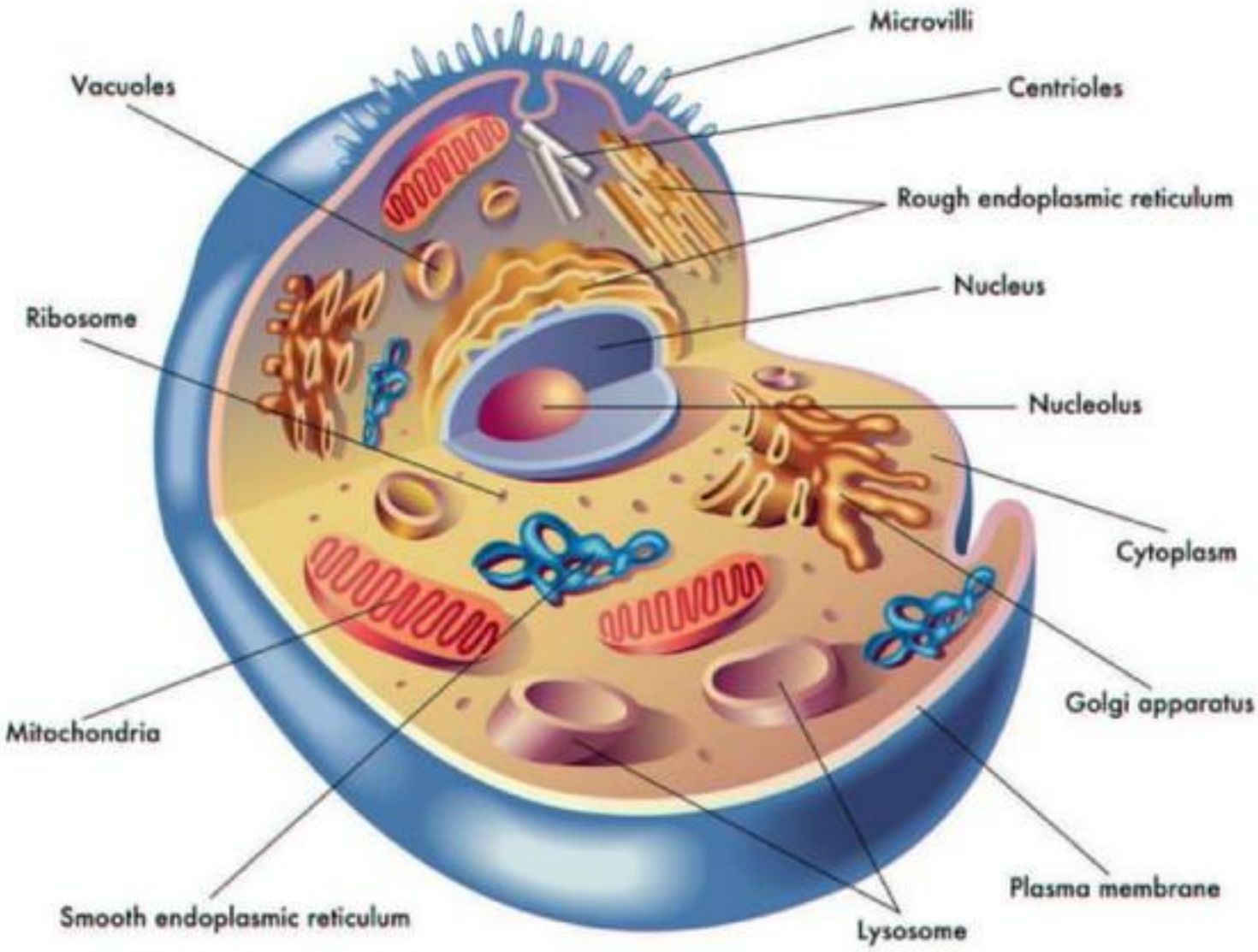

Microvilli
Vacuoles
Centrioles
Rough endoplasmic reticulum
Nucleus
Ribosome
Nucleolus
Cytoplasm
Golgi apparatus
Mitochondria
Plasma membrane
Smooth endoplasmic reticulum
Lysosome

1. The cell (from the Latin word cellula meaning 'small room') is the basic structural and functional unit of life forms.
2. Every cell consists of a cytoplasm enclosed within a membrane, which contains many biomolecules such as proteins and nucleic acids.

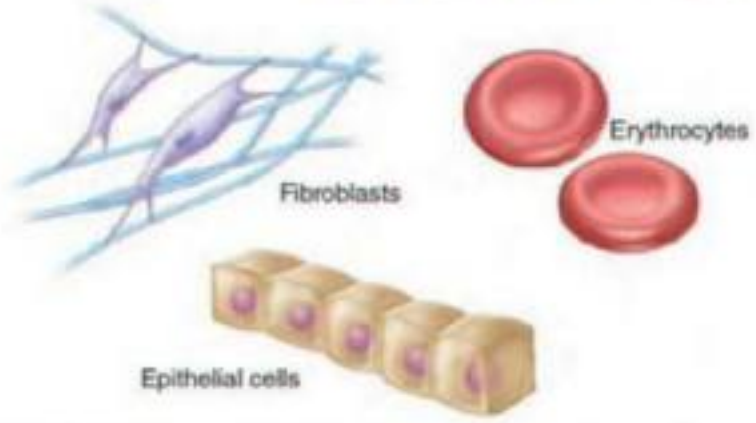
1. Initially discovered by **Robert Hooke** in **1665**, the cell has a rich and interesting history that has ultimately given way to many of today's scientific

1. 2.The first cell is thought to have arisen by the enclosure of self-replicating RNA and associated molecules in a membrane composed of phospholipids. Each phospholipid molecule has two long hydrophobic

1. Cells are composed of water, inorganic ions, and carbon-containing (organic) molecules.
2. Water is the most abundant molecule in cells, accounting for 70% or more of total cell mass. Consequently, the interactions between water and the other constituents of cells are of central importance in biological chemistry.

- **Cells** are the structural units of all living things.
- All cells arise from existing cells by the process of **cell division,** in which one cell divides into two identical cells.
- The English scientist **Robert Hooke first** observed plant cells with a crude microscope in the late 1600s.
- Then, in the 1830s two German scientists, **Matthias Schleiden and Theodor Schwann, proposed that all living things are composed of cells.**

Cell diversity

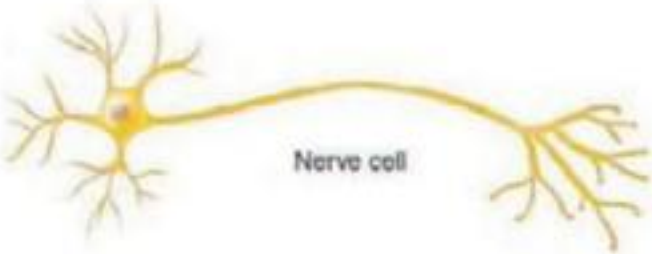


(a) Cells that connect body parts, form linings, or transport gases

(b) Cells that move organs and body parts

(c) Cell that stores nutrients

(d) Cell that fights disease



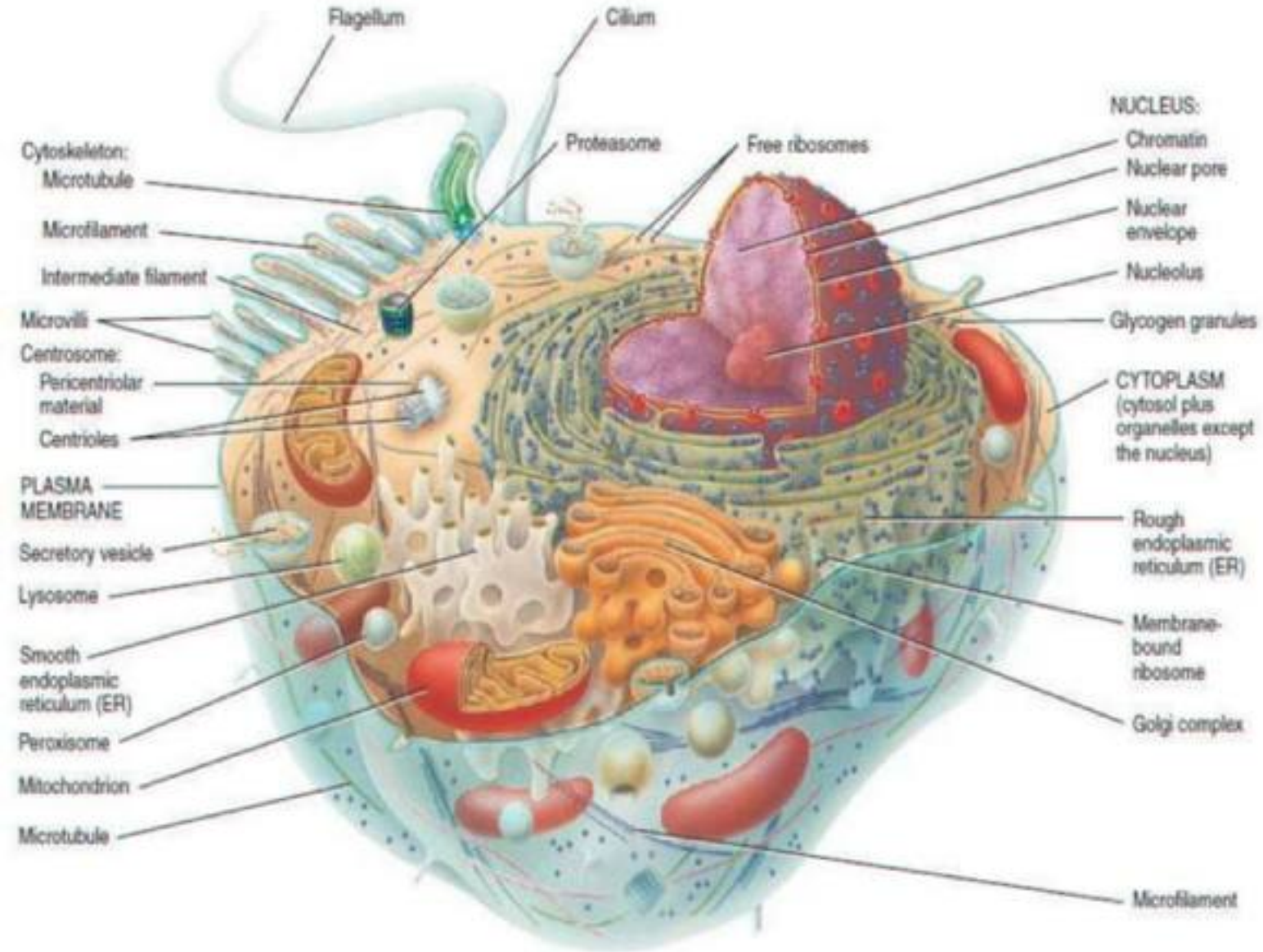
(e) Cell that gathers information and controls body functions

(f) Cell of reproduction

PARTS OF A CELL

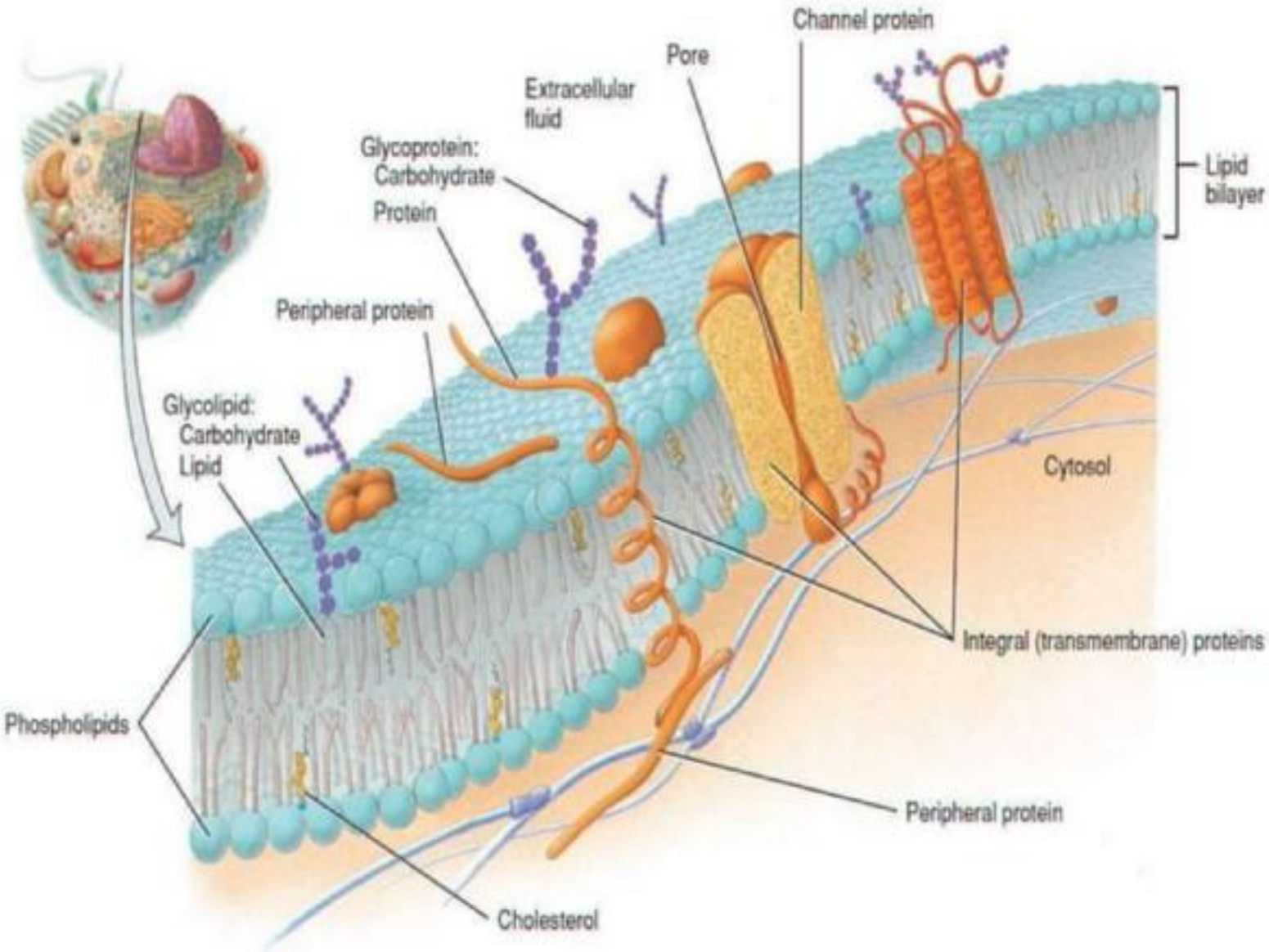
A human cell has three main parts:

- **The plasma membrane:** the outer boundary of the cell.
- **The cytoplasm**: the intracellular fluid packed with organelles, small structures that perform specific cell functions.
- **The nucleus:** an organelle that controls cellular activities. The nucleus lies near the cell's center.


Flagellum
Cilium
NUCLEUS:
Chromatin
Nuclear pore
Nuclear envelope
Nucleolus
Glycogen granules
Cytoskeleton:
Microtubule
Microfilament
Intermediate filament
Microvilli
Centrosome:
Pericentriolar material
Centrioles
Proteasome
Free ribosomes
CYTOPLASM (cytosol plus organelles except the nucleus)
PLASMA MEMBRANE
Secretory vesicle
Lysosome
Smooth endoplasmic reticulum (ER)
Peroxisome
Mitochondrion
Microtubule
Rough endoplasmic reticulum (ER)
Membrane-bound ribosome
Golgi complex
Microfilament

A. THE PLASMA MEMBRANE

- The **plasma membrane** defines the extent of a cell, thereby separating two of the Body major fluid compartments the *intracellular* fluid within cells and the *extracellular* fluid (ECF) outside cells. The plasma membrane encloses cell contents, mediates exchanges with the extracellular environment, and plays a role in cellular communication.


Channel protein
Pore
Extracellular fluid
Glycoprotein:
Carbohydrate
Protein
Lipid bilayer
Peripheral protein
Glycolipid:
Carbohydrate
Lipid
Cytosol
Integral (transmembrane) proteins
Phospholipids
Peripheral protein
Cholesterol

Structure

The Fluid Mosaic Model

- The **fluid mosaic model** of membrane structure depicts the plasma membrane as an exceedingly thin (7–10 nm) structure composed of a double layer of lipid molecules with protein molecules dispersed in it.
- The proteins which float in the fluid *lipid bilayer*, form a constantly changing mosaic pattern.

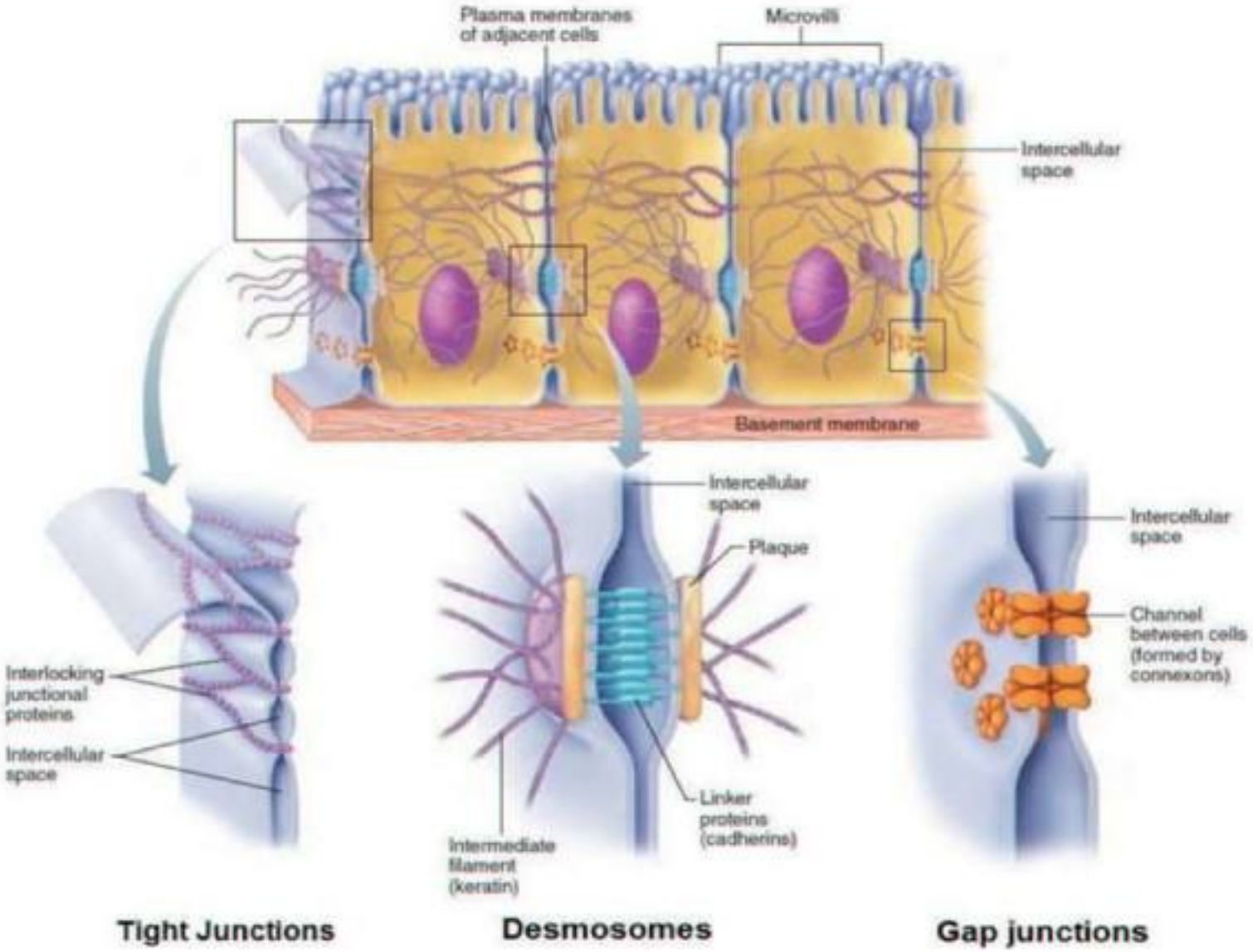
The Glycocalyx

- Plasma membrane contains a carbohydrate rich area at the cell surface called glycocalyx.

Cell junctions.

- An epithelial cell is shown joined to adjacent cells by three common types of cell junctions.

1. **Tight Junctions:** Impermeable junctions prevent molecules from passing through the intercellular space.
2. **Desmosomes:** Anchoring junctions bind adjacent cells together like a molecular "Velcro" and help form an internal tension reducing network of fibers.
3. **Gap junctions:** Communicating junctions allow ions and small molecules to pass for intercellular communication


Plasma membranes of adjacent cells
Microvilli
Intercellular space
Basement membrane
Interlocking junctional proteins
Intercellular space
Intercellular space
Plaque
Linker proteins (cadherins)
Intermediate filament (keratin)
Intercellular space
Channel between cells (formed by connexons)
Tight Junctions
Desmosomes
Gap junctions

B. THE CYTOPLASM

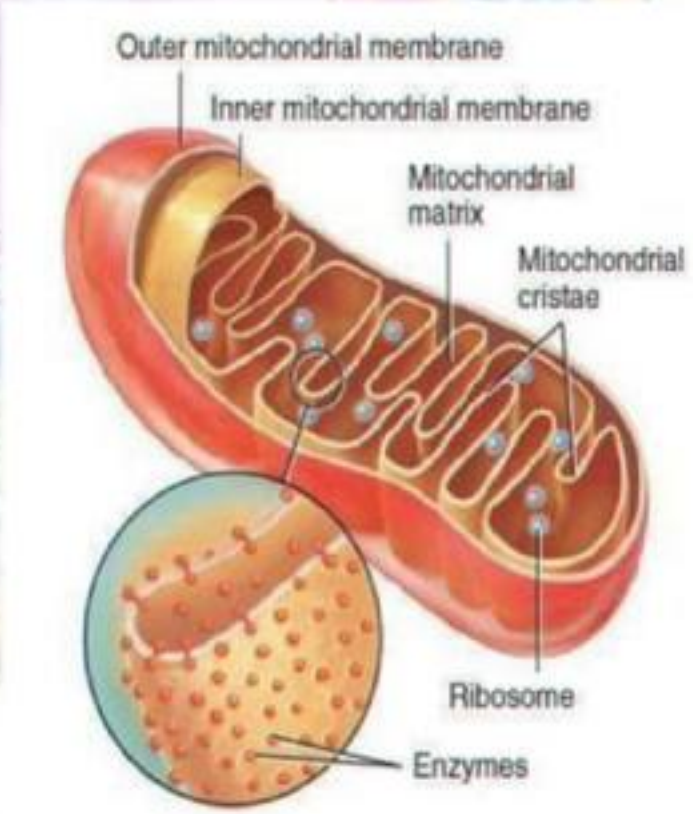
The cellular material between the plasma membrane and the nucleus, is the site of most cellular activities. It consists of three elements:

- The cytosol
- Organelles
- Inclusions.

1. **The cytosol:** it is the viscous, semitransparent fluid in which the other cytoplasmic elements are suspended.
2. **The organelles** are the metabolic machinery of the cell. Each type of organelle carries out a specific function for the cell.
3. **The inclusions** are chemical substances that may or may not be present, depending on cell type.

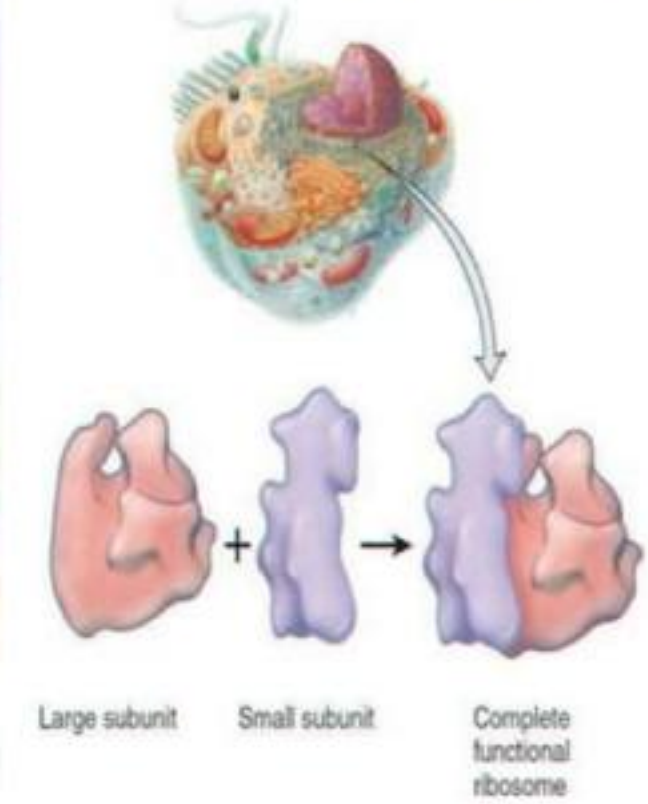
Mitochondria

- Rodlike, double-membrane structures; inner membrane folded into projections called cristae.
- Site of ATP synthesis; powerhouse of the cell.



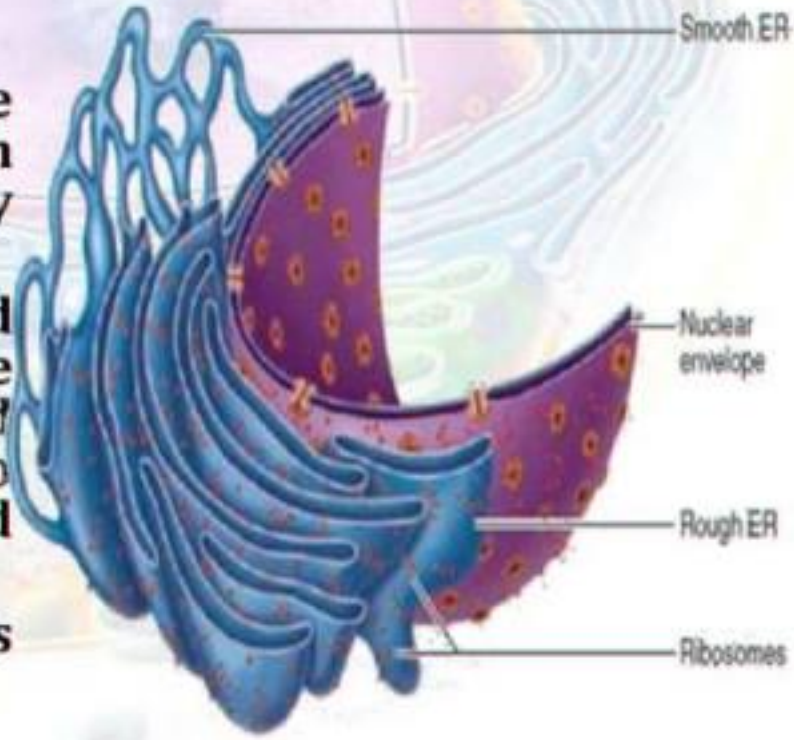
Ribosomes

- Dense particles consisting of two subunits, each composed of ribosomal RNA and protein. Free or attached to rough endoplasmic reticulum.
- The sites of protein synthesis.



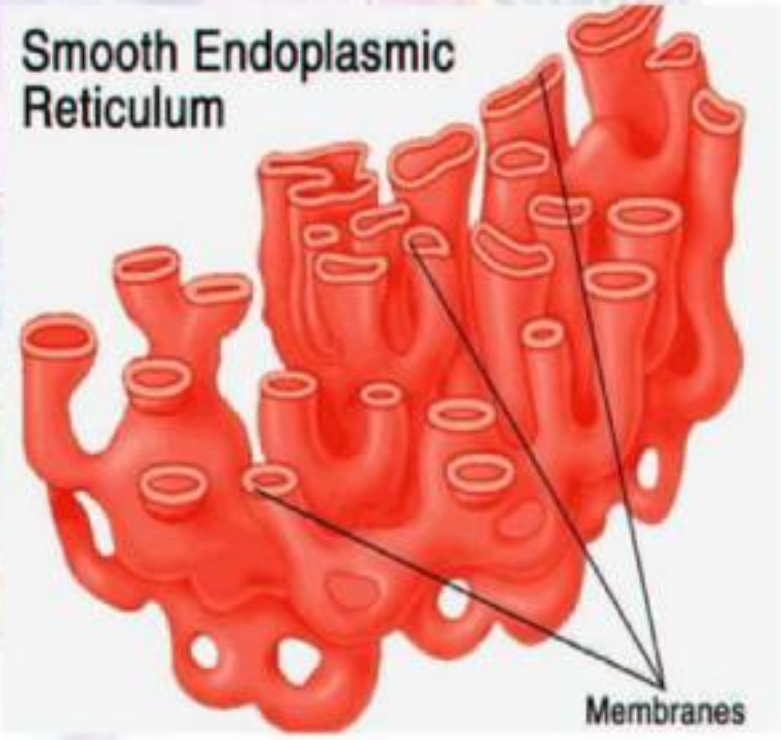
Rough endoplasmic reticulum

- Membranous system enclosing a cavity, the cistern, and coiling through the cytoplasm. Externally studded with ribosomes.
- Sugar groups are attached to proteins within the cisterns. Proteins are bound in vesicles for transport to the Golgi apparatus and other sites.
- External face synthesizes phospholipids.



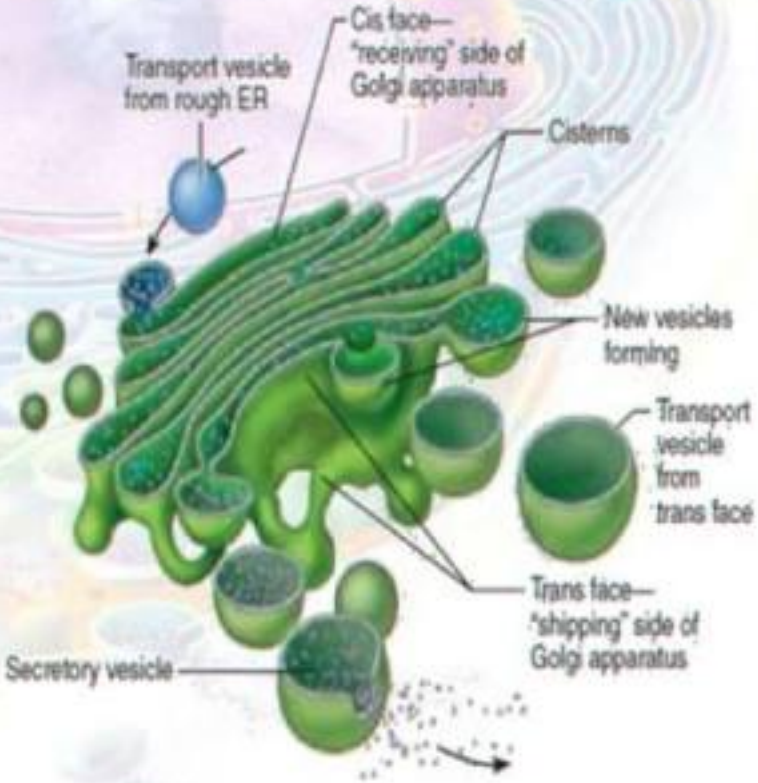
Smooth endoplasmic reticulum

- Membranous system of sacs and tubules; free of ribosomes.
- Site of lipid and steroid (cholesterol) synthesis, lipid metabolism, and drug detoxification.



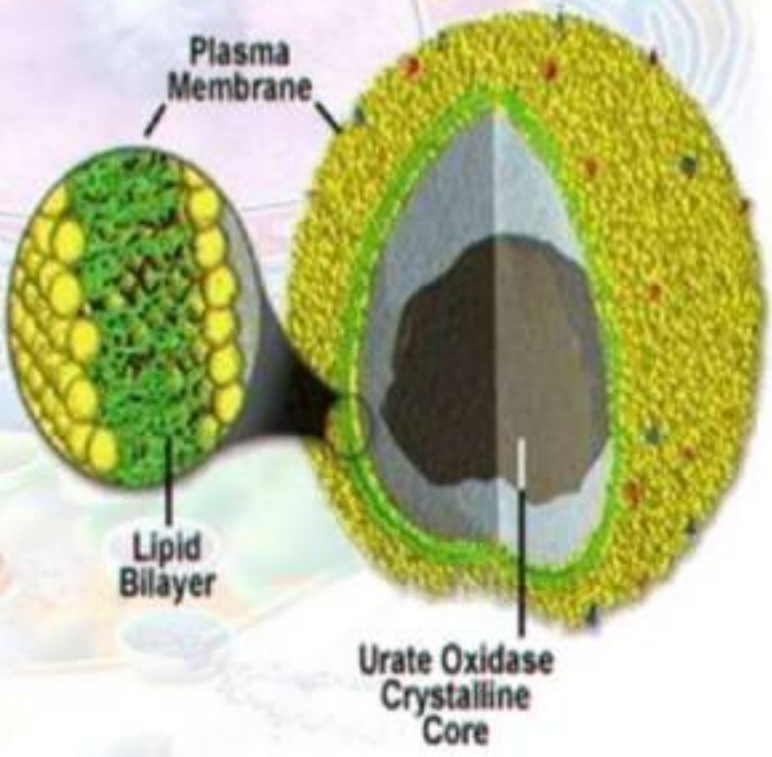
Golgi apparatus

- A stack of flattened membranes and associated vesicles close to the nucleus.
- Packages, modifies, and segregates proteins for secretion from the cell, inclusion in lysosomes, and incorporation into the plasma membrane.



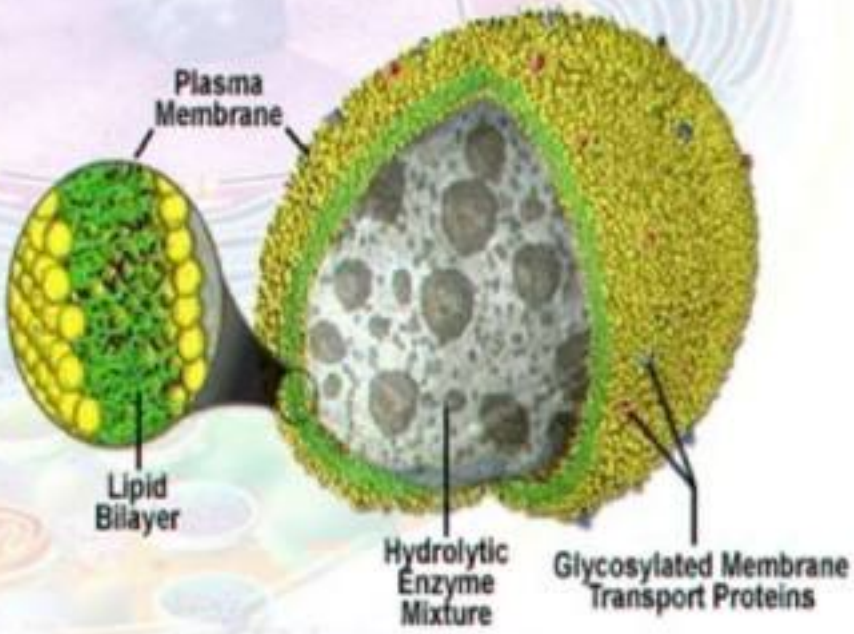
Peroxisomes

- Membranous sacs of catalase and oxidase enzymes.
- The enzymes detoxify a number of toxic substances. The most important enzyme, catalase, breaks down hydrogen peroxide.



Lysosomes

- Membranous sacs containing acid hydrolases.
- Sites of intracellular digestion.

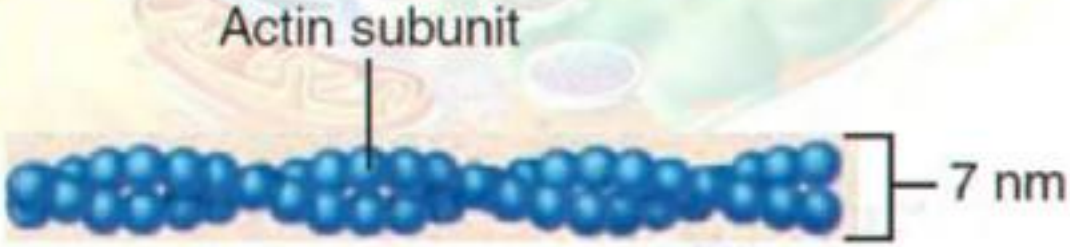


Microtubules

- Cylindrical structures made of tubulin proteins.
- Support the cell and give it shape. Involved in intracellular and cellular movements. Form centrioles and cilia and flagella, if present.

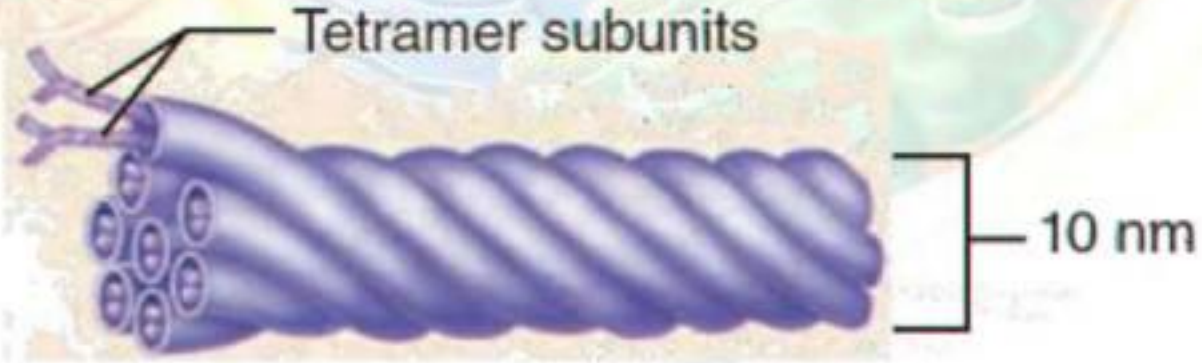
Microfilaments

- Fine filaments composed of the protein actin. Involved in muscle contraction and other types of intracellular movement, help form the cell's cytoskeleton.



Intermediate filaments

- Protein fibers; composition varies. The stable cytoskeletal elements; resist mechanical forces acting on the cell.



Centrioles

- Paired cylindrical bodies, each composed of nine triplets of microtubules.
- Organize a microtubule network during mitosis (cell division) to form the spindle and asters. Form the bases of cilia and flagella.

Inclusions

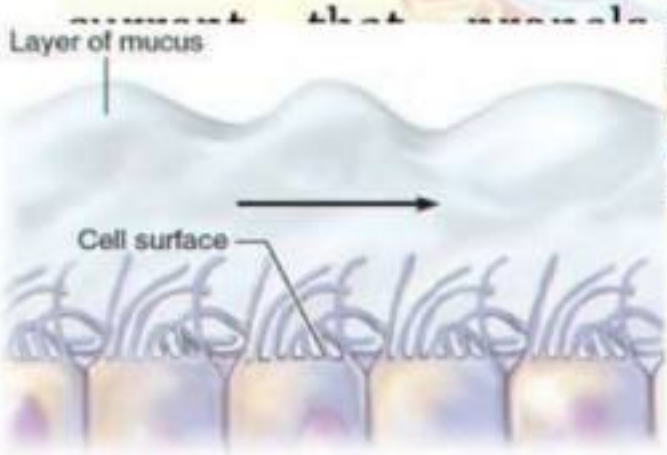
- **Inclusions** includes stored nutrients such as lipid droplets and glycogen granules, protein crystals, pigment granules. Storage for nutrients, wastes, and cell products.

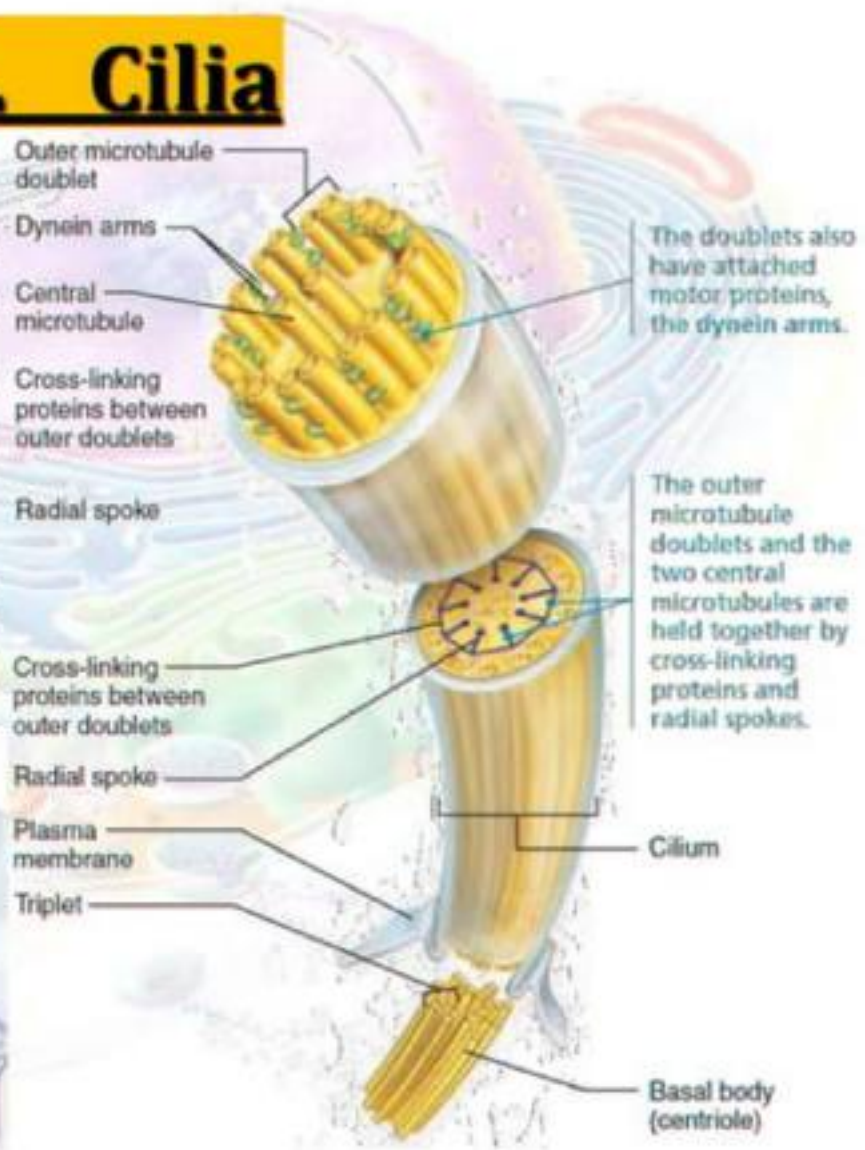
Cellular Extensions

- The major cellular extensions are
  1. Cilia
  2. Flagellum
  3. Microvilli

1. Cilia

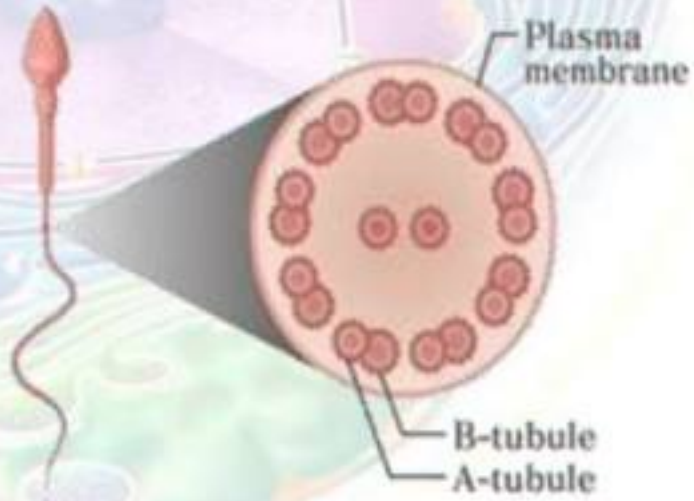
- Short cell-surface projections; each cilium composed of nine pairs of microtubules surrounding a central pair.
- Coordinated movement creates a unidirectional





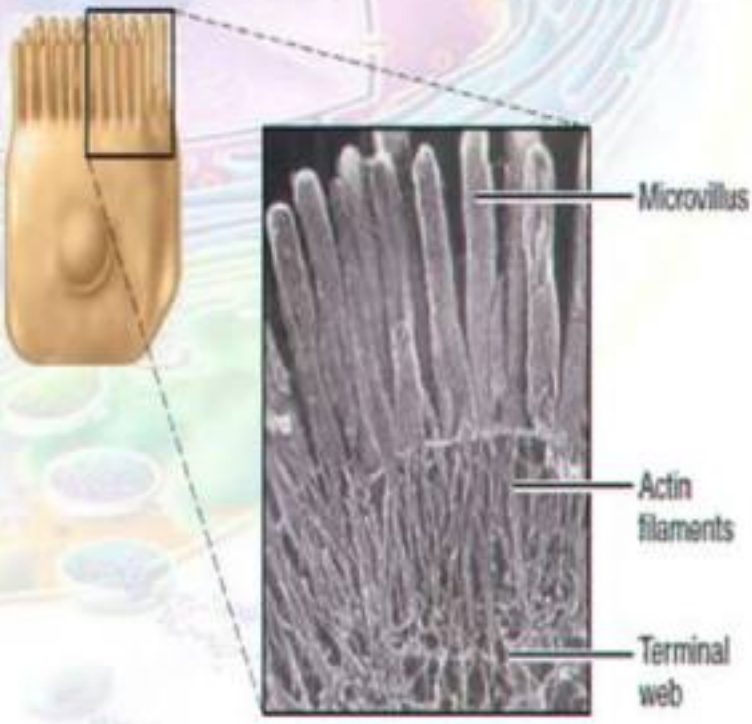
2. Flagellum

- Like a cilium, but longer; only example in humans is the sperm tail. Propels the cell.



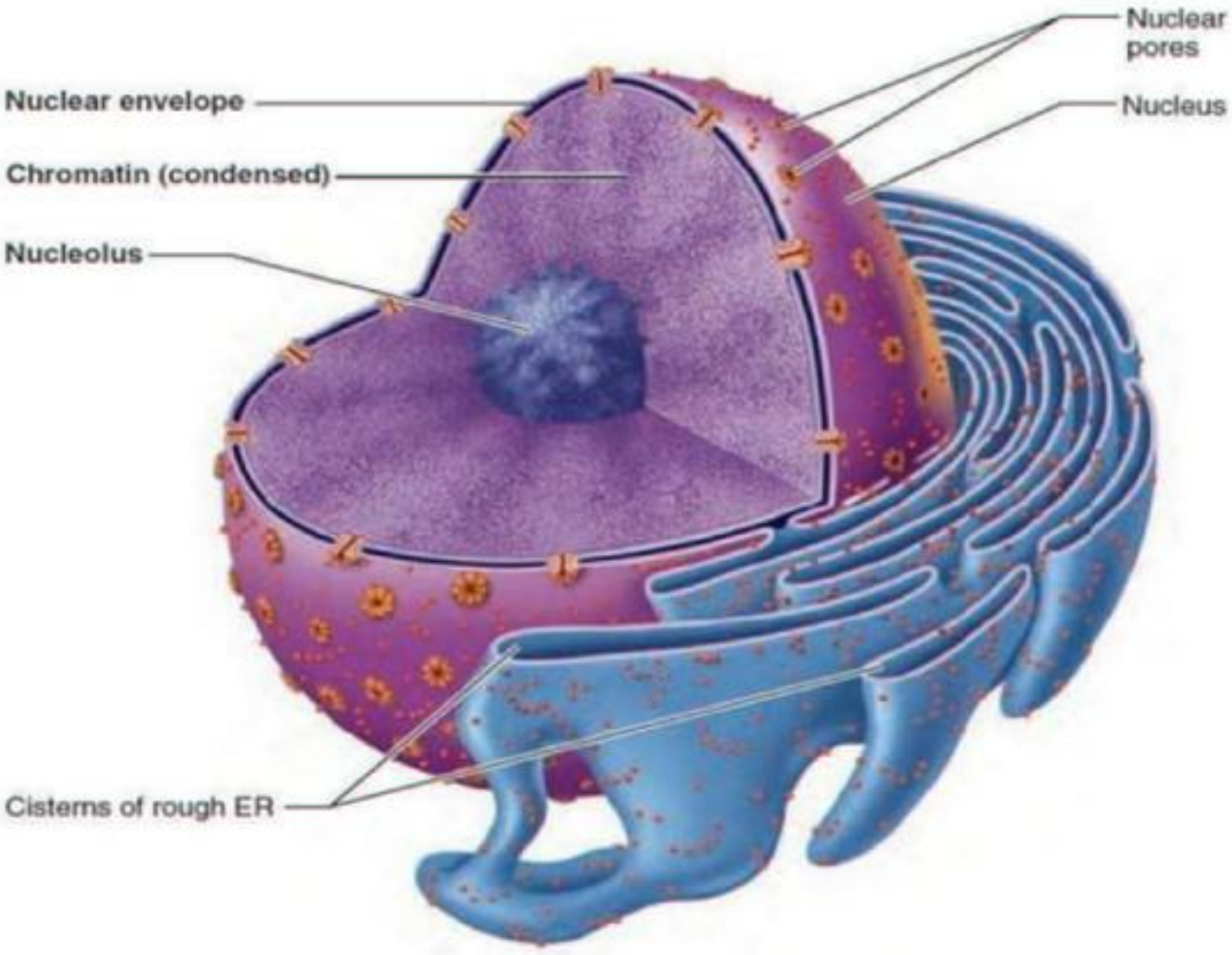
3. Microvilli

- Tubular extensions of the plasma membrane; contain a bundle of actin filaments. Increase surface area for absorption.



C. NUCLEUS

- The nucleus is a spherical or oval-shaped structure that usually is the most prominent feature of a cell. Surrounded by the nuclear envelope; contains fluid nucleoplasm, nucleoli, and chromatin.
- Control center of the cell; responsible for transmitting genetic information and providing the instructions for protein synthesis.


Nuclear pores
Nuclear envelope
Nucleus
Chromatin (condensed)
Nucleolus
Cisterns of rough ER

Structure of the Nucleus

1. The nuclear envelope
2. Nucleoplasm
3. Chromatin
4. The nucleolus

Nuclear Envelope

- The nuclear envelope is a double-layered membrane perforated with pores, which control the flow of material going in and out of the nucleus.
- The outer layer is connected to the **endoplasmic reticulum, communicating with the cytoplasm of the cell.** The exchange of the large molecules (protein and RNA) between the nucleus and cytoplasm happens here.

Nucleoplasm

- **A jelly-like (made mostly of water) matrix within the nucleus**
- All the other materials "float" inside
- Helps the nucleus keep its shape and serves as the median for the transportation of important molecules within the nucleus

Chromatin

- **Chromatin appears** as a fine, unevenly stained network, but special techniques reveal it as a system of bumpy threads weaving through the nucleoplasm.
  - Chromatin is composed of approximately
  - 30% **DNA, our genetic material**
  - 60% globular **histone proteins which package and** regulate the DNA
  - 10% RNA chains, newly formed or forming

Chromosomes

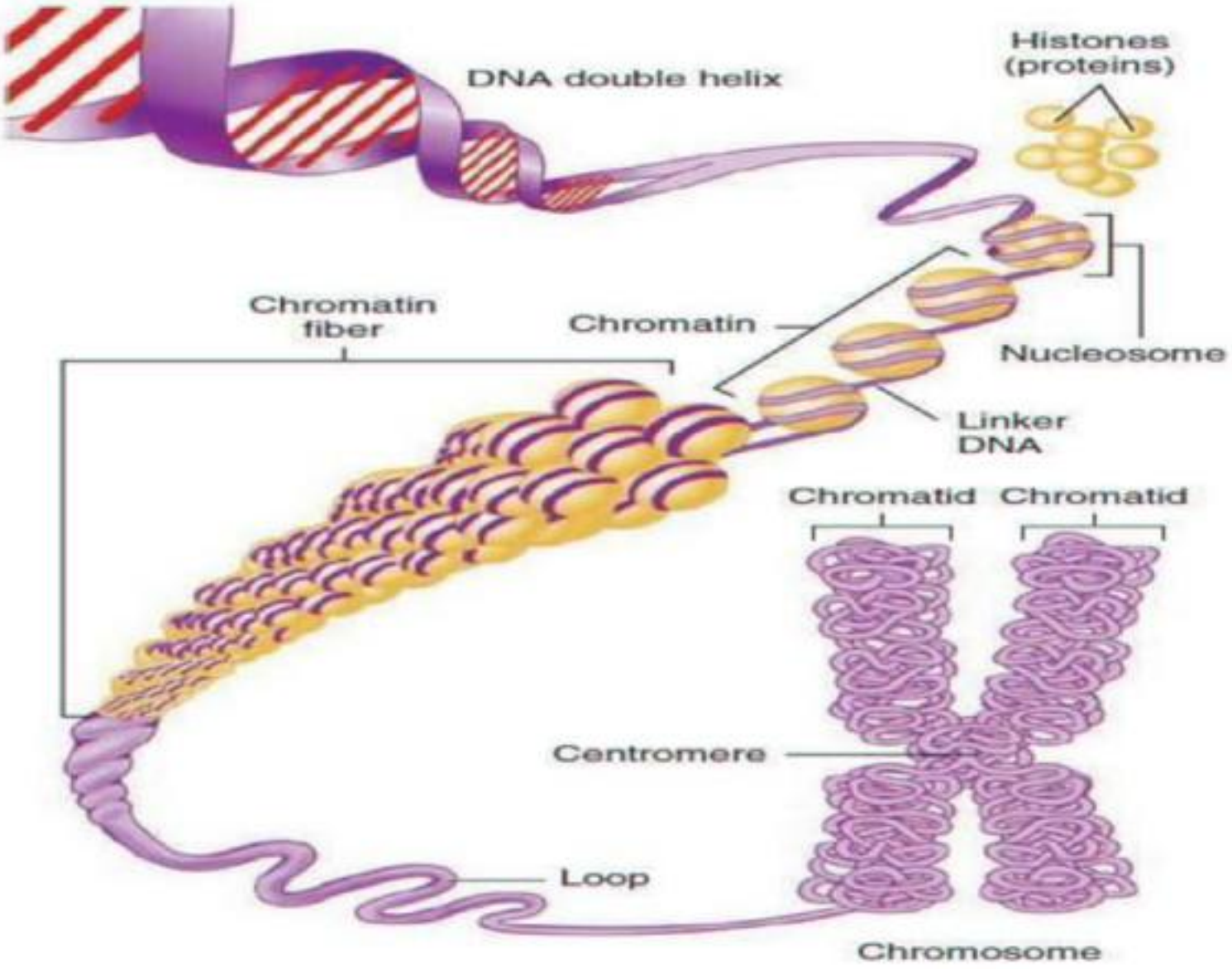
- Chromosomes contain DNA in a condensed form attached to a histone protein.
- Chromatin is comprised of DNA. There are two types based on function.
  - Heterochromatin: highly condensed, transcriptionally inactive mostly located adjacent to the nuclear membrane
  - Eu bn roc delicate, less condensed hromatin: chromatin, located in a organization of transcribing cell

Functions

- The nucleus is often compared to the "command center," as it controls all functions of the cell.
- It is important in regulating the actions of the cells.
- It plays an important part in creating the cell's proteins.
- It is involved in important processes dealing with DNA and other genetic molecules.

DNA

- DNA or deoxyribonucleic acid, contains the information needed for the creation of proteins (which include enzymes and hormones) and is stored in the nucleus, as already said, in the form of chromatin or chromosomes.
- The nucleus is the site of DNA duplication, which is needed for cell division (mitosis) and organism reproduction and growth.


Histones
(proteins)
DNA double helix
Chromatin
fiber
Chromatin
Nucleosome
Linker
DNA
Chromatid
Chromatid
Centromere
Loop
Chromosome

RNA

- RNA are made fromthe DNA template:
  1. Messenger RNA (mRNA) directs the synthesis of a protein.
  2. Ribosomal RNA (rRNA) joins with ribosomal proteins to make ribosomes.
  3. Transfer RNA (tRNA) binds to an amino acid and holds it in place on a ribosome until it is incorporated into a protein during translation

Proteins and Cell Regulation

- The nucleus oversees cells' functions and regulatory mechanisms for keeping the cell healthy and alive.
- The nucleus controls growth of the cell through the synthesis of structural proteins, energy and nutrient metabolism.
- The nucleus regulates the secretion of ribosomes, which are made in the nucleolus and are the sites of gene transcription.

Molecule Movement

- Passive Transport
- Active Transport
- Endocytosis
  (phagocytosis & pinocytosis)
- Exocytosis

Passive Transport

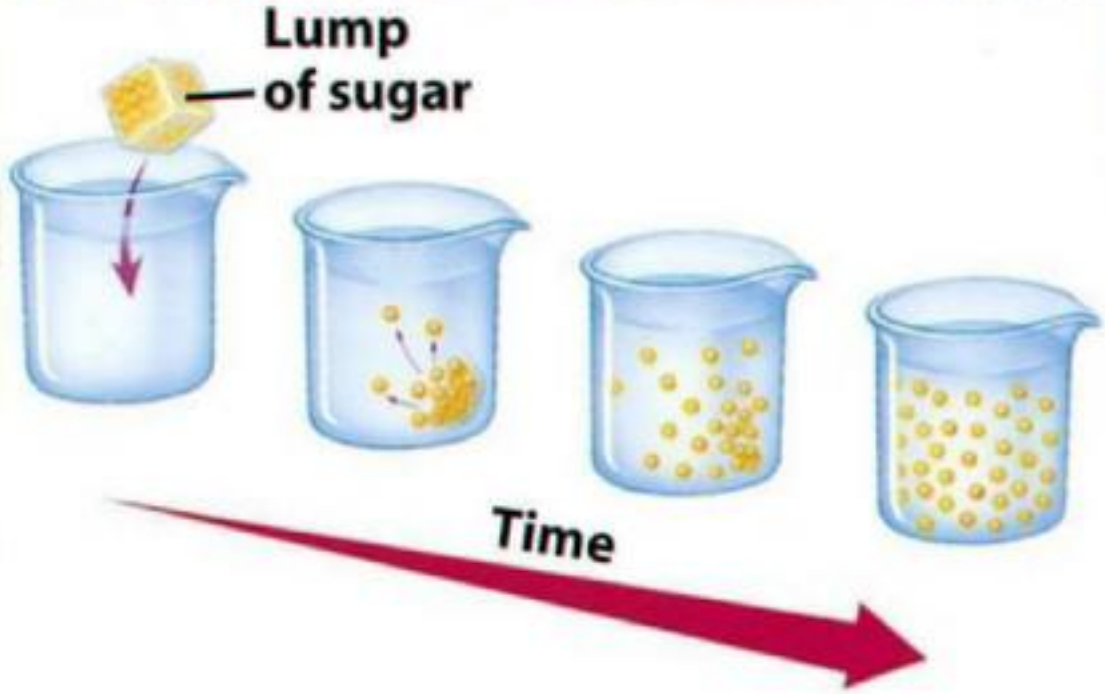
- No energy required
- Move due to gradient
  - differences in concentration, pressure, charge
- Move to equalize gradient
  - High moves toward low

Types of Passive Transport

1. Diffusion
2. Osmosis
3. Facilitated diffusion

Diffusion

- Molecules move to equalize concentration

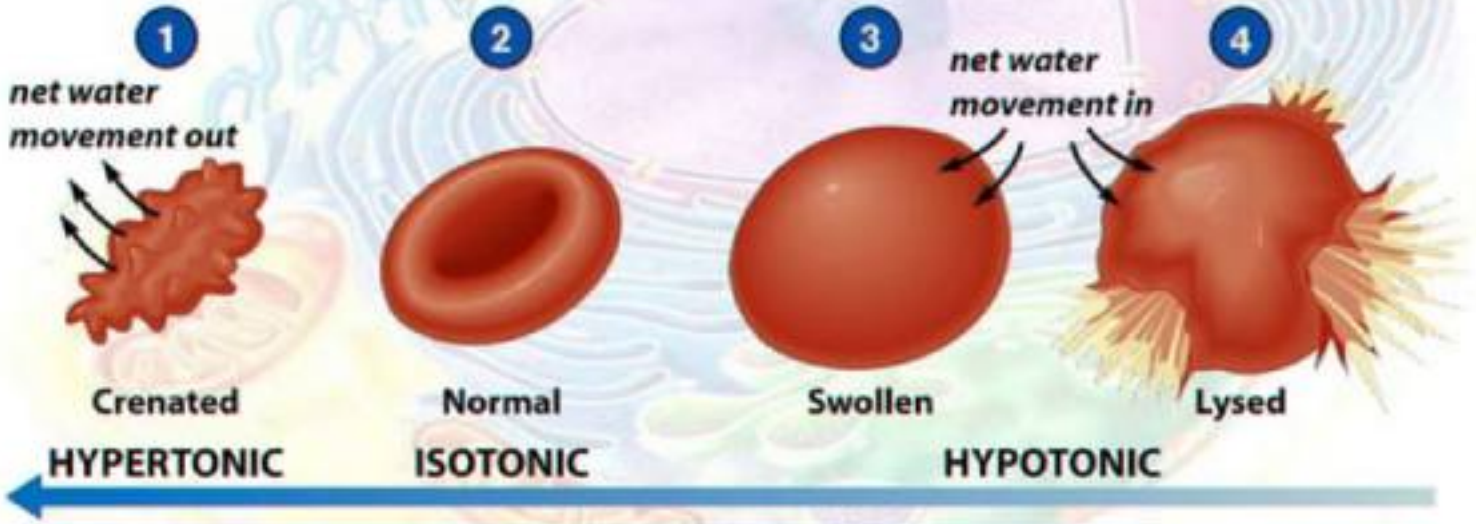


Osmosis

- Special form of diffusion
- Fluid flows from lower solute concentration
- Often involves movement of water
  - Into cell
  - Out of cell

Solution Differences

- 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



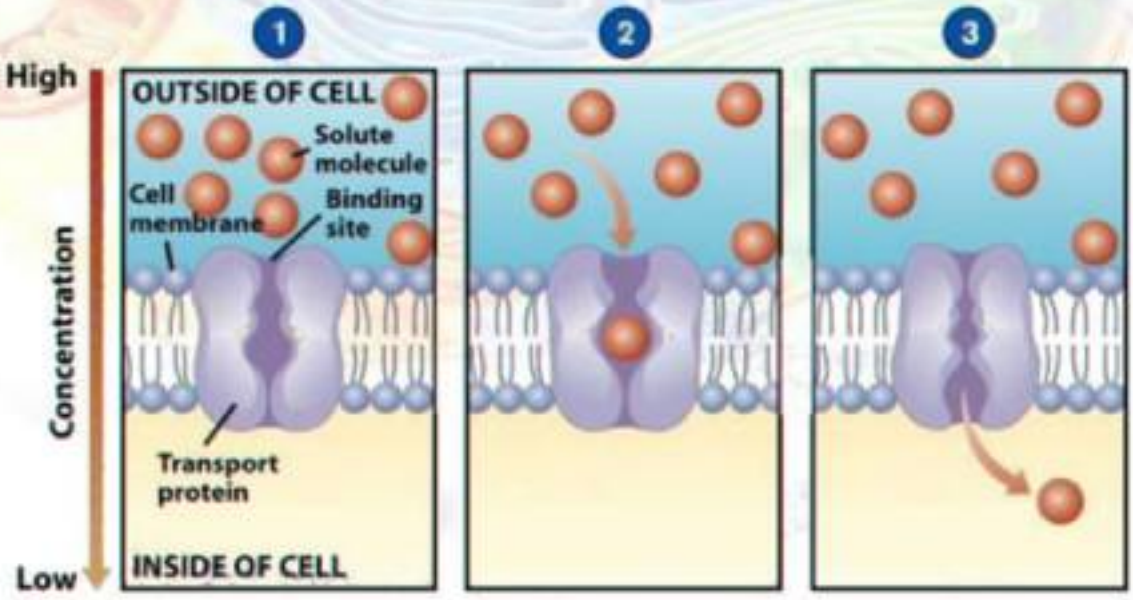
Prepared by....
Mr.JITENDRA BHARGAV
Assistant lecturer

Facilitated Diffusion

- Differentially permeable membrane
- Channels (are specific) help molecule or ions enter or leave the cell
- Channels usually are transport proteins (aquaporins facilitate the movement of water)
- No energy is used

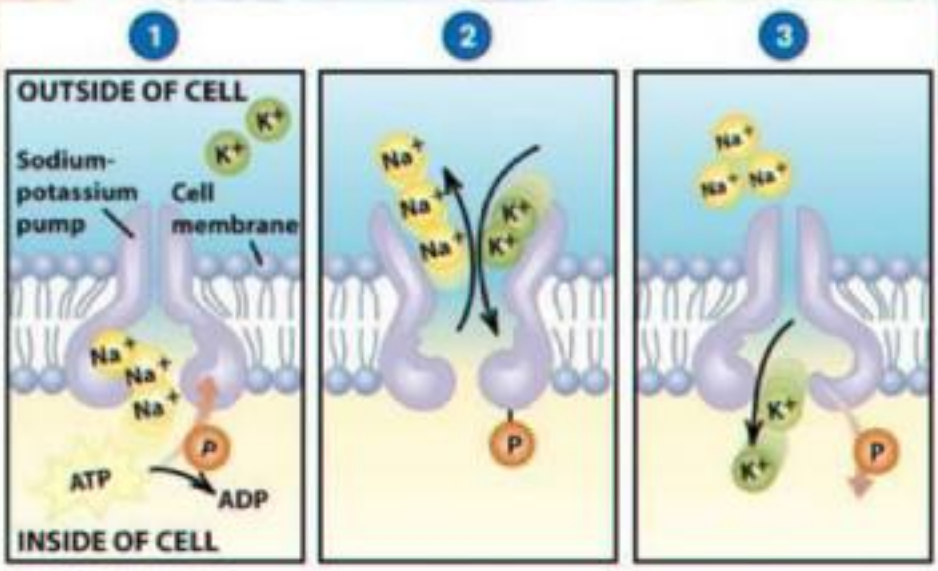
Process of Facilitated Transport

- Protein binds with molecule
- Shape of protein changes
- Molecule moves across membrane



Active Transport

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

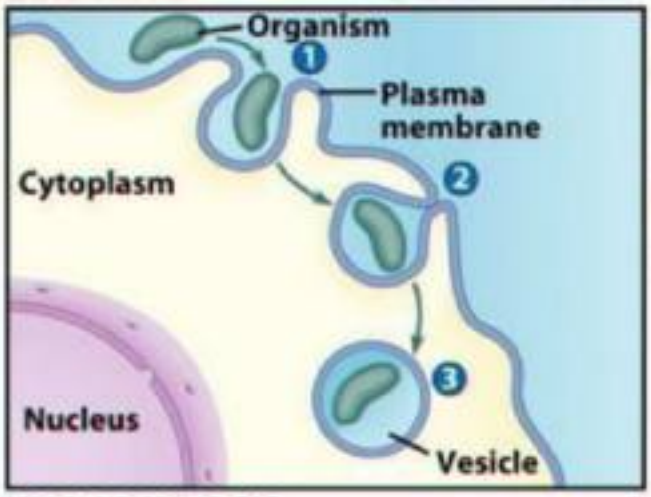


Endocytosis

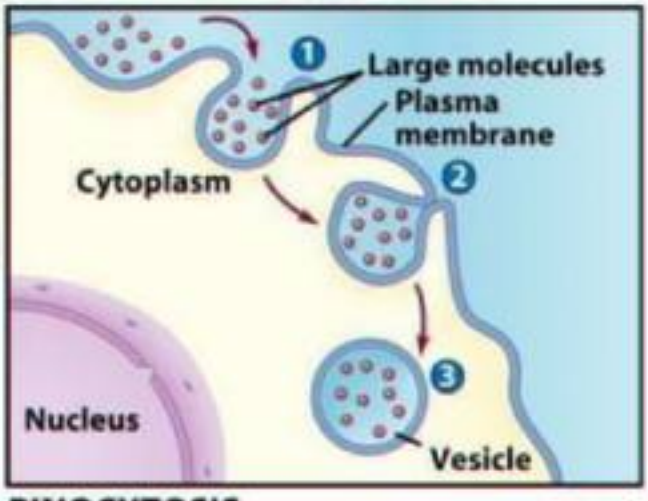
- Movement of large material
  - Particles
  - Organisms
  - Large molecules
- Movement is into cells
- Types of endocytosis
  - bulk-phase (nonspecific)
  - receptor-mediated (specific)

Process of Endocytosis

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



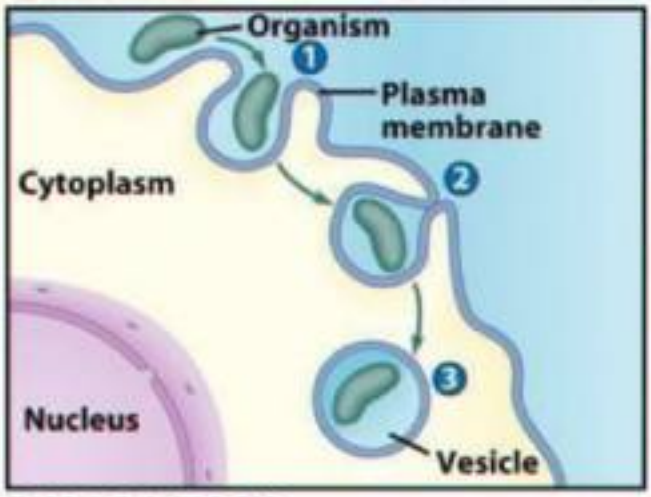
PHAGOCYTOSIS



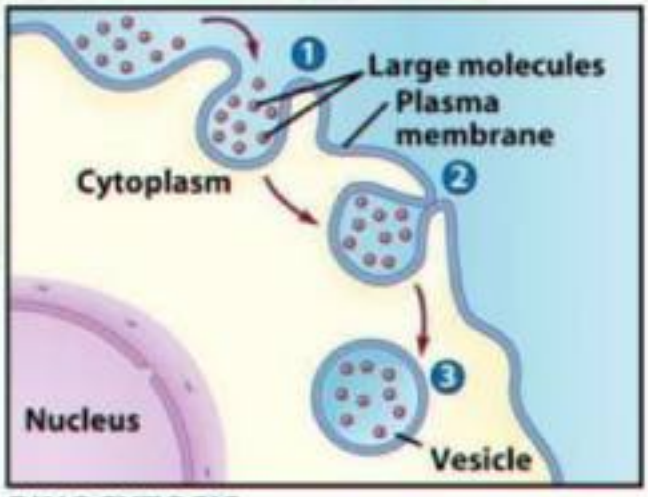
PINOCYTOSIS

Forms of Endocytosis

- Phagocytosis – cell eating
- Pinocytosis – cell drinking



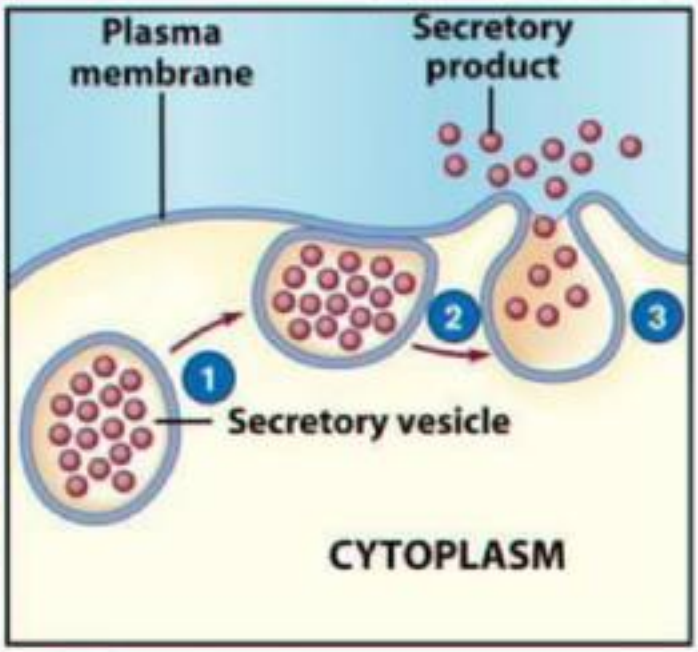
PHAGOCYTOSIS



PINOCYTOSIS

Exocytosis

- Reverse of endocytosis
- Cell discharges material
- Vesicle moves to cell surface
- Membrane of vesicle fuses
- Materials expelled



- There are two types of cell division: mitosis and meiosis.

1. **Mitosis**
2. Mitosis is how most of the cells in the body divide. The "parent" cell splits into two "daughter" cells.
3.
3. Both daughter cells have the same chromosomes as each other and the parent. People refer to them as diploid because they have two complete copies of the chromosomes.

- **Meiosis**
- In meiosis, the body produces sperm cells and egg cells.
-
- **In males, meiosis occurs after puberty**
- Diploid cells within the testes undergo meiosis to produce haploid sperm cells with 23 chromosomes.
- A single diploid cell **yields four haploidsperm cells.**
- They contain one complete set of 23 chromosomes.

Cell types

- Stem cells
- Stem cells are cells that must choose what they are going to become.
- Some differentiate to become a certain cell type, and others divide to produce more stem cells.
- **The embryo and some adult tissues, such as bone marrow, house them.**

- **Bone cells**
- There are at least threeTrusted Source main types of bone cells

- osteoclasts, which dissolve bone
- osteoblasts, which form new bone
- osteocytes, which help communicate with other bone cells

- **Blood cells**
- There are many types of blood cells, including:
-
- red blood cells, which carry oxygen around the body
-
- white blood cells, which are part of the immune system
- platelets, which help blood clot to prevent blood loss after injury
- neutrophils and basophils, and other types of white blood cells

Muscle cells

Also called myocytes, muscle cells are long, tubular cells. Muscle cells are important for a range of functions, including movement, support, and internal functions, such as peristalsis — the movement of food along the gut.

Sperm cells

These **tadpole**-shaped cells are the smallest in the human body.

They are motile, meaning that they can move. They achieve this movement by using their tail, which contains **energy-giving mitochondria.**

Sperm cells cannot divide. **They only carry one haploid, unlike the majority of cells, which carry diploids.**

- **Female egg cell**
- Compared with the sperm cell, the female egg cell is a **giant**.
- It is the largest human cell.
- The egg cell is also haploid so that the chromosomes from the sperm and egg can combine to create a diploid cell during the process of **fertilization**.

- **Fat cells**
- **1.Fat** cells are also called adipocytes, the main adipose tissue constituents.
- They contain stored fats called triglycerides that the body can use as energy.

Once the body uses the triglycerides, the fat cells shrink.

- Adipocytes also produce some hormones.

Nerve cells

Nerves cells form the communication system of the body. Also called neurons, they consist of two major parts — the cell body and nerve processes, known as axons and dendrites.

The central body contains the nucleus and other organelles, and the nerve processes run like long fingers, carrying messages far and wide. Some of the axons are around 1 meterTrusted Source long.

functions

- Movement. muscle cells can generate forces that produce motion.
- Conductivity. ...
- Metabolic absorption. ...
- Secretion. ...
- Excretion. ...
- Respiration. ...
- Reproduction. ...
- Communication.

- Cells must perform 11 main functions in order to support and maintain life:
- absorption,
- digestion,
- respiration,
- biosynthesis,
- excretion,
- egestion,
- secretion,
- movement,
- irritably,
- homeostasis, and reproduction.