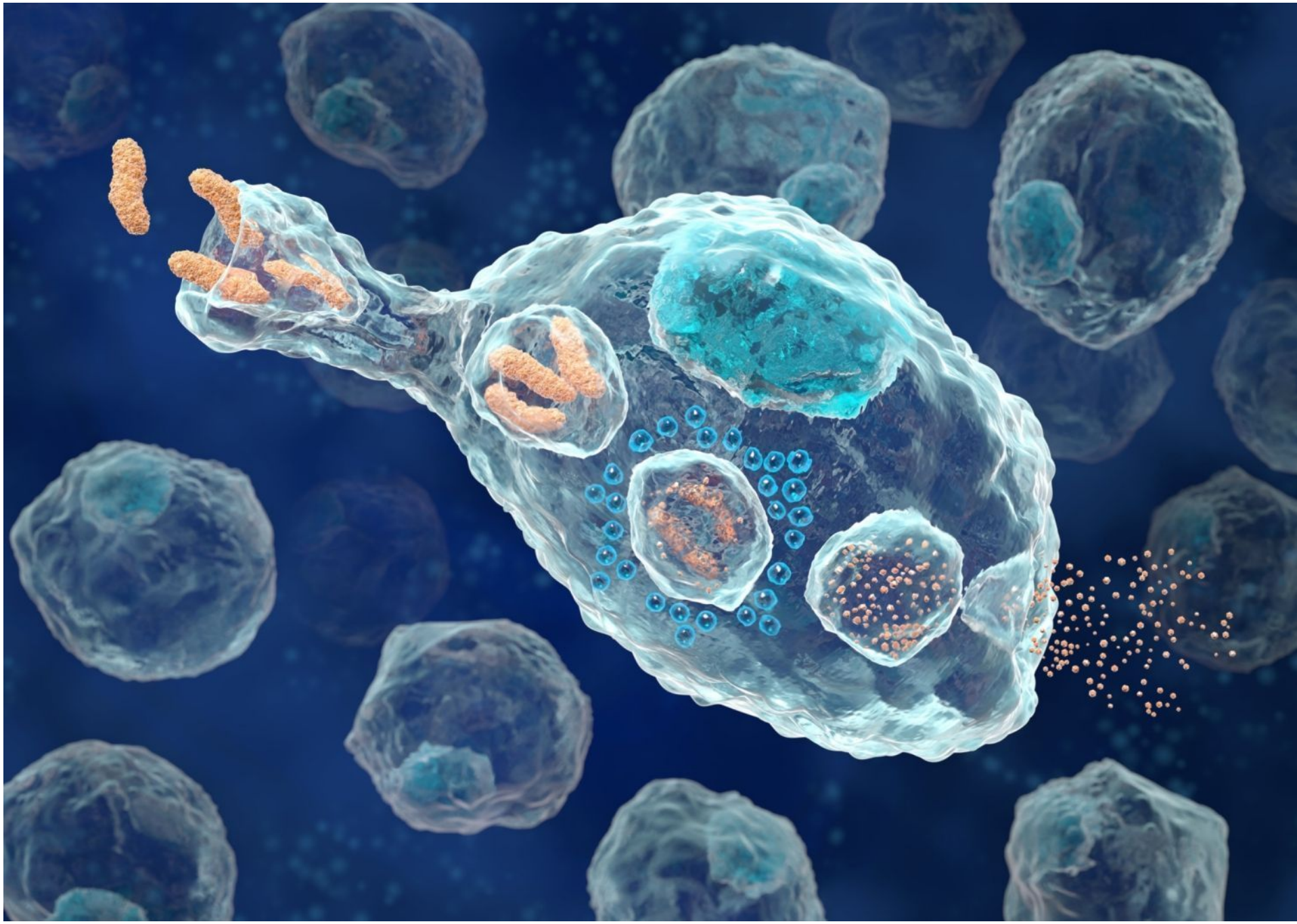
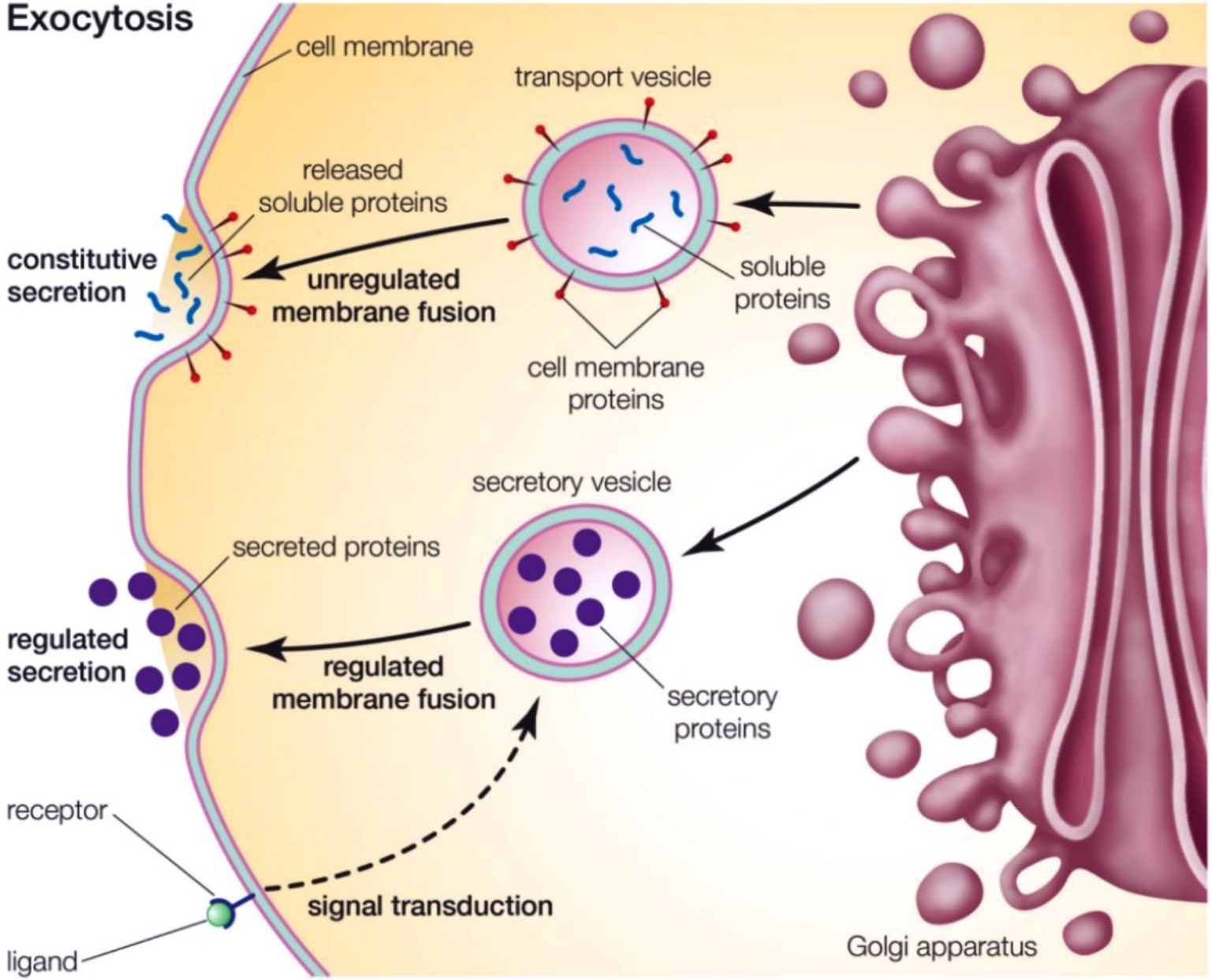


PINOCYTOSIS


Macrophage




Exocytosis
cell membrane
transport vesicle
released
soluble proteins
constitutive
secretion
unregulated
membrane fusion
soluble
proteins
cell membrane
proteins
secretory vesicle
secreted proteins
regulated
secretion
regulated
membrane fusion
secretory
proteins
receptor
signal transduction
ligand
Golgi apparatus


THANK YOU
THANK YOU
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