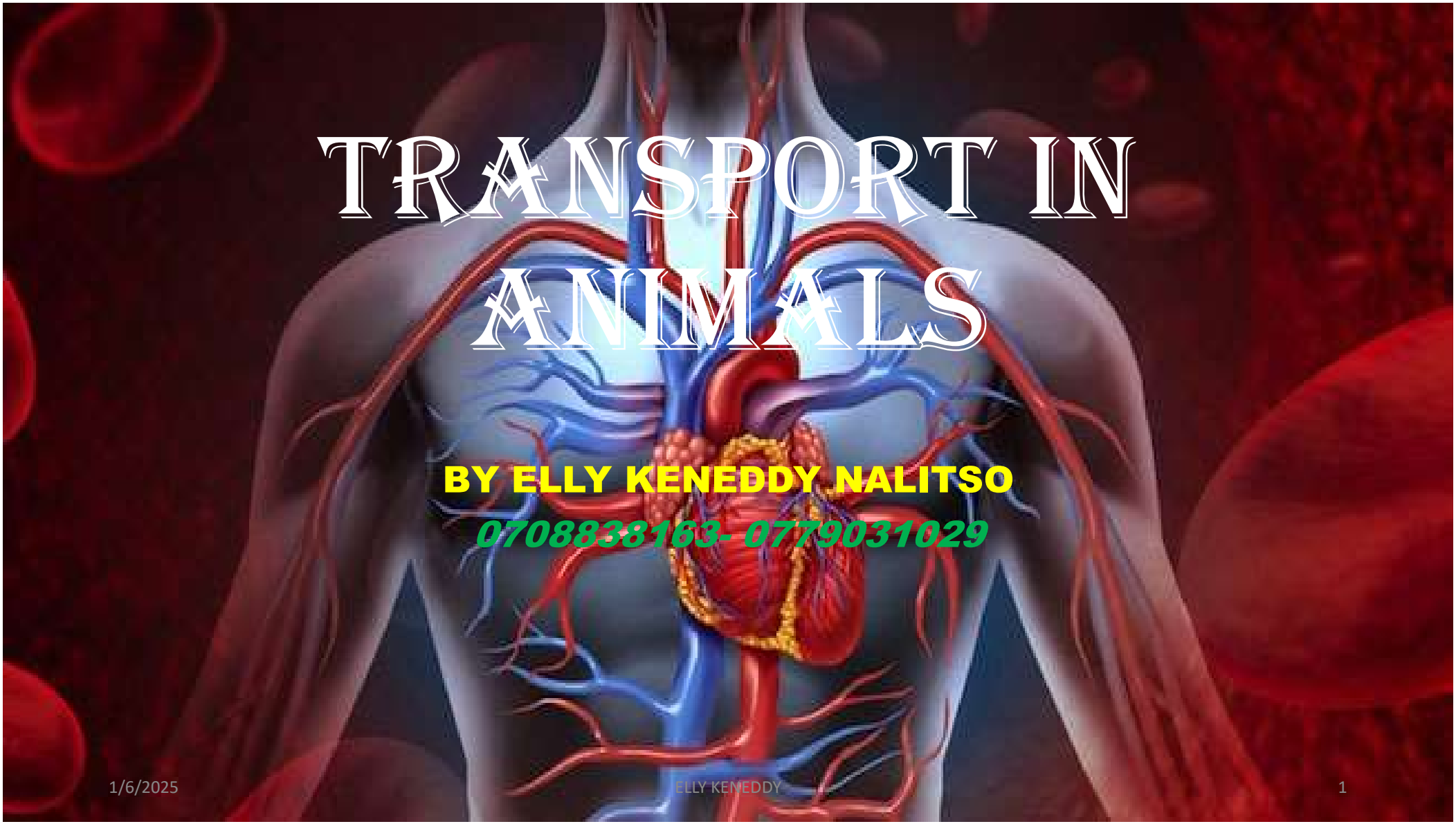


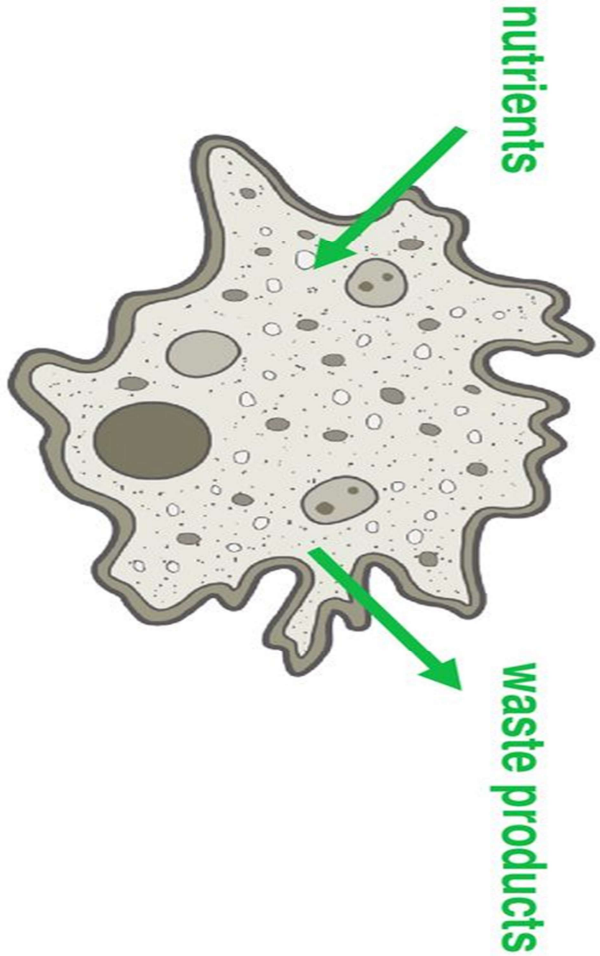
TRANSPORT IN ANIMALS

BY ELLY KENEDDY NALITSO

0708838163- 0779031029

INTRODUCTION.

- This refers to the ***movement of materials from one part of the organism to another***.
- Materials are moved into and out of the animals body.
- The type of transport depends on the on the size and complexity of the organism.
- Unicellular organisms like bacteria require simple means of transport .
- This is because their bodies are small and **have a large surface area to volume ratio**



QTN

- Why do multicellular organisms need a transport system?





NEED FOR A TRANSPORT SYSTEM



- Smaller organisms (protozoa) that have large surface area to volume ratio carry out transport by simple diffusion.
- Multicellular organisms like man require well developed means of transport because their **bodies are big**, **complex** and **have a small surface area to volume ratio.**
- Because of the increased size of the organisms(multicellular) and **the great distance over which materials are supposed to move** makes **diffusion rate slow which in turn make it inadequate for the distribution** of these materials.

CONT.....



To overcome the physical limitation on size placed by diffusion, multicellular animals have the major adaptations.

- They have organs that provide a large surface area for absorption of nutrients such as small intestines and exchange of gases such as lungs/ gills, without a great increase in total body volume.
- They have a transport (circulatory) system within the body, so that substances can be carried to cells that need them and waste products removed more quickly than in diffusion.

IMPORTANCE OF A TRANSPORT SYSTEM IN ANIMALS



- **Distribution of Nutrients:** The transport system, such as the circulatory system, ensures that nutrients absorbed from the digestive system are delivered to all cells in the body for growth, repair, and energy.
- **Oxygen Delivery:** In many animals, the transport system (especially the cardiovascular system) is responsible for carrying oxygen from the lungs or gills to tissues and organs, which is essential for cellular respiration and energy production.
- **Waste Removal:** The transport system helps in removing metabolic wastes like carbon dioxide and urea from the body, transporting them to excretory organs like the lungs and kidneys for elimination.

CONT.....



•**Hormone Transport:** Hormones produced by endocrine glands are distributed throughout the body via the transport system, regulating various physiological processes like growth, metabolism, and reproduction.

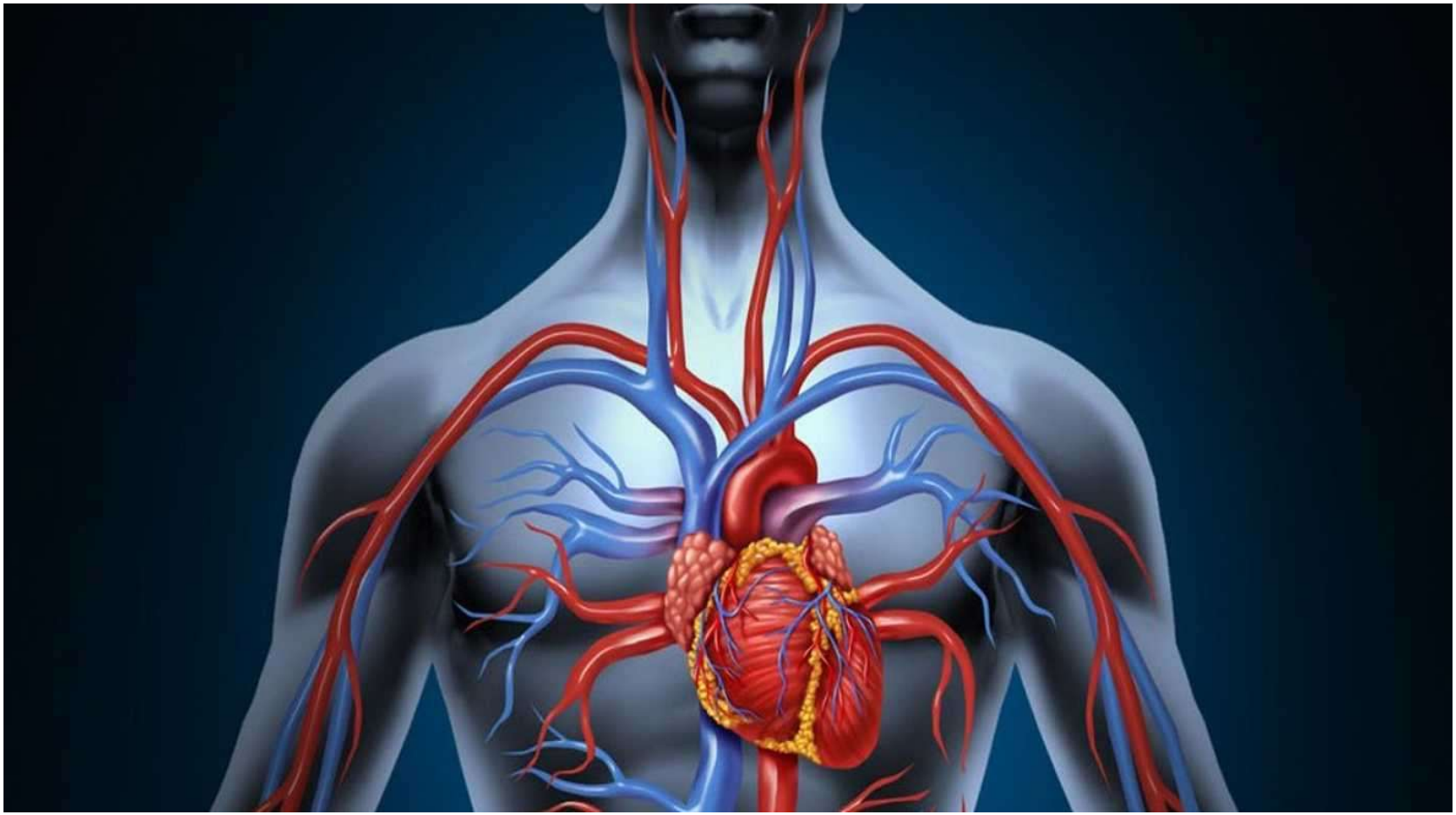
•**Immune Response:** The transport system plays a key role in the immune response by distributing white blood cells and antibodies that help fight infections and diseases.

•**Temperature Regulation:** In warm-blooded animals, the transport system helps in maintaining body temperature by distributing heat generated by metabolism and by regulating blood flow to the skin.

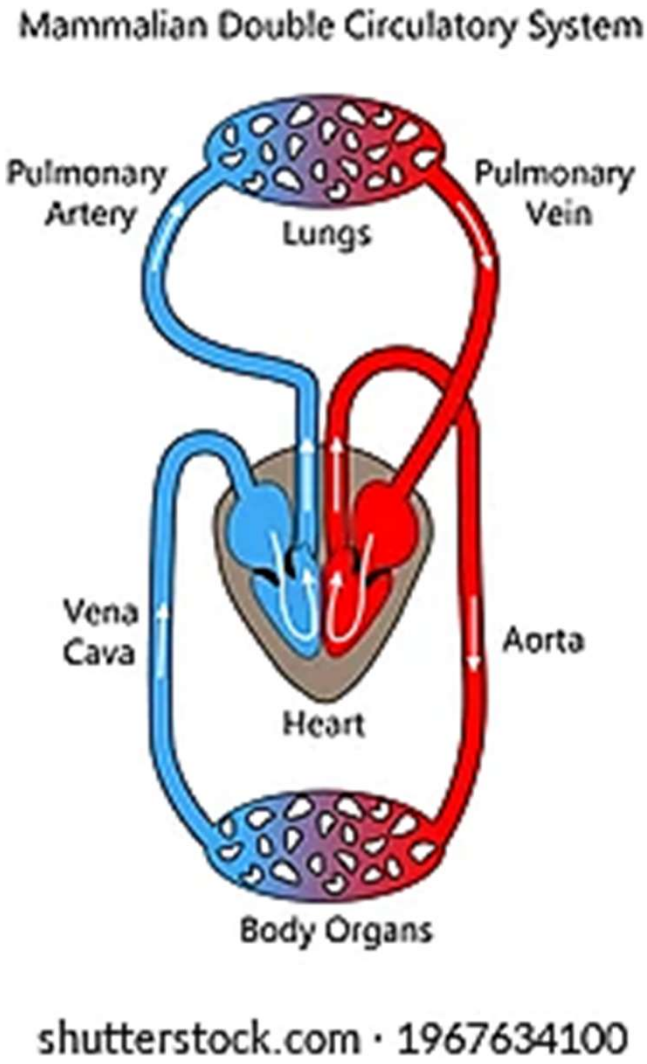
•**Maintaining Homeostasis:** Overall, the transport system is essential in maintaining the internal environment of an animal's body, keeping it stable and balanced (homeostasis)

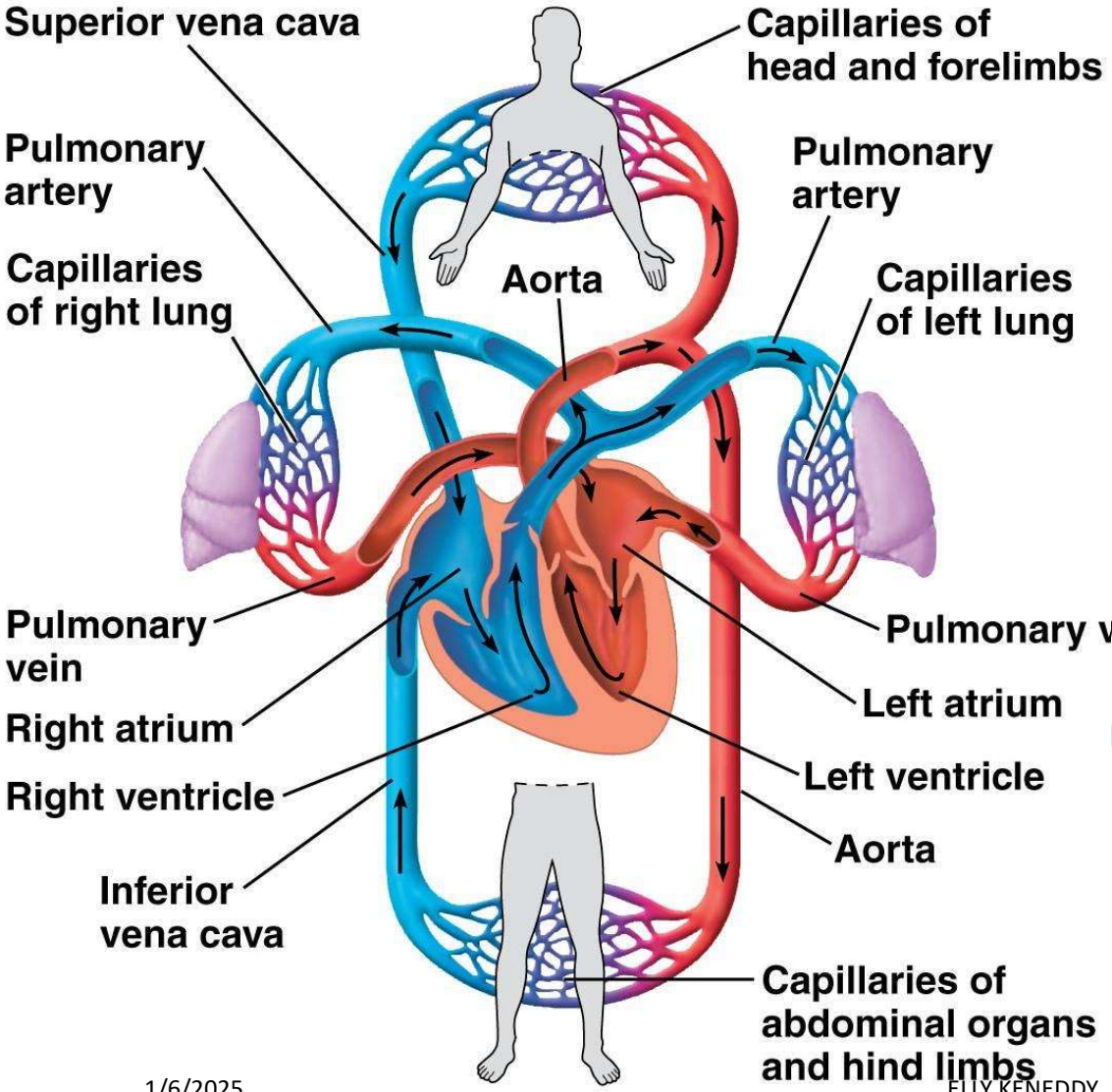
MAMMALIAN CIRCULATORY SYSTEM.

- Identify the major components of the mammalian circulatory system

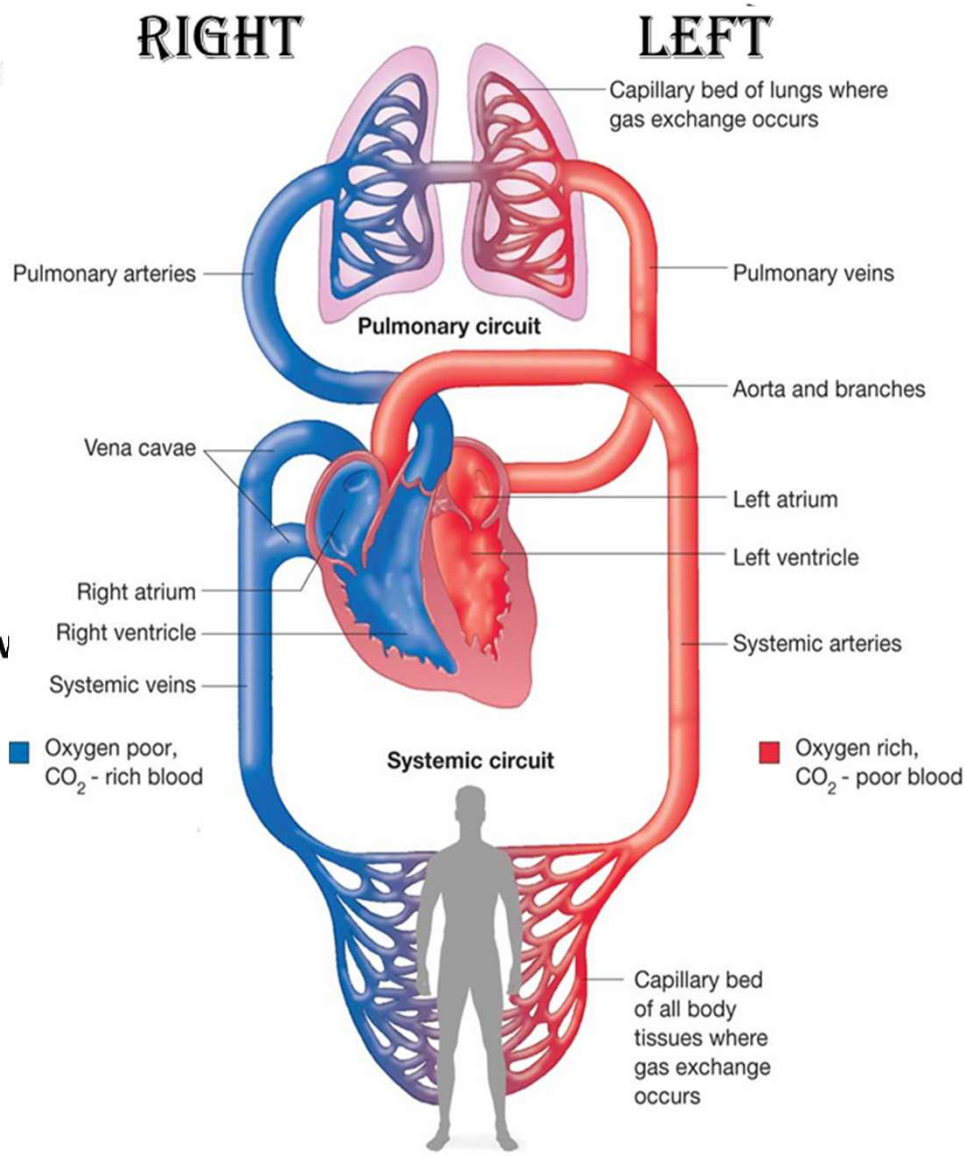


- The continual circulation of blood in mammals is due to the pumping action of the heart. The circulation of blood in mammals is divided into two. That is;
- **The pulmonary circulation**; this is the circulation of blood from the heart to the lungs and from the lungs back to the heart. It is the simplest circulation where blood moves a very short distance.
- This type of circulation involves the pulmonary artery and pulmonary vein.
- **The systemic circulation**; this is the circulation of blood from the heart to the rest of the body apart from the lungs and from the rest of the body back to the heart.

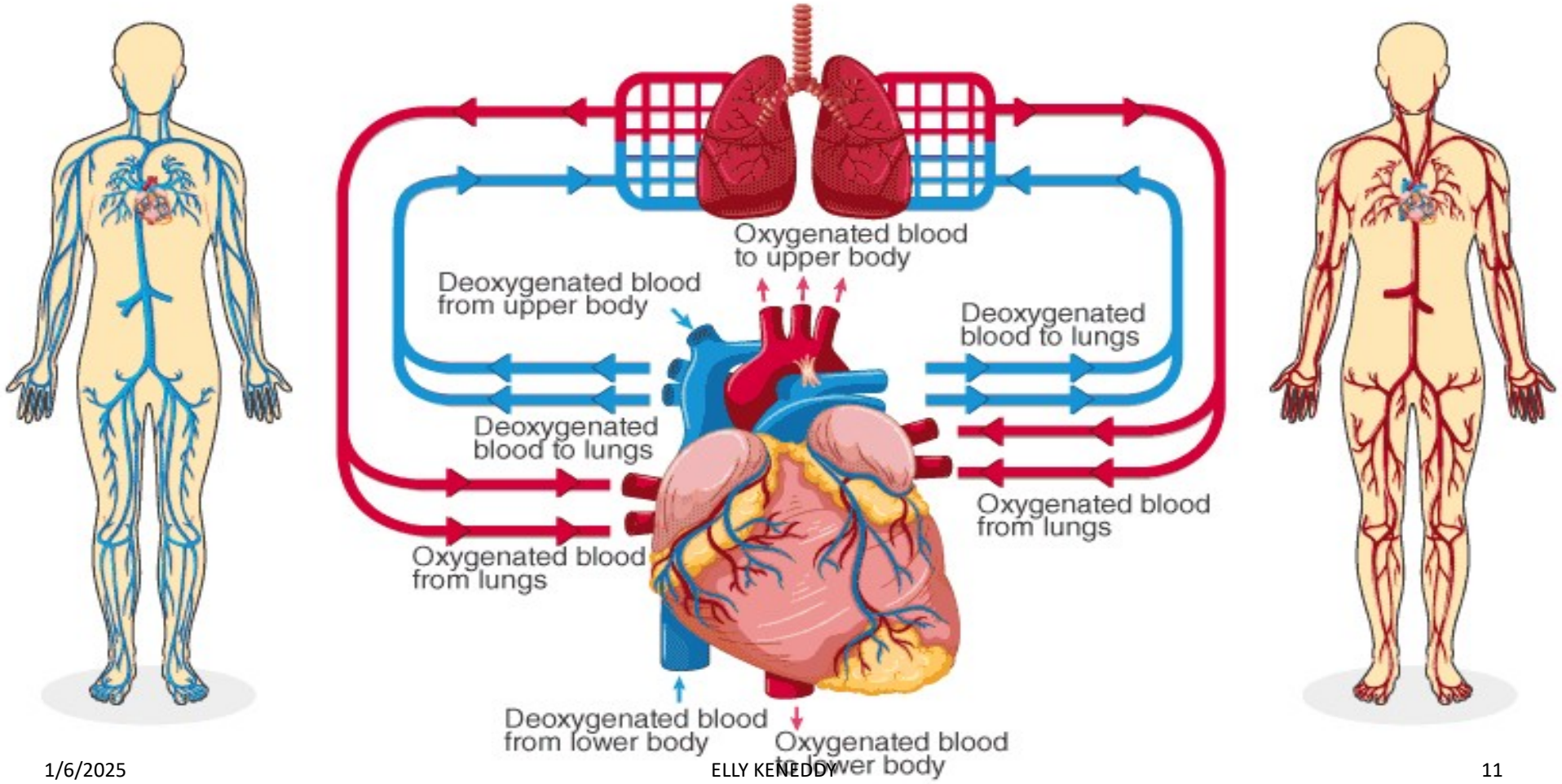




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HUMAN CIRCULATORY SYSTEM TRANSPORTATION

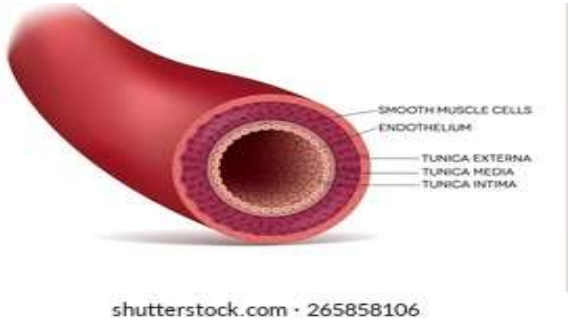


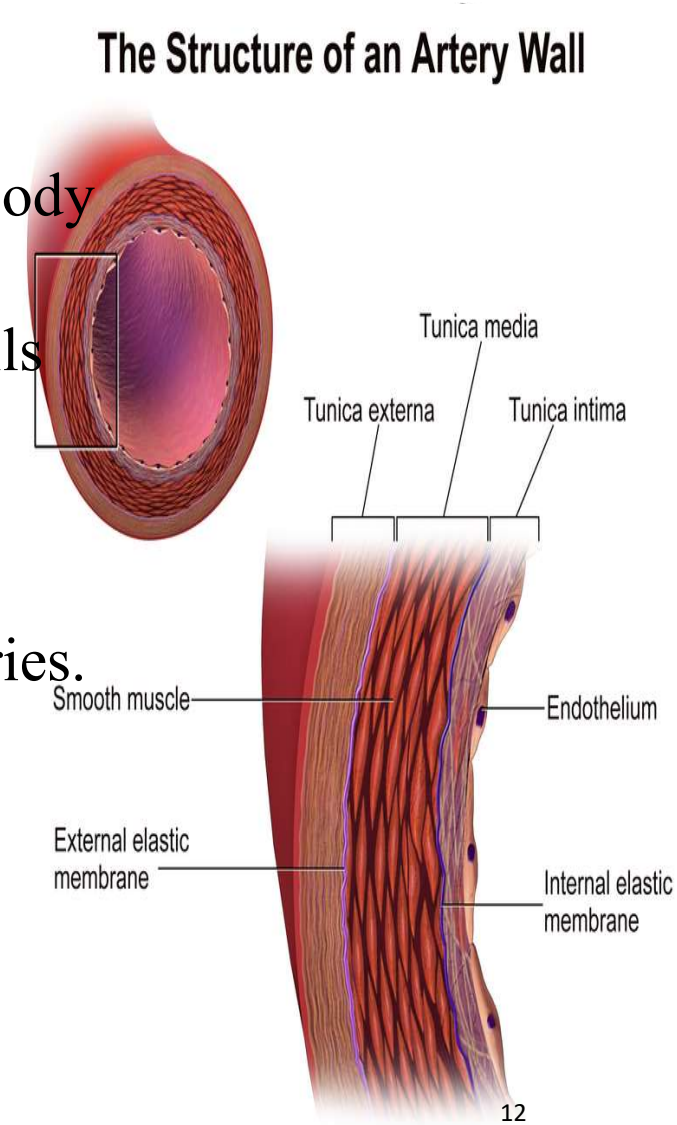
BLOOD VESSELS

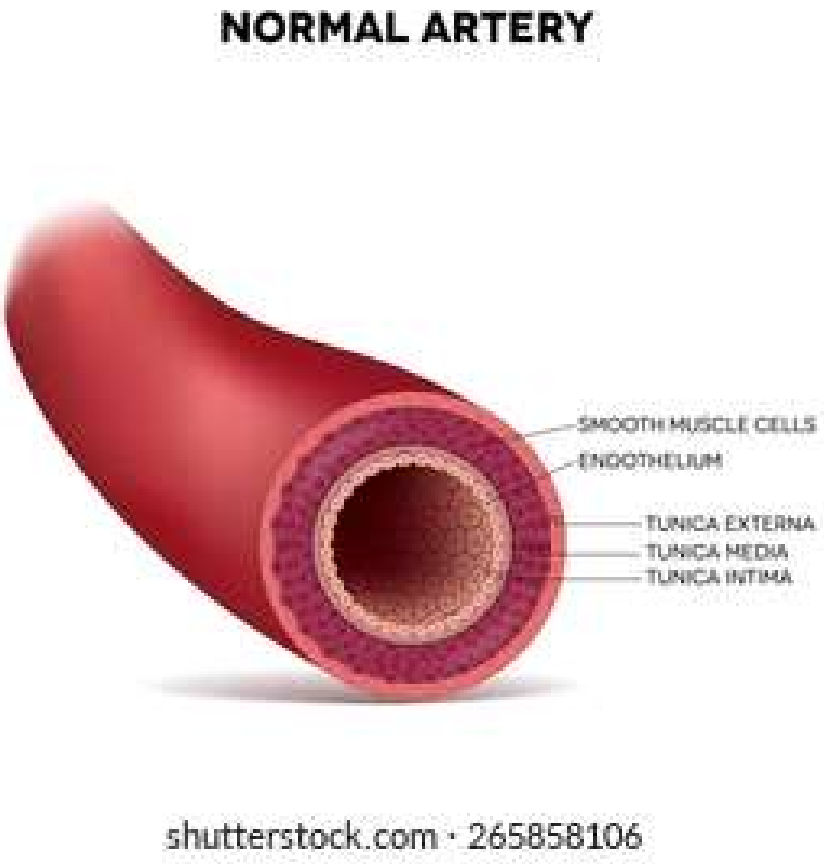
- These are the tubes that carry blood throughout the body and they include: **arteries**, **veins**, and **capillaries**
- Arteries and veins both have three layers in their walls but the layer of the muscles (elastic tissue).is much greater in arteries than in the veins.

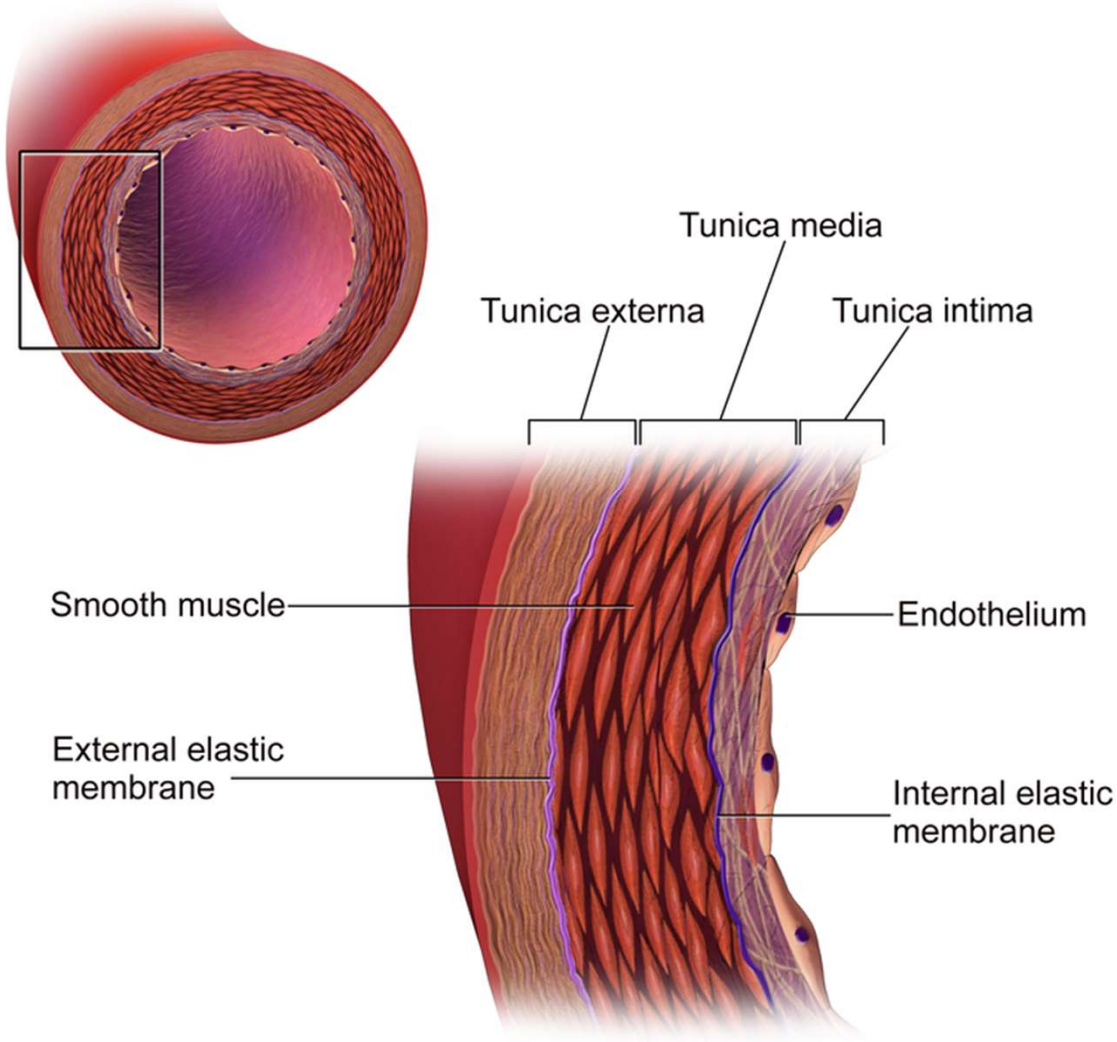
ARTERIES

- These carry blood from the heart to the body capillaries. Arteries divide into smaller vessels called arterioles which then divide repeatedly to form capillaries.



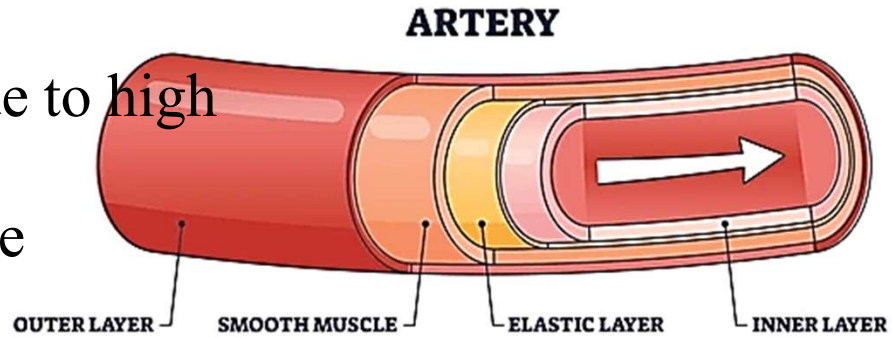


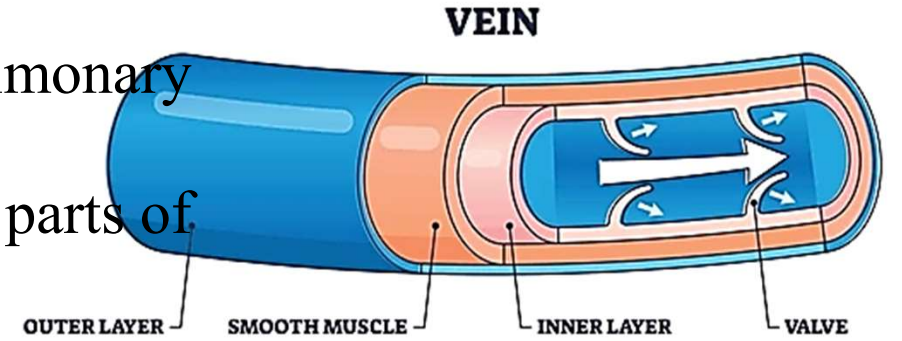

NORMAL ARTERY
SMOOTH MUSCLE CELLS
ENDOTHELIUM
TUNICA EXTERNA
TUNICA MEDIA
TUNICA INTIMA
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The Structure of an Artery Wall
Tunica media
Tunica externa
Tunica intima
Smooth muscle
Endothelium
External elastic membrane
Internal elastic membrane

CHARACTERISTICS OF ARTERIES

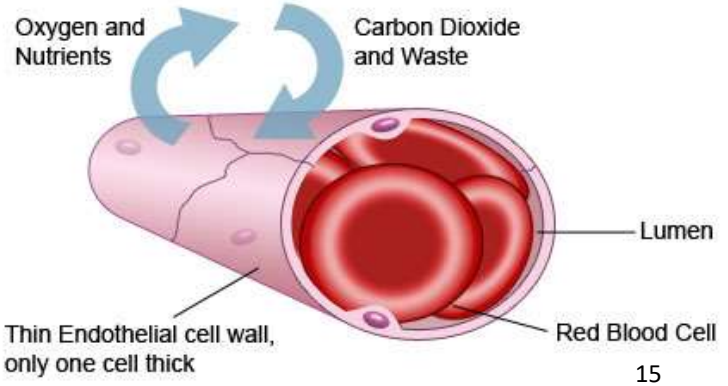
- They have fibrous outer wall so as to withstand high pressure
- Their walls are elastic to allow stretching due to high blood pressure.
- They have no valves except at the base of the pulmonary artery and aorta.
- They have narrow lumen than veins which maintains blood flow at high pressure.
- They carry oxygenated blood except the pulmonary artery and umbilical artery.
- They all carry blood from the heart to other parts of the body.
- They are found deeply in the body.





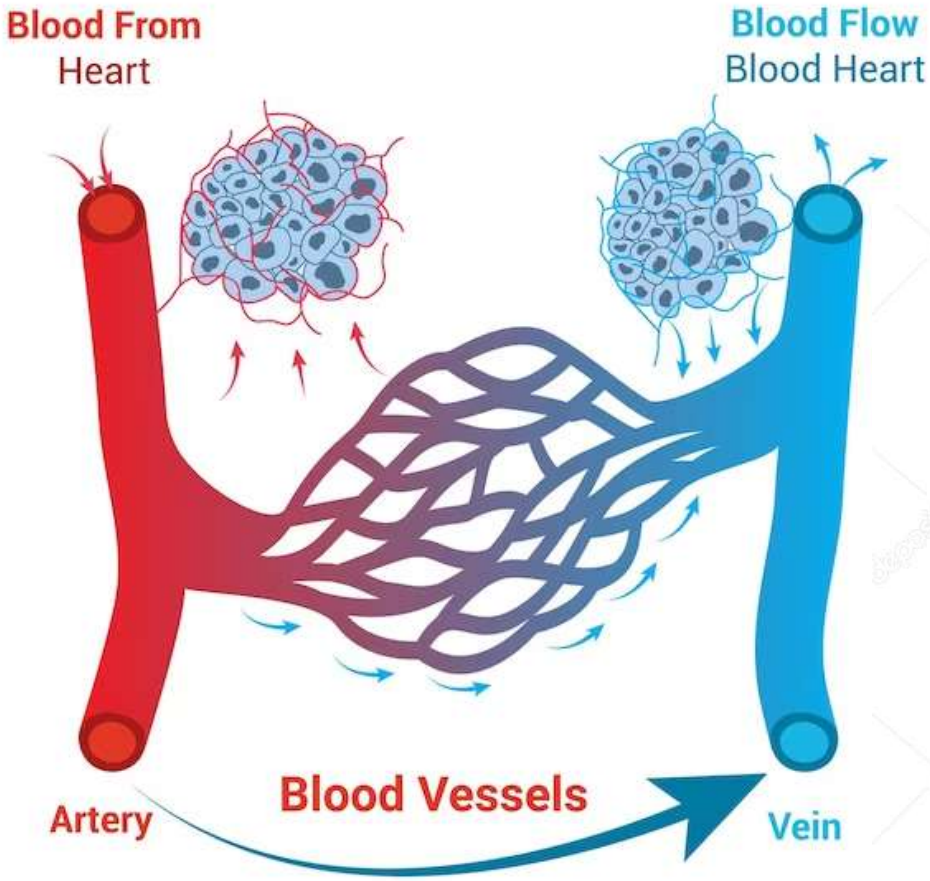
CAPILLARIES

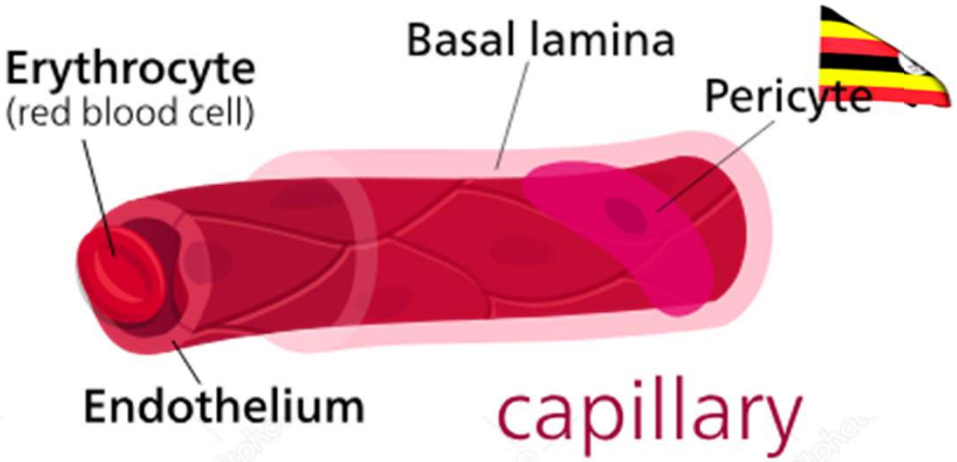
- These are **the smallest blood vessels** with **thin walls to allow diffusion of materials** between blood and the tissue fluid.
- They connect arterioles to venules.
- They pass very close to the cells taking to the cells food, oxygen, and mineral salts etc. as well as taking a way carbon dioxide, urea and other waste products from the cells.
- They are responsible for the exchange of materials between blood and cells, because their walls are permeable.
- Blood pressure reduces in them as a result of their resistance, and blood flows in them slowly without pulse.

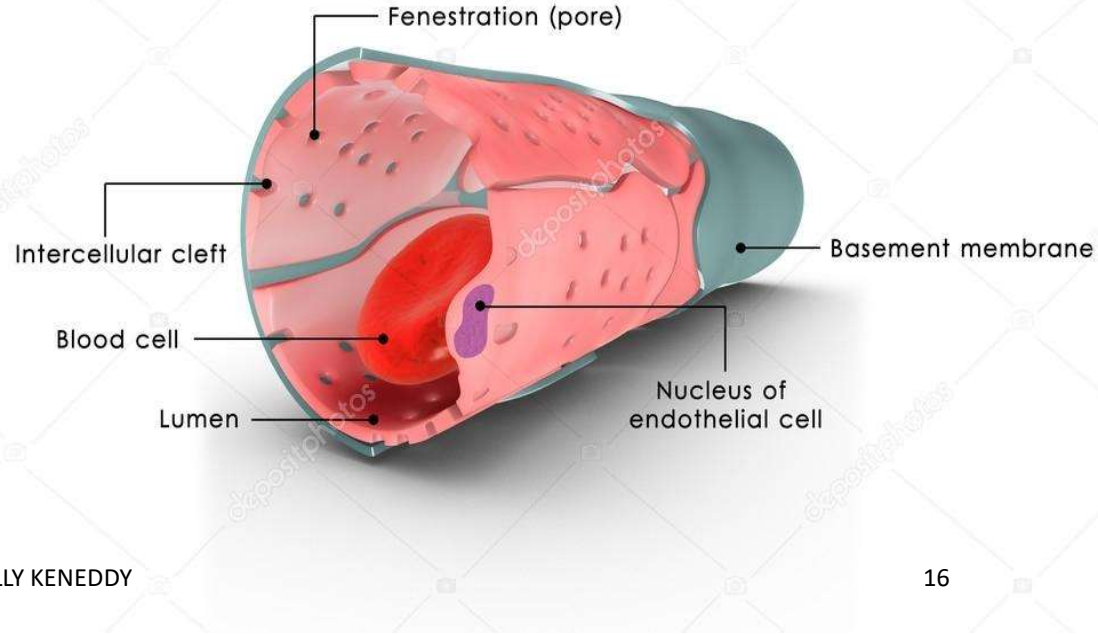


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CAPILLARIES.

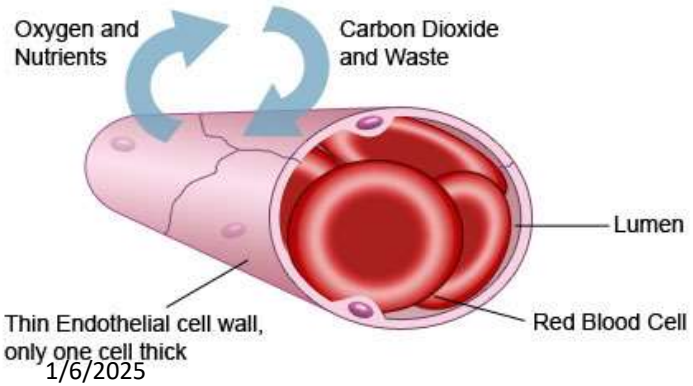


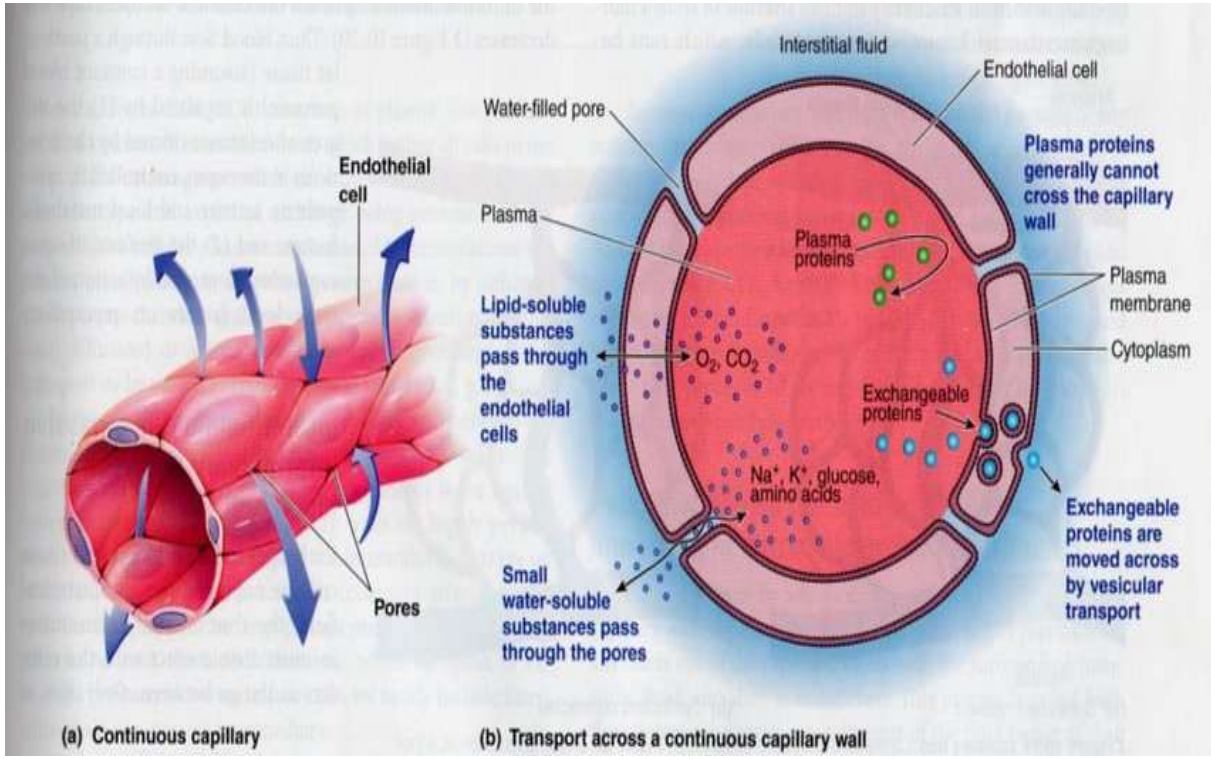




CHARACTERISTICS OF CAPILLARIES

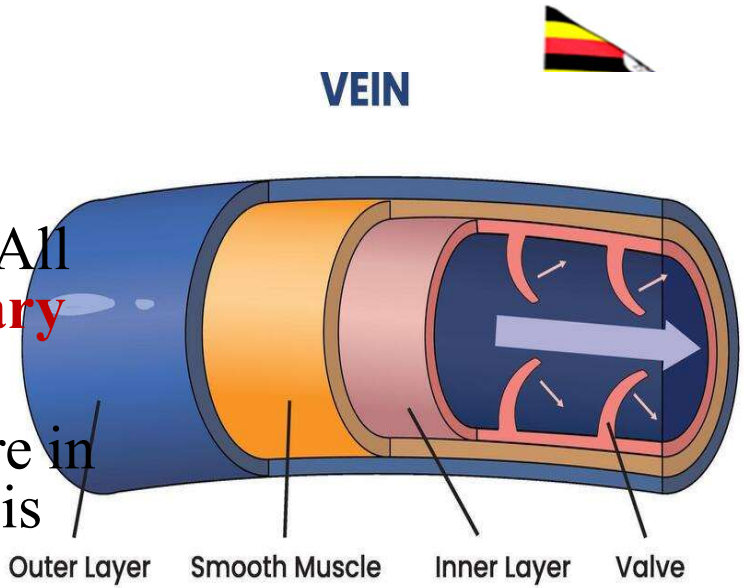
- They carry both deoxygenated and oxygenated blood.
- They have a small lumen.
- They have permeable thin walls to allow diffusion of materials.
- They have no valves.
- Blood flows slowly.
- There is a decrease in pressure.

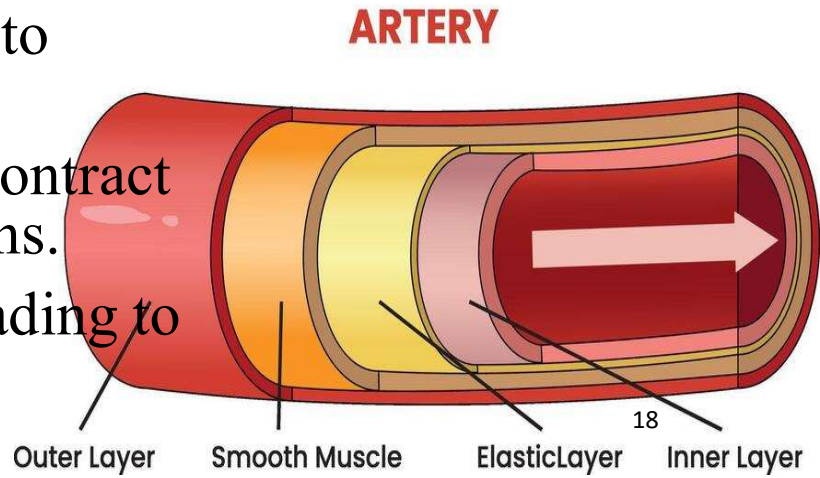


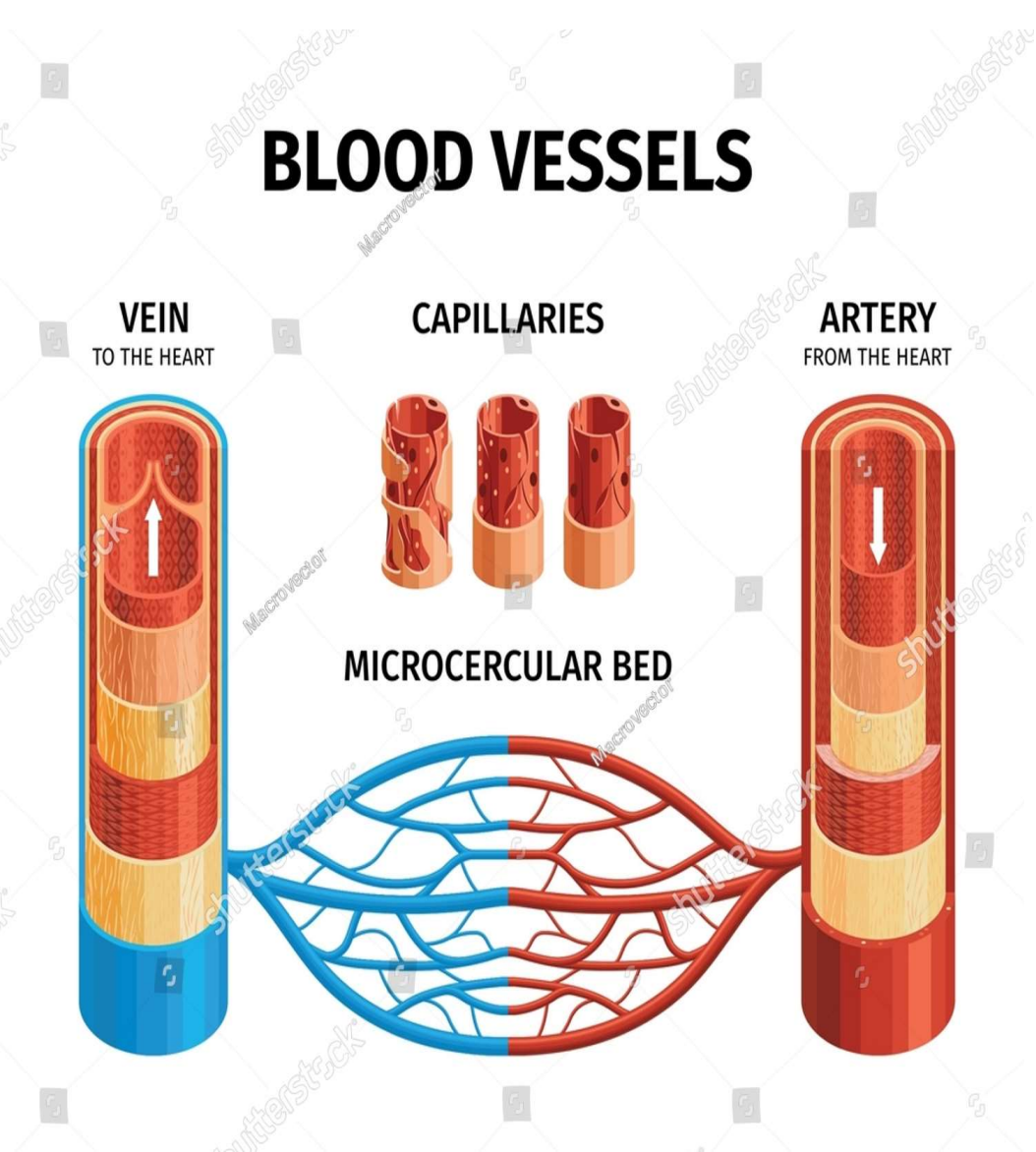


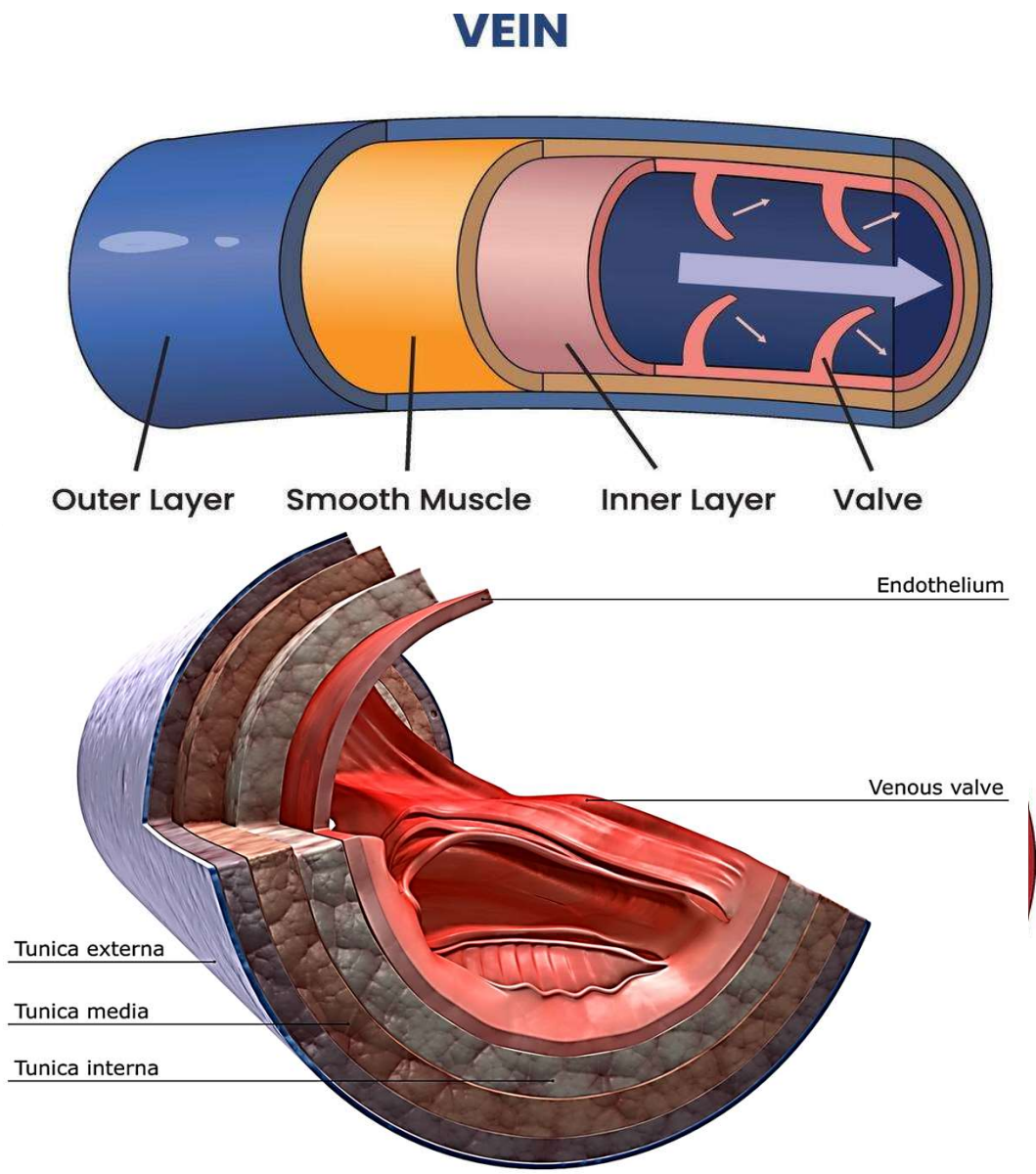
VEINS

- These carry blood from **tissues** to **the heart**. The pressure in them is steady and less than in arteries. All veins **carry de-oxygenated** blood **except pulmonary vein.**
- Blood in the veins flows slowly after losing pressure in the capillaries; however the sluggish flow of blood is maintained by:
- Possession of valves which prevent back flow.
- Having a wide lumen that offers a low resistance to blood flow.
- Action of skeletal muscles against veins as they contract during movement increases blood pressure in veins.
- Inhaling lowers the pressure in thoracic cavity leading to flow of blood towards the heart.



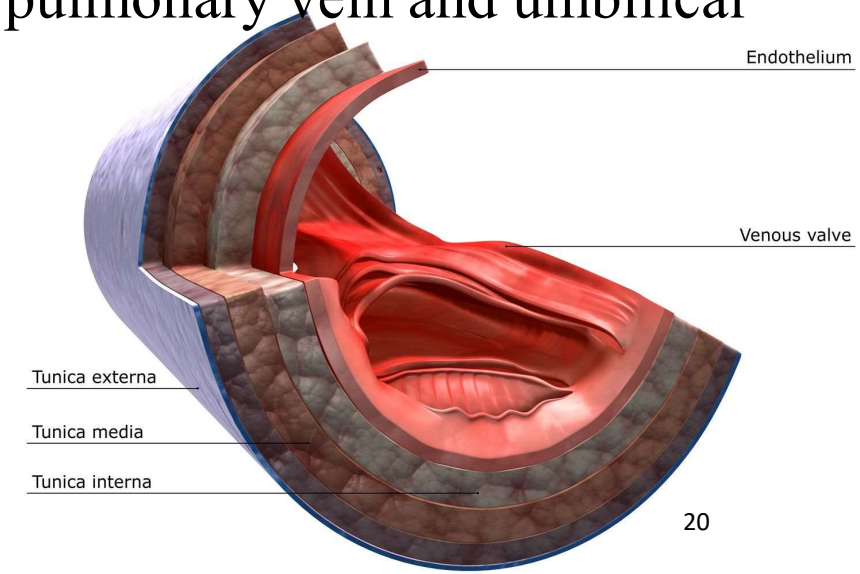



BLOOD VESSELS
VEIN
TO THE HEART
CAPILLARIES
ARTERY
FROM THE HEART
MICROCERCULAR BED


VEIN
Outer Layer
Smooth Muscle
Inner Layer
Valve
Endothelium
Venous valve
Tunica externa
Tunica media
Tunica interna

CHARACTERISTICS OF VEINS

- They have wide lumen to encourage flow of blood at low pressure.
- They have thinner walls than arteries which are adequate to withstand low pressure.
- They have valves at intervals along their length which prevent blood from flowing backwards / maintain flow of blood in one direction.
- They are not capable of constricting.
- They transport deoxygenated blood except the pulmonary vein and umbilical vein.
- They have less elastic muscles.
- They are found near the body surface.

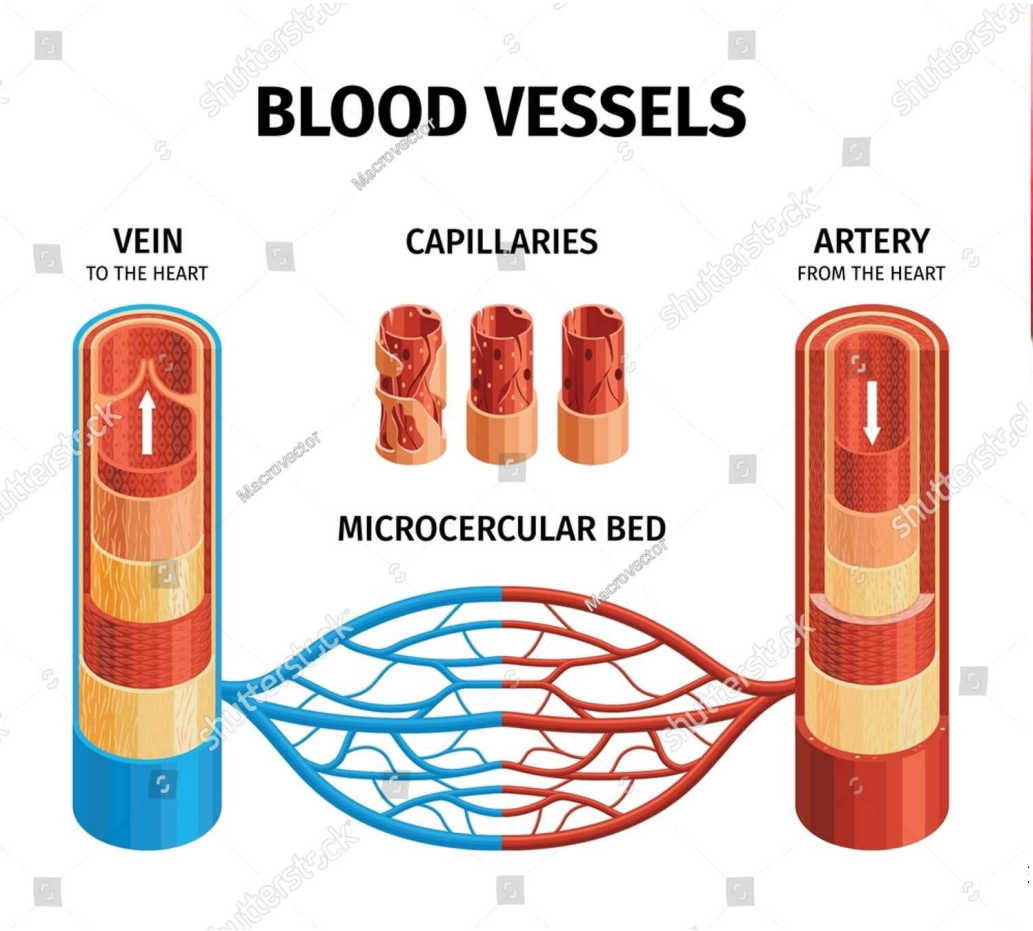


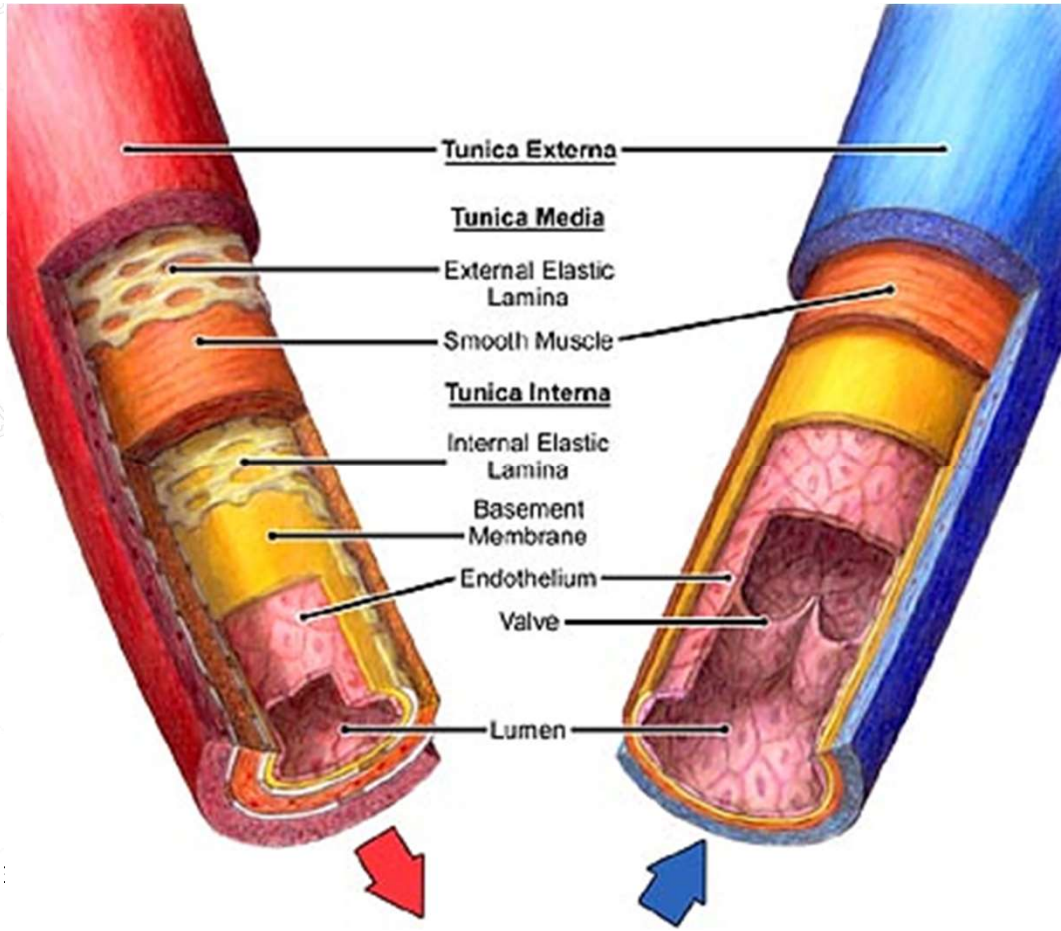
DIFFERENCES BETWEEN ARTERIES, VEINS AND CAPILLARIES



Artery	Veins	Capillaries
Have thick walls with smooth muscles	Have thin walls with smooth muscles	Have thinner walls with smooth muscles
have more elastic fibres	Have few elastic fibres	Do not have elastic fibres
Have smaller lumen relative to diameter	Have a wider lumen relative to diameter	Have largest lumen relative diameter
Have no valves except at the base of aorta	Have valves throughout their length	Have no valves
Can constrict	Can't constrict	Can't constrict
Walls not permeable	Walls not permeable	Walls permeable

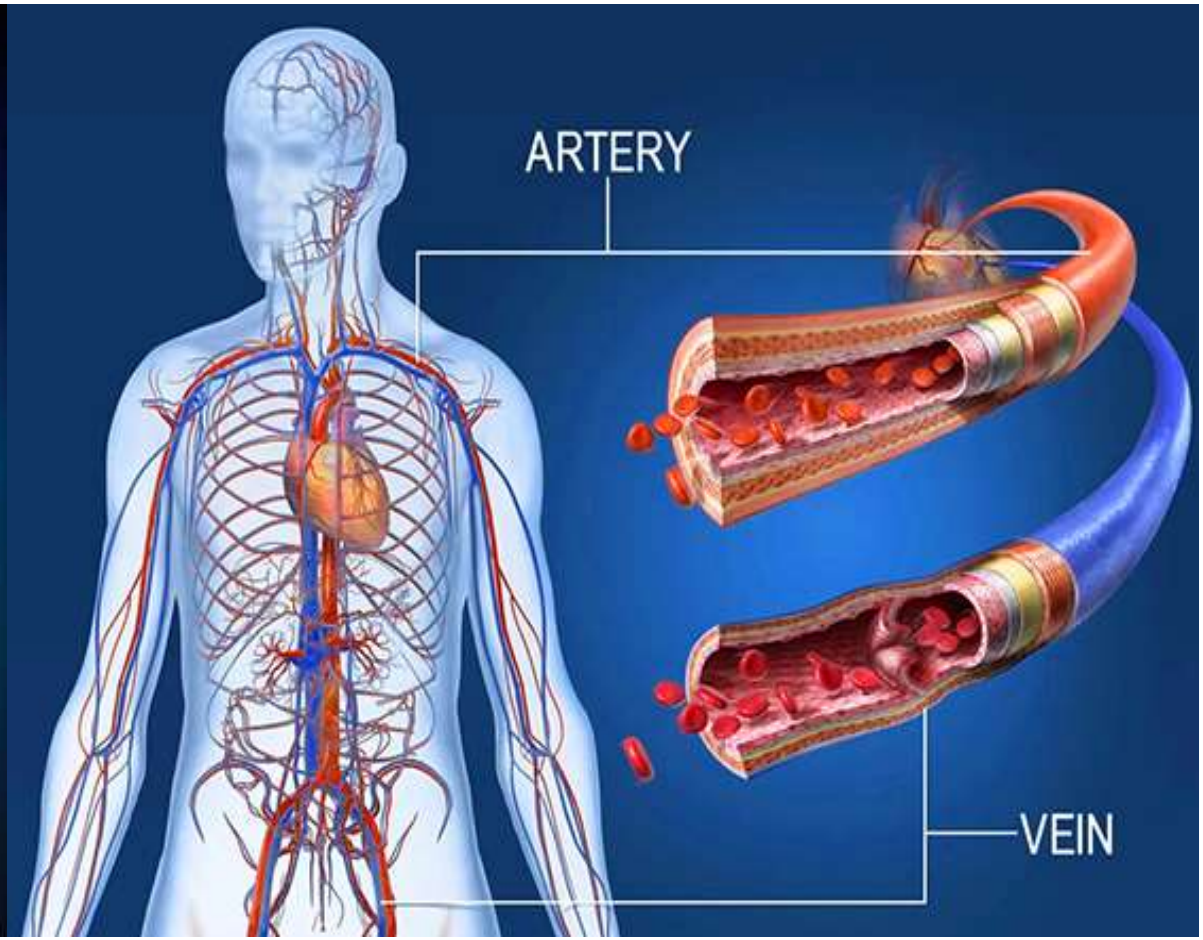
COMPARISION OF STRUCTURE





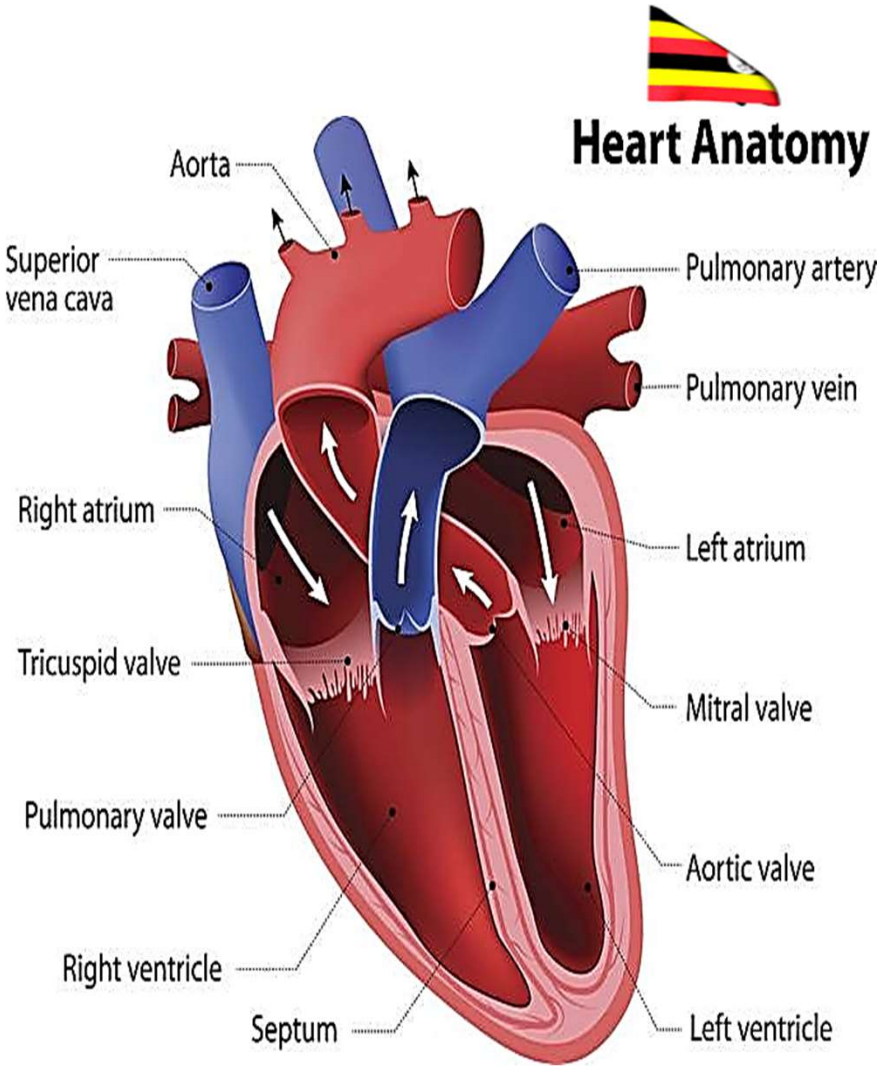
DISTRIBUTION OF ARTERIES AND VEINS

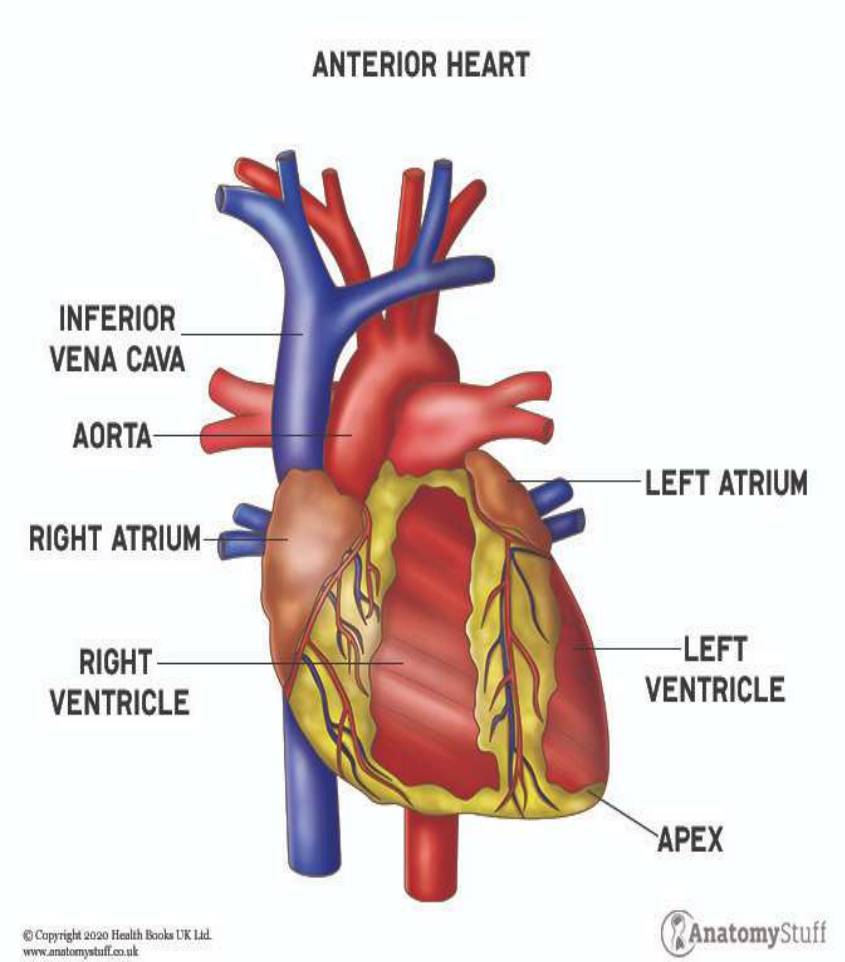


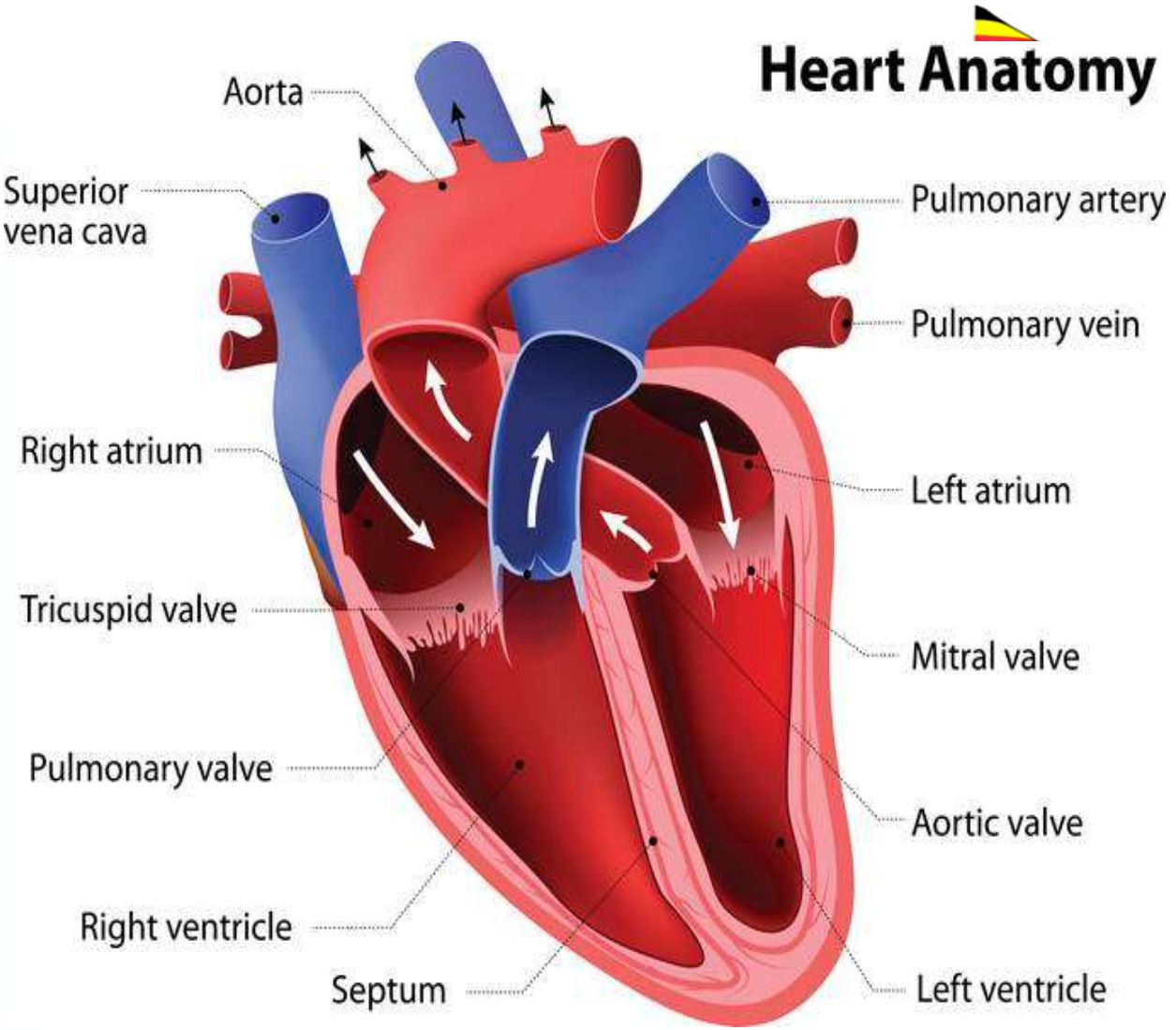


THE MAMMALIAN HEART

- Its function is to pump blood around the body.
- The whole heart is surrounded by the **pericardium** which has two layers between which is the pericardial fluid that reduce friction between them.
- The heart is made of tissues called which have the potential to contract rapidly. **cardiac muscles**
- It's divided in to **four** chambers. The **upper** chambers are called **atrium / auricle** and the **lower chambers** are each called **ventricle**.
- The heart is divided in to sections i.e. left and right by a muscular septum whose function is to prevent mixing of oxygenated and deoxygenated blood




ANTERIOR HEART
INFERIOR VENA CAVA
AORTA
RIGHT ATRIUM
RIGHT VENTRICLE
LEFT ATRIUM
LEFT VENTRICLE
APEX
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Heart Anatomy
Aorta
Superior vena cava
Pulmonary artery
Pulmonary vein
Right atrium
Left atrium
Tricuspid valve
Mitral valve
Pulmonary valve
Aortic valve
Right ventricle
Septum
Left ventricle

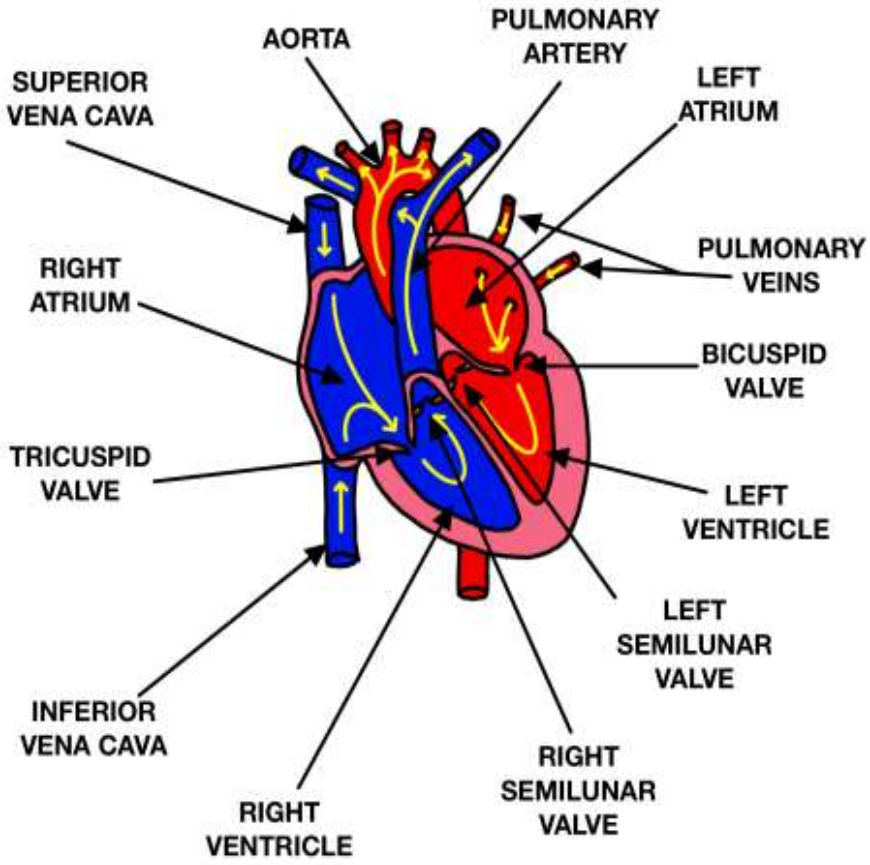
CONT.....



- Movement of blood in the heart is maintained in a single direction i.e. from the auricle to ventricle and then to blood vessels.
- Blood flow in one direction in the heart is maintained by the presence of **valves** ie tricuspid and bicuspid valves and semilunar valves.
- The auricles receive blood from all parts of the body while the ventricles pump blood to the body
- The ventricle walls are more **muscular** (have thicker walls) than those or the auricles because the **auricle pump blood to shorter distance** i.e. to the ventricle while the **ventricles pump blood longer distances i.e. to body and lungs.**
- The walls of the left ventricle that pump blood in to the systemic circulation are thicker than those of the right ventricle which pump blood to pulmonary circulation.

FLOW OF BLOOD THROUGH THE HEART

- Blood flows in to the heart from the rest of the body via the vena cava to the right atrium which pumps it to the right ventricle via the tricuspid valve.
- The right ventricle pumps blood to the pulmonary artery to the lungs.
- Blood flows back to the left atrium via the pulmonary vein which pumps it to the left ventricle via the bicuspid valve
- Then finally pumped to the rest of the body via the aorta.



CARDIAC CYCLE.

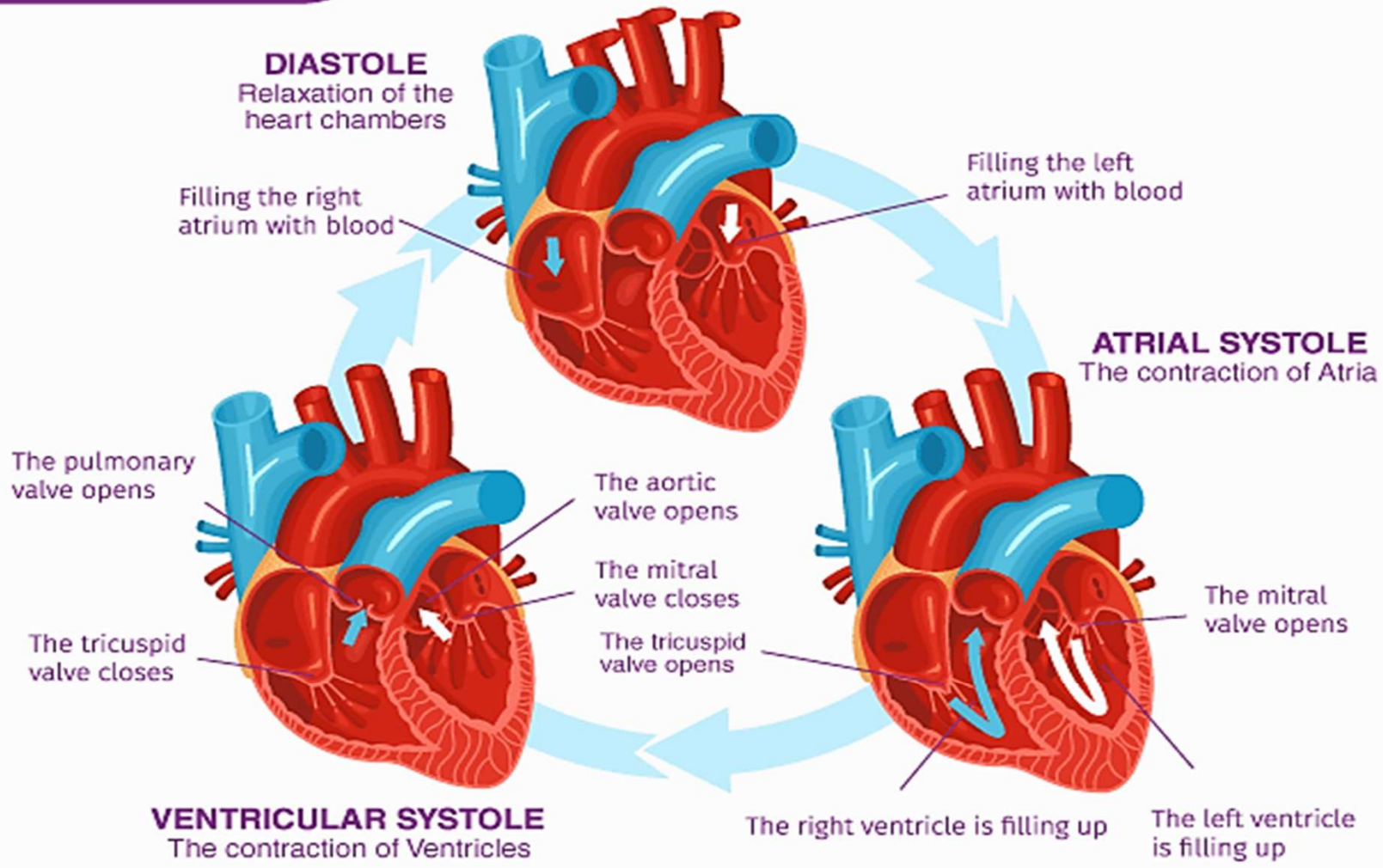


This refers to the sequence of events by which the heart pumps and is refilled with blood. The cardiac cycle involves two phases:

- ➢Re-filling of the heart with blood
- ➢Pumping of blood

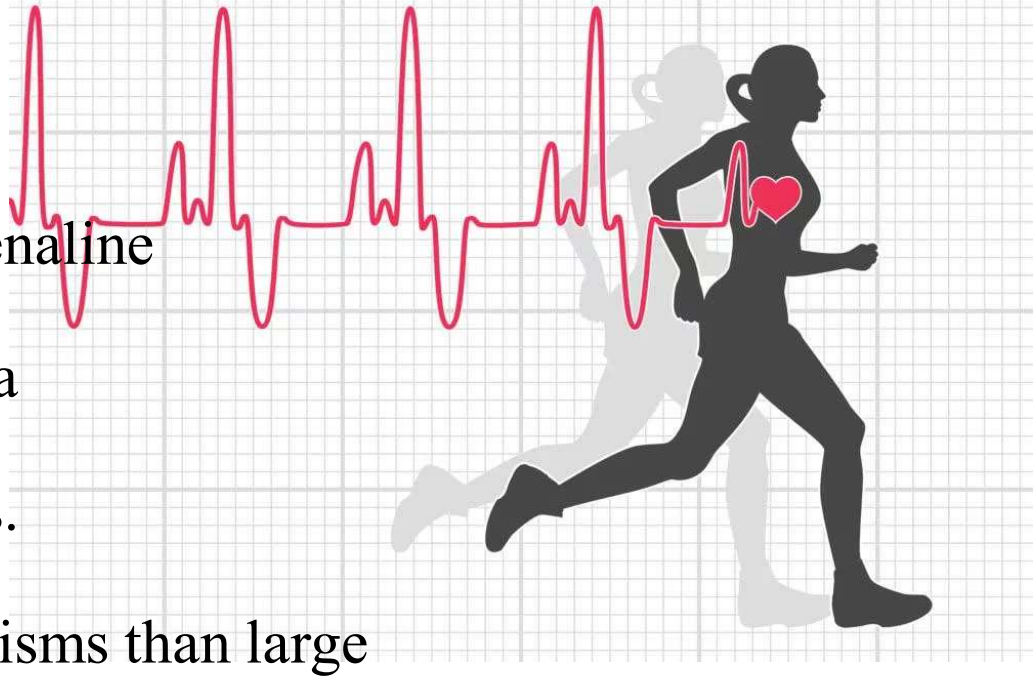
- The pumping action of the heart consists of alternate contraction and relaxation of cardiac muscles in the walls of the heart.
- **Contraction** of cardiac muscles is called **systole** while **relaxation** is called **diastole**.
- **During diastole**, the cardiac muscles in the walls of the **atria relax and expand**; blood from the vena cava and pulmonary vein enter the atria and becomes filled with blood.
- The walls of the ventricles relax and expand while those of the atria contract, forcing blood from the atria into ventricles via **bicuspid and tricuspid** valves as **semilunar** valves remain **closed**.

CARDIAC CYCLE



- **During systole**, cardiac muscles of the ventricles contract, forcing blood out of the heart via the semi lunar valves into the aorta and pulmonary artery.
- At this time, the atria relax and expand in order to be re-filled with blood. The cuspid valves close against high blood pressure to prevent the back flow of blood into the auricles.
- The closure of the valves produces the heart sound termed as '**lub**'.
- After expelling blood, ventricles relax and their pressure lowers compared to aorta and pulmonary artery pressure.
- This would cause back flow of blood to the heart but is prevented by sudden **closure of the semi lunar valves**. The closure of the semi lunar valves causes a second heart sound called '**dub**'.
- The 2 sounds 'lub' and 'dub' are so close and often described as 'lub-dub' and they form a single heartbeat.

FACTORS AFFECTING THE HEART BEAT RATE



- Exercise.
- Lack of hormones in the body e.g. adrenaline
- State of health and diseases e.g. malaria
- Age i.e. it's faster in infants than adults.
- Body size i.e. it is faster in small organisms than large
- Sex i.e. faster in female than in male.

NB: In normal adults at rest, heart contracts about 70 to 72 times per minute.

BLOOD PRESSURE



- This is the force with which blood flows from one part of the body to another. The blood pressure is due to the pumping action of the heart as experienced by the blood vessels.
- The narrow blood vessels experience high blood pressure and wide vessels experience low blood pressure. Sometimes fats accumulate in the blood vessels making their rumens narrow.
- This increases blood pressure and it is the major cause of high blood pressure in fat people, however small people also experience high blood pressure. This is due to conditions like stress, anxiety, fear, etc.
- These conditions tend to increase the rate of heartbeat and more blood is pumped to the blood vessels causing high pressure in them.

BLOOD



- Blood is a connective tissue made up of cells suspended in a fluid matrix called plasma. There are two types of cells in blood i.e. White blood cells (leucocytes) and red blood cells (erythrocytes).
- The platelets (thrombocytes) are fragments of cells.
- In an adult human being, there are five to six liters of blood with blood making up approximately 10% of the body weight.

Main components of blood

- ➢Red blood cells/erythrocytes
- ➢White blood cells/leucocytes
- ➢Platelets/thrombocytes
- ➢Plasma

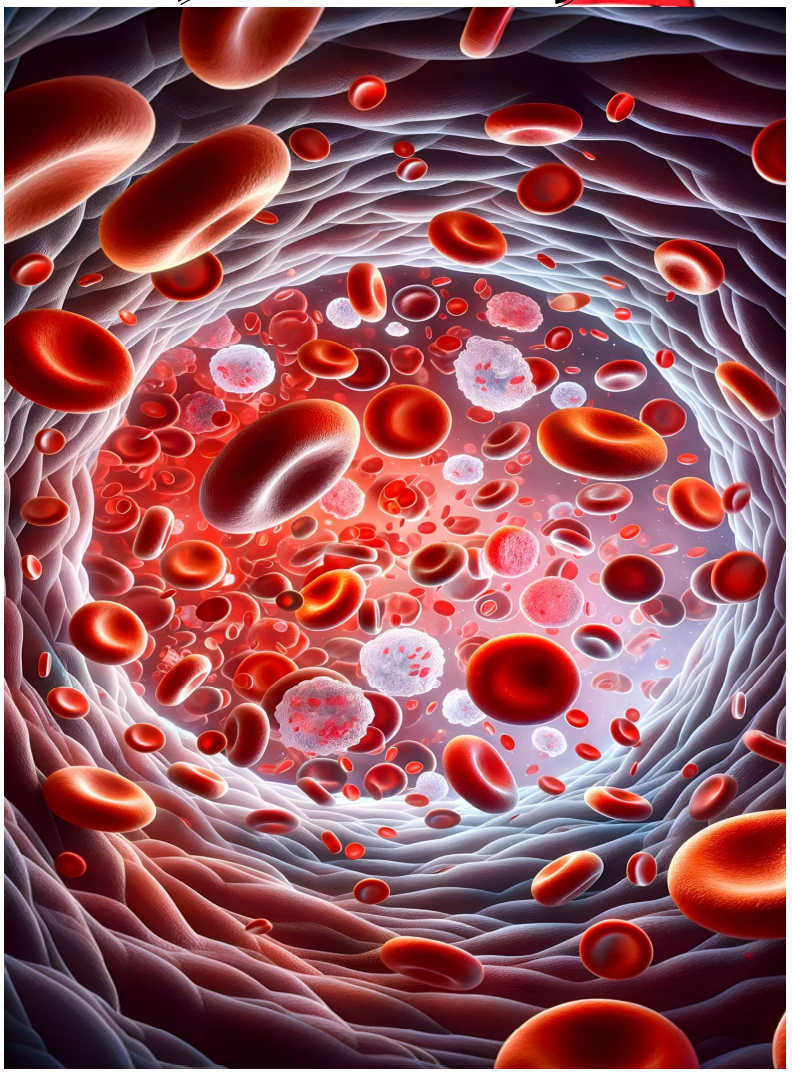


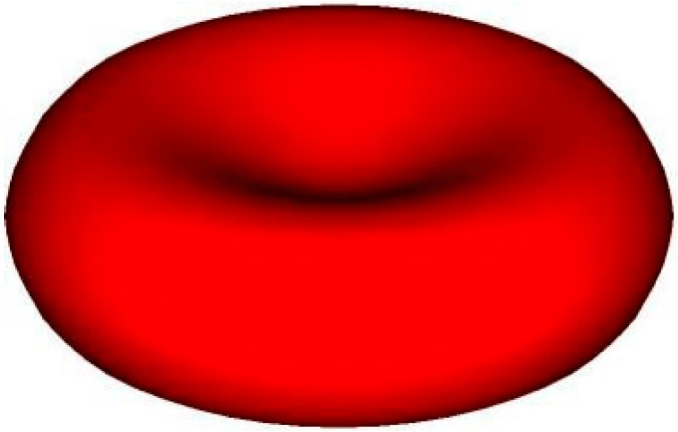
GENERAL IMPORTANCE OF BLOOD IN THE BODIES OF ANIMALS

- It transports oxygen from the lungs to all parts of the body.
- It transports digested food from the ileum to other parts of the body for use.
- It transports Carbon dioxide from the tissues to the lungs.
- It transports nitrogenous wastes from the liver to the kidney where they are excreted.
- It transports hormones from their site of production to where they perform their functions.
- It distributes heat and aids in temperature control.
- It prevents infection by transportation of white blood cells.

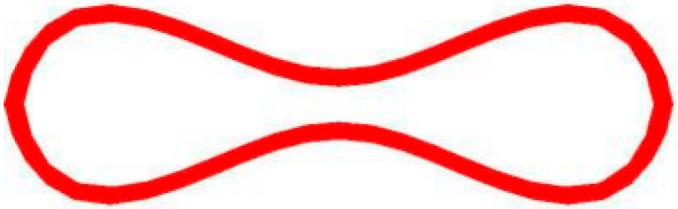
THE RED BLOOD CELLS (ERYTHROCYTES)

- They have hemoglobin molecules which carry oxygen from the lungs to the tissues.
- They lack nuclei
- They have thin cell membranes that reduces the diffusion distance for gases.
- They are manufactured from the red bone marrow.
- On average, red blood cells last for four month after which they are destroyed by the liver to form bile pigment.
- They have a biconcave disk shape

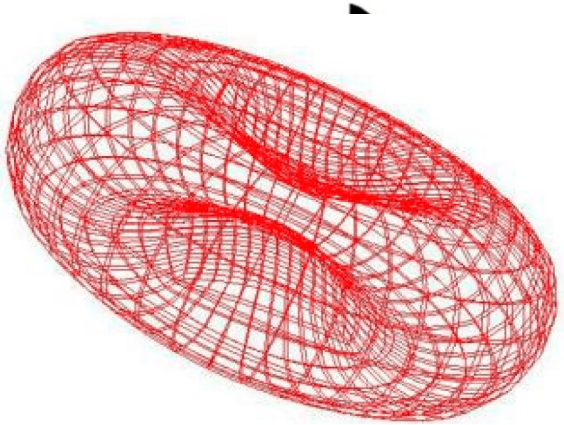




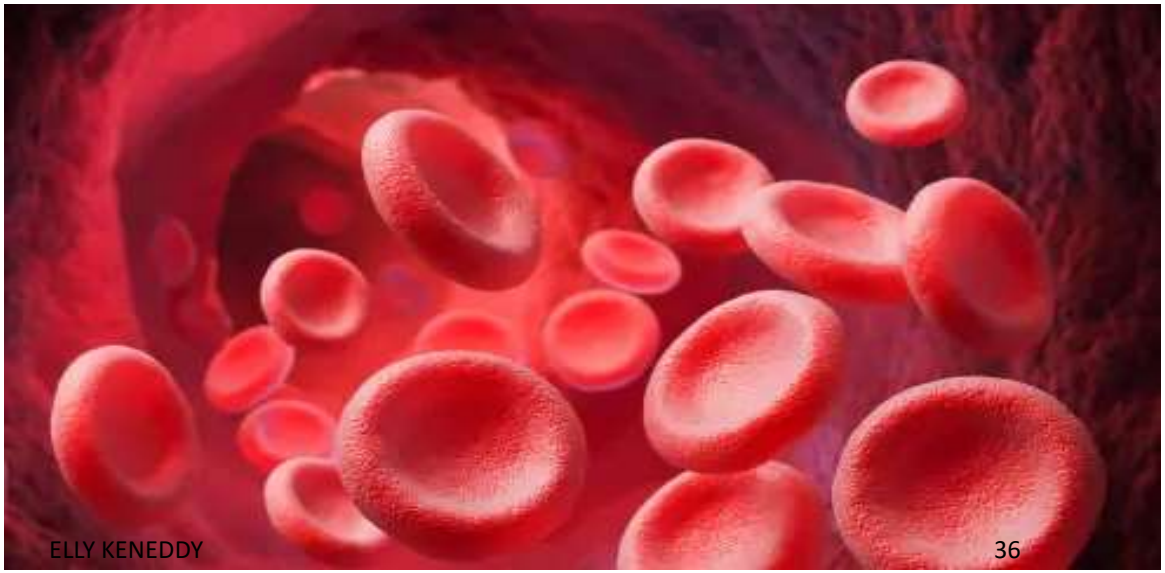
(**a**) 3D RBC model



(**b**) Cross section



(**c**) Surface mesh



Importance of Red Blood Cells



- They transport oxygen from gaseous exchange surfaces to the tissues
- They transport carbon dioxide from tissues to the gaseous exchange surfaces.

Adaptation of Red Blood Cells to carry out their function

- They are biconcave in shape so as to avail a large surface area to volume ratio for absorption of oxygen.
- They have hemoglobin molecules that bind to oxygen and transport it from the lungs to the tissues.
- They have a thin membrane which reduces the diffusion distance for the respiratory gases in and out of the cells.
- They lack nuclei which provides enough space for packaging of haemoglobin
- They lack mitochondria and generate their ATP exclusively by anaerobic respiration to prevent them from using the oxygen they are carrying.
- They are numerous per mm3 to increase surface area for transportation of oxygen
- They have flexible membranes which make them able to squeeze through capillary networks as they exchange materials they transport with the surrounding tissues.

THE WHITE BLOOD CELLS (LEUCOCYTES)

- These are blood cells made from the white bone marrow of long bones. They are also made in the spleen and lymphatic system.
- They are responsible for defense of the body against infection. They are fewer in blood than the red blood cells.

Characteristics of white blood cells

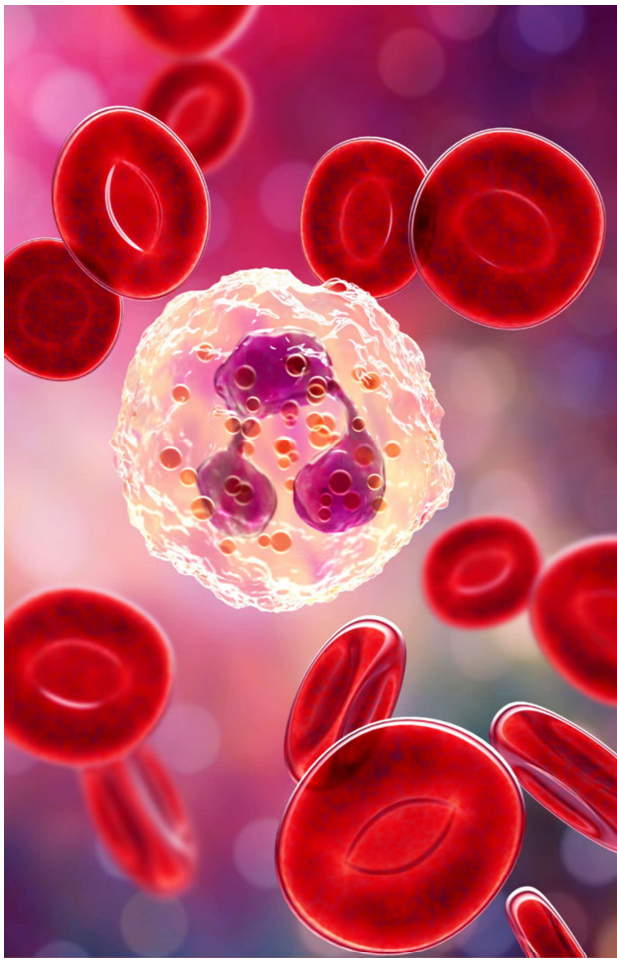
✓They have no definite shape (they are amoeboid)

✓They have a nucleus even at maturity.

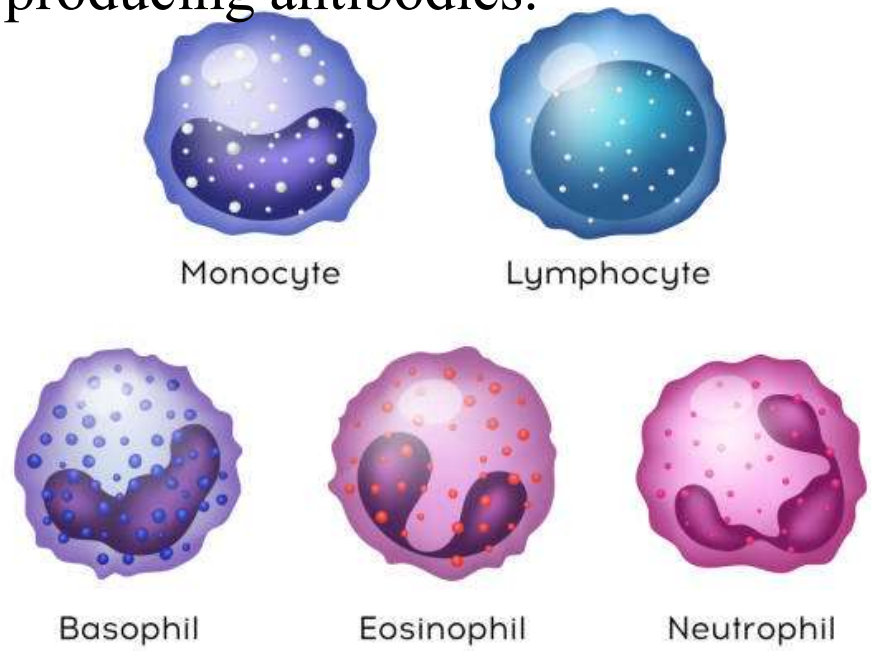
✓They are relatively few in blood but their number increases when the body is attached by an infection.

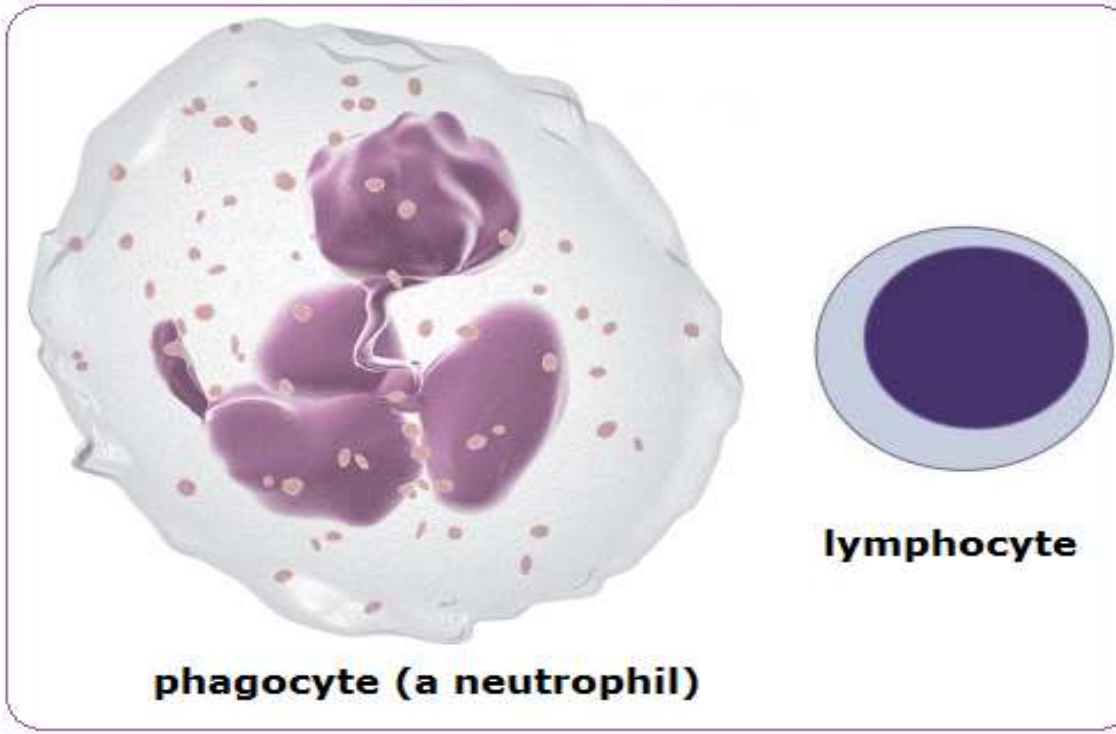
✓They lack haemoglobin.

✓They feed on foreign particles by Phagocytes



- White blood cells are divided into two major categories. These are;
- **Phagocytes**: These are white blood cells with a lobed nucleus. They ingest and destroy germs by phagocytes.
- **Lymphocytes**: These are white blood cells, which defend the body by producing antibodies.



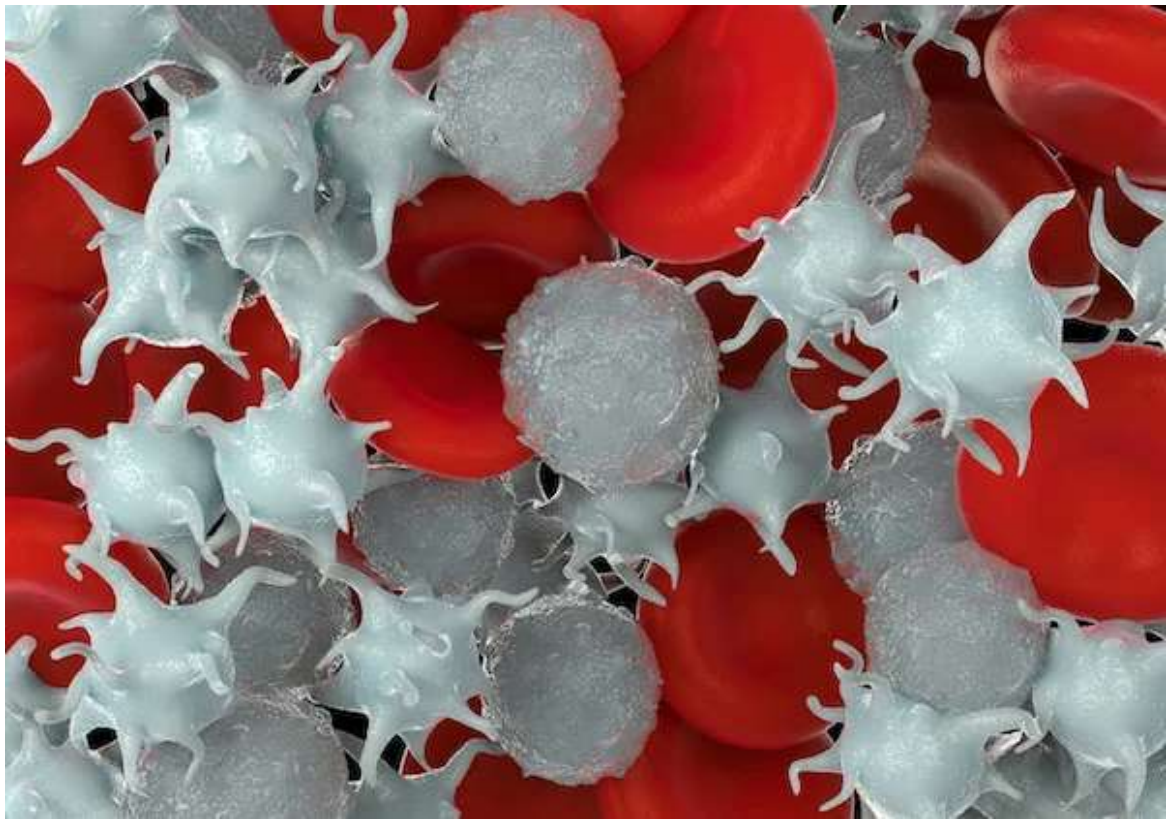


THE PLATELETS (THROMBOCYTES)

These are blood cells formed as fragments in the bone marrows during the formation of red blood cells. They are responsible for blood clotting.

Characteristics of platelets

- ❑They are cell fragments.
- ❑They are spherical in shape.
- ❑They do not have a nucleus.
- ❑They do not have haemoglobin.



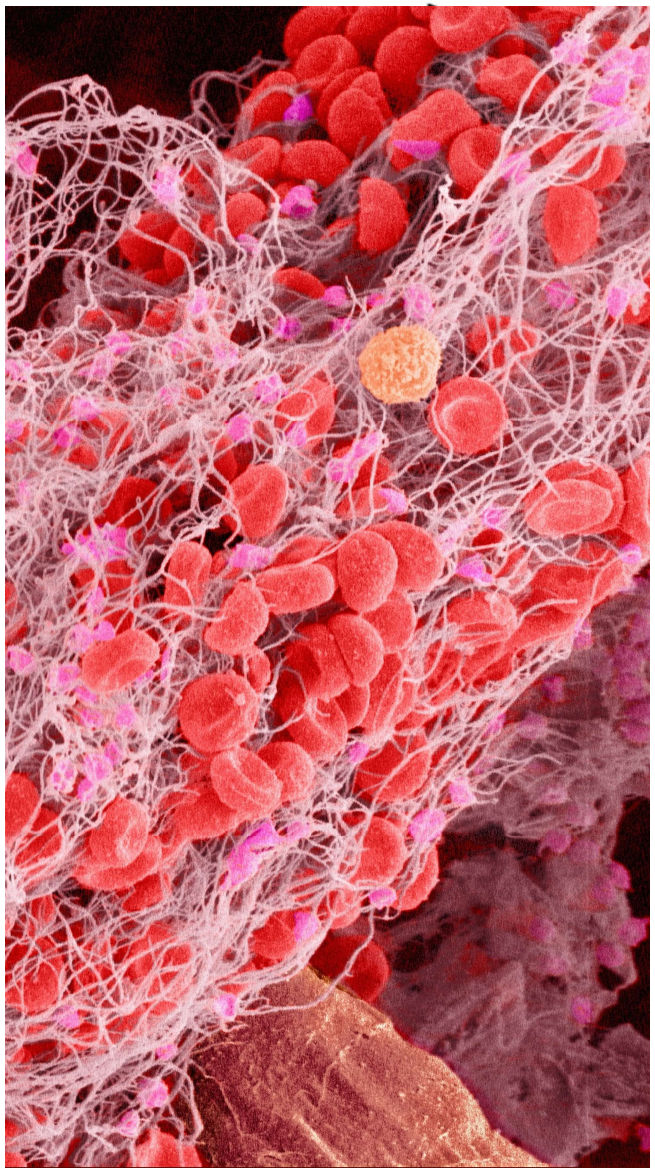
FUNCTIONS OF PLATELETS

- They play a role in blood clotting which protects the body against excessive loss of blood and entry of pathogens through the injured part. Blood clotting is the process by which blood stops oozing out of a cut or wound. It is important because of the following reasons.

❑It prevents excessive loss of blood from the body.

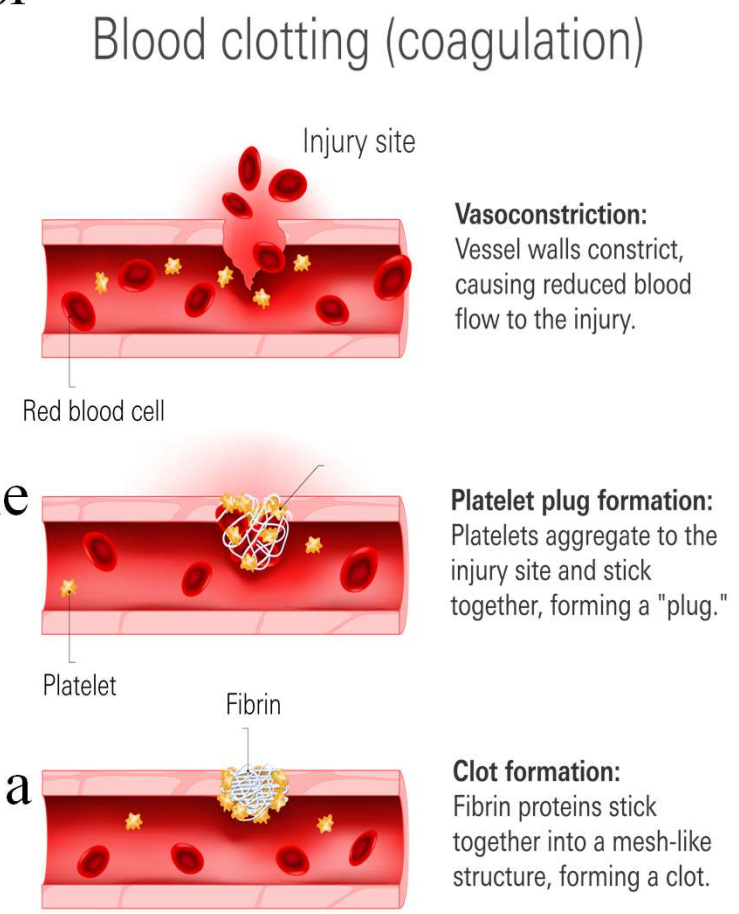
❑It is a step towards healing of cuts and wounds.

❑The blood clot creates a barrier to prevent entry of bacteria and other pathogens in the body.

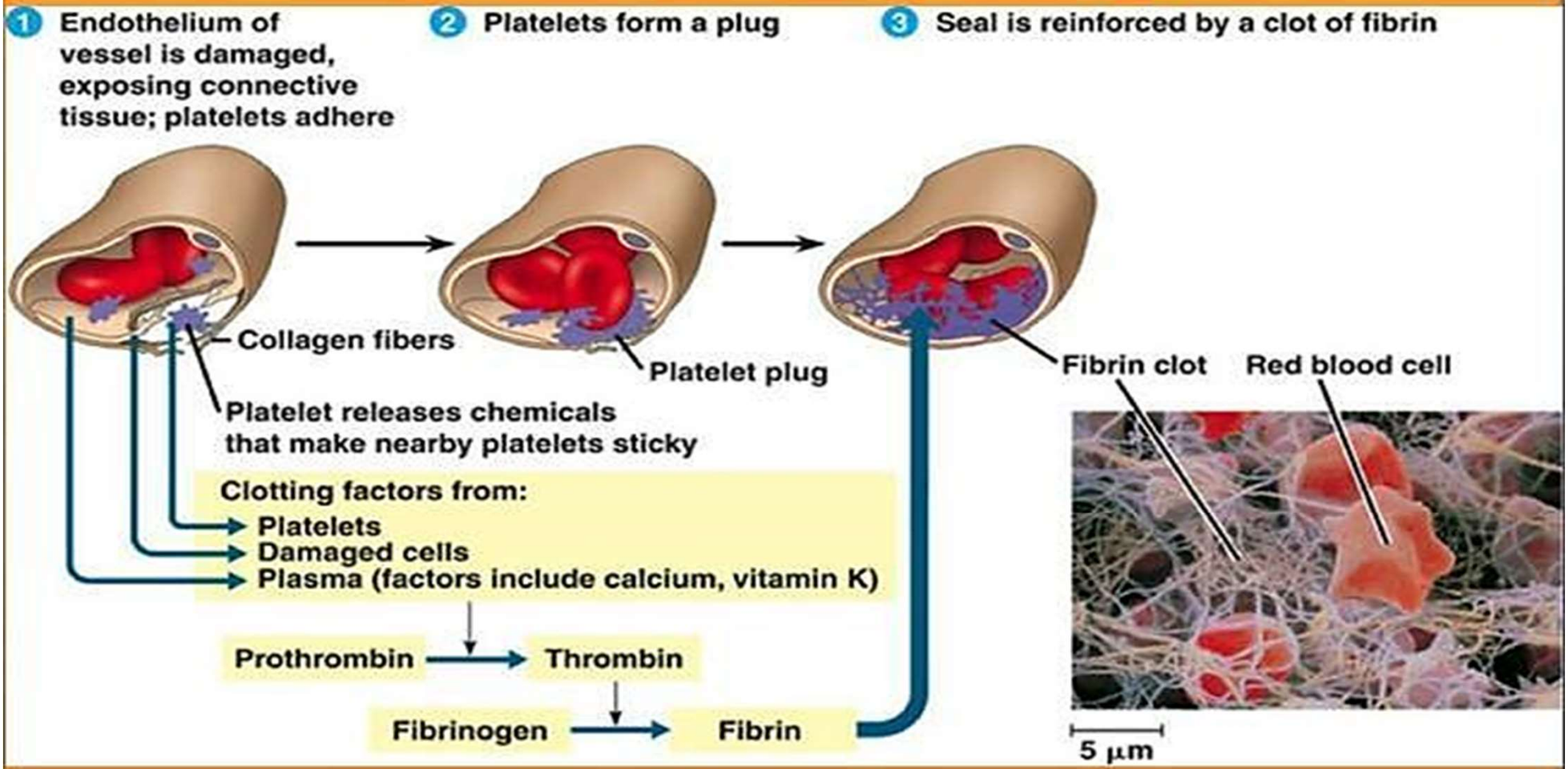


THE MECHANISM OF BLOOD CLOTTING:

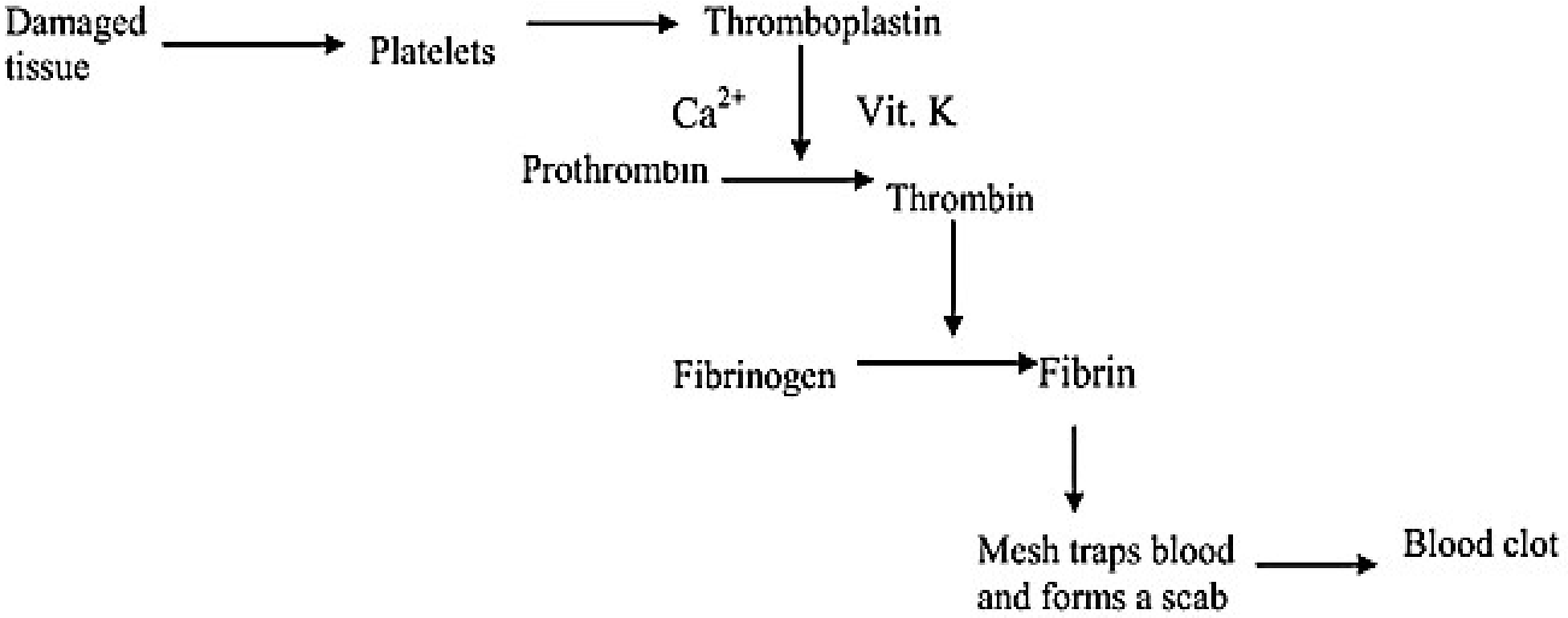
- When blood is exposed to air as a result of a cut or wound, the platelets in the blood at the damaged tissue stimulate the release of a chemical called Thromboplastin (thrombokinase).
- In the presence of calcium ions and vitamin K, thromboplastin stimulates the conversion of prothrombin to thrombin enzyme.
- Thrombin then catalyzes the conversion of soluble blood protein fibrinogen to the insoluble form fibrin.
- Fibrin forms fibers, which form a mesh and trap blood cells and proteins. This mesh dries to form a scab, which is called the blood clot.



Blood Clotting

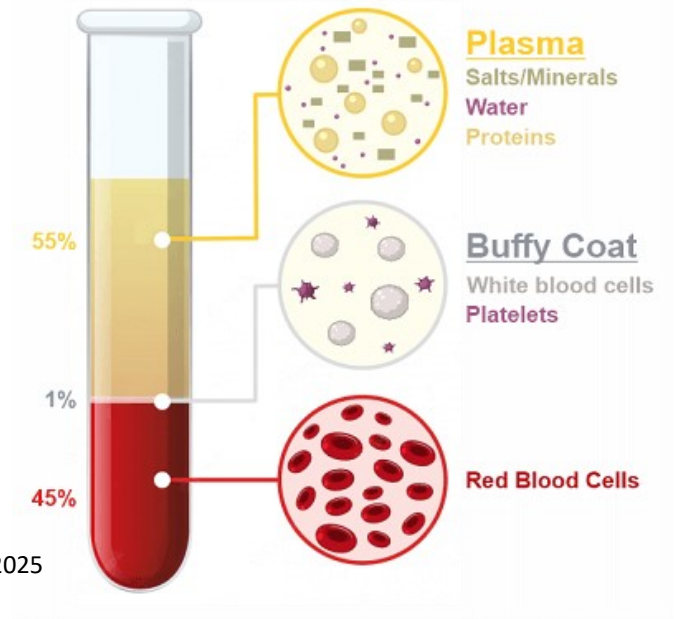


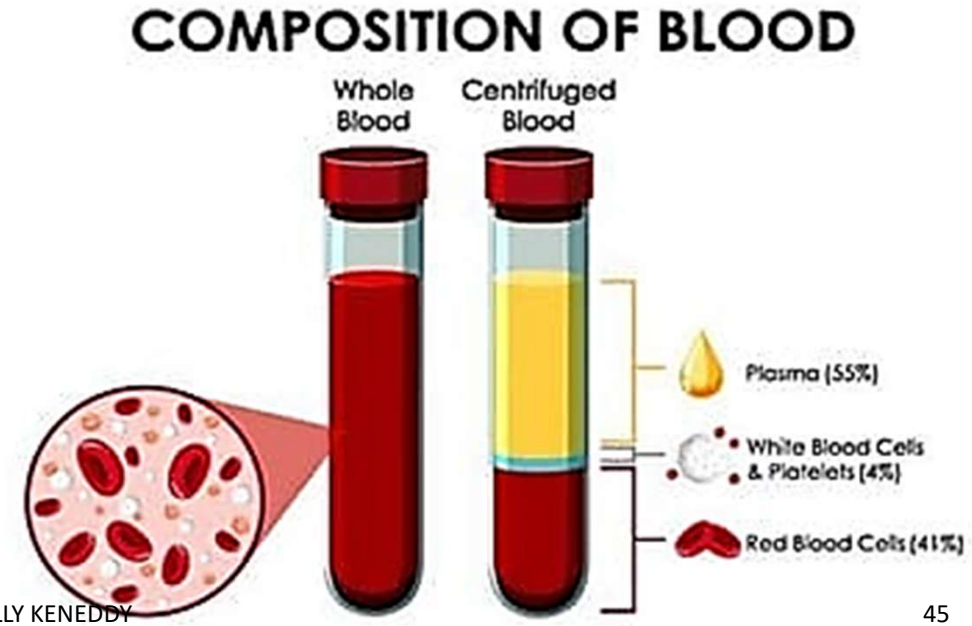
SUMMARY OF PROCESS



BLOOD PLASMA

- This is the fluid part of blood. It is made up of;
- A soluble protein called fibrinogen that plays a role in blood clotting.
- Serum, a watery fluid containing a variety of substances transported from one part of the body to another e.g. hormones, lipids, enzymes, urea, carbon dioxide, plasma, proteins, amino acids etc.





FUNCTIONS OF BLOOD PLASMA



- To transport hormones from gland producing them to the target sites.
- To transport food nutrients from the gut to the other parts of the body.
- To transport antibodies to the infected parts of the body.
- To transport Urea from the liver to the Kidneys for excretion.
- To transport carbon dioxide from the body muscles to gaseous exchange system.
- To transport heat from the liver and body muscles to other body parts hence maintaining a constant body temperature range.
- To transport platelets to injured sites on the body so as to initiate blood clotting.
- To distribute salts around the body so as to maintain the body's electrolytes balance.

DISEASES ASSOCIATED WITH THE CIRCULATORY SYSTEM.



1.Atherosclerosis: This is the hardening and narrowing of arteries due to the buildup of fatty deposits called plaques. It's often caused by a diet high in fat, smoking, high cholesterol, and hypertension.
2.Coronary Artery Disease (CAD): CAD occurs when the coronary arteries that supply blood to the heart muscle become narrowed or blocked due to plaque buildup. Risk factors include smoking, high blood pressure, high cholesterol, and diabetes.
3.Heart Attack (Myocardial Infarction): A heart attack happens when blood flow to a part of the heart is blocked, usually by a blood clot, causing damage to the heart muscle. It can be triggered by atherosclerosis, high blood pressure, smoking, and diabetes.
4.Arrhythmia: This refers to irregular heartbeats, which can be too fast, too slow, or erratic. Causes include heart disease, electrolyte imbalances, and certain medications.
5.Heart Failure: This condition occurs when the heart cannot pump blood effectively to meet the body's needs. It can result from other heart conditions, high blood pressure, and damage to the heart muscle

CONT.....



6.Hypertension (High Blood Pressure): Hypertension is when the force of the blood against artery walls is too high. It can be caused by genetics, poor diet, lack of exercise, obesity, and stress.

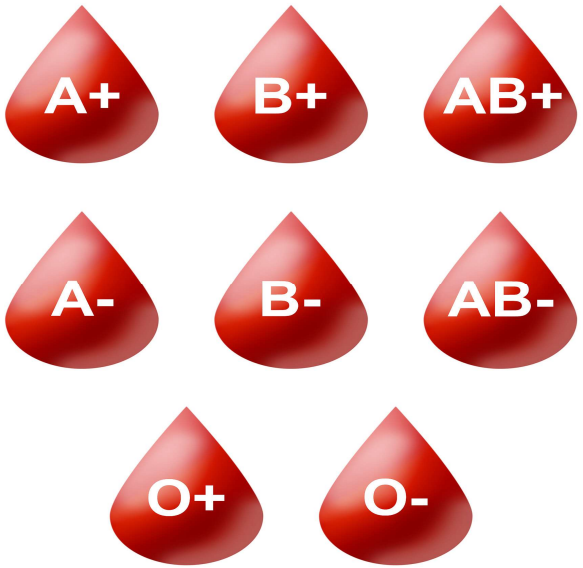
7.Stroke: A stroke happens when blood flow to a part of the brain is interrupted, leading to brain damage. It can be caused by a blood clot (ischemic stroke) or a burst blood vessel (hemorrhagic stroke).

8.Peripheral Artery Disease (PAD): PAD is the narrowing of arteries other than those that supply the heart or brain, often leading to pain and mobility issues. It's usually caused by atherosclerosis.

9.Angina: Angina is chest pain caused by reduced blood flow to the heart muscle. It's often a symptom of CAD and can be triggered by physical exertion or stress.

10.Mitral Valve Prolapse: This condition occurs when the mitral valve in the heart doesn't close properly, allowing blood to flow backward into the heart. It can be due to genetic factors or other heart conditions.

BLOOD GROUPS



There are 4 main blood groups i.e.

- Blood group A
- Blood group B
- Blood group AB
- Blood group O
- When one has got less blood than necessary, blood transfusion is carried out.
- The one who gives blood to a patient is called a donor and the one receiving is known as a recipient.
- Doctors have to match the blood of the donor to that of the recipient because when incompatibles blood is mixed, the red blood cells stick together (agglutinate) and blood clots.



- Agglutination is caused by the presence of proteins called antigens on the surface of cells being mixed with specific antibodies, which work against them.
- Blood groups are determined by the type of antigens one has in blood.
- This means that one having antigen A belongs to blood group A.
- Those with antigen B belong to blood group B.
- Those with antigens A and B belong to blood group AB while those without antigens belong to blood group O.
- Each blood produces particular antibodies, which work against particular antigens when introduced into the body.
- For example,
- blood group A produces antibody b. This means that blood group A is anti (against) blood containing antigen B (blood group B).

CONT……



Note

Antibodies are represented by small letters while antigens are represented by capital letters. Before doctors can carry out transfusion, they carry out tests to make sure that the patient's and donor's blood are compatible

Blood group	Antigen present	Antibody produced
A	A	b
B	B	a
AB	A and B	None
O	No antigen	a and b

BLOOD TRANSFUSION.



- Blood transfusion is the process of transferring donated blood to another person.
- The one who gives blood to a patient is called a donor and the one receiving is known as a recipient
- Before doctors can carry out transfusion, they carry out tests to make sure that the patient's and donor's blood are compatible (*the recipient's blood must not contain antibodies that act on the antigens in the donor's blood*).
- For example **antigen A** would **agglutinate if mixed** with blood containing **antibody a**. i.e. blood group B




NEWS

Table of compatibility

Recipient

Donor

	A	B	AB	O
A	√	X	√	X
B	X	√	√	X
AB	X	X	√	X
O	√	√	√	√

Key

X --------- Incompatible

√ --------- Compatible

Note

Blood group AB can receive blood from all other blood groups because it has no antibodies and it is therefore called a universal recipient.

Blood group O can donate blood to all blood groups because it has no antigens and it is therefore called a universal donor

CONT.....

- An individual of blood group A can receive blood from individuals of blood group A and O only.
- An individual of blood group B can receive blood from individuals of blood group B and O only.
- An individual of blood group O can receive blood from individuals of blood O only.
- An individual of blood group AB can receive blood from individuals of blood group A,B,AB and O(all blood groups).

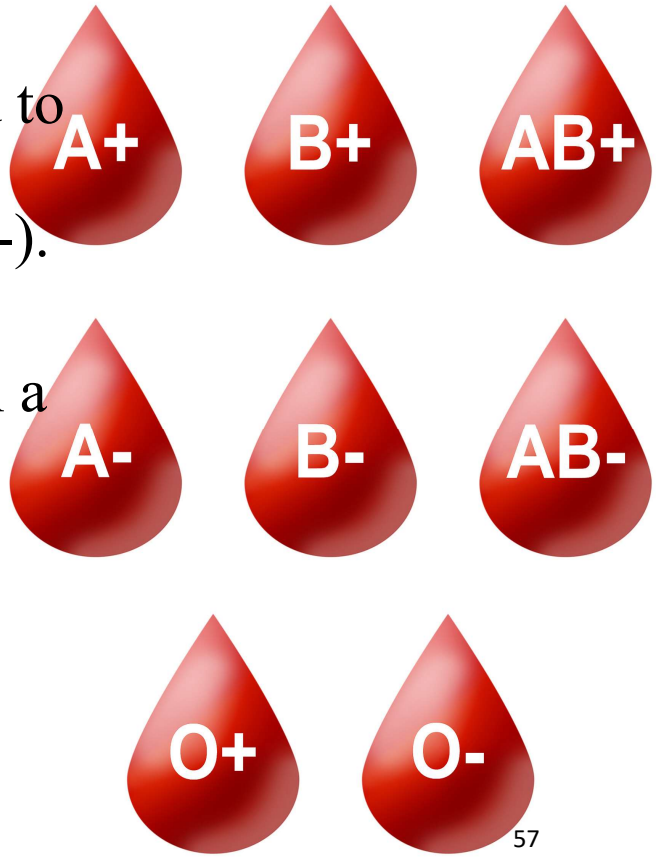
FACTORS CONSIDERED DURING BLOOD DONATION.



- Every adult has the potential to donate blood however the following are usually considered before blood donation.
- Age : only individuals who are between 16 and 50 years old can donate blood.
- Health status: individuals who are sick or recovering from sickness should not donate blood.
- Pregnancy : pregnant and breast feeding mothers should not donate blood.
- Weight: the person donating blood should weigh at least 50kg
- Time: women can donate blood once every four months while men can donate blood once every three months.

RHESUS FACTOR" SYSTEM

- Rhesus factor is a protein (antigen) also found on the cell membranes of the red blood cells.
- Many individuals have the Rhesus factor and are said to be rhesus positive (Rh+) while a few do not have the Rhesus factor and are said to be Rhesus negative (Rh-).
- A person who is Rhesus factor positive can receive a successful blood donation without agglutination from a person of Rhesus positive and a person of Rhesus negative



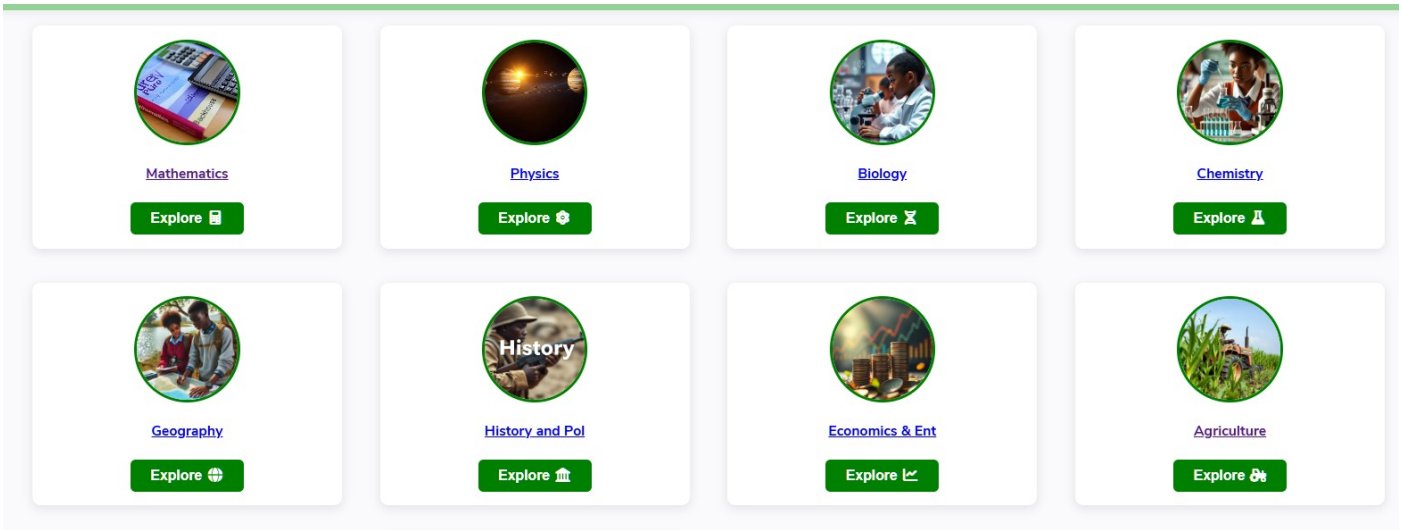
ALWAYS AIM FOR EXCELLENCE



By ELLY KENEDDY NALITSO

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