AL- Frat AL-Awsat Technical university
Technical institute / Kufa
Nursing Technology Department

Physiology

First class

Nursing department
physiology
First class
Lecture -1 , 2 -

Physiology

Introduction

Physiology from Ancient Greek *(physis)*, meaning 'nature, origin', and *logia)*, meaning 'study of is the scientific study of the functions and mechanisms which work within a living system .

As a sub-discipline of , biology the focus of physiology is on how , organisms , organ system , organs , cells , and biomolecules carry out the chemical and physical functions that exist in a living system .

The **physiologic** state is the condition occurring from normal body function , while the pathological state is centered on the abnormalities that occur in animal diseases , according to the type of investigated organisms , the field can be divided into animal physiology (including that of humans) , plant physiology , cellular physiology and microbial physiology .

The blood

* Blood
* blood components
* blood cells
* Blood clotting
* Anemia

Blood

is a body fluid in humans and other animals that delivers necessary substances such as nutrients and oxygen to the cells and transports metabolic waste products away from those same cells .

The blood that runs through the veins , arteries , and capillaries is known as whole blood, a mixture of about 55 percent plasma and 45 percent blood cells. About 7 to 8 percent of your total body weight is blood. An average-sized man has about 12 pints of blood in his body, and an average-sized woman has about nine pints.

Functions

Blood performs many important functions within the body including:

1- Supply of oxygen to tissues (bound to hemoglobin , which is carried in red cells) .

2- supply of nutrients such as glucose , amino acid and fatty acids (dissolved in the blood or bound to plasma proteins (e.g. blood lipids) .

3- Removal of waste such as carbon dioxide, urea and lactic acid .

4- Immunological functions, including circulation of white blood cell and detection of foreign material by antibodies .

5- Coagulation the response to a broken blood vessel, the conversion of blood from a liquid to a semisolid gel to stop bleeding .

6- Messenger functions, including the of transport hormones and the signaling of tissue damage .

7- Regulation of core body temperature .

Hemoglobin

Hemoglobin is the principal determinant of the color of blood in vertebrates. Each molecule has four heme groups, . In vertebrates , arterial blood and capillary blood are bright red , as oxygen imparts a strong red color to the heme group. Deoxygenated blood is a darker shade of red ; this is present in veins , and can be seen during blood donation and when venous blood samples are taken.

Blood plasma

is a yellowish liquid component of blood that holds the blood cells in whole blood in suspension .It is the liquid part of the blood that carries cells and proteins throughout the body . It makes up about 55% of the body's total blood volume. It is the intravascular fluid part of extracellular fluid (all body fluid outside cells) . It is mostly water (up to 95% by volume), and contains dissolved protein (6 – 8%) (e.g. serum albumins , globulins , and fibrinogen) , glucose , clotting factors , electrolyte (Na^+, Ca^{2+}, Mg^{2+}, HCO_3^-, Cl^-, etc.) , hormones , carbon dioxide (plasma being the main medium for excretory product transportation) and oxygen .
plasma plays a vital role in an intravascular osmotic effect that keeps electrolyte concentration balanced and protects the body from infection and other blood disorder .

Blood serum is blood plasma without clotting factors .

Red Blood Cells (also called erythrocytes or RBCs)

red cells are the most abundant cell in the blood , accounting for about 40 to 45 percent of its volume . The shape of a red blood cell is a biconcave disk with a flattened center .

Production of red blood cells is controlled erythropoietin, a hormone produced primarily by the kidneys . Red blood cells start as immature cells in the bone marrow and after approximately seven days of maturation are released into the blood stream.

Unlike many other cells, red blood cells have no nucleus and can easily change shape, helping them fit through the various blood vessels in your body. However, while the lack of a nucleus makes a flexible . The red blood cell survives on red blood cell more average only 120 days .

Red cells contain a special protein called hemoglobin , which helps carry oxygen from the lungs to the rest of the body and then returns carbon dioxide from the body to the lungs so it can be exhaled. Blood appears red because of the large number of red blood cells , which get their color from the hemoglobin .

White Blood Cells (WBCs)

White blood cell, also called leukocyte or white corpuscle, a cellular component of the blood that lacks hemoglobin , has a nucleus , is capable of motility , and defends the body against infection and disease by ingesting foreign materials and cellular debris , by destroying infectious agents and cancer cells , or by producing antibodies .

Types of WBCs

White blood cells protect the body from infection. they are much fewer in number than red blood cells, Accounting for about (1) percent of your blood. there are five major types of white blood cell :

1- Basophiles

2- Eosinophiles

3- Lymphocytes (T cells, B cells, and Natural Killer cells)

4- Monocytes

5- Neutrophiles

Type of WBCs	Normal percentage of overall WBC count
1- Neutrophil	55 to 73 percent
2- Lymphocyte	20 to 40 percent
3- Eosinophile	1 to 4 percent
4- Monocyte	2 to 8 percent
5- Basophile	0.5 to 1 percent

A healthy adult human has between 4,500 and 11,000 white blood cells per cubic millimetre of blood . Fluctuations in white cell number occur during the day ; lower values are obtained during rest and higher values during exercise. An abnormal increase in white cell number is known as leukocytosis , whereas an abnormal decrease in number is known as leukopenia . White cell count may increase in response to intense physical exertion , pain pregnancy , convulsions, acute emotional reactions, labour , and certain disease states , such as infections and intoxications . The count may decrease in response to certain types of infections or drugs or in association with certain conditions , such as chronic anemia , malnutrition, or anaphylaxis .

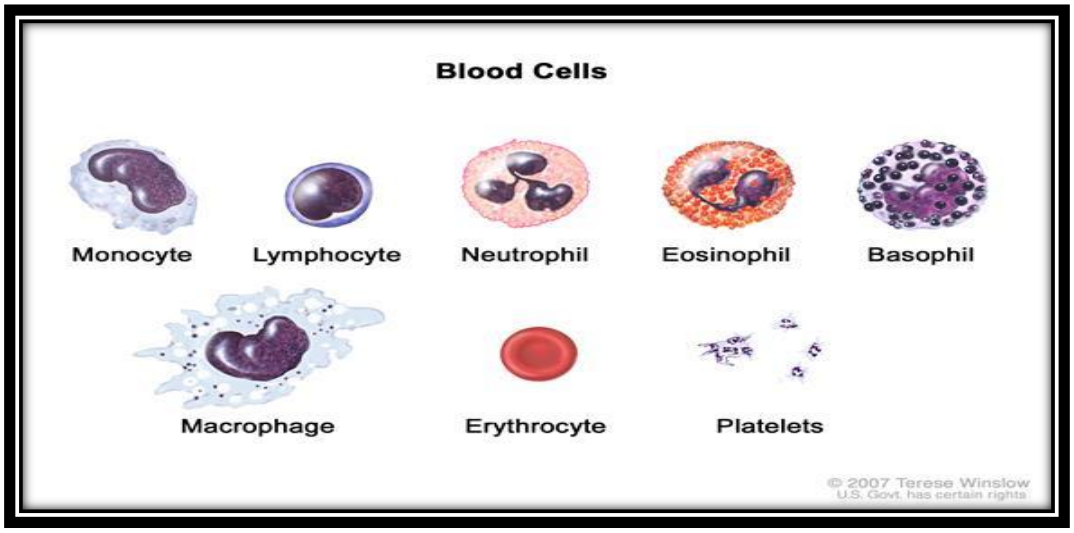
The most common type of white blood cell is the Neutrophil, which is the "immediate response" cell and accounts for 55 to 70 percent of the total white blood cell count. Each Neutrophil lives less than a day,

(Transfusion of Neutrophiles is generally not effective since they do not remain in the body for very long.) .

The other major type of white blood cell is a lymphocyte . There are two main populations of these cells. T lymphocytes help regulate the function of other immune cells and directly attack various infected cells and tumors. B lymphocytes make antibodies , which are proteins that specifically target bacteria , viruses , and other foreign materials .

Platelets (also called thrombocytes)

Unlike red and white blood cells , platelets are not actually cells but rather small fragments of cells . Platelets help the blood clotting process (or coagulation) by gathering at the site of an injury , sticking to the lining of the injured blood vessel , and forming a platform on which blood coagulation can occur. This results in the formation of a fibrin clot , which covers the wound and prevents blood from leaking out . Fibrin also forms the initial scaffolding upon which new tissue forms, thus promoting healing.



pH values

Acid-base homeostasis

Blood pH is regulated to stay within the narrow range of 7.35 to 7.45 , making it slightly basic . Blood that has a pH below 7.35 is too acidic , whereas blood pH above 7.45 is too basic.

Blood pH , partial pressure of oxygen (pO_2) , partial pressure of carbon dioxide (pCO_2) , and bicarbonate (HCO_3^-) are carefully regulated by a number of homeostatic mechanisms, which exert their influence principally through the respiratory system and the urinary system to control the acid-base balance and respiration.

Anemia

Means a deficiency of red blood cells with hematocrit so etimes as low as (10) percent , which can be caused by either too much blood loss or by too slow production of red blood cells .

Types of anemia

1- blood loss (hemophilia , thrombocytopenia) .

2- bone marrow destruction (drug poisonings ,gamma ray irradiation)

3- failure of red blood cells to mature (Vit B12 or folic acid)

4- hemolysis of red cells (resulting from many possible causes such as drug poisoning , hereditary for example sickle cell anemia and erythroblastosis fetal is a disease of newborn in which antibodies from mother destroy red cells in the baby

Nursing department
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First class
Lecture -3,4,5 -

The cardiovascular system

-Definition
- Functions
-Structures
-Systemic and pulmonary circulation
- Autonomic rhythmicity of the heart
- Electrocardiographe ECG

Definition

Circulatory system serves as an internal transport mechanism for the body , as the blood passes through the capillaries of the different organs much of dissolved substances diffuses rapidly back and forth between the blood and tissue fluids .

*Functions

1- Oxygen is carried to the cells from the lungs and the carbon dioxide from in all the cells of the body is transported and excreted by the lungs .

2- Nutrient are transported to the cells from the intestinal tract and extra transported away from the cells .

3- The waste products are carried to the kidneys and excreted to the urine .

*Structures

1- The heart .

2- The arteries which transported the blood to the tissues .

3- The veins which transported the blood from the tissues back to the heart .

4- The capillaries which are the minute porous vessels connecting smaller arteries to the smallest veins in all tissues of the body where nutrient substances and wastes products pass between the blood and tissue fluids .

- **The heart** : is a pulsated four chamber pump composed of :

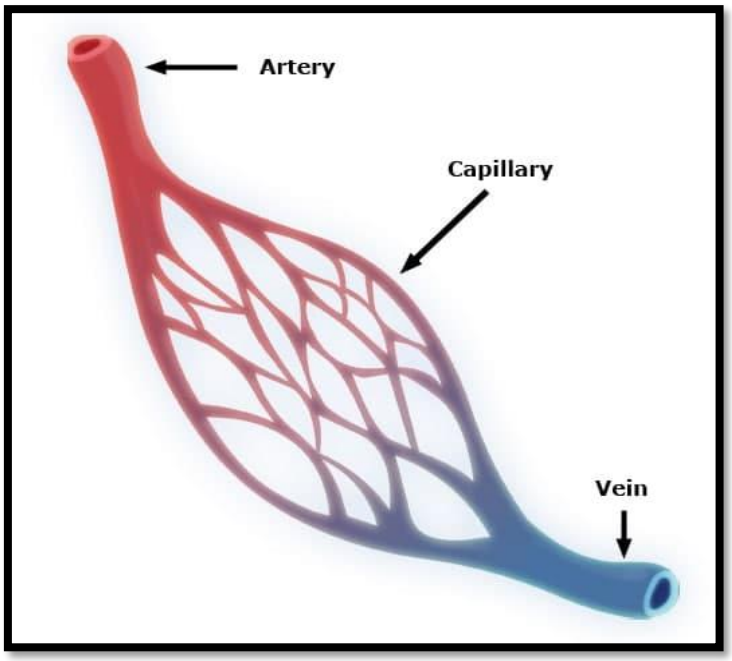
-**Two atrial** : entry ways the ventricles , they pump weakly to help move the blood to the ventricles .

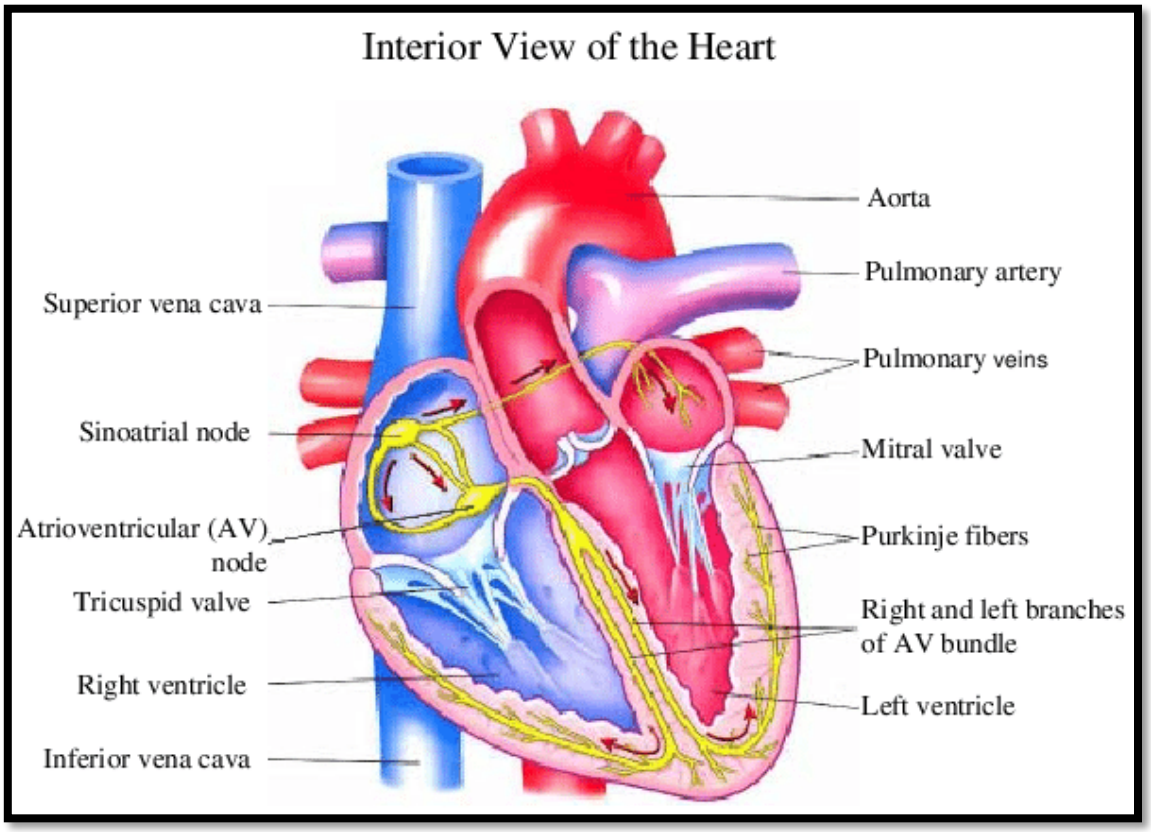
- **Two ventricles** :supply the main forces that propels blood through the lung and through the peripheral circulating system .

- **The atrio ventricular valves** : prevented back flow of blood from the ventricles to the atria** (tricuspid valve – right side and mitra valve – left side) .

-**The semi lunar valves** : prevented back flow from the aorta and pulmonary arteries in to the ventricles **(aortic valve – left side and pulmonary valve – right side) .

(the heart valves are the structures which allow blood to flow in one direction only) they are passive structures that they do not contain any muscle tissues .


Artery
Capillary
Vein


Interior View of the Heart
Aorta
Pulmonary artery
Superior vena cava
Pulmonary veins
Sinoatrial node
Mitral valve
Atrioventricular (AV) node
Purkinje fibers
Tricuspid valve
Right and left branches of AV bundle
Right ventricle
Left ventricle
Inferior vena cava

The systemic and pulmonary circulation

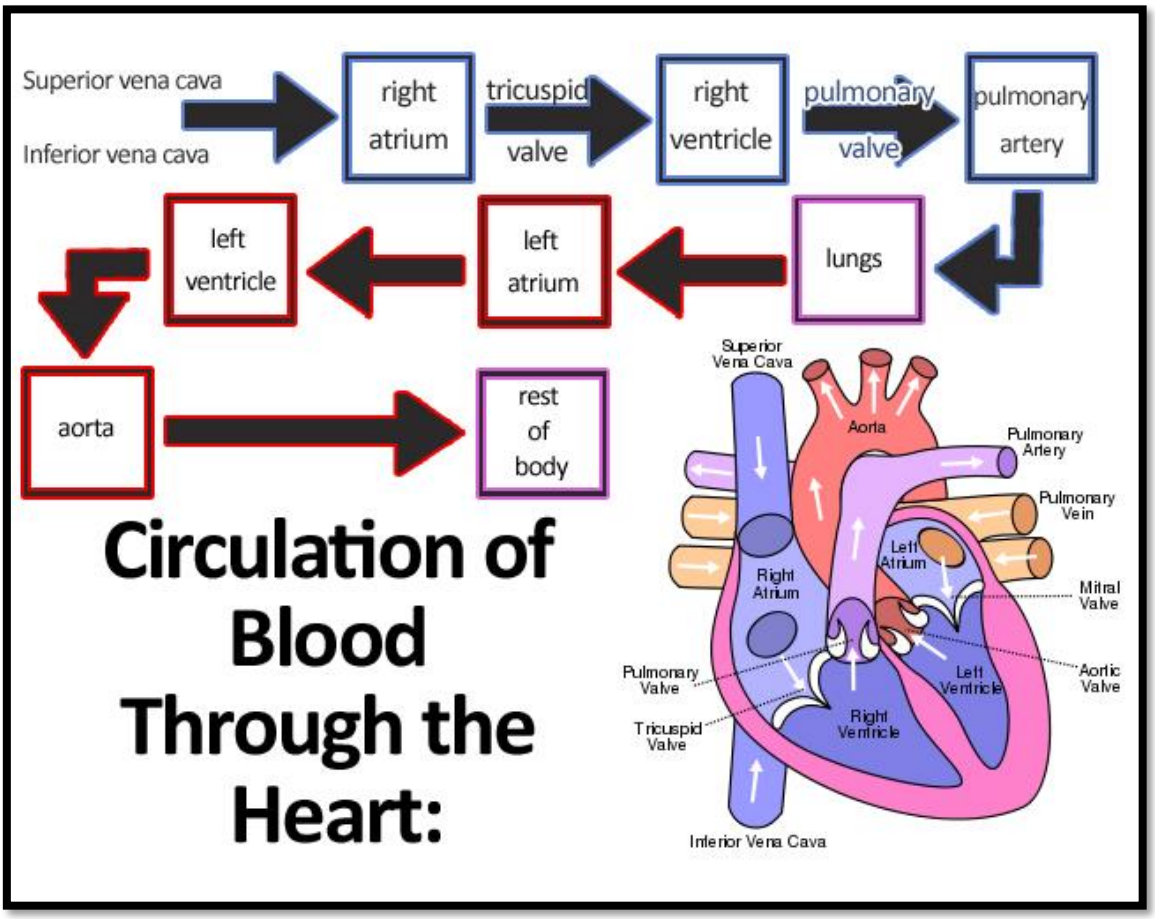
1- Un oxygenated blood returns to the heart by the superior and inferior vena cava , these large veins enter the right atrium.

2- Next the blood passes the right AV valve in to the right ventricle , then to the pulmonary artery .

3- The pulmonary artery divides into two branches each branch carrying un oxygenated blood to the capillaries of the lungs where Co2 in the blood is exchanged for O2 from the alveolar air .

4-Then the oxygenated blood carries from the lungs by the pulmonary veins and enter left atrium .

5- The blood passes through the left AV valve into the left ventricle , then to the aorta which is the main artery in the body finally the oxygenated blood reach the capillaries in all the tissues where O2 are exchanged for Co2 from cells .


Superior vena cava
Inferior vena cava
right atrium
tricuspid valve
right ventricle
pulmonary valve
pulmonary artery
lungs
left atrium
left ventricle
aorta
rest of body
Circulation of Blood Through the Heart:
Superior Vena Cava
Aorta
Pulmonary Artery
Pulmonary Vein
Left Atrium
Right Atrium
Mitral Valve
Aortic Valve
Pulmonary Valve
Left Ventricle
Tricuspid Valve
Right Ventricle
Inferior Vena Cava

Causes of rithmicity

The contraction of cardiac muscle (heart muscle) in all animals is initiated by electrical impulses known as action potentials. The rate at which these impulses fire, controls the rate of cardiac contraction, that is, the heart rate.

The cells that create these rhythmic impulses, are called pacemaker cells , and they directly control the heart rate . In humans , the concentration of pacemaker cells in the sinoatrial (SA) node .

the sinoatrial node (also known as the SA node or the sinus node) is a group of cells located in the wall of the right atrium of the heart , These cells have the ability to spontaneously produce an electrical impulse (action potential) , that travels through the heart via the electrical conduction system causing it to contract .

The electrical signal generated by the SA node moves from cell to cell down through the heart until it reaches the atrioventricular node (AV node) , a cluster of cells situated in the center of the heart between the atria and ventricles . The AV node serves as a gate that slows the electrical current before the signal is permitted to pass down through to the ventricles . This delay ensures that the atria have a chance to fully contract before the ventricles are stimulated. After passing the AV node , the electrical current travels to the ventricles along special fibers embedded in the walls of the lower part of the heart called purkinje fibers .

An action potential is a rapid change in membrane potential , produced by the movement of charged atoms (ions). In the absence of stimulation , non-pacemaker cells (including the ventricular and atrial cells) have a relatively constant membrane potential ; this is known as a resting potential .

This resting phase ends when an action potential reaches the cell . This produces a positive change in membrane potential , known as depolarization , which is propagated throughout the heart and initiates muscle contraction . Pacemaker cells, however, do not have a resting potential . Instead , immediately after repolarization , the membrane potential of these cells begins to depolarize again automatically ,

Phases of action potential

Phase 1

This is the depolarization phase . When the membrane potential reaches the threshold potential (around -20 to -50 mV) , the cell begins to rapidly depolarize (become more positive). This is mainly due to the flow of Ca2+ through calcium channels , which are now fully open.

Phase 2

This phase is the repolarization phase . This occurs due to the inactivation of calcium channels (preventing the movement of Ca2+ into the cell) and the activation of potassium channels, which allows the flow of K+ out of the cell, making the membrane potential more negative .

this process continues over and over throughout life , thereby providing rhythmic excitation of the S-Anode fiber at normal resting about 72 time per minute .

The nervous regulation of the heart

the atria are specially well supplied with large number of both sympathetic and parasympathetic nerves there effect are :

1- changing the heart rate

2- changing the strength of contraction of the heart

In general the sympathetic stimulation increase heart rate and increase the strength of the heart muscle contraction , whereas the parasympathetic stimulation decrease them .

The cardiac cycle

The contraction phase of a chamber of the heart is termed systole . The relaxation phase is termed diastole .

The cardiac cycle is the period from the end of one heart contraction to the end of the next or it is the sequence of one systole followed by one diastole .

At rest systole last (0.3 sec) diastole is longer (0.5 sec) .

Mechanical events of the cardiac cycle

A- atrial systole : contraction of the atria propels additional blood in to the ventricles .

B- ventricular stole :

*The mitral and tricuspid valves are closed .

* intra ventricular pressure rises .

*aortic and pulmonary valves are open .

*the phase of ventricular ejection begins .

C- early diastole :

*ventricular pressure drop more rapidly .

*AV valves are open .

*Filling of ventricle .

D- late diastole :

*mitral and tricuspid valves are open .

*aortic and pulmonary valves are closed .

*blood flows in to the heart , filling the atria and ventricles at last the cusps of A-V valves drift toward the closed position .

The heart sounds

Two sounds are normally herd through stethoscope during each cardiac cycle :

1- The first sound : caused by sudden closure of the mitral and tricuspid valves it like the word (lub) this sound marks the onset of ventricular systole .

2- The second sound : caused by closure of the aortic and pulmonary valves it is like the word (dub),this marks end of ventricular systole and start of ventricular diastole .

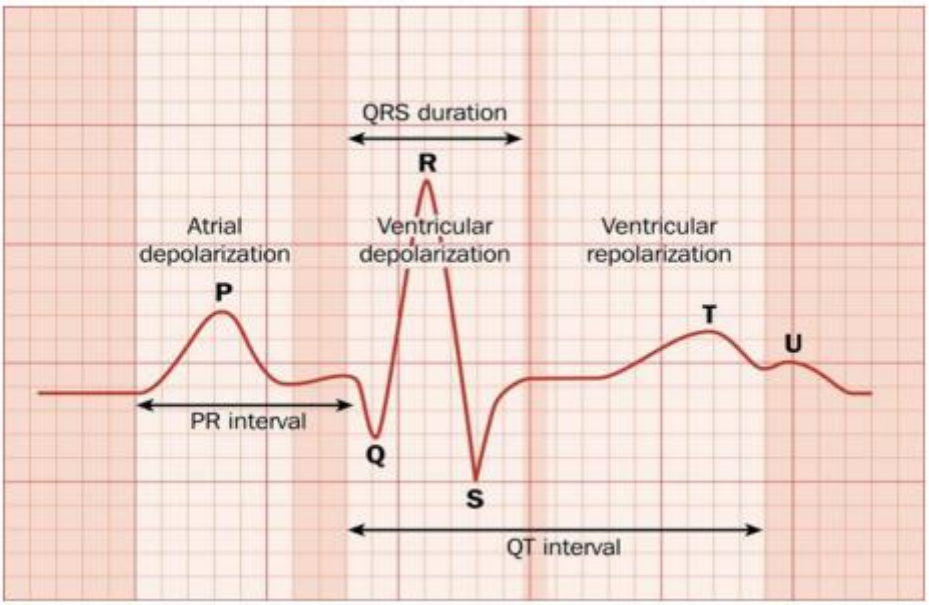
Electro cardio gram ECG

The spread of the heart beat from the S-Anode first to the atria , then down to the atrioventricular bundles finally to the ventricles is associated with electrical voltage changes which can be recorded at distances remote from the heart this electrical record is termed the electro cardio gram .

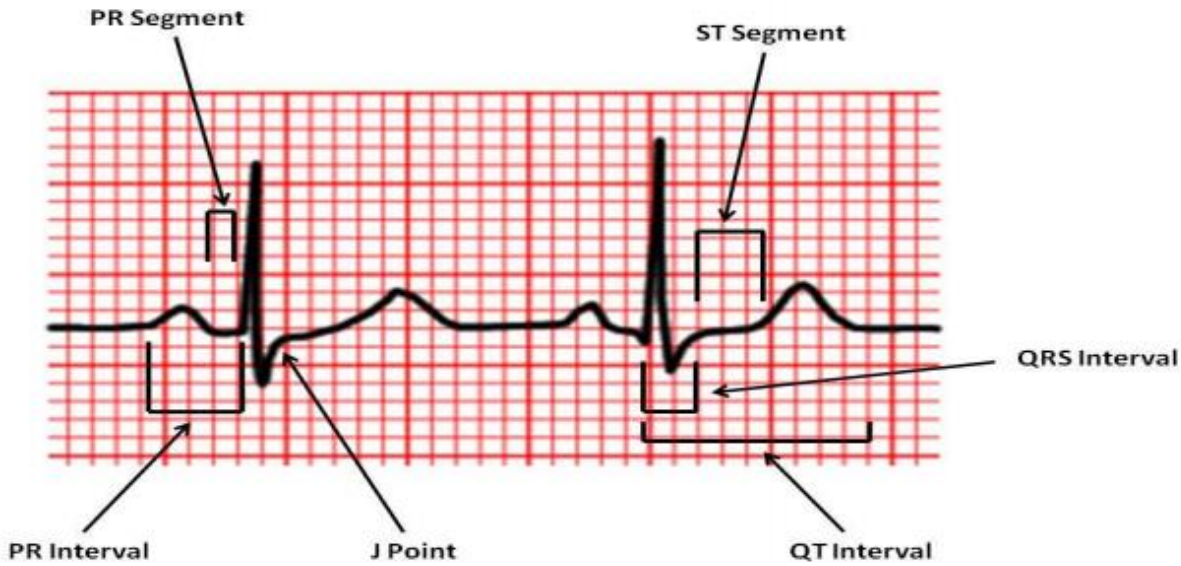
The normal ECG is composed of :

- **P wave** : correspond to atrial systole .
- **ORS- complex** : is a series of waves corresponds to the ventricular systole .

-**T wave** : it caused by current generated as a ventricles recover from state of depolarization .



Intervals and segment



PR Interval: From the start of the P wave to the start of the QRS complex .

PR Segment: From the end of the P wave to the start of the QRS complex .

J Point: The junction between the QRS complex and the ST segment .

QT Interval: From the start of the QRS complex to the end of the T wave .

QRS Interval: From the start to the end of the QRS complex .

ST Segment: From the end of the QRS complex (J point) to the start of the T wave

Nursing department
physiology
First class
Lecture -6 -

Blood pressure

- definition
- factors determining blood pressure

The expression blood pressure refers the pressure in the aorta and large arteries .
The organ of the body require blood flow , so the arterial pressure is needed to push the blood through the arterioles , capillaries and veins .
The maximum pressure in the aorta and large arteries is termed systolic pressure, the minimum pressure is termed diastolic pressure.

Factors determining blood pressure

In order to have a blood pressure there must be two factors :

1- cardiac output (Co)

2- peripheral resistance to blood flow (pr)

Blood pressure = cardiac out x peripheral resistance

Cardiac output : is the amount of blood pumped out by each ventricle per minute , it depends on two factors :

a- heart rate (Hr) : is determine by the rate which SA node beat per minute

b- stroke volume (S v): is amount of blood pumped out of each ventricle by beat

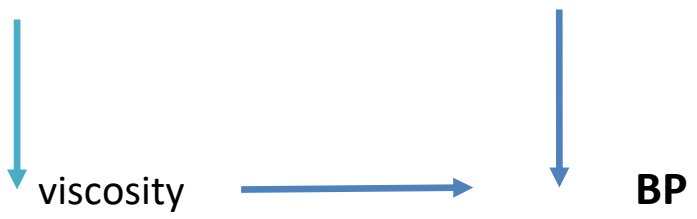
peripheral resistance Pr :

this resistance to blood flow lies mainly in the small arteries of the body which are termed ((arterioles)) , the capillaries are even smaller vessels then arterioles but although each individual capillary will offer a higher resistance then arterioles there is a large number of alternative pathways for the blood to take in it is passage from an arterioles through the veins and because of this the capillary network does not offer such resistance to bloods flow .

Factors affecting Pr

Pr depending on

1- viscosity of the blood , the blood is offer (2-3) times more resistance then water , this viscosity depend on plasma and on number of Rbc present .



2- diameter of the blood vessels : the arterioles have smooth muscle in their coat this muscle is circularly arranged around the blood vessels , when this muscle contract it make the muscle smaller .

↓ Diameter → ↑ BP

Nervous control on arterioles

Blood vessels have nerve supply from sympathetic nervous system , which acting upon them and produce a state of vasoconstriction as a result of contraction of smooth muscles , this sympathetic activity originate from collection of cells in the brain termed vasomotor center VMC .

↑ Activity of VMC → ↑ vasoconstriction → ↑ Pr → ↑ BP

↓ Activity of VMC → ↓ vasoconstriction → ↓ Pr → ↓ BP

(vasodilator)

The Bp is maintained at constant level by (baroreceptors)these are sensory receptors found in the wall of blood vessels in the region of aortic arch ,these receptors are sensitive to Bp and send information concerning the Bp at the vasomotor center .

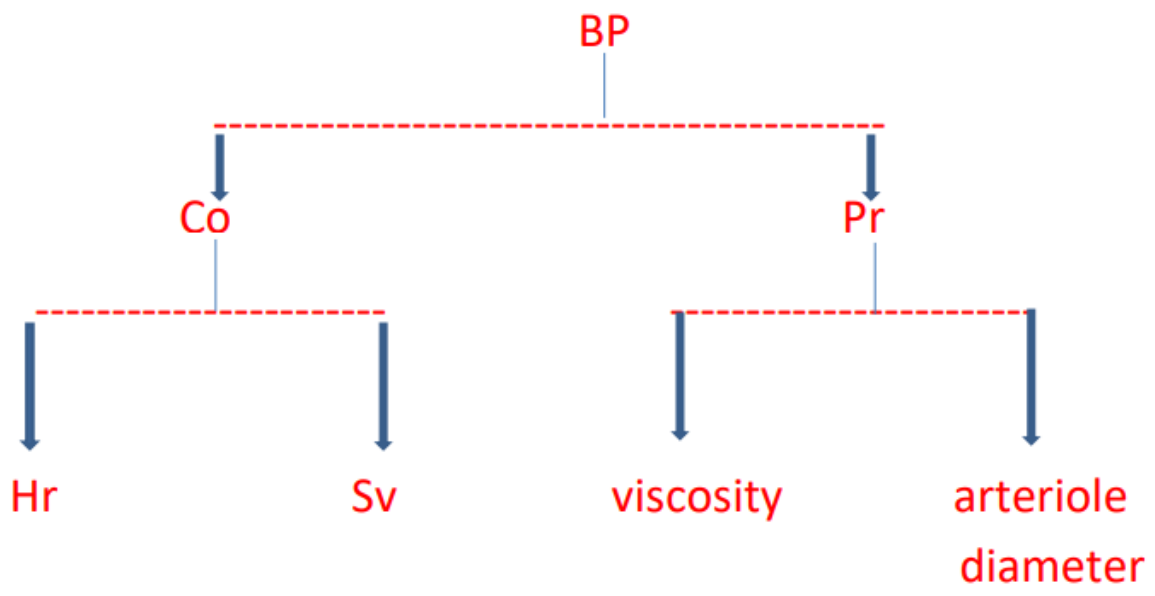
Factors affecting VMC

* emotional excitement ↑ VMC الاثارة العاطفية

* anoxia moderate (↓O_2) → ↑ VMC نقص الاوكسجين المعتدل

* pain → ↑ VMC

* sever pain → ↓ VMC



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First class
Lecture -7 -

Respiratory system

What Is the Respiratory System ?

The respiratory system is the organs and other parts of your body involved in breathing , when you exchange oxygen and carbon dioxide.

Parts of the Respiratory System :

1- Nose and nasal cavity .

2- Sinuses .

3- Mouth .

4-Throat (pharynx) .

5- Voice box (larynx) .

6-Trachea .

7- Diaphragm .

8- Lungs .

9- Bronchial tubes / bronchi .

10- Bronchioles .

11- Air sacs (alveoli) .

12- Capillaries .

How Do We Breathe?

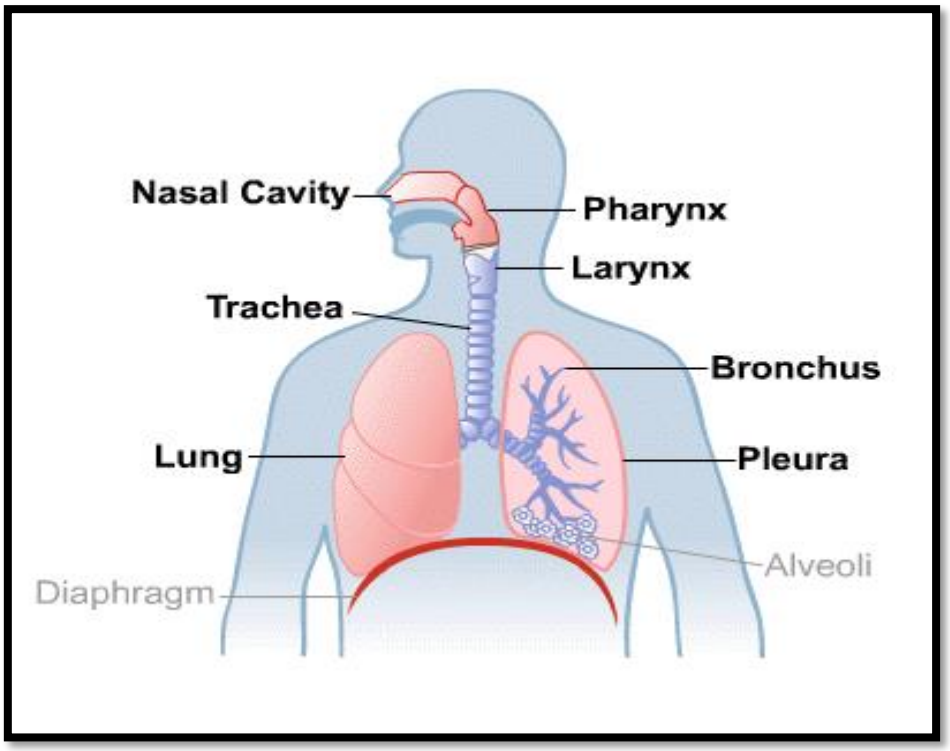
Breathing starts when you inhale air into your nose or mouth. It travels down the back of your throat and into your windpipe, which is divided into air passages called bronchial tubes . lungs to perform their best , these airways need to be open. They should be free from inflammation or swelling and extra mucus.

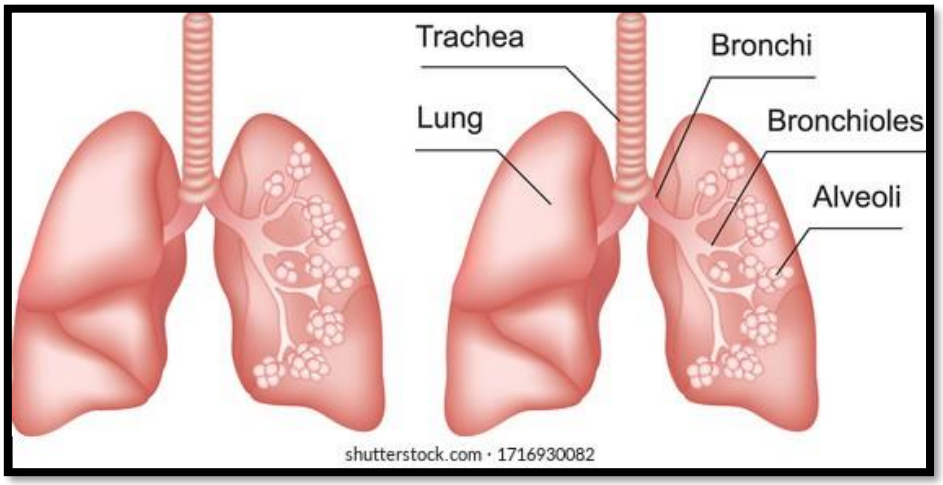
As the bronchial tubes pass through your lungs, they divide into smaller air passages called bronchioles. The bronchioles end in tiny balloon-like air sacs called alveoli. Your body has about 600 million alveoli.

The alveoli are surrounded by a mesh of tiny blood vessels called capillaries . Here, oxygen from inhaled air passes into your blood.

After absorbing oxygen, blood goes to your heart. Your heart then pumps it through your body to the cells of your tissues and organs.

As the cells use the oxygen, they make carbon dioxide that goes into your blood. Your blood then carries the carbon dioxide back to your lungs, where it’s removed from your body when you exhale.


Nasal Cavity
Pharynx
Larynx
Trachea
Bronchus
Lung
Pleura
Alveoli
Diaphragm


Trachea
Bronchi
Lung
Bronchioles
Alveoli
shutterstock.com · 1716930082

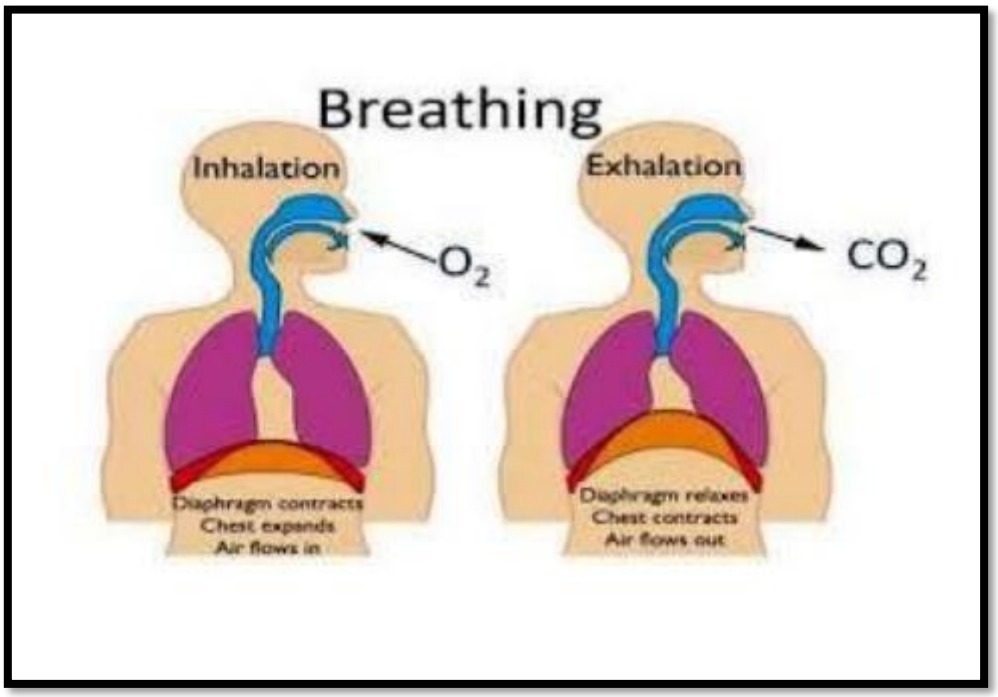
Inhalation and Exhalation :

Inhalation and exhalation are how your body brings in oxygen and gets rid of carbon dioxide.

The process gets help from a large dome-shaped muscle under your lungs called the diaphragm.

When you breathe in, your diaphragm pulls downward, creating a vacuum that causes a rush of air into your lungs .

The opposite happens with exhalation: Your diaphragm relaxes upward, pushing on your lungs, allowing them to deflate.



Nursing department
physiology
First class
Lecture -8,9 -

The nervous system

Definition

Structures

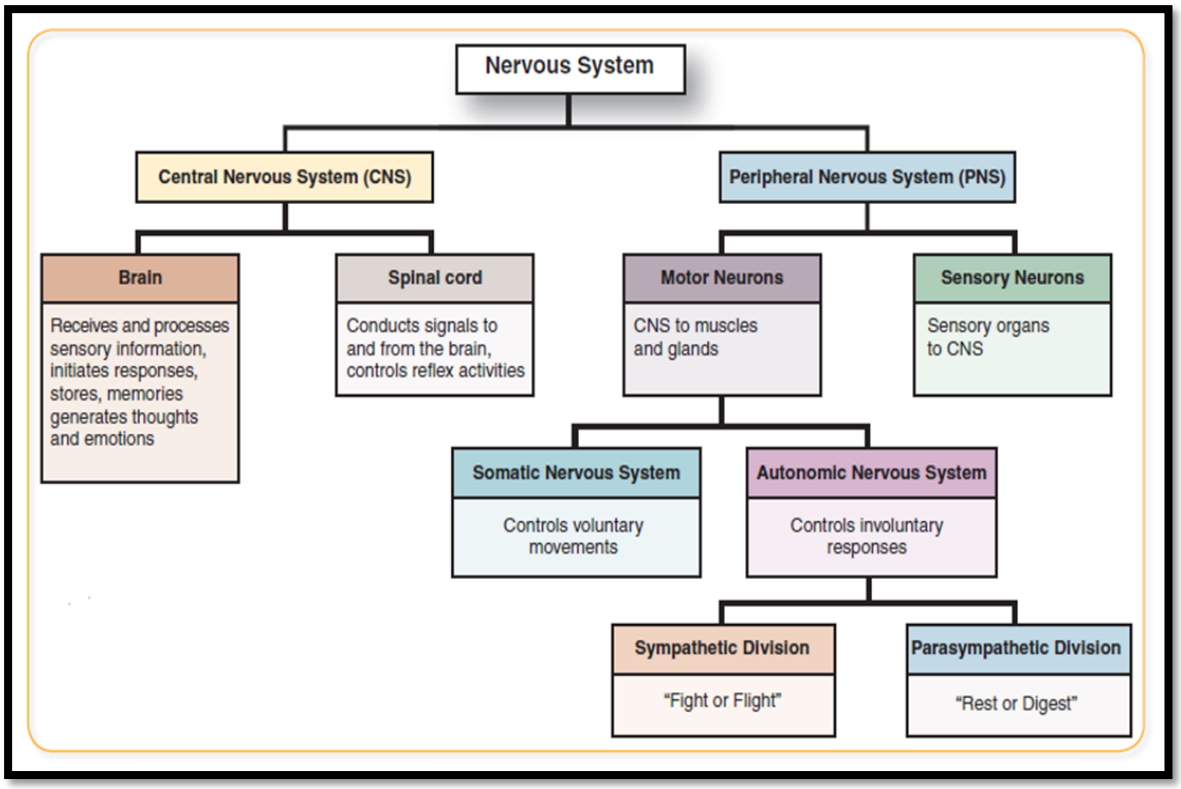
functions

The nervous system

Is the sensation , thinking and controlling system of our body , To perform these functions it collect sensory information from all the body , and transmits this information through the nerves in to spinal cord and brain which react immediately to this information and send signals to the muscle or organs to cause some response or stored perhaps a few minute later a month or even a year this might at last lead to some motor response .

structures of the nervous system

The nervous system consists of the brain , spinal cord , sensory organs, and all of the nerves that connect these organs with the rest of the body .The brain and spinal cord form the control center known as the central nervous system (CNS), where information is evaluated and decisions made . The nerves and sense organs of the peripheral nervous system (PNS).



The nervous tissue

Nervous tissues , whether it be in the brain , the spinal cord or peripheral nerves contains two basic type of cell :

1- neuron

2- supporting and insulating cells hold the neuron in place and prevent signals from spreading between the neurons there is called neuroglia in central nervous system , in peripheral nervous system called Schwann cell .

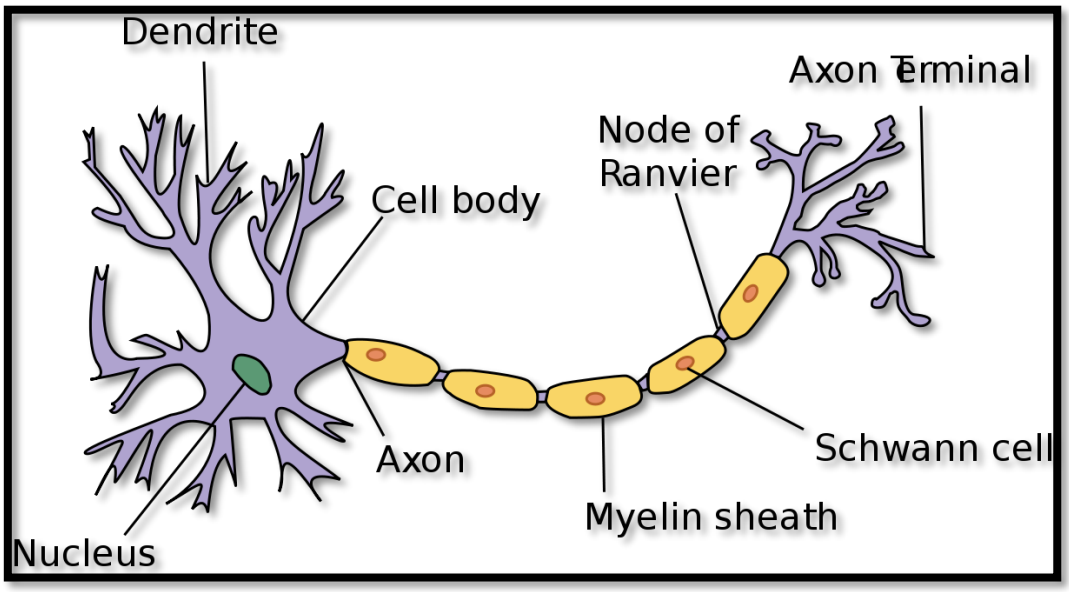
The neurons

A typical neuron of the brain and spinal cord ,consist of :

1- cell body .

2- dendrites: usually many dendrites , bring information to the cell .

3- axon: only one axon , take information away from the cell body .



Types of neurons

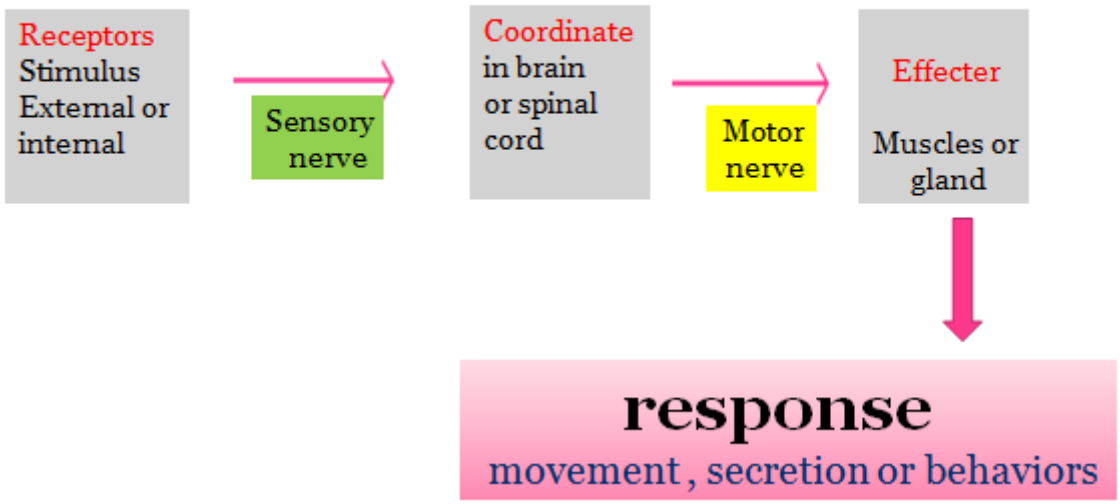
1- sensory neurons (afferent): have long axon and transmit nerve impulses from sensory receptors to the CNS .

2- motor neurons (efferent):also have long axon and transmit nerve impulses from CNS to effectors (muscles or gland) all over the body

3- interneuron also called connectors neuron are usually much smaller cells with many interconnections .

The three types of neuron are arrange in circuits and networks, the simplest of which is the reflex arch .

Reflex arch



Neurons different other cells of the body because they have specialized extensions (axon and dendrites) which communicate the neuron with each other through an electrochemical process and contain specialized structure (synapses) and chemicals messenger (neurotransmitters) .

synapses

All axon s branch near their end many times ,at the end of each theses branches is specializes axon terminal that in CNS called synaptic knob, providing a contact point with other neuron (one neuron can alter the activity of another neuron) .

At most synapses , the activity is transmitted from one neuron to another by chemical messenger known as neurotransmitters .

In fact neuron are often identified by the type of transmitter they release at their synapses with other neuron .

Functions of the CNS

1- The brain : receive sensory input from the spinal cord to processing it and initiating appropriate and coordinated motor output

2- spinal cord : conducts sensory information from the peripheral nervous system both (somatic and autonomic) to the brain and conducts motor information from the brain to various effectors .

Functions of PNS

PNS consist of cranial and spinal nerves . The peripheral nervous system is divided into the following section :

* Somatic nerves – control skeletal muscles as well as external sensory organs.

*Autonomic nervous system – control involuntary muscles such as smooth and cardiac muscle .

Autonomic nervous system

Is the collection of nerves that control most of the autonomic sub conscious functions of the body , its so important to the functions of every physiological system in the body .

Division of ANS

Its divided in to two nervous divisions

1- sympathetic nervous system

2- parasympathetic nervous system

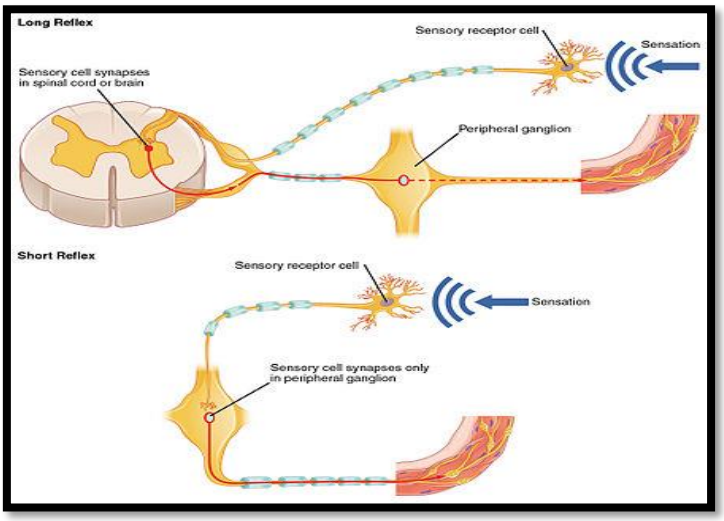
The sympathetic fiber from the thoracic and lumber region of spinal cord Both of them are stimulated by multiple brain centers , located specially in hypothalamus and brain stem and parasympathetic from brain and sacral portion . In the ANS the neuron and the effecter cells consist of the neuron and one synapse called autonomic ganglia , the fiber passing between the CNS and ganglia called preganglionic fiber , those between ganglia and effecter cells called post ganglionic fiber

in both division the major neurotransmitter synapse between pre an post ganglionig is acetyle colin .

In parasympathetic the neurotransmitter between the post ganglion and effecter cells is also acetyle cholin but in parasympathetic division is usually noreepiniphrin .

** fiber that release neuroepiniuphrin called adrenergic nerves

Fiber that release aceytlcholin called colinergic nerves .



SYMPATHETIC

T-L Region → Pregangli → post ganglion → effecter

Ach epinephrin

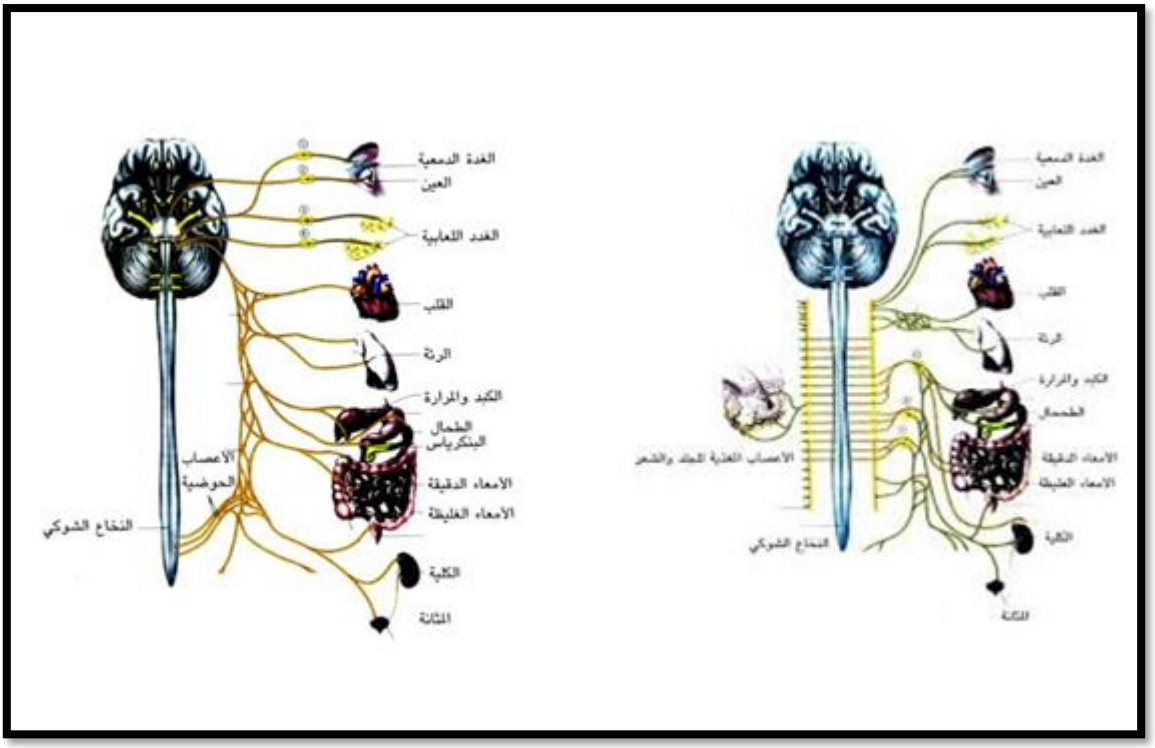
PARA SYMPATHETIC

C- S Region → Pregangli → post ganglion → effecter

Ach Ach

Effects of ANS

Structures	sympathetic	Parasympathetic
Heart	↑ Heart rate Heart force	↓ Heart rate Heart force
Lungs	bronchial muscle relax	Bronchial muscles contracted
Eyes	Pupil dilation	Pupil constriction
Intestine	↓ Motality	↑ Digestion
Bladder		
bladder	Sphincter closed	Sphincter relax
Kidneys	↓ Urine secretion	↑ Urine secretion



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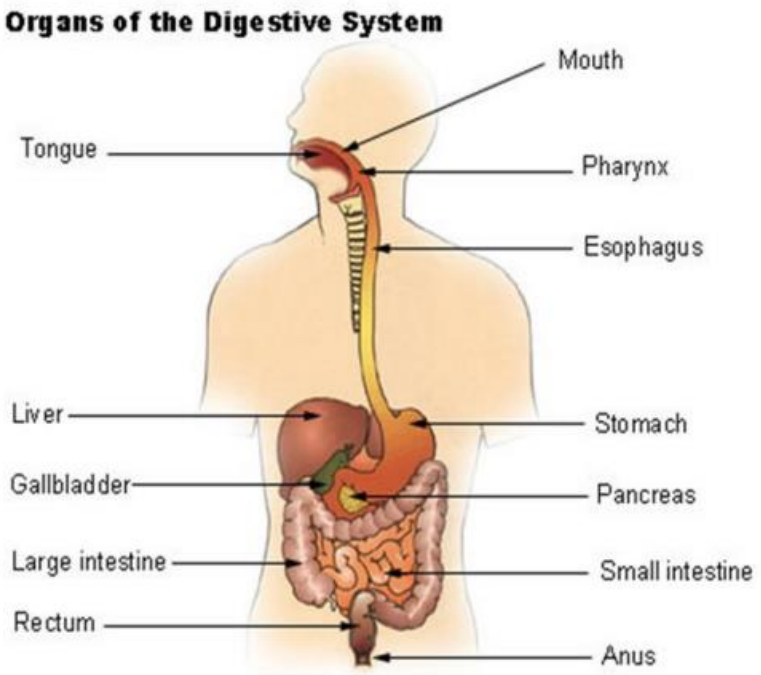
Digestive System

The digestive system is a group of organs working together to convert food into energy and basic nutrients to feed the entire body. Food passes through a long tube inside the body known as the alimentary canal or the gastrointestinal tract (GI tract) . The alimentary canal is made up of the oral cavity , pharynx , esophagus , stomach , small intestines , and large intestines . In addition to the alimentary canal , there are several importan accessory organs that help your body to digest food but do not have food pass through them . Accessory organs of the digestive system include the teeth , tongue , salivary glands, liver, gallbladder, and pancreas .



Digestive System Physiology

The digestive system is responsible for taking whole foods and turning them into energy and nutrients to allow the body to function, grow , and repair itself . The six primary processes of the digestive system include :

1- Ingestion of food - intake of food

2- Secretion of fluids and digestive enzymes

In the course of a day, the digestive system secretes around 7 liters of fluids. These fluids include Saliva , mucus , hydrochloric acid , enzymes, and bile .

Saliva moistens dry food and contains salivary amylase, a digestive enzyme that begins the digestion of carbohydrates .

Mucus serves as a protective barrier and lubricant inside of the GI tract. Hydrochloric acid helps to digest food chemically and protects the body by killing bacteria present in our food . Enzymes are like tiny biochemical machines that disassemble large macromolecules like proteins , carbohydrates , and lipids into their smaller components . Finally , bile is used to emulsify large masses of lipids into tiny globules for easy digestion .

3- Mixing and movement of food and wastes through the body

The digestive system uses 3 main processes to move and mix food

A- Swallowing : Swallowing is the process of using smooth and skeletal muscles in the mouth, tongue, and pharynx to push food out of the mouth , through the pharynx , and into the esophagus

B- Peristalsis : Peristalsis is a muscular wave that travels the length of the GI tract , moving partially digested food a short distance down the tract .

C- Segmentation: Segmentation occurs only in the small intestine as short segments of intestine contract like hands squeezing a toothpaste tube. Segmentation helps to increase the absorption of nutrients by mixing food and increasing its contact with the walls of the intestine .

4- Digestion of food in to smaller pieces

Digestion is the process of turning large pieces of food into its component chemicals .

Mechanical digestion is the physical breakdown of large pieces of food into smaller pieces .

Chemical digestion begins in the mouth with salivary amylase in saliva splitting complex carbohydrates into simple carbohydrates . The enzymes and acid in the stomach continue chemical digestion, but the bulk of chemical digestion takes place in the small intestine thanks to the action of the pancreas . The pancreas secretes an incredibly strong digestive cocktail known as pancreatic juice , which is capable of digesting lipids , carbohydrates, proteins and nucleic acids .

5- Absorption nutrients

Once food has been reduced to its building blocks, it is ready for the body to absorb. Absorption begins in the stomach with simple molecules like water and alcohol being absorbed directly into the bloodstream. Most absorption takes place in the walls of the small intestine, which are densely folded to maximize the surface area in contact with digested food .

Small blood and lymphatic vessels in the intestinal wall pick up the molecules and carry them to the rest of the body . The large intestine is also involved in the absorption of water and vitamins B and K before feces leave the body .

6- Excretion of wastes

The final function of the digestive system is the excretion of waste in a process known as defecation. Defecation removes indigestible substances from the body so that they do not accumulate inside the gut . The timing of defecation is controlled voluntarily by the conscious part of the brain , but must be accomplished on a regular basis to prevent a backup of indigestible materials .

Human body systems--digestive

organ	function
Mouth	Saliva is added to food to break down starches, moistens the food, teeth and tongue move and cut food into smaller pieces
Esophagus	Moves food to the stomach
Stomach	Mixes food with enzymes and acids.
Small intestine	Absorbs nutrients into bloodstream
Large intestine	Absorb water and recycle it
Liver	Filters blood, and produces bile to break down fats
Gall bladder	Stores bile
pancreas	Make enzymes to break down foods

Effects of Digestive Enzymes		
Active Site	**Enzyme**	**Effect on Food**
Mouth	Salivary amylase	Breaks down starches into disaccharides
Stomach	Pepsin	Breaks down proteins into large peptides
Small intestine (from pancreas)	Amylase	Continues the breakdown of starch
	Trypsin	Continues the breakdown of protein
	Lipase	Breaks down fat
Small intestine	Maltase, sucrase, lactase	Breaks down remaining disaccharides into monosaccharides
	Peptidase	Breaks down dipeptides into amino acids

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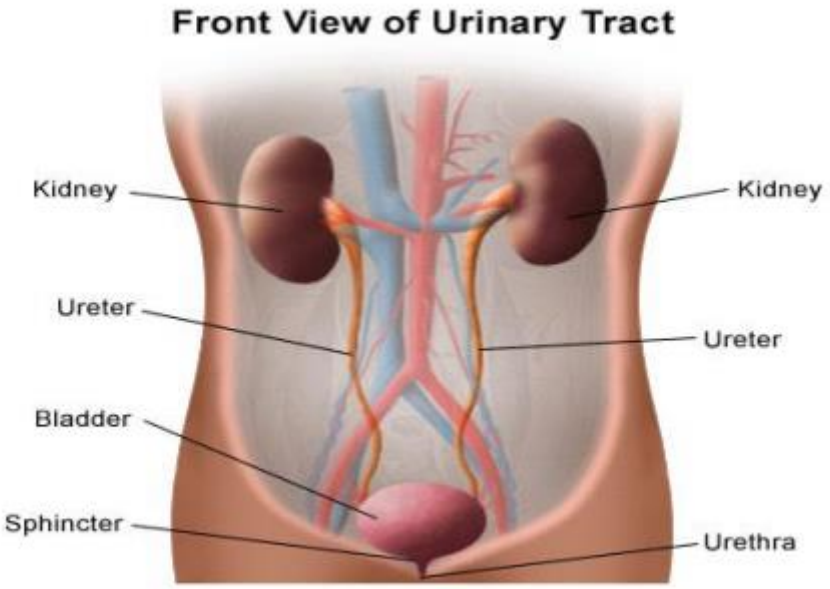
The urinary system

The urinary system's function is to filter blood and create urine as a waste byproduct . The organs of the urinary system include the kidneys, renal pelvis, ureters , bladder and urethra .

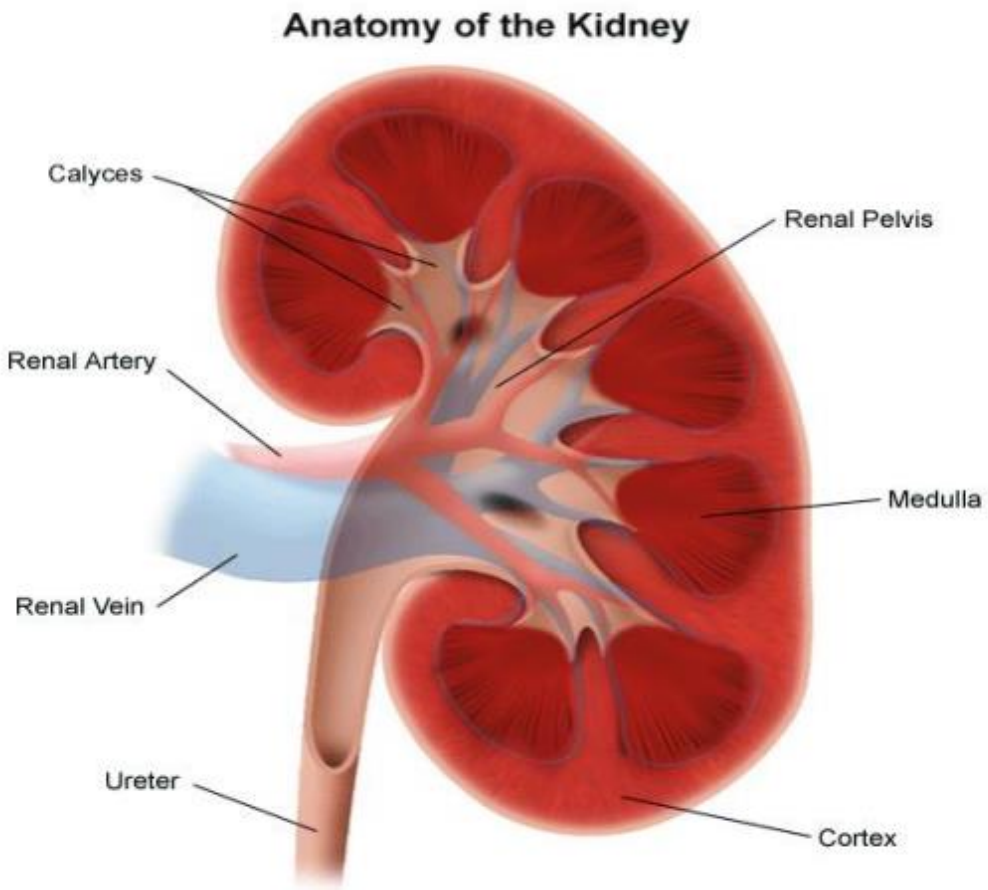


How does the urinary system work ?

The body takes nutrients from food and converts them to energy. After the body has taken the food components that it needs, waste products are left behind in the bowel and in the blood .

The kidney and urinary systems help the body to eliminate liquid waste called urea , and to keep chemicals , such as potassium and sodium , and water in balance . Urea is produced when foods containing protein, such as meat, poultry, and certain vegetables , are broken down in the body . Urea is carried in the bloodstream to the kidneys, where it is removed along with water and other .wastes in the form of urine .

Other important functions of the kidneys include blood pressure regulation and the production of erythropoietin, which controls red blood cell production in the bone marrow . Kidneys also regulate the acid-base balance and conserve fluids .



Urinary system parts and their function

*** Two kidneys** . This pair of purplish - brown organs is located below the ribs toward the middle of the back .

Their function is to :

1- Remove waste products and drugs from the body .

2- Balance the body's fluids .

3- Release hormones to regulate blood pressure .

4 -Control production of red blood cell .

The kidneys remove urea from the blood through tiny filtering units called nephrons. healthy adult has 1 to 1.5 million nephrons in each kidney .

* Nephron

The nephron is the microscopic structural and functional unit of the kidney. It is composed of :

1- A renal corpuscle .

2- A renal tubule .

1- A renal corpuscle

is the site of the filtration of blood plasma . The renal corpuscle consists of the

A- glomerulus

B- The glomerular capsule or Bowman's capsule .

A- The glomerulus

Is the network known as a tuft , of filtering capillaries located in Bowman's capsule . Each glomerulus receives its blood supply from an afferent arteriole of the renal circulation . The glomerular blood pressure provides the driving force for water and solutes to be filtered out of the blood plasma , and into the interior of Bowman's capsule, called Bowman's space .

B- Bowman's capsule

The Bowman's capsule , also called the glomerular capsule , surrounds the glomerulus. Fluids from blood in the glomerulus are ultrafiltered through several layers , resulting in what is known as the glomerulus filtrate .

2- Arenal tubule

The filtrate next moves to the renal tubule, where it is further processed to form urine. The different stages of this fluid are collectively known as the tubular fluid .

The components of the renal tubule are :

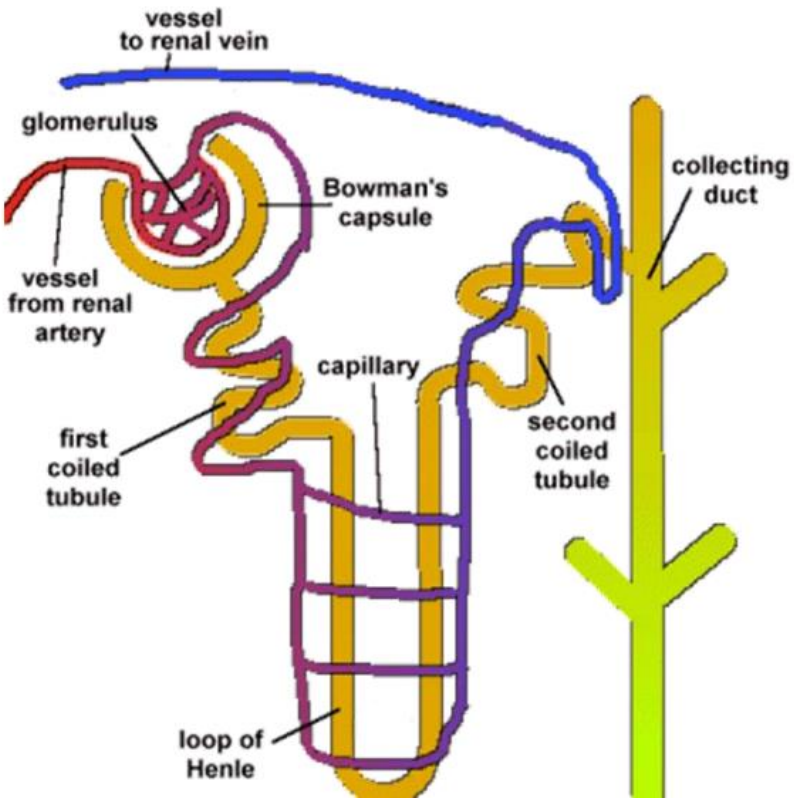
* Proximal convoluted tubule (lies in cortex) .
* Loop of Henle i.e. U-shaped , and lies in medulla composed of Descending limb of loop of Henle and Ascending limb of loop of Henle .

* Distal convoluted tube .

* Collecting duct .

The tubule has adjacent peritubular capillaries that run between the descending and ascending portions of the tubule. As the fluid from the capsule flows down into the tubule , it is processed by the epithelial cells lining the tubule : water is reabsorbed and substances are exchanged (some are added , others are) This process regulates the volume of body fluid as well as levels of removed many body substances . At the end of the tubule , the remaining fluid—urine—exits: it is composed of water, metabolic waste, and toxins .

The peritubular capillaries then recombine to form an efferent venule, which combines with efferent venules from other nephrons into the renal vein, and rejoins the main bloodstream .



Urine formation

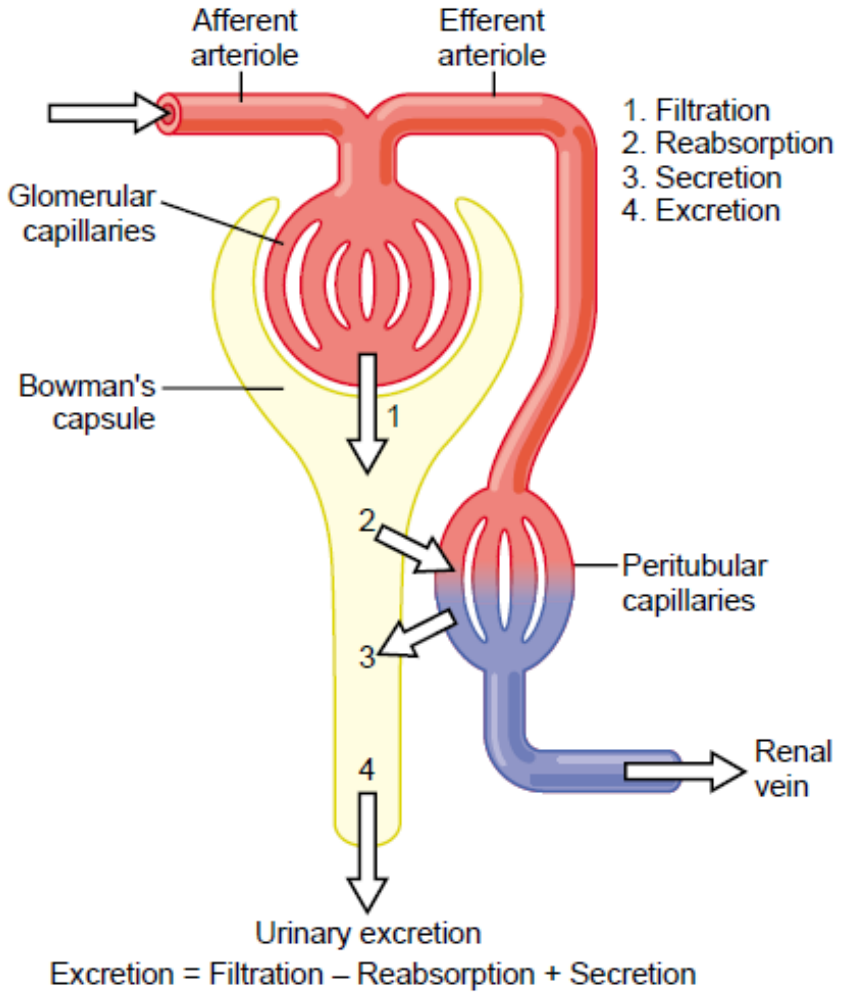
The four mechanisms used to create and process the filtrate (the result of which is to convert blood to urine) are :

1- **Filtration** : Filtration occurs in the glomerulus and is largely passive . it is dependent on the intracapillary blood pressure . Normally the only components of the blood that are not filtered into Bowman's capsule are blood proteins , red blood cells , white blood cells and platelets . Over 150 liters of fluid enter the glomeruli of an adult every day .

2- Reabsorption : 99% of the water in that filtrate is reabsorbed . reabsorption occurs in the renal tubules and is either passive , due to diffusion , or active , due to pumping against a concentration gradient Substances reabsorbed include : water , sodium chloride, glucose, amino acids, lactate, magnesium, calcium .phosphate, uric acid, and bicarbonate .

3- **Secretion:** also occurs in the tubules and is active . Substances secreted include urea, creatinine, potassium, hydrogen, and uric .

4- **excretion** .

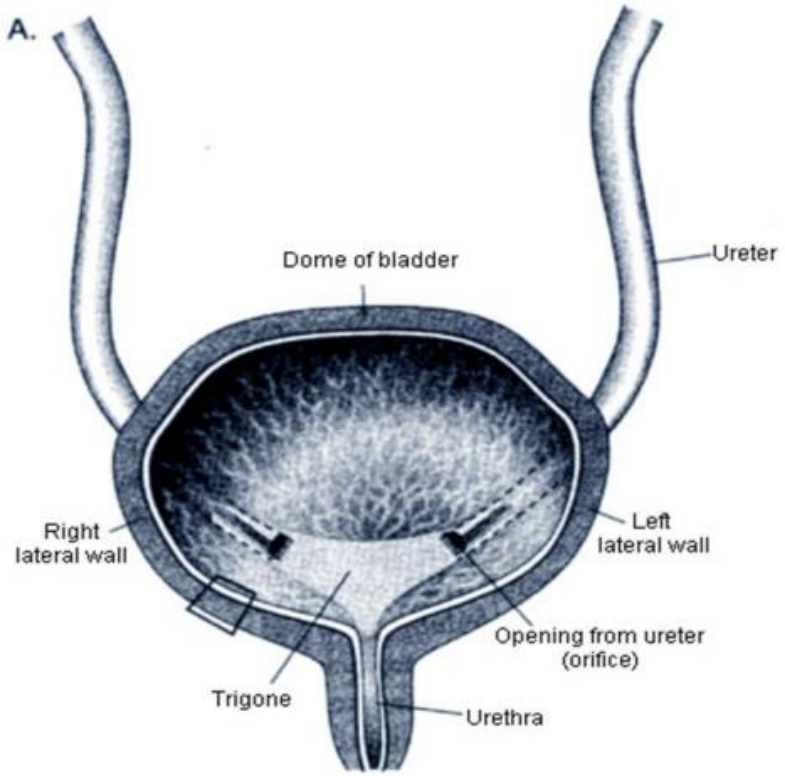


Two ureters : These narrow tubes carry urine from the kidneys to the bladder. . About every 10 to 15 seconds, small amounts of urine are emptied into the bladder from the ureters .

Bladder : This triangle-shaped, hollow organ is located in the lower abdomen. It is held in place by ligaments that are attached to other organs and the pelvic bones. The bladder's walls relax and expand to store urine, and contract and flatten to empty urine through the urethra. The typical healthy adult bladder can store up to two cups of urine for two to five hours .

Urethra : This tube allows urine to pass outside the body.

The brain signals the bladder muscles to tighten, which squeezes urine out of the bladder . At the same time , the brain signals the sphincter muscles to relax to let urine exit the bladder through the urethra. When all the signals occur in the correct order , normal urination occurs .



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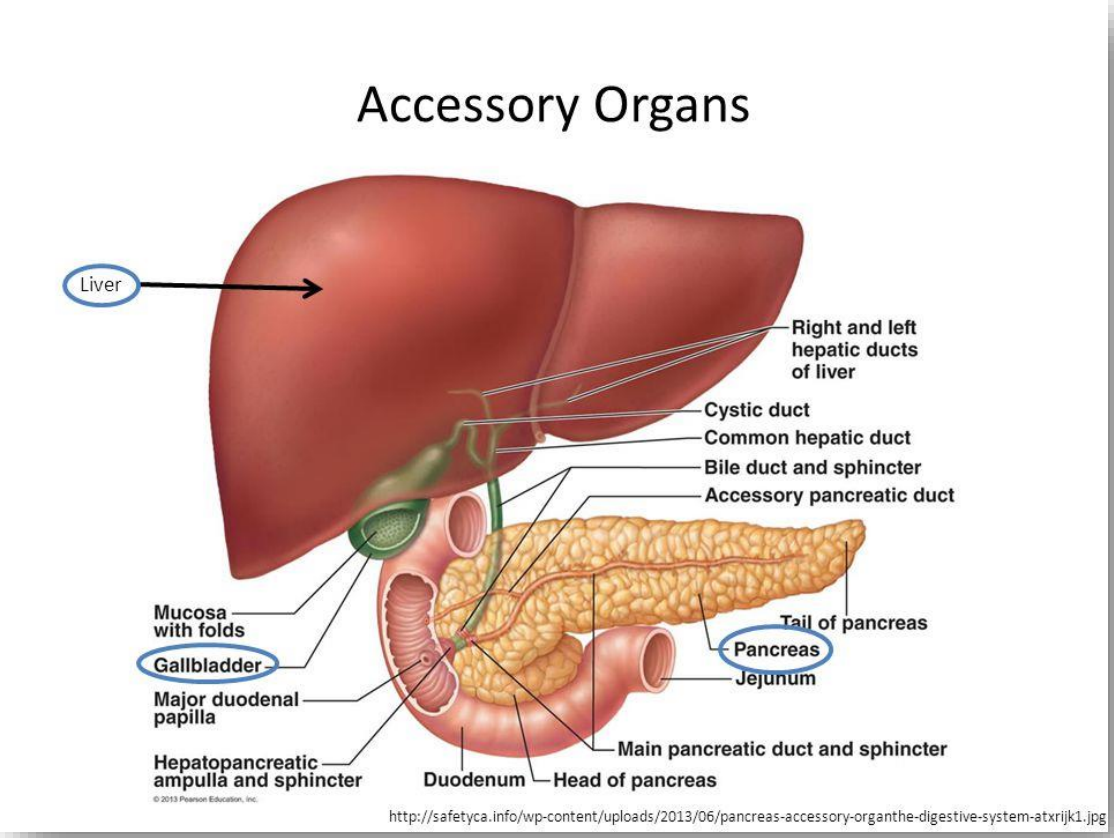
Accessory Organs

The salivary glands, liver, gallbladder, and pancreas are not part of the digestive tract, but they have a role in digestive activities and are considered accessory organs.



Salivary Glands

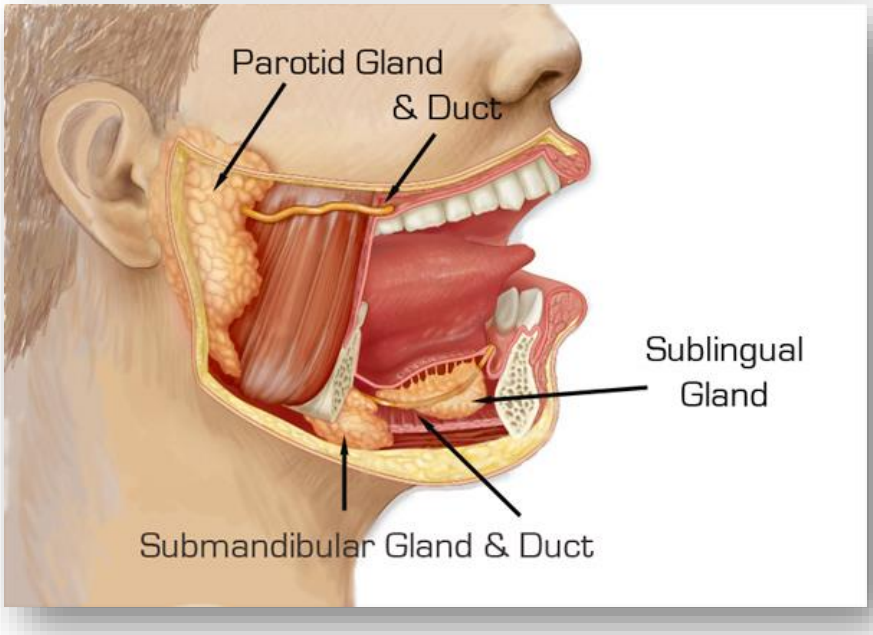
Three pairs of major salivary glands (parotid , sub mandibular , and sublingual glands) and numerous smaller ones secrete saliva into the oral cavity , where it is mixed with food during mastication . Saliva contains water , mucus , and enzyme amylase. Functions of saliva include the following:

1- It has a cleansing action on the teeth.

2- It moistens and lubricates food during mastication and swallowing.

3- It dissolves certain molecules so that food can be tasted.

4- It begins the chemical digestion of starches through the action of amylase, which breaks down polysaccharides into disaccharides.



Liver

The liver is located primarily in the right hypochondriac and epigastric regions of the abdomen, just beneath the diaphragm. It is the largest gland in the body . On the surface , the liver is divided into two major lobes and two smaller lobes. The functional units of the liver are lobules with sinusoids that carry blood from the periphery to the central vein of the lobule .The liver receives blood from two sources. Freshly oxygenated blood is brought to the liver by the common hepatic artery , a branch of the celiac trunk from the abdominal aorta . Blood that is rich in nutrients from the digestive tract is carried to the liver by the hepatic portal vein . The liver has a wide variety of functions and many of these are vital to life . Hepatocytes perform most of the functions attributed to the liver , but the phagocytic Kupffer cells that line the sinusoids are responsible for cleansing the blood .Liver functions include the following :

1- secretion .

2- synthesis of bile salts .

3- synthesis of plasma protein .

4- storage .

5- detoxification .

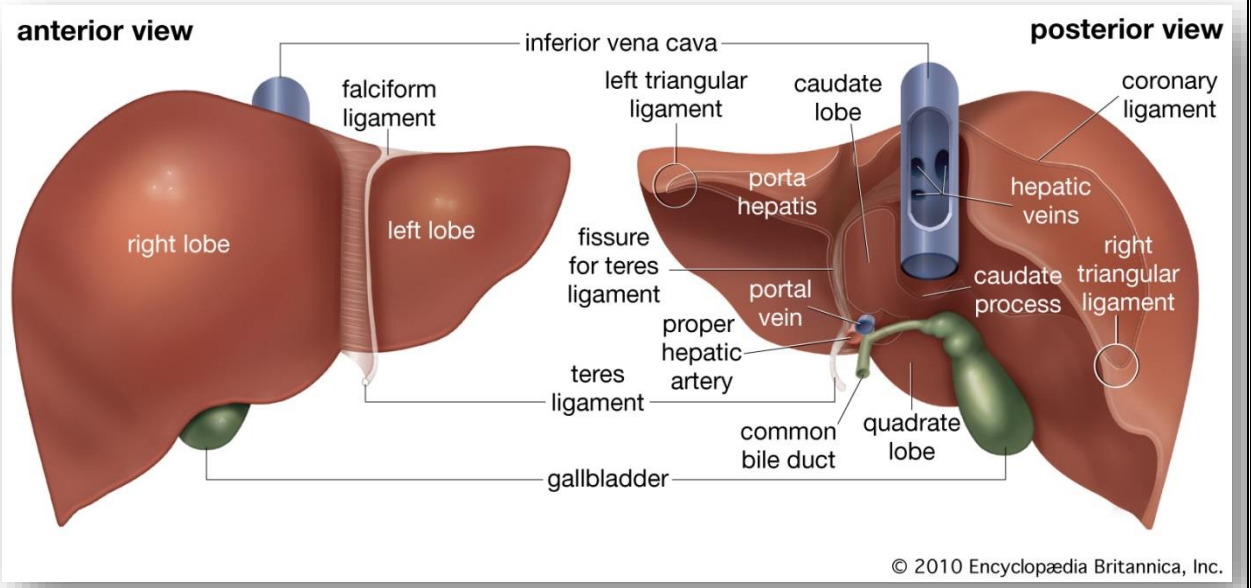
6- carbohyrate metabolism .

7- lipid metabolism .

8- protein metabolism .

9- filtering .

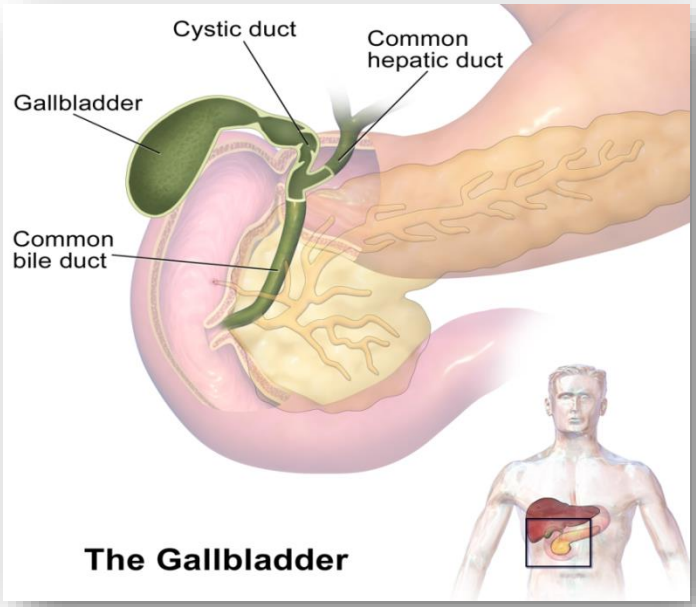
10- excretion .



Gallbladder

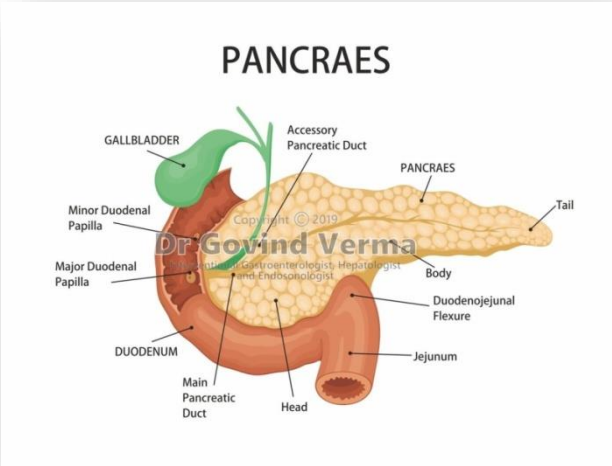
The gallbladder is a pear-shaped sac that is attached to the visceral surface of the liver by the cystic duct . The principal function of the gallbladder is to serve as a storage reservoir for bile . Bile is a yellowish-green fluid produced by liver cells . The main components of bile are water, bile salts, bile pigments, and cholesterol.

Bile salts act as emulsifying agents in the digestion and absorption of fats. Cholesterol and bile pigments from the breakdown of hemoglobin are excreted from the body in the bile.



Pancreas

The pancreas has both endocrine and exocrine functions. The endocrine portion consists of the scattered islets of Langerhans , which secrete the hormones insulin and glucagon into the blood. The exocrine portion is the major part of the gland . It consists of pancreatic acinar cells that secrete digestive enzymes into tiny ducts interwoven between the cells. Pancreatic enzymes include anylase , trypsin , peptidase , and lipase . Pancreatic secretions are controlled by the hormones secretion and cholecystokinin .


PANCRAES
GALLBLADDER
Accessory
Pancreatic Duct
PANCRAES
Tail
Minor Duodenal
Papilla
Major Duodenal
Papilla
Body
Duodenojejunal
Flexure
DUODENUM
Jejunum
Main
Pancreatic
Duct
Head
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