Stage: First

Doaa Ali Saeed Al musawi

Lab 1,2: Introduction to Physiology and Gastrointestinal tract

Introduction to Physiology

Physiology is the branch of biology that studies how living organisms function—their organs, tissues, cells, and systems work together to sustain life. Its importance lies in multiple aspects:

1. Understanding Normal Body Function

Physiology explains how the body works under normal conditions, including processes like breathing, circulation, digestion, and nerve signaling.

This knowledge forms the foundation for understanding what happens when things go wrong (disease).

2. Medical and Health Applications

Its helps in diagnose and treat diseases effectively

Understanding organ function is critical for medical procedures, drug development, and therapies.

3. Scientific Research

It allows scientists to study the effects of drugs, toxins, and environmental changes on the body.

4.Technological and Clinical Innovation

Knowledge of physiology guides the creation of medical devices, artificial organs, and life-support systems.

6. Education and Awareness

Understanding how the body works encourages healthy lifestyles and preventive healthcare.

Gastrointestinal tract

The G.I.T comprises

1. The Gastrointestinal Tract 2. Accessory Organs.

• The gastrointestinal tract consists of the oral cavity, pharynx, esophagus, stomach, small intestine, and large intestine.

• **The accessory organs are**

1. Teeth 2, Tongue, Glandular organs such as salivary glands, liver, gallbladder, and pancreas

The digestive system performs six basic processes:

1. Ingestion. taking foods and liquids into the mouth.

2. Secretion. Each day, cells within the GIT and accessory digestive organs secrete about 7 liters of water, acid, buffers, and enzymes into the lumen of the tract.

3. Mixing and propulsion. Alternating contractions and relaxations of smooth muscle in the walls of the GIT mix food and secretions and move them toward the anus**.**

4. Digestion Mechanical and chemical processes break down ingested food into small molecules.

5. Absorption. absorbed substances pass into blood or lymph and circulate to cells throughout the body.

6. Defecation. Wastes, indigestible substances, bacteria, cells sloughed from the lining of the GI tract leave the body through the anus

The Oral Cavity:

• Is the 1st part of G.I.T.

Functions of Oral Cavity:

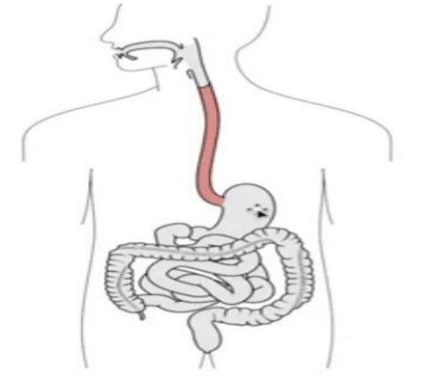
1. Mechanical processing via the action of the teeth, tongue, and palatal surfaces.

2. Lubrication by mixing food material with mucus and salivary gland secretion.

3. Limited digestion of carbohydrates and lipids

The Esophagus

❖ The esophagus's primary function is to empty food materials into the stomach via waves of contraction of its muscle known as peristalsis.



Stomach

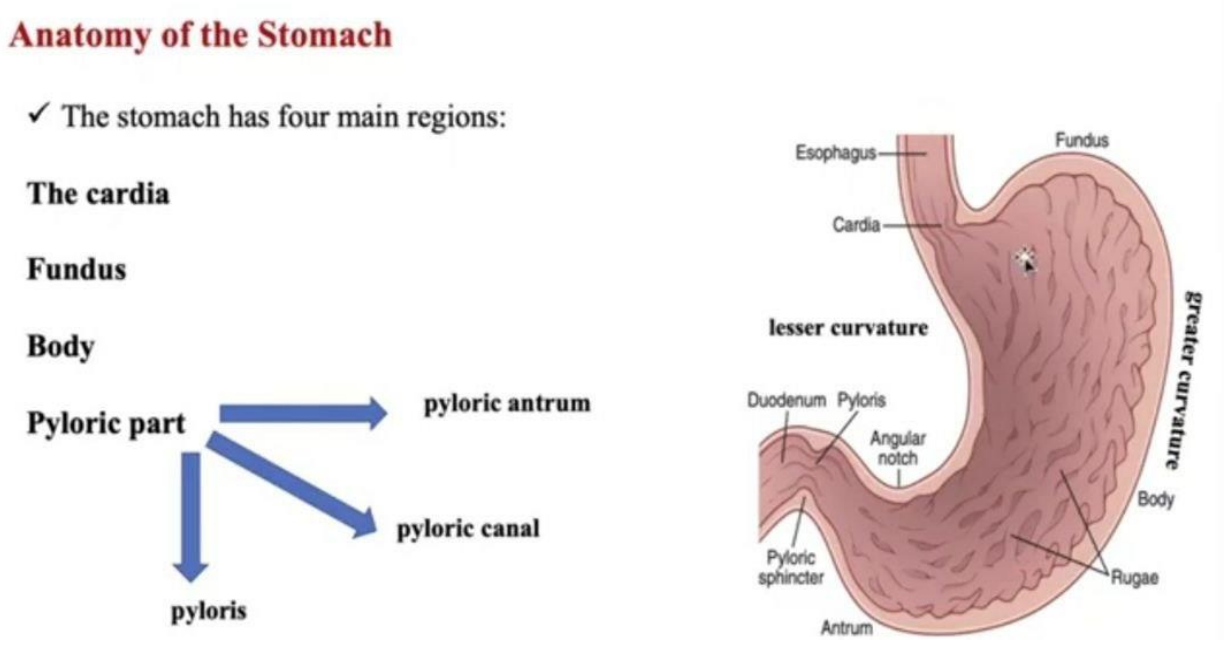
J-shaped enlargement of the GIT inferior toe diaphragm

Connects the esophagus to the duodenum.

Serve as a mixing chamber and holding reservoir.

In the stomach, digestion of starch and triglycerides

continues, while digestion of proteins begins**.**



Small Intestine:

Most digestion and absorption of nutrients occur in small intestine.

Its length is about 3 m in a living person and about 6.5 m in a cadaver.

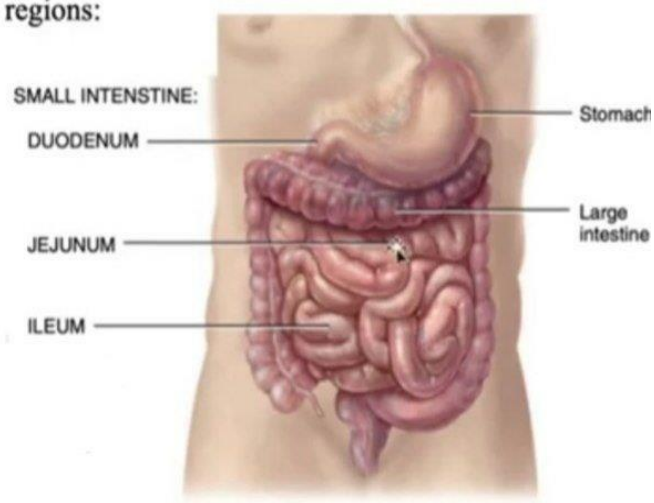
The surface area further increased by circular folds, villi, and microvilli.

Anatomy of the Small intestine

✓ The small intestine is divided into three regions:

- The duodenum *about 25 cm*
- The jejunum *about 1 m*
- the ileum about 2 m

✓



Large Intestine:

The terminal portion of the GI tract.

Complete the absorption.

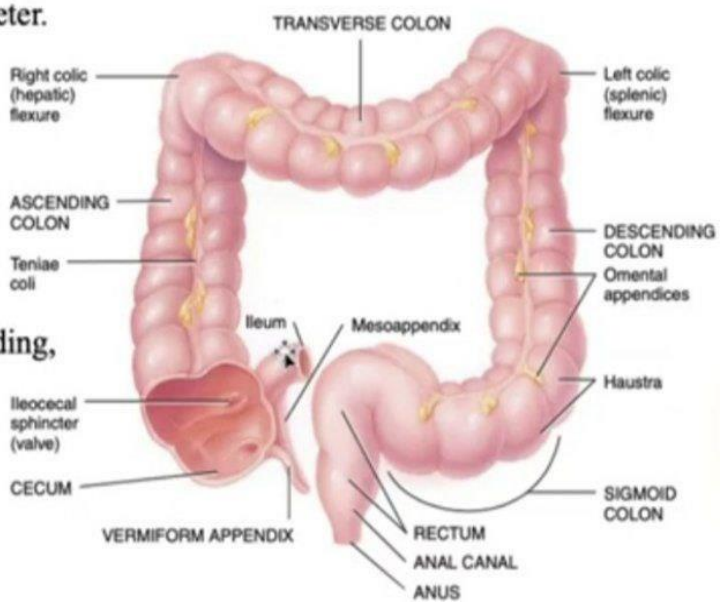
Produce certain vitamins.

Formation and expulsion of feces

from the body.

Anatomy of the large intestine

- ✓ About 1.5 m long and 6.5 cm in diameter.
- ✓ Extends from the ileum to the anus.
- ✓ Divided into four regions:
  - ➢ **Cecum** *about 6 cm long* ***(vermiform appendix)*** 8 cm in length
  - ➢ **Colon:** ascending, transverse, descending, and sigmoid portions
  - ➢ **Rectum** *about 15 cm in length*
  - ➢ **Anal canal** *about 2–3 cm in length*



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Cellular basis of medical physiology

Definition of physiology: It is the science that study of the function of

living organisms and their parts. -In human physiology, we are concerned with characteristics of the human body

Homeostasis -Is defined as the maintenance of a stable internal environment, -Essentially, all organs and tissues of the body perform functions that help to maintain these stable conditions.

Cell Physiology -The basic living unit of the body is the cell, and each organ is an aggregate of many different cells held together by intercellular supporting structures. -Each type of cells is especially adapted to perform one or a few particular functions.

What Is a Cell?

- cell:- are the basic building blocks of the living things
- It is basic structural and functional unit of any living thing
- The human body is composed of 75 to 100 trillions of cells

Cell Size

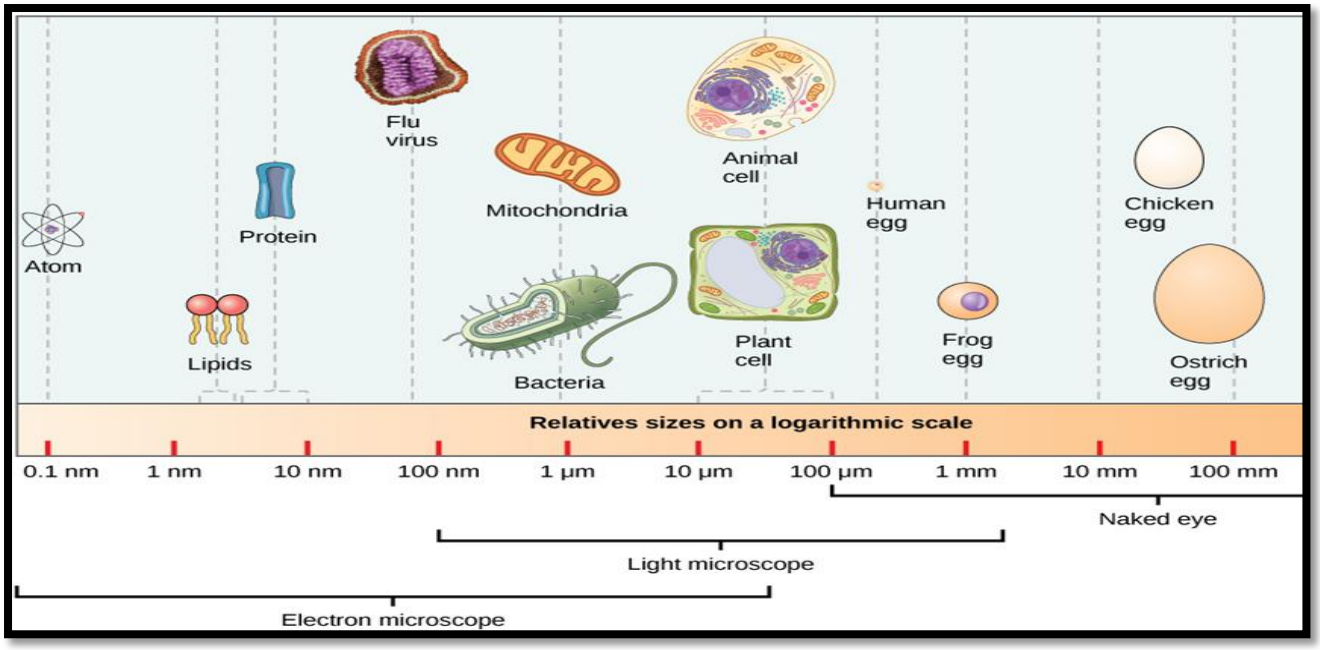
- A few cells, such as a hen's egg or a frog's egg, are large enough to be seen by the naked eye.
- In comparison, a human egg cell is around 100 μm in size
- Most cells are small and can be seen only under a microscope. they are measured using *micrometer* (μm).

How Cells Are Organized Cells

are classified into two broad categories:

The **prokaryotes** : like bacteria

The **eukaryotes:** like cells of animals, plants, fungi



Structure of the cell

A cell is the basic unit of structure and function in a living thing. When cells divide, the hereditary information they contain, as DNA, is passed from cell to cell. The term protoplasm includes the" **living part**" of the cell. It can be differentiated into **cytoplasm** and the **nucleus**.

1- Plasma membrane

It is an outer membrane that regulates what enters and exits a cell. It is a phospholipid bilayer. that looks like a “sandwich”, made of two layers of phospholipids.

- Their polar phosphate molecules (hydrophilic) form the top and bottom surfaces of the bilayer, and the no polar lipid lies in between (hydrophobic).
- The phospholipid bilayer is selectively permeable
- This means it allows certain molecules—but not others—to enter the cell.

- Proteins scattered throughout the plasma membrane play important roles in allowing substances to enter the cell.

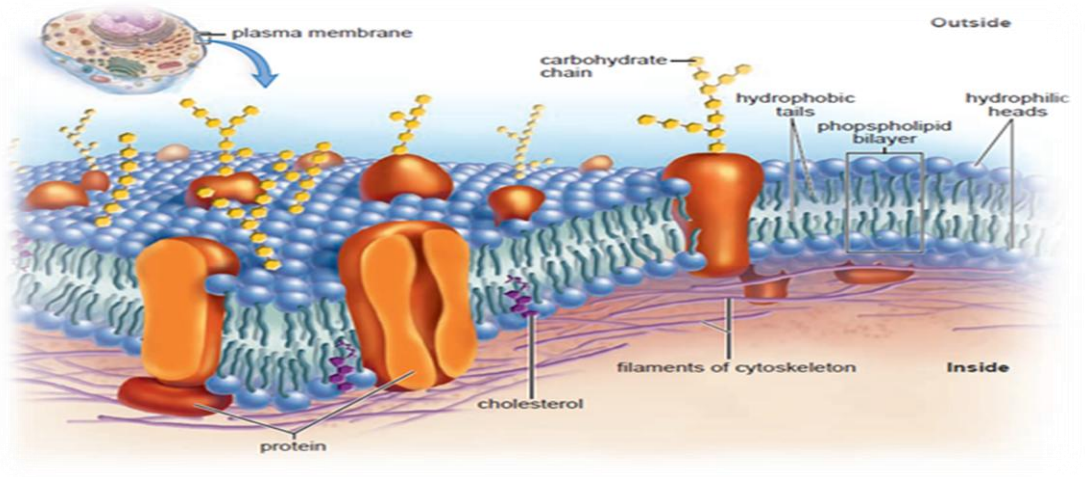


Figure of Organization of the plasma membrane

2- The cytoplasm

Cytoplasm is homogenous, clear jelly-like materials that fill the cells. The cytoplasm consists of cytosol and the cellular organelles except the nucleus. The cytoplasm plays a mechanical role ,i.e. to maintain the shape, the consistency of the cell and to provide suspension to the organelles

3-The Nucleus

- The nucleus, a prominent structure in cells, stores genetic information.
- Every cell in the body contains the same genes.

- Genes are segments of DNA that contain information for the production of specific proteins.
- The nuclear envelope has nuclear pores of sufficient size to permit the passage of ribosomal subunits out of the nucleus and proteins into the nucleus.

Chromatin

Chromatin is the combination of DNA molecules and proteins that make up the chromosomes.

•Chromatin can coil tightly to form visible chromosomes during meiosis (cell division that forms reproductive cells in humans) and mitosis (cell division that duplicates cells).

Organelles

The endoplasmic reticulum

The endoplasmic reticulum (ER) is a series of interconnected membranous sacs and tubules that modifies proteins and synthesizes lipids.

1. Rough ER

The RER is generally a series of connected flattened sacs. Rough ER is named for its rough appearance, which is due to the ribosomes attached to its outer (cytoplasmic) surface. Rough ER lies immediately adjacent to the cell nucleus, and its membrane is continuous with the outer membrane of the nuclear envelope.

The RER also **makes** phospholipids for cellular membranes and synthesis of protein

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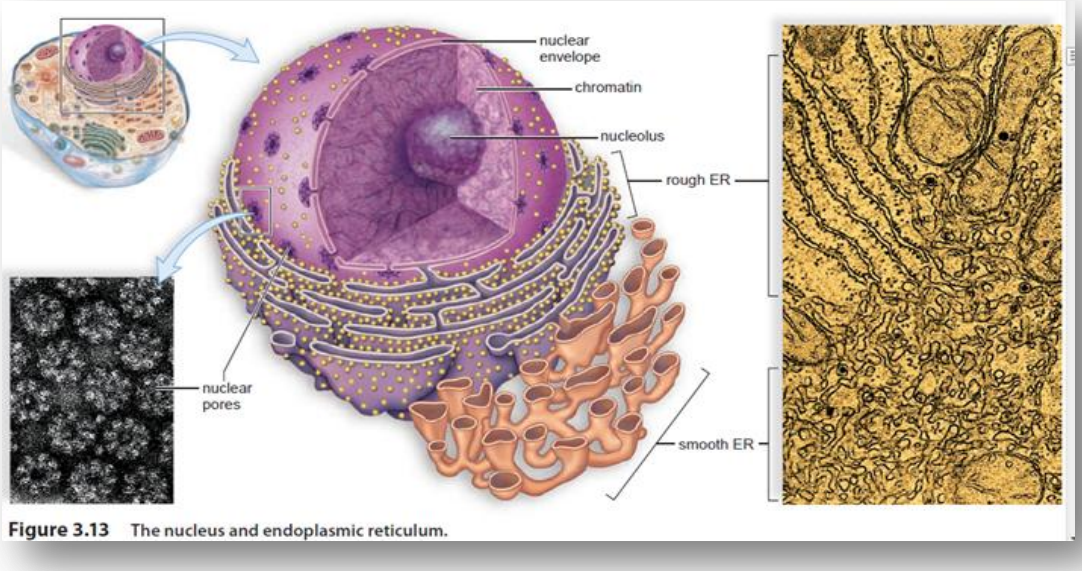


Figure 3.13 The nucleus and endoplasmic reticulum.

2. Smooth ER

It is composed of a network of smooth tubules; free of ribosomes . Smooth ER develops from rough ER and is connected directly to it. **Functions** of the SER include synthesis of carbohydrates, lipids, and steroid hormones; detoxification of medications and poisons; and storage of calcium ions.

Ribosome

•Ribosomes are organelles composed of proteins and rRNA.

•Protein synthesis occurs at the ribosomes.

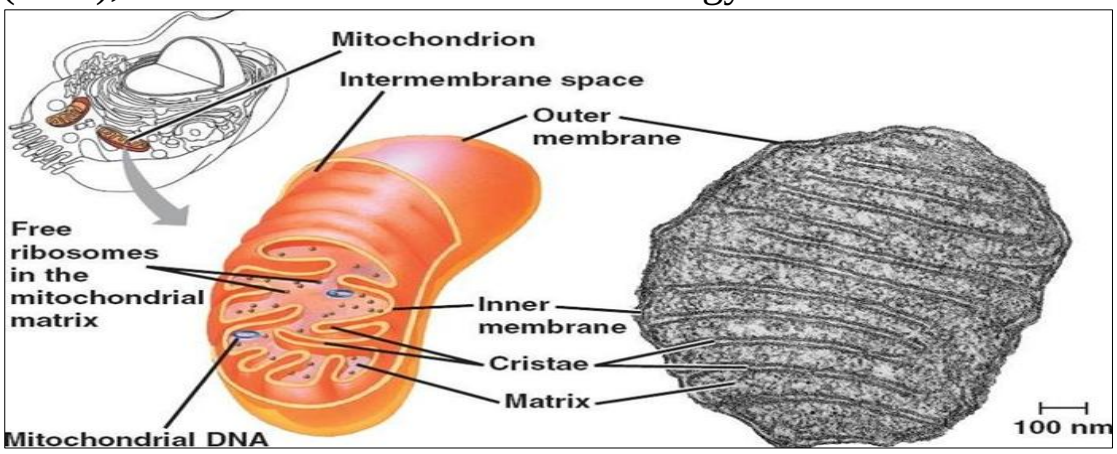
•Ribosomes are often attached to the endoplasmic reticulum; but they also may occur free within the cytoplasm, either singly or in groups called polyribosomes

Golgi apparatus The Golgi apparatus (also called the Golgi body), is a cellular organelle that packages and sorts proteins and other molecules before they are sent to their final destination. **Function:**

1) Golgi apparatus modifies proteins that it receives from the RER.
2) Transport lipids to vital parts of the cell and creates lysosomes.and attaching polysaccharides to proteins, cutting proteins into smaller active fragments

Mitochondria

The **mitochondrion** (plural mitochondria) is a double membrane-bound organelle found in all eukaryotic organisms, although some cells in some organisms may lack them (e.g. red blood cells). Mitochondria have been described as "the powerhouse of the cell" because they generate most of the cell's supply of adenosine triphosphate (ATP), used as a source of chemical energy.



Lysosomes

- Lysosomes, membranous sacs produced by the Golgi apparatus, contain *hydrolytic enzymes*.
- Lysosomes are found in all cells of the body but are particularly numerous in white blood cells that
- engulf disease-causing microbes.

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Blood

Blood: is a Vascular connective tissue specializing connective tissue it consists of erythrocyte, leukocyte, and the intercellular substance is the plasma, the fibers appear as fibrin when blood is clotted.

Blood: - has been defined as a highly specialized tissue, which along with the circulatory system is adapted to meet the needs of the body tissues and organ systems. Such as exchange of gases, provision of nutrients, and removal of waste products.

Functions of blood

1.Transportation: blood is the primary transport medium of the body.

a. $\mathbf{O_2}$ enters the blood from the lungs and is carried to cells, and CO_2 produced by cells is carried from the blood to the lung from which it is expelled.

b.The blood from the gastrointestinal tract to cells transports ingested nutrients, electrolytes & water, and waste products are transported from cells to kidneys for elimination in urine.

2.Maintenance: blood plays a crucial role in maintaining homeostasis(constancy of internal environment).

a. many of the hormones and enzymes that regulate body processes , are found in blood which act as buffers which help keep the blood's PH within its normal limits of 7.35 – 7.45.

b.Temeprature regulation :because blood can hold heat,

3**. Protection:** cells and chemicals of the blood constitute an important in **immune system,** protecting against foreign substances such as microorganisms and toxins. **Blood clotting** also provides protection against excessive fluid & cell loss when blood vessels are damaged.

Composition of Blood

The normal total circulating blood volume is 8% of the body weight . consisting of:

1- Blood cells: the **solid portion** of blood.

A. Specialized cells (Erythrocytes and Leukocytes).

B. Cell fragments (platelets or thrombocytes).

2- Plasma: the **fluid portion** of blood.

Erythrocytes= R.B.C.

•Most numerous cells in blood and it is **biconcave disc** in shape.

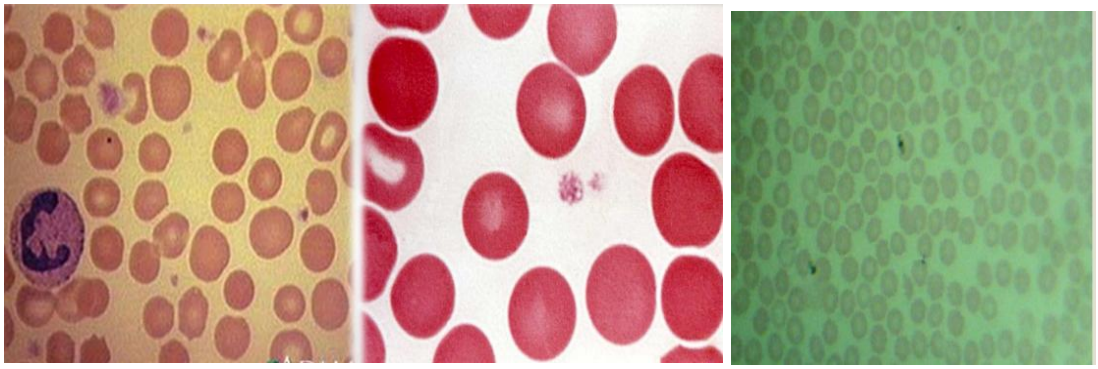
•Erythrocytes are **no nucleated** cells that remain in the blood.

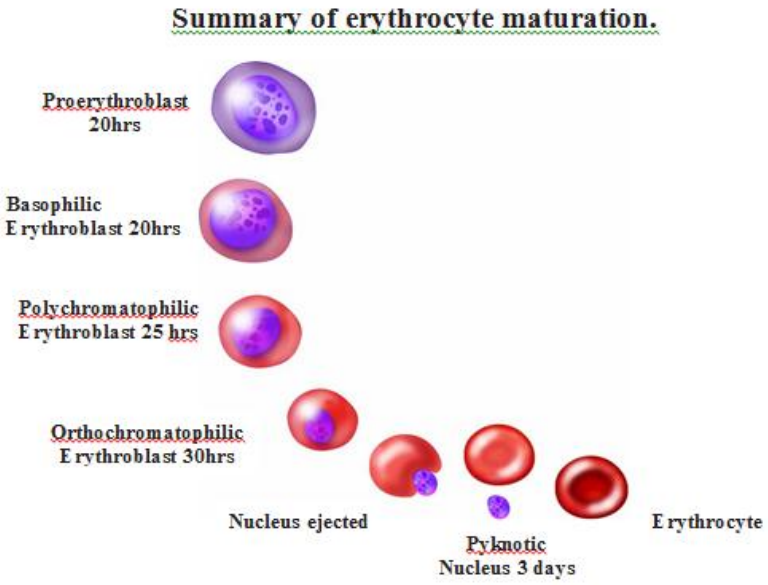
•Contain hemoglobin with iron molecules in cytoplasm.

•Carry oxygen as oxyhemoglobin and carbon dioxide as carbaminohemoglobin

•Biconcave shape **increases surface area** to carry respiratory gases

•**Life span** is about 120 days, after which cells are phagocytosed in spleen, liver and bone marrow.





Leukocytes= W.B.C.

White blood cells **are spherical in shape**, according to the type **granules of their cytoplasm** and the **shape of their nuclei**, leukocyte are divided into:

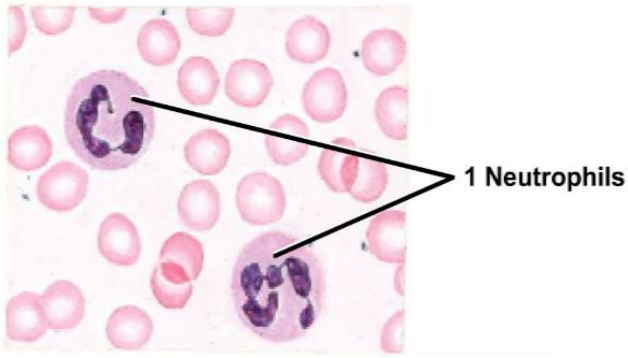
1) **Granular leukocytes: contain specific granules and have nuclei with two or more lobes . There are** three types **of granular leukocytes:**

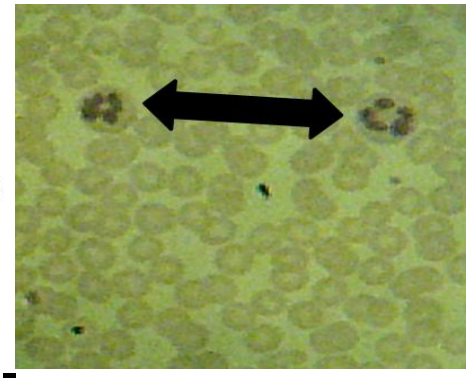
A-Neutrophils

-Cytoplasm appears contain specific granules.

-Polymorphonuclear leukocytes,
-Nucleus contains from 3-5 irregular ovoid lobes connected by fine threads of chromatin

-Constitute about 60 to 70% of blood leukocytes



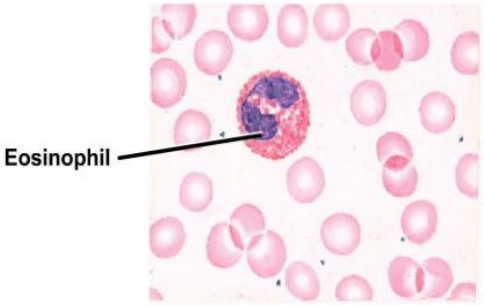


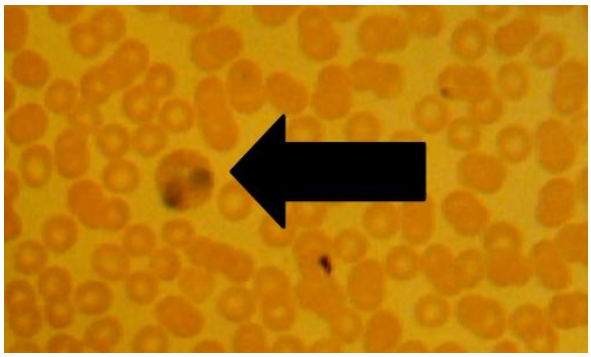
B- Eosinophils or (acidophils):

• are larger than neutrophils,

.cytoplasm is filled with course granules and stain with acidic dyes.

• Nucleus typically **bilobed**
• Increase during parasitic infestation to destroy helminthic parasites
• Constitute about 2 to 4% of the blood leukocytes



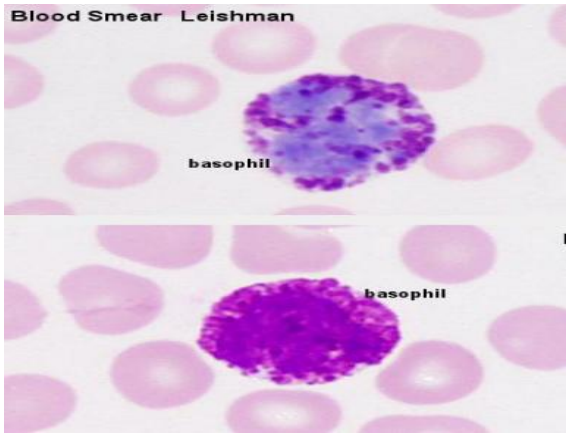


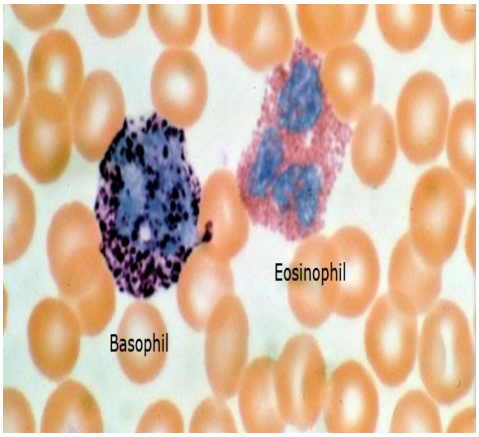
C-Basophils

• are the same size as neutrphil,

. Cytoplasm contains dark blue or brown granules
• Have a short life span
• nucleus usually irregular two lobes appearing as (S) shape.

. Nucleus stains pale basophilic,
• Granules contain histamine and heparin allergic reactions
• Constitute less than 1% of blood leukocytes

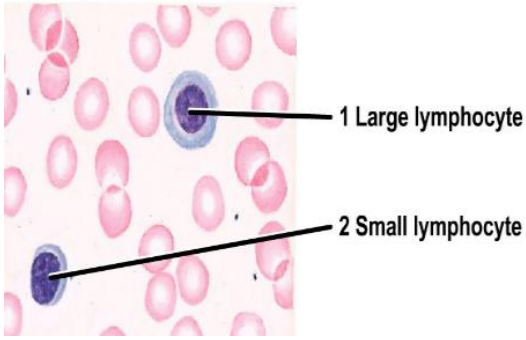


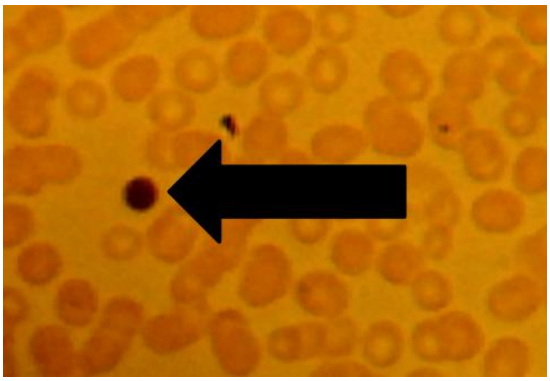


2) A granular leucocytes : • Agranulocytes are without cytoplasmic granules Include;

A- Lymphocytes

• **No granules** in cytoplasm and vary in size from small to large
• are **spherical cells**, most are little larger than erythrocyte.
•Life span is from days to months
• Essential in immunologic defense of organism
• Constitute about 20 to 30% of blood leukocytes

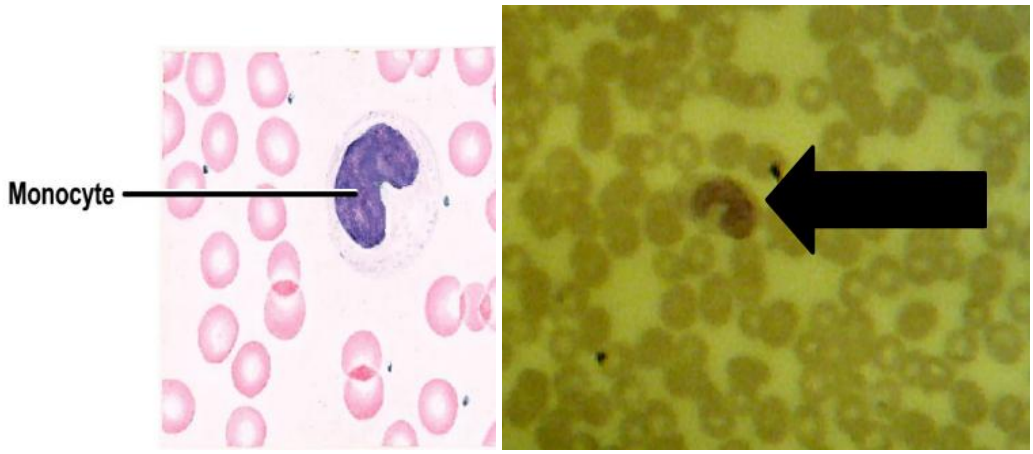




B- Monocytes

• Largest a granular leukocyte ,nucleus is oval or kidney shaped and is generally eccentrically placed
• Live in connective tissue for months

• Are part of the mononuclear phagocyte system
• Constitute about 3 to 8% of blood leukocytes

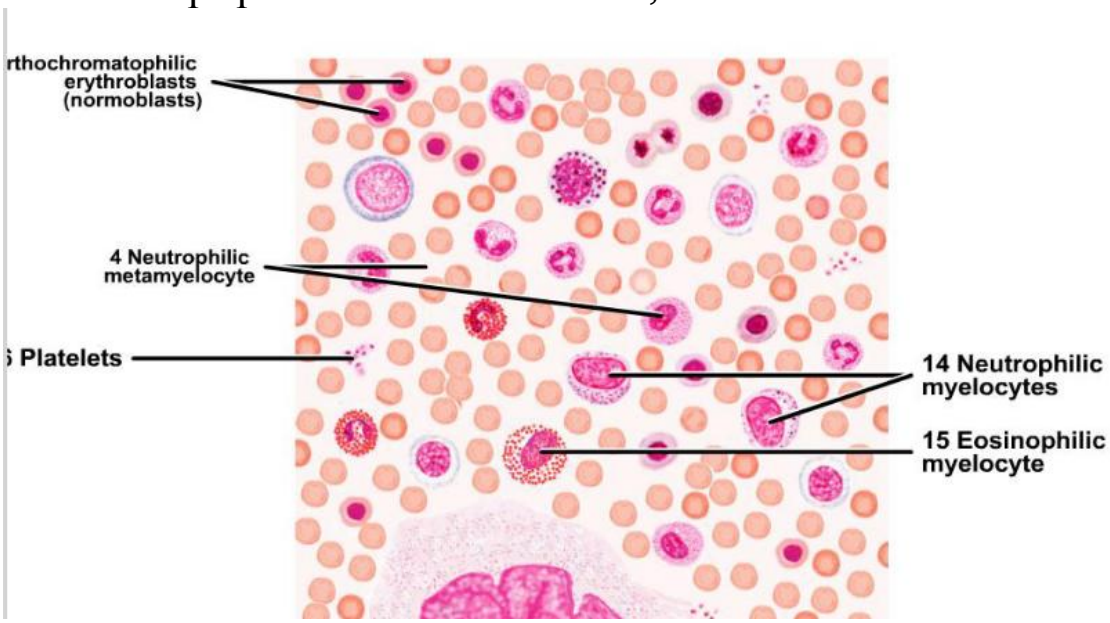


Platelets

• are non-nucleated, disk- like cell fragments. **Platelets** are around or ovoid in shape and **aggregate as groups**
Are fragments of bone marrow megakaryocytes and not blood cells

• Function in blood vessels to **promote blood clotting** when blood vessel wall is damaged through adhesive glycoproteins and fibrin

• Fibrin traps platelets and blood cells, and forms blood clot



PLASMA

The normal plasma volume is 55% of total blood volume. Plasma remaining fluid only if an anticoagulant is added to the blood.

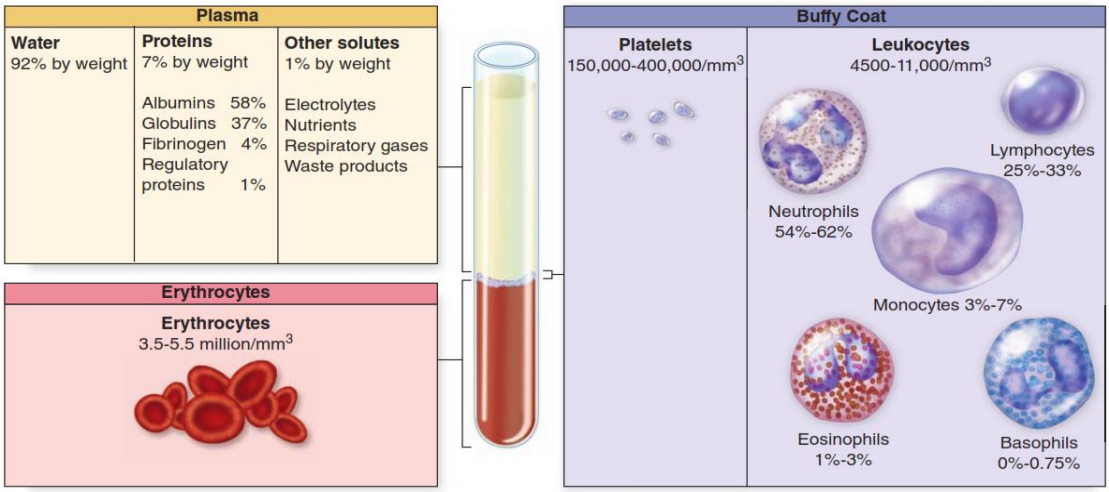
Plasma: is a pale yellow fluid that consists of:

1. **91% water:** which acts as a solvent and suspending medium for blood component

2. 2% other solutes such as ions, nutrients (as a source of energy), vitamins (promote enzyme activity), gases (such as O_2 necessary for aerobic respiration, and CO_2 waste product of aerobic respiration), regulatory substances (such as hormones), and waste products (such as urea, uric acid, etc which are excreted by the kidneys.

3. (7%) plasma proteins: Most of the suspended substances are plasma proteins, which include **albumin, globulins, and fibrinogen.**

Separation of proteins in a plasma sample is performed by a technique called **electrophoresis.**



Serum

If whole blood is allowed to clot and the clot is removed, the remaining fluid is called serum. Serum has essentially the same composition as plasma except that

1- its **clotting factors**: fibrinogen (factor I), prothrombin (factor II), labile factor (factor V), and antihemophilic factor VIII

2- it has a higher **serotonin** content because of the breakdown of platelets during clotting mechanism

LYMPH

Lymph is watery fluid that moves through your lymphatic system. Your lymphatic system helps support your overall health**.** Have same blood component except red bleed cells.

Lymph collects fluids from your tissues and returns them to your blood.

It carries nutrients and proteins to your cells and tissues.

It also collects any harmful substances found in your cells and tissues

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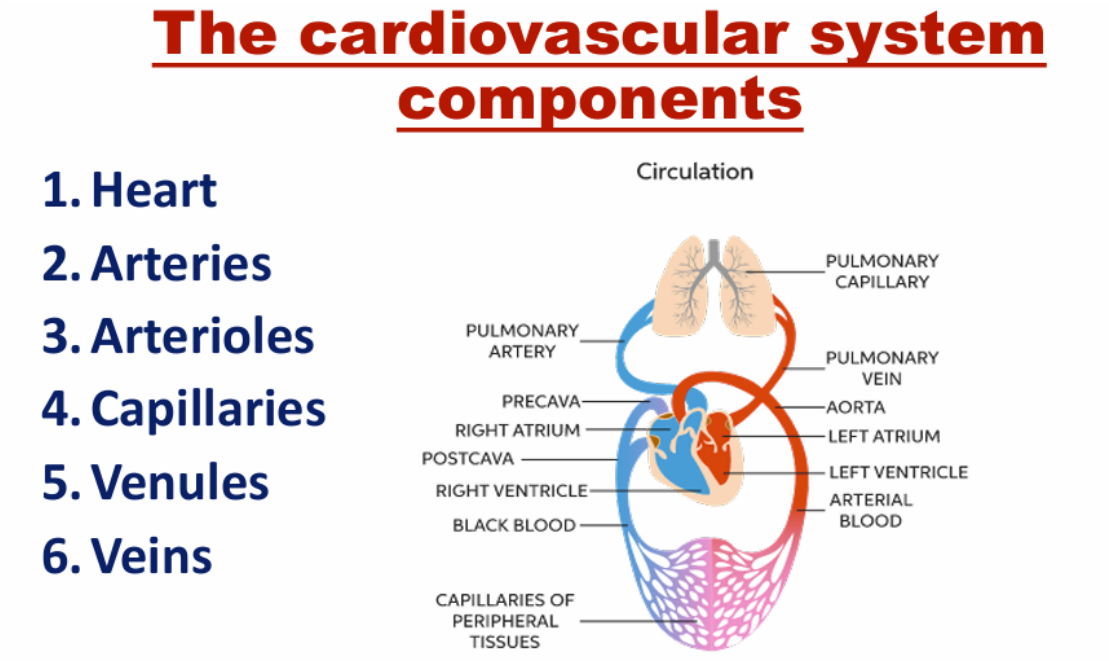
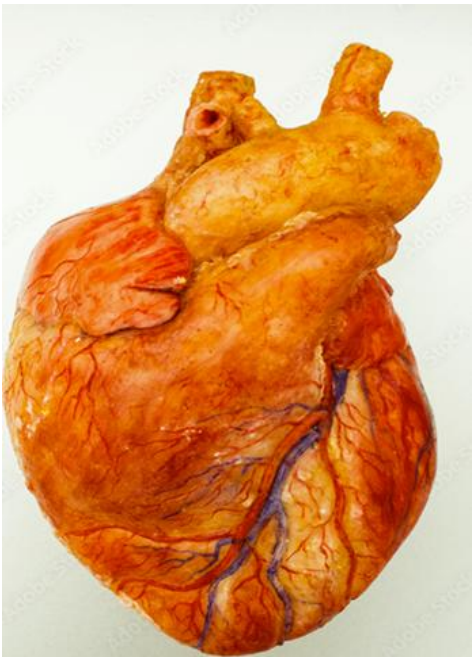
Cardiovascular system

Cardiovascular system Is a closed system that distributes blood which carry the oxygen and nutrients to all parts of the body and bringing back the wast products and CO2 from the different tissues to be expelled out the body.



The Heart

Is little larger than a **person fist** its weight is about (Hear in **female** & 250-300gm, 300-350 gm in **male**) usually beating about 60 to 100 times per minute by a repeated rhythmic involantry contractions. regulated by the **sinoatrial (SA) node** of the heart, which serves as the heart's pacemaker ,each heart beat called a = 70 ml/beat stroke volume



The **primary function** of the heart is to **pump blood and supply oxygen and nutrients to all body cells.**

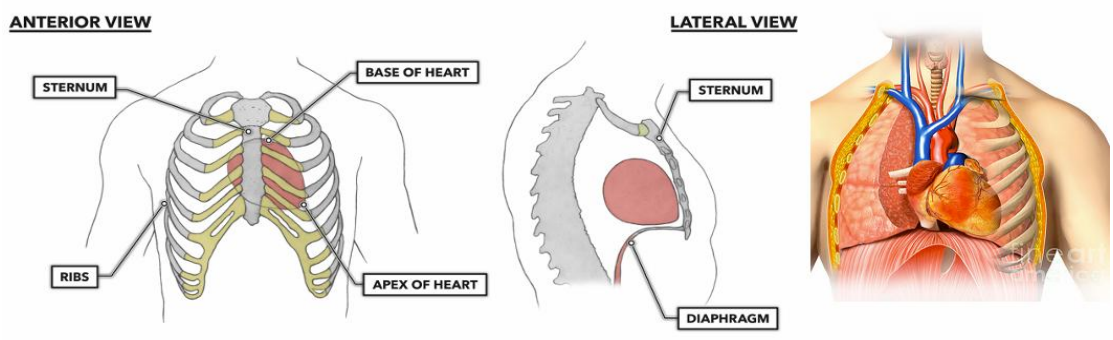
The heart **consists of four chambers**

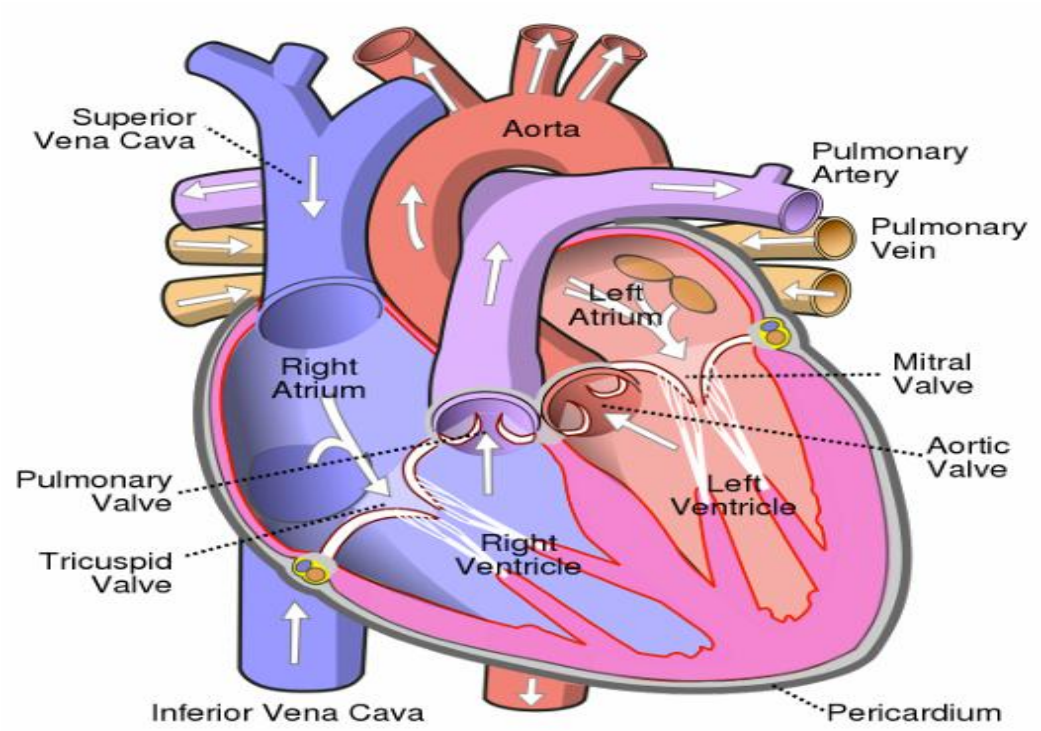
upper chambers two called the right atria and left atria and

lower chambers two called the right ventricle and left ventricle.

There are **valves** called **atrioventricular valves** between the upper and lower chambers that ensure blood flows only in a single direction through your heart.

The heart is **located** in **the middle of the chest**, between the lungs and under the rib cage slightly to the left of the sternum (breastbone).



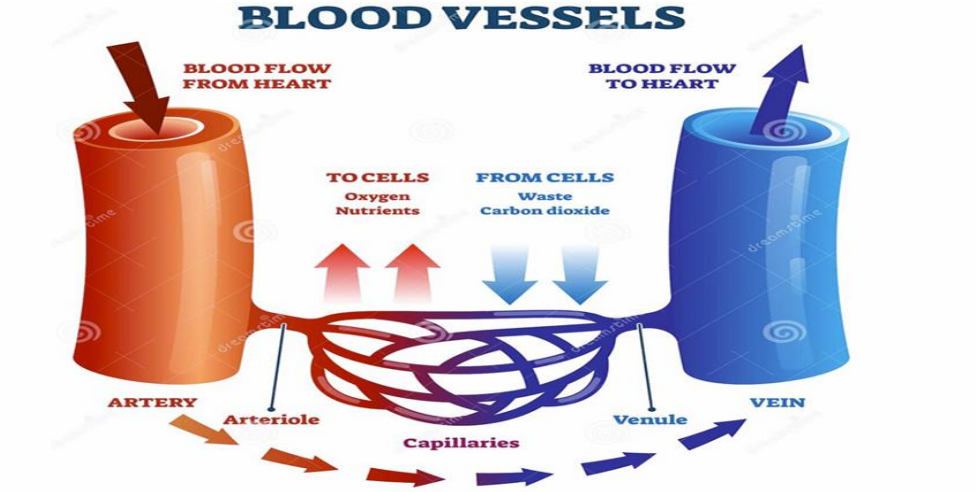


The main functions of the heart :

1. **Pumping oxygenated blood** to the other body parts through the arterial system
2. **Pumping hormones** and other vital substances to different parts of the body.
3. **Receiving deoxygenated blood** and carrying metabolic waste products from the body by superior and inferior vena cava veins and pumping it to the lungs for oxygenation.
4. **Maintaining blood pressure.**

Three Kinds of Blood Vessels

- *Arteries*
  - Carry blood *away* from heart and carry it to the capillaries
- *Capillaries*
  - Microscopic vessels where exchange between cells and blood takes place
- *Veins*
  - Receive blood from capillaries and carry it *back* to the heart



the conduction system of the heart

heart's conduction system is the network of nodes (groups of cells that can be either nerve or muscle tissue).

Two types of cells control heart beating :

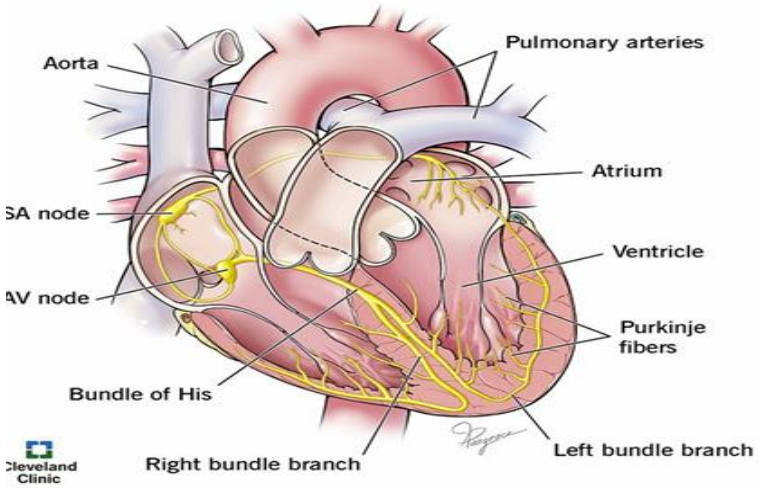
- **Conducting cells carry the electric signals.**
- **Muscle cells control the heart's contractions.**

The electrical signals that travel through the heart conduction system cause heart to expand and contract.

These contractions control how blood flows through the heart ,

the specialized cells are:

- **Sinoatrial node.**
- **Atrioventricular node.**
- **Bundle of His (atrioventricular bundle).**
- **Purkinje fibers**



Cardiac output is how many liters of blood the heart pumps in one minute.

The cardiac output equation: multiply stroke volume (SV) by heart rat(HR).

• Stroke volume So CO = HR X SV

(the amount of blood that the heart sends to the body in one heart beat) .

Stroke volume can go up or down based on the heart health and whether individual at rest or moving.

• Heart rate (number of heart beats per minute) is normally 60 to 100 beats per minute.

The heart rate can go up or down depending on whether person resting or exercising.

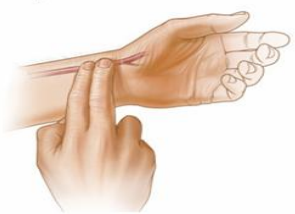
Heart Sounds

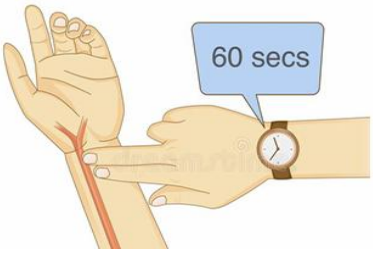
- First heart sound
  - "Lubb"- ventricles contract and both AV valves close
- Second heart sound
  - "Dupp"- semilunar valves close at end of ventricular systole

- Systole is between first and second sounds.
- Diastole is between second and first sounds.

Heart Rate

- A normal resting heart rate for adults ranges from 60 to 100 beats per minute. Generally, a lower heart rate at rest implies more efficient heart function and better cardiovascular fitness. For example, a well-trained athlete might have a normal resting heart rate closer to 40 beats per minute.





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Cardiac cycle

It is the inclusive period of time from the start of one heartbeat to the initiation of the next.

In each cardiac cycle, there are alternate contractions and relaxation of all chambers. Each **contraction is called systole** and each **relaxation is called diastole**.

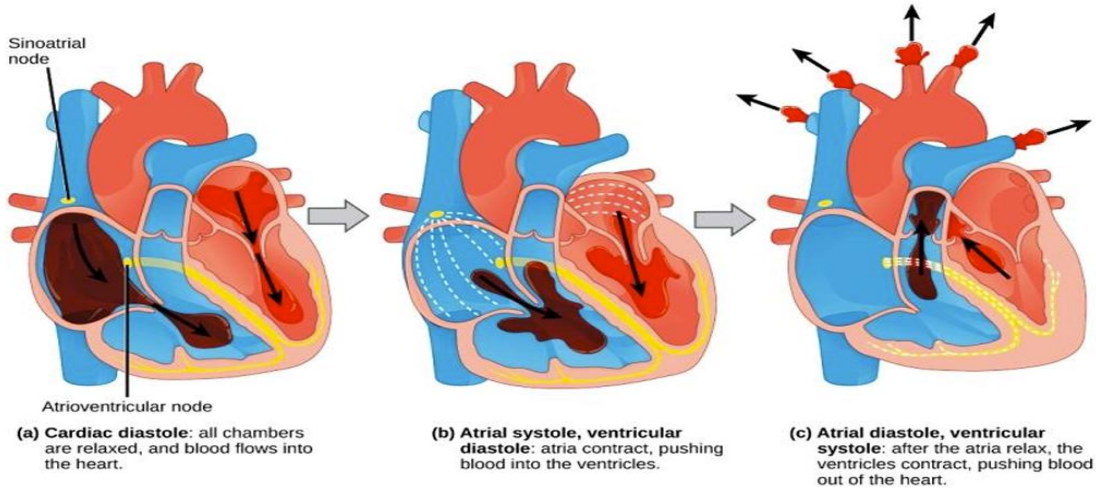
The events at single cardiac cycle:

1. **Atrial systole:** contraction of both atria (left and right) simultaneously leads to move blood (20%) from atria to the ventricles (from right atrium to the right ventricle through **tricuspid valve.** And from left atrium to the left ventricle through **mitral valve**).

2. Atrial diastole:

3. Ventricular systole: In this period, the tricuspid and mitral valves are closed, and the blood forced into the blood vessels through **semilunar valves** (from left ventricle to the pulmonary artery. And from left ventricle to the aorta).

4. Ventricular diastole: most of blood (80%) flows passively from relaxing atria into the ventricles through the open **aterioventricle valves.**

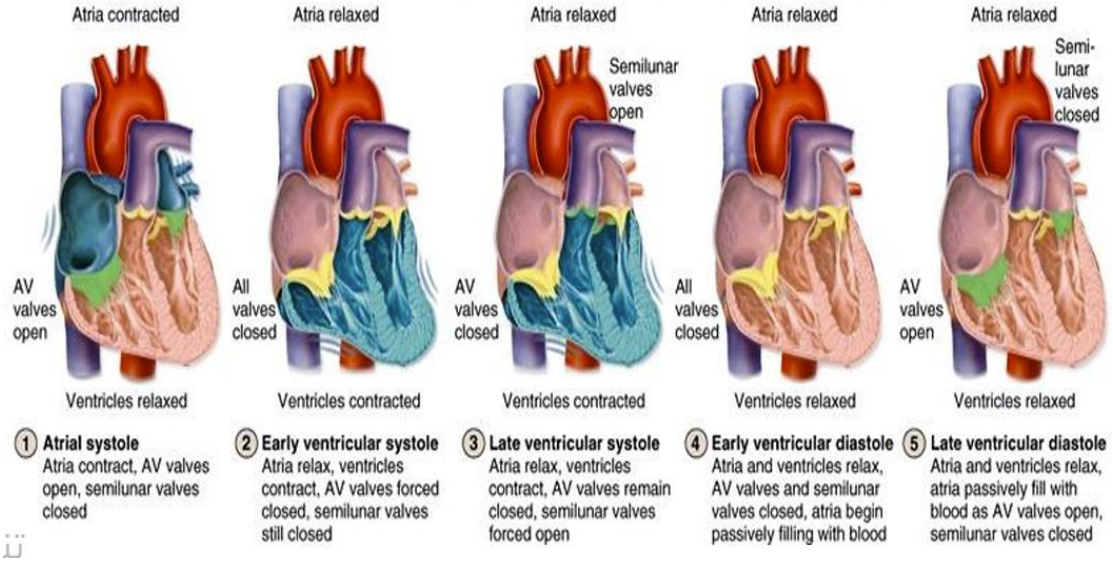


(a) **Cardiac diastole**: all chambers are relaxed, and blood flows into the heart.

(b) **Atrial systole, ventricular diastole**: atria contract, pushing blood into the ventricles.

(c) **Atrial diastole, ventricular systole**: after the atria relax, the ventricles contract, pushing blood out of the heart.

Structure \ Phase	Atrial systole	Early ventricular systole ⟷ Late ventricular systole	Early ventricular diastole ⟷ Late ventricular diastole
Atria	Contract	Relax	Relax
Ventricles	Relax	Contract	Relax
AV valves	Open	Closed	Open
Semilunar valves	Closed	Open	Closed



What is Circulation?

Before we delve into the difference between pulmonary and systemic circulation, let's first understand what circulation itself means. Circulation refers to the movement of blood throughout the body, which ensures that oxygen, nutrients, and waste products are efficiently transported to and from tissues and organs.

Blood is circulated through two main pathways:

Pulmonary circulation and Cystemic circulation

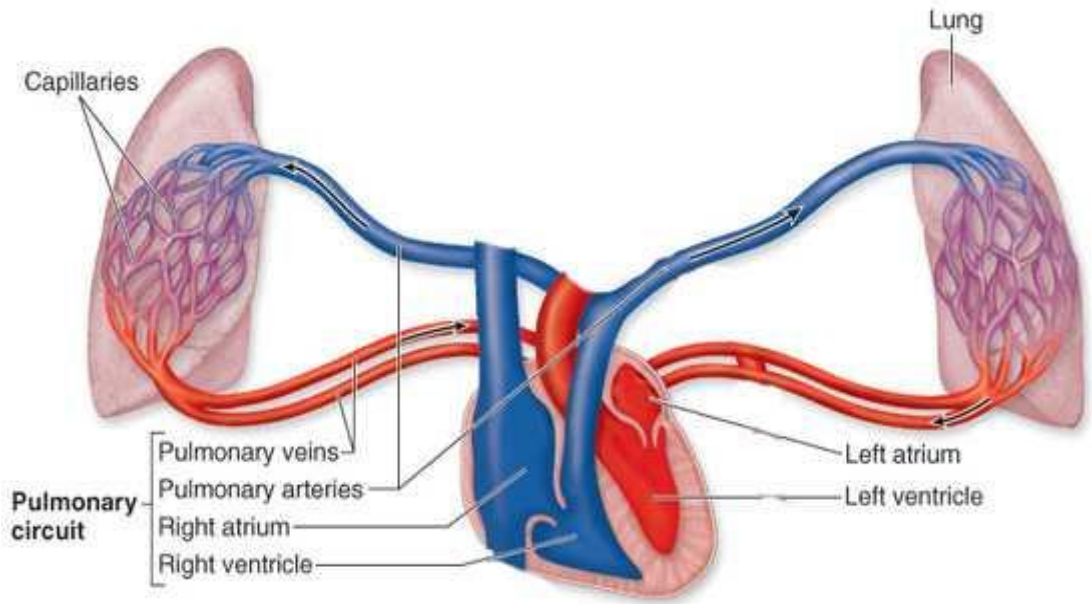
Pulmonary Circulation

is the process through which deoxygenated blood is transported from the heart to the lungs and then returned as oxygenated blood to the heart. It is a shorter and more focused circuit compared to systemic circulation, playing a vital role in oxygenating blood before it is distributed to the rest of the body.

Here’s how pulmonary circulation works:

1. **Deoxygenated Blood Flow**: Blood that has delivered oxygen to the body’s tissues returns to the heart’s right atrium through veins. This blood is low in oxygen and high in carbon dioxide.
2. **Right Ventricle Pumping**: From the right atrium, the blood moves to the right ventricle. When the right ventricle contracts, it pushes the blood into the pulmonary arteries.
3. **Lungs Oxygenation**: The pulmonary arteries carry the deoxygenated blood to the lungs. In the lungs, the blood releases carbon dioxide and absorbs oxygen through the alveoli (tiny air sacs).
4. **Oxygenated Blood Returns**: Once oxygenated, the blood returns to the heart’s left atrium through the pulmonary veins, completing the pulmonary circulation.

Pulmonary circulation is crucial for replenishing oxygen levels in the blood and removing carbon dioxide, which is a waste product of metabolism.

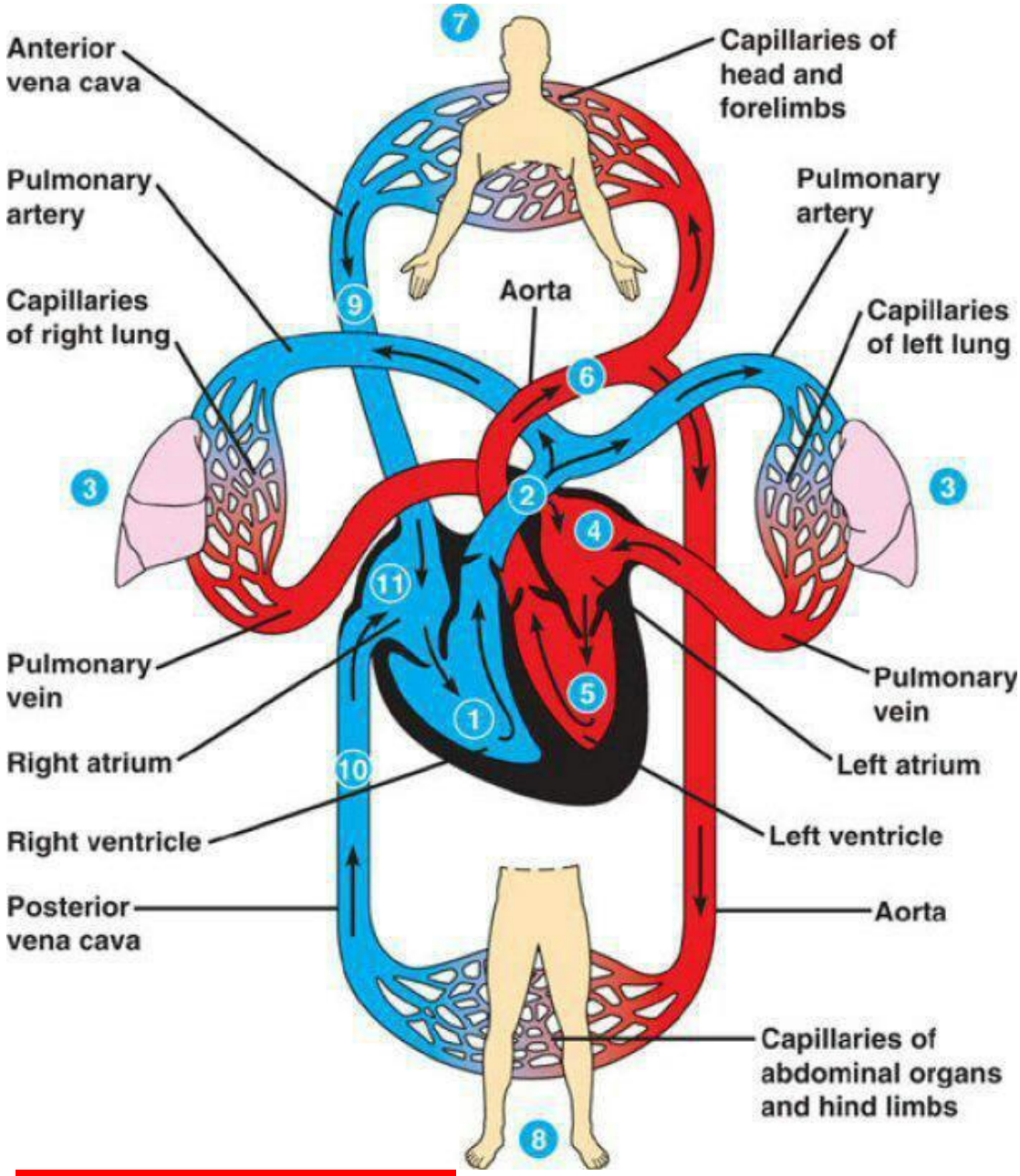


Systemic Circulation

Systemic circulation, is responsible for distributing oxygenated blood from the heart to all parts of the body, except the lungs. This pathway ensures that every tissue and organ in the body receives the necessary oxygen and nutrients to function properly, while also collecting waste products like carbon dioxide and bringing them back to the heart.

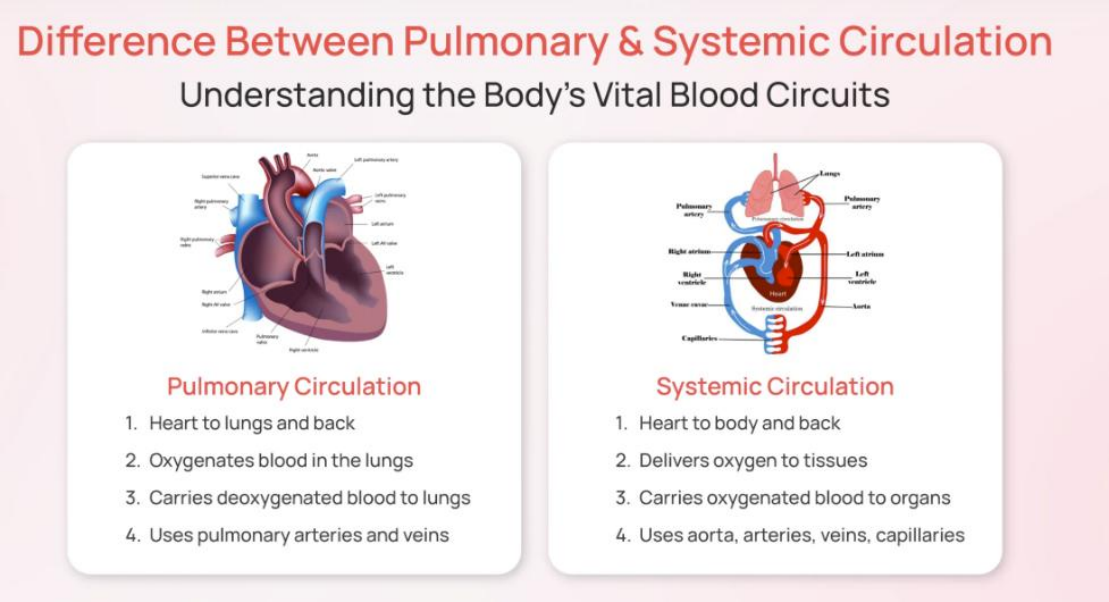
The process of systemic circulation can be outlined as follows:

1. **Oxygenated Blood Flow**: Once blood has been oxygenated in the lungs, it returns to the left atrium of the heart. From there, it flows into the left ventricle.
2. **Left Ventricle Pumping**: The powerful left ventricle pumps the oxygenated blood into the aorta, the body's largest artery.
3. **Blood Distribution**: From the aorta, the blood is distributed through a network of arteries to various parts of the body, delivering oxygen and nutrients to cells.
4. **Waste Collection**: As the blood flows through capillaries, it collects waste products like carbon dioxide from tissues. The deoxygenated blood is then transported back to the heart through veins.
5. **Return to the Heart**: The deoxygenated blood eventually returns to the right atrium of the heart, where it is then sent through the pulmonary circulation for oxygenation once again.



How They Work Together

1. Deoxygenated blood enters the **right side of the heart**.
2. Right side pumps it to the lungs (pulmonary) to get oxygen.
3. Oxygenated blood returns to the **left side of the heart**.
4. Left side pumps it out to the body (systemic).
5. Deoxygenated blood returns to the right side, restarting the cycle.

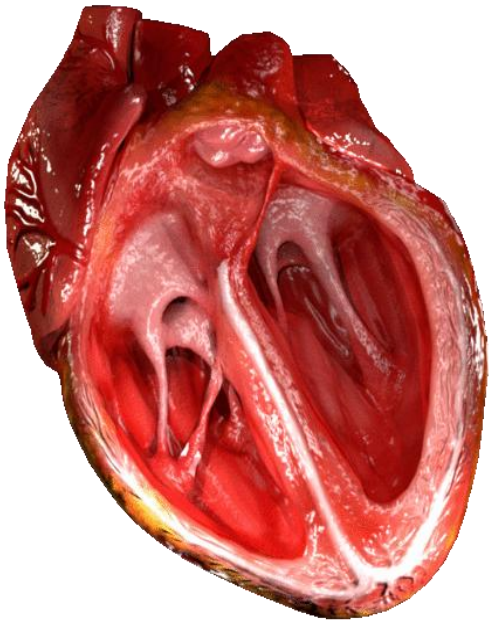


Key Difference Between Pulmonary and Systemic Circulation

1. **Pathway**:
   - **Pulmonary Circulation**: Blood flows from the right side of the heart to the lungs and back to the left side of the heart.
   - **Systemic Circulation**: Blood is pumped from the left side of the heart to the rest of the body and then returns to the right side of the heart.
2. **Function**:
   - **Pulmonary Circulation**: Its primary function is to oxygenate the blood by facilitating gas exchange in the lungs.
   - **Systemic Circulation**: Its role is to deliver oxygen-rich blood to tissues and organs, ensuring they receive the necessary nutrients and oxygen to function.
3. **Type of Blood**:
   - **Pulmonary Circulation**: Transports deoxygenated blood from the heart to the lungs and returns oxygenated blood to the heart.

- **Systemic Circulation**: Circulates oxygenated blood throughout the body and brings deoxygenated blood back to the heart.

4. **Pressure**:
   - **Pulmonary Circulation**: Operates under low pressure because it only needs to pump blood to the nearby lungs.
   - **Systemic Circulation**: Works under higher pressure as it must pump blood to distant organs and tissues, such as the brain, kidneys, and limbs.
5. **Distance**:
   - **Pulmonary Circulation**: Covers a short distance as it only involves the heart and lungs.
   - **Systemic Circulation**: Covers a much longer distance, supplying blood to the entire body except the lungs.
6. **Blood Vessels**:
   - **Pulmonary Circulation**: Involves the pulmonary arteries and pulmonary veins.
   - **Systemic Circulation**: Involves the aorta, systemic arteries, veins, and capillaries.



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Respiratory system

Every cell in the body needs oxygen to survive. The respiratory system provides a way for oxygen (O2) to enter the body. It also provides a way for carbon dioxide (Co2), the waste product of cells, to leave the body.

The respiratory system is made up of 2 sections:

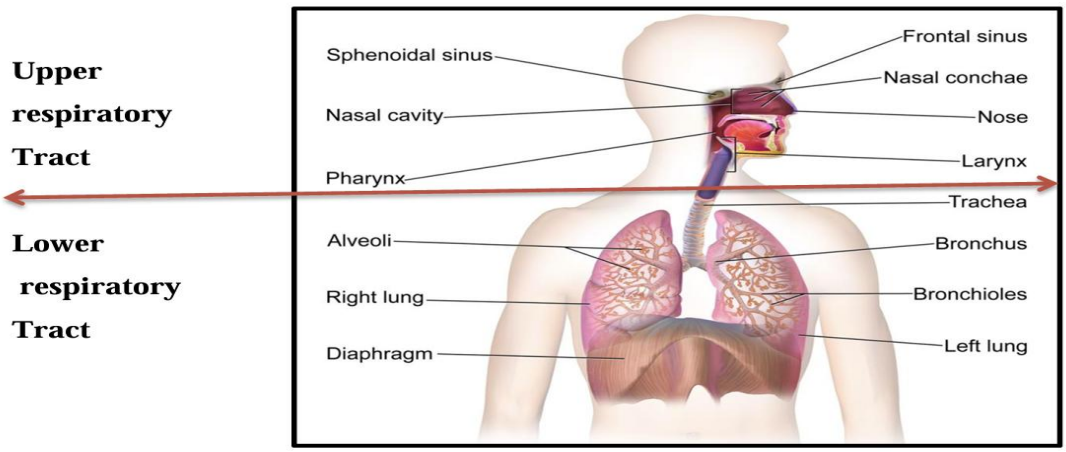
1- The upper respiratory tract and

2- The lower respiratory tract

Respiratory tract

Respiratory tract is the anatomical structure through which air moves in and out. The organs of the respiratory tract can be divided “STRUCTURALLY” into 2 groups:

The Upper Respiratory Tract	The Lower Respiratory Tract
* Nose * Nasal cavity * Sinuses * Pharynx * Larynx	* Trachea * Bronchial Tree * Lungs



The organs of the *Respiratory Tract* can be divided "***FUNCTIONALLY***" into 2 groups:

The Conducting Portion	**The Respiratory Portion**
system of interconnecting cavities and tubes that conduct air into the lungs	system where the exchange of respiratory gases occurs
* Nose * Pharynx * Larynx * Trachea * Bronchi	* Respiratory bronchioles * Alveolar Ducts * Alveoli

ANATOMY OF RESPIRATON: - It comprises respiratory tract and respiratory organs.

RESPIRATORY TRACT

It consists of a pair of external nostrils, nasal cavity, internal nares, and a nasopharynx (throat), larynx (voice box), trachea (wind pipe), bronchi, bronchioles, alveolar duct and alveolar sac.

 External nares- There are a pair of slit at the lower end of nose which opens into nasal cavity.

 The anterior structure of the external nose has three functions.

a) Warming, moistening and filtering of the incoming air

b) Detecting olfactory stimuli

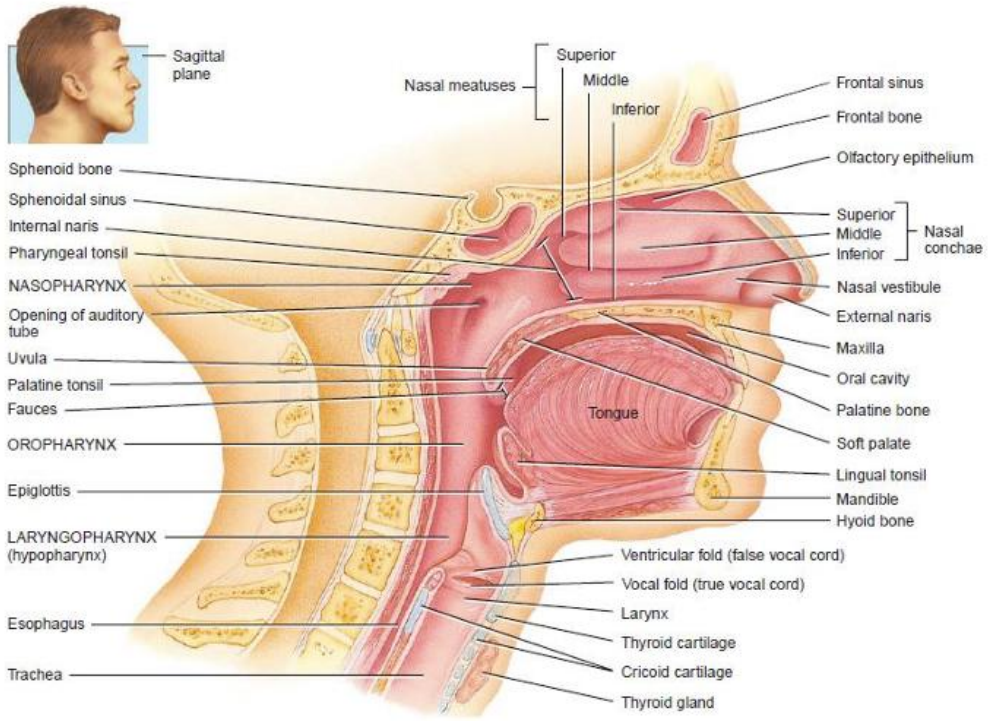
c) Modifying speech vibration as they pass through the large, hollow, resonating chamber

 Nasal cavity—It is the large cavity lined by mucous-secreting epithelium and is divided into two nasal chambers by the nasal septum.

 Anteriorly, the nasal cavity merge with the external nose, and

posteriorly it communicates with the pharynx through two openings called the internal nares. In nasal chamber air is cleaned, warmed and filtered.

It is only externally visible organ of respiratory system.



PHARYNX The pharynx is 12-14 cm long tube that lies behind the nasal and mouth cavities and larynx. Thus, **it belongs** to both **respiratory and digestive systems.** Air flows into the placed larynx in part anteriorly and food goes into the oesophagus in part posteriorly. During **swallowing**, the epiglottis covers the entrance to the larynx.

Divide into-

Nasopharynx - It is the upper narrow part pharynx in which the internal nares open.

Oropharynx – It is the oral part of pharynx.

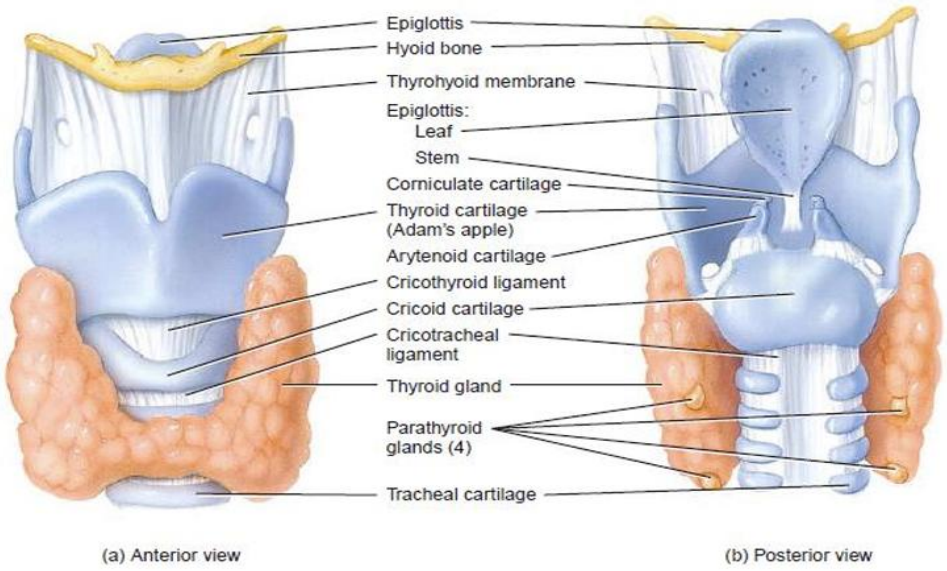
Laryngopharynx – It is laryngeal part of pharynx.

LARYNX (VOICE BOX) It is a small box like structure situated in the neck, anterior to oesophagus and is **supported by these cartilages:**

a) Thyroid cartilage (Adam's apple)

b) Cricoid cartilage

c) Arytenoid cartilage



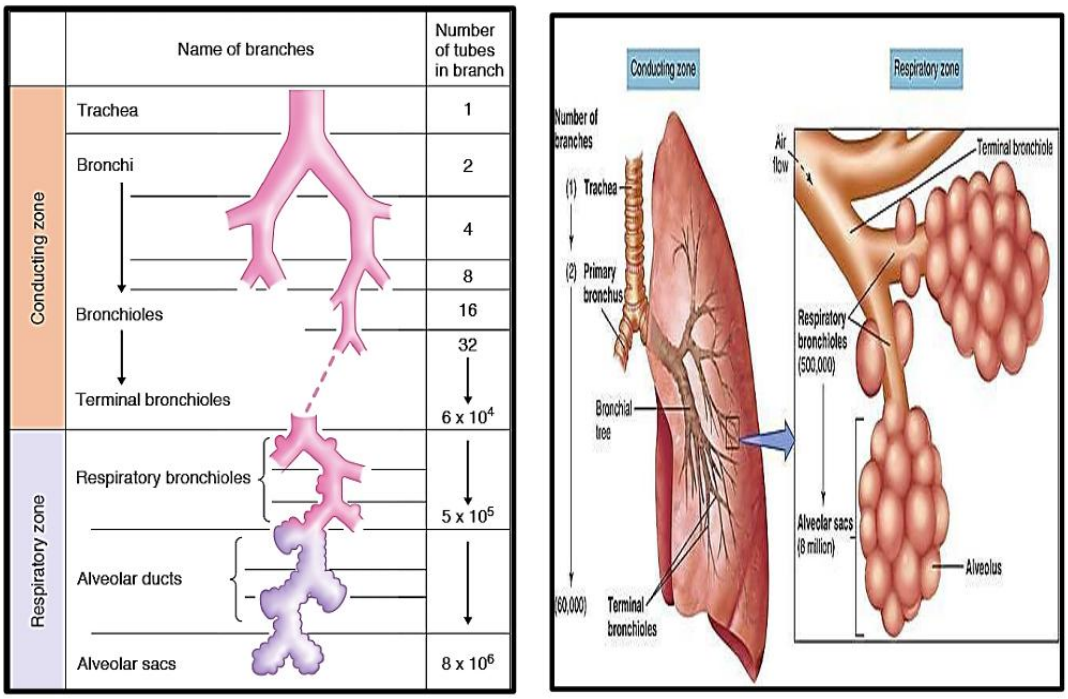
TRACHEA (WIND PIPE)

It is a long, thin walled (12cm) tube running through the neck is supported by C- shaped cartilaginous ring prevent it from collapsing. It lies **in front of oesophagus** and descends vertically from sixth cervical vertebra between the two lungs. In the thoracic region, it divides into pair of pulmonary bronchi. The whole respiratory passage i.e. branching network of trachea constitutes trachea-bronchial tree.

BRONCHI & BRONCHIOLES

Primary bronchi enter into right and left lungs where they further divided into secondary bronchi, tertiary bronchi and bronchioles. ⟩ Each bronchiole is about 1mm in diameter and is

divided into number of alveolar ducts each about 0.2mm in diameter. ⎱ Each alveolar duct enters into alveolar sac. ⎱ The total surface area of alveolar sac in man is approx. 100mm2



Tracheobronchial Tree

The trachea and bronchi are together called tracheobronchial tree. It forms a part of air passage. Components of **tracheobronchial tree:**

1. Trachea bifurcates into two main or **primary bronchi** called right and left bronchi.

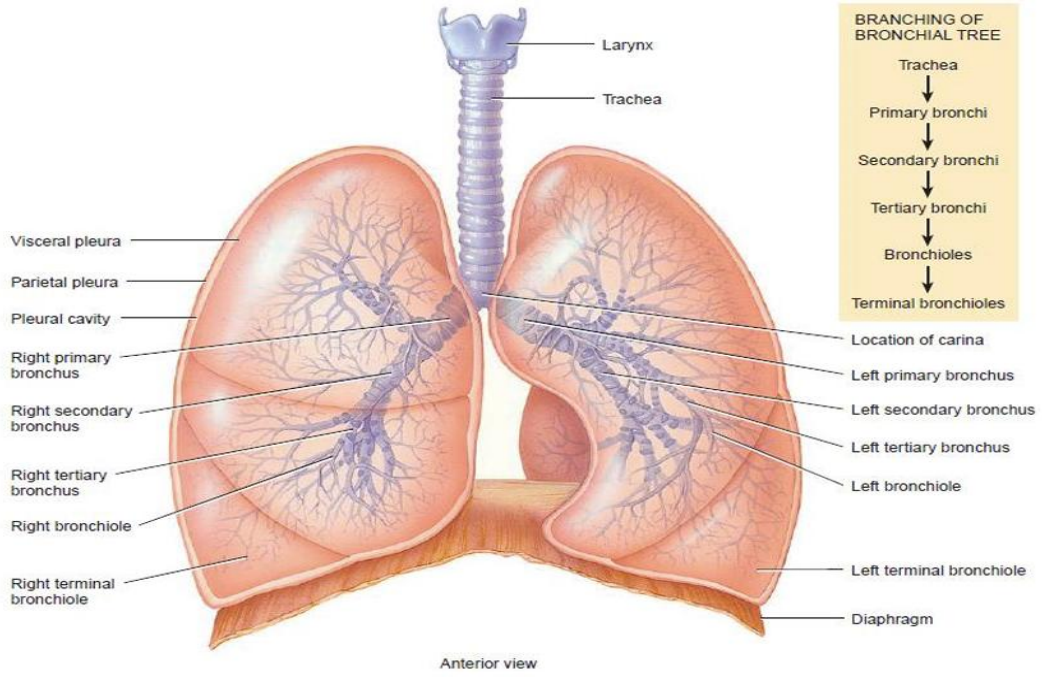
2. Each primary bronchus enters the lungs and divides into **secondary bronchi.**

3. Secondary bronchi divide **into tertiary bronchi**. In right lung, there are 10 tertiary bronchi and in left lung, there are eight tertiary bronchi

4. Tertiary bronchi divide several times with reduction in length and diameter into many generations of bronchioles.

5. When the diameter of bronchiole becomes 1 mm or less, it is called **terminal bronchiole**.

6. Terminal bronchiole continues or divides into **respiratory bronchioles,** which have a diameter of 0.5 mm.



Anterior view

Respiratory unit

Respiratory unit is defined as the structural and functional unit of **lung;** the exchange of gases occurs only in this part of the respiratory tract. The respiratory unit starts from the respiratory bronchioles. Each respiratory bronchiole divides into alveolar ducts. Each alveolar duct enters an enlarged structure called the alveolar sac. The space inside the alveolar sac is called antrum. Alveolar sac consists of a cluster of alveoli. Thus,

Respiratory unit includes:

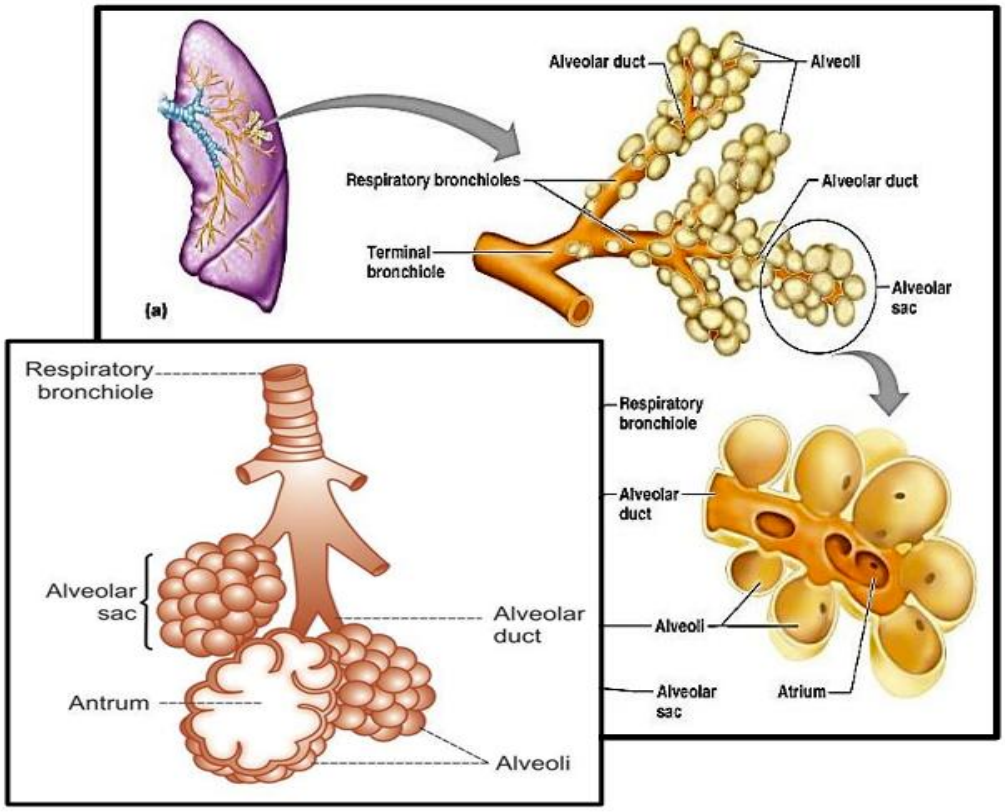
1. Respiratory bronchioles.

2. Alveolar ducts.

3. Alveolar sacs.

4. Antrum.

5. Alveoli.



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Respiration

Respiration is a procedure in which movement of oxygen (O2) from the outside environment to the cells within tissues, and the transport of carbon dioxide (Co2) in the opposite direction**. Or,** it is the exchange of gases between the **atmosphere, lungs, blood, and tissues;** where the O2 is taken in and Co2 is given out.

During this process food is oxidize to produce carbon dioxide, water and energy.

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 38ATP$

This process involves:-

- Intake of environment oxygen
- Oxidation of food
- Elimination of carbon dioxide and water
- Conservation of energy in the form of ATP.

Types of Respiration

Respiration is often classified into two types:

1. External respiration that involves exchange of respiratory gases, O2 and Co2 between lungs and blood.

2. Internal respiration which involves exchange of gases between blood and tissues.

Stages of Respiration

Respiration occurs in two stages:

1. Inspiration during the air enters the lungs from atmosphere

2. Expiration during the air leaves the lungs.

FUNCTION OF RESPIRATION

1. Pulmonary ventilation means in which the inflow and outflow of air occurs between the atmosphere and lung alveoli.

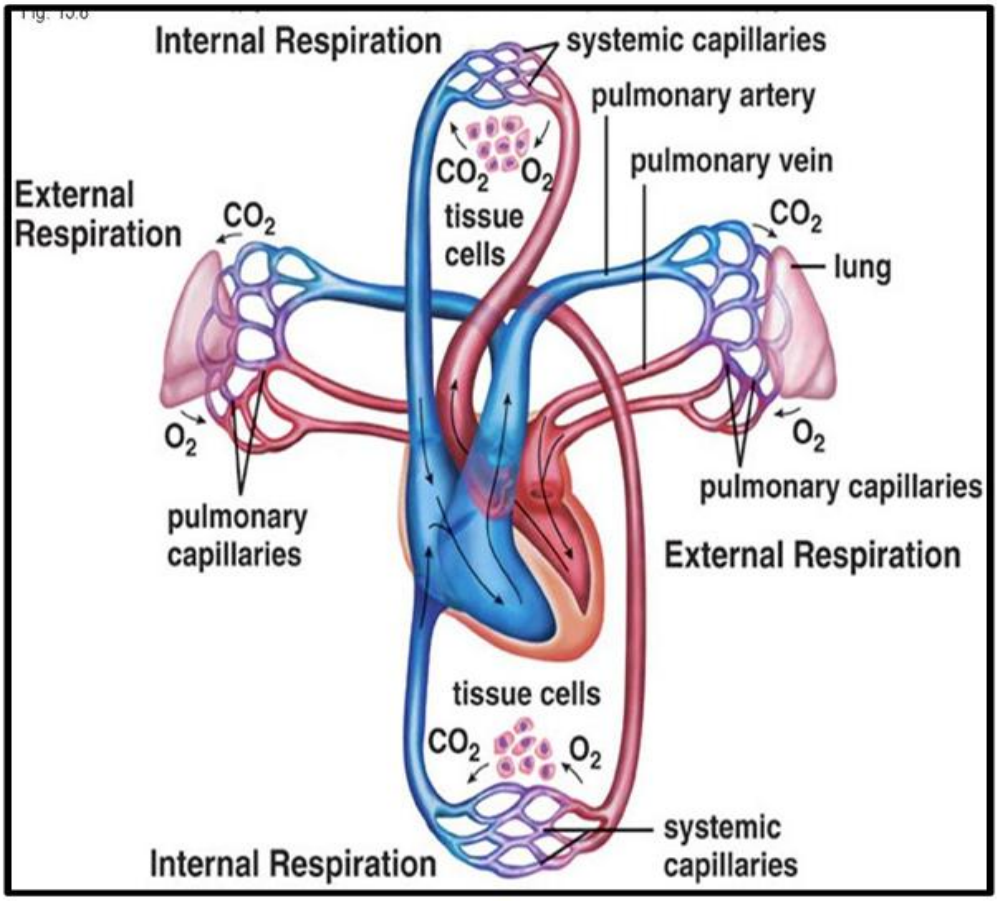
2. Diffusion of oxygen and carbon dioxide among the alveoli and the blood.

3. Transport of oxygen and carbon dioxide in the blood and the body fluid to and from the body tissue cells.

4. Regulation of ventilation.

The term respiration includes 4 basic separate processes:

1. **Pulmonary ventilation= (breathing)** It is the inhalation (inflow) & exhalation (outflow) of air. Involve the exchange of air between the atmosphere and lungs alveoli (in and out)
2. **External respiration= (pulmonary)** within the lungs. It is exchange of gases between lung's alveoli & blood in pulmonary capillaries which gains O2 and loses Co2.
3. **Transport of respiratory gases= (via the blood).** Oxygen and carbon dioxide transported to and from the lungs and tissue cells of the body via the bloodstream.
4. **Internal respiration = (cellular respiration)** within the tissue “O2 utilization” It is exchange of gases between blood in systemic capillary & tissue cells.



External and Internal Respiration

Mechanics of Pulmonary Ventilation:

The lungs can be expanded and contracted in two ways:

1. By downward and upward movement of diaphragm to lengthen or shorten the chest cavity.

2. By elevation and depression of ribs to increase and decrease the anteroposterior diameter of chest cavity.

Inhalation (inspiration):

Stages involved during inhalation (active process) are:

1. External intercostal muscle contract and internal intercostal muscle relax, expanding rib cage (increased thoracic volume laterally).

2. Rib cage moves upward and forward.

3. Diaphragm contracts and flattens; increased thoracic volume vertically.

4. Intrapulmonary pressure decreases.

5. Air pushes in.

Exhalation (expiration):

Stages involved during exhalation (passive process) are:

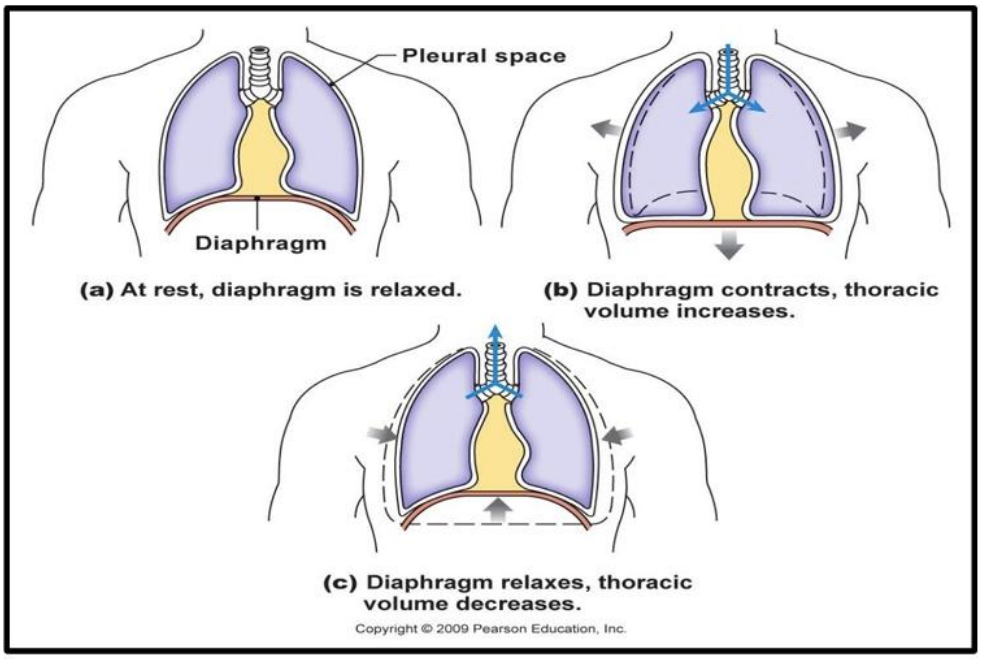
1. External intercostal muscles relax and internal intercostal muscle contract, reducing rib cage - (decreased thoracic volume laterally).

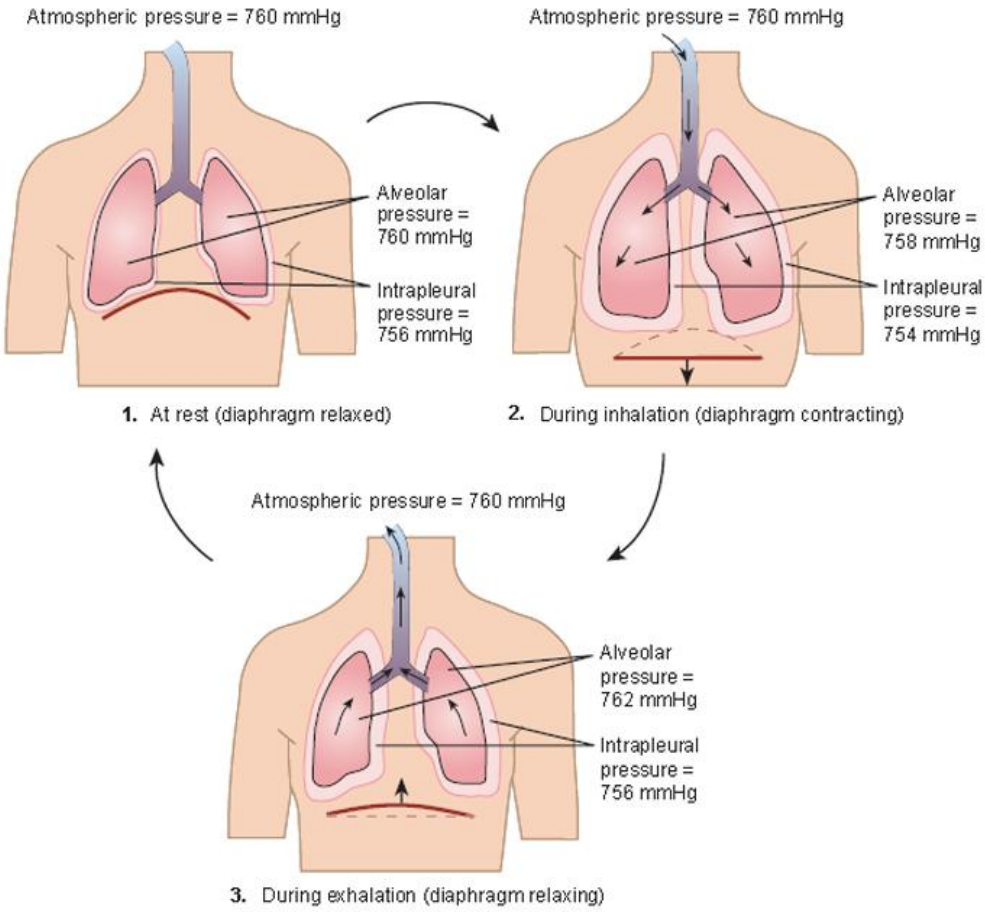
2. Rib cage moves downward and backward.

3. Diaphragm relaxes; decreased thoracic volume vertically.

4. Intrapulmonary pressure increases.

5. Air moves out.




Atmospheric pressure = 760 mmHg
Alveolar pressure = 760 mmHg
Intrapleural pressure = 756 mmHg
1. At rest (diaphragm relaxed)
Atmospheric pressure = 760 mmHg
Alveolar pressure = 758 mmHg
Intrapleural pressure = 754 mmHg
2. During inhalation (diaphragm contracting)
Atmospheric pressure = 760 mmHg
Alveolar pressure = 762 mmHg
Intrapleural pressure = 756 mmHg
3. During exhalation (diaphragm relaxing)


Thank You