PCB1102L: HUMAN ANATOMY & PHYSIOLOGY (Lab)

PRELIMS | 1st Term A.Y. 2026-2027 **ORGANIZATION OF THE HUMAN BODY**

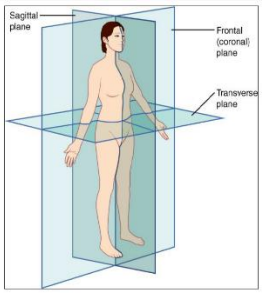
PLANES

- An imaginary two-dimensional surface that passes through the body.

1. **SAGITTAL PLANE**
   - A plane that divides the body or an organ vertically into right and left sides.
   - Midsagittal or median plane
   - Parasagittal plane or longitudinal section

2. **FRONTAL PLANE**
   - Divides the body or an organ into an anterior (front) portion and a posterior (rear) portion.
   - Also referred to as the **coronal plane**.
   - "Corona" is Latin for "crown."

3. **TRANSVERSE PLANE**
   - Divides the body or an organ horizontally into upper and lower portions.
   - Transverse planes produce images referred to as **cross sections**.

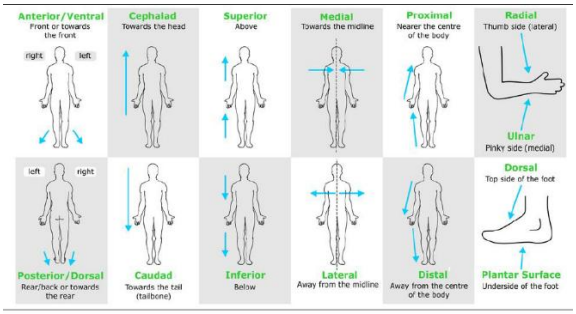


SECTION

- A two-dimensional surface of a three-dimensional structure that has been cut.

ANATOMICAL DIRECTIONS

- Directional anatomical terms are essential for describing the relative locations of different body structures.



DIRECTIONAL TERM	MEANING
Superior	Above (toward the head)
Inferior	Below (toward the feet)
Distal	Farther from the trunk or origin
Proximal	Closer to the trunk or origin
Superficial	Toward or on the surface
Deep (internal)	Away from the surface
Anterior (ventral)	Toward the front (toward the belly)
Posterior (dorsal)	Toward the rear (toward the back)
Medial	Toward the midline
Lateral	Toward the side

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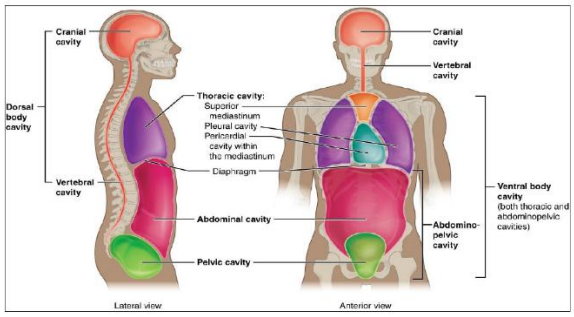
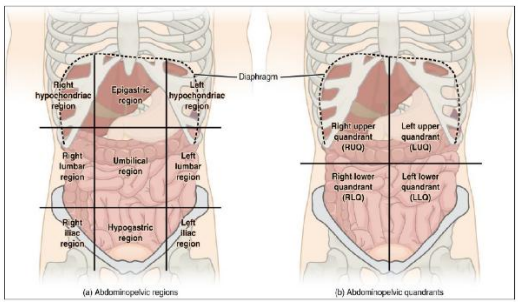
BODY CAVITIES

- The body maintains its internal organization by means of membranes, sheaths, and other structures that separate compartments.
- The ***DORSAL (POSTERIOR) CAVITY*** and the ***VENTRAL (ANTERIOR) CAVITY*** are the largest body compartments.
- These cavities contain and protect delicate internal organs. The ventral cavity allows significant changes in the size and shape of organs as they perform their functions.
- The lungs, heart, stomach, and intestines, for example, can expand and contract without distorting other tissues or disrupting the activity of nearby organs.



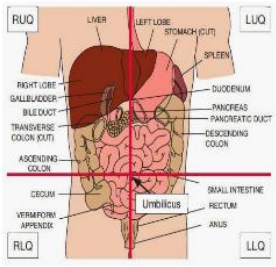
ABDOMINAL REGIONS & QUADRANTS

- **ABDOMINOPELVIC CAVITY**
  - The largest cavity in the body.
- To promote clear communication, such as describing the location of abdominal pain or a suspicious mass, healthcare providers typically divide the cavity into either **nine regions or four quadrants**.

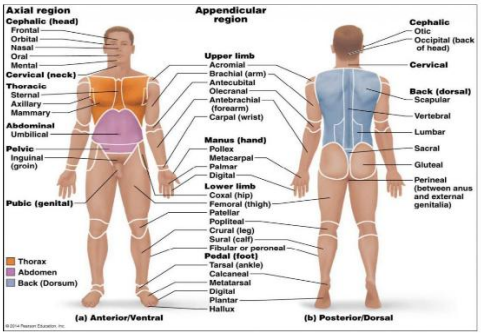


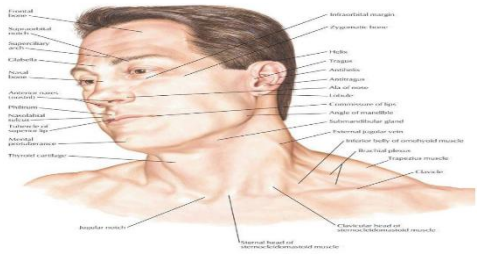
BODY QUADRANTS

- The abdominopelvic cavity is large and contains many organs, so it is further divided into body regions.
- Body regions describe areas of the body that have a special function or are supplied by specific blood vessels or nerves.



APPENDICULAR REGION





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PRELIMS | 1st Term A.Y. 2026-2027 **CELLS**

2 FUNDAMENTAL TYPES OF CELL

1. **PROKARYOTIC (before nucleus)**
   - Lack nuclei & other membrane-bound organelles.
   - Classified into two domains:
     - Archaea
     - Eubacteria

2. **EUKARYOTIC (true nucleus)**
   - Larger & more complex.
   - Have membrane-bound organelles.
   - Have network of specialized structures which are microtubules & microfilaments organized into cytoskeleton giving shape & allows intracellular communication.

2 BASIC TYPES OF CELLS

- Cells in the body of sexually producing organisms can be:
  - **SOMATIC CELLS**
    - Body cells
    - Contain the DIPLOID [2n] chromosome number.
    - Produced through MITOSIS.
    - Examples: muscle cell, nerve cell, stomach cell.
  - **GAMETES**
    - Sex cells
    - Contain the HAPLOID [n] chromosome number.
    - Produced through MEIOSIS.
    - Examples: sperm cell and egg cell

3 BASIC PARTS OF EUKARYOTIC CELLS

1. **PLASMA MEMBRANE**
   - Outer boundary of the cells.

2. **CYTOPLASM** (Gr. kytos-hollow vessel & plasm-fluid)
   - It has cytosol & organelles.

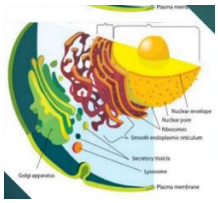
3. **NUCLEUS** (plural, nuclei)
   - Control center of the cell. It has nuclear membrane, chromosomes & nucleoplasm.

MODERN VERSION OF CELL THEORY

- Cell is the basic & functional unit of life.
  1. All energy flow of life occurs within cells (metabolism & biochemistry).
  2. Cell contain hereditary information which is passed from cell to cell during cell division.
  3. All cells come from pre-existing cells.
  4. All cells are basically the same in chemical composition.

ENDOMEMBRANE SYSTEM

- Made up of lipid bilayer with proteins attached to either side or traversing them, also provides a transport system, for moving molecules through the interior of the cell, as well as interactive surfaces for lipid & protein synthesis.
- It includes plasma membrane, ER, nuclear membrane (not nucleus), lysosome, Golgi body, vacuoles & vesicles.



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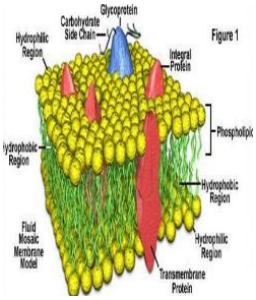
FLUID MOSAIC MODEL / PLASMA MEMBRANE MODEL

- 1960s — ***GL NICHOLSON*** & ***SJ SINGER*** proposed the popular fluid mosaic model of the plasma membrane.

PLASMA MEMBRANE / CELL MEMBRANE / PLASMALEMMA

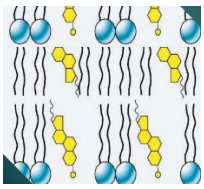
- **PHOSPHOLIPID BI-LAYER**
  - Forms a barrier across which only lipid soluble molecules can migrate and provides a framework for the membrane proteins.
  - A few membrane lipids participate in communication between the extracellular environment and the cell.
  - Not only the external boundary of the cell but also provides a selective barrier between the cell and the outside world.
  - Embedded in this phospholipid bilayer are integral and peripheral proteins and cholesterol, which permit it to function:
    - in cell-cell recognition
    - in endocytosis and exocytosis
    - as a receptor site for signaling molecules (e.g., G proteins)
    - as an initiator and controller of the secondary messenger system

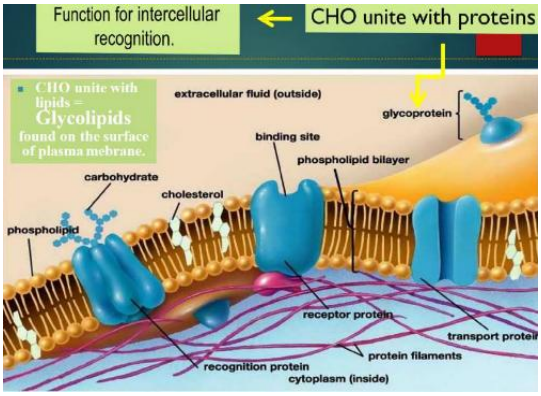
- Lipid molecules are ***AMPHIPATHIC MOLECULES***.



CHOLESTEROL MOLECULES

- ***Importance of cholesterol in plasma membrane:***
  - It helps make membrane impermeable to small water-soluble molecules & keeps the membrane flexible over a wide range of temperatures.





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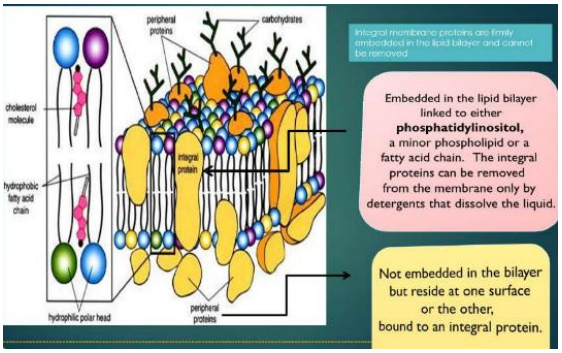
PROTEIN COMPONENTS OF CELL MEMBRANE

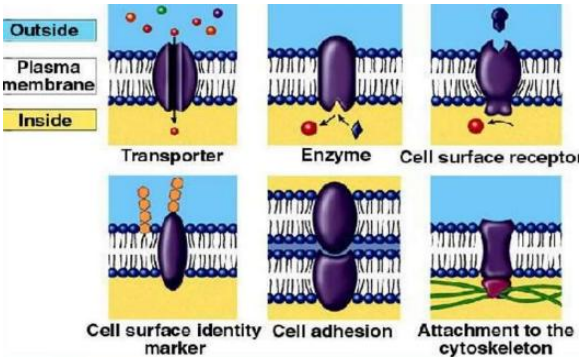
- **INTEGRAL MEMBRANE PROTEINS**
  - Firmly embedded in the lipid bilayer and cannot be removed.

- Embedded in the lipid bilayer linked to either ***PHOSPHATIDYLINOSITOL***, a minor phospholipid, or a fatty acid chain. The integral proteins can be removed from the membrane only by detergents that dissolve the lipid.

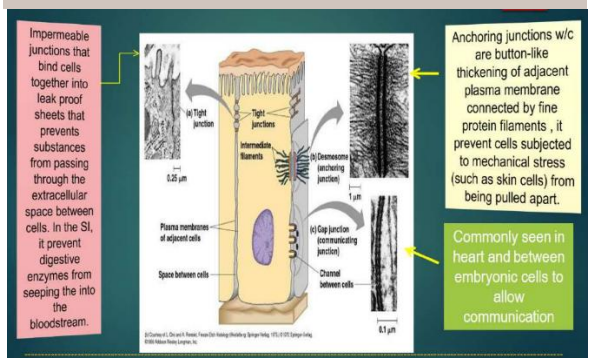
- **PERIPHERAL PROTEINS**
  - Not embedded in the bilayer but reside at one surface or the other, bound to an integral protein.



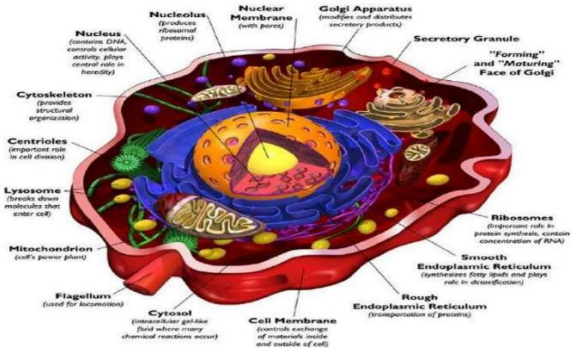
FUNCTIONS OF PLASMA MEMBRANE PROTEINS



SPECIALIZATIONS OF PLASMA MEMBRANE



PARTS OF CELL



1. RIBOSOMES

- "Protein workbenches" or the site of protein synthesis.
- Contains protein and rRNA (ribosomal RNA).
- Consists of a small and larger subunit, which bind together during ***TRANSLATION***.
- *2 Types of Ribosomes:*
  1. **BOUND RIBOSOMES**
     - Attached to the endoplasmic reticulum; produce proteins for export or storage in membranes.
  2. **FREE RIBOSOMES**
     - Float freely in the cytoplasm; produce proteins for growth & maintenance of cell.

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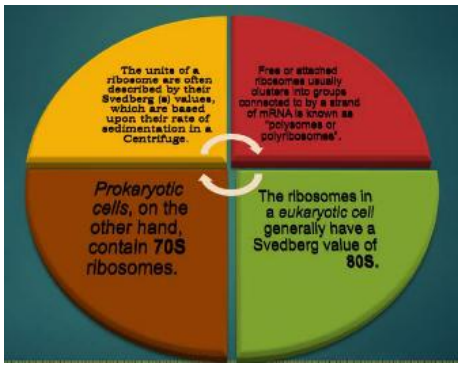
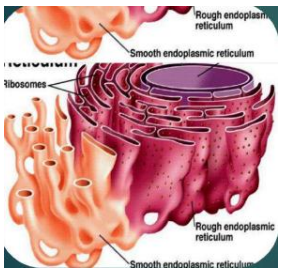


2. ENDOPLASMIC RETICULUM

- ***Production & Transport:***
  - A complex membrane-bound labyrinth of flattened sheets, sacs, & tubules that branches & spreads throughout the cytoplasm.
  - Series of channels that helps various materials to circulate throughout cytoplasm, storage unit for enzymes & other proteins, and point of attachment for ribosomes.



a.) SMOOTH ER

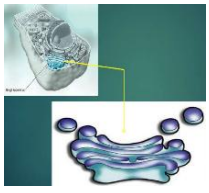
- Functions in the synthesis of cholesterols and lipids as well as in the detoxification of certain drugs and toxins (such as barbiturates and alcohol).
- Additionally, in skeletal muscle cells, this is specialized to sequester and release calcium ions and thus regulate muscle contraction and relaxation.

b.) ROUGH ER

- Whose cytoplasmic surface possesses receptor molecules for ribosomes and signal recognition particles (known as ribophorins and docking proteins, respectively); continuous with the outer nuclear membrane.
- Functions in the synthesis and modification of proteins that are to be packaged, as well as in the synthesis of membrane lipids and proteins.

3. GOLGI APPARATUS

- ***Packaging, sorting & Export:***
  - Named after Italian microscopist ***CAMILLO GOLGI*** who discovered it in 1898.
  - Flattened sacs of membrane-bound cisternae (closed spaces serving as fluid reservoirs).
  - Sorts, packages, & secretes proteins & lipids.



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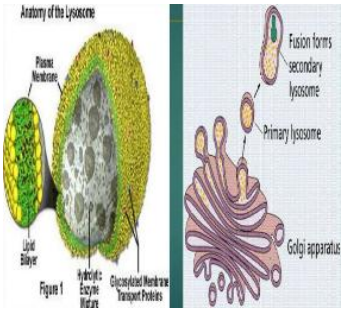
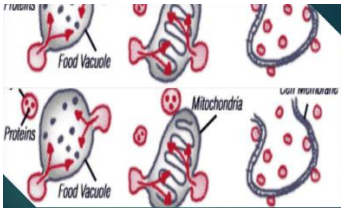
4. LYSOSOMES

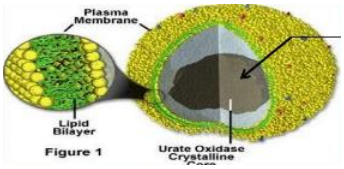
- ***Digestion & Degradation:***
  - Spherical organelles that contain "acid hydrolases" that digest organic molecules under acidic conditions.
  - This is the cell's garbage disposal system.
  - Isolated in 1950s by Christian de Duve & associates.





5. PEROXISOMES

- Crystalline structure inside a sac which also contains amorphous gray material.
- Functions to rid the body of toxic substances using the enzyme "catalase".
- ***Liver Functions Context:***
  - Detoxification
  - Synthesis & Storage of Amino Acids
  - Proteins, Vitamins & Fats
  - Blood Glucose Regulation
  - Bile Drainage
  - Blood Circulation & Filtration



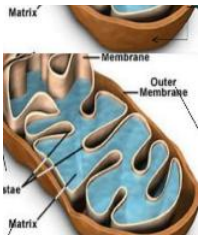
6. MITOCHONDRIA (Power Generator)

- Double membrane-bound organelle that is spherical to elongate in shape.
- Function: Site of ATP synthesis; contains respiratory or electron transport chain, which releases energy as electrons pass through the system.

- **INNER MEMBRANE**
  - Folds into incomplete partitions (cristae), which serve to increase surface area for chemical reactions that trap usable energy for cell.

- **OUTER MEMBRANE**
  - Gives the mitochondria its shape.

- **MATRIX**
  - The space between the cristae that contains ribosomes, circular DNA & other material.



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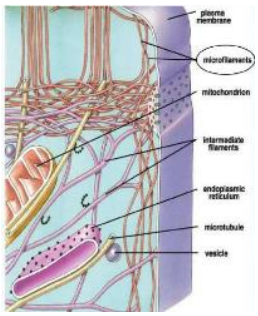
7. CYTOSKELETON

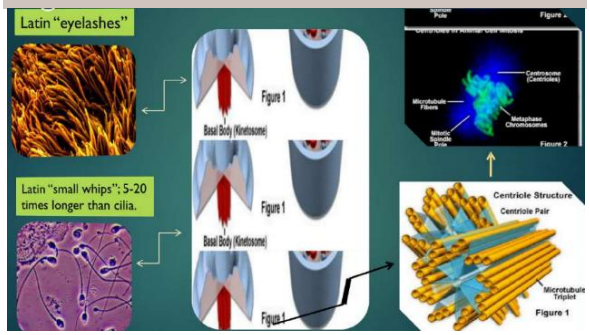
- **MICROFILAMENTS**
  - Solid strings of protein (actin) molecules.
  - Actin microfilaments are most highly developed in muscle cells as myofibrils.

- **INTERMEDIATE FILAMENTS**
  - Chemically heterogeneous group of protein fibers, which vary with the type of cell.
  - Helps maintain shape of cell & the spatial organization of organelles & promotes mechanical activities within the cytoplasm.

- **MICROTUBULES**
  - Hollow, slender, cylindrical structures in animal cells.
  - Functions in the movement of organelles such as secretory vesicles & chromosome movement during cell division.
  - Part of transport system within the cell.



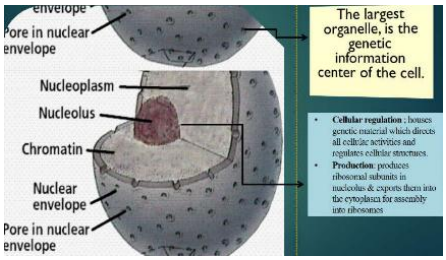
8. CILIA & FLAGELLA *(Movement)*



9-10. NUCLEUS & NUCLEOLUS

- **NUCLEUS**
  - The largest organelle is the genetic information center of the cell.

- **NUCLEOLUS**
  - ***Cellular regulation***
    - Houses genetic material which directs all cellular activities and regulates cellular structures.
  - ***Production***
    - Produces ribosomal subunits in nucleolus & exports them into the cytoplasm for assembly into ribosomes.



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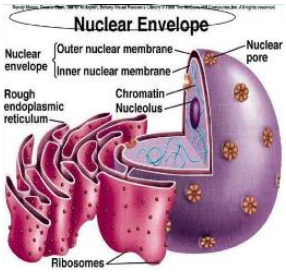
11. NUCLEAR MEMBRANE

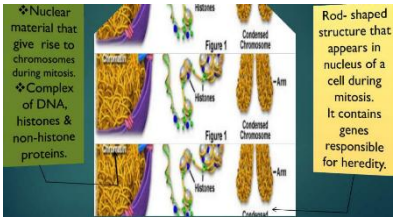
- Gateway to nucleus.
- Separates the nucleus from cytoplasm & is continuous with the ER.



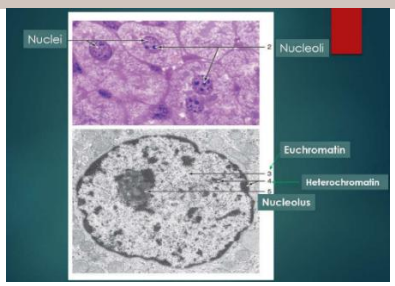
12-13. CHROMATIN & CHROMOSOMES

- **CHROMATIN**
  - Nuclear material that gives rise to chromosomes during mitosis; complex of DNA, histones & non-histone proteins.

- **CHROMOSOME**
  - Rod-shaped structure that appears in nucleus of a cell during mitosis; contains genes responsible for heredity.



TWO CATEGORIES OF CHROMATIN OF MOST NON-DIVIDING CELLS DISTINGUISHABLE IN THEIR NUCLEI



- **Euchromatin**
  - Visible as finely dispersed granular material; lightly stained & predominates in active cells such as large neurons.

- **Heterochromatin**
  - Appears as a coarse, electron-dense material; intensely basophilic clumps; more abundant in cells with little synthetic activity such as circulating lymphocytes.

  - **Constitutive Heterochromatin:**
    - Generally similar in all cell types and contains mainly repetitive, gene-poor DNA sequences including centromeres and telomeres.

  - **Facultative Heterochromatin**
    - Contains other regions of DNA with genes where transcription is variably inactivated in different cells by epigenetic mechanism and can undergo reversible transitions from compact transcriptionally silent states to more open, transcriptionally active conformation.

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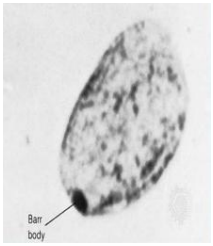
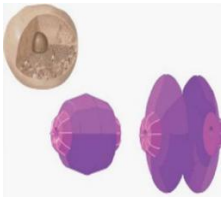
14. BARR BODY

- The Barr, or sex chromatin, body is an inactive X chromosome.
- It appears as a dense, dark-staining spot at the periphery of the nucleus of each somatic cell in the human female.
- A vital tool for determination of sex of the individual (hermaphroditism, the condition of having both male and female reproductive organs).



15. VAULTS
(Newly discovered organelle)

- First described in 1986, are cytoplasmic ribonucleic proteins, shaped like octagonal barrels.
- A single cell can contain thousands of vaults.
- Leading speculations considered vaults as "cellular trucks".
- Its structure is consistent with the role in either subcellular transport or sequestering large nuclear protein assemblies.



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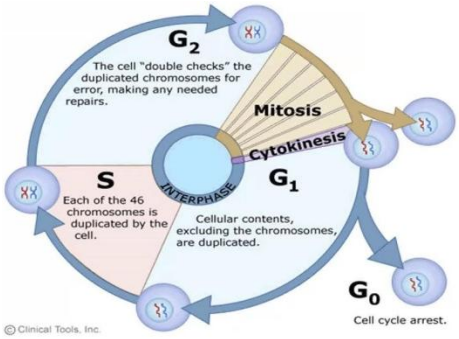
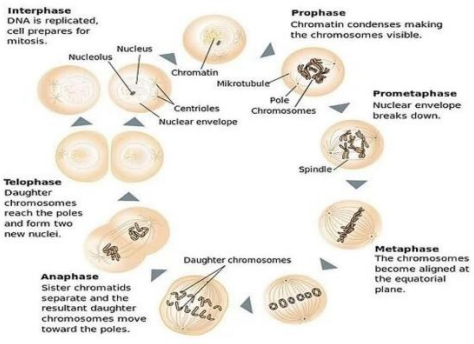
PRELIMS | 1st Term A.Y. 2026-2027 **MITOSIS**

CELL CYCLE

1. **INTERPHASE**
   - DNA is replicated, cell prepares for mitosis.
     - **G_1**
       Cellular contents, excluding the chromosomes, are duplicated.
     - **S**
       Each of the 46 chromosomes is duplicated by the cell.
     - **G_2**
       The cell "double checks" the duplicated chromosomes for error, making any needed repairs.
2. **MITOSIS**
   - Cell divides its DNA and cytoplasm, forming two new cells.
     - **Prophase**
       Chromatin condenses making the chromosomes visible.
     - **Prometaphase**
       Nuclear envelope breaks down.
     - **Metaphase**
       The chromosomes become aligned at the equatorial plane.
     - **Anaphase**
       Sister chromatids separate and the resultant daughter chromosomes move toward the poles.
     - **Telophase**
       Daughter chromosomes reach the poles and form two new nuclei.

G_0 - Cell cycle arrest.





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TYPES OF CELLS
(Base on their ability to regenerate)

1. **LABILE CELLS**
    - Squamous epithelium of skin, mouth, vagina and cervix
    - Columnar epithelium of intestinal tract
    - Transitional epithelium of urinary tract
    - Bone marrow cells

2. **STABLE CELLS**
    - Liver hepatocytes
    - Alveolar cells of lung
    - Epithelium of kidney tubules

3. **PERMANENT CELLS**
    - Neurons
    - Skeletal and cardiac muscle

TISSUE REPAIR

4. The substitution of viable cells for dead cells and it can occur by **regeneration or replacement.**

REGENERATION

- The new cells are the same type as those that were destroyed, and normal function is usually restored.

REPLACEMENT

5. A new type of tissue develops that eventually causes scar production & the loss of some tissue function.

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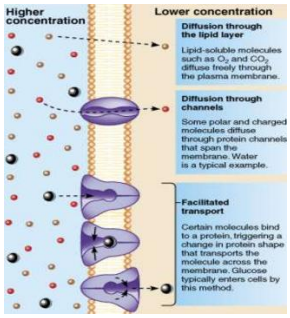
PRELIMS | 1st Term A.Y. 2026-2027 **TRANSPORT MECHANISM**

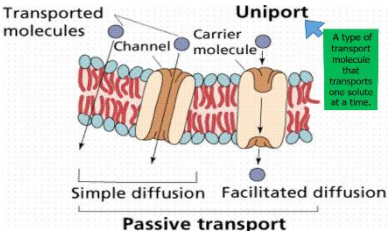
PASSIVE TRANSPORT

- Particles always move with (down) a concentration gradient (the difference in concentrations across a membrane).

1. **SIMPLE DIFFUSION**
   - Process by which water, oxygen and other molecules move from areas of high concentration to areas of low concentration, down a concentration gradient.

2. **FACILITATED DIFFUSION**
   - A process by which substances are assisted by proteins (channel or carrier proteins)

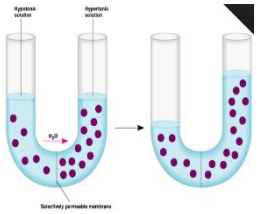




- **FACTORS THAT AFFECT THE RATE OF DIFFUSION**
  - Size of the molecules
  - Temperature
  - Distance traveled by substances
  - If the material is solid, liquid or gas

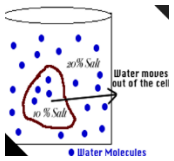
OSMOSIS

- The movement of water "down" a concentration gradient, that is across a semi-permeable membrane from a region of greater water concentration to a lower water concentration.



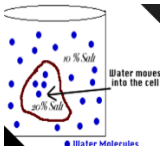
HYPERTONIC SOLUTION

- The concentration of solute is higher outside the cell than inside the cell, so water moves out of the cell.
- Causes a drop in turgor or osmotic pressure: called ***PLASMOLYSIS***.
- Plasmolysis causes animal cells to shrivel up and plants to wilt.



HYPOTONIC SOLUTION

- Hypo, means less.
- Water enters cell. Therefore, cell swells and bursts (cytolysis).



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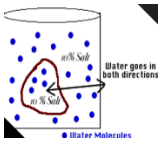
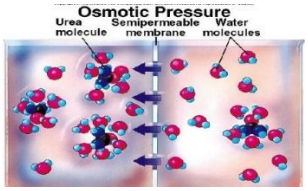
ISOTONIC SOLUTION

- The concentration of solute inside and outside of the cell is the same.



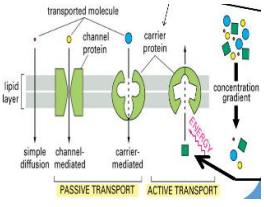
OSMOTIC PRESSURE

- Always move water toward the hypertonic side (the side containing the least amount of water) of a membrane.



ACTIVE TRANSPORT

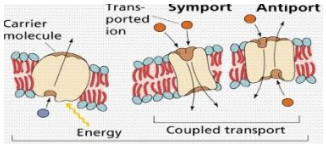
- Uses transport/carrier proteins (protein pumps) embedded in the plasma membrane.
- Carrier proteins are specific for the molecules that they allow through.
- The carrier protein changes shape which requires energy (ATP).
- Capable of moving solute particles against the conc. gradient (from low conc. to high conc.)



- Requires the cell to spend energy, usually in the form of ATP. Ex. transport of large molecules (non-lipid soluble) & the sodium-potassium pump.

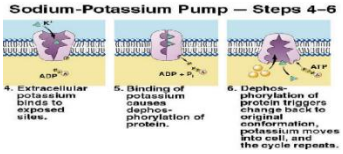
- **SYMPORT**
  - Transports the solute and a cotransported solute at the same time in the same direction.

- **ANTIPORT**
  - Transports the solute in (or out) and the co-transported solute the opposite direction. One goes in the other goes out or vice-versa.



SODIUM-POTASSIUM PUMP

- It must break ATP down into ADP in order to pump sodium three ions outside the cell (continued below), while it pumps two potassium ions into the cell.
- The ATP phosphorylates (adds a phosphate to) the membrane protein as it binds to the sodium and breaks down, and it dephosphorylates the protein as it binds with the potassium.
- Cellular respiration must occur to add the phosphate back to ADP, thus restoring the ATP.



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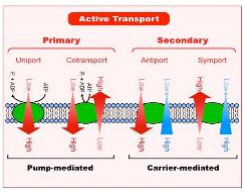
2 MAIN TYPES OF ACTIVE TRANSPORT

1. **PRIMARY (DIRECT) ACTIVE TRANSPORT**
   - Involves the direct use of metabolic energy (e.g. ATP hydrolysis) to mediate transport.

2. **SECONDARY (INDIRECT) ACTIVE TRANSPORT**
   - Involves coupling the molecule with another moving along an electrochemical gradient.

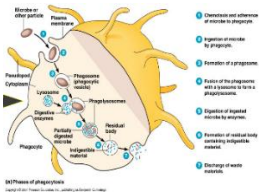


VESICLE-MEDIATED TRANSPORT

- Vesicles & vacuoles that fuse with the cell membrane may be utilized to release or transport chemicals out of the cell or to allow them to enter a cell.

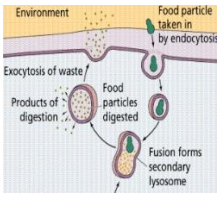
PHAGOCYTOSIS

- Type of endocytosis where an entire cell is engulfed.
- **MONOCYTES**
  - Are type of WBC typically 12-20 um in diameter with kidney-shaped nuclei and blue-grey cytoplasm which looks somewhat "foamy". w/c function to combat microbes by the process of phagocytosis (after transforming into fixed or wandering macrophages).



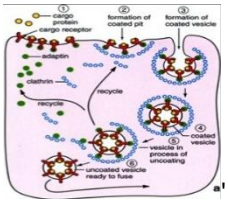
EXOCYTOSIS

- An active process, is the term applied when transporting substances out of the cell.
- **Ex:** protein or waste product.



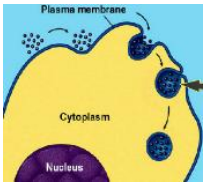
RECEPTOR-MEDIATED ENDOCYTOSIS

- PA process which occurs when the material to be transported binds to certain specific molecules in the membrane.
- **Ex:** include the transport of insulin & cholesterol into animal cells



PINOCYTOSIS

- A process when the external fluid is engulfed.



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INTEGUMENTARY SYSTEM

- An organ system consist of skin and its accessory parts namely hair, nails, and exocrine glands.

FUNCTIONS OF INTEGUMENTARY SYSTEM

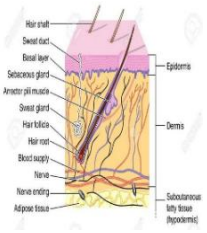
- **S**ensation
- **H**eat regulation
- **A**bsorption
- **P**rotection
- **E**xcretion
- **S**torage of fats

LAYERS OF THE SKIN

- The skin is consists of three layers, the Epidermis and Dermis.
- Hypodermis is not strictly a part of the skin, although the border between the hypodermis and dermis can be difficult to distinguish.

1. **EPIDERMIS**
   - Outermost layer of skin, provides a waterproof barrier and creates our skin tone.
2. **DERMIS**
   - Beneath the epidermis, contains tough connective tissue, hair follicles, and sweat glands.
3. **HYPODERMIS**
   - Deeper subcutaneous tissue (hypodermis) is made of fat and connective tissue. It is well-vascularized, with loose, areolar connective tissue and adipose tissue, for fat storage and provides insulation and act as cushioning for the integument.

true skin



1. LAYERS OF EPIDERMIS

1. **STRATUM CORNEUM** horny layer
   - Most superficial layer.
   - 20-30 layers of dead, flattened, anucleate, keratin-filled keratinocytes.
   - Protects against friction and water loss.

dead skin

2. **STRATUM LUCIDUM** clear layer
   - 2-3 layers of anucleate, dead cells.
   - Seen only in thick skin. of palms & soles
3. **STRATUM GRANULOSUM**
   - 3-5 layers of keratinocytes with distinct kerato-hyaline granules.

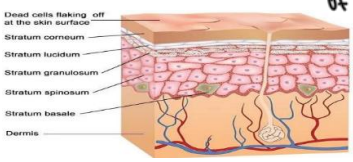
granular layer

4. **STRATUM SPINOSUM**
   - Several layers of keratinocytes all joined by desmosomes.
   - Langerhans cells present.

spiny layer

5. **STRATUM BASALE** / germinativum
   - Deepest, single layer of cuboidal to low columnar cells in contact with basement membrane
   - Mitosis occurs here.
   - Melanocytes and Merkel cells also.

10B dead skin cells shed of every day



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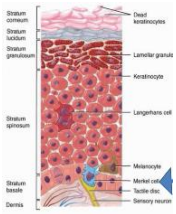
CELL OF EPIDERMIS

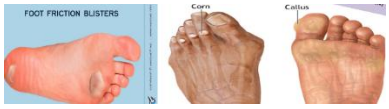
1. **STEM CELLS**
   - Undifferentiated cells that give rise to keratinocytes.
   - Found in the deepest layer of the epidermis.
   - ***KERATINOCYTES***
     - Make up the majority of epidermal cells and synthesize keratin.
   - ***MELANOCYTES***
     - Only found in the deepest layer and they synthesize melanin.
2. **TACTILE CELLS**
   - Found in the deepest layer and have touch receptors associated with dermal nerve fibers.
3. **DENDRITIC CELLS**
   - Are macrophage like and migrated from bone marrow.
   - They guard against toxins, microbes, and other pathogens.
4. **LANGERHANS CELLS**
   - It recognize, phagocytose, and process foreign antigens and then present them to T lymphocytes for an immune response.
   - Thus, these cells function as antigen-presenting cells (APCs) and are part of the immunologic defense of the skin.
5. **MERKEL CELLS**
   - Found in the stratum basale layer of the epidermis and are most abundant in the fingertips.
   - Function as mechanoreceptors for cutaneous sensation.



FRICTION BLISTERS & CORNS, CALLUSES

- **FRICTION BLISTERS**
  - Soft pocket of raised skin filled with clear fluid caused by irritation from continuous rubbing or pressure.
  - Usually occur on the feet, where tight or poor-fitting shoes can rub and irritate delicate toes and heels for long periods of time.

- **CORNS AND CALLUSES**
  - Hard, painful areas of skin that often develop on the feet in response to pressure or friction.
  - Thick, hardened layers of skin that develop in the skin tries to protect itself against friction and pressure.
  - Compared with corns, calluses are larger and have a more irregular (more spread out) shape.



2. LAYERS OF DERMIS

- Part of skin also known as ***CORIUM***.

- **PAPILLARY LAYER**
  - Made of loose, areolar connective tissue.
  - Its superficial layer projects into the stratum basale of the epidermis to form finger-like dermal papillae.

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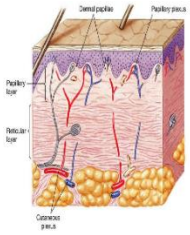
- **RETICULAR LAYER**
    - Much thicker layer of dermis consists of dense, irregular connective tissue.
    - Well vascularized and has a rich sensory and sympathetic nerve supply.
    - Appears reticulated (net-like) due to a tight meshwork of fibers.

fibroblast



ARTERIO-VENOUS ANASTOMOSES (AVAs)

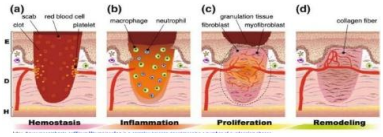
- Direct connections between small arteries and small veins with no capillary section between them.
- Since they contain no capillary segment, they cannot transport dissolved substances to or from the tissues.
- The only transport function they could possibly have is the transport of heat from the body core to surface areas containing AVAs.
- In humans they are numerous in the glabrous skin of the hands and feet.
- All arteriovenous anastomoses have rich innervation and are supplied by blood vessels.
- A **connective tissue sheath (7)** encloses the glomus **(2)**. The **dermis (4)** around the glomus **(2)**contains **blood vessels (8)**, peripheral **nerves (1)**, and excretory **ducts of sweat glands (3)**.

Glomus in the thick skin

pain - nociceptors

WOUND HEALING

- It is a complex process in which the skin, and the tissues under it repair themselves after injury.
- *The four phases are:*
    1. **HEMOSTASIS** (blood clotting)
    2. **INFLAMMATION** (localized swelling, controls bleeding and prevents infection)
    3. **PROLIFERATION** (tissue growth)
    4. **MATURATION** (tissue remodeling)



HAIR

- Hairs develop in the fetus as epidermal down growths that invade the underlying dermis.
- Important for the following reasons:
    1. **PROTECTION**
        - Hairs located in eyebrows and eyelashes protect the eyes from foreign particles, as does hair in the nostrils & in the external ear canal.
    2. **REGULATION OF BODY TEMPERATURE**
        - Hair on the head guards the scalp from injury& sun's rays, also decreases heat loss from the scalp.

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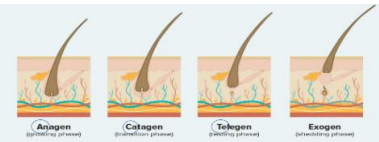
3. **ACT AS SENSE ORGANS**
    - Touch receptors associated with hair follicles (hair root plexuses) are activated whenever a hair is even slightly moved.
    - Thus, hair function in sensing light touch.

4. **FACILITATION OF EVAPORATION OF PERSPIRATION**

STAGES OF HAIR GROWTH

1. **Anagen** (growing phase)
2. **Catagen** (transition phase)
3. **Telegen** (resting phase)
4. **Exogen** (shedding phase)



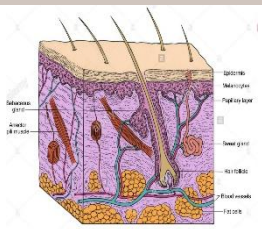
TYPES OF HUMAN HAIR

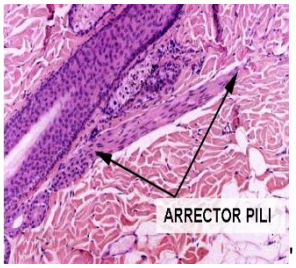
1. **LANUGO HAIR**
    - Fine, downy, unpigmented hair that appears on the fetus in the last three months of development.

2. **VELLUS HAIR**
    - Fine, pale hair that replaces lanugo by the time of birth, and makes up two thirds of the hair on women and one-tenth of the hair on men.
    - Makes up all of the hair on the body of children except for eyelashes, eyebrows, and scalp.

3. **TERMINAL HAIR**
    - Longer, coarser, and usually more heavily pigmented hair located in eyebrows, eyelashes, and hair on scalp and forms the axillary and pubic hair after puberty.

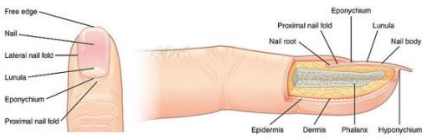
ARRECTOR PILLI





NAILS

- A horny covering protecting the upper surface of the tip of the finger and toe in humans and other primates.



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+ceruminous gland - ear wax/ cerumen
mamahary - milk

CUTANEOUS SENSORY RECEPTORS

1. **FREE NERVE ENDINGS**
   - Free nerve endings are thought to be integrated with a variety of sensations including pain, heat, cold, and touch.

2. **MEISSNER CORPUSCLE**
   - Detect light motion against the skin.

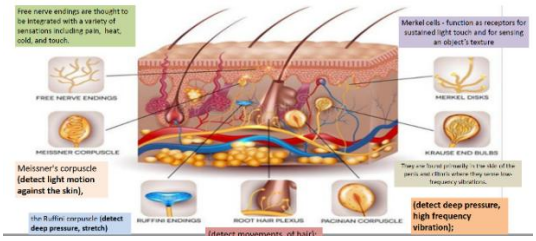
3. **MERKEL DISKS**
   - Function as receptors for sustained light touch and for sensing an object's texture.

4. **KRAUSE END BULBS**
   - They are found primarily in the skin of the penis and clitoris where they sense low-frequency vibrations.

5. **RUFFINI ENDINGS**
   - Detect deep pressure, stretch.

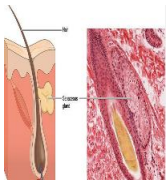
6. **ROOT HAIR PLEXUS**
   - Detect movements of hair.

7. **PACINIAN CORPUSCLE**
   - Detect deep pressure, high frequency vibration.

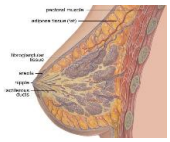


GLANDS

- **SEBACEOUS GLANDS**
  - A microscopic exocrine gland that secretes an oily or waxy matter, called ***SEBUM***, consist of lipids and some proteins.
  - Functions to lubricate and waterproof the skin and hair of mammals.



- **MAMMARY GLANDS**
  - A type of exocrine glands which are enlarged and modified sweat glands and are the characteristic of mammals.
  - Functional in women during childbearing years under the stimulation of ovarian and pituitary hormones.
  - ***LACTATION*** is known as secretion of mammary glands.



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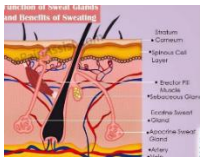
- **SUDORIFEROUS/SWEAT GLANDS**
    - **Eccrine Sweat Glands**
        - It is distributed all over the body and numerous in the palm of the hands, soles of the feet, and the forehead.
        - It discharge the secretions directly to the surface of the skin and function to **regulate the temperature of the body** by cooling it from the outside heat. It also helps in elimination of excess salt and other electrolytes in the body.

    - **Apocrine Sweat Glands**
        - These glands are found in the armpits and larger in size than eccrine sweat glands.
        - It start function only after a person has attained puberty.
        - It produce a secretion which is **viscous and cloudy in nature** and end in the canals of hair follicles instead of pores.



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