Cardiovascular System

-Humans and other vertebrates have a closed circulatory system called the **cardiovascular system**

-A cardiovascular system consists of **heart, blood vessels** and **blood**

-**Arteries** carry blood away from the heart to organs, Arteries branch to **Arterioles** that give rise to **Capillaries**

-Networks of capillaries called capillary beds are the sites of chemical exchange between the blood and interstitial fluid

-Capillaries rejoin to form **Venules** which converge to form **Veins** that return blood to the heart

-Arteries and veins are distinguished by the direction of blood flow, not by O_2 content, Arteries carry blood from the heart toward capillaries, and veins return blood to the heart from capillaries.

-The hearts of all vertebrates contain two or more muscular chambers. The chambers that receive blood entering the heart are called **atria** (singular, *atrium*). The chambers responsible for pumping blood out of the heart are called **ventricles.**

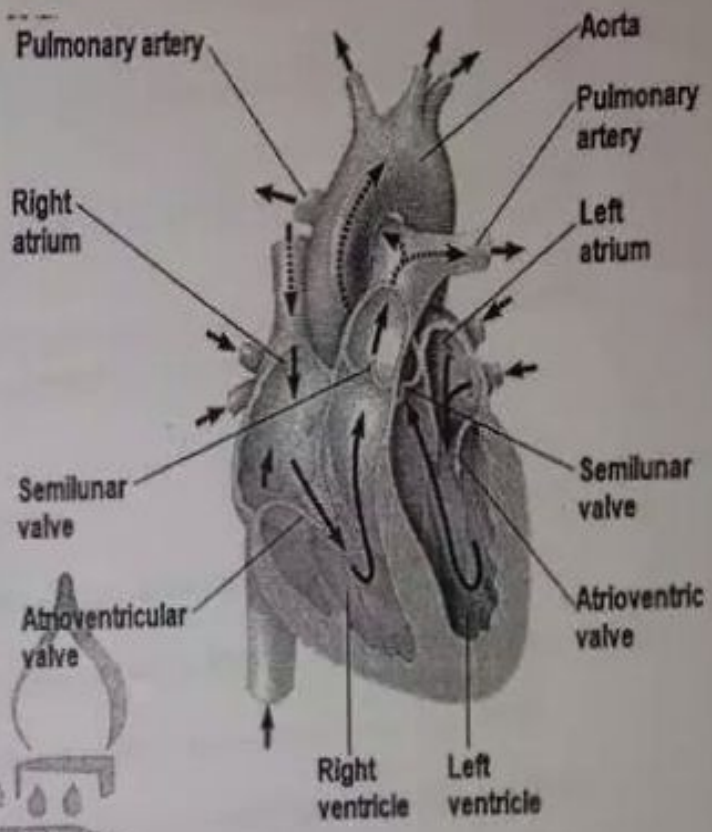
The Human Heart

-Cone shaped organ, size of clenched fist, located under the breast bone (Sternum)

-Consist mostly of cardiac muscle tissue

-The two atria have thin walls and function as collection chambers for blood returning to the heart

-The two ventricles have thick powerful walls that pump blood to the organs



Mammalian Circulation

The Pulmonary (lung) Circulation

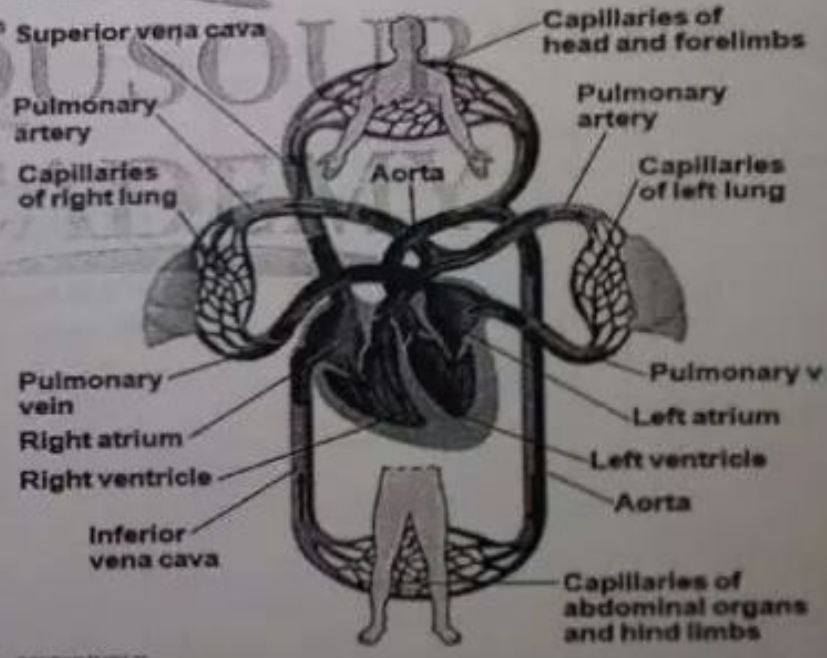
-The right ventricle pumps the blood to the lungs via pulmonary arteries, in lungs blood loads O2 and unloads CO2 via the capillary beds, now oxygen rich blood return to the left atrium via pulmonary veins

The Systemic Circulation

-The oxygen-rich blood flows to the left ventricle when it opens and the atrium contract

-The left ventricle pumps the oxygen-rich blood to the body tissues via the aorta, which conveys blood to arteries then to arterioles then to capillaries throughout the body

-The first branches from the aorta are the coronary arteries, which supply blood to the heart muscle itself, and then come branches leading to capillary beds in the head and arms (forelimbs)



-The aorta continues in a posterior direction, supplying O2 rich blood to abdominal organs and legs.

-Within the capillaries O2 will move from the blood to the tissues and CO2 from tissues to the blood according their concentration gradient

-Capillaries rejoin, forming venules which convey O2 poor blood from the head, neck and forelimbs to veins called the superior vena cava

-The inferior vena cava drain oxygen-poor blood from the trunk and hind limbs -Both vena cava empty their blood into the right atrium, and finally blood flow to the right ventricle

The Hearts Rhythmic Cycle

-The heart contracts and relaxes in a rhythmic cycle

-When it contacts it pumps the blood when it relaxes its chambers fill with blood

-A complete sequence of contraction (pumping) and relaxation (filling) is the **cardiac cycle**

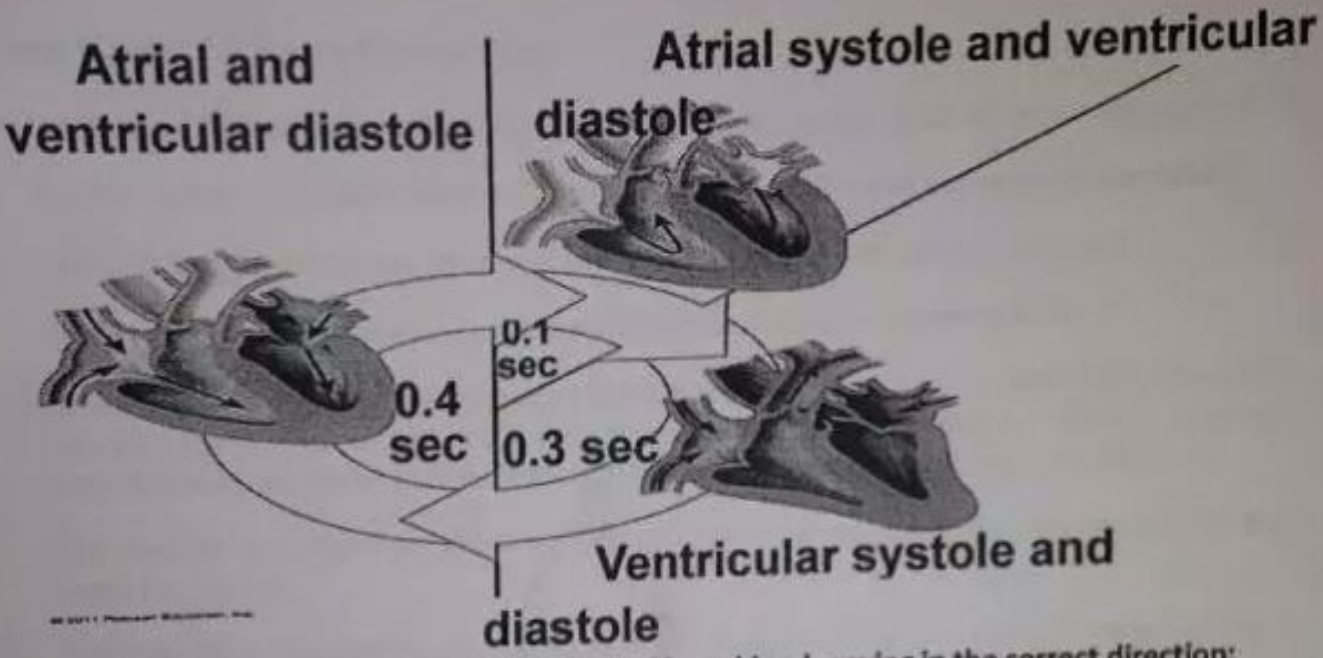
a. During **systole** (the contraction phase), heart muscles contract to pump the blood

b. During **diastole** (the relaxation phase), the heart muscles relax to receive (fill) the blood

-**Cardiac output:** The volume of blood per minute that the left ventricle pumps into the systemic circuit, (5.0 liter per minute), and it depends on two factors:

a. **Heart rate (rate of contraction):** also called the pulse, which is the number of heart beats per minute. Resting heart rate is about 72 beats per minute.

b. **Stroke volume:** the amount of blood pumped by the left ventricle in each contraction (average 70 ml per beat).



-Four valves in the heart prevent backflow and keep blood moving in the correct direction:

1. **Atrioventricular (AV) valves (2):** found between each atrium and ventricle

-They keep blood from flowing back into the atria during ventricular contraction (systole)

2. **Semilunar valves (2):** located at the two exits of the heart; where the aorta leaves the left ventricle and where the pulmonary artery leaves the right ventricle

-They prevent flow of the blood back into the ventricles when they relax (diastole)

-The recoil of the blood against the closed AV valve causes the first heart sound (lup)

-The recoil of the blood against the closed semilunar valves causes the second heart sound (dup)

-Heart murmur: is a defect of one or more valves where a stream of blood flow backward through these valves, some people born with heart murmur; in others, valves may be damaged by infection.

Maintaining the Heart's Rhythmic Rate

-Cardiac muscles are self excitable and can contract without any signal of the nervous system

-Heart's rhythm rate is controlled by the **sino-atrial node (SA node)** also called **(pacemaker)**

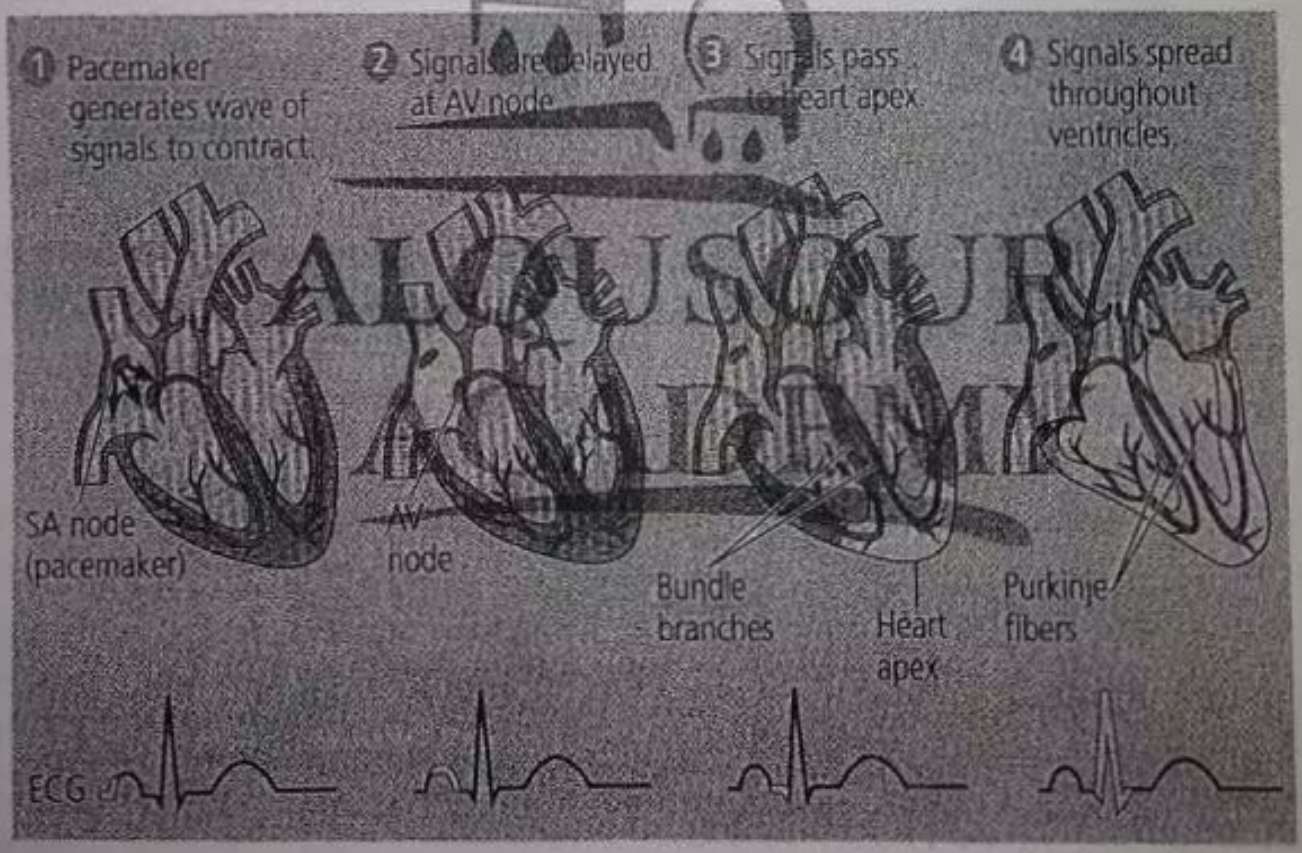
-The SA is located in the right atrial wall near the entrance of the superior vena cava

-Muscle tissue of the SA node has characteristics of both muscle and nerve tissue

-Contractions of the SA node generate electrical impulses that spread rapidly from the node and cause the atria to contract at the same time; this wave of contraction will pass the atria and reach the **atrioventricular (AV) node** located near the base of wall separating the atria

-The impulse is delayed for 0.1 sec to ensure the atria are completely empty before the ventricles contract

-The impulse is then carried by a mass of specialized muscle fibers called bundle branches purkinje fibers to the apex of the heart and throughout the ventricular walls



-Impulses that travel during the cardiac cycle can be recorded as an **electrocardiogram (ECG or EKG)**

-The pacemaker is regulated by two portions of the nervous system: the sympathetic and parasympathetic divisions

-The sympathetic division speeds up the pacemaker

-The parasympathetic division slows down the pacemaker

-The pacemaker is also regulated by hormones and temperature:

Ex: Epinephrine, the "fight-or-flight" hormone secreted by the adrenal glands, causes the heart rate to increase.

An increase of only 1°C raises the heart rate by about 10 beats per minute

-The vertebrate heart is referred to myogenic heart, because it's made of a specialized tissue located within heart

Blood Vessel Structure and Function

-A vessel's cavity is called the central lumen

-The epithelial layer that lines blood vessels is called the endothelium

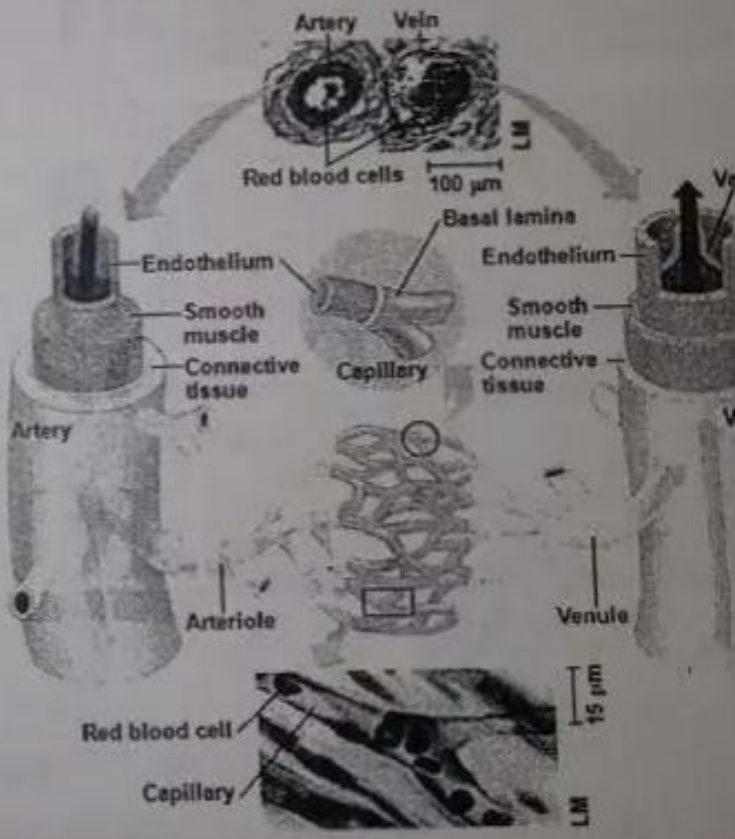
-The endothelium is smooth and minimizes resistance

-Capillaries have thin walls, the endothelium plus its basal lamina, to facilitate the exchange of materials

-Arteries and veins have an endothelium, smooth muscle, and connective tissue

-Arteries have thicker walls than veins to accommodate the high pressure of blood pumped from the heart

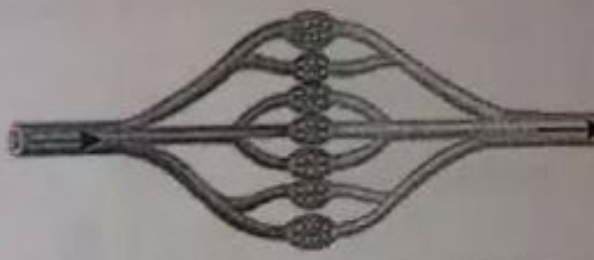
-In the thinner-walled veins, blood flows back to the heart mainly as a result of muscle action



Blood Flow Velocity

-Velocity of blood flow is slowest in the capillary beds, as a result of the high resistance and large total cross-sectional area
-Blood flow in capillaries is necessarily slow for exchange of materials

Blood Pressure



-Blood flows from areas of higher pressure to areas of lower pressure

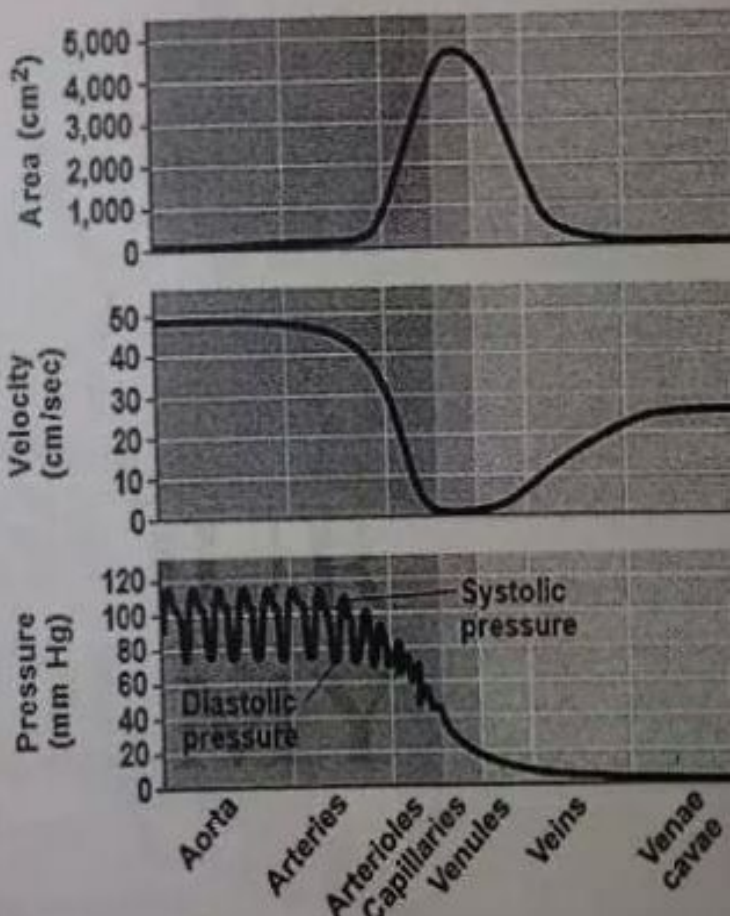
-Blood pressure is the pressure that blood exerts against the wall of a vessel

-In rigid vessels blood pressure is maintained; less rigid vessels deform and blood pressure is lost.

-**Systolic pressure** is the pressure in the arteries during ventricular systole; it is the highest pressure in the arteries

-**Diastolic pressure** is the pressure in the arteries during diastole; it is lower than systolic pressure

-A **pulse** is the rhythmic bulging of artery walls with each heartbeat



Regulation of Blood Pressure

-Blood pressure is determined by cardiac output and peripheral resistance due to constriction of arterioles

-**Vasoconstriction** is the contraction of smooth muscle in arteriole walls; it increases blood pressure

-**Vasodilation** is the relaxation of smooth muscles in the arterioles; it causes blood pressure to fall

-Vasoconstriction and vasodilation help maintain adequate blood flow as the body's demands change

-**Nitric oxide** is a major inducer of vasodilation

-The peptide **endothelin** is an important inducer of vasoconstriction

-Blood pressure is generally measured for an artery in the arm at the same height as the heart

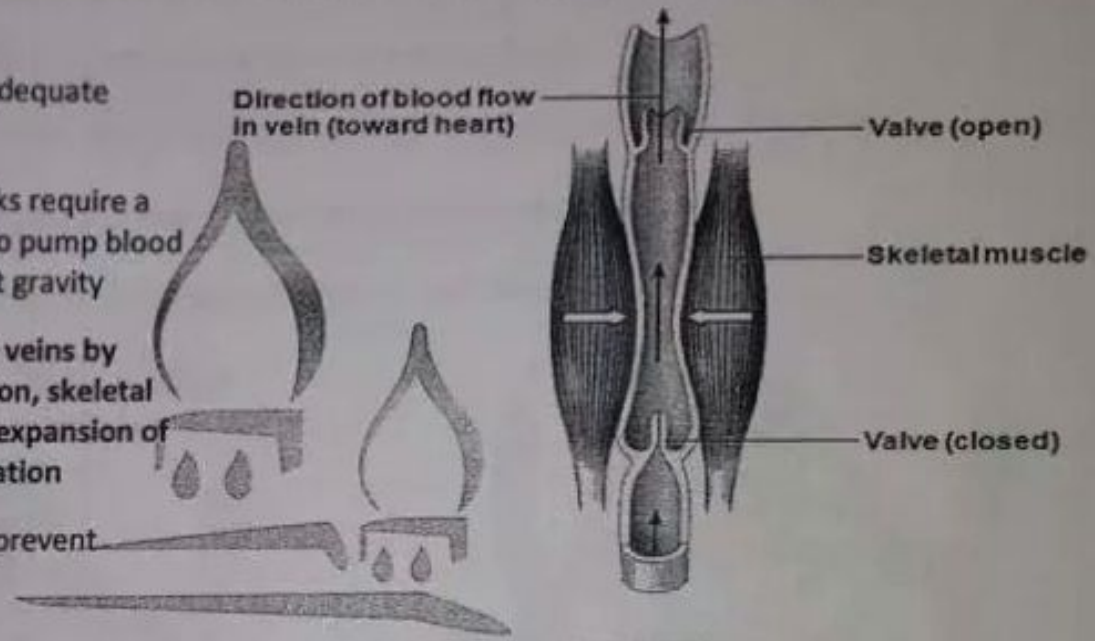
-Blood pressure for a healthy 20 year old at rest is 120 mm Hg at systole and 70 mm Hg at diastole

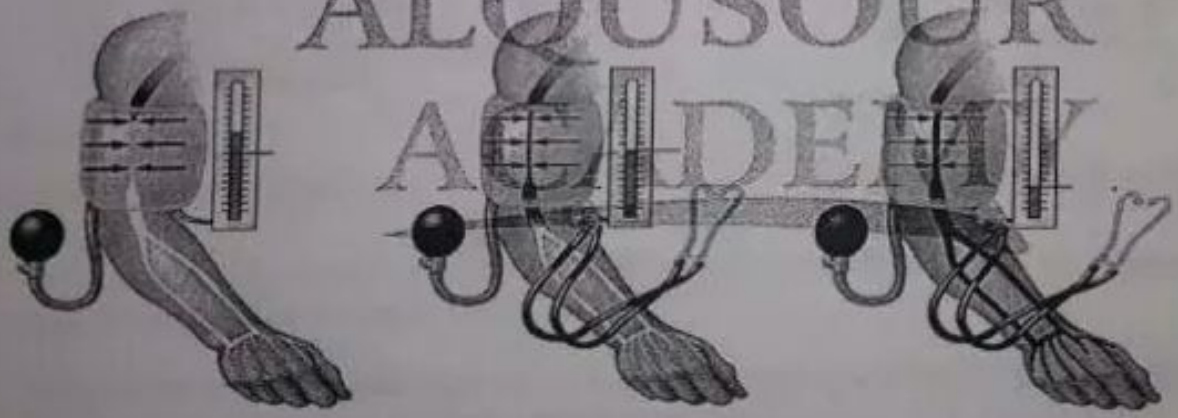
-Fainting is caused by inadequate blood flow to the head

-Animals with longer necks require a higher systolic pressure to pump blood a greater distance against gravity

-Blood is moved through veins by smooth muscle contraction, skeletal muscle contraction, and expansion of the vena cava with inhalation

-One-way valves in veins prevent backflow of blood





Artery closed (120) **Sounds audible in stethoscope (120)** **Sounds stop (70)**

Blood pressure reading: 120/70

Capillary Function

-Blood flows through only 5–10% of the body's capillaries at a time

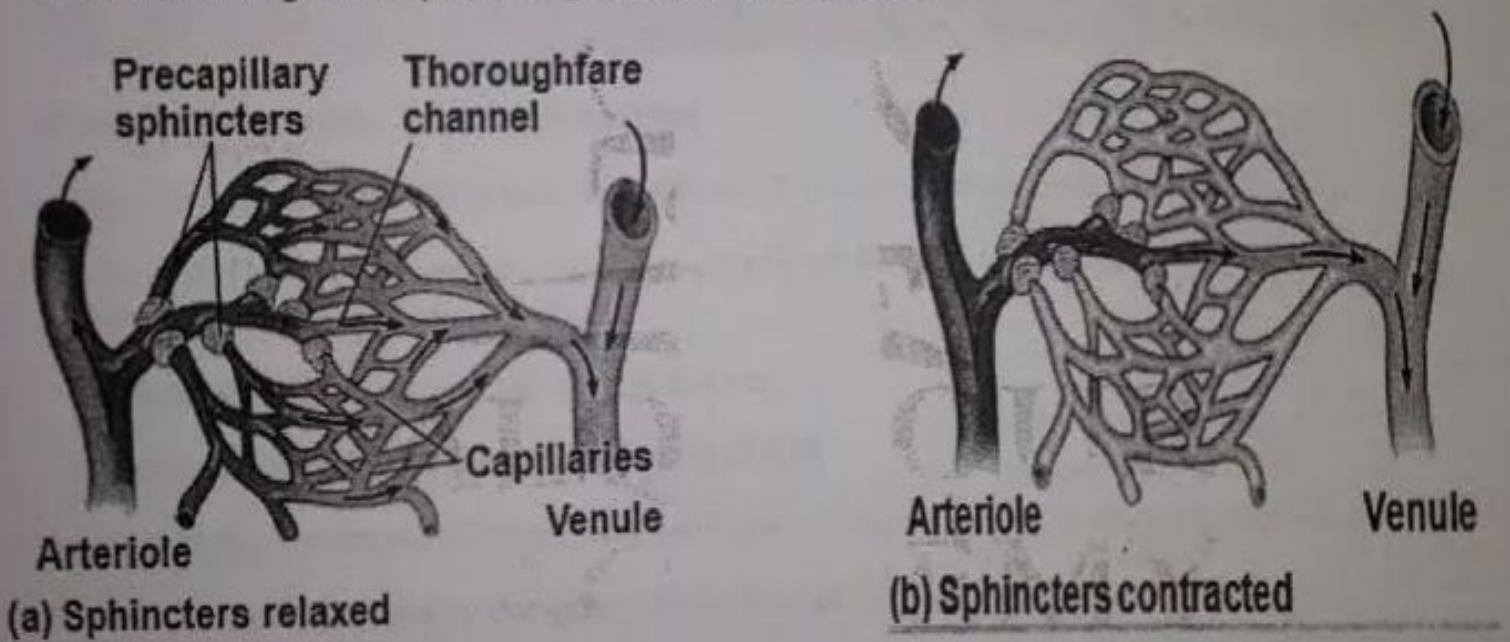
-Capillaries in major organs are usually filled to capacity; Capillaries in the brain, heart, kidneys, and liver are usually filled to capacity, but at many other sites the blood supply varies over time as blood is diverted from one destination to another.

-Two mechanisms regulate distribution of blood in capillary beds:

1. Contraction of the smooth muscle layer in the wall of an arteriole constricts the vessel

2. Precapillary sphincters control flow of blood between arterioles and venules

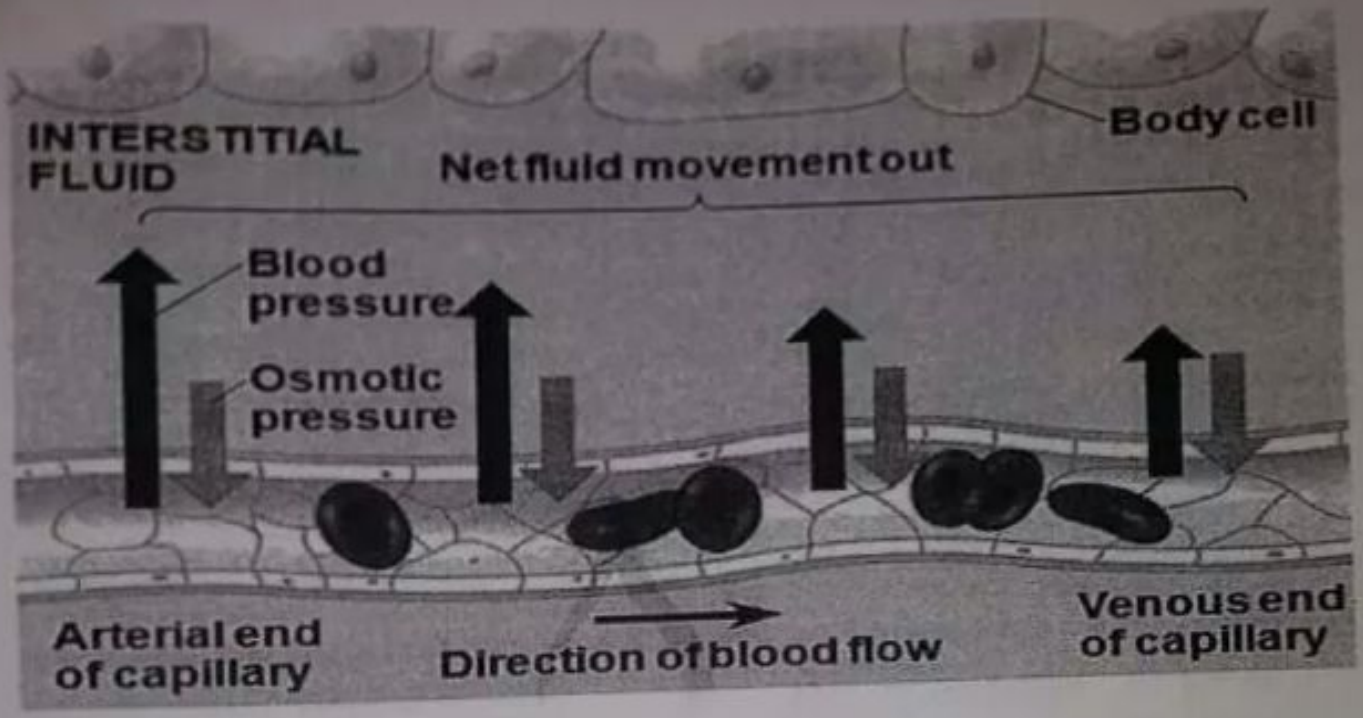
-Blood flow is regulated by nerve impulses, hormones, and other chemicals



-The exchange of substances between the blood and interstitial fluid takes place across the thin endothelial walls of the capillaries

-The difference between blood pressure and osmotic pressure drives fluids out of capillaries at the arteriole end and into capillaries at the venule end

-Most blood proteins and all blood cells are too large to pass through the endothelium



Fluid Return by the Lymphatic System

-The lymphatic system returns fluid that leaks out from the capillary beds

-Fluid, called lymph, reenters the circulation directly at the venous end of the capillary bed and indirectly through the lymphatic system

-The lymphatic system drains into veins in the neck

-Valves in lymph vessels prevent the backflow of fluid

-**Lymph nodes** are organs that filter lymph and play an important role in the body's defense

-Edema is swelling caused by disruptions in the flow of lymph

Blood is a Connective Tissue with Cells Suspended in Plasma

-Blood is a connective tissue with several cell types suspended in a liquid matrix called plasma

-Humans have 5 liters of whole blood (plasma (55%) + cellular elements (45%))

Plasma 55%	
Constituent	**Major functions**
Water	Solvent for carrying other substances
Ions (blood electrolytes) Sodium Potassium Calcium Magnesium Chloride Bicarbonate	Osmotic balance, pH buffering, and regulation of membrane permeablity
Plasma proteins	
Albumin	Osmotic balance, pH buffering
Fibrinogen	Clotting
Immunoglobulins (antibodies)	Defense
Substances transported by blood Nutrients Waste products Respiratory gases Hormones	

Blood Plasma

-Water accounts for 90% of plasma which also contains electrolytes and proteins

-Electrolytes: inorganic salts in the form of dissolved ions that help maintain osmotic balance of the blood

-Plasma proteins: which influence blood pH, osmotic pressure, and viscosity. Various plasma proteins function in lipid transport, immunity, and blood clotting

-Serum: is the blood plasma that has the clotting factors removed

Cellular Elements

1. Erythrocytes, Red Blood Cells, (RBC)

-Each µl of human blood contains 5-6 million RBC, lack nuclei and mitochondria and generates ATP by anaerobic respiration

-RBC Carry Oxygen through Hb (each Hb molecule bind up to four molecules of O2), so RBC carries 1 billion O2 molecules

-Hb also carries nitric oxide NO, which dilates capillaries allowing the RBC to pass

-Sickle-cell disease is caused by abnormal hemoglobin proteins that form aggregates, these aggregates can deform an erythrocyte into a sickle shape, these sickled cells can rupture, or block blood vessels

2. Leukocytes, White Blood Cells, (WBC)

-Function in defense and immunity

-There are five types of leukocytes: **basophils, eosinophils** (increases during parasitic infestation as in worms), **neutrophils, lymphocytes** and **monocytes**

-There are usually 5000-10000 WBC in each µl of blood this number increase during infections
-Spend most of their time outside the circulatory system in the interstitial fluid and lymphatic system

-The defense mechanism for leukocytes done by phagocytosis of bacteria and debris (as in neutrophil and monocytes) or by producing antibodies(as in type B lymphocytes).

-The life span of neutrophil is about few days, monocytes about months while lymphocytes about years

3. Platelets

-Fragments of cells, 2-3 micrometer in diameter

-Lack nuclei and function in blood clotting

Blood Clotting

-Is a complex process that involves about 12 clotting factors (proteins in plasma)

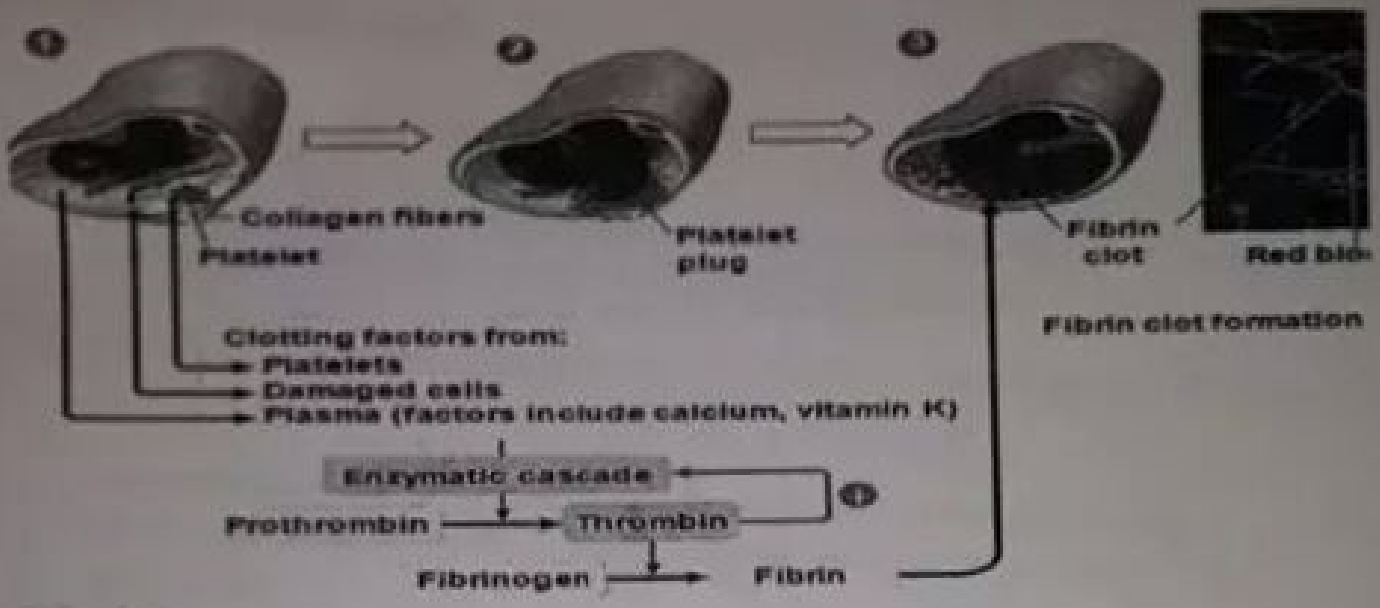
- Coagulation is the formation of a solid clot from liquid blood

-Clotting factors need Vitamin K and Calcium for proper functioning

-A clot form when platelets clump together to form a temporary plug and release clotting factors

-Clotting factors result in conversion of inactive fibrinogen to active Fibrin, Fibrin aggregates into threads that form the clot

-A blood clot formed within a blood vessel is called a **thrombus** and can block blood flow



-**Hemophilia**: Disease characterized by excessive bleeding from even a minor cut, caused by a genetic mutation that affects any of the clotting steps

Stem Cells and the Replacement of Cellular Elements

-The cellular elements of the blood must be replaced as they wear out

-Erythrocytes circulate in the blood for 3-4 months before being destroyed by phagocytic cells in the liver and spleen

-Erythrocytes, leukocytes, and platelets all develop from a common source of **stem cells** in the red marrow of bones, especially ribs, vertebrae, sternum, and pelvis

-The hormone **erythropoietin (EPO)** stimulates erythrocyte production when O_2 delivery is low

-They produce a number of new blood cells equivalent to the number of dying cells

Cardiovacular Diseases

-Diseases of the heart and blood vessels

-Low-density lipoprotein (LDL) delivers cholesterol to cells for membrane production, High concentration of LDLs in the blood correlates with atherosclerosis

-High-density lipoprotein (HDL) scavenges cholesterol for return to the liver, HDL reduce deposition of cholesterol in arterial plaques

1. Heart Attack: Death of the cardiac muscle resulting from prolonged blockage of one or more coronary arteries, (Coronary arteries supply oxygen-rich blood to the heart muscle)

2. Stroke: Death of nervous tissue in the brain due to lack of O2; often resulting from rupture or blockage of arteries in the brain

3. Thrombus: A blood clot that blocks a major blood vessel, **Embolus:** is a moving clot

5. Atherosclerosis: Chronic cardiovascular disease characterized by plaques that develop in the inner walls of arteries and narrow the lumen of the vessel

6. Arteriosclerosis: Form of atherosclerosis in which plaques are hardened with calcium deposits within arteries

7. Angina pectoris: chest pain that occur when heart receives insufficient oxygen due to blockage of the coronary arteries and results in chest pains.

8. Hypertension:

-High blood pressure (systolic >140 mmHg &/or diastolic >90mmHg), increase the risk of atherosclerosis, heart attack and stroke

-Hypertension can be reduced by dietary changes, exercise, and/or medication

Risk Factors and Treatment of Cardiovascular Disease

-A high LDL to HDL ratio increases the risk of cardiovascular disease

-The proportion of LDL relative to HDL can be decreased by exercise, not smoking, and avoiding foods with trans fats

-Drugs called statins reduce LDL levels and risk of heart attacks

-Inflammation plays a role in atherosclerosis and thrombus formation

-Aspirin inhibits inflammation and reduces the risk of heart attacks and stroke

Gas Exchange

Mammalian Respiratory System

-Located in the thoracic (chest) cavity, a system of branching ducts convey air to lungs

-Air enters through the nostrils and is then filtered by the hair, wormed, humidified and smelled when it flows in the nasal cavity

-The nasal cavity leads to the pharynx which regulates food passage to the esophagus and not to the **larynx** (voice box that contains pairs of vocal cords, and it's the upper part of the respiratory tract)

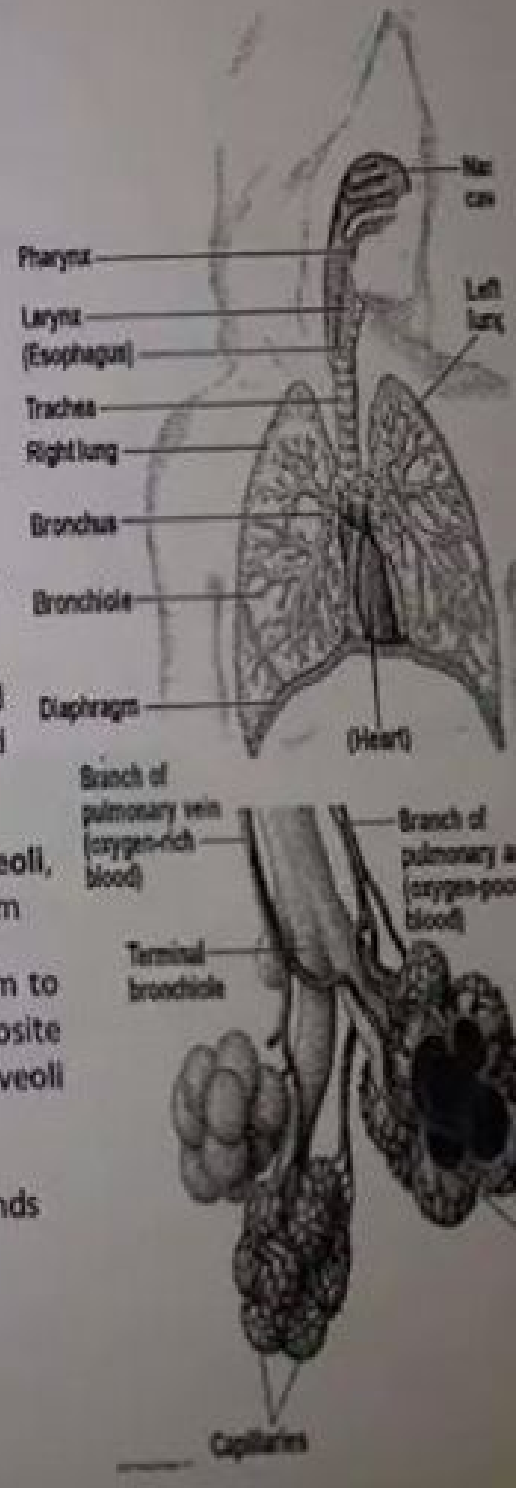
-From the larynx, air pass to the trachea, then trachea branches into two **bronchi** (singular: bronchus) one for each lung

-Within lungs the bronchus branches into finer and finer tubes called **bronchioles** (just like a tree), the lining of these ducts are covered with cilia and a thin film of mucus to trap dust and pollutant

-The dead-end of these branches is a cluster of air sacs called **alveoli**, here in the alveoli the gas exchange occurs across the thin epithelium

-When oxygen enters the alveoli it diffuses through the epithelium to the capillaries that surround each alveoli, CO_2 diffuse in the opposite direction from the capillaries to epithelium to air space and then alveoli to exit from the body

-Exhaled air passes over the vocal cords in the larynx to create sounds



-The "mucus escalator" cleans the respiratory system and allows particles to be swallowed into the esophagus

-Alveoli lack cilia and are susceptible to contamination

-Secretions called **surfactants** coat the surface of the alveoli

-Preterm babies lack surfactant and are vulnerable to respiratory distress syndrome; treatment is provided by artificial surfactants

-Animals can use air or water as a source of O2, or respiratory medium

-In a given volume, there is less O2 available in water than in air

-Obtaining O2 from water requires greater efficiency than air breathing

-Animals require large, moist respiratory surfaces for exchange of gases between their cells and the respiratory medium either air or water

-Gas exchange across respiratory surfaces takes place by diffusion

-Respiratory surfaces vary by animal and can include the outer surface, skin, gills, tracheae, and lungsGills in Aquatic Animals

-Gills are outfoldings of the body that create a large surface area for gas exchange

Marine worm

Parapodium (functions as gill)

Crayfish

Gills

Sea star

Gills

-Ventilation moves the respiratory medium over the respiratory surface

-Aquatic animals move through water or move water over their gills for ventilation

-Fish gills use a countercurrent exchange system, where blood flows in the opposite direction to water passing over the gills; blood is always less saturated with O2 than the water it meets

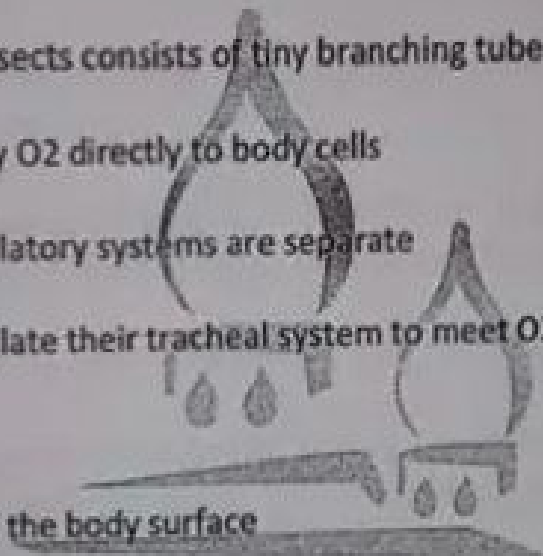
Tracheal Systems in Insects

-The tracheal system of insects consists of tiny branching tubes that penetrate the body

-The tracheal tubes supply O2 directly to body cells

-The respiratory and circulatory systems are separate

-Larger insects must ventilate their tracheal system to meet O2 demands



Lungs

-Lungs are an infolding of the body surface

-The circulatory system (open or closed) transports gases between the lungs and the rest of the body

-The size and complexity of lungs correlate with an animal's metabolic rate

Gas Exchange

-**Gas exchange** supplies O_2 for cellular respiration and disposes of CO_2

-Vertebrates ventilate their lungs by **Breathing**, by maintaining a maximum O2 concentration and minimum CO2 concentration in the alveoli that alternate inhalation and exhalation of air

-**There are two type of breathing:**

a. Positive pressure breathing: amphibians like frogs ventilate their lungs by positive pressure breathing: air is pushed down the windpipe into Frog lungs

-During inhalation, muscles lower the floor of the oral cavity drawing in air through the nostrils

-The nostrils and mouth are closed and the floor of the mouth is raised forcing air down the trachea

-During exhalation, elastic recoil of the lungs and compression by the muscular body wall force air back out of the lungs

b. Negative pressure breathing: Mammals ventilate their lungs by negative pressure breathing where air is pulled instead of being pushed into the lung during **inhalation**

-Lung volume increase as a result of contraction of the rib muscles and the diaphragm,

-When the rib muscles contract the breast bone is pushed outward and the ribs upward when the diaphragm contracts, it pushes down towards the abdomen, enlarging the thoracic cavity (expands the rib cage)

-This lowers the air pressure in the lungs below atmospheric pressure and causes inhalation, because gas flows from a region of high pressure to a region of lower pressure, so air rushes through the nostrils and down the breathing tubes to the alveoli

-During exhalation: the rib muscles and diaphragm relax, lung volume decreases, the air pressure increases within alveoli, forcing air up the breathing tube and out through the nostrils

-**Tidal Volume:** the volume of air an animal inhales and exhales with each breath; It averages about (500 ml in resting humans)

-**Vital Capacity**: the maximum tidal volume that can be inhaled and exhaled during forced breathing (4800 ml in young males and 3400 ml in females)

-**Residual Volume:** is the amount of air that remains in the lungs even after forced breathing

How a Bird Breathes?

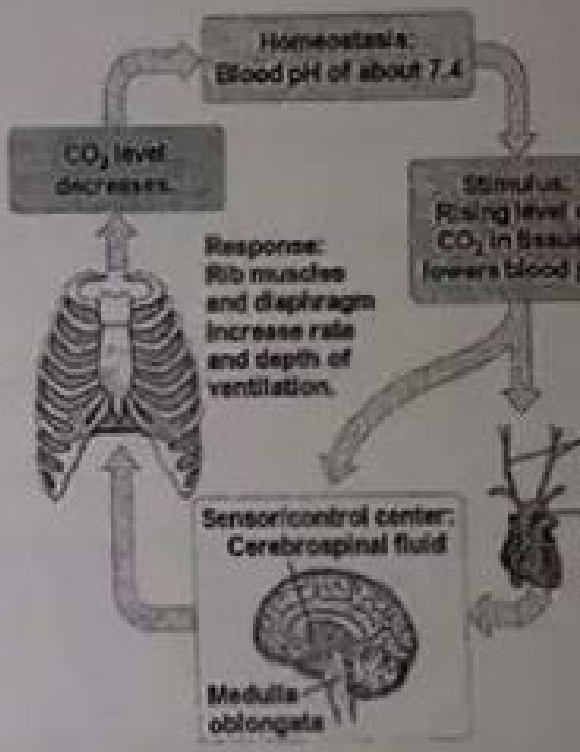
-Birds have eight or nine air sacs that function as bellows that keep air flowing through the lungs

-Air passes through the lungs in one direction only

-Every exhalation completely renews the air in the lungs

The Control of Breathing

-Breathing is an automatic action. We inhale when nerves in the **Breathing control centers** of the medulla oblongata and pons send impulses to the rib muscles or diaphragm, stimulating the muscles to contract, and this occurs about 10-14 time per minute



-The medulla's control center also monitors blood and cerebrospinal fluid pH, which drops as blood CO2 concentration increase

-When pH is dropped (increase of CO_2), the rate and depth of breathing is increased and the excess CO_2 is removed in exhaled air

-The pons regulates the tempo

-O_2 concentration in the blood only affects the breathing control centers when it becomes extremely low

-Sensors in the aorta and carotid arteries monitor O_2 and CO_2 concentrations in the blood

-These sensors exert secondary control over breathing

Gases Diffusion

-Gases diffuse down pressure gradients in the lungs and other organs; the diffusion of gases depends on the difference of quantity called **partial** pressure

-The partial pressure of any gas in the atmosphere is the proportion (ratio) of gas pressure contributed to the total atmospheric pressure which is760mm Hg at sea level

-Oxygen represents 21% of the atmosphere, its partial pressure: **(Po_2)= 0.21 x 760 = 160mm Hg**

-Partial pressure of CO2 at sea level (Pco_2= 0.23 mm Hg)

-Gases diffuse always from areas of high partial pressure to those of low partial pressures

-Blood arriving at the lungs from systemic circulation has a lower Po_2 and a higher Pco_2 than air in the alveoli

-Thus the blood exchange gases with air in the alveoli and the Po_2 of the blood increases while the Pco_2 decreases.

-In the alveoli, O_2 diffuses into the blood and CO_2 diffuses into the air

-In tissue capillaries, partial pressure gradients favor diffusion of O_2 into the interstitial fluids and CO_2 into the blood

Respiratory Pigments

-Are proteins that transport oxygen, greatly increase the amount of oxygen that blood can carry

-Most animal transport most of their O2 bound to a protein called **respiratory pigment**

-In human the respiratory pigment is Hb (Hemoglobin, red) which consist of four subunits, each with a cofactor (heme), that has Fe II at its center

-Without this pigment blood can carry 4.5ml of O2 in each Liter of blood by dissolving in plasma (O2 is slightly soluble in water), but with Hb, each Liter of Blood can carry 200 ml of O_2

-Some arthropods have respiratory pigments called hemocyanin (blue) because it contains copper

Oxygen Transport

-Oxygen is carried by **respiratory pigments** (hemoglobin) in the blood of most animals since oxygen is not very soluble in water

-Hemoglobin is the oxygen transporting pigment in almost all vertebrates

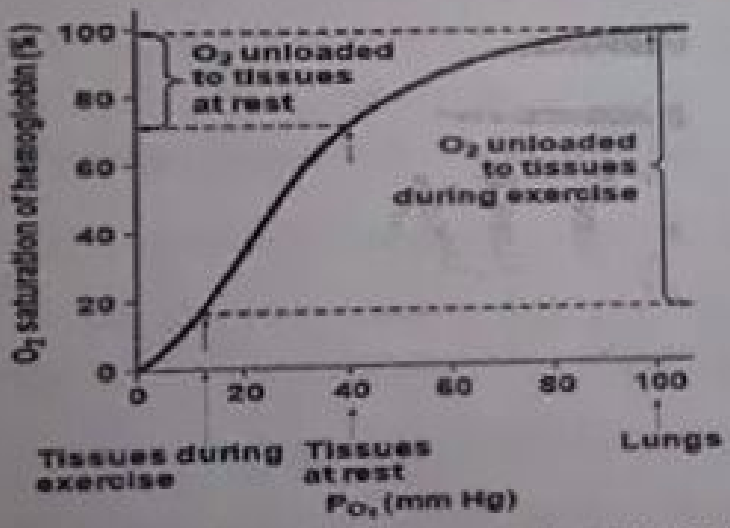
-Binding of oxygen to hemoglobin is reversible: binding occur in the lungs, release occurs in the tissues

-Binding and release of oxygen depends on conformational change of Hemoglobin

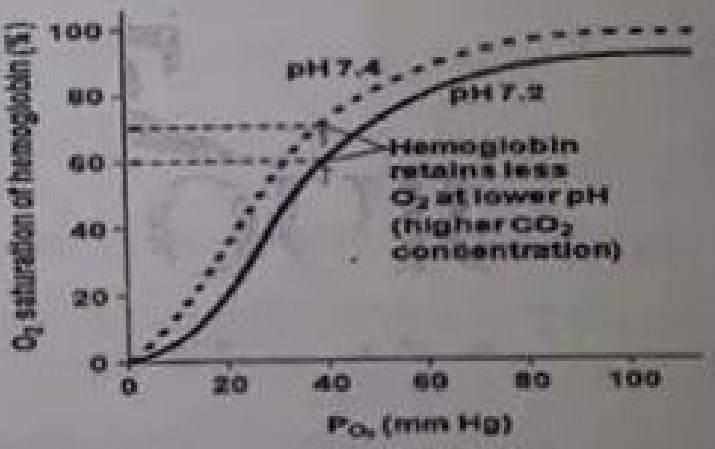
-**Bohr shift** is the lowering of hemoglobin's affinity for oxygen due to a drop in pH (change the pH will cause denaturation or change in the conformation of the protein)

-This occurs in active tissues where CO2 react with water to form H2CO3 which is acidic and lowers the pH

-A drop in pH shifts the O2 dissociation curve to the right

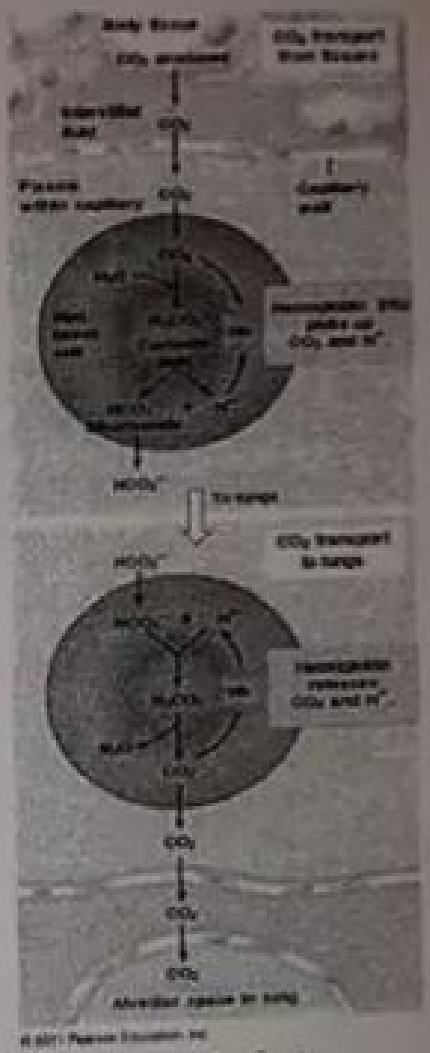


(a) P_{O_2} and hemoglobin dissociation at pH 7.4



(b) pH and hemoglobin dissociation

Carbon Dioxide Transport



-Carbon dioxide is transported by the blood in three forms:

1. Dissolved CO2 in the plasma (7%)
2. Bound to the amino groups of hemoglobin (23%)
3. As bicarbonate ions ($HCO3^-$) in the plasma (70%)

-In the tissues CO_2 from cells diffuses into the blood plasma and then more than 90% into RBC

-In the RBCs, CO2 reacts with water to form carbonic acid (H2CO3) then Carbonic acid quickly dissociate into H+ and bicarbonate ($HCO3^-$)

-Bicarbonate then diffuses out of RBCs to the blood plasma. The hydrogen ions attach to the hemoglobin

$$CO_2 + H_2O = H2CO3 - HCO3^- + H^+$$

-This process is reversed in the lungs, (bicarbonate diffuse back to the RBCs and binds to H+ to form H2CO3 which will convert back to CO2 and water to be eliminated from the body

Respiratory Adaptations of Diving Mammals

-Diving mammals have evolutionary adaptations that allow them to perform extraordinary feats

-For example, Weddell seals in Antarctica can remain underwater for 20 minutes to an hour and elephant seals can dive to 1,500 m and remain underwater for 2 hours

-These animals have a high blood to body volume ratio

-Deep-diving air breathers stockpile O2 and deplete it slowly

-Diving mammals can store oxygen in their muscles in myoglobin proteins

-Diving mammals also conserve oxygen by

-Changing their buoyancy to glide passively

-Decreasing blood supply to muscles

-Deriving ATP in muscles from fermentation once oxygen is depleted

Sample Questions

1. **The function of pulmonary circulation is to _____.**

   a. Carry oxygen and nutrients to tissues where they are needed

   b. Retrieve waste products from the body tissues

   c. Carry absorbed nutrients from the small intestine to the liver

   d. Carry carbon dioxide to the lungs and pick up oxygen from the lungs

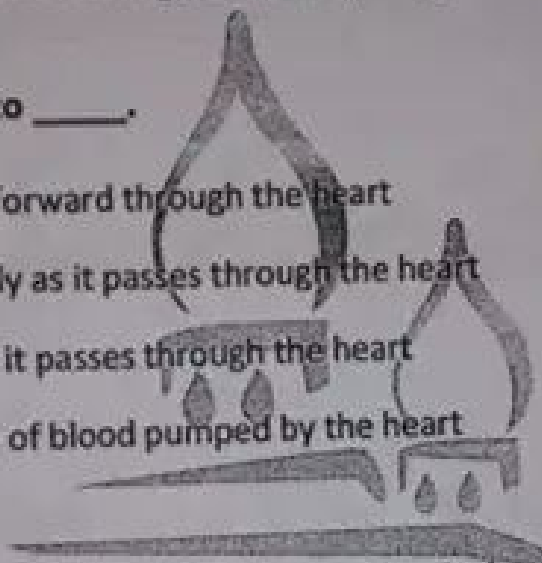
2. **Heart valves function to _____.**

   a. Keep blood moving forward through the heart

   b. Mix blood thoroughly as it passes through the heart

   c. Slow blood down as it passes through the heart

   d. Control the amount of blood pumped by the heart



3. **The SA node generates an electrical impulse from its location in the _____.**

   a. Left atrium, causing ventricular contraction

   b. Left ventricle wall, from which the impulse is carried to the bundle branches and on to the Purkinje fibers

   c. Right atrium, causing atrial contraction

   d. Left ventricle, causing atrial contraction

Answers

QUESTIOIN	ANSWER
1	D. Carry carbon dioxide to the lungs and pick up oxygen from the lungs
2	A. Keep blood moving forward through the heart
3	C. Right atrium, causing atrial contraction