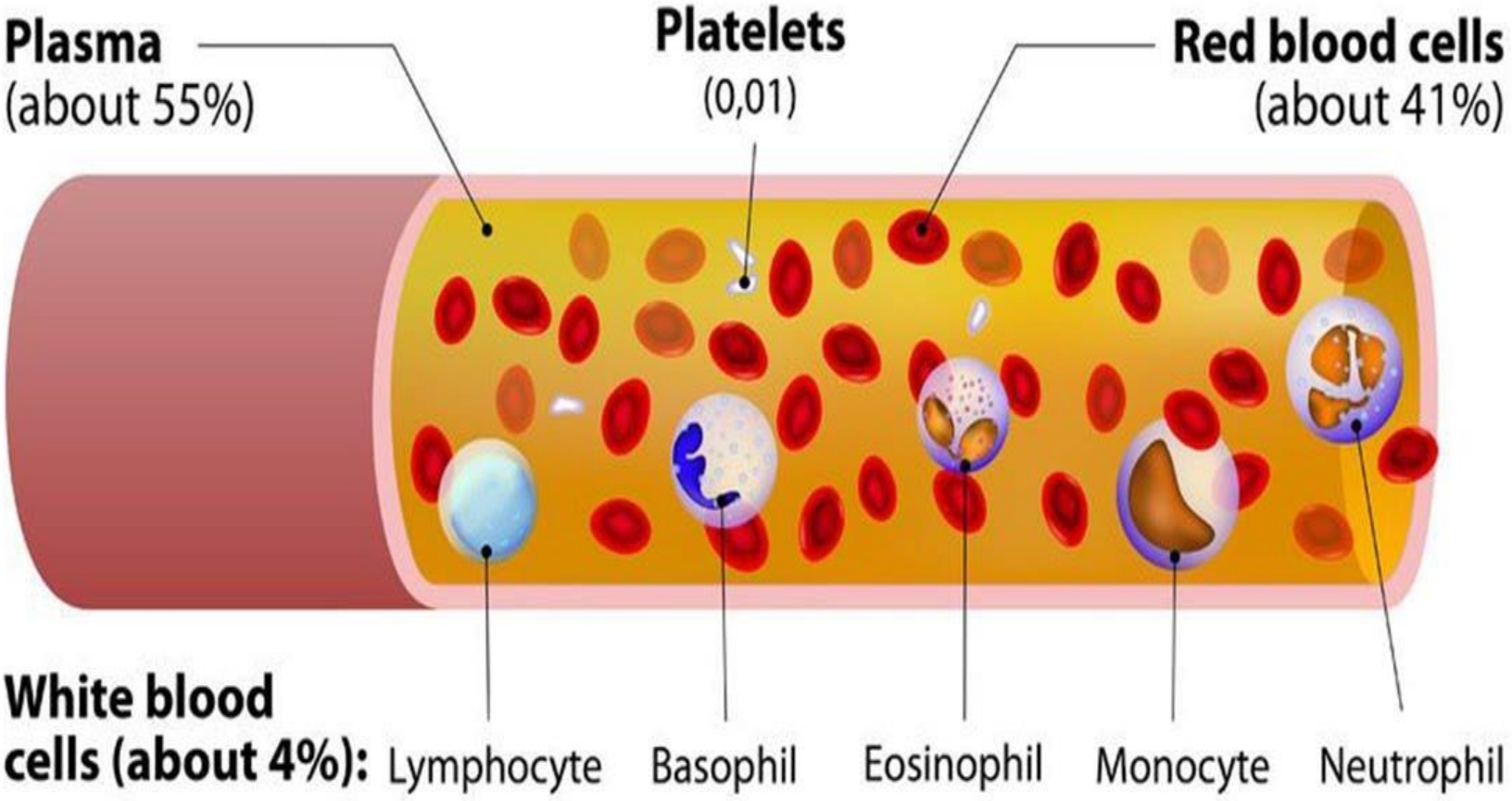
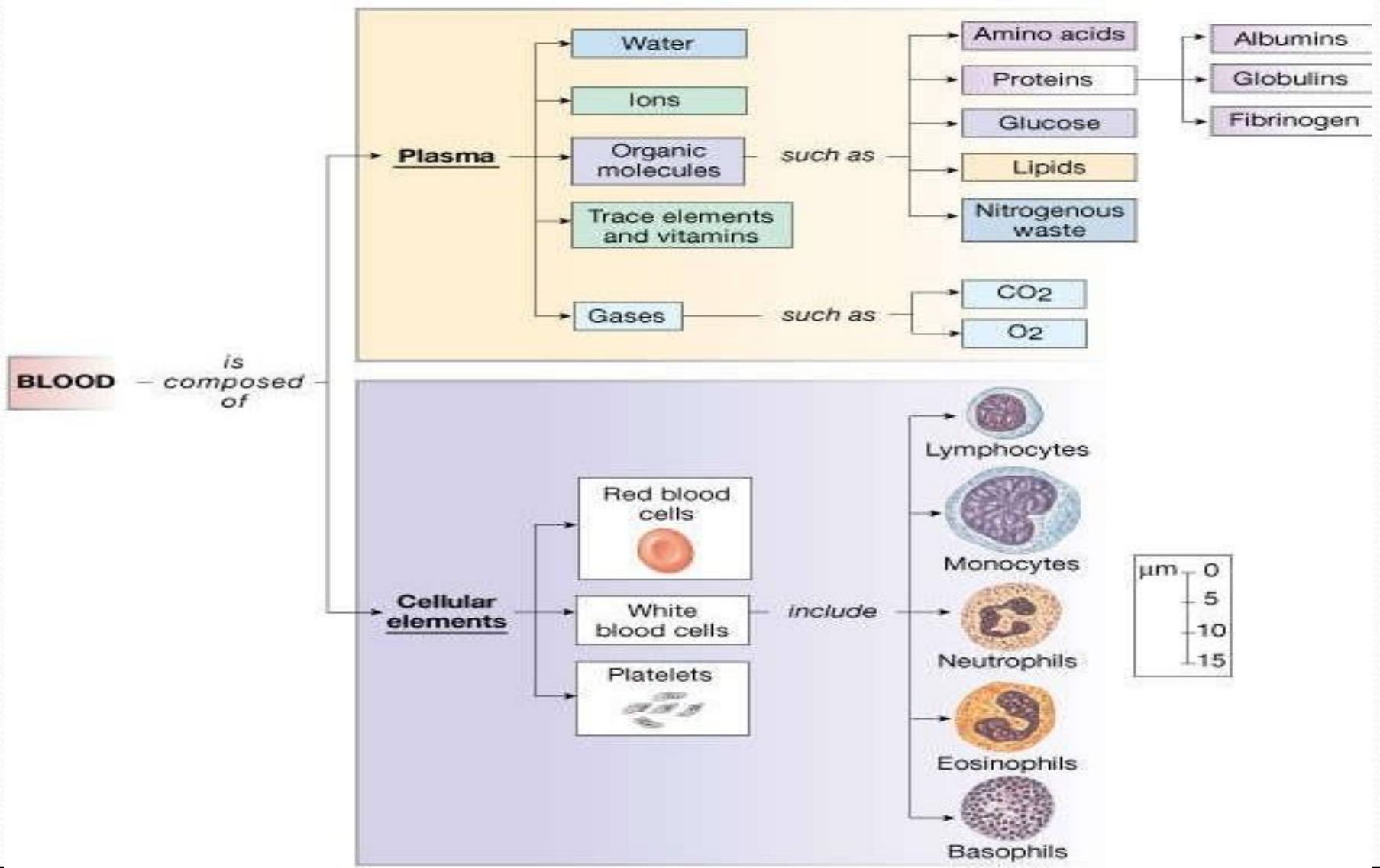
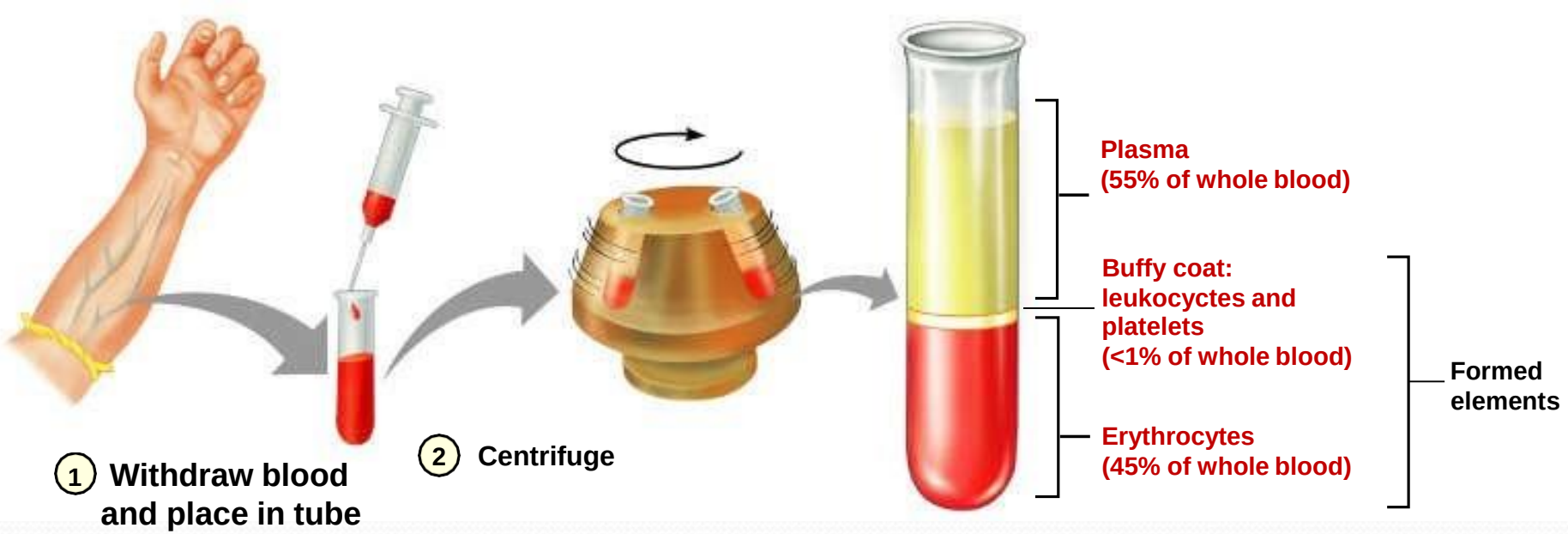
BLOOD AND ITS COMPONENT



Blood Components:





✓ Hematocrit – the percentage of RBCs out of the total blood volume

Physical characteristics of blood…

- Blood is a sticky, opaque fluid with a metallic taste.
- Color varies from scarlet (oxygen-rich) to dark red (oxygen- poor).
- The pH of blood is 7.35–7.45.
- Specific gravity is 1050-1060
- Temperature is 38ºC, slightly higher than "normal" body temperature.
- Blood accounts for approximately 8% of body weight
- Average volume of blood is 5–6 L for males, and 4–5 L for females.

Functions of blood

1. Transport:

- transport of oxygen and carbon dioxide
- transport of nutrients and products of metabolism

2. Osmotic.

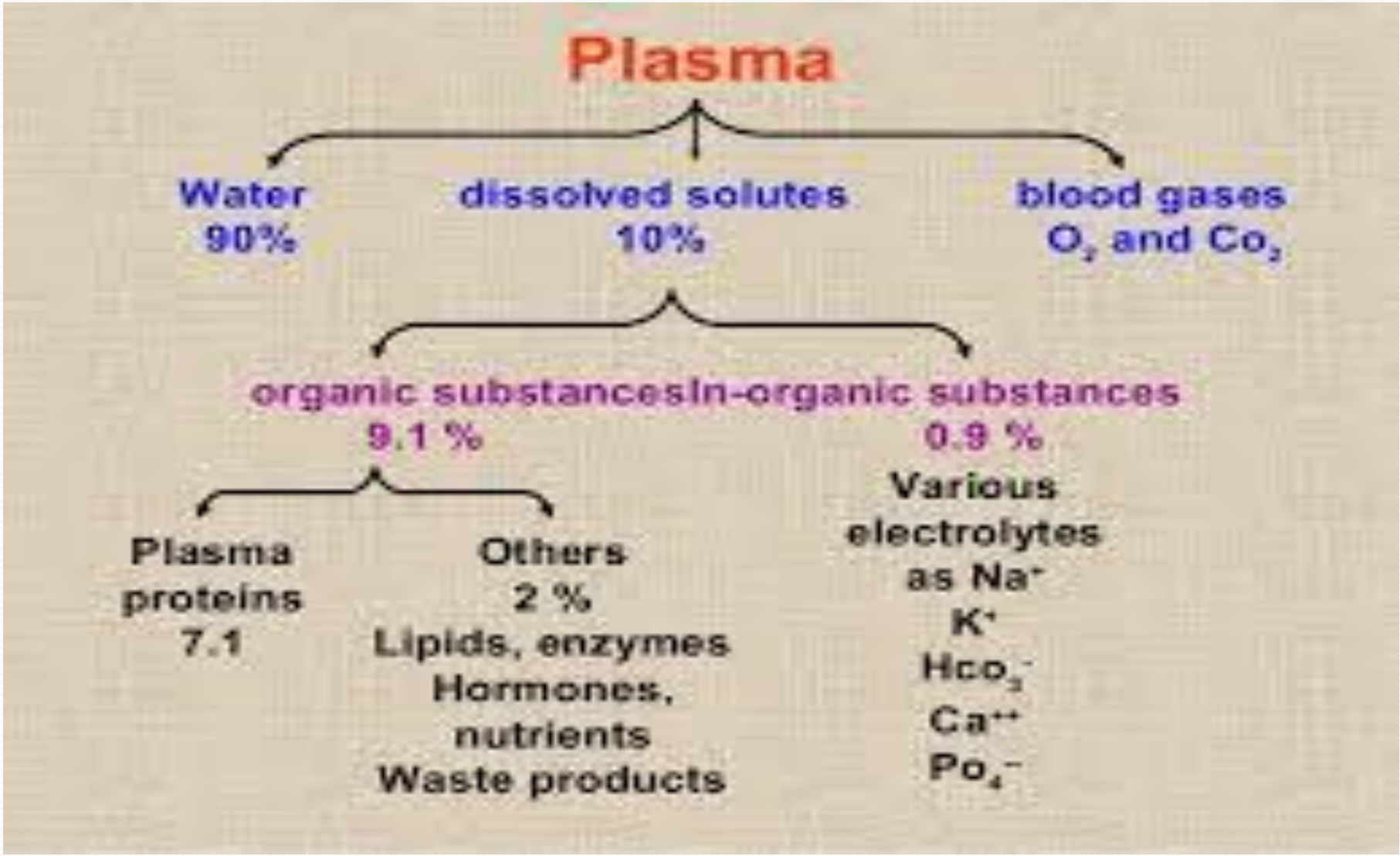
3. Regulatory (formation of hormonoids).

4. Protective.

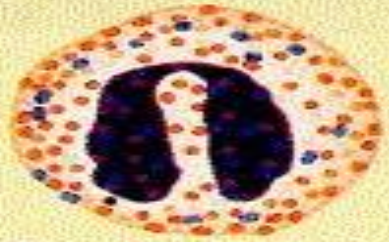
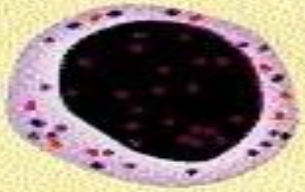
5. Detoxification.

6. Thermoregulatory.

Blood Plasma….

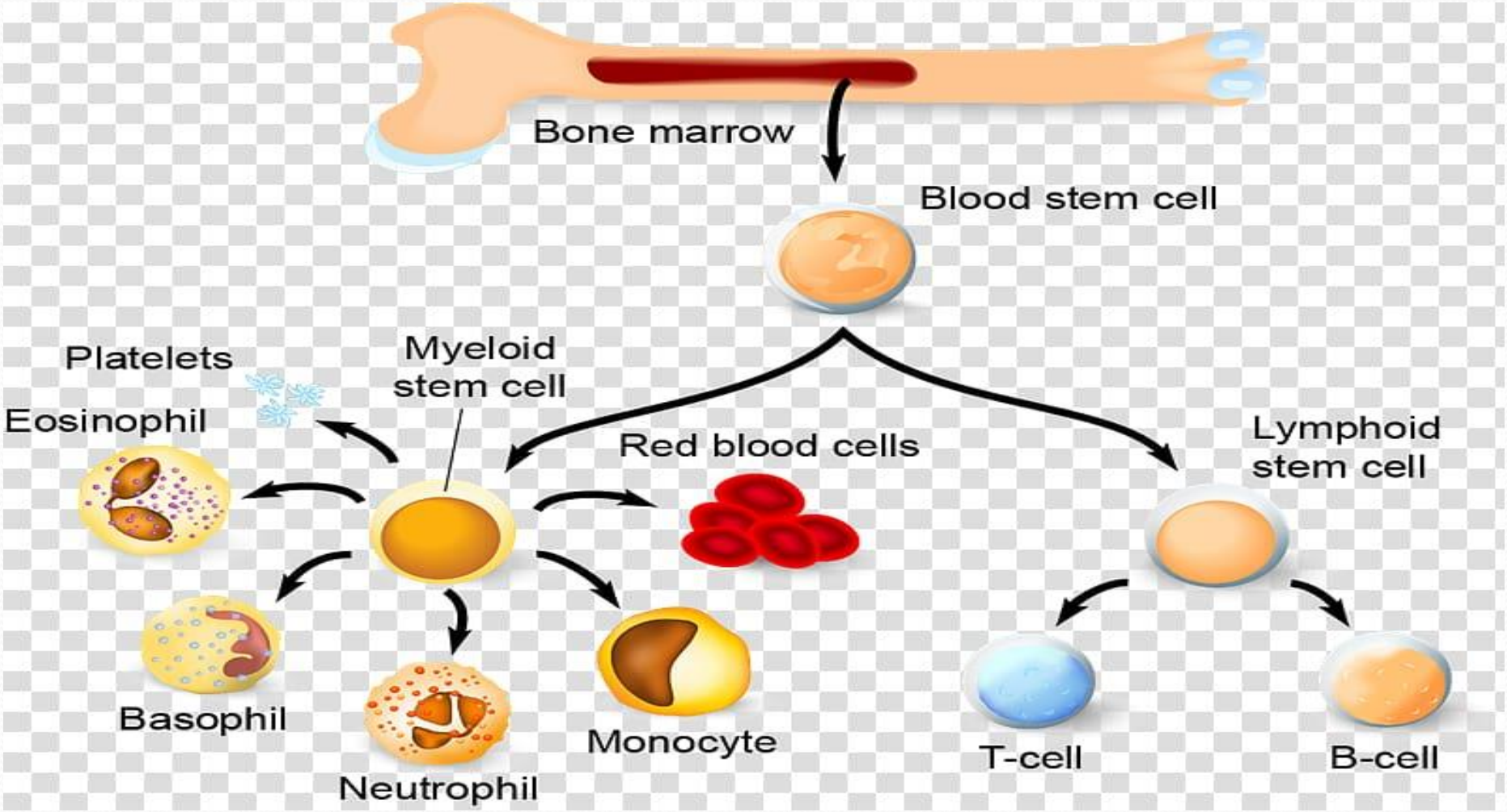


Formed Elements (cells) 45%

Cell type	NUMBER (per mm^3 of blood)*	FUNCTIONS
Erythrocytes (red blood cells) 	4–6 million	Transport oxygen and help transport carbon dioxide
Leukocytes (white blood cells)	4000–11,000	Defense and immunity
Basophil 		
Eosinophil 		
Lymphocyte 		
Neutrophil 		
Monocyte 		
Platelets 	250,000–500,000	Blood clotting

Hemopoeisis…

- ✓ Mostly in bone marrow from stem cells
- ✓ Rate regulated by cytokines & growth factors

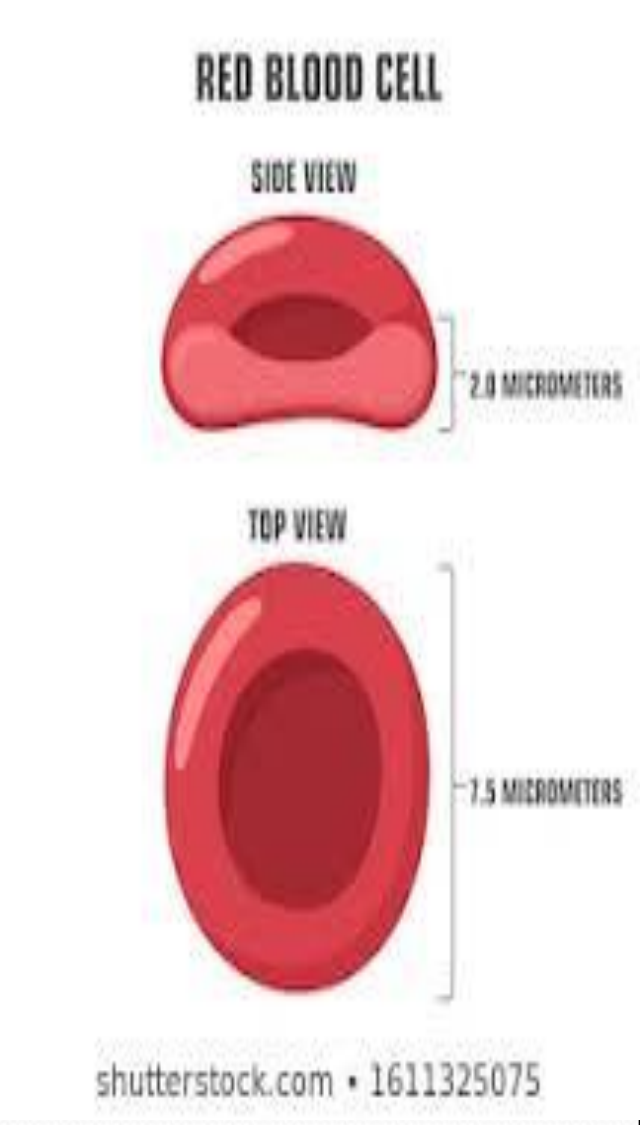


Hematopoietic Growth Factors

- Colony Stimulating Factors.
- Erythropoietin (Epoetin alfa).
- Granulocyte colony-stimulating factor(G-CSF).
- Granulocyte-macrophage colony-stimulating factor (G-CSF).
- Interleukin-11 (IL-11).
- Thrombopoietin.

Erythrocytes (RBC's)

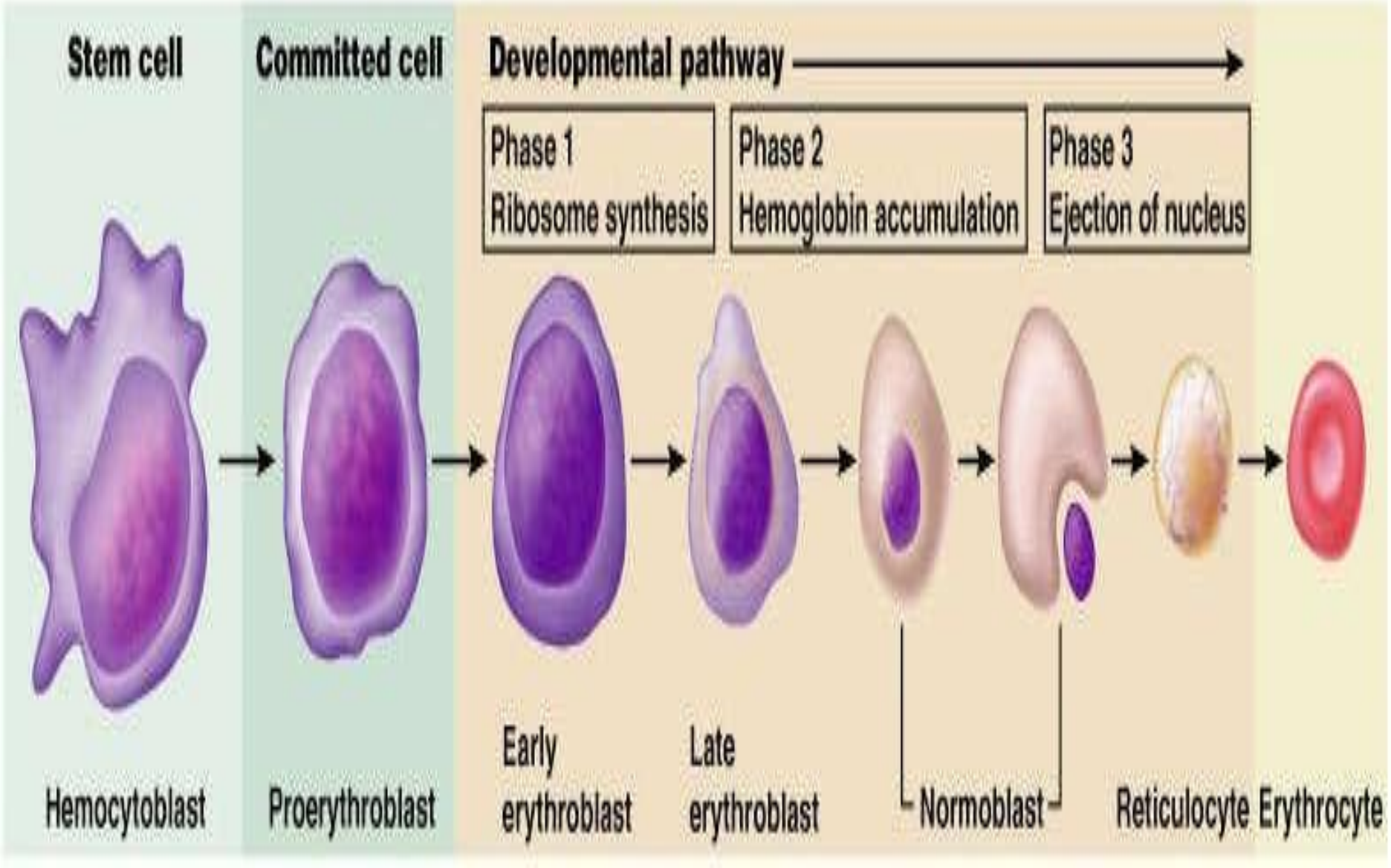
- These are biconcave discs, anucleate, essentially no organelles.
- Filled with hemoglobin (Hb), a protein that functions in gas transport.
- Contain the plasma membrane protein and other proteins that:
  - Give erythrocytes their flexibility
  - Allow them to change shape as necessary



Erythrocyte Functions

- Erythrocytes are dedicated to respiratory gas transport
- Hemoglobin reversibly binds with oxygen and most oxygen in the blood is bound to hemoglobin
- Hemoglobin is composed of the protein globin, made up of two alpha and two beta chains, each bound to a heme group
- Each heme group bears an atom of iron, which can bind to one oxygen molecule
- Each hemoglobin molecule can transport four molecules of oxygen

Erythropoiesis….



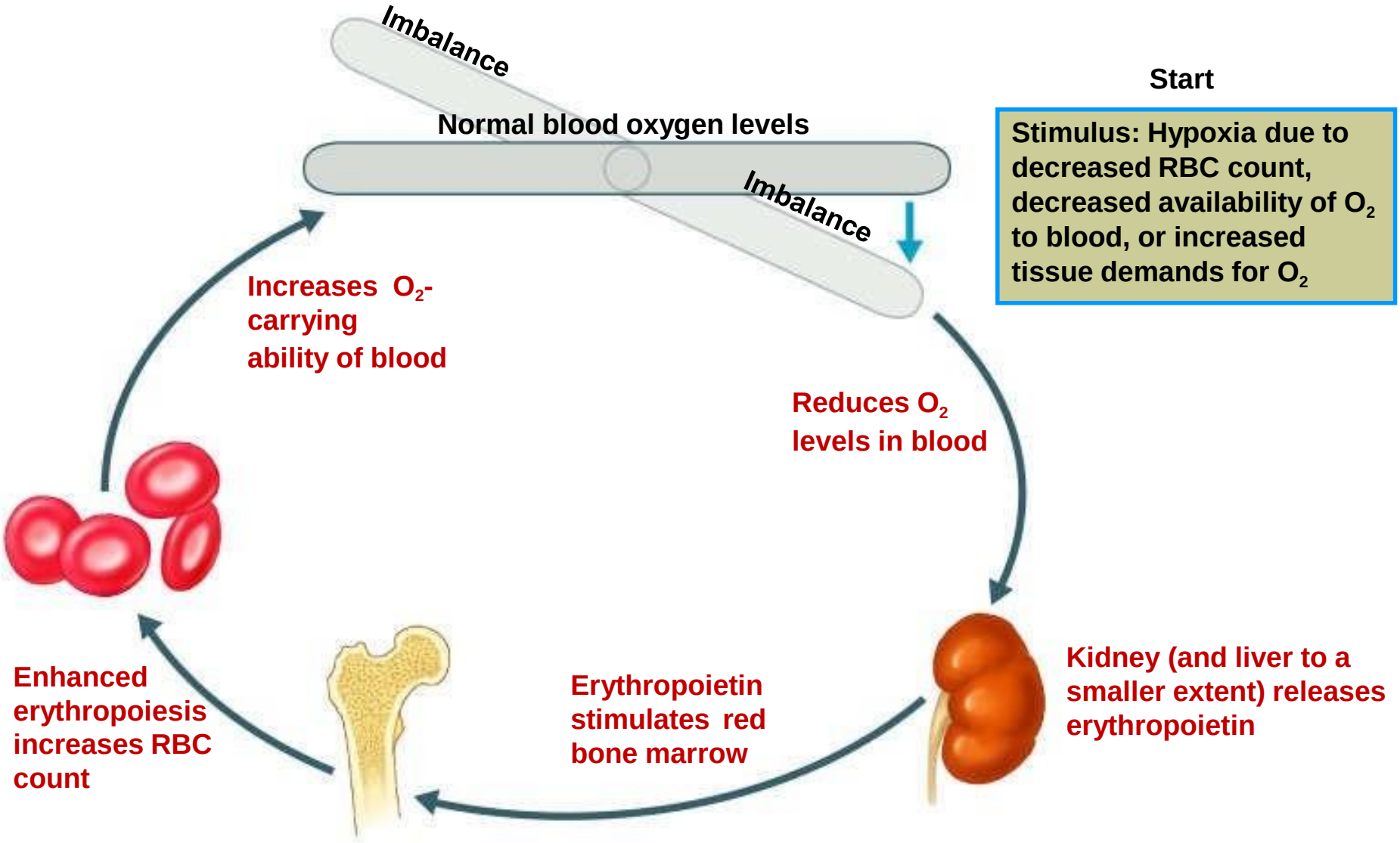
Production of Erythrocytes:

- A hemocytoblast is transformed into a committed cell called the pro-erythroblast.
- Pro-erythroblasts develop into early erythroblasts.
- The developmental pathway consists of three phases…
  - Phase-1- ribosome synthesis in early erythroblasts
  - Phase-2-hemoglobin accumulation in late erythroblasts and normoblasts
  - Phase-3- ejection of the nucleus from normoblasts and formation of reticulocytes
- Reticulocytes then become mature erythrocytes

Hormonal Control of Erythropoiesis…

- Erythropoietin (EPO) release by the kidneys is triggered by:
  - Hypoxia due to decreased RBC's
  - Decreased oxygen availability
  - Increased tissue demand for oxygen
- Enhanced erythropoiesis increases the:
  - RBC count in circulating blood
  - Oxygen carrying ability of the blood

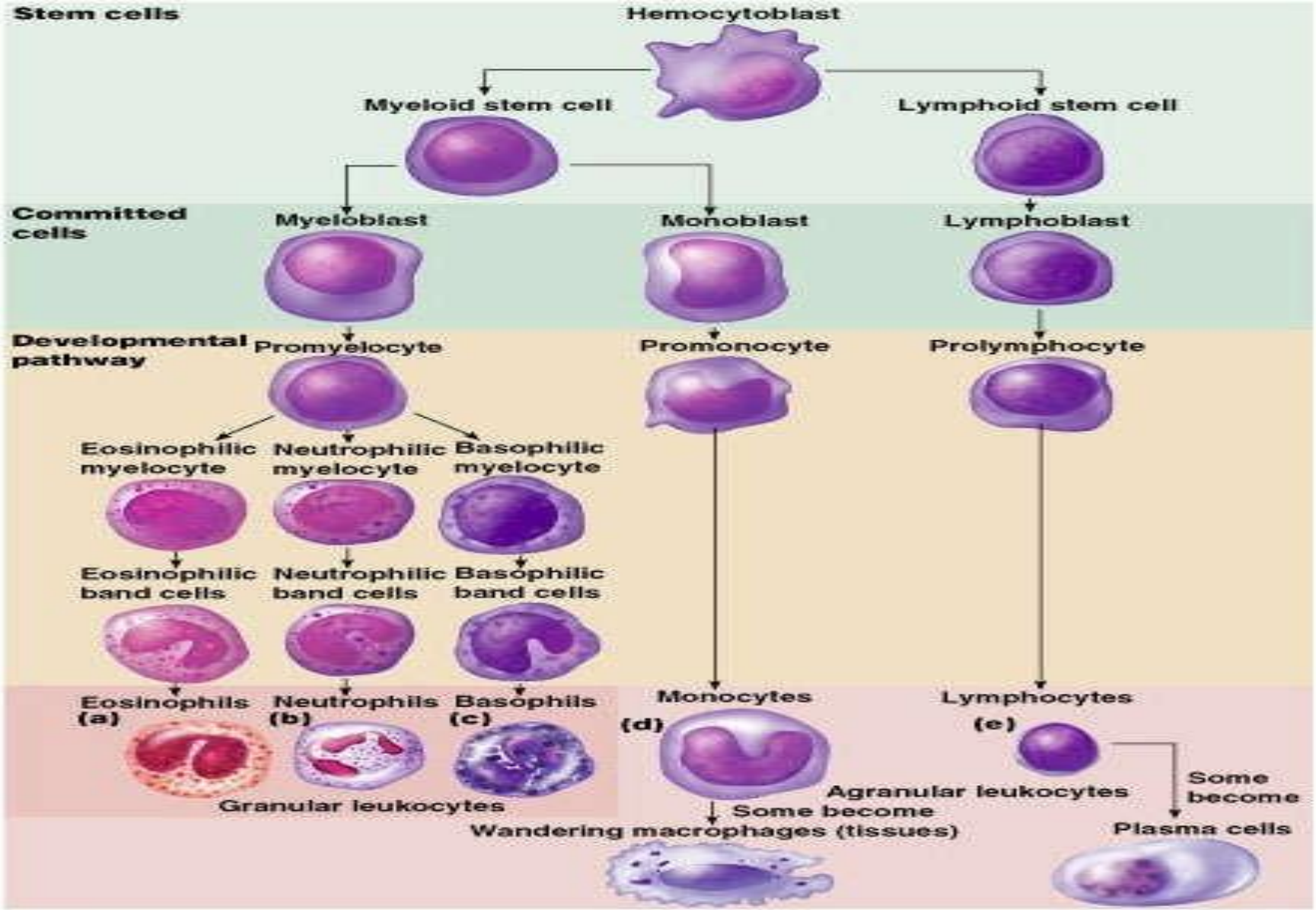
Erythropoietin Mechanism:



Dietary Requirements of Erythropoiesis

- Erythropoiesis requires:
  - Proteins, lipids, and carbohydrates
  - Iron, vitamin B_{12}, and folic acid

Formation of Leukocytes: Leukopoiesis



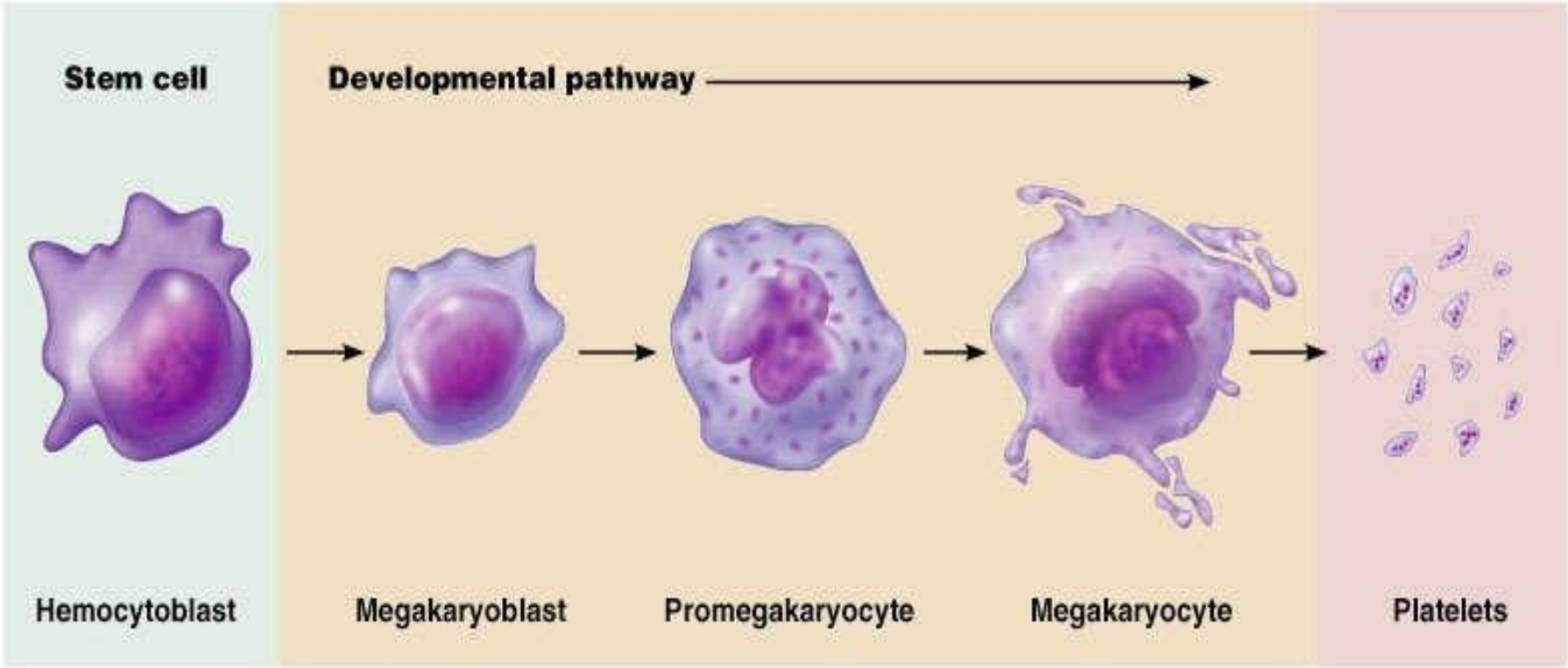
- All leukocytes originate from hemocytoblasts
- Hemocytoblasts differentiate into myeloid stem cells and lymphoid stem cells
- Myeloid stem cells become myeloblasts or monoblasts
- Lymphoid stem cells become lymphoblasts
- Myeloblasts develop into eosinophils, neutrophils, and basophils
- Monoblasts develop into monocytes
- Lymphoblasts develop into lymphocytes

WBC functions

- Neutrophil – phagocytic
- Eosinophil – phagocytic and damage to larval stages of parasite.
- Basophil – storage of histamine, involved in immediate hypersensitivity reaction.
- Monocyte – phagocytic, cellular and humoral immunity

Genesis of Platelets:

- The stem cell for platelets is the hemocytoblast.
- The sequential developmental pathway is hemocytoblast, megakaryoblast, promegakaryo-cyte, megakaryocyte, and platelets.



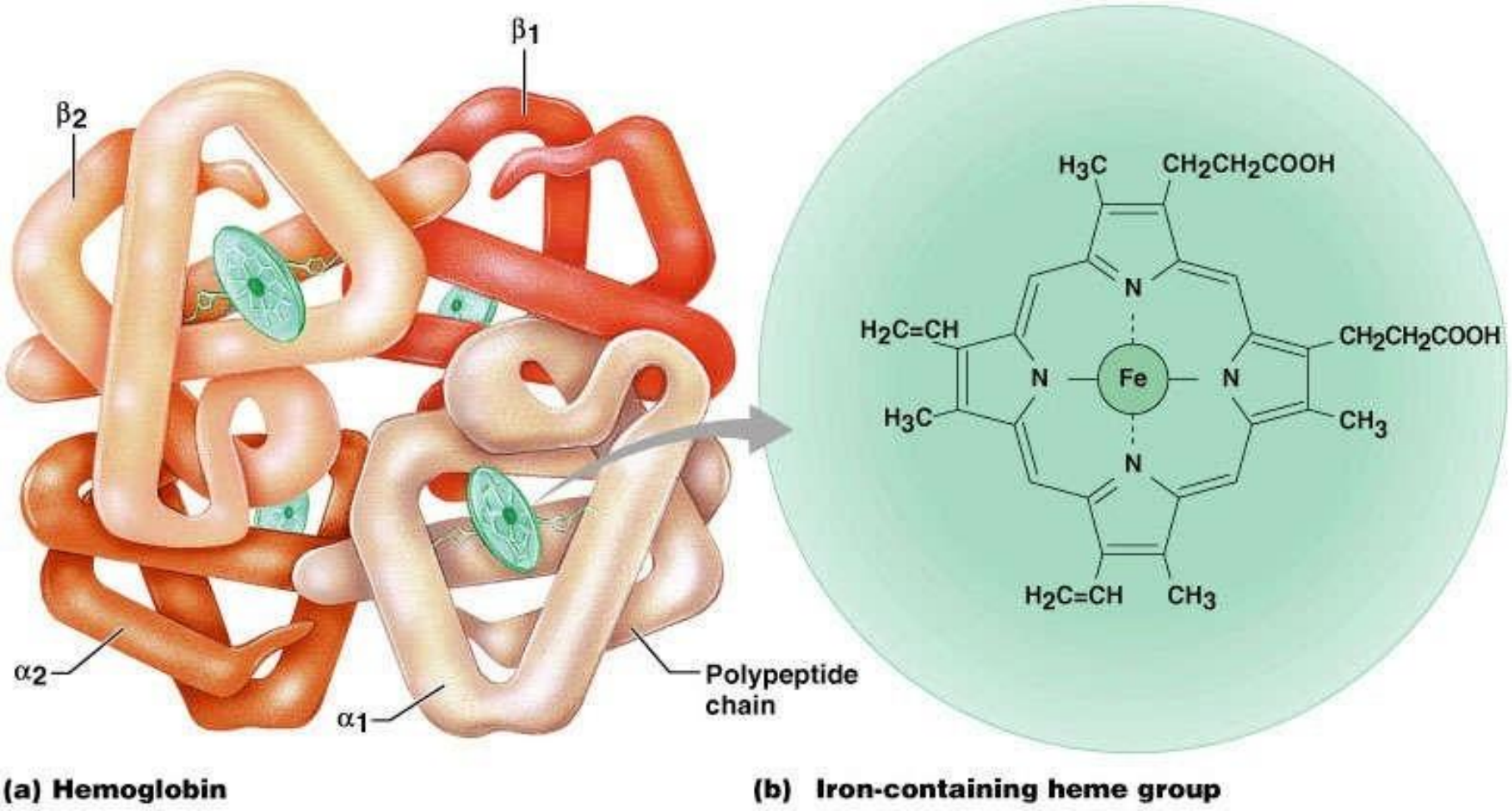
FUNCTIONS OF PLATELETS

- Platelets have been observed to play a role in the following;
- Maintain haemostasis
- Maintain vascular integrity (with endothelial cells)
- Blood coagulation, (provide platelet phospholipid (platelet factor 3), carry coagulation factors on their surfaces.
- Clot retraction (contractile protein system involving thrombosthenin).

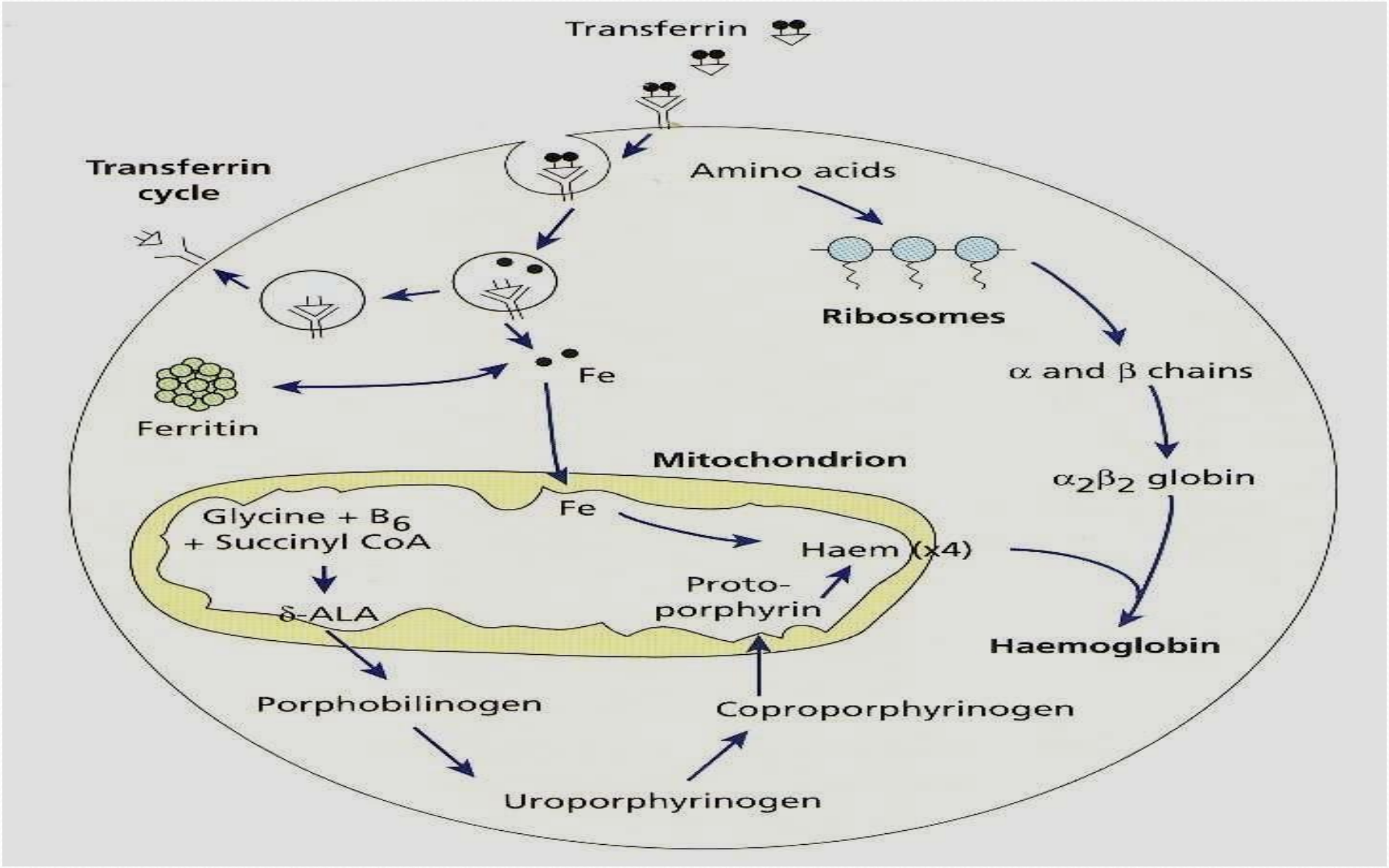
Hemoglobin…

- Oxy-hemoglobin - hemoglobin bound to oxygen. Oxygen loading takes place in the lungs.
- De-oxyhemoglobin- hemoglobin after oxygen diffuses into tissues.
- Carbamino-hemoglobin- hemoglobin bound to carbon dioxide.
  - Carbon dioxide loading takes place in the tissues

Structure of Hemoglobin..



SYNTHESIS OF HEMOGLOBIN:



- Haem & globin produced at two different sites in the cells
  - Haem in mitochondria
  - Globin in polyribosomes
- Normal hemoglobin production is dependent upon 3 processes: Adequate iron delivery and supply, adequate synthesis of protoporphyrins and adequate globin synthesis.

Functions of hemoglobin

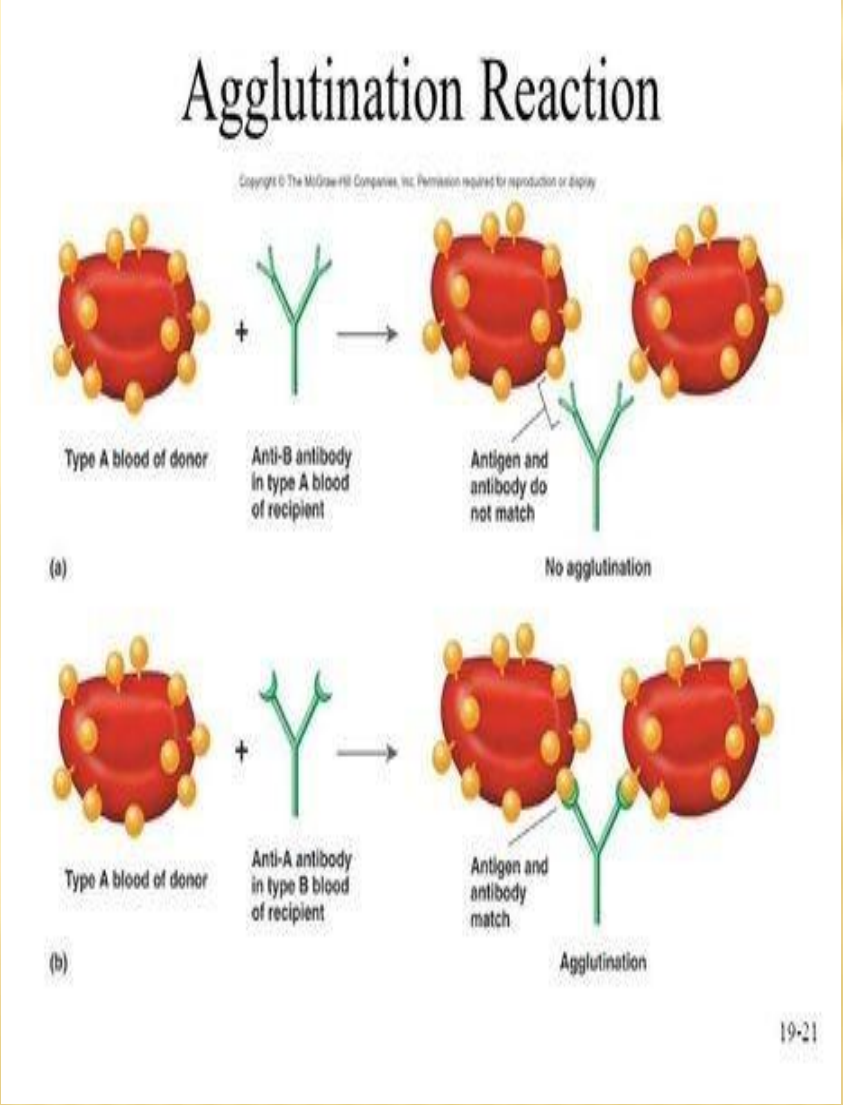
- Imparts red color to the blood.
- Helps to carry out the oxygen and other gases assisting the respiratory system.
- It buffers the blood pH and maintains it to the tolerable limits.
- Source of physiological active catabolites.
- Genetic resistance to malaria, etc.


THANK
YOU!

BLOOD GROUPS

INTRODUCTION….

- **Agglutinogens:** Antigens present on cell membrane of RBC's.
- **Agglutinins:**
- Antibodies against agglutinogens present in plasma.
- **Agglutination:**
- It is the reaction between these two.



MAJOR BLOOD GROUPING SYSTEM…

- ABO Blood grouping system.
- Rh blood grouping system.

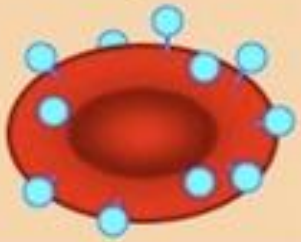
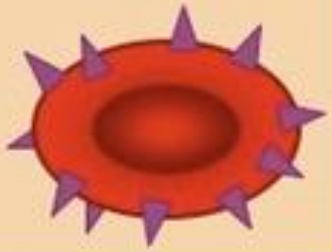
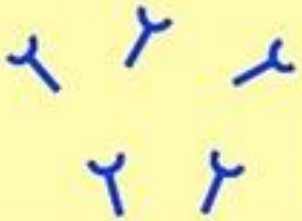
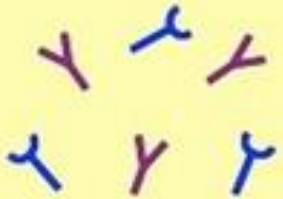
ABO Blood grouping system…

A & B Agglutinogens- These are the complex oligosaccharides differing in terminal sugar molecule.

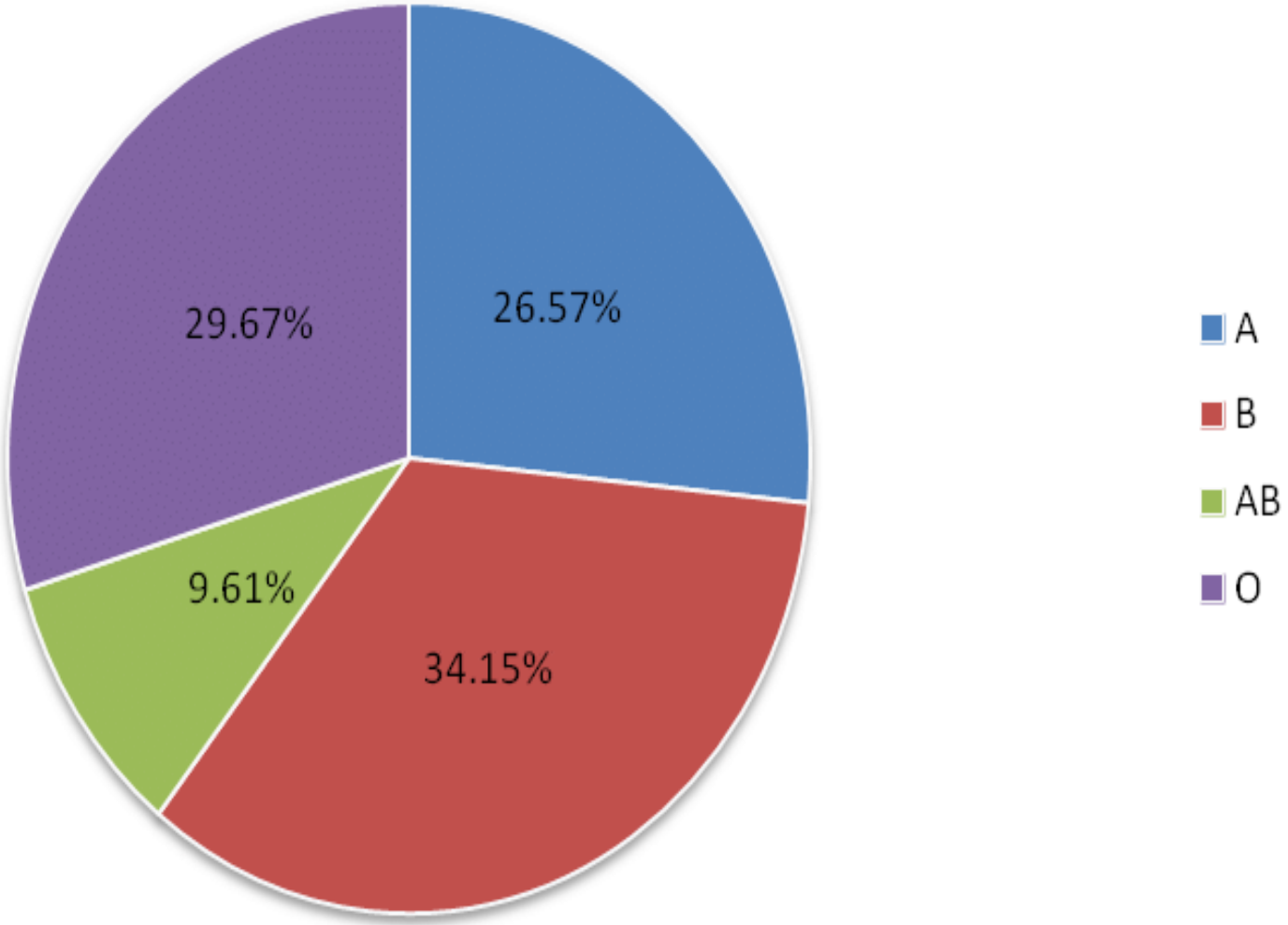
- In Antigen-A- N-acetylgalactosamine

  In Antigen B – galactose.

Types of ABO Blood Groups:

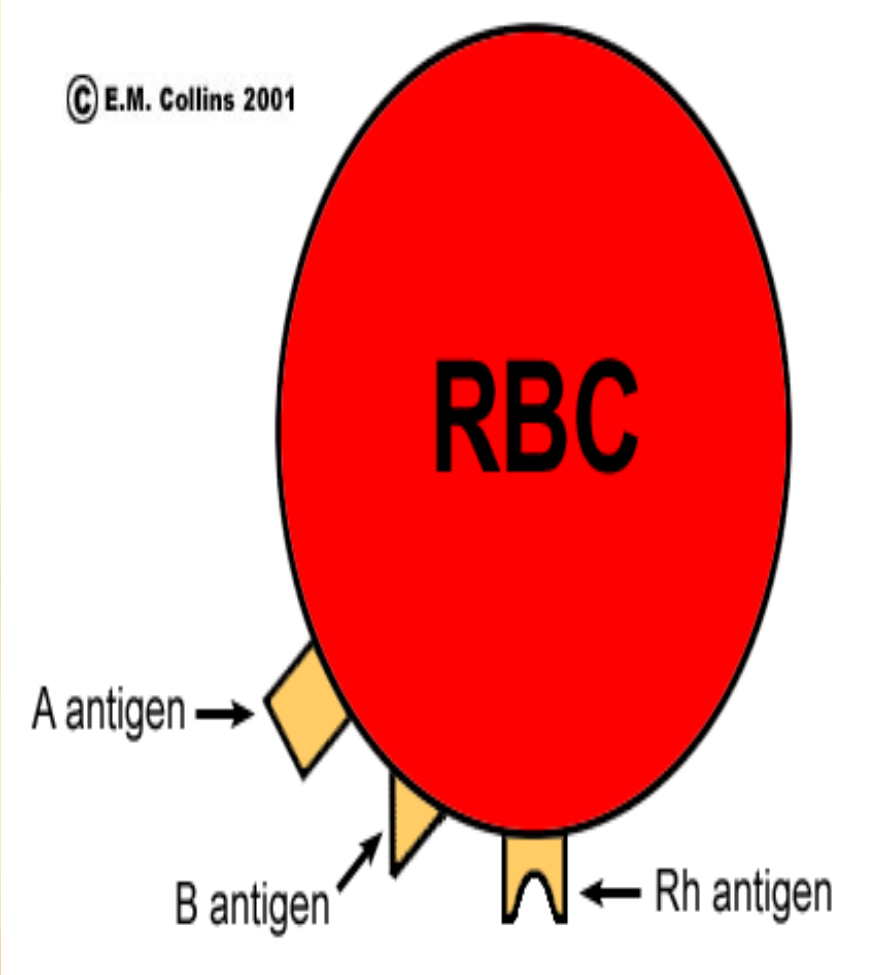
ABO Blood Groups				
Antigen (on RBC)	Antigen A 	Antigen B 	Antigens A + B 	Neither A or B 
Antibody (in plasma)	Anti-B Antibody 	Anti-A Antibody 	Neither Antibody	Both Antibodies 
Blood Type	**Type A** Cannot have B or AB blood Can have A or O blood	**Type B** Cannot have A or AB blood Can have B or O blood	**Type AB** Can have any type of blood Is the universal recipient	**Type O** Can only have O blood Is the universal donor

Frequency of ABO blood group distribution



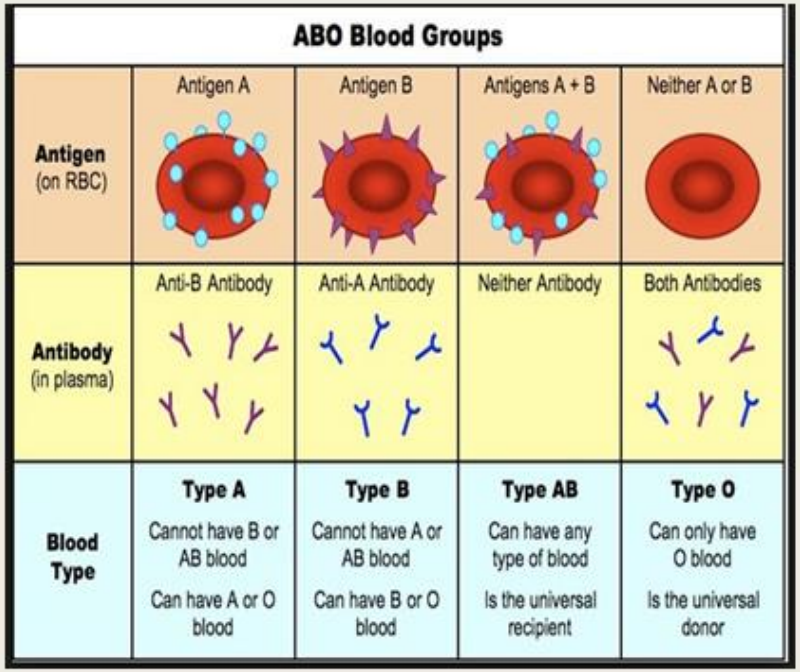
Appearance of antigens and antibodies…

- Antigens A & B appears in 6th week of fetal life, at birth 1/5th of adult level & rises during puberty & adolescence.
- Antibodies are absent at birth, appear 10-15 days after birth, reach maximum at 10 yrs.



Determination of ABO blood groups

Slide method: Blood collected from the capillary mixed well with antisera on glass slide marked with anti sera and checked for agglutination



ABO Blood Groups				
Antigen (on RBC)	Antigen A	Antigen B	Antigens A + B	Neither A or B
Antibody (in plasma)	Anti-B Antibody	Anti-A Antibody	Neither Antibody	Both Antibodies
Blood Type	**Type A** Cannot have B or AB blood. Can have A or O blood	**Type B** Cannot have A or AB blood. Can have B or O blood	**Type AB** Can have any type of blood. Is the universal recipient	**Type O** Can only have O blood. Is the universal donor

Source: Knowledge class

Tube method: Saline washed red blood cells washed with antisera in test tube. The mixture incubated and centrifuged. Serum grouping done with mixing the antisera

The patient's red cells are mixed with anti-D reagent. The monoclonal IgM anti-D antiserum is used for Rh typing

Rh Blood group system…

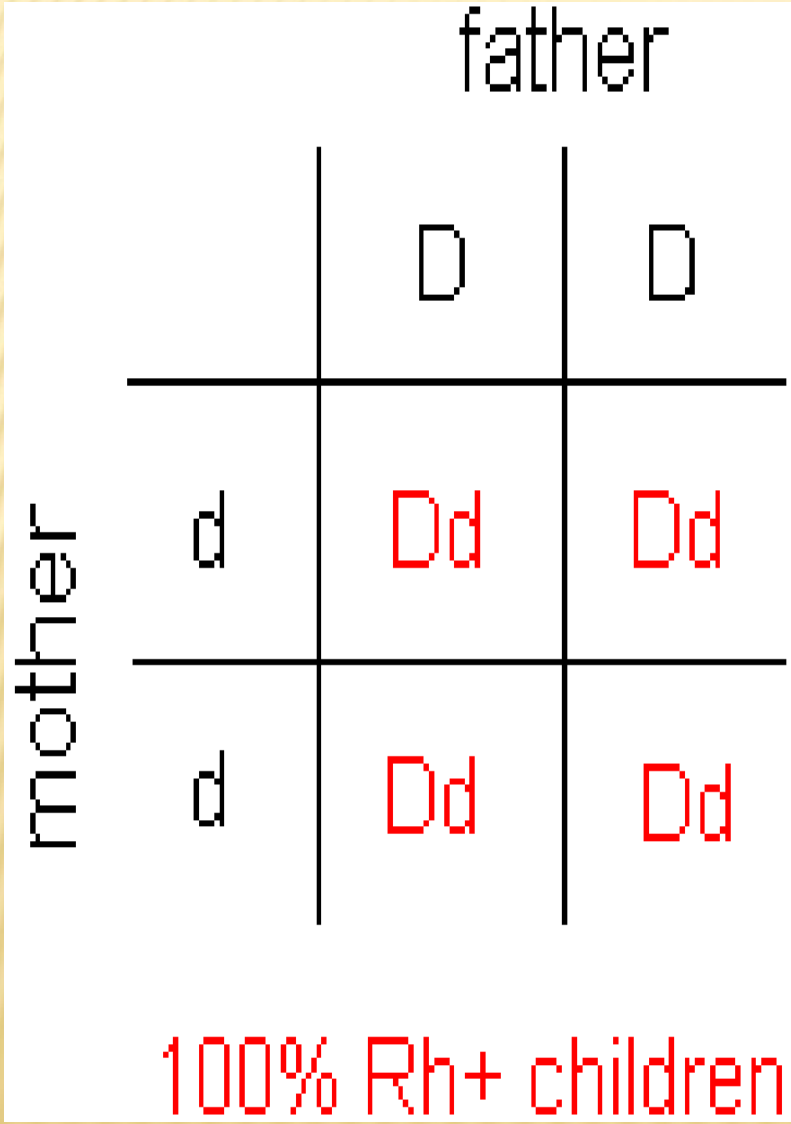
Rhesus blood group system

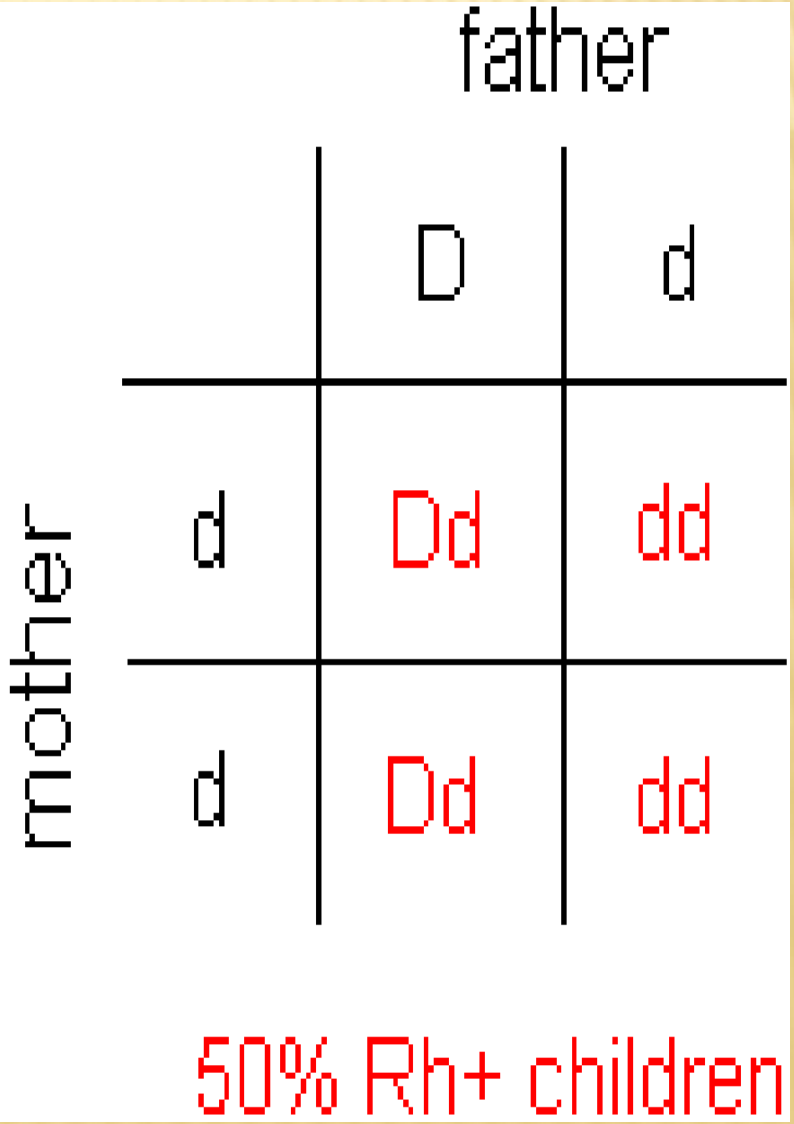
- The Rh blood group system is one of the most polymorphic and immunogenic systems known in humans.
- It is the most complex system, with over 45 antigens.
- Discovered in 1940 after work on Rhesus monkeys.
- RH gene located on short arm of chromosome 1.

Rh Antibody….

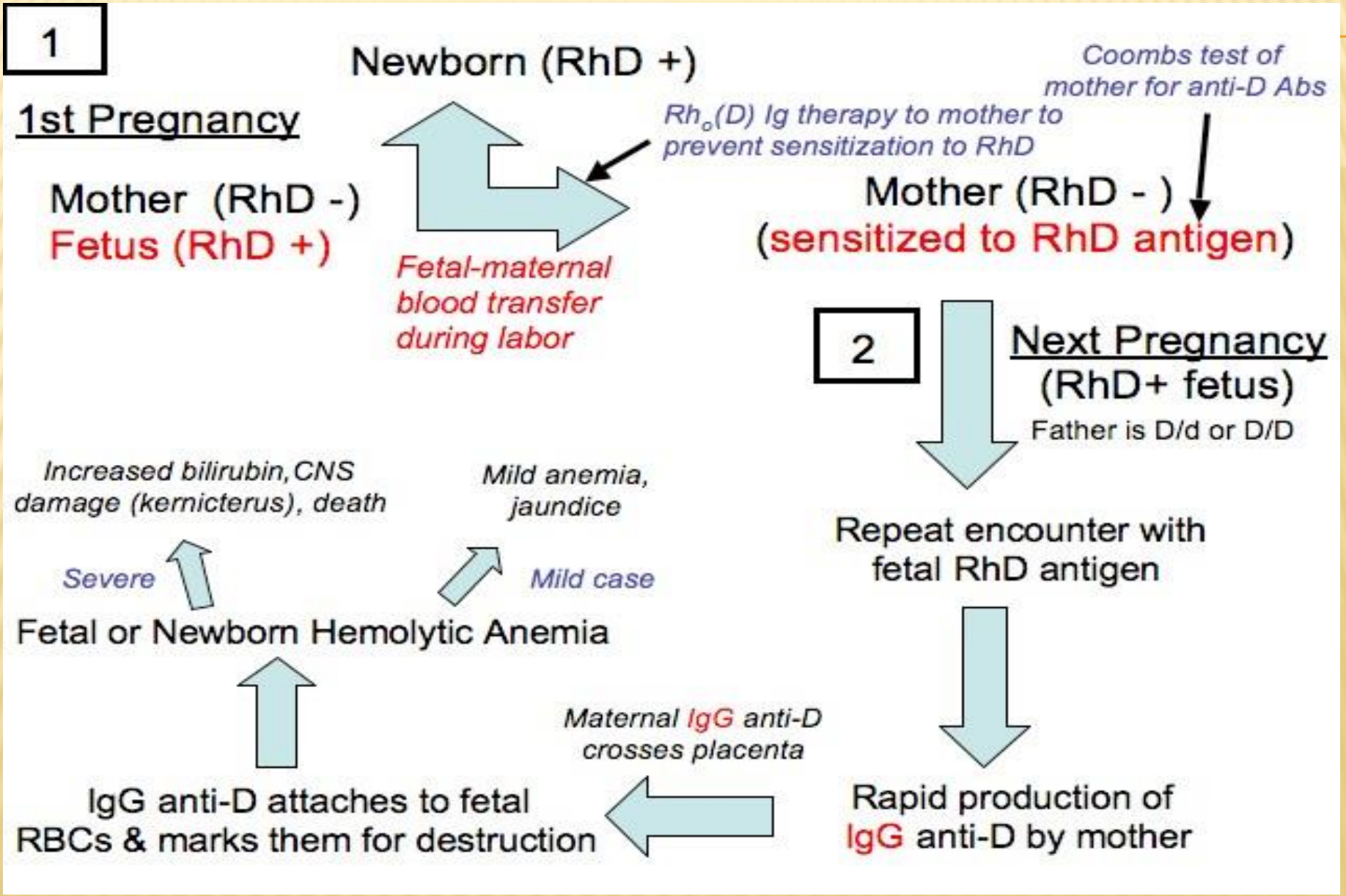
- No natural antibodies like ABO blood groups system.
- Rh antibodies are produced when Rh -ve individual is transfusu-ed with Rh +ve blood.

INHERITANCE OF RH BLOOD GROUPS





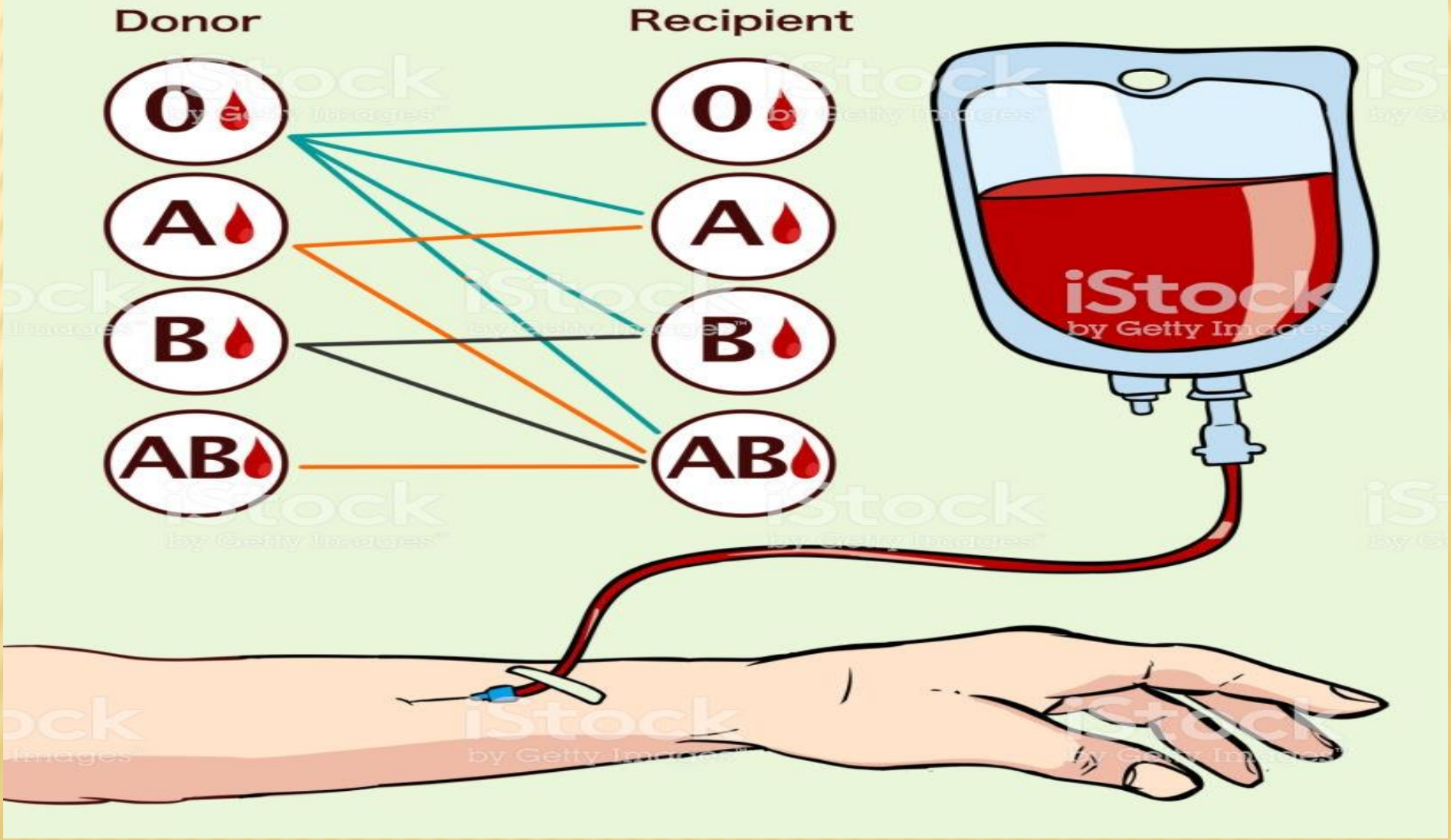
Mechanism of Hemolytic disease in newborn babies..



Clinical Applications of Blood Groups….

- In blood transfusion.
- In Preventing Hemolytic Disease.
- In Paternity Disputes.
- In Medico-legal Cases.
- In knowing Susceptibility to Diseases.

BLOOD TRANSFUSION



Indications of blood transfusion……..

- **Blood loss** – Accidents, major operations, rupture peptic ulcer, rupture aortic aneurysm & rupture ectopic pregnancy.
- **For Quick restoration of haemoglobin.**
- **Exchange transfusion.**
- **Blood diseases**- Aplastic anaemia, agranulocytosis, leukemias, purpurae & clotting defects
- **Acute poisoning** – Carbon monoxide poisoning.

Precautions to be taken during blood donar selection:

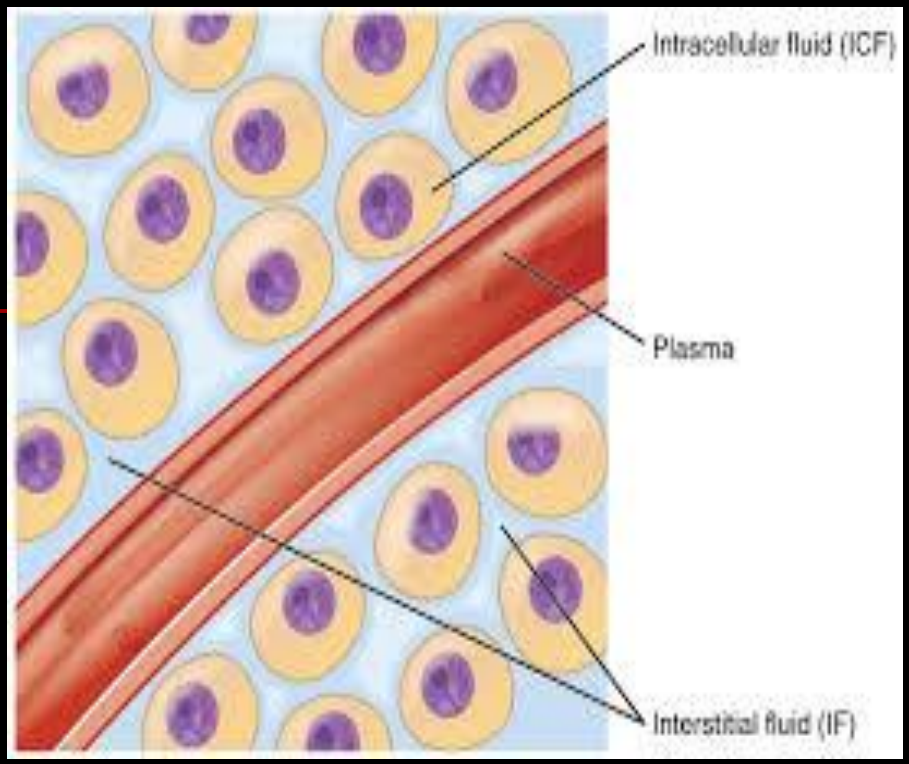
- ✓ Should be **Healthy**
- ✓ **Age** – 18- 60 yrs
- ✓ **Contraindicated** in pregnant & lactating mothers
- ✓ **Screening** for – AIDS, viral hepatitis, malaria, syphilis.

Hazards of blood transfusion:

- ✓ Agglutination of donor's RBC
- ✓ Tissue ischemia –chest pain or back pain
- ✓ Haemolysis of agglutinated RBC- Haemoglobinemia
- ✓ Haemolytic Jaundice
- ✓ Renal vasoconstriction
- ✓ Circulatory shock
- ✓ Haemoglobinuria.
- ✓ Renal tubular damage, acute renal shutdown & Uraemia.


THANK
YOU

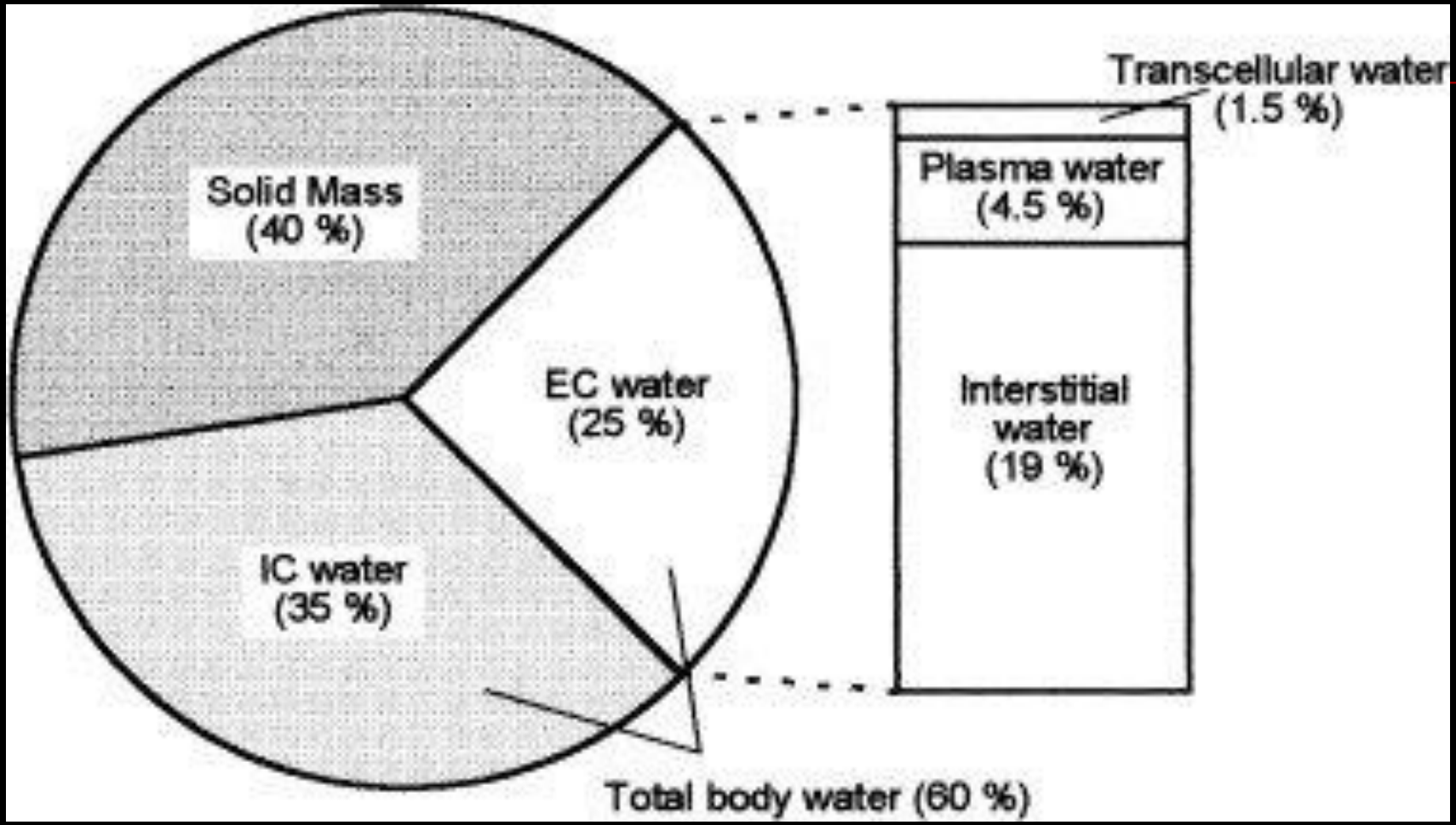
BODY FLUIDS



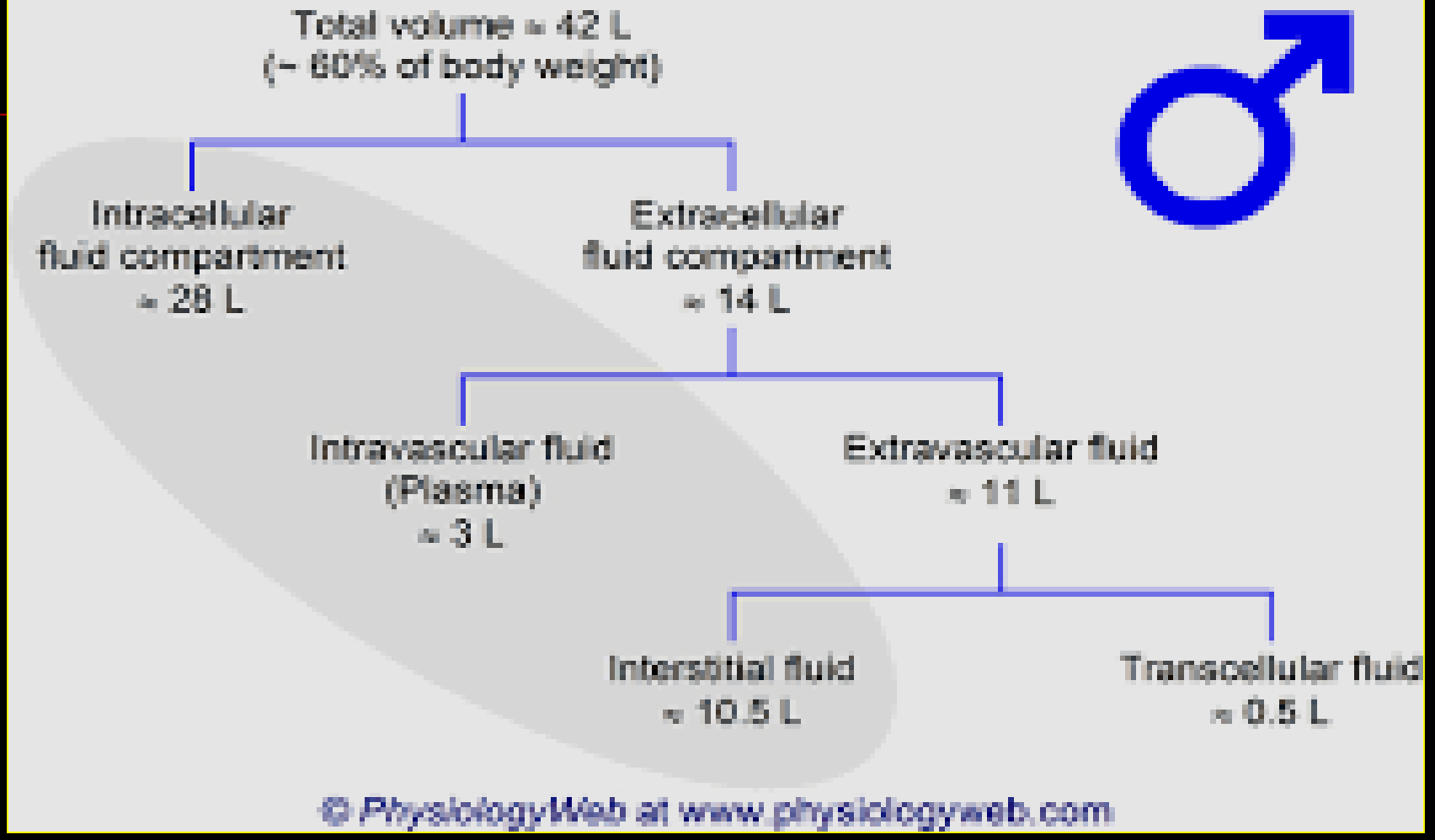
Body fluids

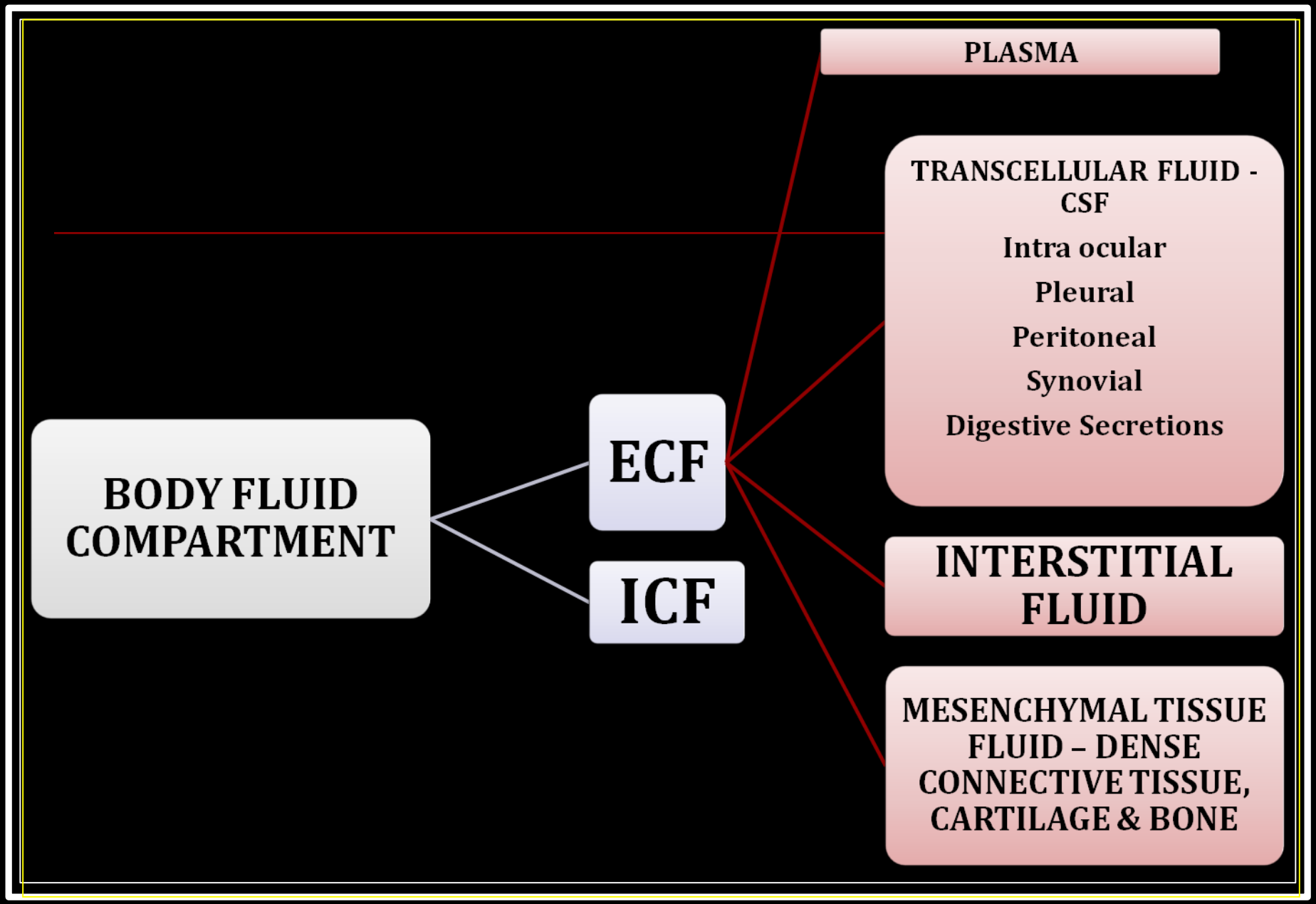
- Body contains many fluids differ in composition to meet their functions .The most important body fluids are :blood ,urine, milk, semen, cerebrospinal fluids , aqueous homour ,sweat , tear, lymph , amniotic fluids, synovial fluids,pericardial and peritoneal fluids.

BODY FLUID COMPARTMENTS



Body Fluid Compartments of a 70-kg Adult Man



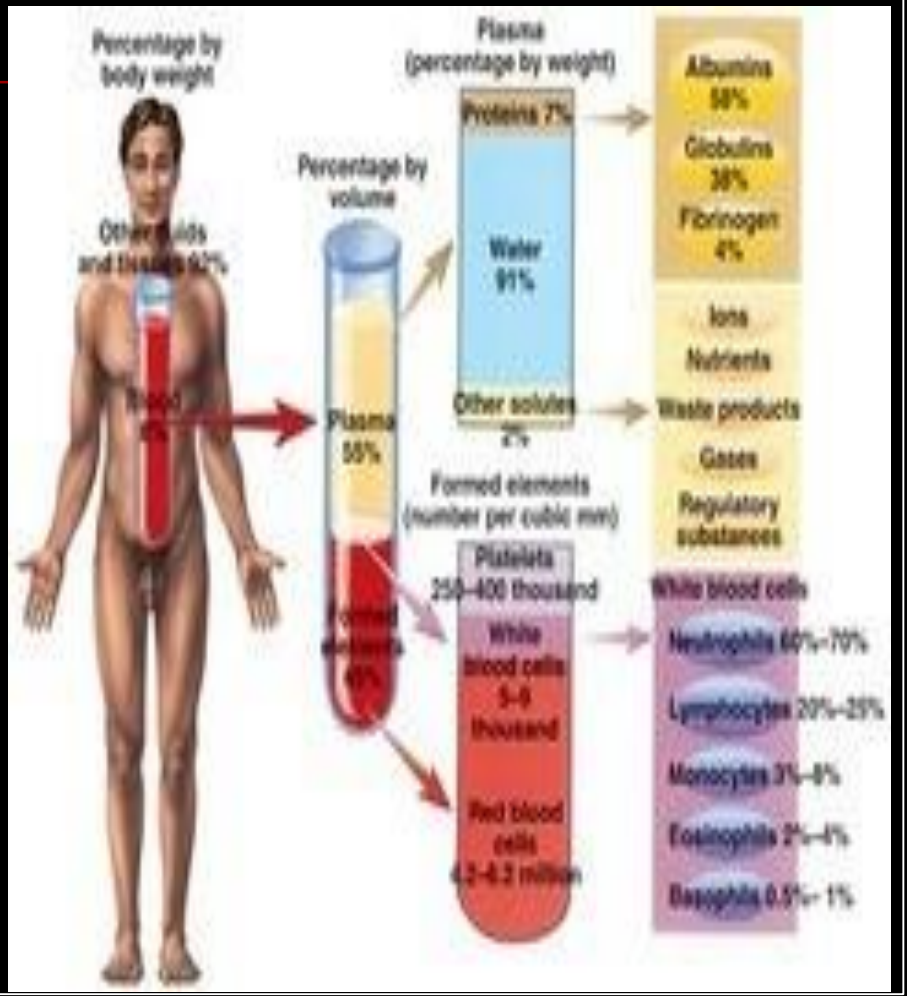

BODY FLUID COMPARTMENT
ECF
ICF
PLASMA
TRANSCELLULAR FLUID - CSF
Intra ocular
Pleural
Peritoneal
Synovial
Digestive Secretions
INTERSTITIAL FLUID
MESENCHYMAL TISSUE FLUID – DENSE CONNECTIVE TISSUE, CARTILAGE & BONE

COMPOSITION OF BODY FLUIDS

- Body fluids contain water and solids. Solids are organic and inorganic substances.

- **ORGANIC SUBSTANCES:**

  Glucose, amino acids, fatty acids, hormones and enzymes.

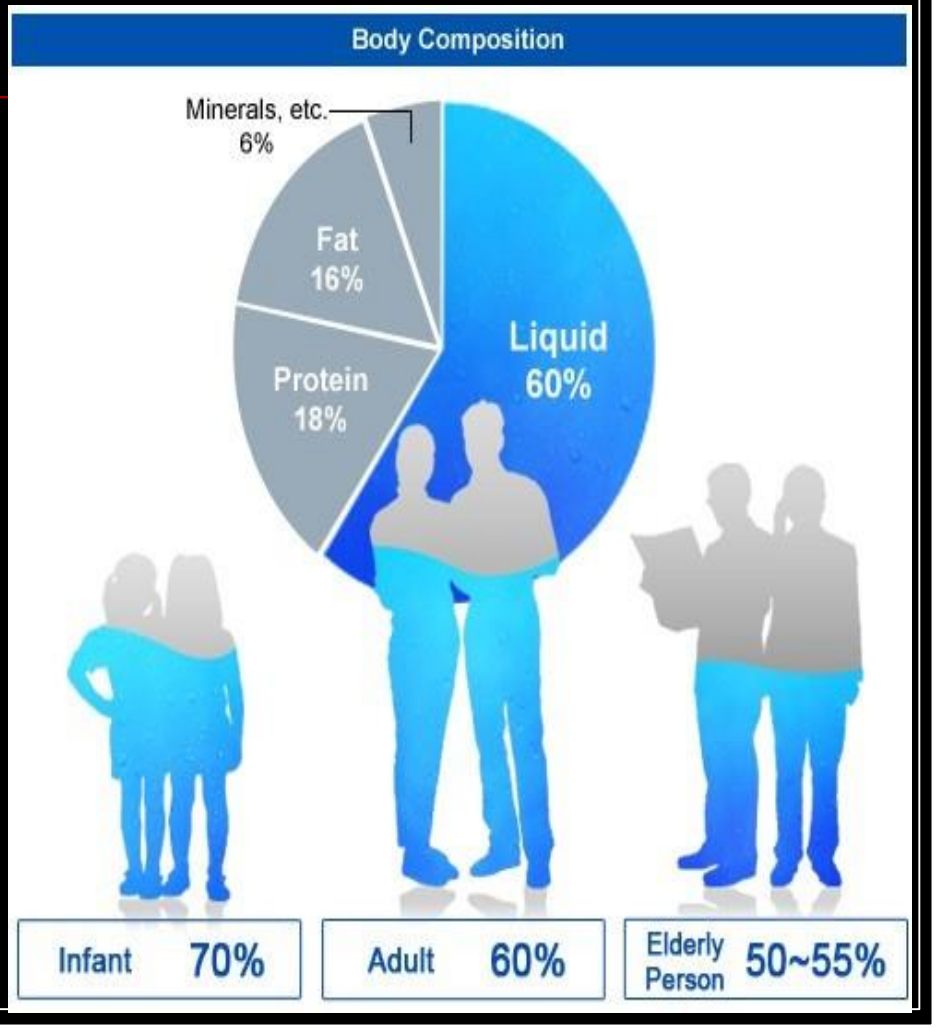


COMPOSITION OF BODY FLUIDS

INORGANIC SUBSTANCES:

- Extracellular fluid: contains large quantity of sodium, chlorides, bicarbonate, glucose, fatty acids and oxygen.
- Intracellular fluid: contains large quantities of potassium, magnesium, phosphates, sulphates and proteins.

PH of ECF is 7.4 PH of ICF is 7



PERCENTAGE OF WATER IN THE BODY

Total Body Water varies depending on body fat:

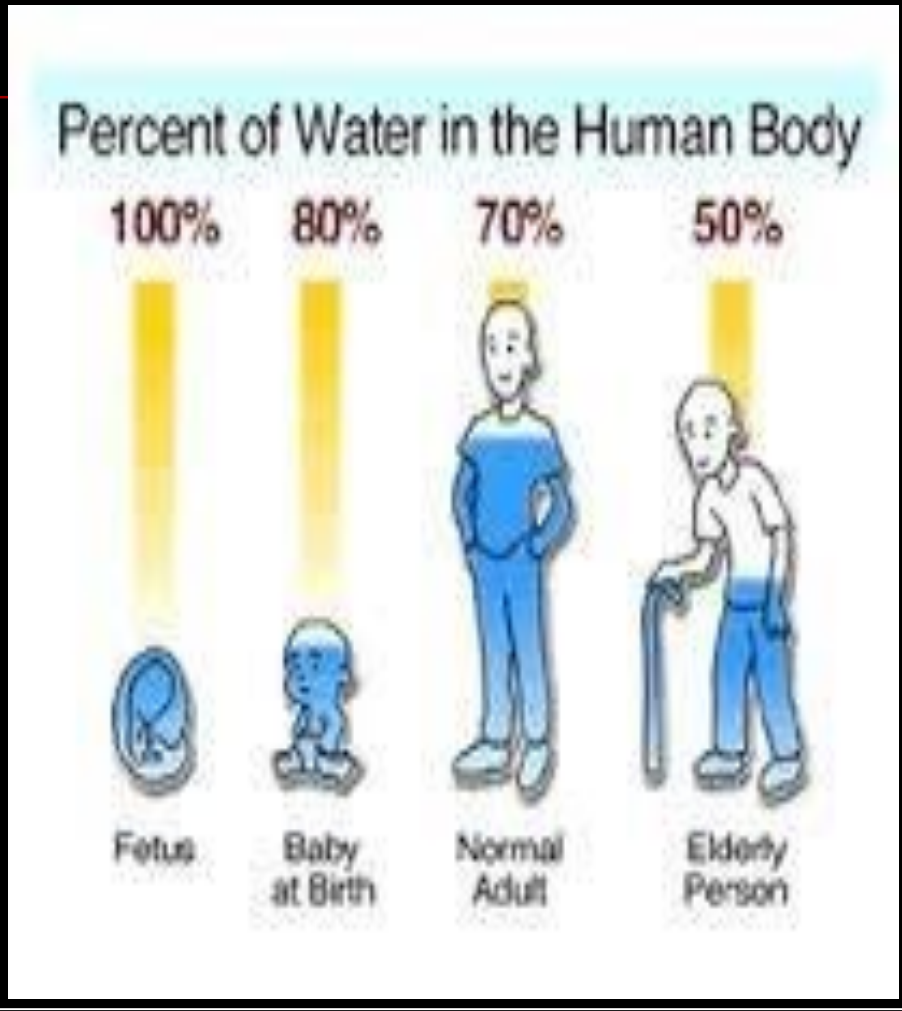
Fetus: 100%

Infant: 80%

Male adult: 60%

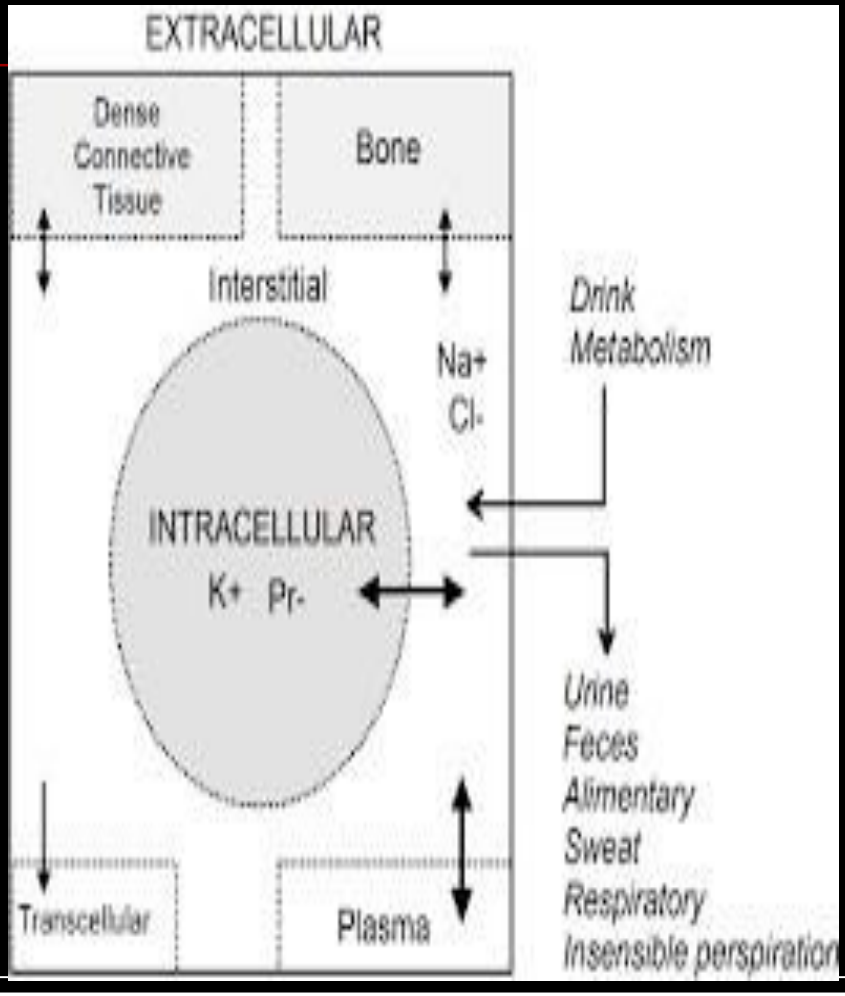
Female adult: 40-50%

Old age 50%



MOVEMENT OF BODY FLUIDS

- ✓ Body fluids are not static.
- ✓ Fluids & electrolytes shift from compartment to compartment.
- ✓ Emphasis is always on maintaining homeostasis



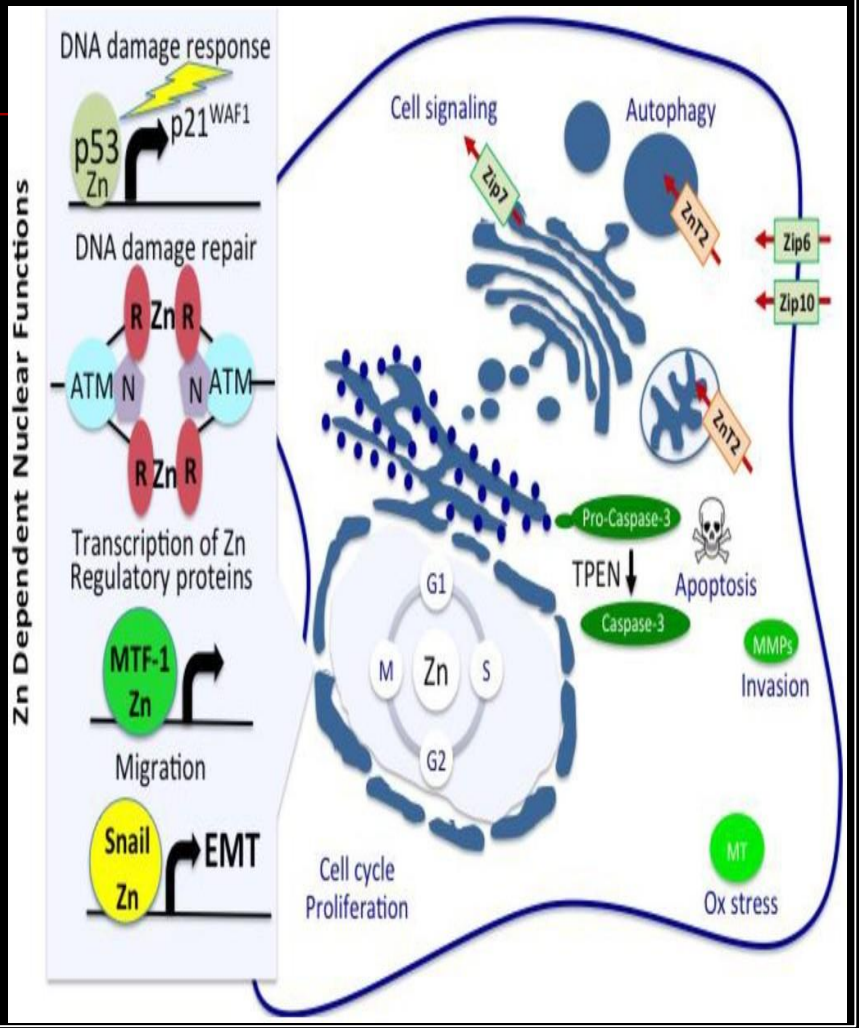
SIGNIFICANCE OF BODY FLUIDS

In Homeostasis:

- Body cells survive in the fluid medium called ***internal environment or milieu interior.***

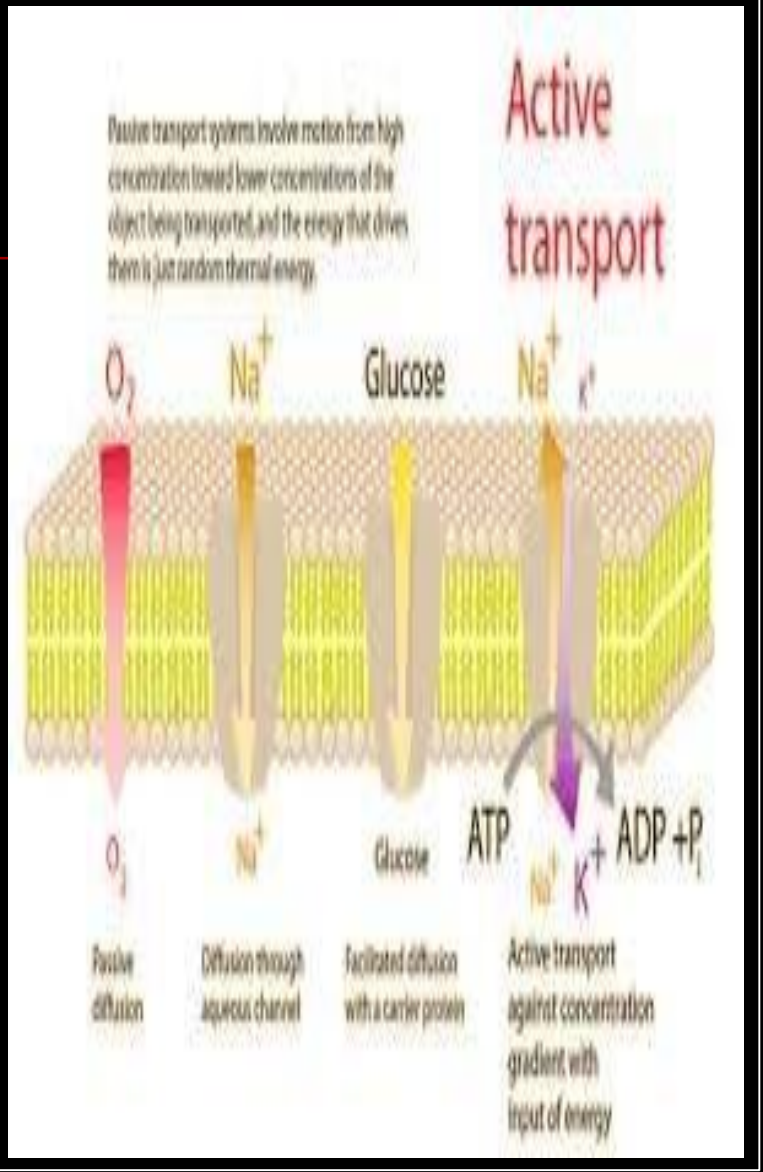
Growth and functions of cells:

Glucose, amino acids, lipids, vitamins, ions and oxygen helps in the growth of cells of the body



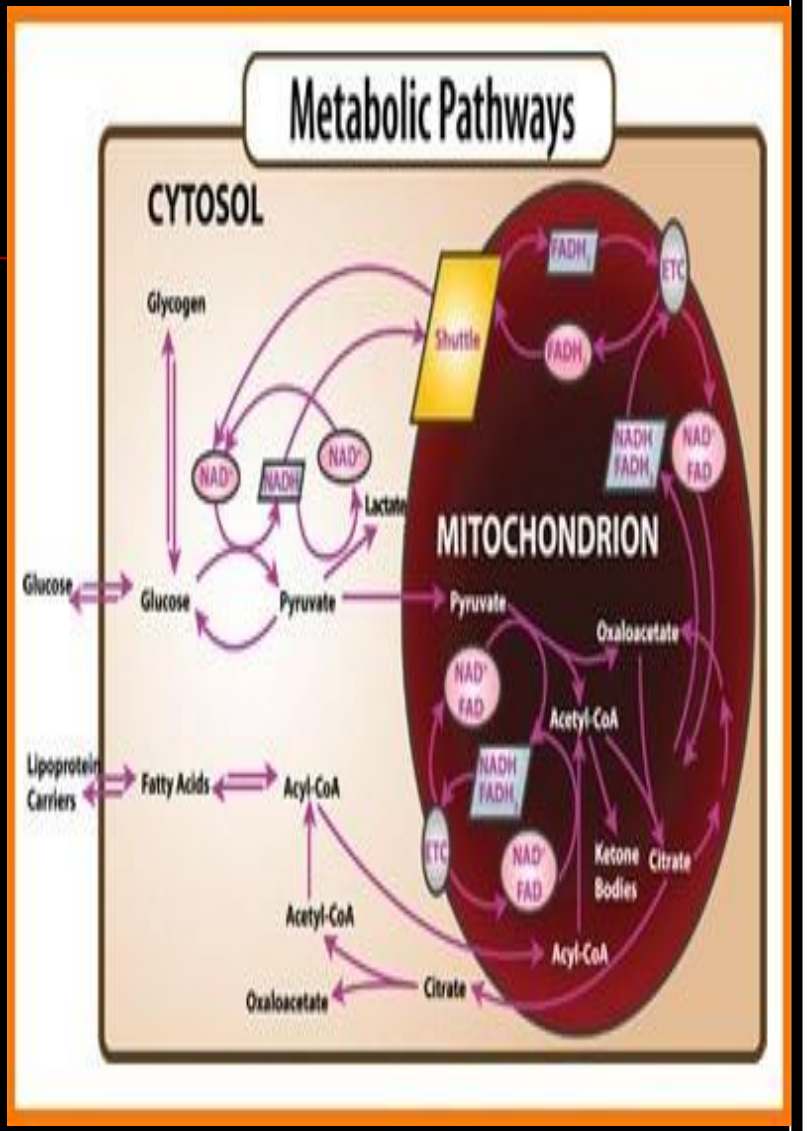
In Transport mechanism:

Body water forms the transport medium by which nutrients and other essential substances enter the cells and wastes come out of the cells.



In Metabolic reactions:

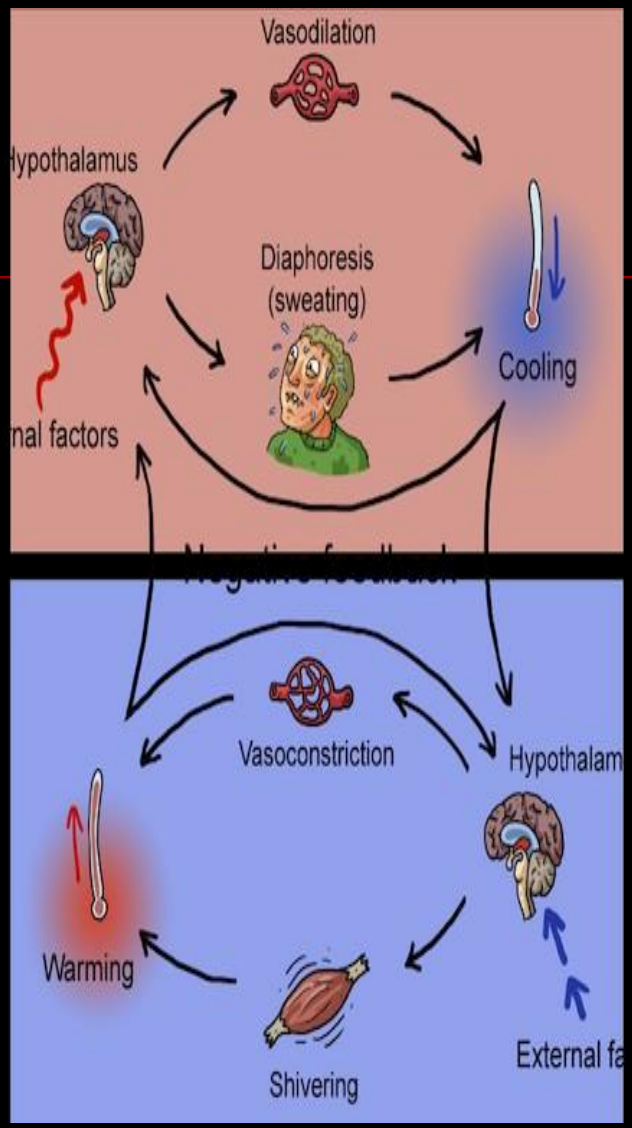
Water inside the cells forms the medium for various metabolic reactions, which are necessary for growth and functional activities of the cells.



In Texture of tissues :

Water inside the cells is necessary for the characteristic form and texture of various tissues.

- ***In Temperature regulation :***
- Body water plays a vital role in the maintenance of normal body temperat



REGULATORY MECHANISMS:

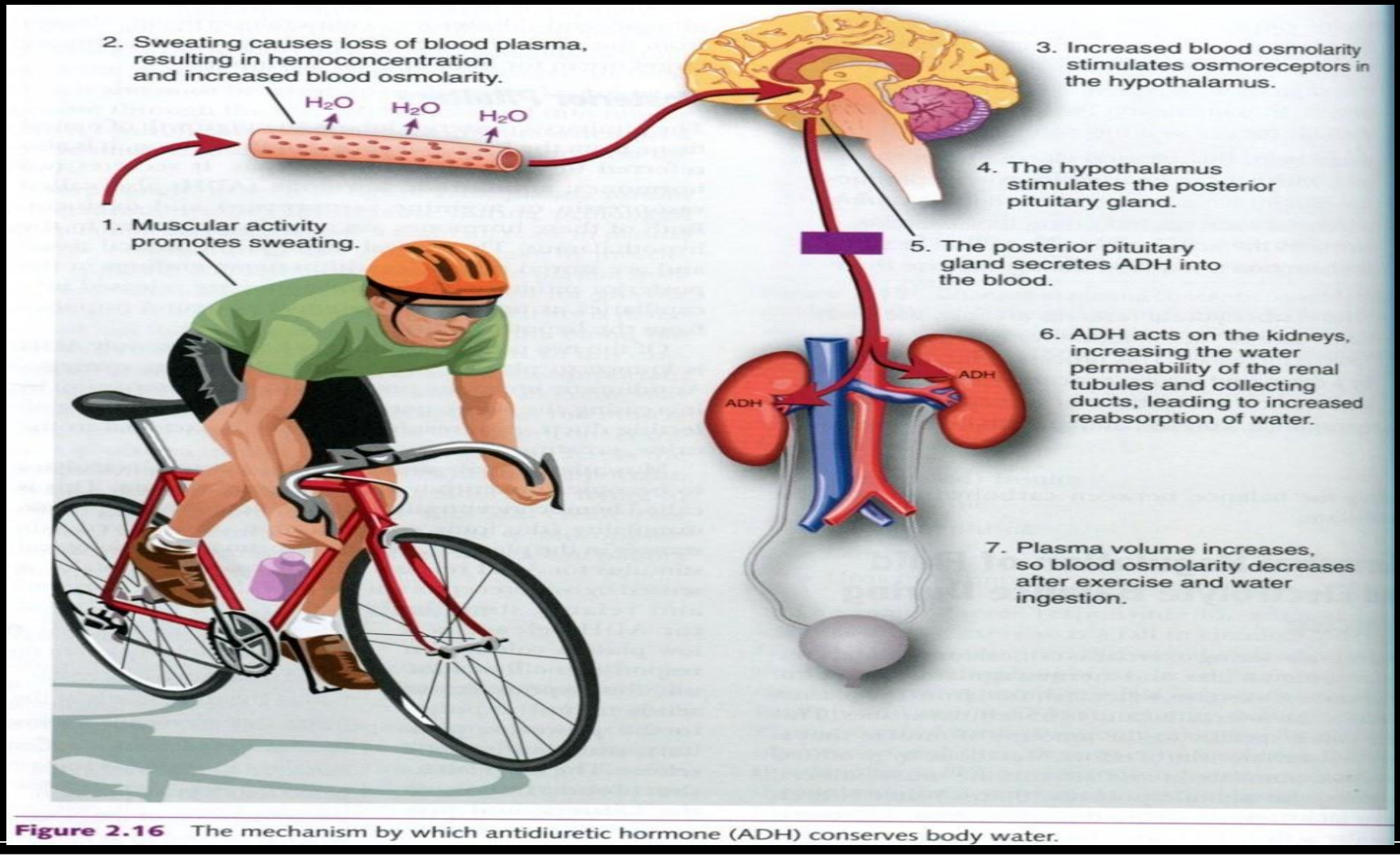


Figure 2.16 The mechanism by which antidiuretic hormone (ADH) conserves body water.


Thank
you !!!
...

COAGULATION MECHANISM

Homostasis…

Hemostasis is defined as arrest or stoppage of bleeding.

When a blood vessel is injured, the injury initiates a series of reactions, resulting in hemostasis. It occurs in three stages.

STAGES OF HEMOSTASIS

- ✓ **Vasoconstriction**
- ✓ **Platelet plug formation**
- ✓ **Coagulation of blood.**

VASOCONSTRICTION

- **Immediately after injury, the blood vessel constricts and decreases the loss of blood from the damages portion.**
- **When the blood vessels are cut, the endothelium is damaged and the collagen is exposed.**
- **Platelets adhere to this collagen and get activated.**
- **The activated platelets secrete serotonin and other vasoconstrictor substances which cause constriction of the blood vessels.**
- **Adherence of the platelets to the collagen is accelerated by Von Willebrand factor.**
- **This factor acts as a bridge between a specific glycoprotein present on the surface of platelet and collagen fibrils.**

Vasoconstriction

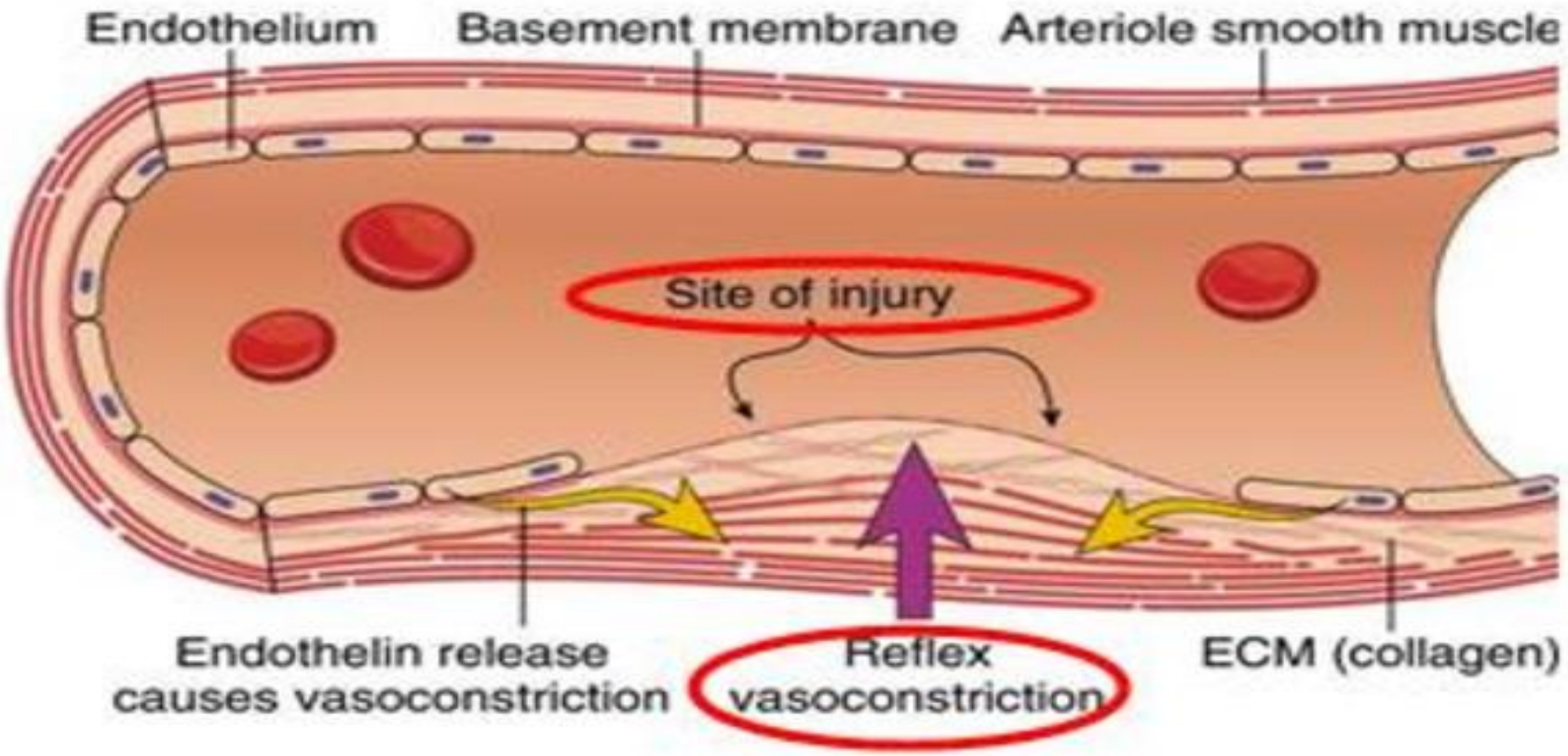
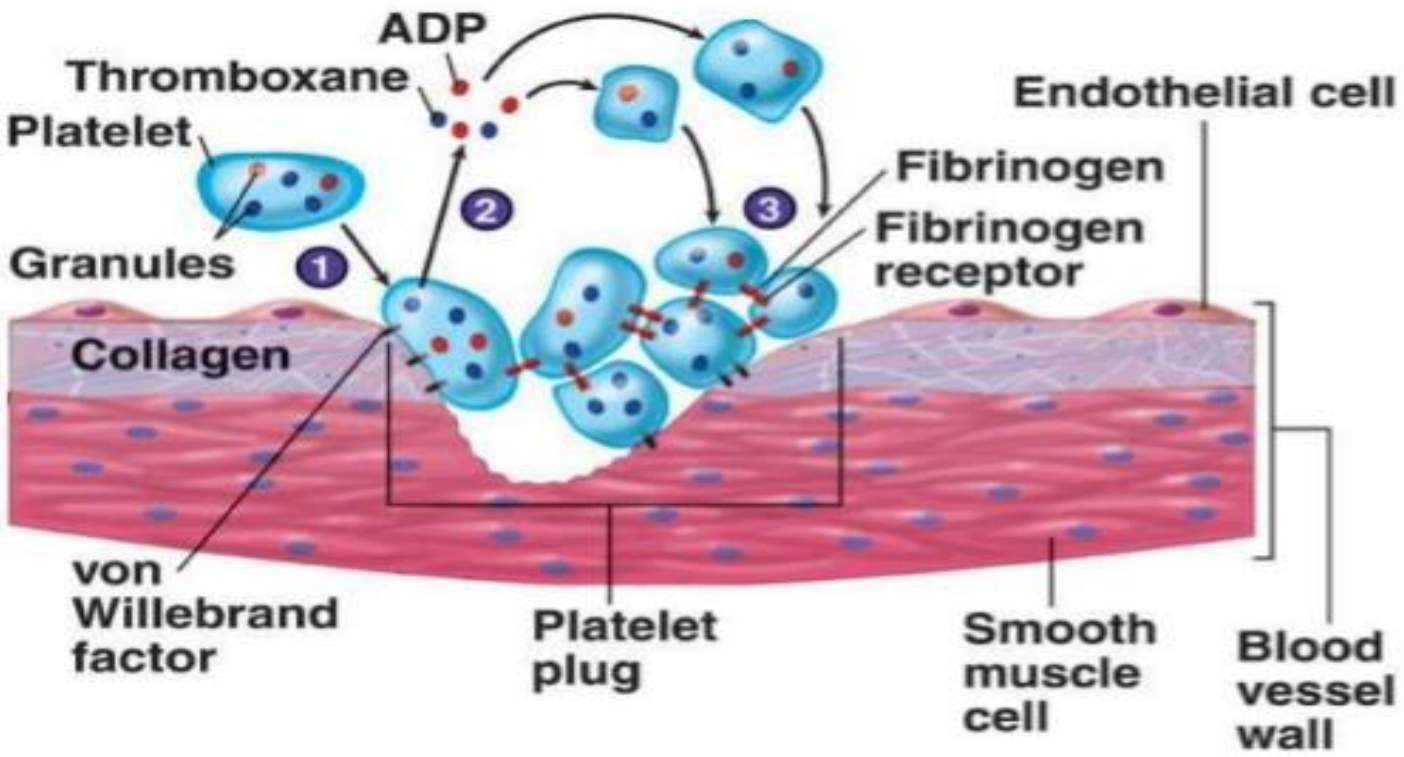


Figure 2. Vasoconstriction phase. Primary hemostasis is characte

PLATELET PLUG FORMATION

- **Platelets get adheres to the collagen of ruptured blood vessel and secrete adenosine diphosphate (ADP) and thromboxane-A.**
- **These two substances attract more and more platelets and activate them.**
- **All these platelets aggregate together and form a loose temporary platelet plug or temporary hemostatic plug, which close the ruptured vessel and prevent further blood loss.**
- **Platelet aggregation is accelerated by Platelet Activating Factor (PAF).**

Platelet Plug Formation



Von Willebrand Factor : A large blood protein that plays an important role in platelet gathering at the site of a wound

COAGULATION OF BLOOD

✓ **During this process , the fibrinogen is converted into fibrin.**

✓ **Fibrin threads get attached to the loose platelet plug, which plugs the ruptured part of blood vessels and prevents further blood loss completely.**

- **Coagulation or clotting is defined as the process in which blood losses its fluid and becomes a jelly like mass few minutes after it is shed out.**

FACTORS INVOLVED IN BLOOD CLOTTING:

- Factor I: Fibrinogen
- Factor II: Prothrombin
- Factor III: Thromboplastin
- Factor IV: Calcium
- Factor V: Labile factor
- Factor VI: Prescence has not been proved
- Factor VII: Stable Factor
- Factor VIII: Antihemophilic
- Factor IX: Christmas factor
- Factor X: Stuart factor
- Factor XI: Plasma Thromboplastin antecedent
- Factor XII: Hagan factor
- Factor XIII: Fibrin stabilizing factor

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STEPS OF BLOOD CLOTTING

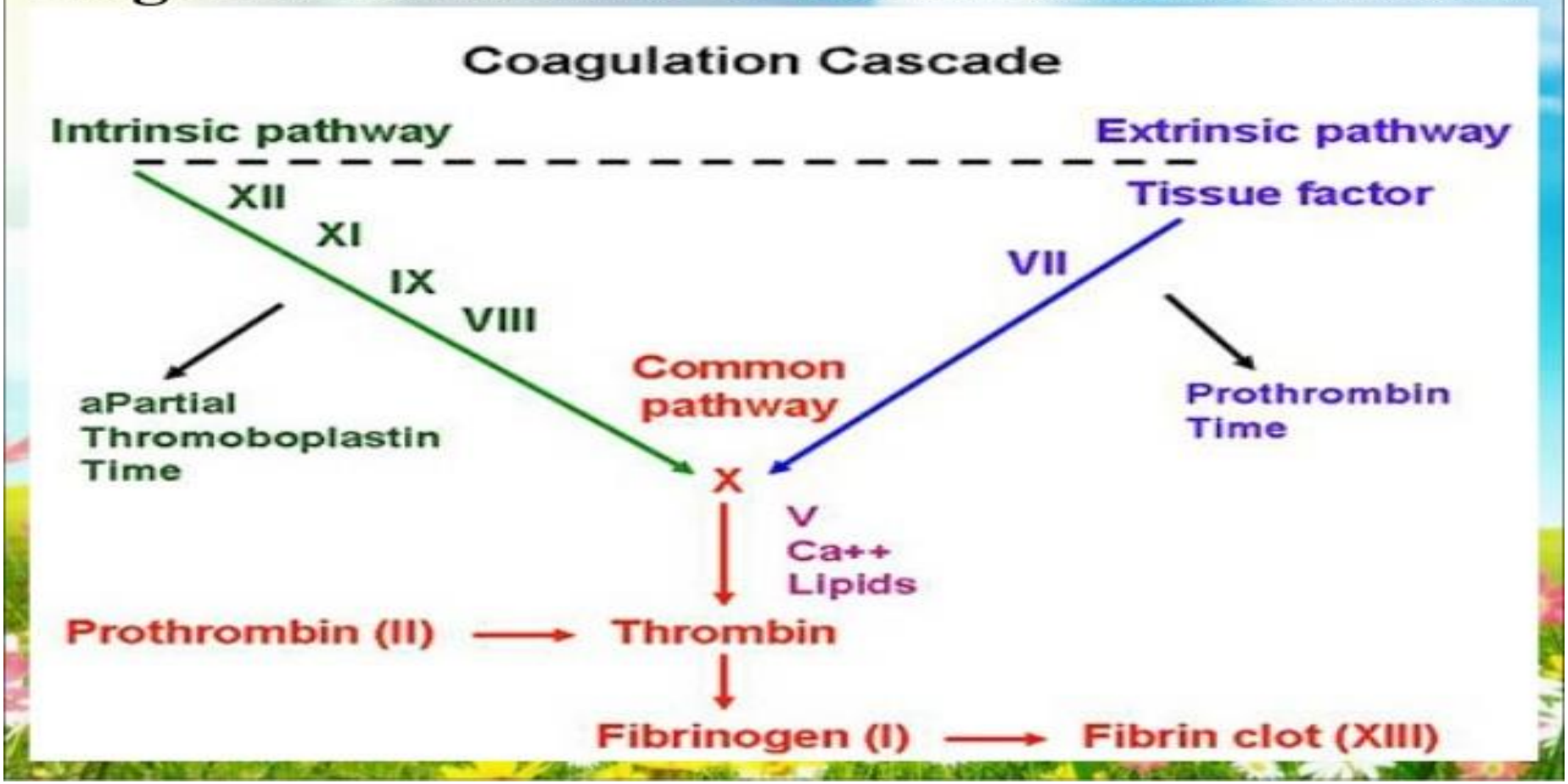
In general blood clotting occurs in three stages.

1) **Formation of Prothrombin activator**

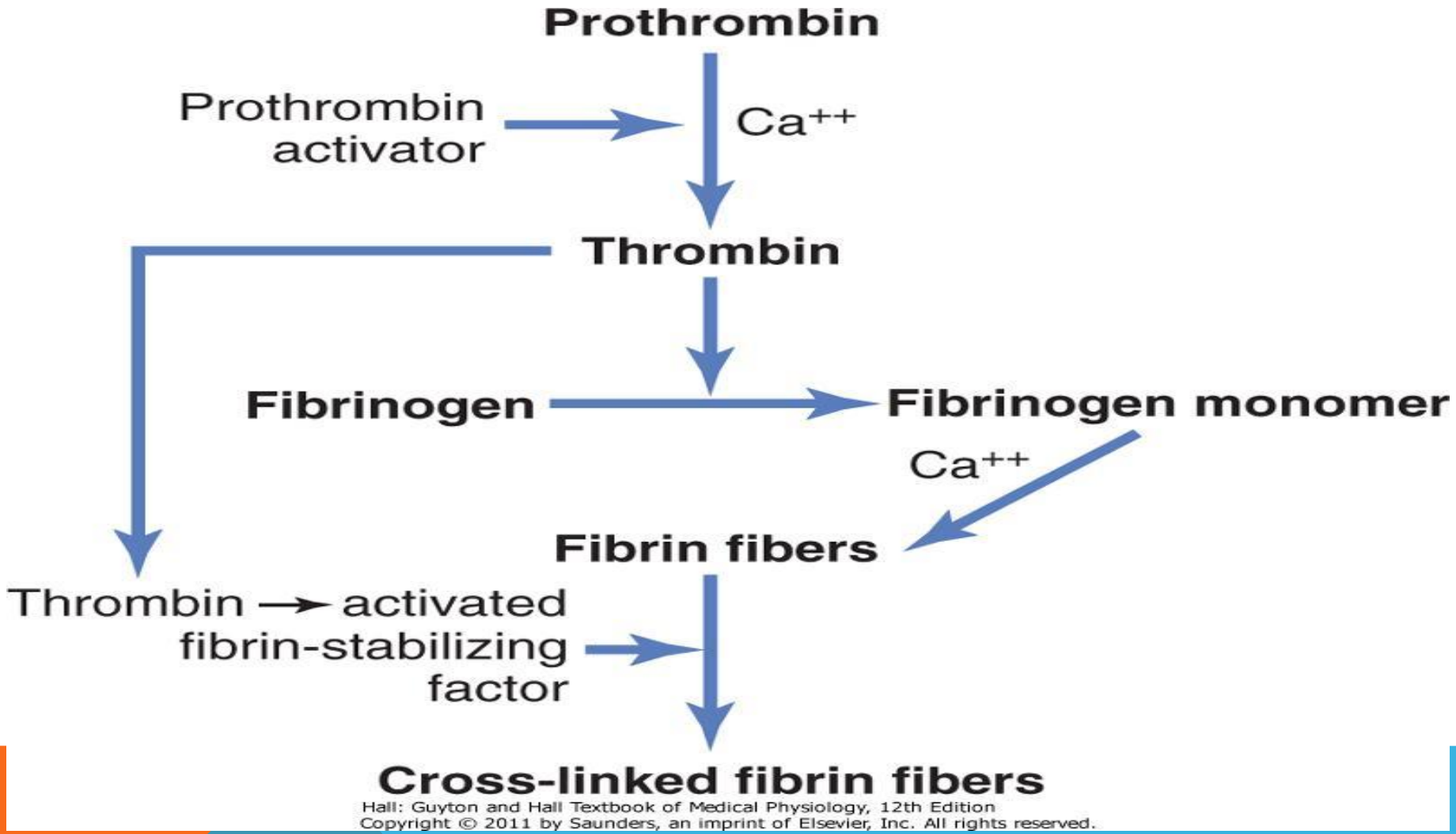
2) **Conversion of prothrombin into thrombin**

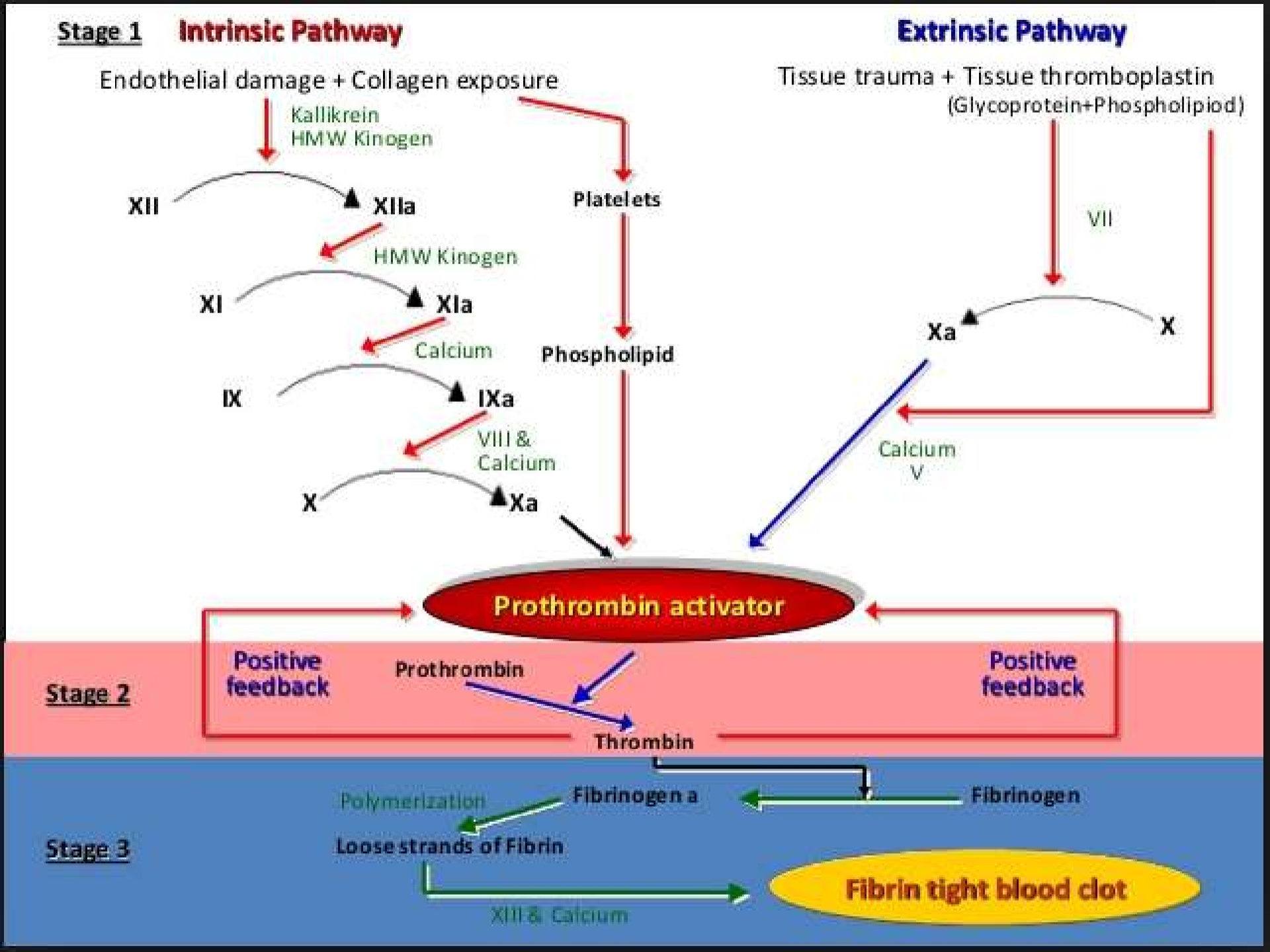
3) **Conversion of fibrinogen into fibrin**

Stage 1 : Formation of Prothrombin activator



Stage 2 & 3:




Stage 1
Intrinsic Pathway
Extrinsic Pathway
Endothelial damage + Collagen exposure
Tissue trauma + Tissue thromboplastin
(Glycoprotein+Phospholipiod)
Kallikrein
HMW Kinogen
XII
XIIa
Platelets
VII
HMW Kinogen
XI
XIa
Calcium
Phospholipid
Xa
X
IX
IXa
VIII &
Calcium
Calcium
V
X
Xa
Prothrombin activator
Positive
feedback
Prothrombin
Positive
feedback
Stage 2
Thrombin
Polymerization
Fibrinogen a
Fibrinogen
Stage 3
Loose strands of Fibrin
Fibrin tight blood clot
XIII & Calcium


Thank You
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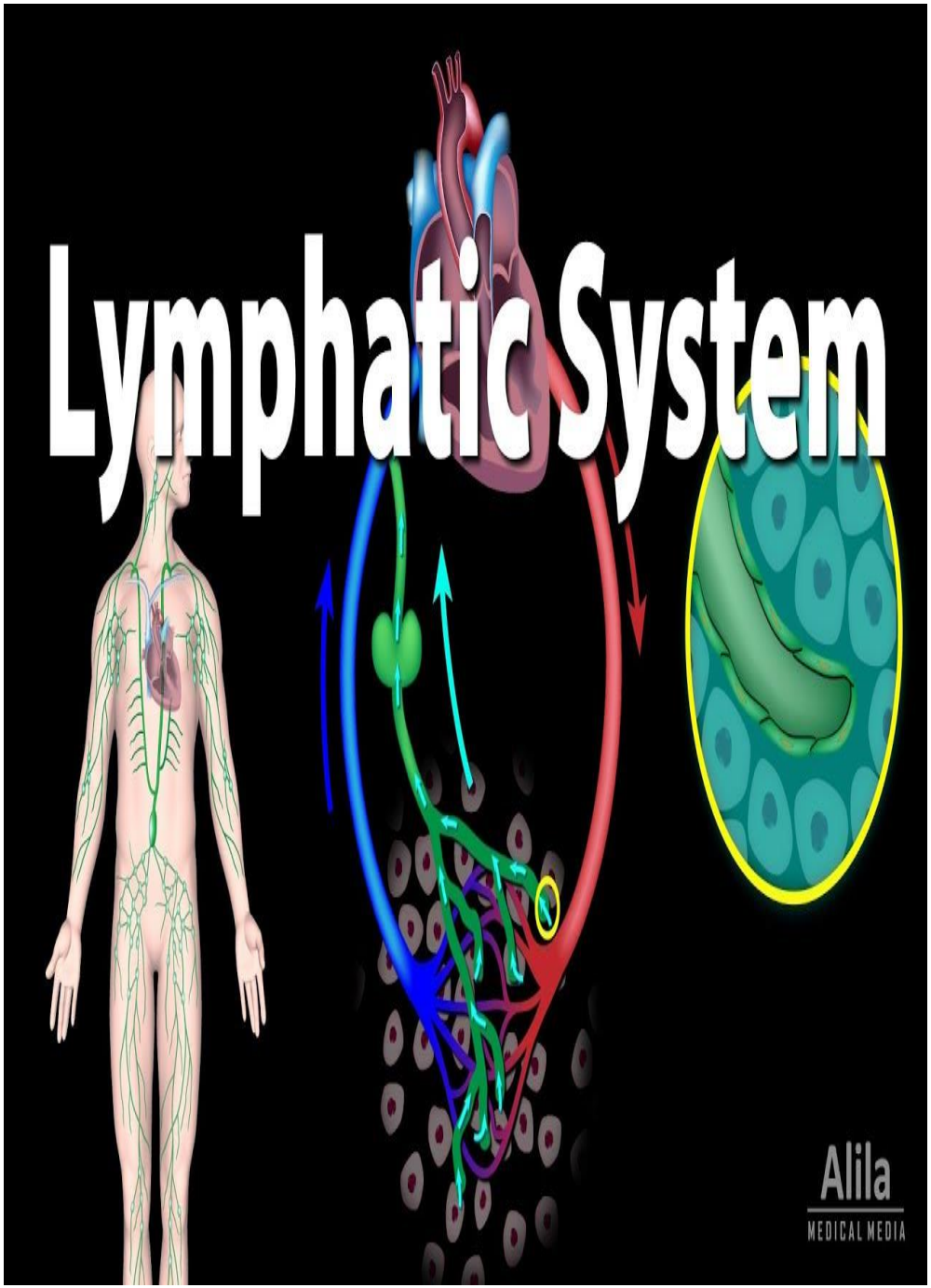
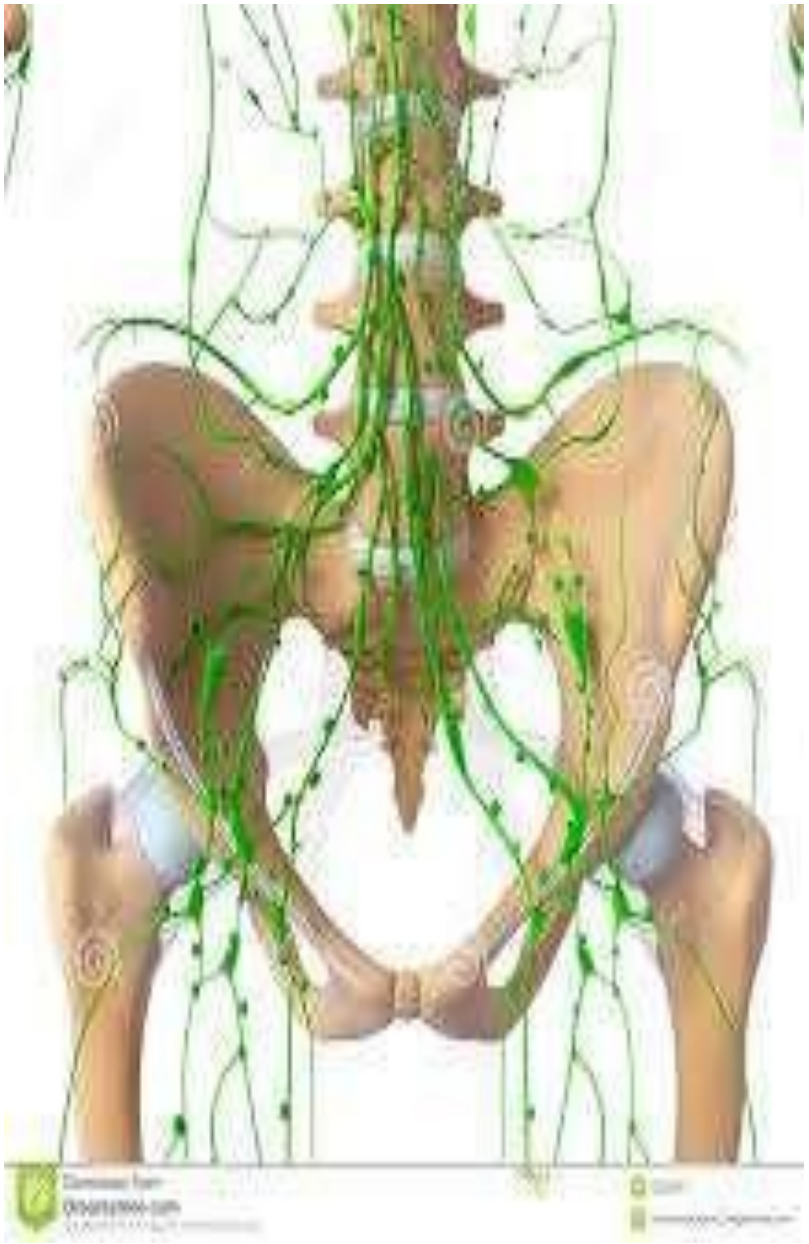

Lymphatic System
Alila
MEDICAL MEDIA



Introduction

- ✓All body tissues are bathed in tissue fluid, consisting of the diffusible constituent of blood & waste material from cell. Some tissue fluid returns to capillaries at their venous and the remainder defuses through the more permeable wall of the lymph capillaries, forming lymph.

- ✓ Cardiovascular & lymphatic system both supplies fluid flow into the body but both are deferent type of fluid.

- ✓ Lymphatic system do not have closed circuit & central pump like heart.

Lymphatic system consist of.....

Lymph

Lymph vessels

Lymph node

_Lymph organ eg. Spleen, Thymus

Diffuse lymphoid tissue eg. Tonsil

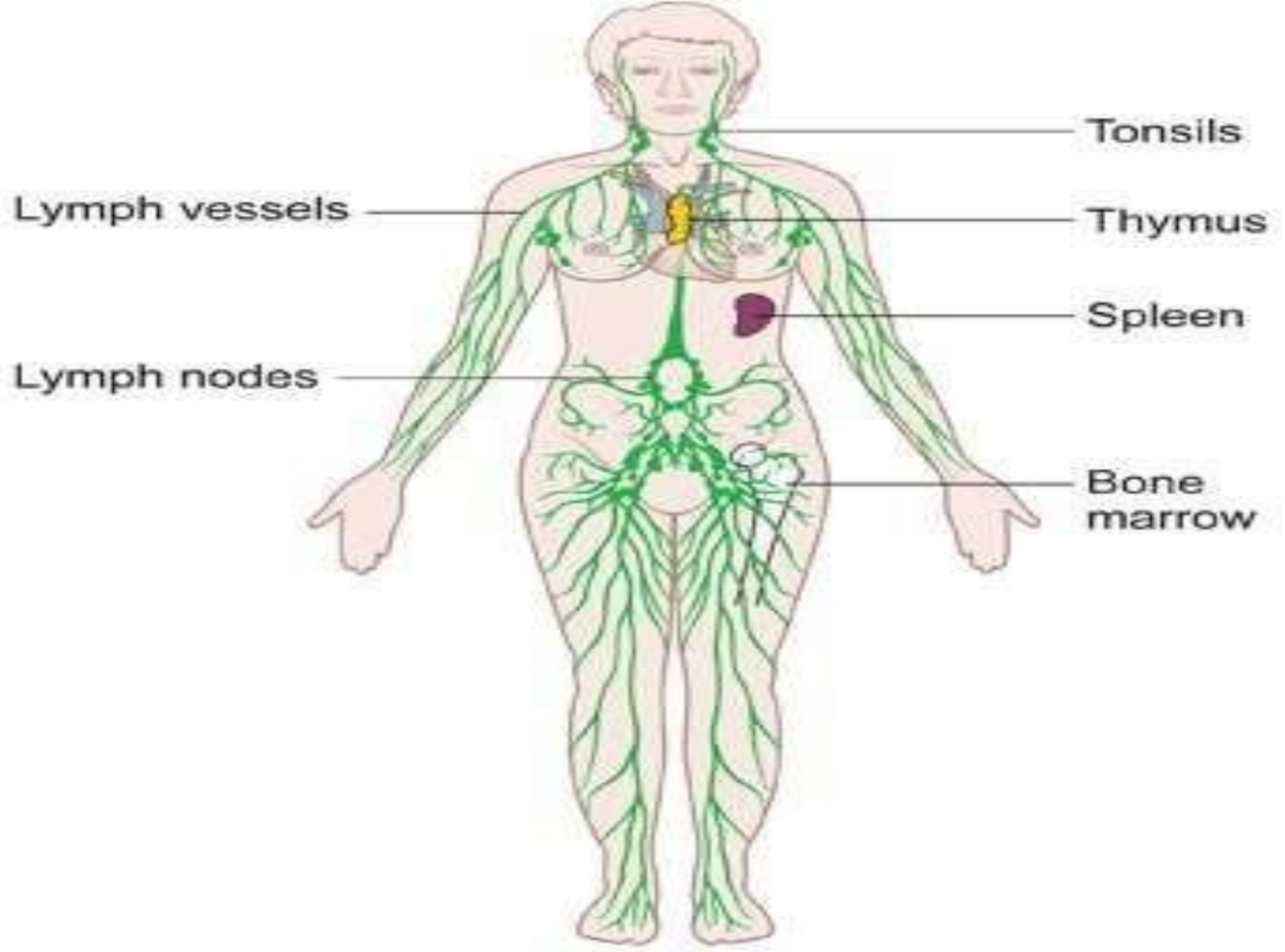
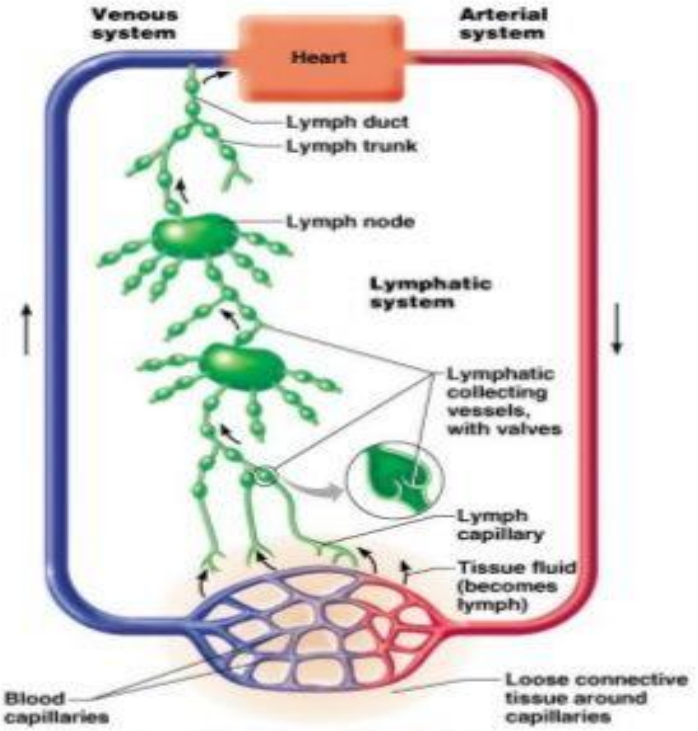


Diagram of the lymphatic system

Functions of lymphatic system…..

The Lymphatic System

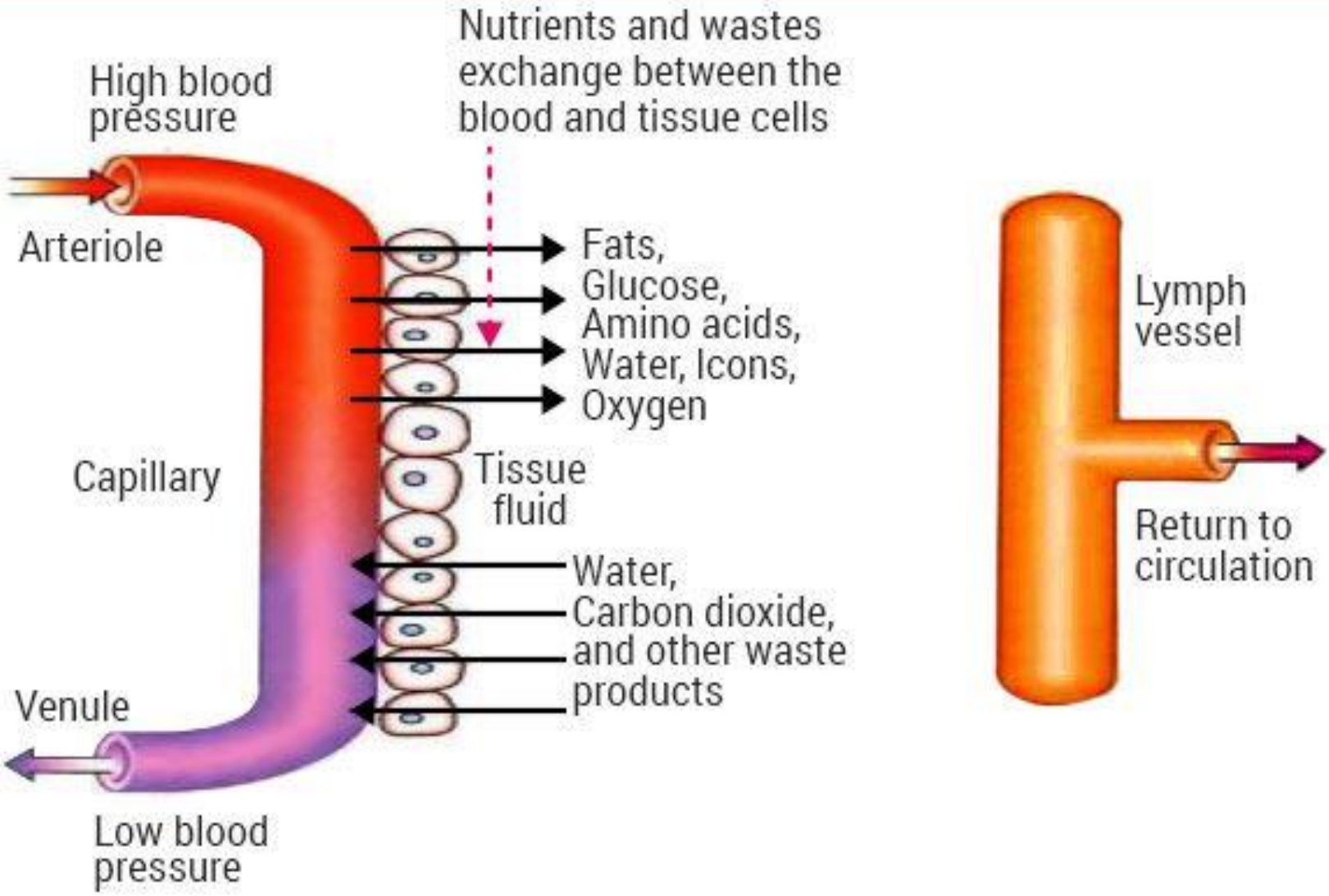
- Lymphatic system functions:
  - Transport clean fluids back to the blood
  - Drains excess fluids from tissues
  - Removes “debris” from cells of body
  - Transports fats from digestive system



Lymph…..

- After blood travels through capillary beds and is moved to the venous system, some of its fluid is left behind in the tissues called lymph.
- Lymph is a clear, colorless liquid with a composition similar to blood plasma.
- It is nothing but the clear, watery blood plasma leaked out through the capillary walls to flow around the cells.
- It contains oxygen, proteins, glucose and white blood cells.

COMPOSITION OF THE LYMPH



The origin on lymph :-

the cardiovascular system pumps blood through its system but it cannot return all the fluid from the body cells.

The lymph system picks up 60%of the fluid dropped off at the cellular level,

at this point we are talking about interstial fluid, the IF picks up plasma and becomes tissue fluid

The tissue fluid is then picked up by lymph capillaries,

the tissue fluid is called *lymph*

FUNCTIONS OF LYMPH….

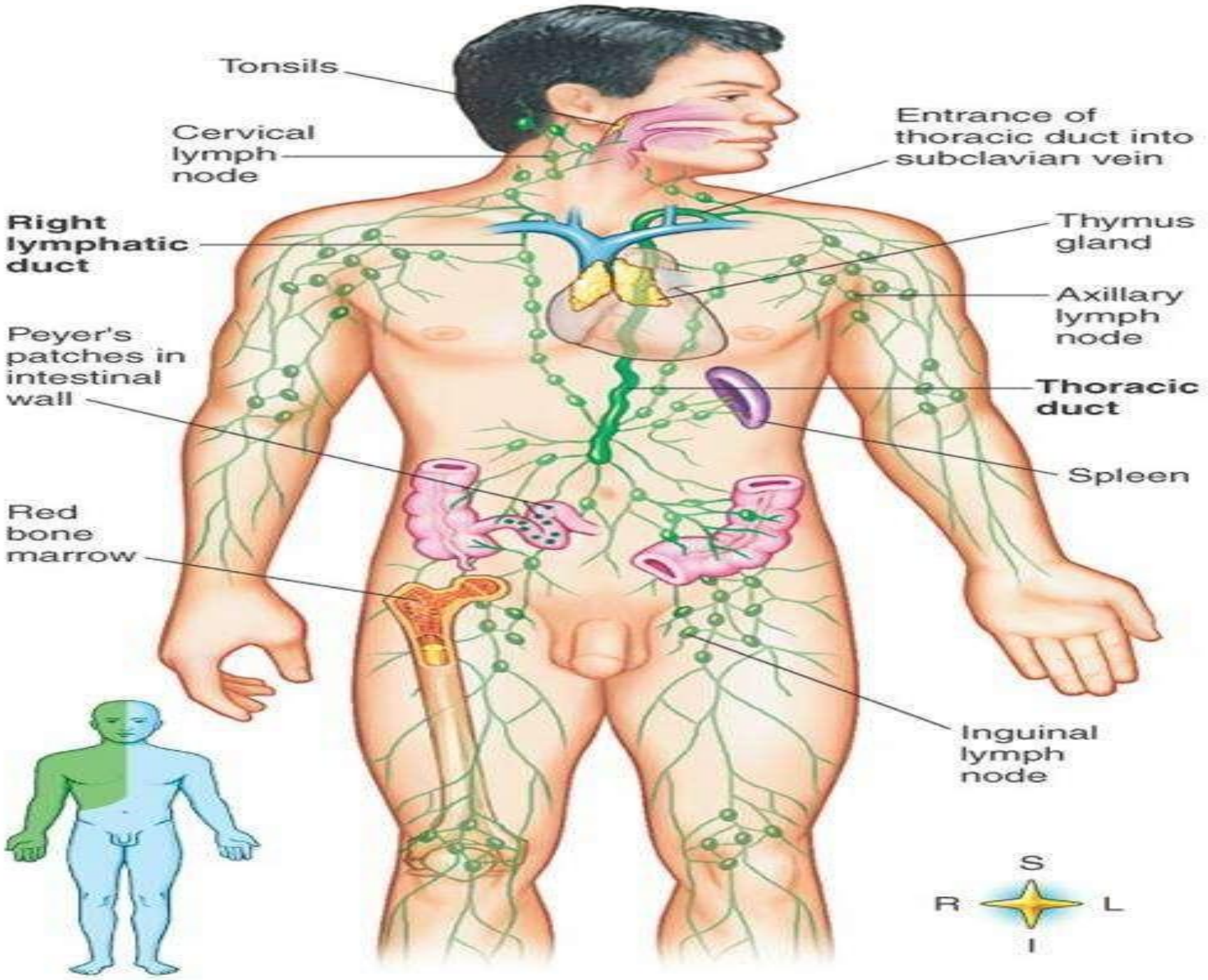
- Lymph acts as a "middle man" which transports oxygen, food materials, hormones etc. to the body cells
- It brings carbon dioxide and other metabolic wastes from the body cells to blood and then finally pours the same into the venous system.
- Body cells are kept moist by the lymph.
- It destroys the invading microorganisms and foreign particles in the lymph nodes

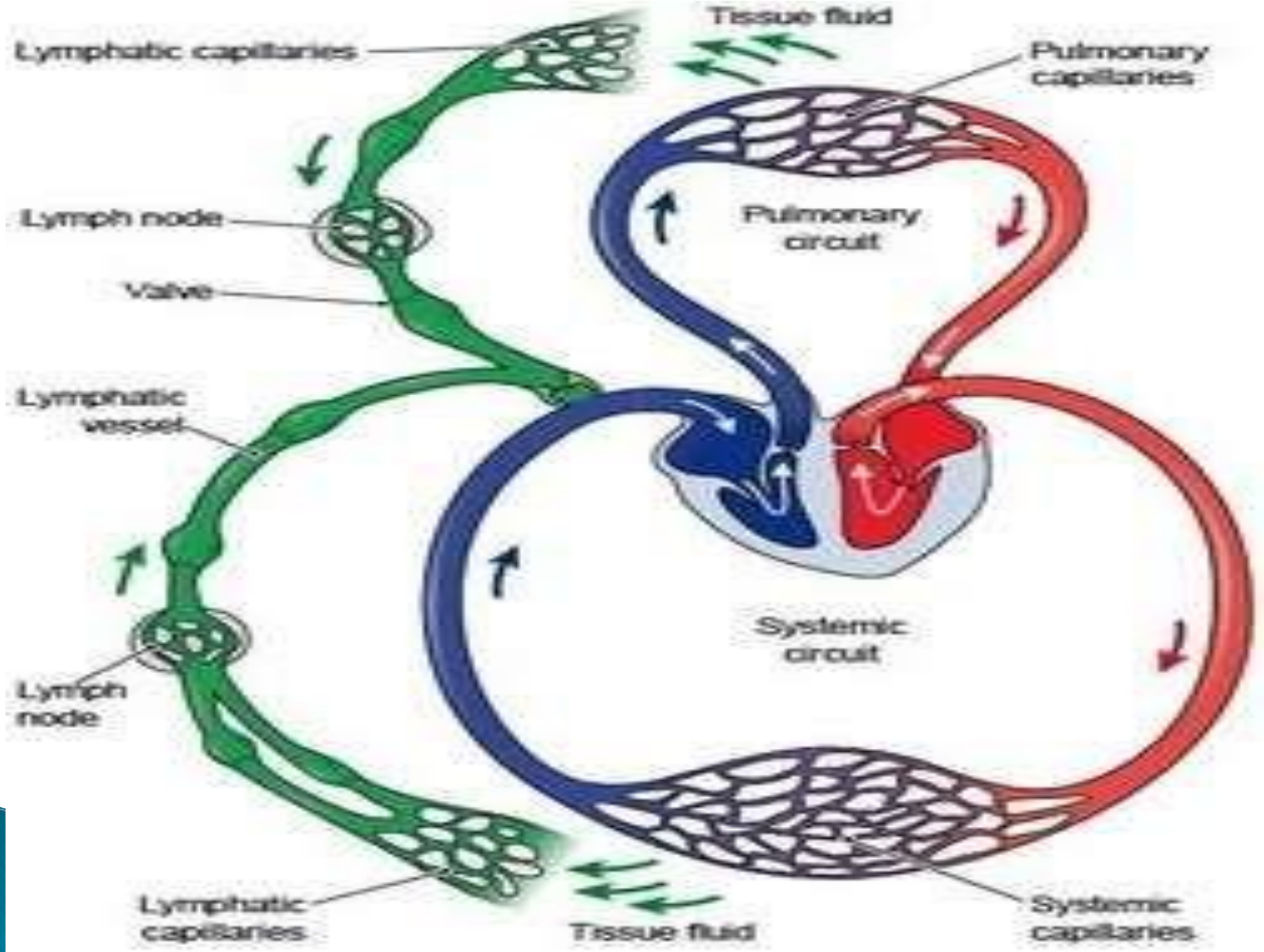
Lymph vessels….

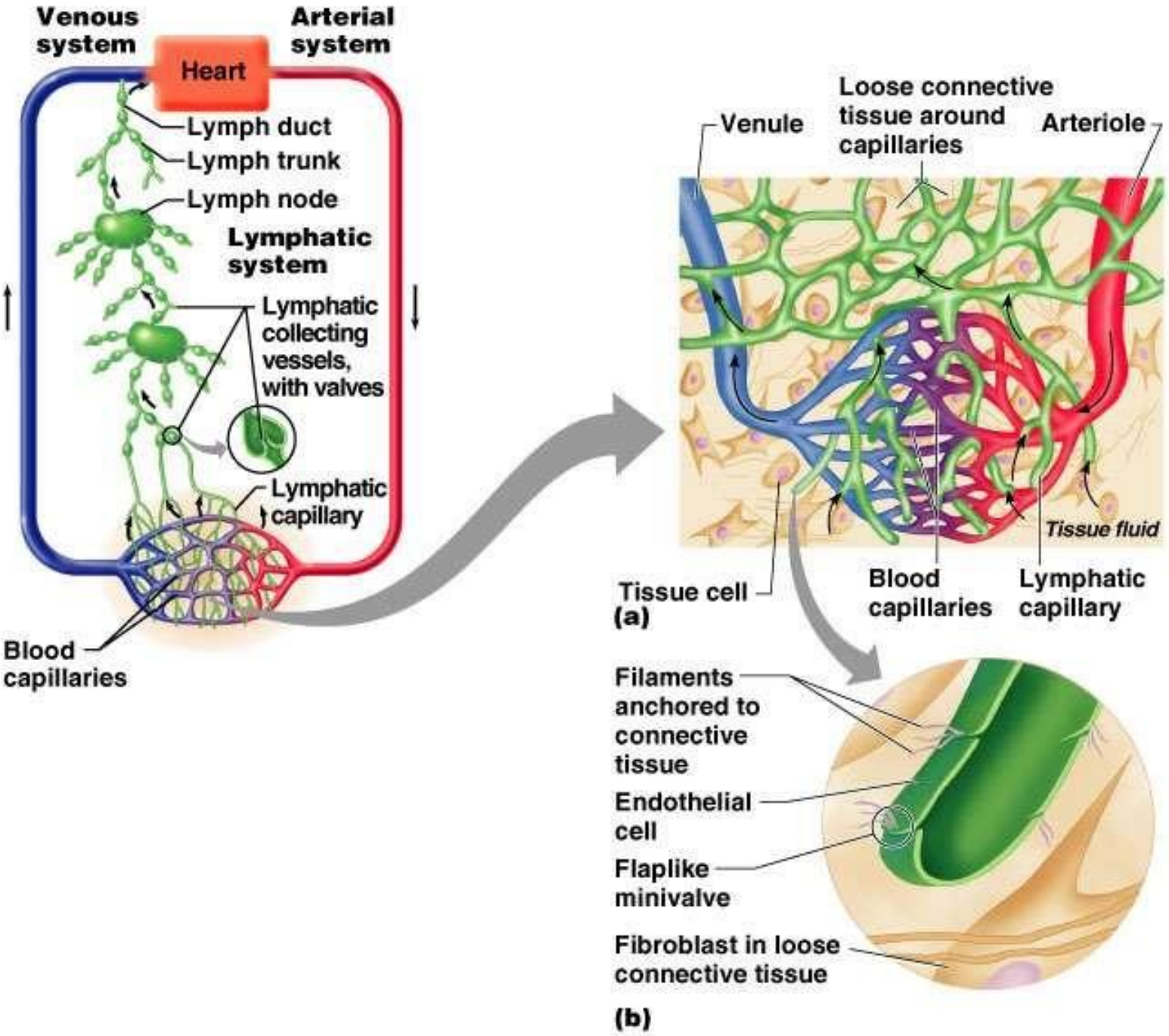
- Lymphatic vessels return to the blood of any fluids that have escaped from the circulation.
- Lymphatic vessels are intimately connected with blood vessels so that they can perform their function.

Distribution of lymphatic vessels

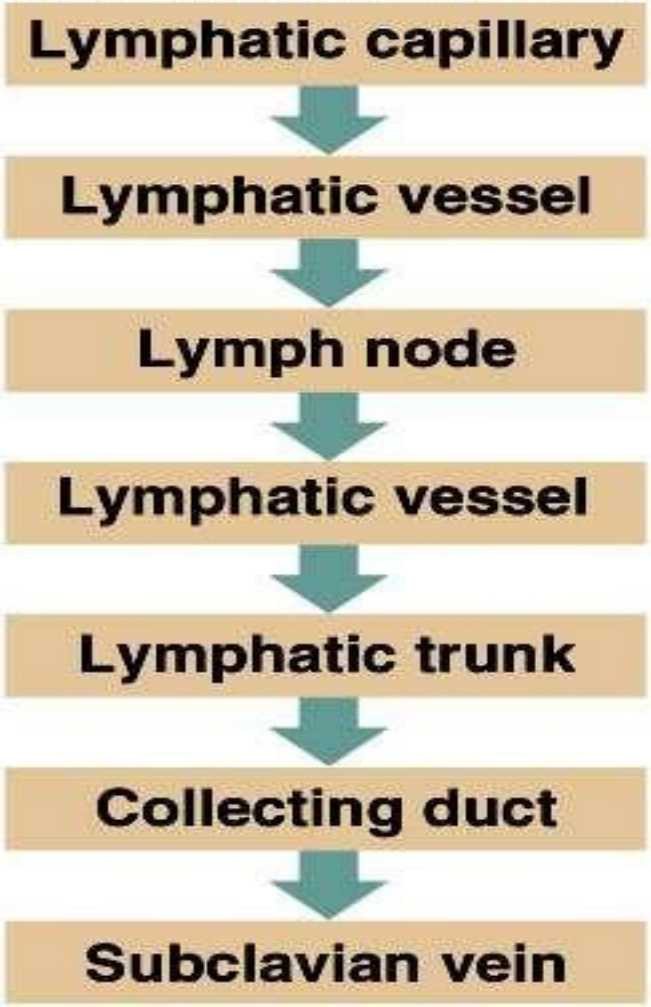
- Lymphatic vessels travel along side blood vessels.
- Lymphatic vessels are absent in bones, teeth, bone marrow and the central nervous system

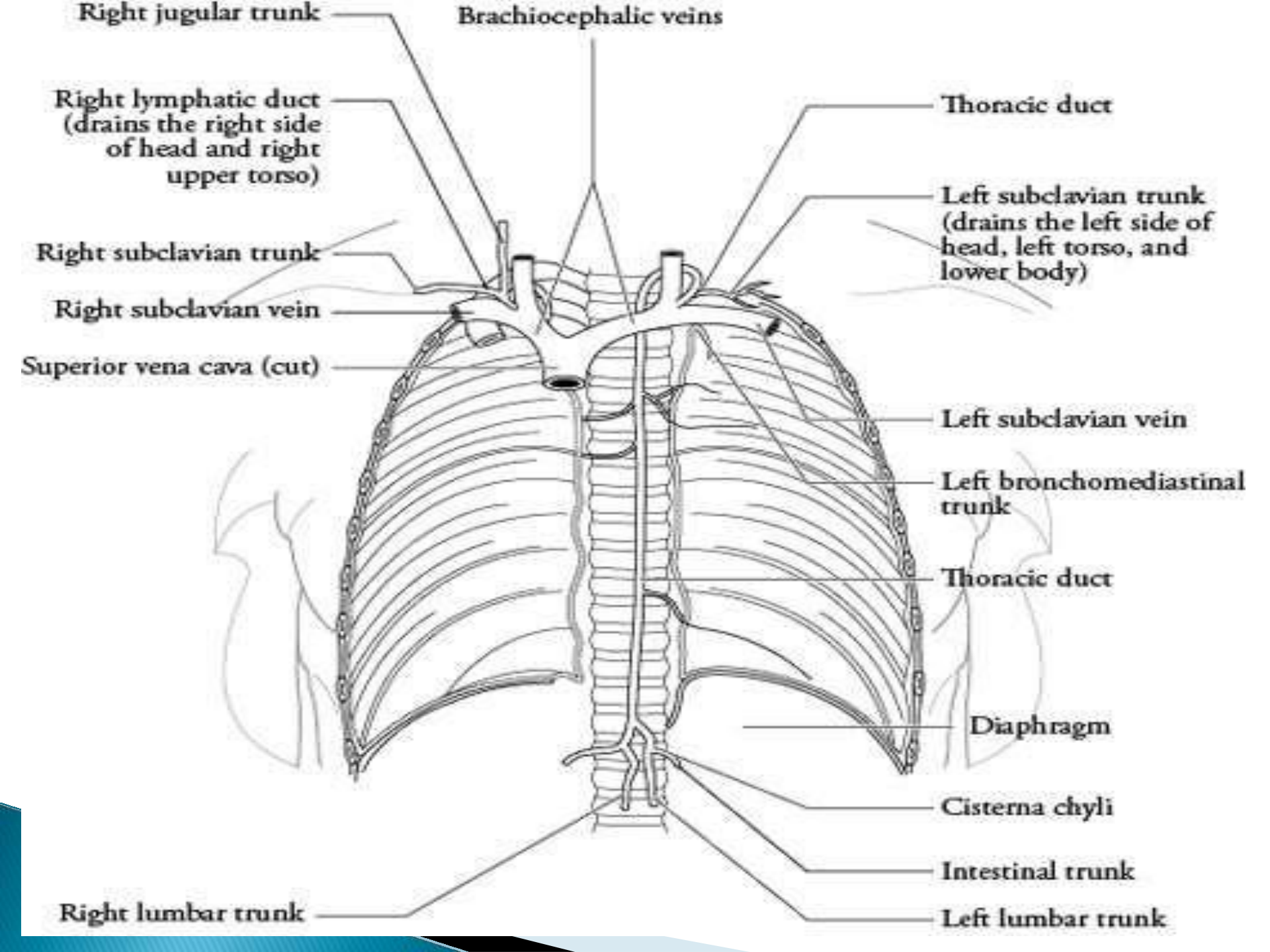

Tonsils
Cervical lymph node
Entrance of thoracic duct into subclavian vein
Right lymphatic duct
Thymus gland
Axillary lymph node
Peyer's patches in intestinal wall
Thoracic duct
Spleen
Red bone marrow
Inguinal lymph node
S
R
L
I


Tissue fluid
Lymphatic capillaries
Pulmonary capillaries
Lymph node
Pulmonary circuit
Valve
Lymphatic vessel
Systemic circuit
Lymph node
Lymphatic capillaries
Tissue fluid
Systemic capillaries



CIRCULATION OF LYMPH….




Right jugular trunk
Brachiocephalic veins
Right lymphatic duct (drains the right side of head and right upper torso)
Thoracic duct
Left subclavian trunk (drains the left side of head, left torso, and lower body)
Right subclavian trunk
Right subclavian vein
Superior vena cava (cut)
Left subclavian vein
Left bronchomediastinal trunk
Thoracic duct
Diaphragm
Cisterna chyli
Intestinal trunk
Right lumbar trunk
Left lumbar trunk

Lymph nodes…..

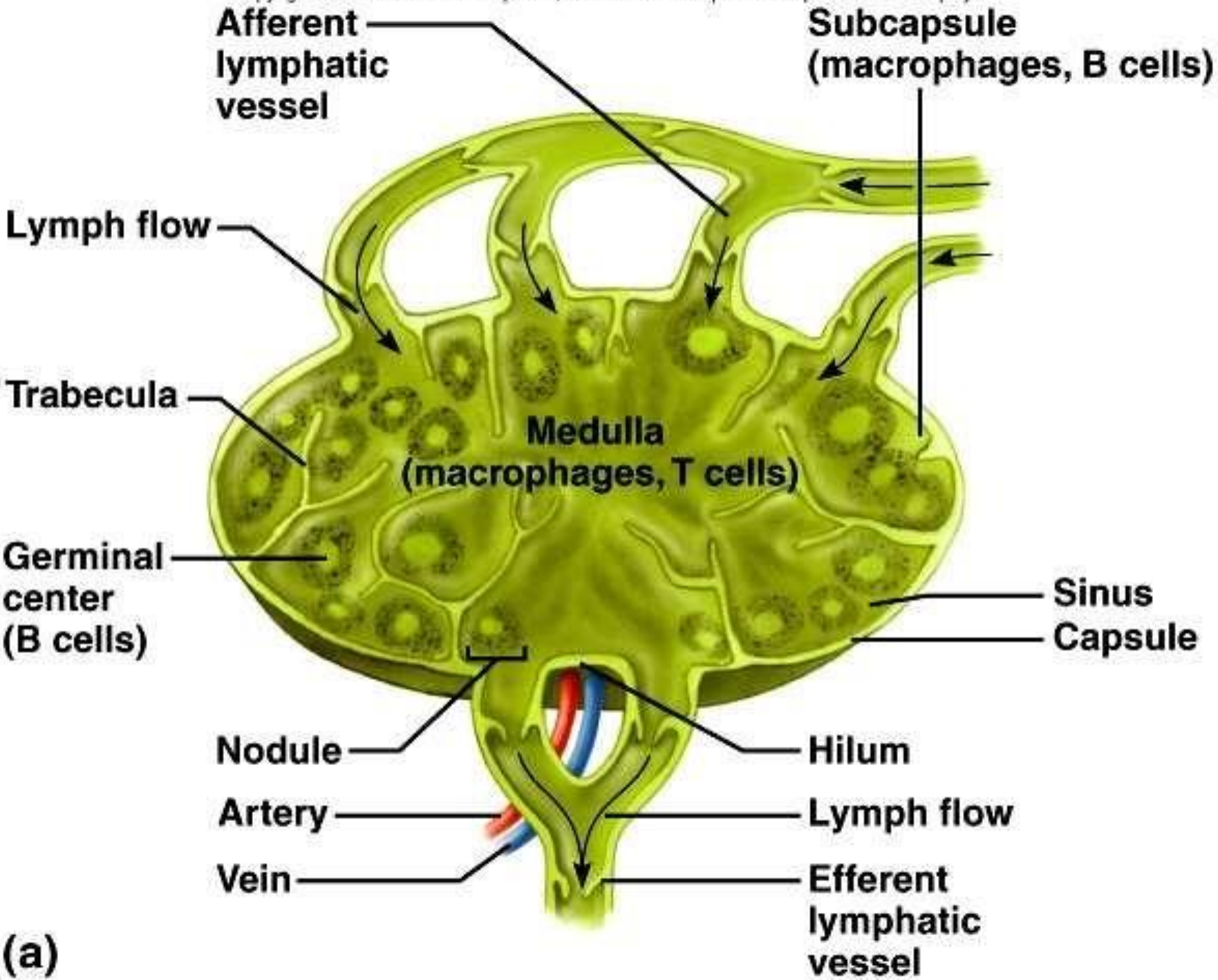
- They are widely distributed throughout the body along the lymphatic pathways.
- Lymph nodes are not present in the central nervous system.
- They are composed of lymphoid tissue.

STRUCTURE OF LYMPH NODES….

These are small bean shaped structures.

- ✓ These are usually less than 2.5 cm (1 inch) in length.
- ✓ Three superficial regions where lymph nodes tend to cluster are….

1. Inguinal nodes in the groin
2. Axillary nodes in the armpit
3. Cervical nodes in the neck



Function of Lymph nodes

- They filter the lymph before it is returned to the blood.
- They prevents foreign particles from entering the blood stream
- They also produce lymphocytes.


Thank you!