Al-Zahraa University for Women

College of Pharmacy

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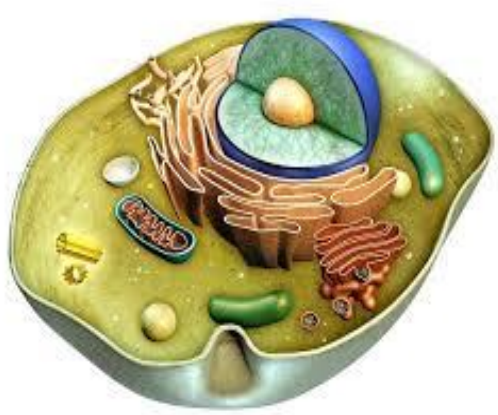
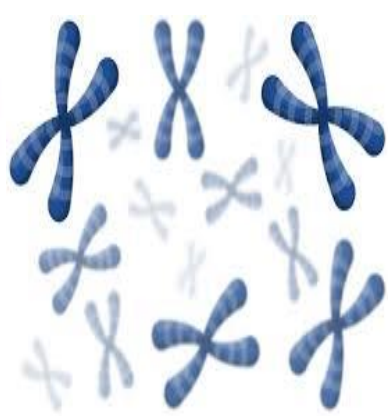
Biology

First stage

First Semester (Practical)





List of contents

Lab 1: Microscopes

Microscopes are essential tools in biology, allowing scientists to observe and study organisms and cells that are too small to be seen with the naked eye.

Microscope Types:

1. **Light Microscope** (Optical Microscope):

   Principle: Uses visible light and a system of lenses to magnify samples.

   Types:

a) Compound Microscope: Features multiple lenses for magnification; ideal for viewing thin sections of specimens. Typically has two or more objective lenses with varying magnifications (e.g., 4x, 10x, 40x, 100x).Uses transmitted light, meaning the light passes through the specimen.

b) Stereo Microscope: Provides a 3D view of larger specimens, useful for dissections.

2. Electron Microscope:

- ❖ Principle: Uses beams of electrons for imaging, allowing much higher magnification and resolution than light microscopes.
- ❖ Types:

a) Transmission Electron Microscope (TEM): Electrons pass through a thin specimen, providing detailed images of internal structures.

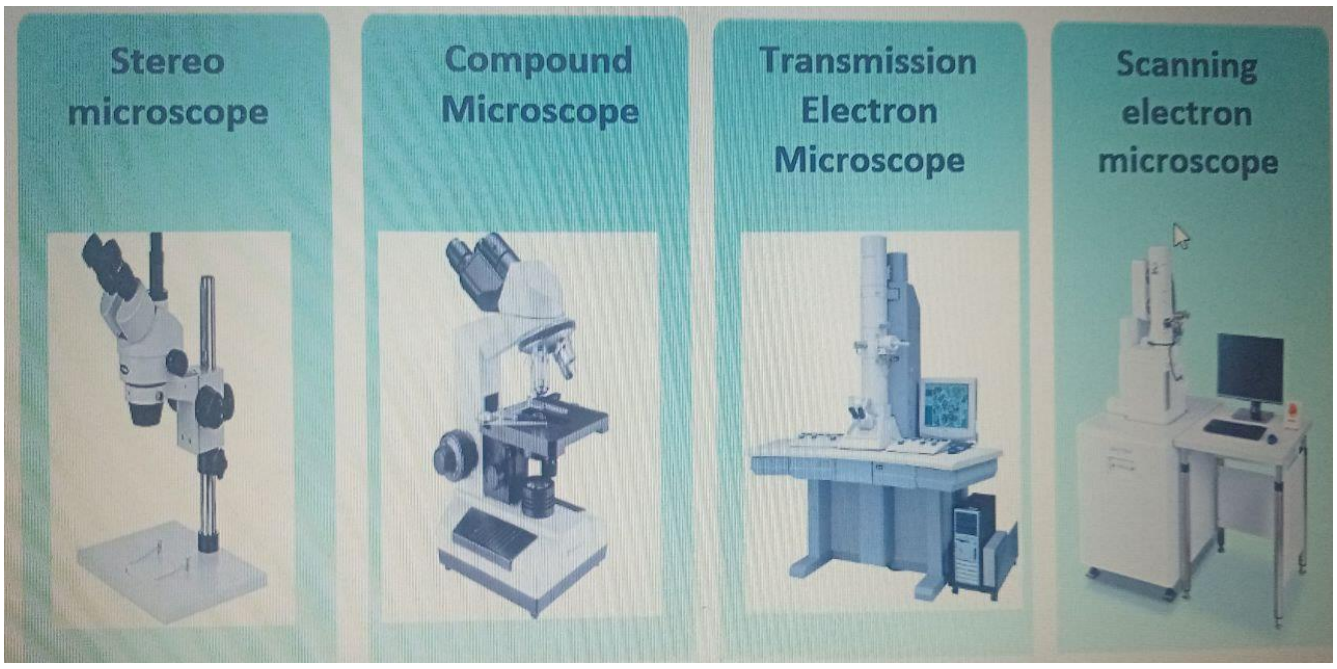
b) Scanning Electron Microscope (SEM): Electrons scan the surface of a specimen, creating detailed 3D images of its topography.

❖ Parts of the light microscope

A compound microscope is made up of both structural and optical components.

the 3 basic structural components are – the head, arm and base.

1. The body or head comprises the optical parts present in the upper part of the microscope.
2. The arm connects and supports the base and head of the microscope. Also, it is used to carry the microscope.
3. Base of the microscope supports the microscope and comprises the illuminator.

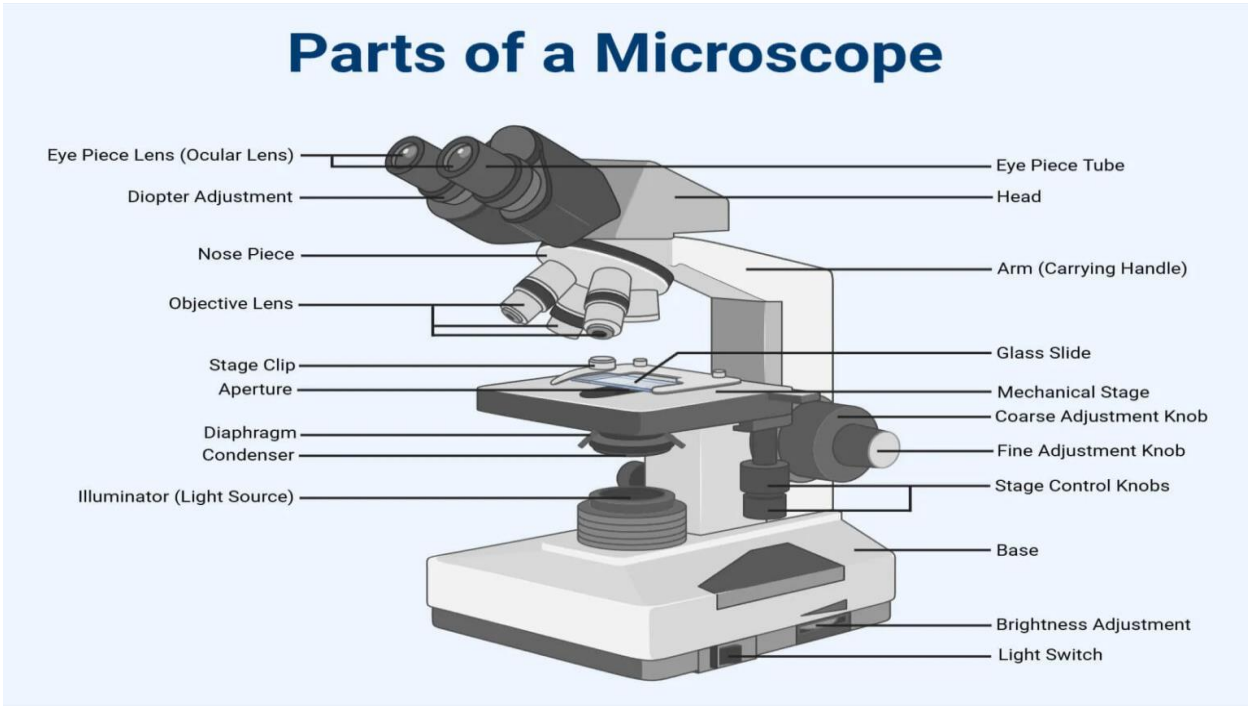


Anatomy of a compound Microscope

The optical part of the microscope includes:

1. Eyepiece or Ocular contain the ocular lens at the top of the microscope.
2. Eyepiece Tube holds the eyepieces in place above the objective lens.
3. Objective lenses are the primary optical lenses on a microscope. They range from 4x,10x,40x and oil immersion 100x and typically include four lenses on most microscope.
4. Nosepiece holds the objective lenses can be rotated to change magnification.
5. Fine & Coarse adjustment knobs are used to moves the stage slightly to sharpen & focusing the image.
6. stage supports the slide being viewed.
7. The aperture is a tiny hole in the stage via which the transmitted light enters the stage.
8. Illuminator is the light source for a microscope typically located in the base of the microscope.
9. Condenser is used to collect and focus the light from the illuminator on the specimen is located under the stage.

10. Condenser Focus knob moves the condenser up or down to control the light focus on the specimen.
11. Diaphragm regulates the amount of light that reaches the specimen.



Applications in Biology:

- Cell Biology: Studying cell structure.
- Microbiology: Identifying and characterizing microorganisms.
- Histology: Examining tissue samples to understand morphology and pathology.

BASIC UNITS FOR MICROSCOPE

1 meter = 1000 millimeter

1 millimeter = 1000 micrometer (µm) = 10^{-6} meter

1 micrometer = 1000 nanometer (nm) = 10^{-9} meter

1 Angstrom (A) = 10^{-10} meter

1 nanometer = 10 Angstrom

MAGNIFICATION AND RESOLUTION

Magnification is the apparent increase in size affected by a convex lens. A compound microscope uses two sets of lenses, with differing focal lengths, to facilitate magnification. The total magnification achieved by the lens array is the product of each individual lens.

Magnification (total) = magnification (obj. lens) x magnification (ocu. lens)

Example:

Mag (obj) = 40X and Mag (ocular) = 10X

Then Mag (total) = (40X) (10X) = 400X.

Resolution is the ability to separate points (in other words, to observe fine detail), or the ability of a lens to distinguish between small objects that are close together.

Microscope Care

- ✓ **Always carry with 2 hands.**
- ✓ **Never touch the lenses with your fingers.**
- ✓ **Only use lens paper for cleaning.**

Lab 2: The Cell

What is the cell?

- The cell is the basic structural, functional, and biological unit of all known living organisms. A cell is the smallest unit of life are often called the "building blocks of life". The study of cells is called cell biology.

- Cell biology: is a branch of biology deals with the study of cells from morphology, structure, function and biochemical point of views, the idea and concept of cell biology evolved during 19th century as a result of gradual advancement in the field of microscopy and biochemistry

- The first cells were observed and named by Robert Hooke in 1665 from slice of cork.

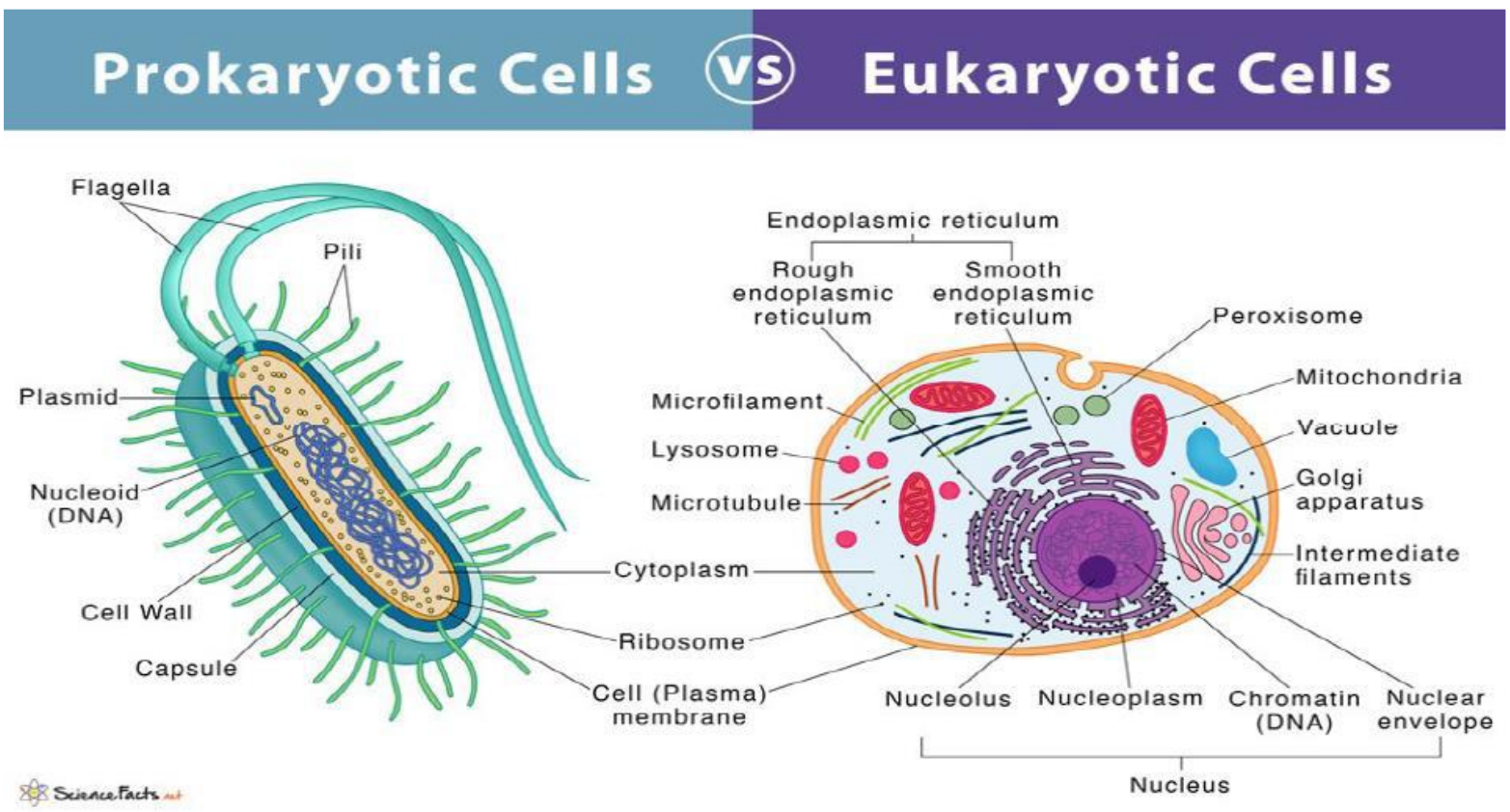
- Cells consist of cytoplasm enclosed within a membrane, which contains many biomolecules such as proteins and nucleic acids. Organisms can be classified as unicellular (consisting of a single cell; including bacteria) or multicellular (including plants and animals).

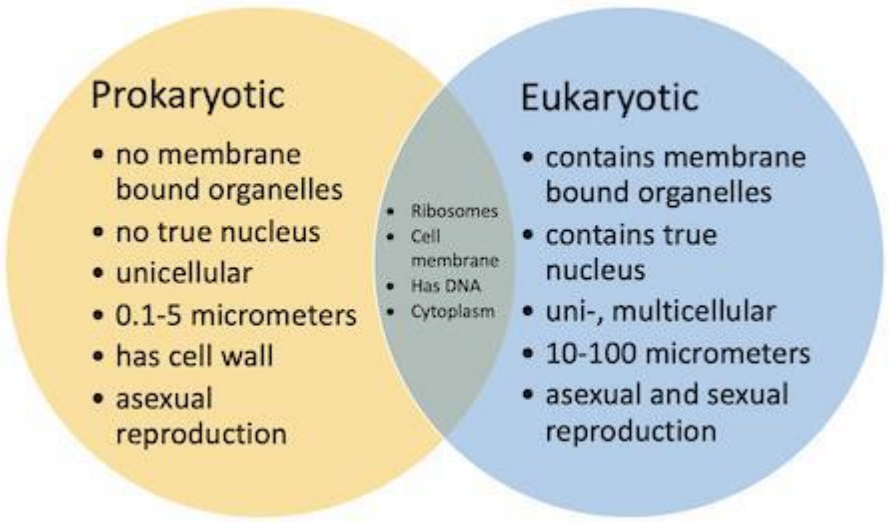
- Humans contain more than 40 trillion cells.

Type of cells

1- Prokaryotic cell: Unicellular organisms which don't have membrane bound organelles like nucleus and mitochondria are referred to as prokaryotic cells. . These organisms are divided into two groups depending on the components of the cell wall: Bacteria and Archaea.

2- Eukaryotic cell: 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. Eukaryotic cells are larger and more complex than prokaryotic cells Eukaryotic.





Cell Structure & Function

1.Cell Membrane

Components:

- Lipids
- Proteins
- Carbohydrates

Function:

1. Allows selective passage in & out the cell

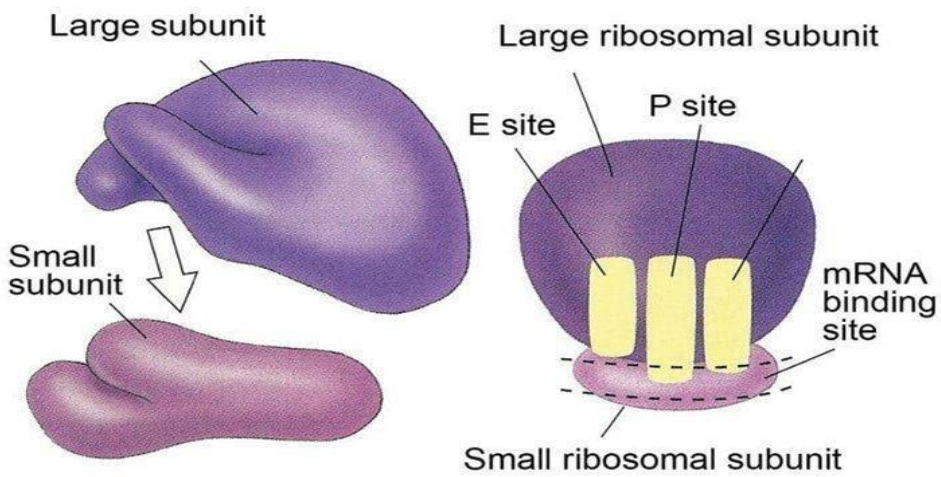
2. Isolates cell contents

3. Controls what gets in and out of the cell

4. Receives signals

2. Ribosomes

- Structure: Tiny particle, so small.
- It is composed of two subunits smaller and larger.
- Function: Make proteins.



3.The Nucleus

- Separated from cytoplasm by nuclear membrane.
- Contains genetic material – DNA.
- Nucleoplasm – fluid of the nucleus.

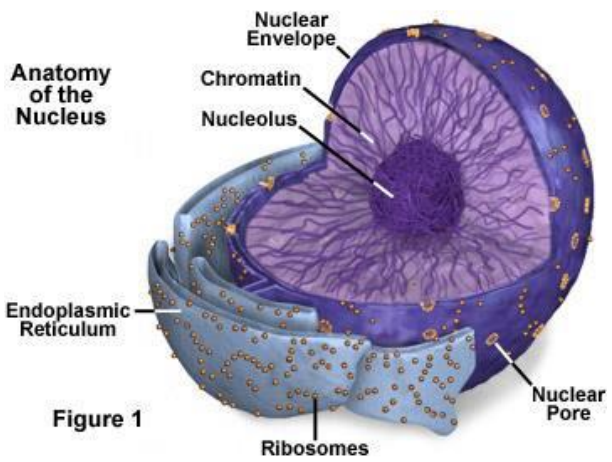


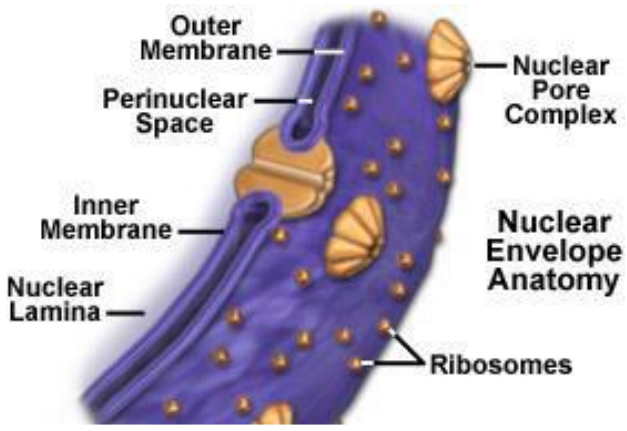
Figure 1

4.Nucleolus

- Inside nucleus. Contains RNA to build proteins.
- Contains RNA to build proteins.

5.Nuclear Membrane

- Surrounds nucleus.
- Double membrane.
- Openings allow material to enter and leave nucleus.

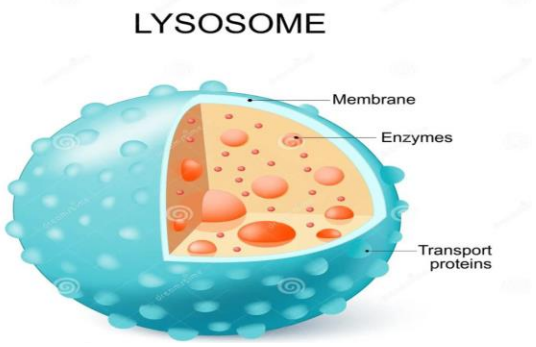


6. Cytoplasm

- Gel-like mixture.
- Surrounded by cell membrane.
- Contains hereditary material in prokaryotic cell.

7. Lysosome

- Round organelles surrounded by membrane.
- Transports undigested material to cell membrane for removal.



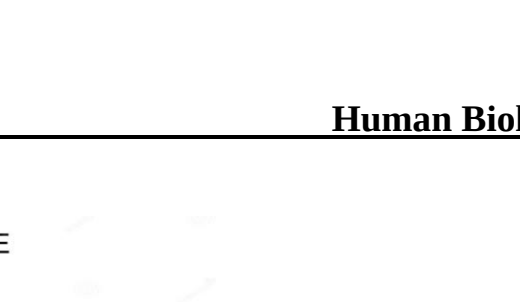
8. Golgi Bodies

- Move materials within the cell.
- Move materials out of the cell.

9. Vacuoles:

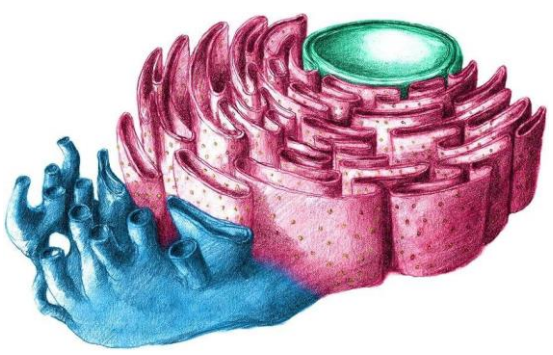
Membrane-bound sacs for storage, digestion, and waste removal.

Stores food and water.



10. Endoplasmic Reticulum (ER)

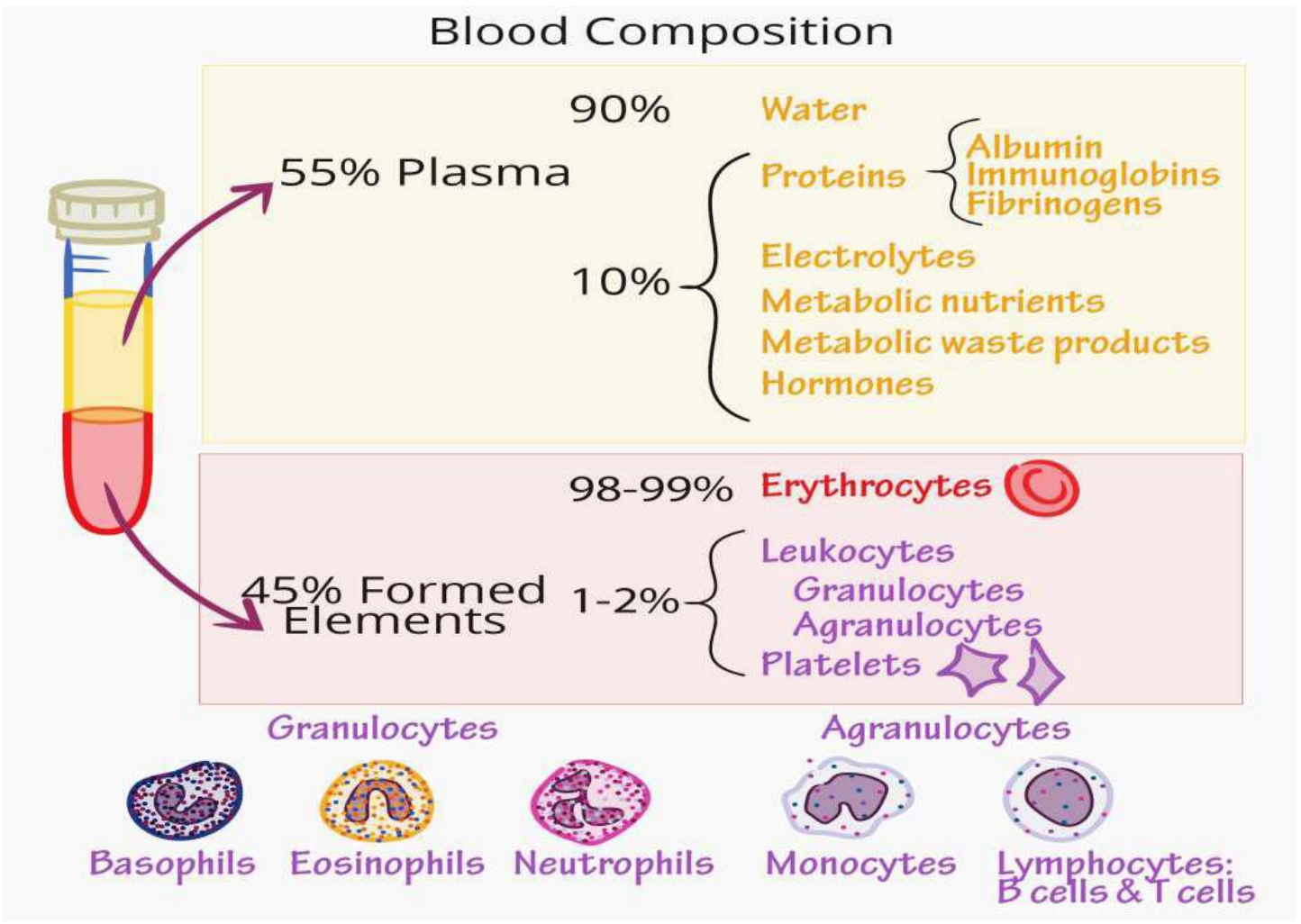
- Like tubes.
- Smooth ER - no ribosomes attached.
- Rough ER - ribosomes are attached.
- Protein synthesis, lipid synthesis, storing calcium.



Lab3: Blood Human

What is Blood?

Blood is a fluid connective tissue that consists of plasma, blood cells and platelets. It circulates throughout our body delivering oxygen and nutrients to various cells and tissues. It makes up 8% of our body weight. An average adult possesses around 5-6 litres of blood.



Serum vs. Plasma: What's the Difference?

Serum and plasma both come from the liquid portion of the blood that remains once the cells are removed, but that's where the similarities end.

•Serum is the liquid that remains after the blood has clotted it doesn't contain cloting factor.

•Plasma is the liquid that remains when clotting is prevented with the addition of an anticoagulant it contains cloting factor such as fibrinogen

Blood Component and their functions

Blood is composed of plasma, red blood cells, white blood cells, and platelets, each playing a vital role in maintaining bodily functions. Plasma transports cells, nutrients, waste, and proteins, while red blood cells carry oxygen and carbon dioxide. White blood cells combat infections and platelets are crucial for blood clotting.

Plasma:

This is the liquid component of blood, making up about 55% of its volume. It acts as a transport medium for blood cells, nutrients (like glucose and amino acids), waste products (like urea), hormones, and proteins (including clotting factors and antibodies). Plasma also helps regulate body temperature and maintain fluid balance.

Red Blood Cells (Erythrocytes):

These cells, also known as erythrocytes, are responsible for carrying oxygen from the lungs to the rest of the body and transporting carbon dioxide back to the lungs for exhalation. They contain hemoglobin, a protein with iron that binds to oxygen, giving blood its red color.

White Blood Cells (Leukocytes):

White blood cells are the body's defense system, protecting against infections and foreign invaders. Different types of white blood cells, like lymphocytes and neutrophils, have specialized roles in fighting off bacteria, viruses, and other pathogens.

Platelets (Thrombocytes):

Platelets are cell fragments that play a crucial role in blood clotting. When a blood vessel is damaged, platelets rush to the site to form a plug, preventing excessive bleeding.

Lab 4 : Connective tissue

Connective tissue typically consists mostly of fibers and ground substance, with widely separated cells. The mesenchyme is a form of embryonic connective tissue. The connective tissues present after birth fall into three broad categories:

1. fibrous connective tissues.
2. supportive connective tissues (cartilage and bone).
3. fluid connective tissue(blood).

classification of connective tissue

Connective tissue is broadly classified into connective tissue proper, specialized connective tissue, and fluid connective tissue. Connective tissue proper is further divided into loose and dense connective tissues.

1. Connective Tissue Proper:

a. Loose Connective Tissue:

Characterized by a gel-like matrix with many cells and relatively few fibers. Examples include:

Areolar Tissue: Found beneath the skin and around organs, providing cushioning and support.

Adipose Tissue: Fat tissue that stores energy and insulates the body.

Reticular Tissue: Forms a framework for organs like the spleen and lymph nodes.

b. Dense Connective Tissue:

Contains more fibers and fewer cells compared to loose connective tissue, providing strength and support. Examples include:

Dense Regular Connective Tissue: Fibers are arranged in parallel, like in tendons and ligaments.

Dense Irregular Connective Tissue: Fibers are arranged randomly, providing support in multiple directions, found in the dermis of the skin.

Elastic Connective Tissue: Contains a high proportion of elastic fibers, allowing for stretch and recoil, found in the walls of arteries and lungs.

2. Specialized Connective Tissue:

a. Cartilage:

A strong, flexible tissue that provides support and cushioning. Examples include:

Hyaline Cartilage: Found in the nose, trachea, and on bone surfaces for smooth movement.

Elastic Cartilage: Found in the ear and epiglottis, providing flexibility and support.

Fibrocartilage: Found in the intervertebral discs and menisci of the knee, providing strength and shock absorption.

b. Bone:

A rigid tissue that provides support, protection, and a reservoir for minerals.

c. Blood:

A fluid connective tissue that transports oxygen, nutrients, and waste products.

3. Fluid Connective Tissue:

a. Blood:

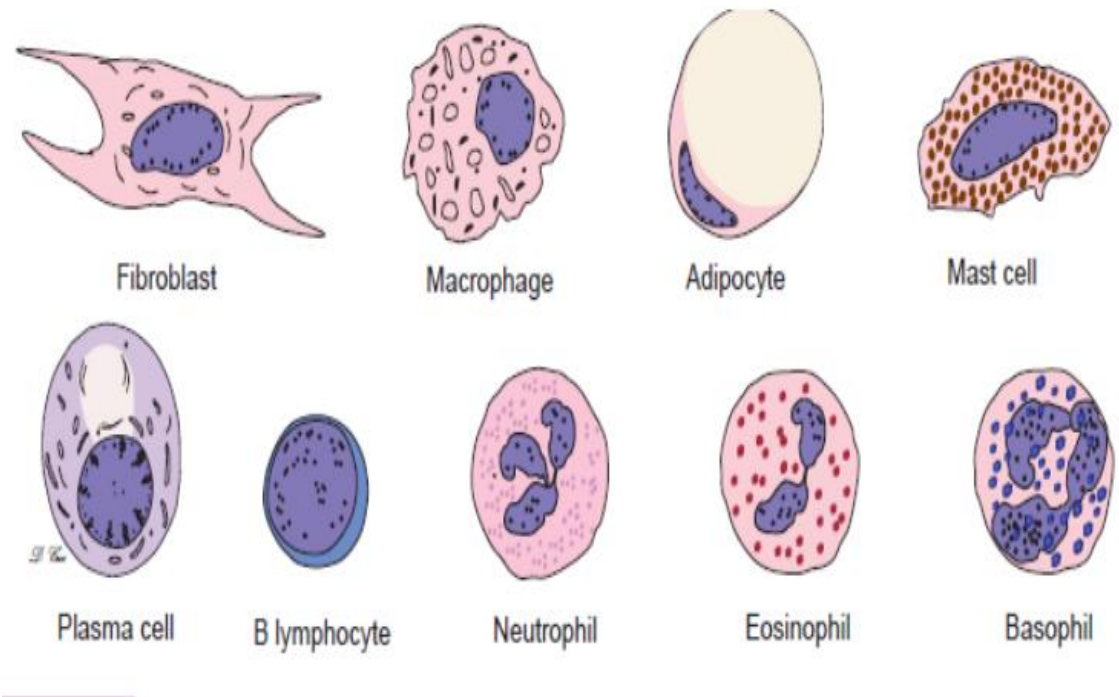
A fluid connective tissue that circulates throughout the body, composed of plasma and various cell types.

b. Lymph:

A fluid that bathes tissues and organs, collecting waste products and returning them to the bloodstream.

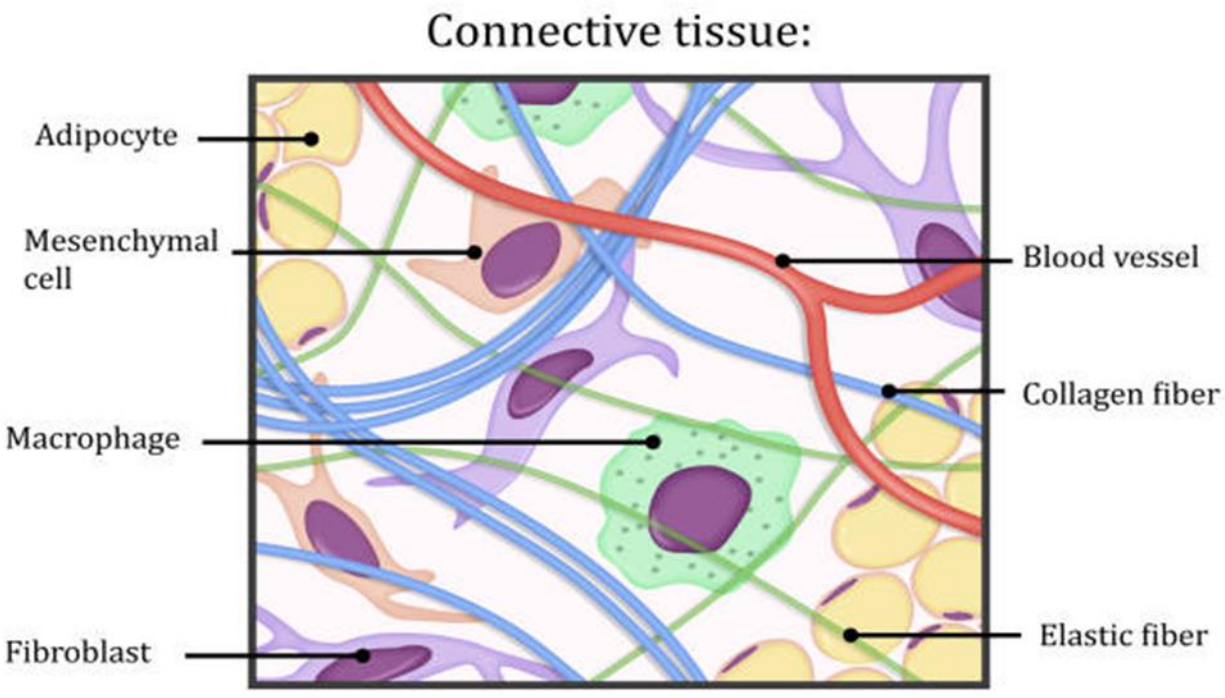
True Connective Tissue Cells

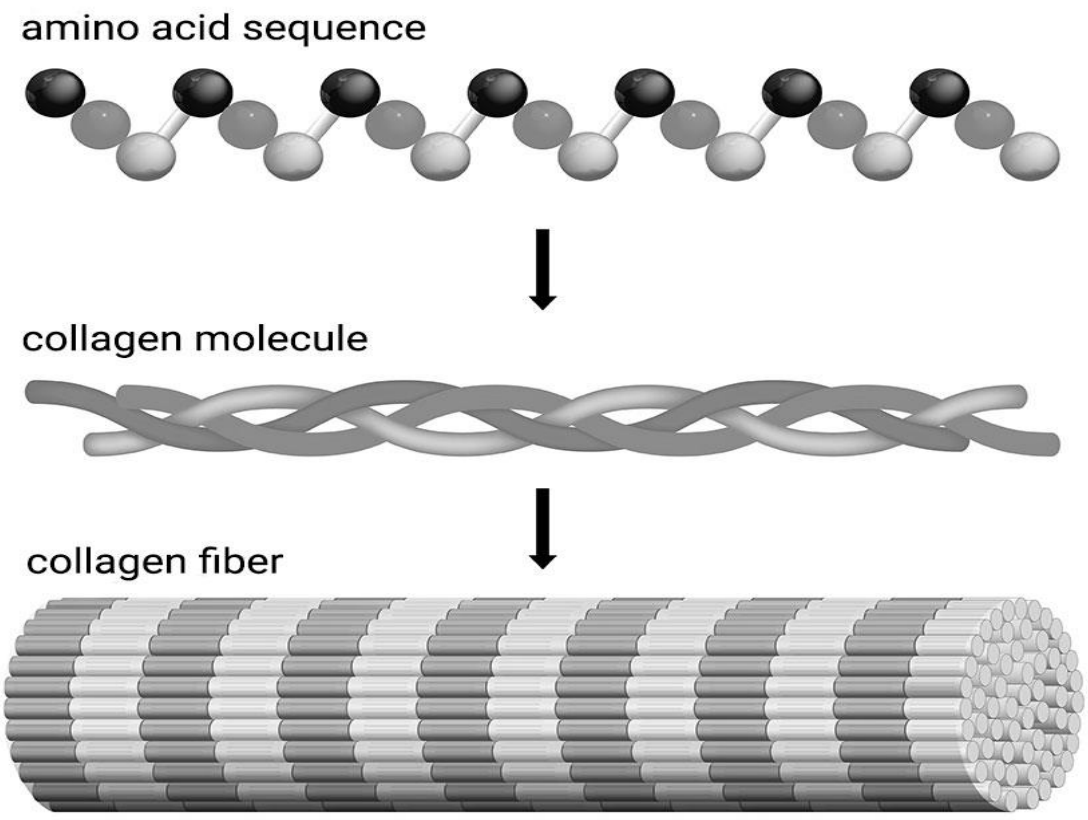
1. Fibroblasts: Secrete both fibers and ground substance of the matrix (wandering)
2. Macrophages: Phagocytes cell that develop from Monocytes (wandering or fixed)
3. Plasma Cells: Antibody secreting cells that develop from B Lymphocytes (wandering)
4. Mast Cells: Produce histamine that help dilate small blood vessels in reaction to injury (wandering)
5. Adipocytes: Fat cells that store triglycerides, support, protect and insulate (fixed)

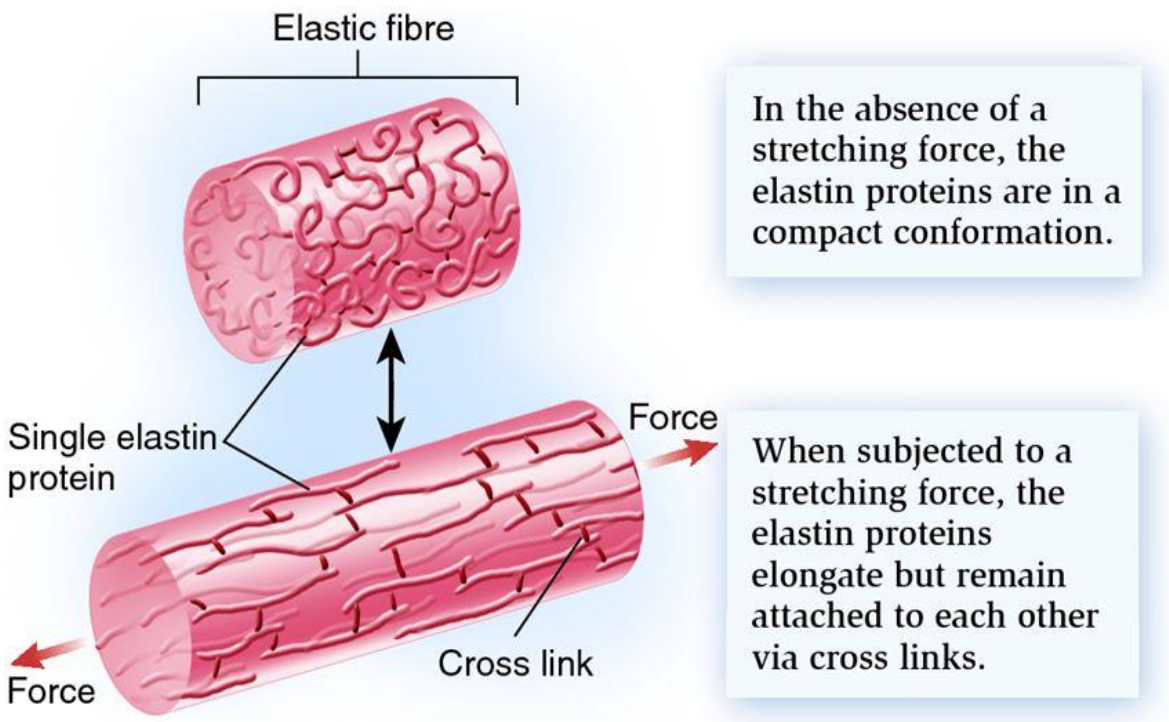


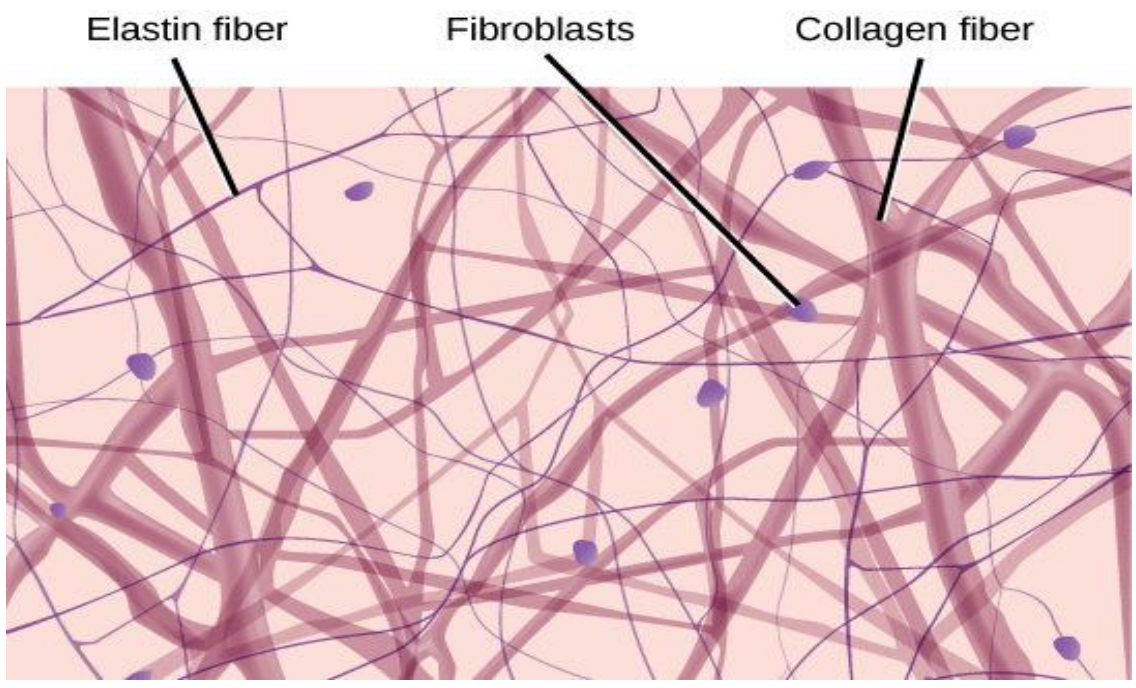
Three types of protein fibers are found in fibrous connective tissues:

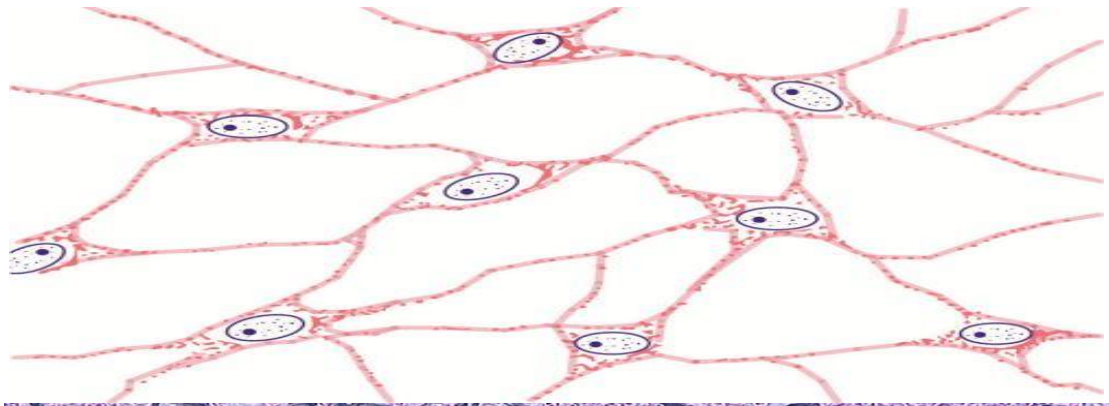
1. Collagen Fibers: Large fibers made of the protein collagen and are typically the most abundant fibers. Promote tissue flexibility, it keeps the muscle from tearing away from the bone.
2. Elastic Fibers: Intermediate fibers made of the protein elastin. Branching fibers that allow for stretch and recoil
3. Reticular Fibers: Small delicate, branched fibers that have same chemical composition of collagen. Forms structural framework for organs such as spleen, liver and lymph nodes.




amino acid sequence
collagen molecule
collagen fiber


Elastic fibre
In the absence of a stretching force, the elastin proteins are in a compact conformation.
Single elastin protein
Force
When subjected to a stretching force, the elastin proteins elongate but remain attached to each other via cross links.
Cross link
Force


Elastin fiber
Fibroblasts
Collagen fiber



❖ EPITHELIAL TISSUES

The epithelial tissue, or epithelium, consists of sheets of cells that cover the external surfaces of the body, line the internal cavities, from various organs and glands, and line their ducts.

Functions:

1. Protection of the underlying tissues.
2. Absorption of substances.
3. Regulation of chemicals between the tissues and body cavity.

Types of epithelial tissues

The simplest classification of these tissues is based on the number of cell layers:

1- Simple epithelia: composed of a single layer of cells.
2- Stratified epithelia: containing two or more layers of cells.

Epithelia can also be classified based on the shape of the cells to three types:

1- Squamous epithelial tissue: (Flat, scale-like cells).
2- Cuboidal epithelial tissue: (cube shaped cells)
3- Columnar epithelial tissue: Cells that are shaped like a column or cylinder)

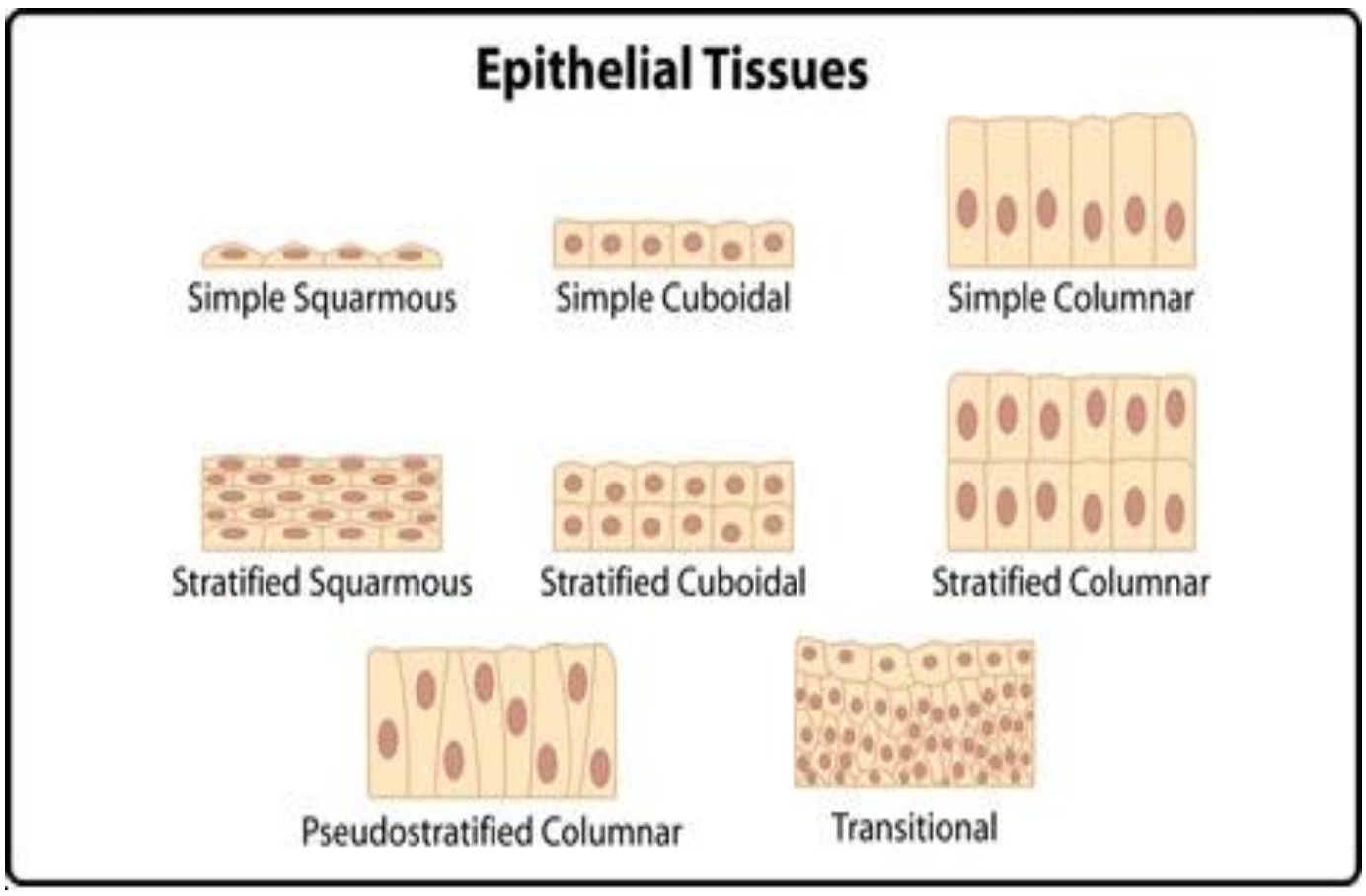
Simple epithelia are classified according to the shape of their cells:

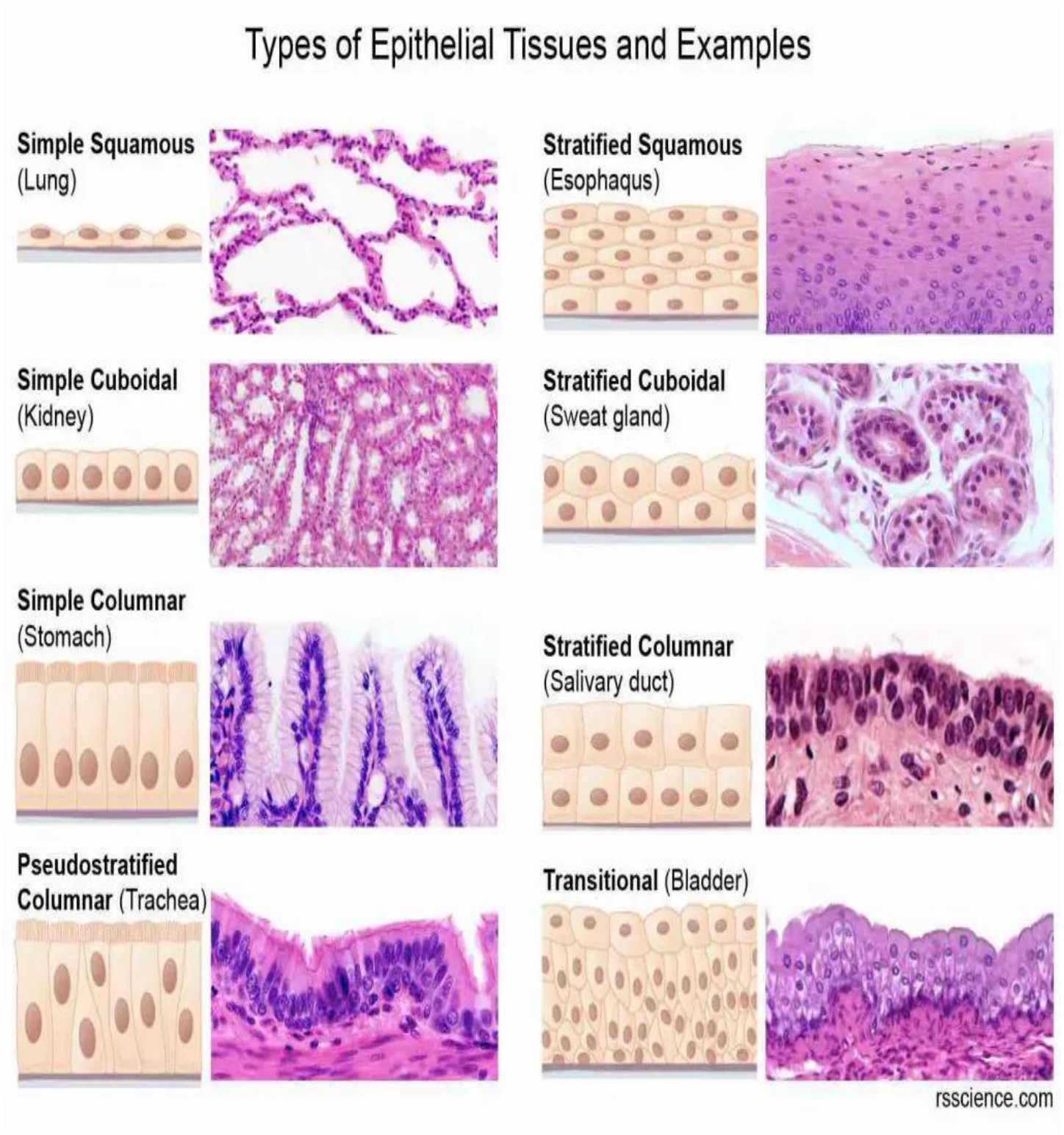
1- Simple Squamous Epithelia consists of a single layer of flat cells.
ex: blood vessels, lymphatic vessels, air sacs of lungs, lining of heart.

2- Simple Cuboidal Epithelia single layer of cells is described as Cuboidal because in transverse section the cells appear square.
ex: Ovaries, thyroid gland, kidney tubukes.

3- Pseudostratified. ex: trachea

4- Simple Columnar Epithelia are all tall columnar and fit together in an essentially hexagonal pattern. Ex: nonciliated type lines most of the digestive tract (stomach, gallbladder).




Types of Epithelial Tissues and Examples
Simple Squamous (Lung)
Stratified Squamous (Esophaqus)
Simple Cuboidal (Kidney)
Stratified Cuboidal (Sweat gland)
Simple Columnar (Stomach)
Stratified Columnar (Salivary duct)
Pseudostratified Columnar (Trachea)
Transitional (Bladder)
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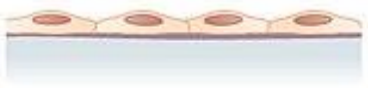
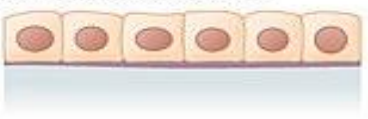
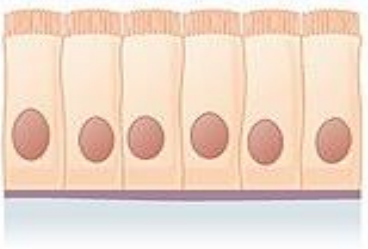
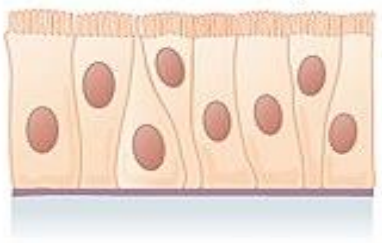
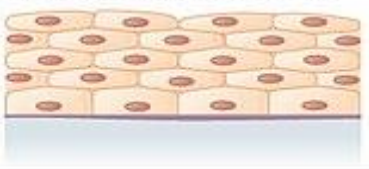
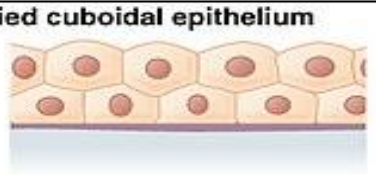
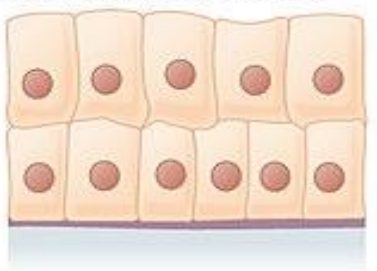
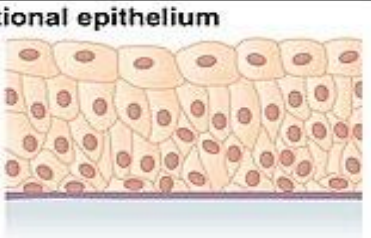
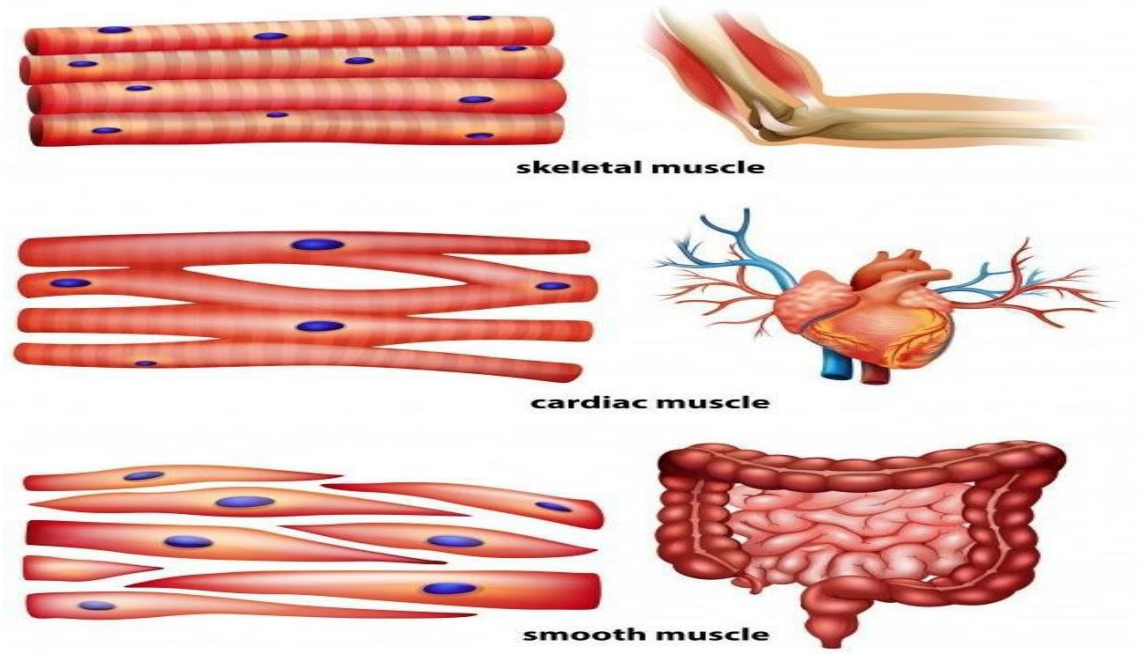
Cells	Location	Function
Simple squamous epithelium 	Air sacs of lungs and the lining of the heart, blood vessels, and lymphatic vessels	Allows materials to pass through by diffusion and filtration, and secretes lubricating substance
Simple cuboidal epithelium 	In ducts and secretory portions of small glands and in kidney tubules	Secretes and absorbs
Simple columnar epithelium 	Ciliated tissues are in bronchi, uterine tubes, and uterus; smooth (nonciliated tissues) are in the digestive tract, bladder	Absorbs; it also secretes mucous and enzymes
Pseudostratified columnar epithelium 	Ciliated tissue lines the trachea and much of the upper respiratory tract	Secretes mucus; ciliated tissue moves mucus
Stratified squamous epithelium 	Lines the esophagus, mouth, and vagina	Protects against abrasion
Stratified cuboidal epithelium 	Sweat glands, salivary glands, and the mammary glands	Protective tissue
Stratified columnar epithelium 	The male urethra and the ducts of some glands	Secretes and protects
Transitional epithelium 	Lines the bladder, uretha, and the ureters	Allows the urinary organs to expand and stretch

Lab 5: Muscular tissue & Nervous tissue

Muscular tissue is a type of tissue that is responsible for the movement in the body. It is classified into three main types, each with distinct structures, functions, and locations.

There are three types of muscle tissue:

Skeletal Muscle – they are typically attached to bones.
Cardiac Muscle – found in the heart.
Smooth Muscle – they are found in the inner walls of organs



Functions of Muscle Tissue

1.Helps in maintaining an erect position, or posture.

2.Helps in the constriction of organs and blood vessels.

3.Involved in both voluntary and involuntary movements.

4.Involved in pumping blood and regulating the flow of blood in arteries.

Muscle tissue

A. Skeletal muscle

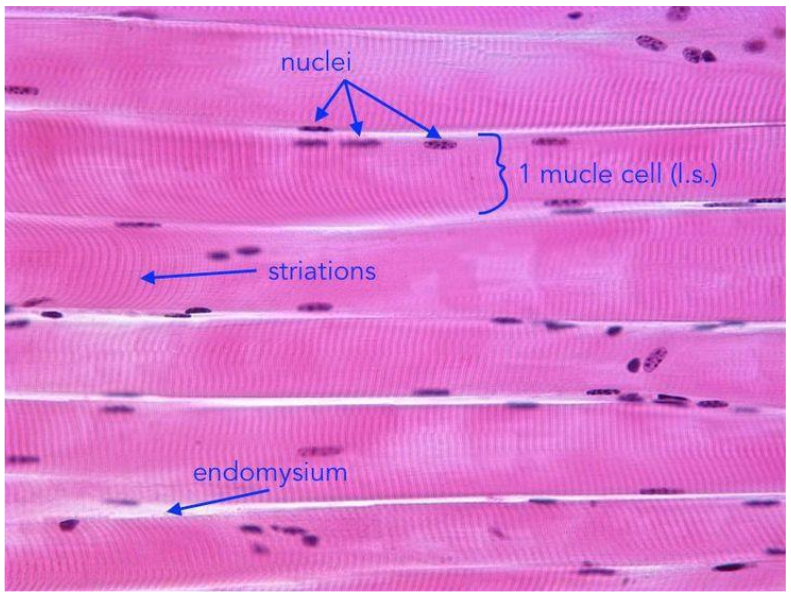
1. Striated and voluntary

2. Skeletal muscle fibers are long, cylindrical, unbranched.

3. Found mostly attached to the skeleton

4. Nuclei are peripherally located

5. location: skeletal muscle attached to the bones by tendons.



B. Cardiac muscle

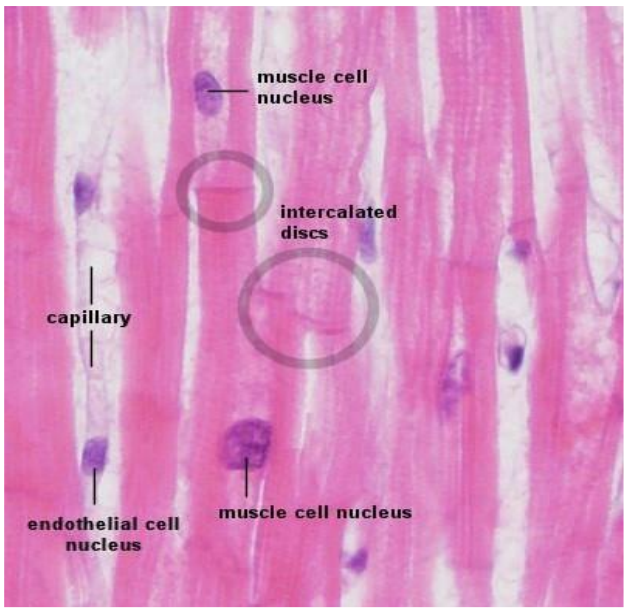
1) Striated and involuntary

2) Composes the majority of the heart wall (myocardium)

3) One central nucleus

4) fiber are short and branched

5)location: the main tissue of the walls of the heart.



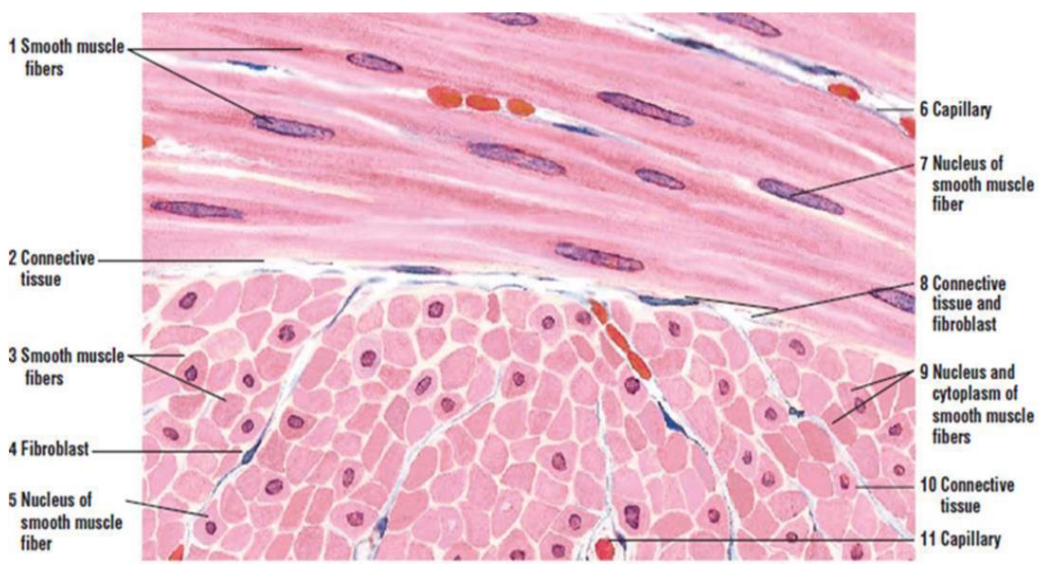
C. Smooth muscle

1) Non striated, involuntary and contain single central nucleus.

2) found in the walls of blood vessels, stomach, and intestines, uterus, ureters, and other hollow organs.

3) fibers are small and spindle in shape.

4) location: in the wall of hollow organs (digestive and urinary tract organs, uterus and blood vessels).



Nervous tissue

Is a tissue that are specialized for receiving different types of stimuli.

Neuron Consists of:

Cell Body : contains Nucleus, Mitochondria, Nissl bodies

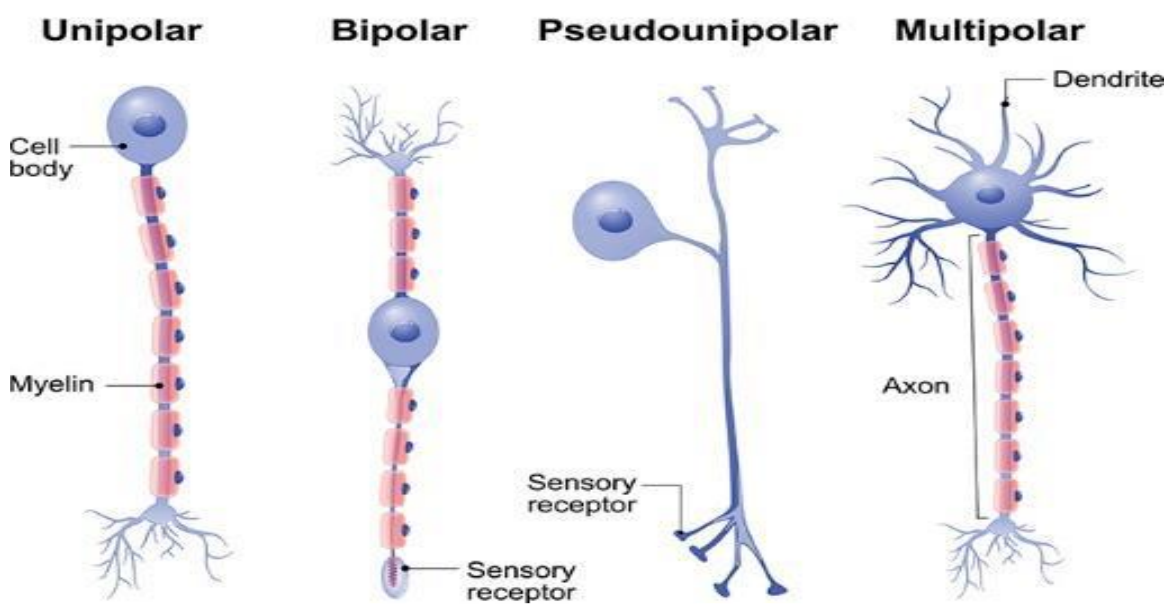
Dendrites: highly branched extensions of the cell body. Conduct impulses towards the cell body

Axon: a single long process. Conducts impulses away from the cell body.

Is a tissue that are specialized for receiving different types of stimuli.

Structural of Neurons:

1. Multipolar neurons: more than two processes one is the axon and the rest are dendrites
2. Bipolar neurons: have two processes one is axon and other one is dendrites
3. Pseudo unipolar neurons: have a single process close to the perikaryon.



Lab 6: Bone & Cartilage

Bone: is a specialized connective tissue composed of calcified extracellular material (mainly collagen fibers and minerals such as calcium phosphate), the bone matrix.

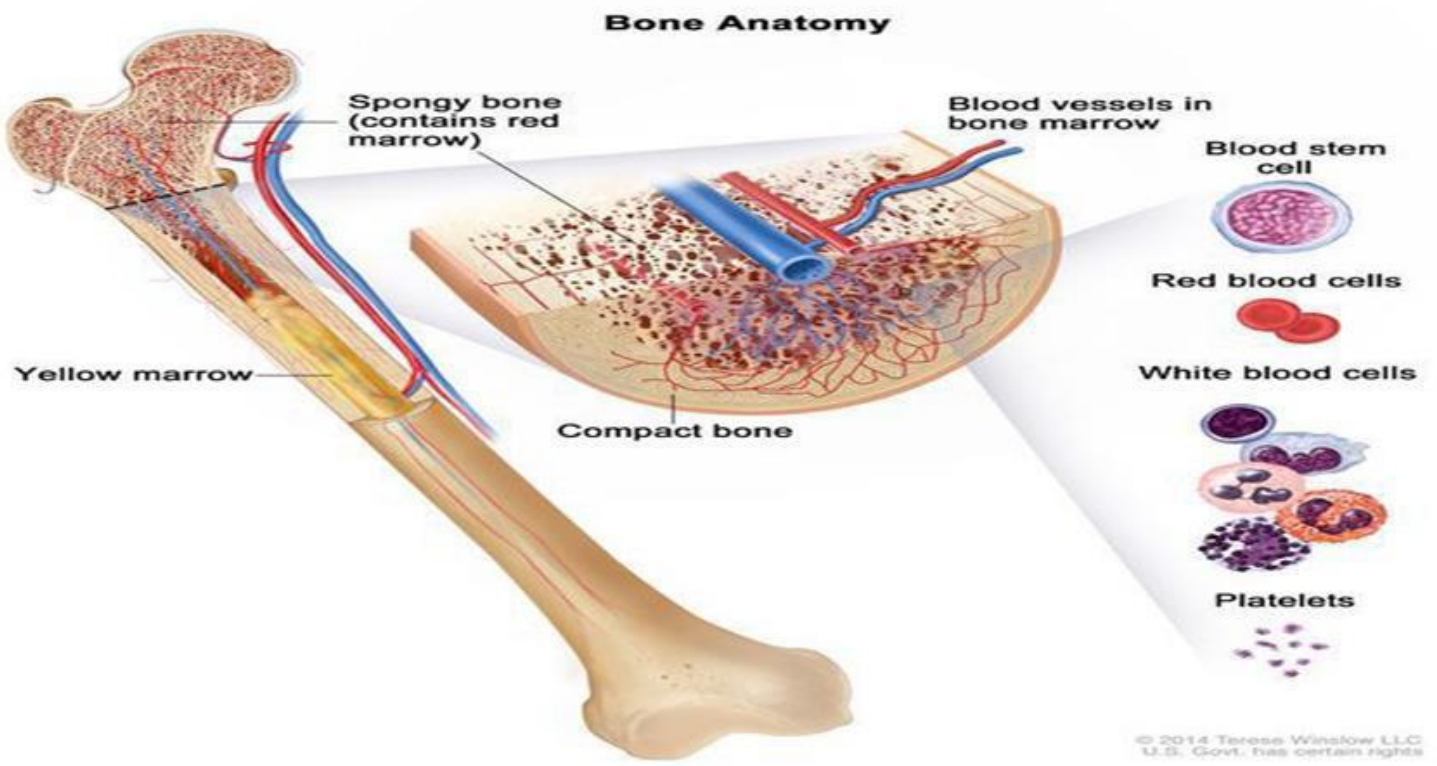
MAJOR FUNCTIONS OF BONES ARE TO:

1.Provide structural support for the body

2.Provide protection of vital organs (e.g., skull protects the brain).

3.Produces blood cells (hematopoiesis) in the bone marrow.

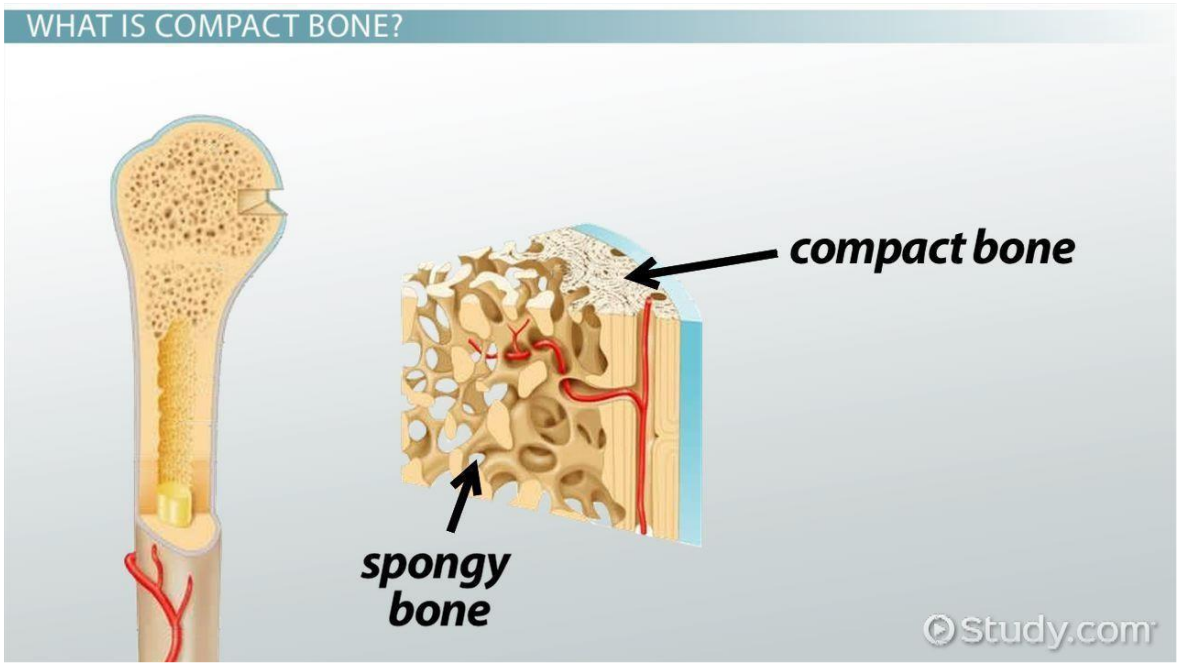
4. Stores minerals (calcium, phosphorus) and fat (in the marrow).



BONES ARE MADE OF TWO TYPES:

Compact bone: also known as cortical bone, this hard-outer layer is strong and dense

Spongy bone: this spongy inner layer is lighter and less dense than cortical bone (more porous, found in the interior).



Bone following three major cell types

• **Osteocytes:** Mature bone cells

• **Osteoblasts:** Bone-forming cells (growing cells) Osteoblasts have three main functions:

1-Growing new bones (bone formation).

2-Reshaping bones to help them change as you age (remodeling).

3-Healing broken bones

Osteoclasts:

1. **Bone Resorption** : Osteoclasts break down bone tissue by secreting acids and enzymes that dissolve the mineral components and collagen matrix of bone.
2. **Calcium Homeostasis** : By breaking down bone, osteoclasts release calcium and phosphate into the bloodstream, helping to regulate mineral levels in the body

• Bone remodeling is a process by both osteoblasts and osteoclasts

Types of bones according to their shapes

Bones in the human body are classified into four main types based on their shape: long, short, flat, and irregular. Sesamoid bones are sometimes considered a fifth type.

1. Long Bones:

- **Shape: Longer than they are wide, with a shaft and two bulky ends.**
- **Examples: Femur (thigh bone), humerus (upper arm bone), radius and ulna (forearm bones), tibia and fibula (lower leg bones), and bones of the fingers and toes.**
- **Function: Primarily for movement and support.**

2. Short Bones:

- **Shape: Roughly cube-shaped, with approximately equal length, width, and thickness.**
- **Examples: Carpals (wrist bones) and tarsals (ankle bones).**
- **Function: Provide stability and some limited motion.**

3. Flat Bones:

- **Shape: Thin and flattened, often curved.**
- **Examples: Skull bones (frontal, parietal, occipital, nasal), ribs, sternum, scapulae (shoulder blades), and bones of the pelvis (ilium, ischium, pubis).**
- **Function: Protect internal organs and serve as areas for muscle attachment.**

4. Irregular Bones:

- **Shape: Don't fit into any other category, with complex shapes.**
- **Examples: Vertebrae (bones of the spine), sacrum, coccyx, ethmoid and sphenoid bones of the skull, and some facial bones.**
- **Function: Provide support, protection, and muscle attachment.**

5. Sesamoid Bones:

- **Shape: Small and round, embedded within tendons.**
- **Examples: Patella (kneecap) is the largest and most consistent sesamoid bone, others can be found in the hands and feet.**
- **Function: Protect tendons from stress and improve leverage.**

Cartilage

Cartilage remains in isolated areas

- Bridge of the nose
- Parts of ribs
- Joints

Characteristics:

- Cartilage is a strong, flexible connective tissue that protects your joints and bone.
- Composed of cartilage cells and a matrix rich in collagen and elastic fibers.

Functions:

- Provides support and flexibility in certain areas (e.g., nose, ears).
- Reduces friction in joints, acting as a cushion.
- Aids in shock absorption.

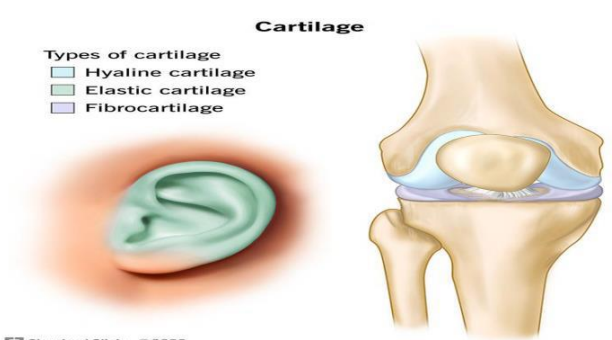
Types of cartilage

There are three types of cartilage in your body:

1-Hyaline cartilage.

2-Elastic cartilage.

3-Fibrocartilage.

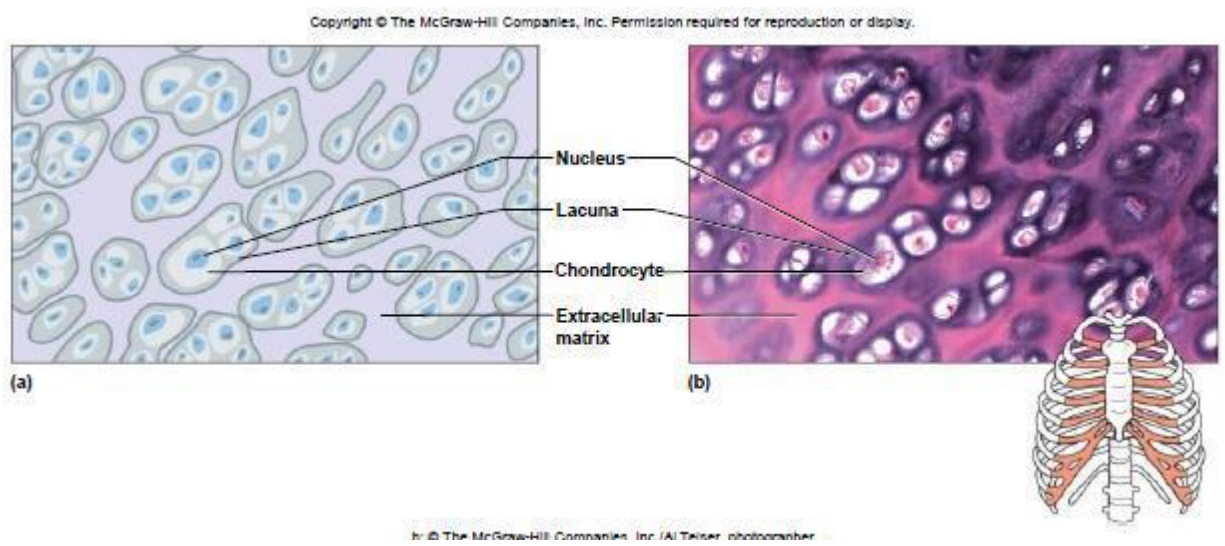


Hyaline cartilage: is the most common type of cartilage in your body.

Hyaline cartilage locations in your body include:

1-At the ends of bones that form joints.

2-Between your ribs.



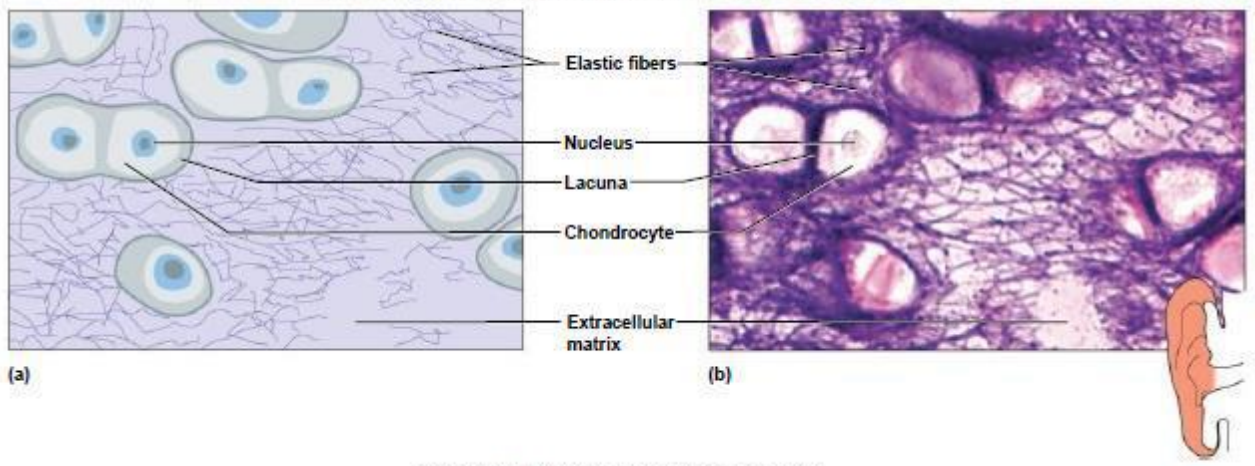
Elastic cartilage: (also called yellow cartilage) is your most flexible cartilage. Your ear is made of elastic cartilage.

Elastic cartilage locations in your body include:

1-Your external ears .

2- the tube that carries sounds from your external ear into your head.

3-Your larynx (your voice box).



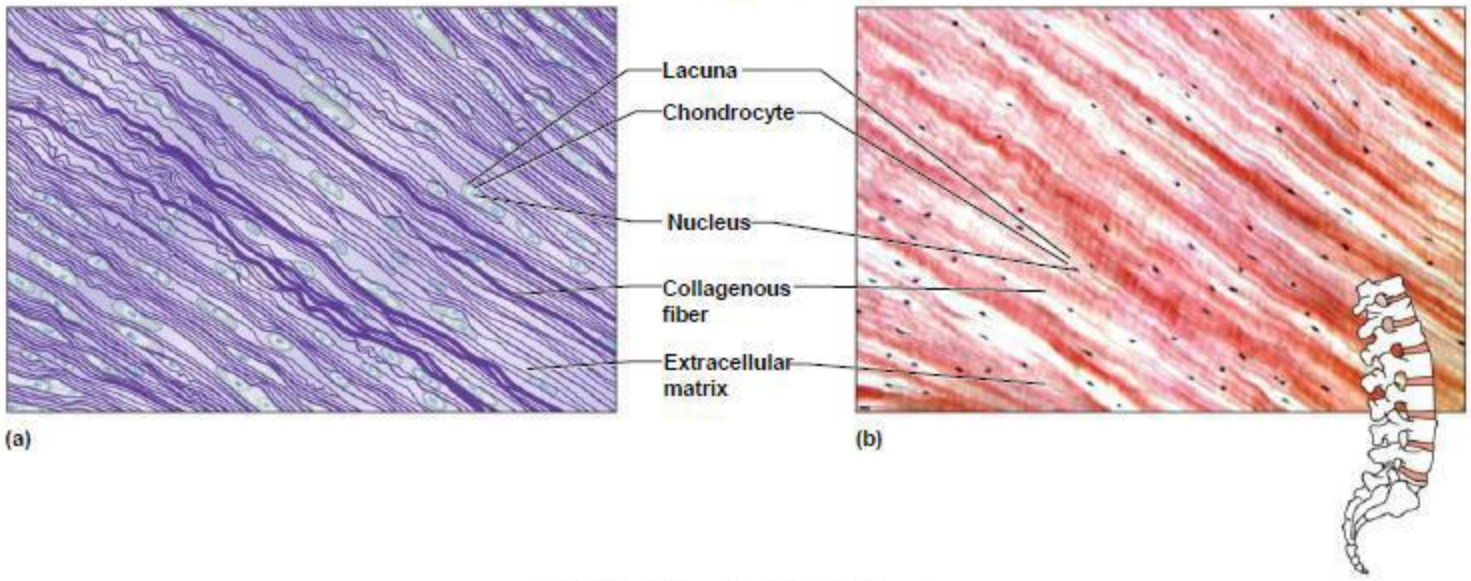
Fibrocartilage: (also called white cartilage)

Fibrocartilage locations in your body include:

1- in your knee.

2-In disks between the vertebrae in your spine.

3-Supporting muscles, tendons and ligaments throughout your body



Lab 7: The Digestive System and Body Metabolism

- ❖ Digestion
  - Breakdown of ingested food
- ❖ Absorption
  - Passage of nutrients into the blood
- ❖ Metabolism
  - Production of cellular energy (ATP)

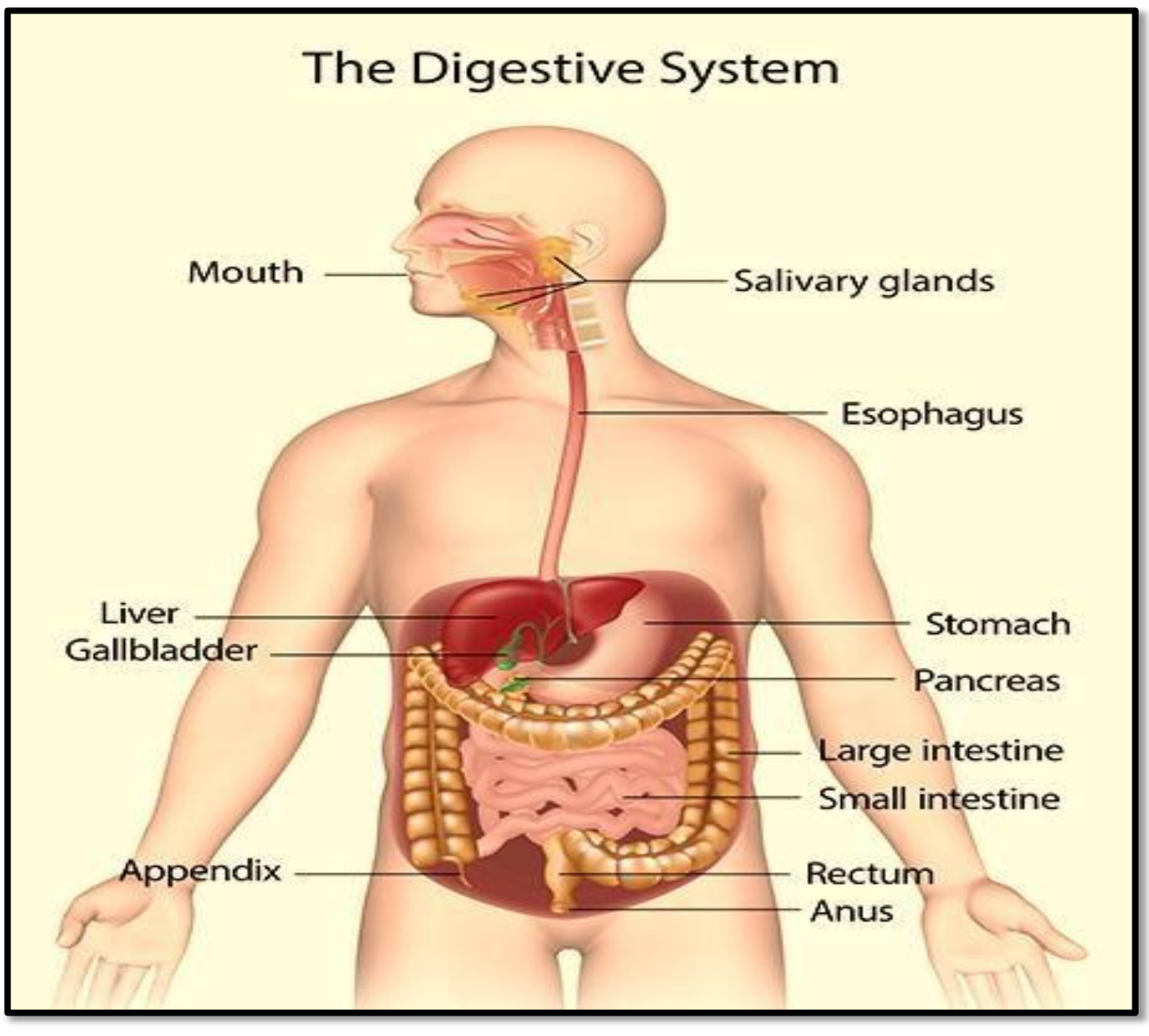
Organs of the Digestive System

Two main groups

- Alimentary canal – continuous coiled hollow tube
- Accessory digestive organs

Organs of the Alimentary Canal

- Mouth
- Pharynx
- Esophagus
- Stomach
- Small intestine
- Large intestine
- Anus



Mouth

- ❖ Teeth mechanically break down food into small pieces. Tongue mixes food with saliva (contains amylase, which helps break down starch).
- ❖ Epiglottis is a flap-like structure at the back of the throat that closes over the trachea preventing food from entering it.

Esophagus

- ❖ A hollow muscular tube
- ❖ About 25 cm long and 2 cm wide

Functions:

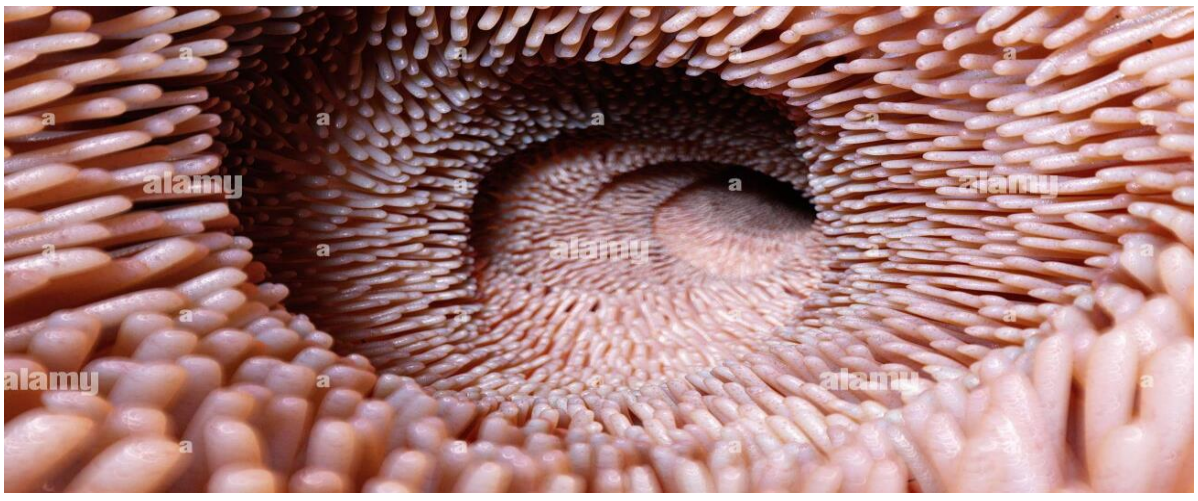
- ❖ Moves food from the throat to the stomach using muscle movement called peristalsis.
- ❖ If acid from the stomach gets in here that's heartburn.

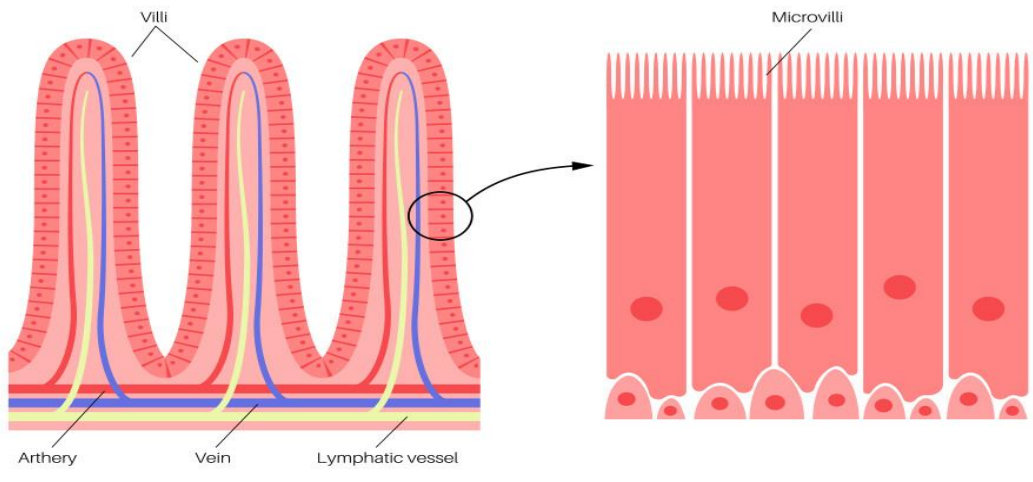
Stomach

- ❖ Sac-like organ of the digestive system between the esophagus and small intestine in which both mechanical and chemical digestion take place.
- ❖ The muscular walls of the stomach churn and mix the food, thus completing mechanical digestion as well as mixing the food with digestive fluids secreted by the stomach.
- ❖ The secretion of hydrochloric acid by the stomach plays an important role in protecting the body against pathogens ingested with food or water. A gastric fluid pH of 1 to 2 is deleterious to many microbial pathogens.
- ❖ With a pH of between one and three, gastric acid plays a key role in the digestion of proteins by activating digestive enzymes (pepsin)
- ❖ Food found in the stomach is (semi-liquid) called chyme.

Small Intestine

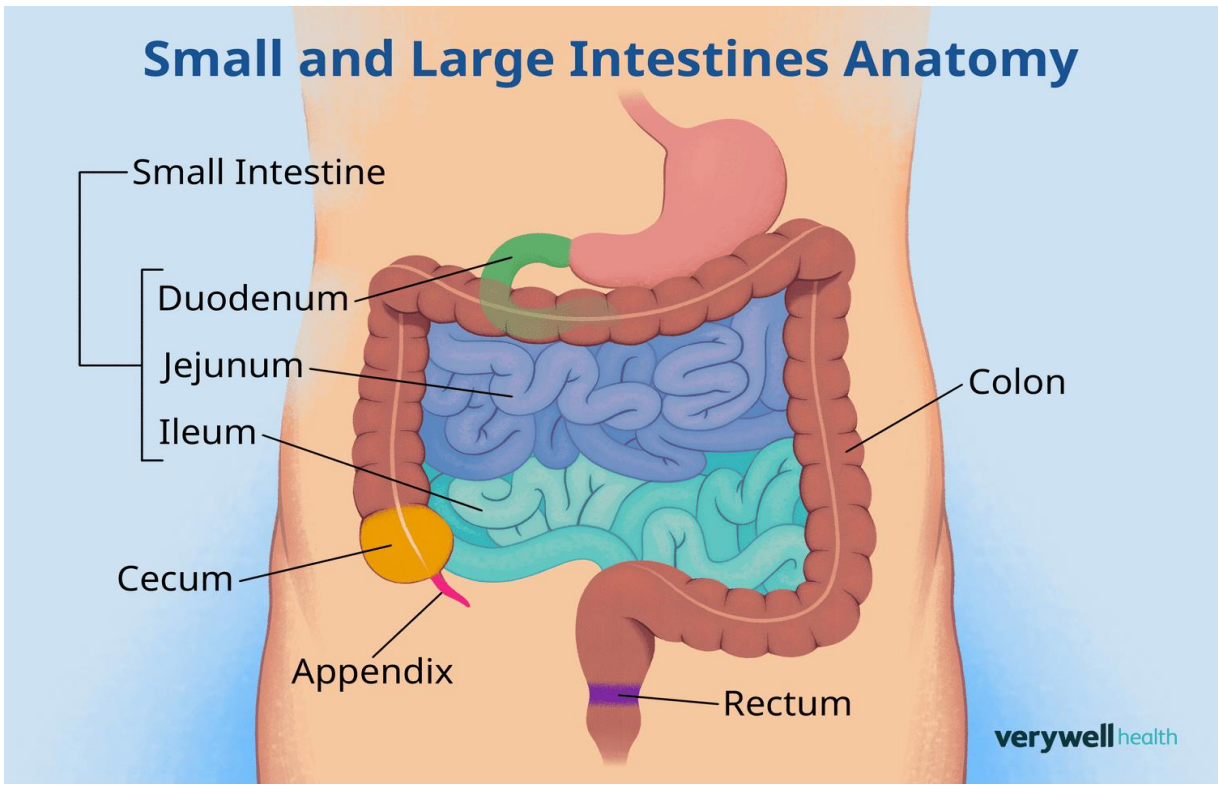
- ❖ Small intestines are roughly 7 meters long
- ❖ Lining of intestine walls has finger-like projections called villi, to increase surface area.
- ❖ The villi are covered in microvilli which further increases surface area for absorption.
- ❖ Nutrients from the food pass into the bloodstream through the small intestine walls.





The small intestine is made up of the:

- ❖ Duodenum
  - Attached to the stomach
  - Curves around the head of the pancreas
- ❖ Jejunum
  - Attaches anteriorly to the duodenum
- ❖ Ileum
  - Extends from jejunum to large intestine



Functions include:

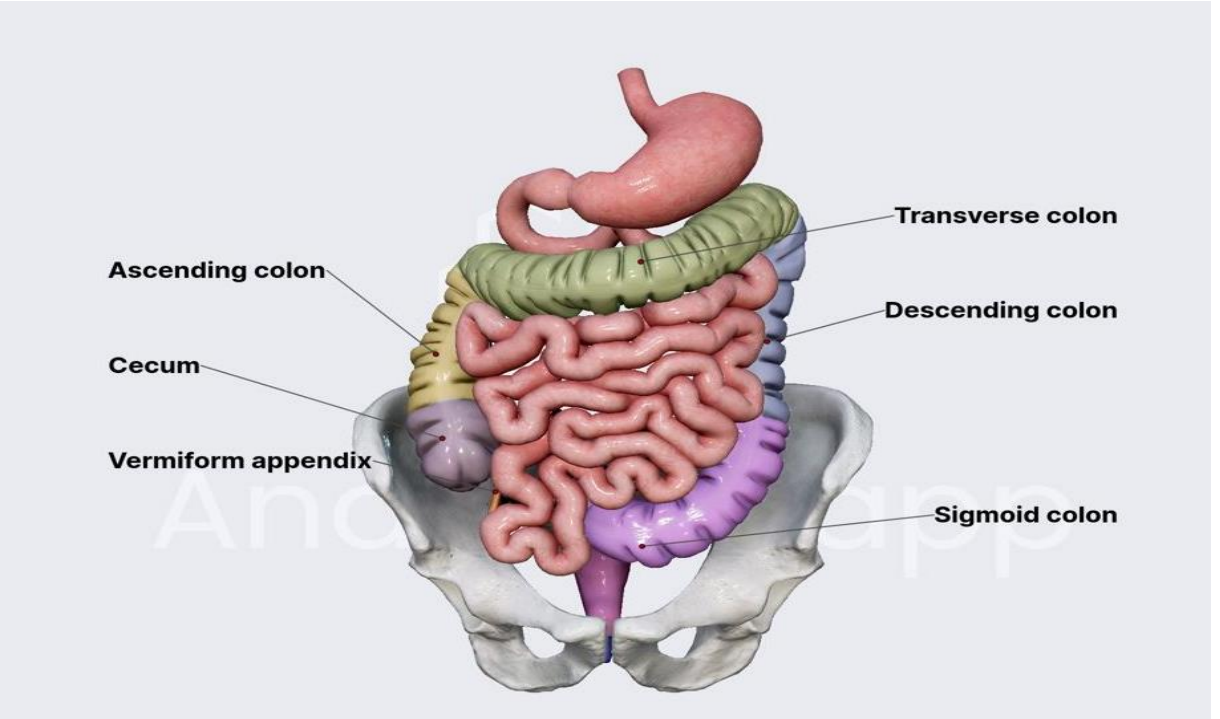
- ❖ Water is absorbed along the length of the small intestine.
- ❖ Most substances are absorbed by active transport through cell membranes.
- ❖ Lipids are absorbed by diffusion.
- ❖ Substances are transported to the liver by the hepatic portal vein or lymph
- ❖ Secretes digestive enzymes

Large intestine

- ❖ Larger in diameter, but shorter than the small intestine
- ❖ Frames the internal abdomen
- ❖ Accepts what small intestines don’t absorb
- ❖ Rectum (short term storage which holds feces before it is expelled).

Structures of the Large Intestine

- ❖ Cecum
- ❖ Colon
  - -Ascending colon
  - -Transverse colon
  - -Descending colon
  - -Sigmoid colon
- ❖ Rectum
- ❖ Anal canal (Anus).

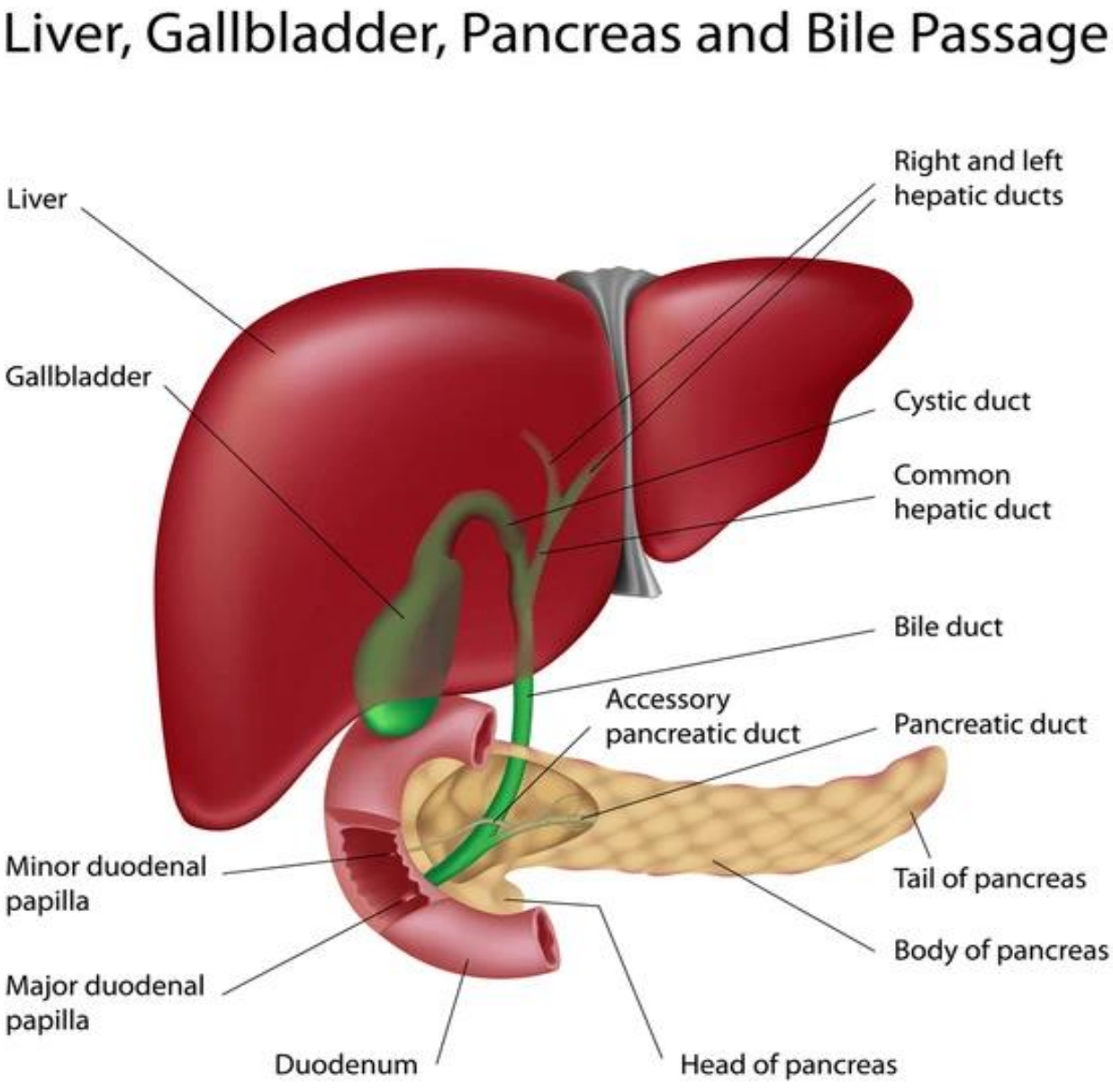


Functions :

- ❖ Absorption of water , vitamins K and B
- ❖ Eliminates indigestible food from the body as feces and Release gases
- ❖ Does not participate in digestion of food, no digestive enzymes are produced
- ❖ Goblet cells produce mucus to act as a lubricant
- ❖ Resident bacteria digest remaining nutrients
- ❖ Produce some vitamin K and B

Accessory Organs

- ❖ Not part of the path of food, but play a critical role.
- ❖ Include: Liver, gall bladder, and pancreas



Liver

Largest gland in the body

Directly affects digestion by producing bile

Bile helps digest fat

filters out toxins and waste including drugs and alcohol.

Located on the right side of the body under the diaphragm

Consists of four lobes suspended from the diaphragm and abdominal wall by the falciform ligament

Connected to the gall bladder via the common hepatic duct

Gall Bladder

- Stores bile from the liver, releases it into the small intestine.
- Bile is introduced into the duodenum in the presence of fatty food

Pancreas

- Produces a wide spectrum of digestive enzymes that break down all categories of food (fa carbohydrates and proteins)
- Enzymes are secreted into the duodenum
- Alkaline fluid introduced with enzymes neutralizes acidic chyme
- Endocrine products of pancreas

-Insulin

-Glucagon

Lab 8: Chromosome and Cell Division

What is a chromosome?

Chromosomes are thread-like structures located inside the nucleus of animal and plant cells. Each chromosome is made of protein and a single molecule of deoxyribonucleic acid (DNA). Passed from parents to daughter, DNA contains the specific instructions that make each type of living creature unique.

Do all living organisms have the same types of chromosomes?

Chromosomes vary in number and shape among living things. Most bacteria have one or two circular chromosomes. Humans, along with other animals and plants, have linear chromosomes that are arranged in pairs within the nucleus of the cell.

Chromosome Structure:

It consists of:

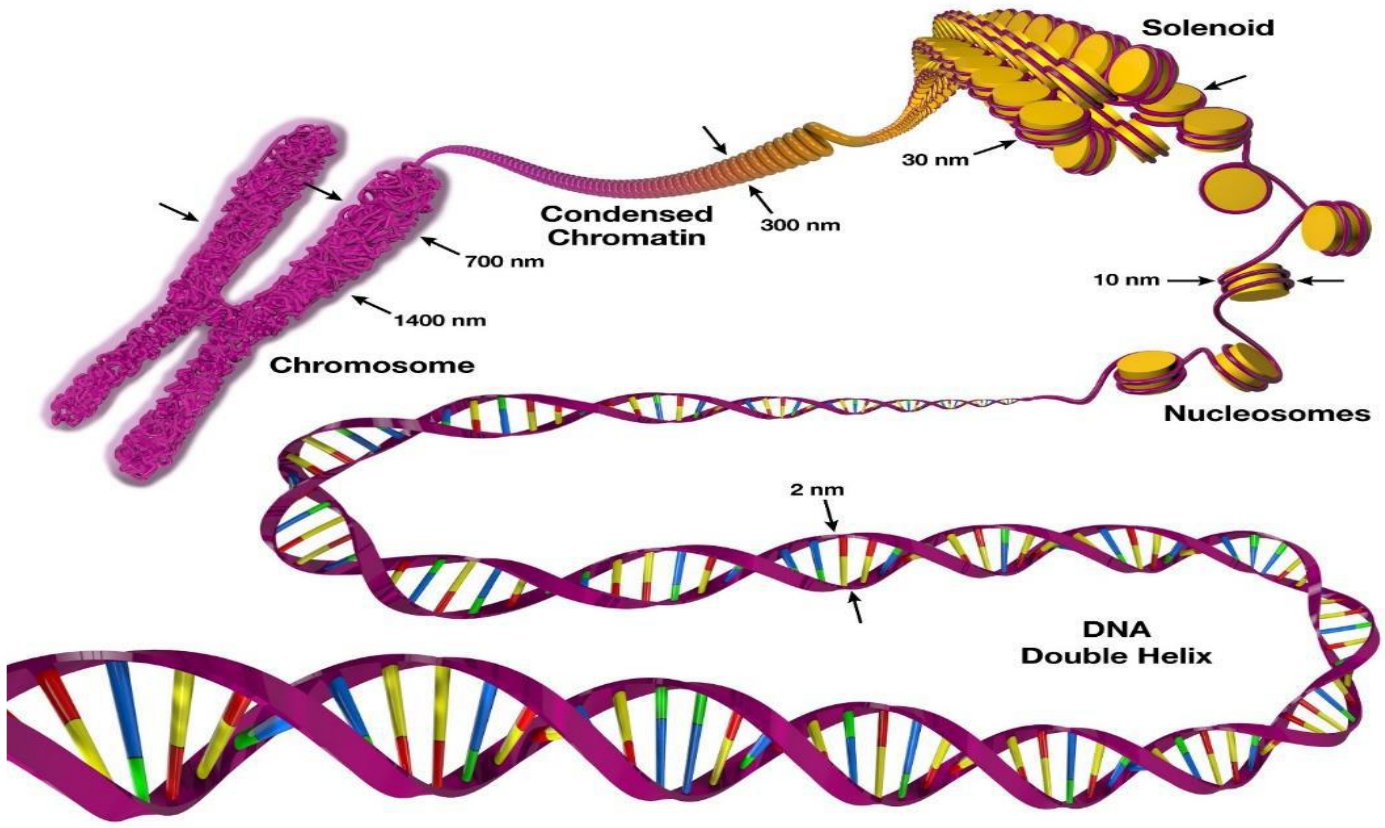
• **Chromatid**: Each chromosome has two symmetrical structures called chromatids or sister chromatids which is visible in mitotic metaphase. ...

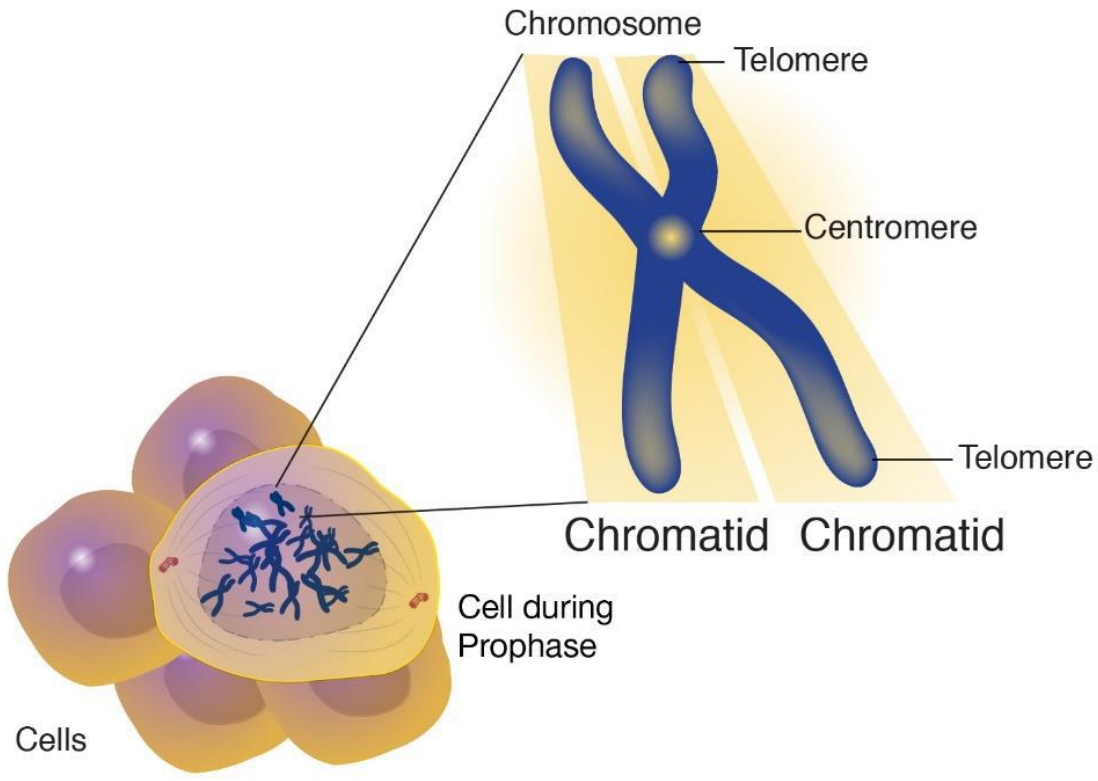
• **Centromere and kinetochore**: Sister chromatids are joined by the centromere.

• **Telomere**: Terminal part of a chromosome is known as a telomere. ...

How many chromosomes are there in humans?

The chromosome number in humans is 23 pairs. Normally, there are 46 chromosomes in total in each cell in humans. Twenty-two of these 23 pairs are referred to as autosomes and are the same in both females and males. However, the difference is in the last pair of chromosomes - 23rd pair. It differs in females and males.





Chromosome and Chromatid

❖ CELL REPRODUCTION

- **Cell Division:** process by which a cell divides to form two new cells (daughter cells)
  - ➢ Three types of cell division, or cell reproduction
    - **– Prokaryotes (bacteria)**
- Amitosis (Binary fission): divides forming two new identical cells

– Eukaryotes

- Mitosis**:** whenever more cells are needed

- Meiosis: formation of sex cells or gametes

Significance of Cell Division

Cell division plays an important role in all living organisms, as it is essential for growth, repair and reproduction.

This process helps in:

1. Renewing of damaged cells.

2. Production of new cells from older ones.

3. Maintains the total number of chromosomes.

4. Provides more cells for growth and development.

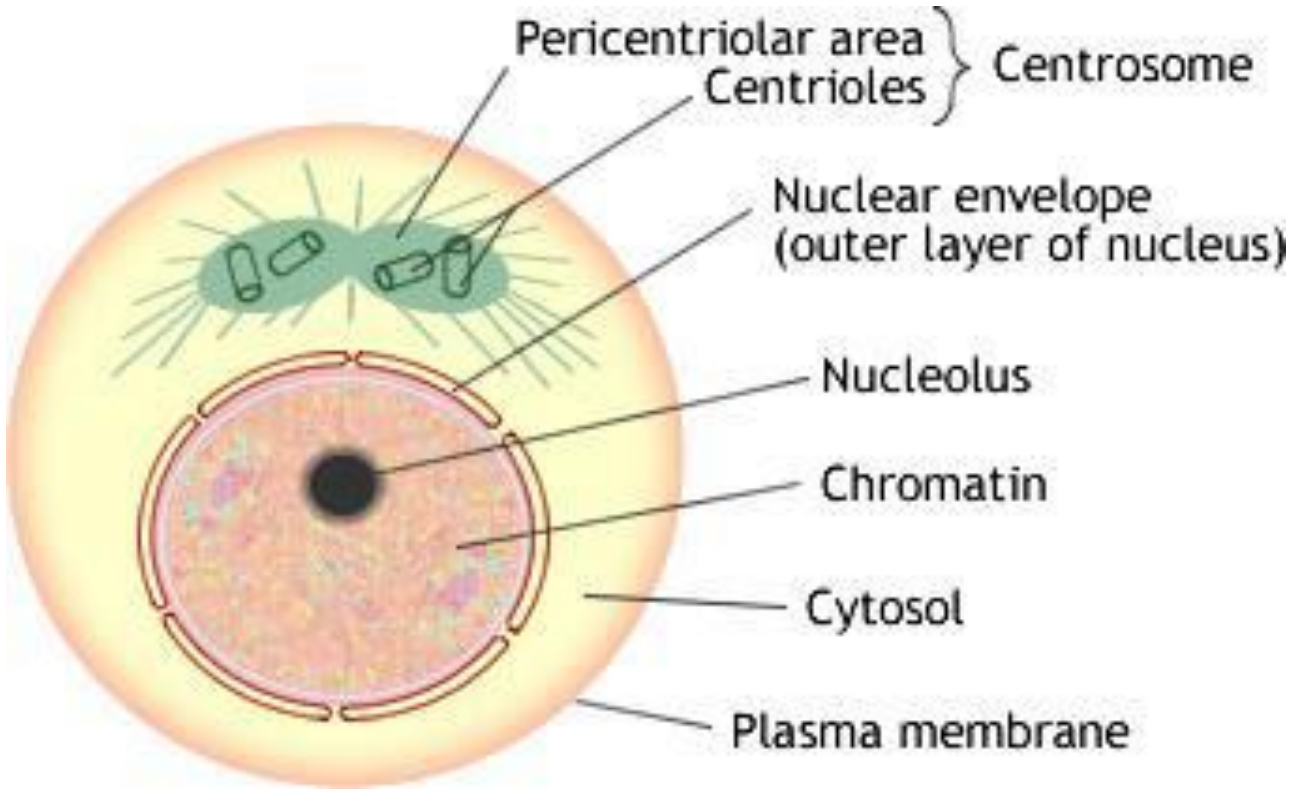
Main steps:

1: Mitosis (4 steps—Prophase, Metaphase, Anaphase, Telophase)

Nucleus divides

2: Cytokinesis—Cytoplasm divide , forming 2 cells

Each new daughter cell is genetically identical to parent cell

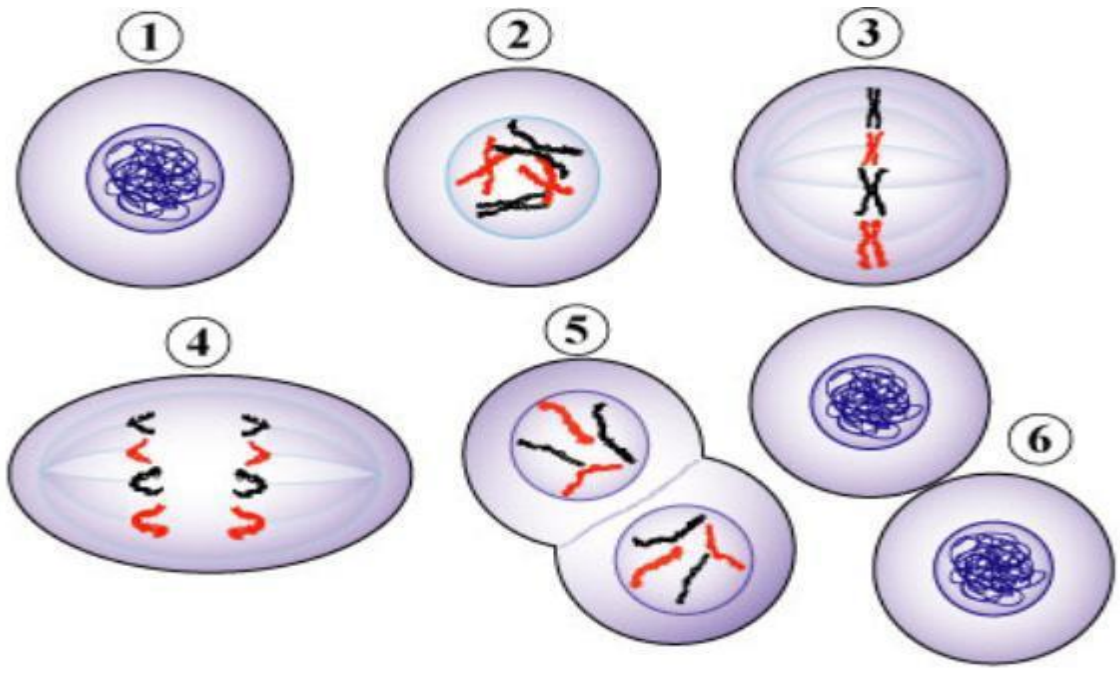


Life cycle of the cell

• Mitosis = nuclear division

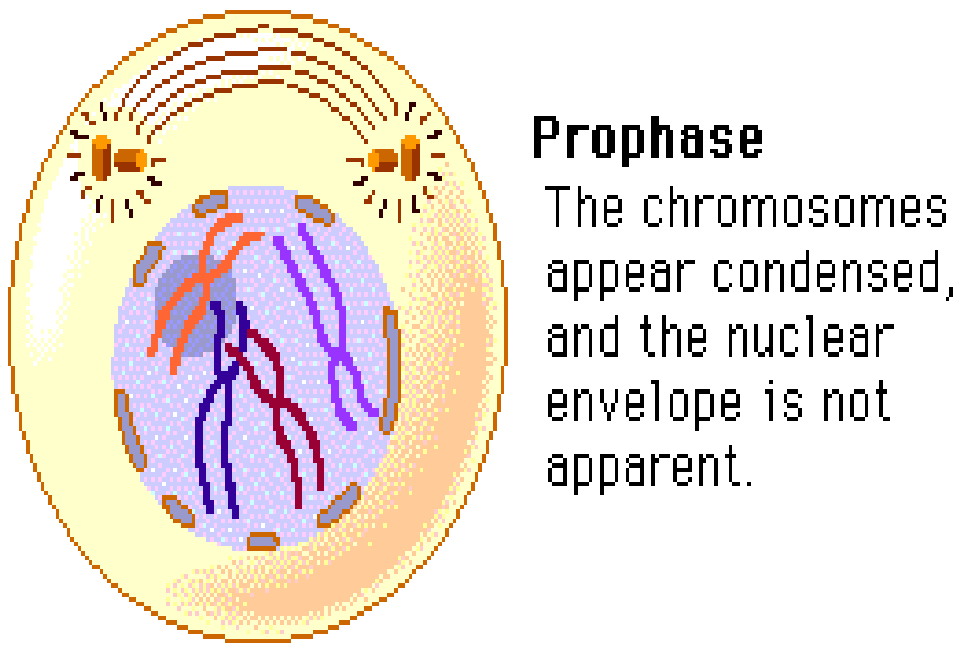
• Mitosis is followed by cytokinesis (cell division)

• The steps of mitosis ensure that each new cell has the exact same number of chromosomes as the original



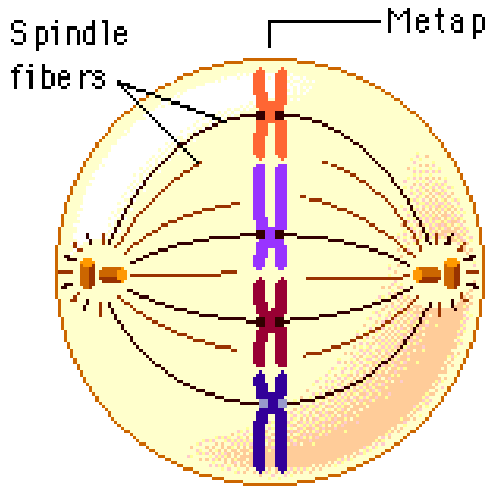
Prophase

1. chromosomes visible (sister chromatids)
2. centrioles migrate to the poles (only in animals)
3. nuclear membrane disappears
4. spindle forms



Metaphase

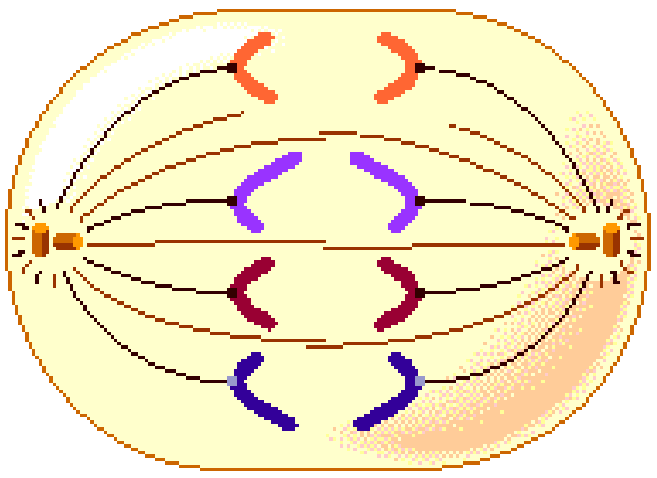
1. chromosomes line up on the equator of the cell
2. spindles attach to centromeres



Metaphase
Thick, coiled chromosomes are lined up in the center of the cell on the metaphase plate. Spindle fibers are attached to the chromosomes.

Anaphase

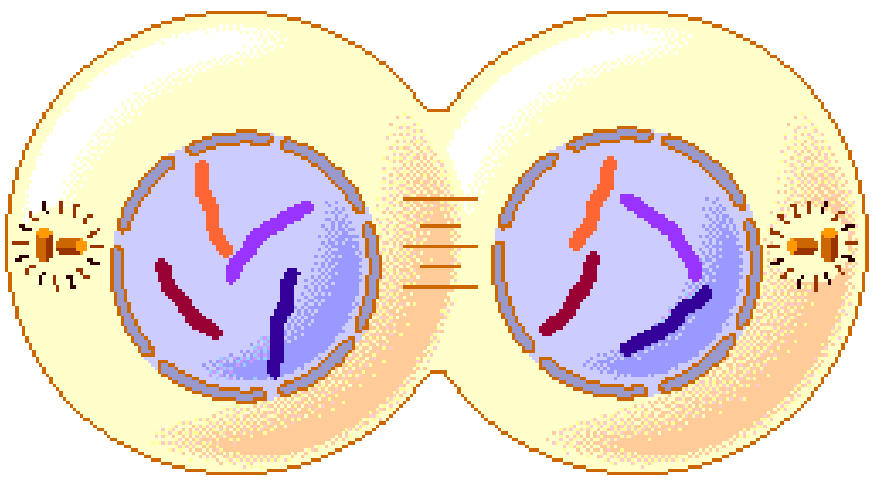
1. sister chromatids separate
2. centromeres divide
3. sister chromatids move to opposite poles



Anaphase
The chromosomes have separated and are moving toward the poles.

Telophase

1. chromosomes uncoil • now chromatin
2. nuclear membranes reform
3. spindle disappears



Telophase
The chromosomes are at the poles, and are becoming more difuse. The nuclear envelope is reforming. The cytoplasm may be dividing.

Cytokinesis

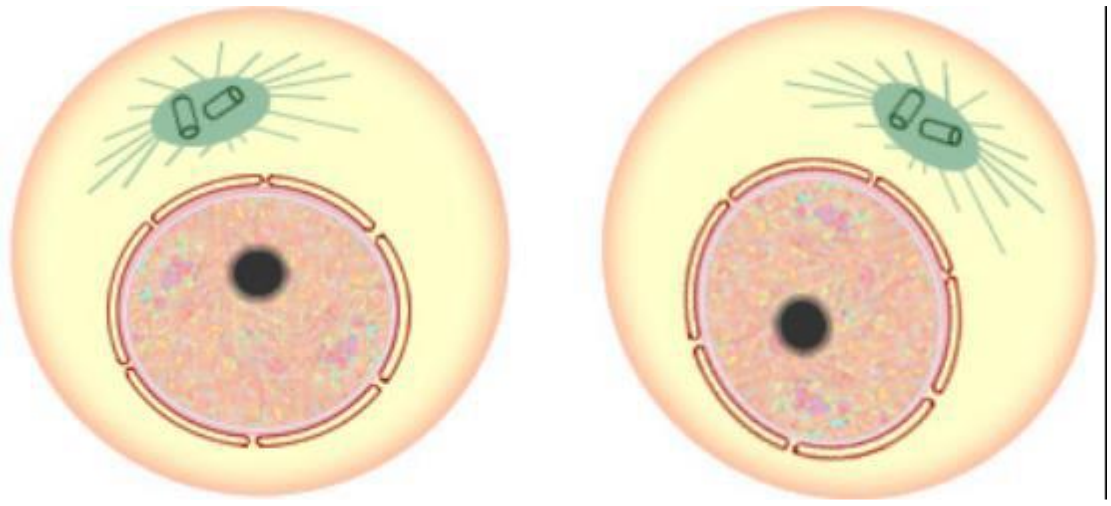
– Occurs at end of Mitosis

– division of the cytoplasm to form 2 new daughter cells

– organelles are divided

– Daughter cells are genetically identical

– Cells return to interface



Meiosis

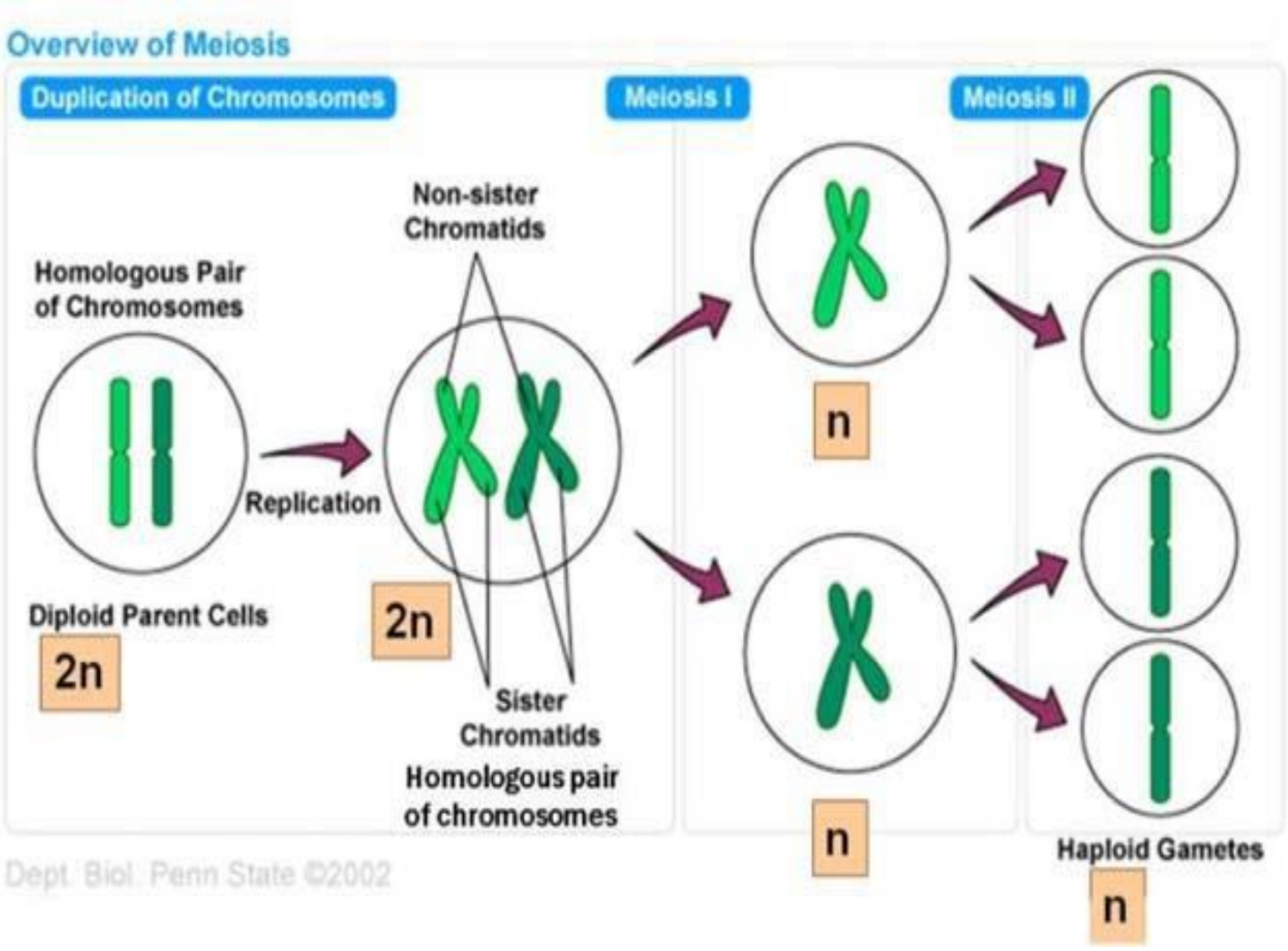
Meiosis functions to reduce the number of chromosomes to one half. Each daughter cell that is produced will have one half as many chromosomes as the parent cell.

Meiosis is part of the sexual process because gametes (sperm, eggs) have one half the chromosomes as diploid (2N) individuals.

Phases of Meiosis

There are two divisions in meiosis; the first division is meiosis I: the number of cells is doubled but the number of chromosomes is not. This results in 1/2 as many chromosomes per cell. The second division is meiosis II: this division is like mitosis; the number of chromosomes does not get reduced. The phases have the same names as those of mitosis.

- **Meiosis I: prophase I (2N), metaphase I (2N), anaphase I (N+N), and telophase I (N+N)**
- **Meiosis II: prophase II (N+N), metaphase II (N+N), anaphase II (N+N+N+N), and telophase II (N+N+N+N).**



Prophase I

Events that occur during prophase of mitosis also occur during prophase I of meiosis. The chromosomes coil up, the nuclear membrane begins to disintegrate, and the centrosomes begin moving apart.

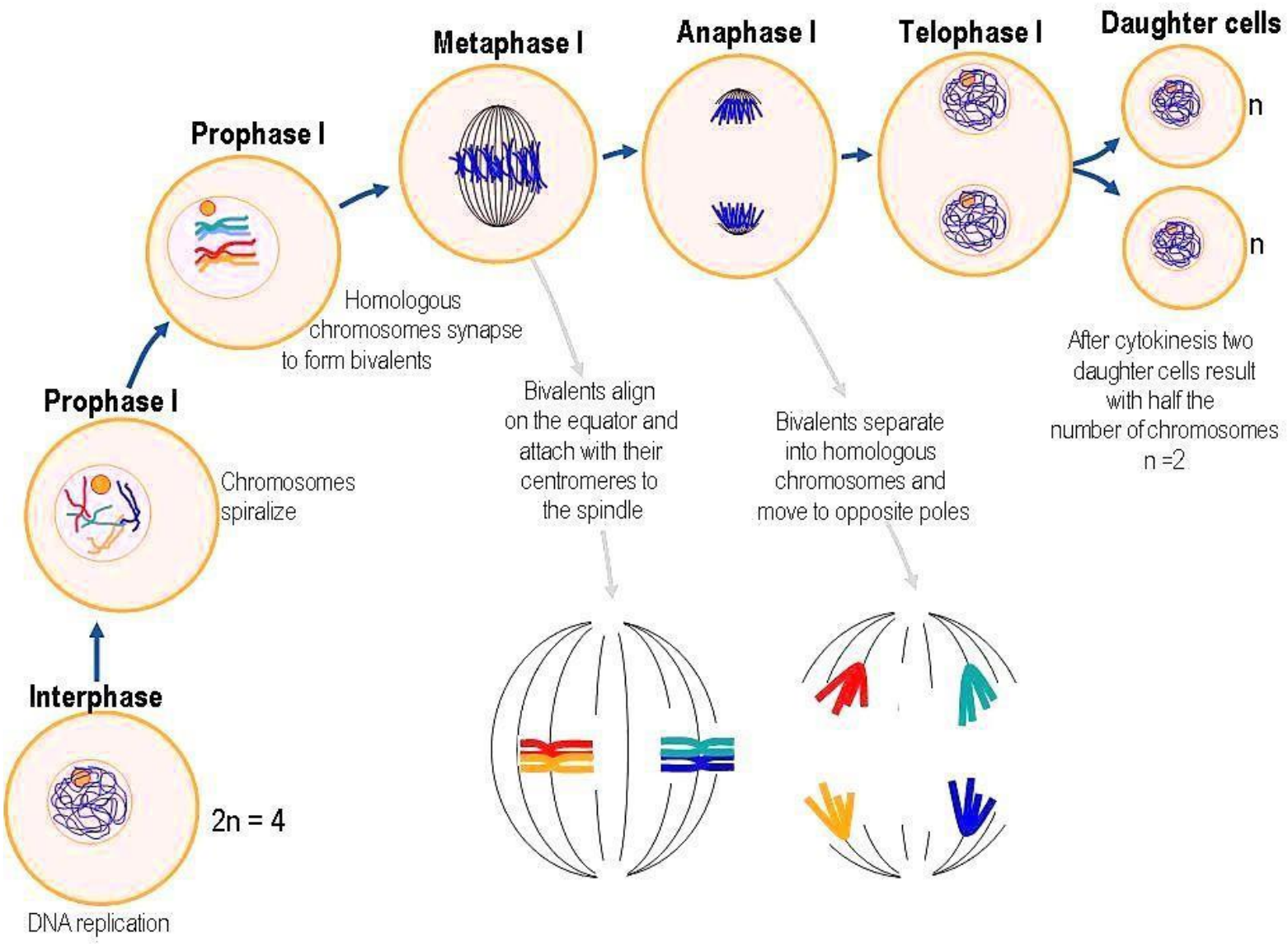
The two chromosomes may exchange fragments by a process called **crossing over**.

When the chromosomes partially separate in late prophase, until they separate during anaphase resulting in chromosomes that are mixtures of the original two chromosomes.

Metaphase I: Bivalents (tetrads) become aligned in the center of the cell and are attached to spindle fibers. Independent assortment refers to the random arrangement of pairs of chromosomes.

Anaphase I: begin when homologous chromosomes separate.

Telophase I: The nuclear envelope reforms and nucleoli reappear**.**


Interphase
2n = 4
DNA replication
Prophase I
Chromosomes spiralize
Prophase I
Homologous chromosomes synapse to form bivalents
Metaphase I
Bivalents align on the equator and attach with their centromeres to the spindle
Anaphase I
Bivalents separate into homologous chromosomes and move to opposite poles
Telophase I
Daughter cells
n
n
After cytokinesis two daughter cells result with half the number of chromosomes n =2
Meiosis 1 daughter cells
n
Prophase II
Metaphase II
Chromosomes align on equator and attach to spindle
Anaphase II
Chromatids separate into daughter chromosomes and move to opposite poles
Telophase II
Daughter cells
n
n
n
n

Meosis II

1. Prophase II

The chromosomes coil up, the nuclear membrane begins to disintegrate, and the centrosomes begin moving apart.

2. Metaphase II

Spindle fibers form and sister chromatids align to the equator of the cell.

3. Anaphase II

Sister chromatids separate.

4. Telophase II & Cytokinesis II

The chromatids reach the poles, and uncoil into thin threadlike chromatin. The nuclear membrane reforms from 2 diploid (2n) cells into 4 haploid (n) Daughter cells.

Lab 9 : Excretory System

Excretion: is the process of removing wastes and excess water from the body.

It is one of the major ways the body maintains homeostasis.

The excretory organs include:

1.kidneys

2.liver

3.skin

4.lungs.

All of these organs of excretion make up the excretory system.

The roles of the excretory organs are summarized below:

1- large intestine, **eliminates solid wastes** that remain after the digestion of food.

2- lungs, in the respiratory system **excrete some waste products**, such as carbon dioxidee and water.

3- get **rids of wastes** through the sweat glands.

4- liver, **excretes bile pigments** that result from the hemoglobin destruction.

5- Kidneys & Urinary System **excrete waste and maintains homeostasis** of body fluids.

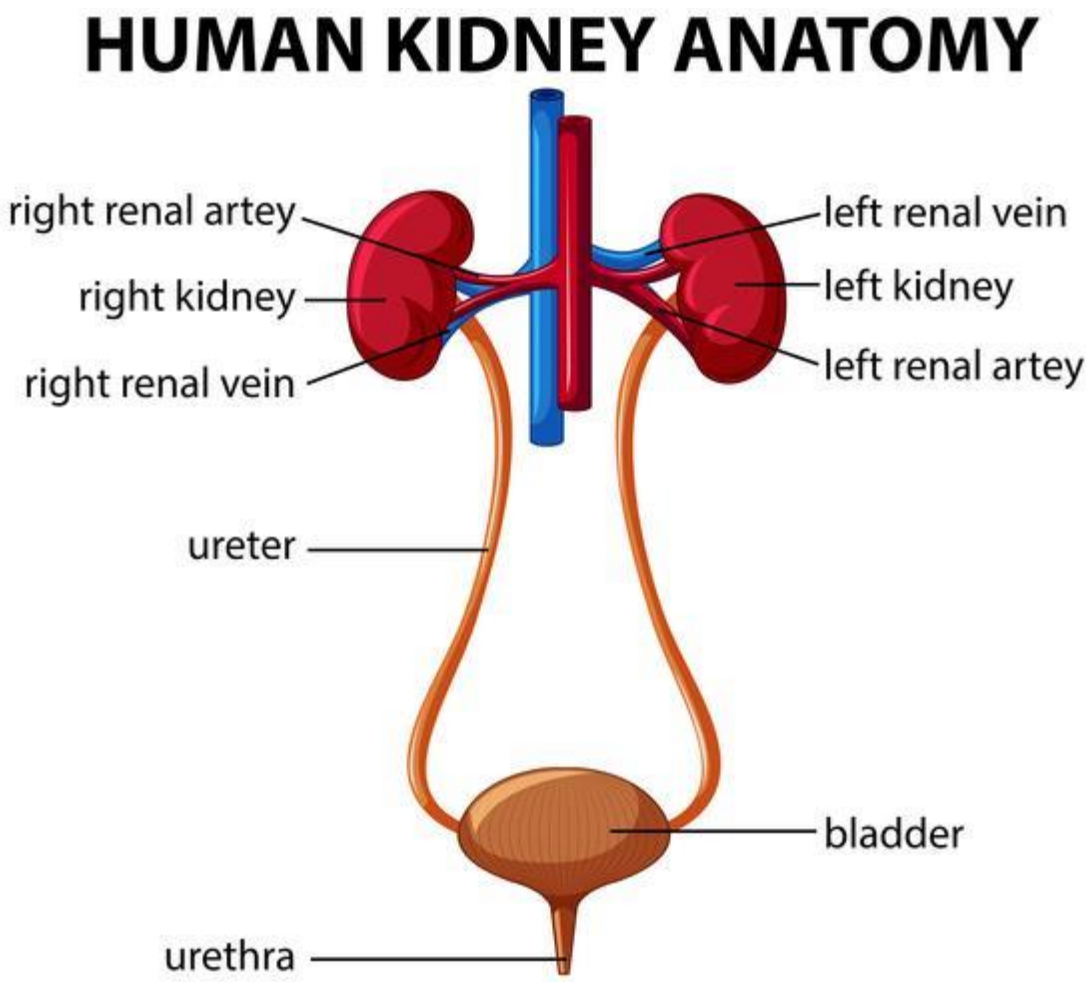
Main Organs of The Urinary System

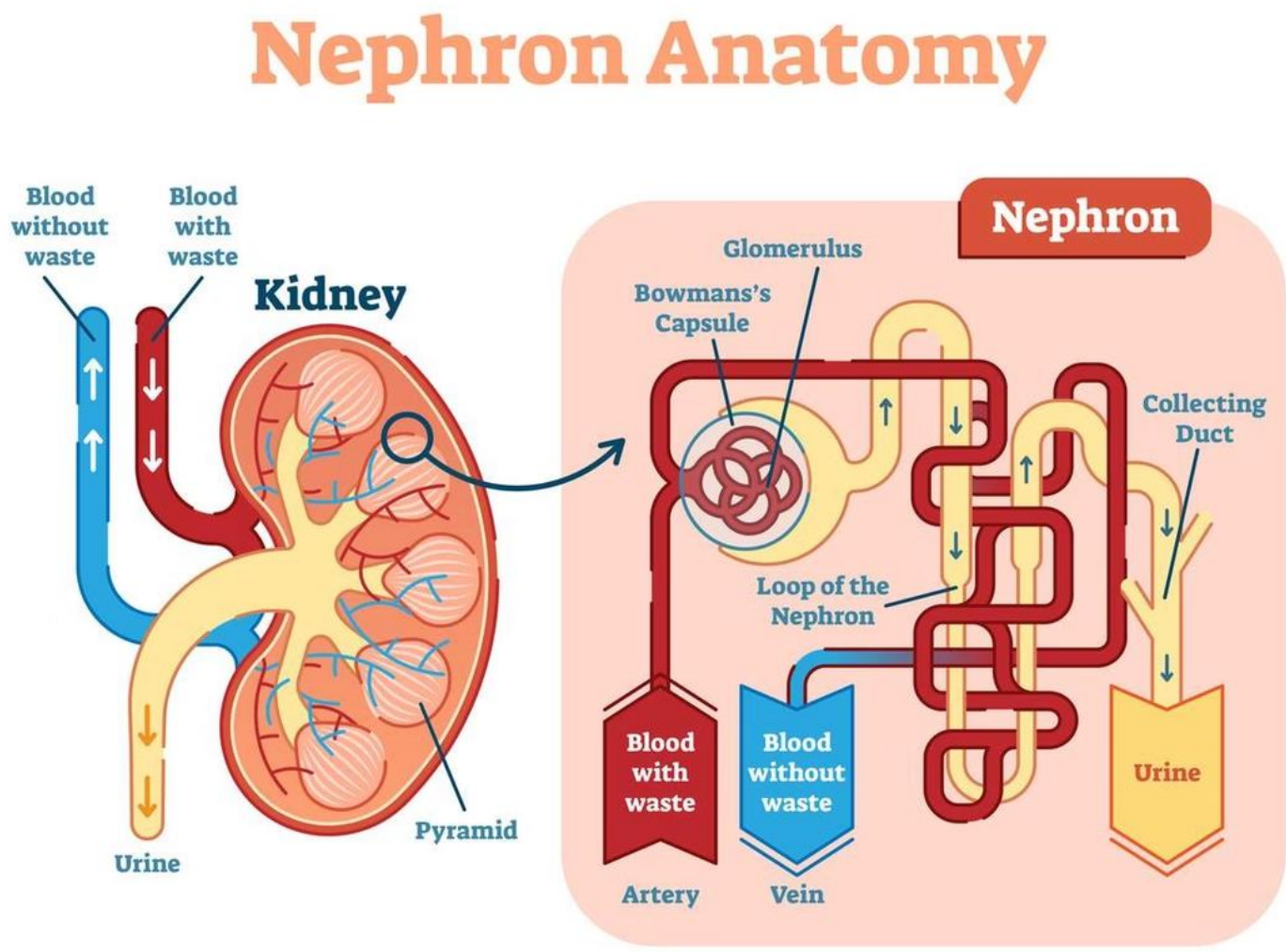
- **Kidneys Nephron,** is the functional units of kidney, it is microscopic units
- that filter blood from wastes.
- (About one million per kidney)
- Each nephron network of coiled tubes called glomerulus (clump of capillaries), diffusion of wastes while useful substances & water are reabsorbed.

Ureters: Narrow muscular tubes connect kidney to bladder.

Bladder: Muscular sac, stores urine, urine squeezed into urethra.

Urethra: Tube leading from bladder to outside of body.

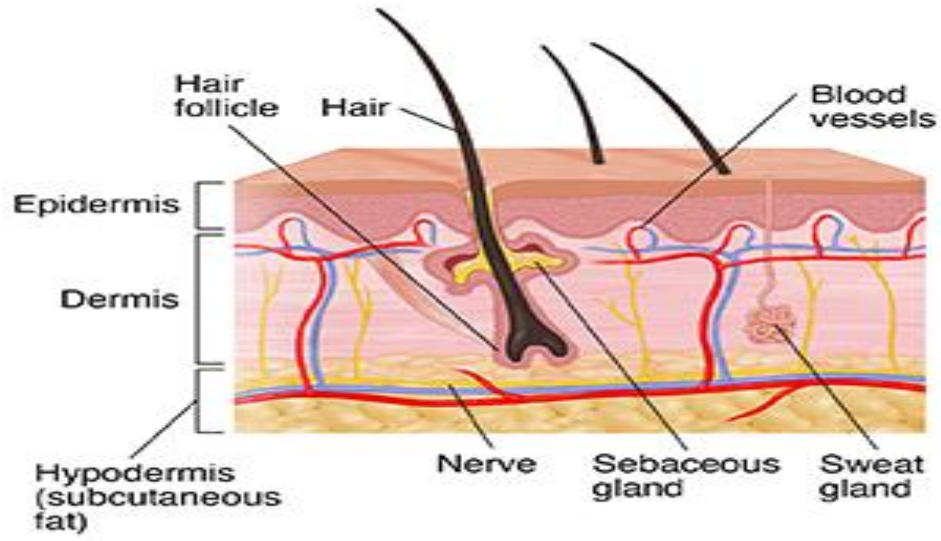




Lab10: Skin

Definition

- The integumentary system, or skin, is the largest organ in the body.
- It comprises of skin and skin appendages including hairs, nails, sweat glands and sebaceous glands.

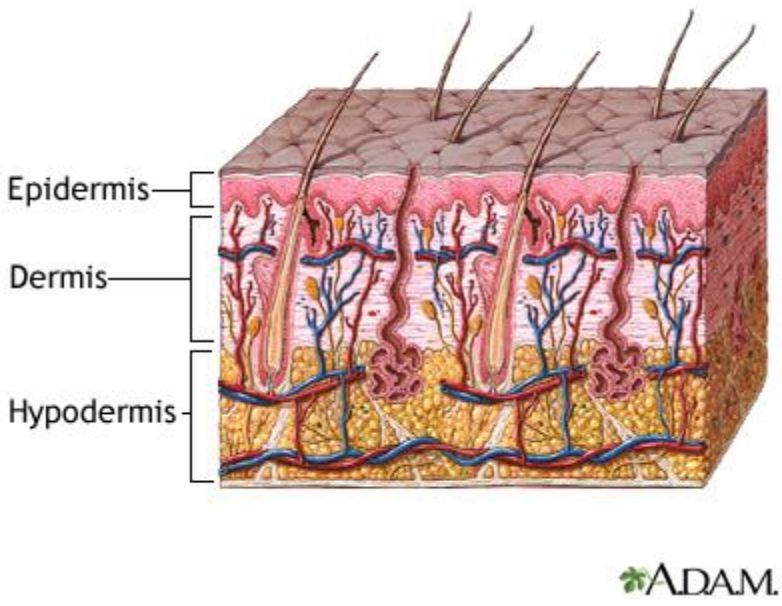


- The skin is the largest component of this system.
- It forms an outer, protective coat around the entire external surface of the body.
- The thickness of skin varies from 0.5mm thick on the eyelids to 4.0mm thick on the heels of feet.

Skin layers

The skin is organized as follows, from superficial to deeper layers:

- Epidermis
- Dermis
- Hypodemis



Epidermis

- Keratinized stratified squamous epithelium.

- It provides a barrier to infection from environmental pathogens and regulates the amount of water released from the body into the atmosphere.
- The epidermis does not contain blood vessels and is nourished by diffusion from the dermis.

Epidermis layers

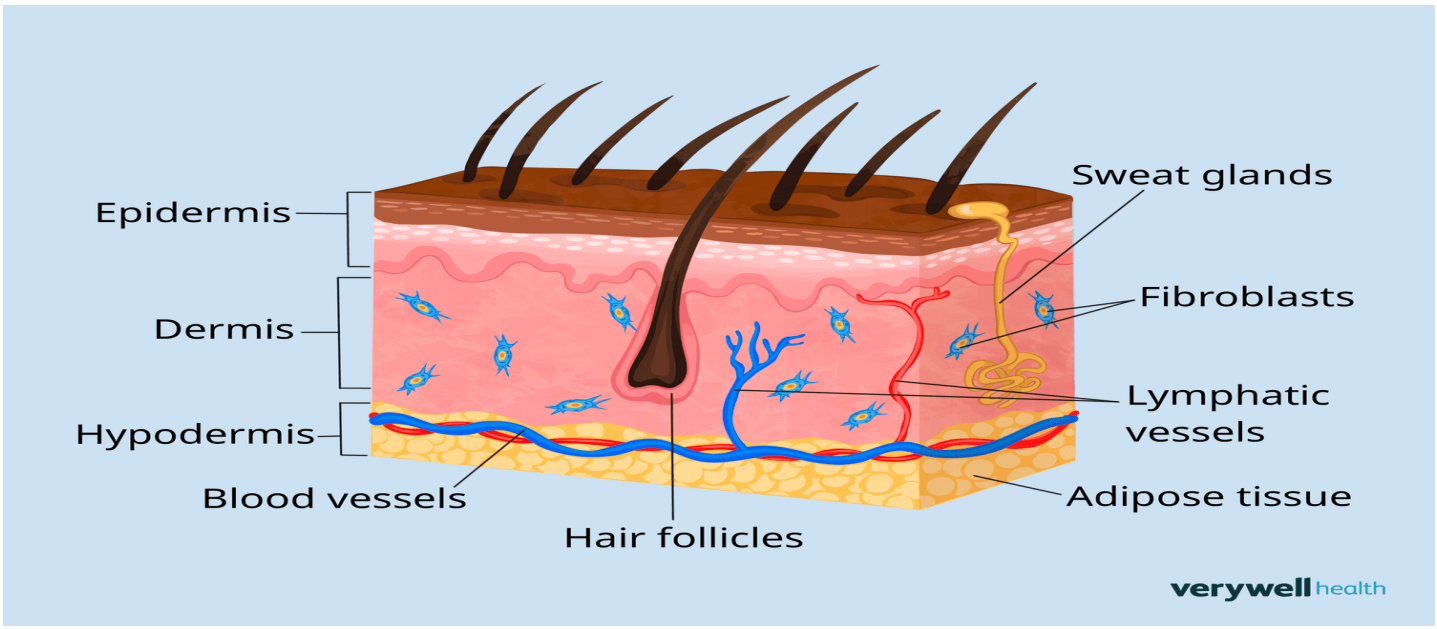
It is composed of the following layers(strata):

Stratum corneum,

Stratum lucidum,

Stratum granulosum,

Stratum spinosum and Sratum basale.



Dermis

- The dermis is the layer of skin that lies beneath the epidermis.
- It is the thickest layer of the skin, and is made up of fibrous and elastic tissue.
- Thus it provides strength and flexibility to the skin.
- It is comprised of two layers:
  - The papillary dermis
  - The reticular dermis

The papillary dermis is the more superficial of the two.

It is made up of **loose connective tissue,** which includes:

Capillaries

Elastic fibers

Reticular fibers

Collagen

The reticular dermis is the deeper and thicker layer of the dermis.

It contains **dense connective tissue**, which includes:

Blood vessels

Elastic fibers

Collagen fibers

Fibroblasts

Mast cells

Nerve endings

Hypodermis

The **hypodermis** (also called the subeutaneous layer or superficial fascia) is a layer directly below the dermis and serves to connect the skin to the underlying fascia (fibrous tissue) of the bones and muscles. It consists of **loose connective tissue and adipose tissue.**

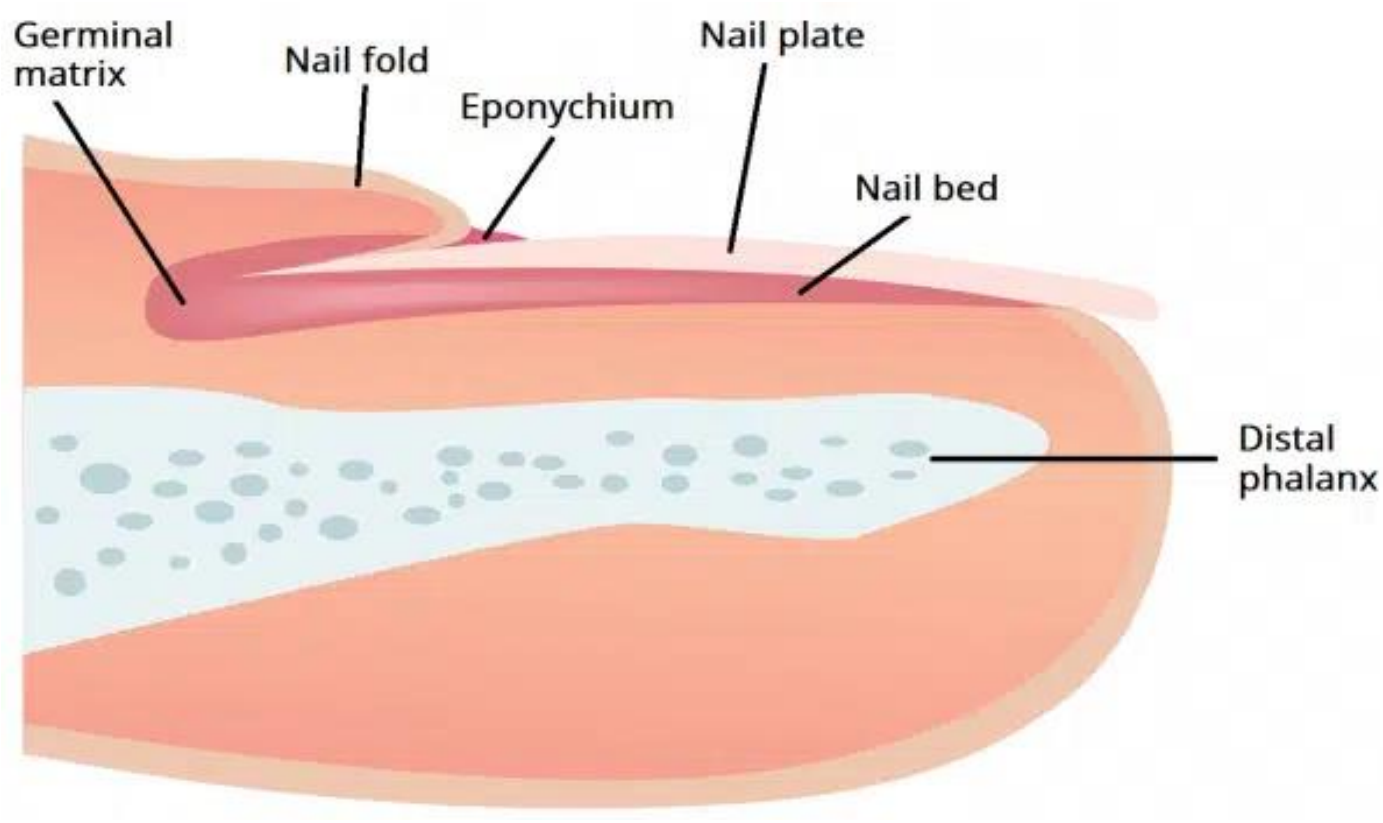
Adipose tissue present in the hypodermis consists of fat-storing cells called **adipocytes**. This stored fat can serve as an energy reserve, insulate the body to prevent heat loss, and act as a cushion to protect underlying structures from trauma.

Skin Functions

1. Protection (against external damage & Pathogen's invasion).
2. Sensation (contains different receptors for touch, pressure, pain and temperature).
3. Thermoregulation (adipose tissue against heat lose & Secretion of sweat for cooling).
4. Metabolic function (Synthesis of Vit D by the action of UV light on precursor molecules).

Accessory structures of the skin:

- **Hair:** Provides insulation, protection, and sensory input.
- **Nails:** Protect the tips of fingers and toes and aid in fine motor movements.
- **Glands:** Include sweat glands (for cooling) and sebaceous glands (for oil production).



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