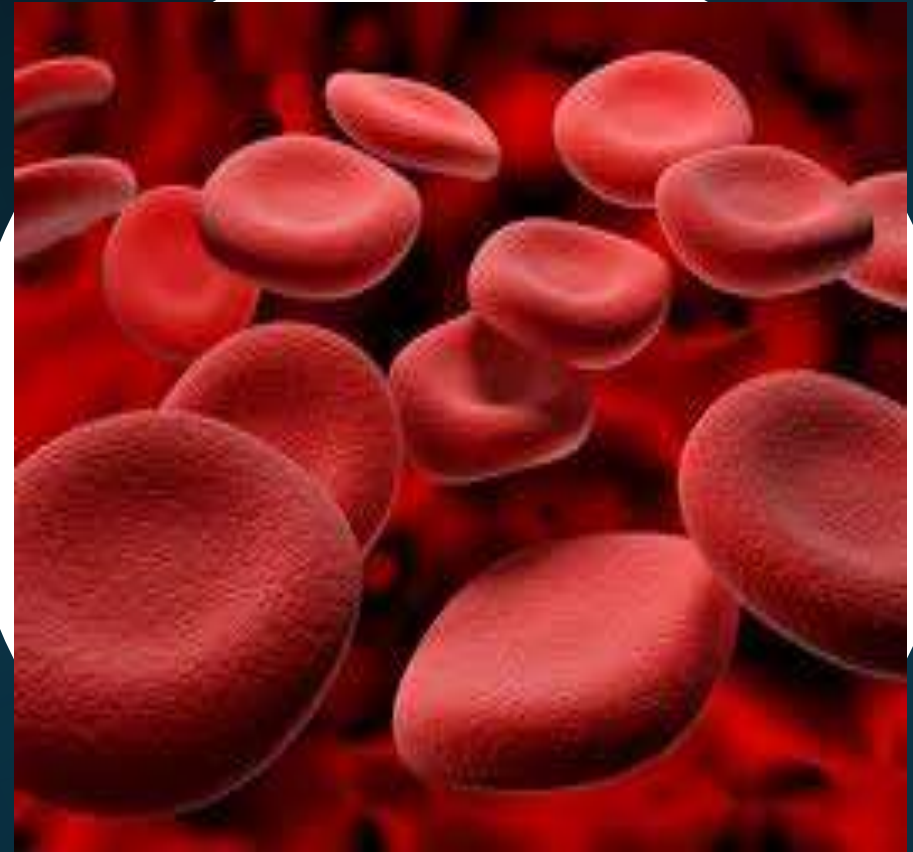


# BLOOD



# Overview

- It is the connective tissue fluid state.
- **Volume**: 8% of the body weight
- **Colour**:
- Scarlet red arterial blood( contain more oxygen)
- Purple red in venous blood (contain more co<sub>2</sub>)
- pH= 7.4 slightly alkaline

# BLOOD

**Male**

**5-6 L**

**Female**

**4-5 L**



**RBCs**

**WBCs**

**Platelets**

million

M: 5-6 /  $\text{mm}^3(\text{uL})$

F : 4-5 /  $\text{mm}^3(\text{uL})$



4.000-11.000/  
 $\text{mm}^3(\text{uL})$



250.000/ml  
(150.000:450.000)



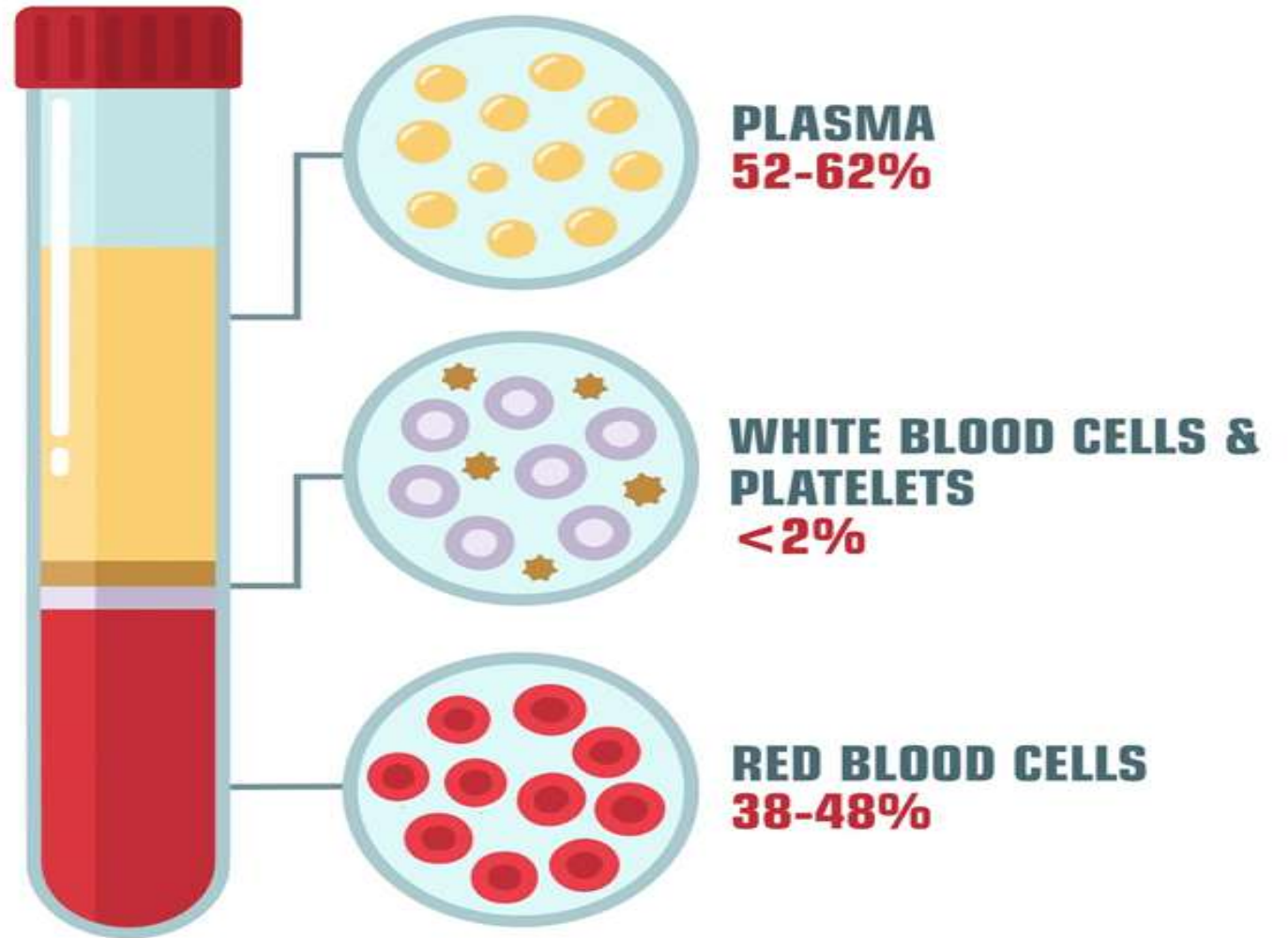
# Functions of the blood

- transporting oxygen and nutrients to the lungs and tissues.
- forming blood clots to prevent excess blood loss.
- carrying cells and antibodies that fight infection.
- bringing waste products to the kidneys and liver, which filter and clean the blood.
- regulating body temperature.



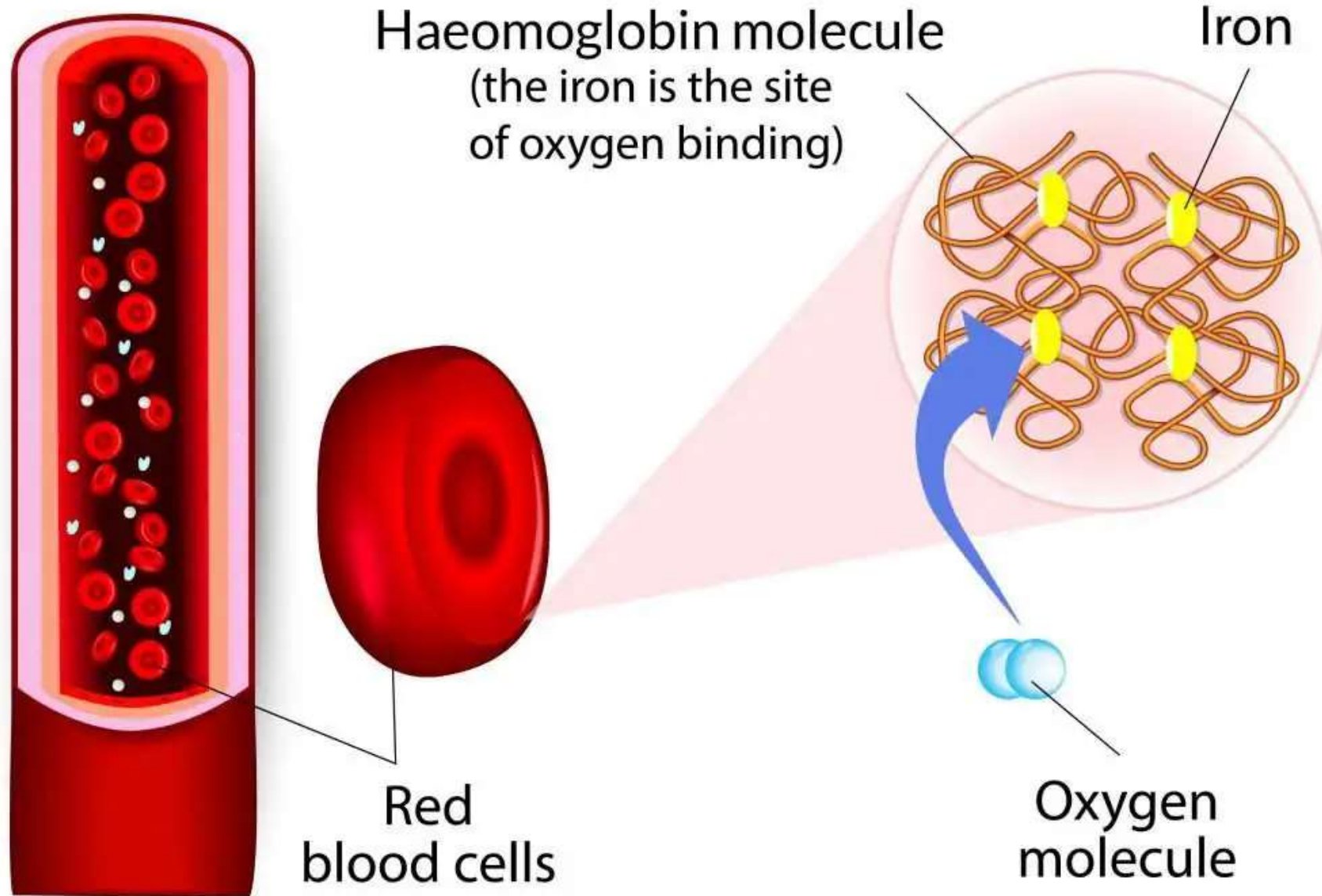
# Composition of the blood

## BLOOD STRUCTURE



# Red blood cells

- The purpose of red blood cells is to carry oxygen from the lungs to the tissues in our body, so our cells can complete **aerobic respiration**.
- Red blood cells contain a molecule called hemoglobin.



- Haemoglobin. binds to oxygen to become oxyhaemoglobin, which is a red pigment
- The equation for this is:
- **Oxygen + Haemoglobin  $\rightleftharpoons$  Oxyhaemoglobin**
- Once the red blood cells have travelled through the blood vessels to the tissues, the oxyhaemoglobin molecule splits, becoming oxygen and haemoglobin again.
- As the oxygen is now free, it can

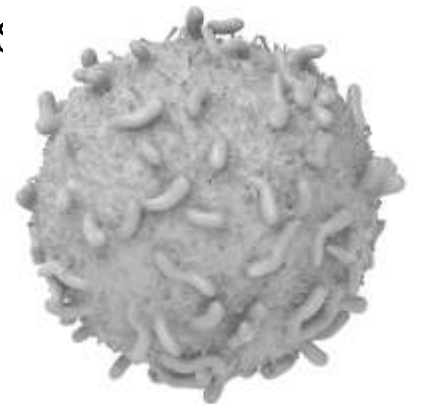


# Adaptation of RBCs:

- **The cytoplasm of red blood cells contains the protein haemoglobin** : which allows oxygen to bind to it.
- **They don't have a nucleus** : There is more space for haemoglobin molecules
- **They are shaped like biconcave disks** : Gives them a large surface area to volume ratio, which makes them more efficient at absorbing oxygen.
- **They are small and flexible** : Allows them to fit through narrow blood vessels (e.g. capillaries)
- **They have a thin cell membrane** : Provides a short diffusion distance

# White blood cells:

- White blood cells make up less than 1% of our blood, however, they are a vital part of our immune system.
- Their purpose is to identify pathogens and protect the body against them.
- Unlike red blood cells, white blood cells have a nucleus.



- There are many different types of white blood cells:
- **Phagocytes** : Can change shape to engulf and digest pathogens, which destroys them
- **Lymphocytes** : Identify pathogens as foreign cells, then produce antibodies to attack and destroy them

## Blood Cells



Monocyte



Lymphocyte



Neutrophil



Eosinophil



Basophil



Macrophage



Erythrocyte



Platelets

# How white blood cells protect us from infection?

- **Lymphocytes**
- Lymphocytes produce antibodies which attach to antigens on the surface of pathogens.
- **Antibodies neutralise pathogens by:**
  - Supporting phagocytes by clumping pathogens together
  - Punching holes in the cell walls of bacterial cells, which can cause them to burst
  - Producing antitoxins, which bind to and neutralise the toxins produced by pathogens



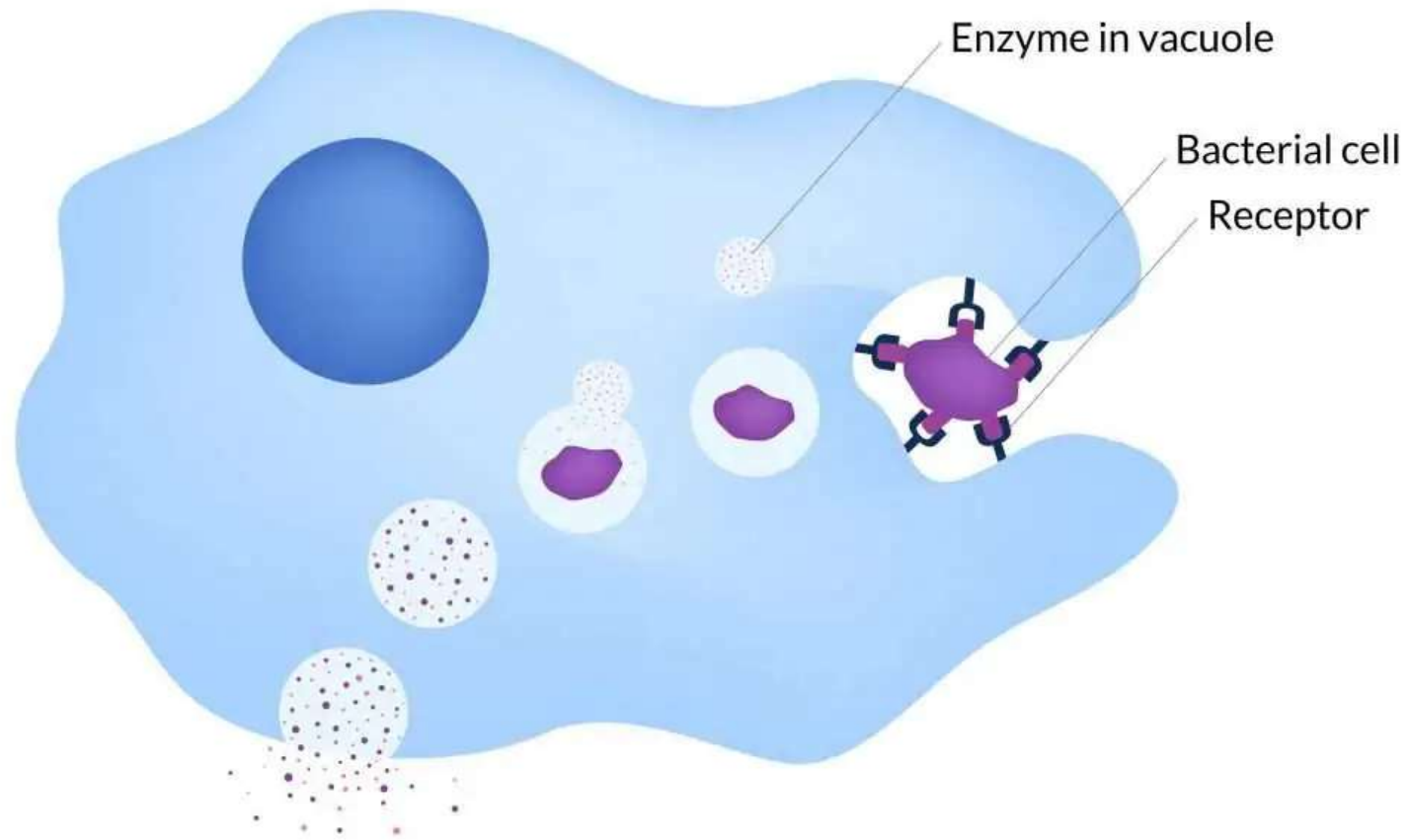
- **Phagocytes :**

- **Phagocytosis** is the act of engulfing pathogens.

1. The phagocyte binds to the surface of the bacterial cell.

2. It draws the bacterial cell inwards, engulfing it and enclosing it in a vacuole.

3. Enzymes are secreted into the vacuole, which destroys the bacterial cell.



# Platelets

- Platelets are not actual cells.
- They are small circulating fragments of cells, which means they do not have a nucleus.
- When we get a cut, platelets rush to the wound and patch it up. This process is called **clotting**.

**Platelet**

**Activated Platelet**

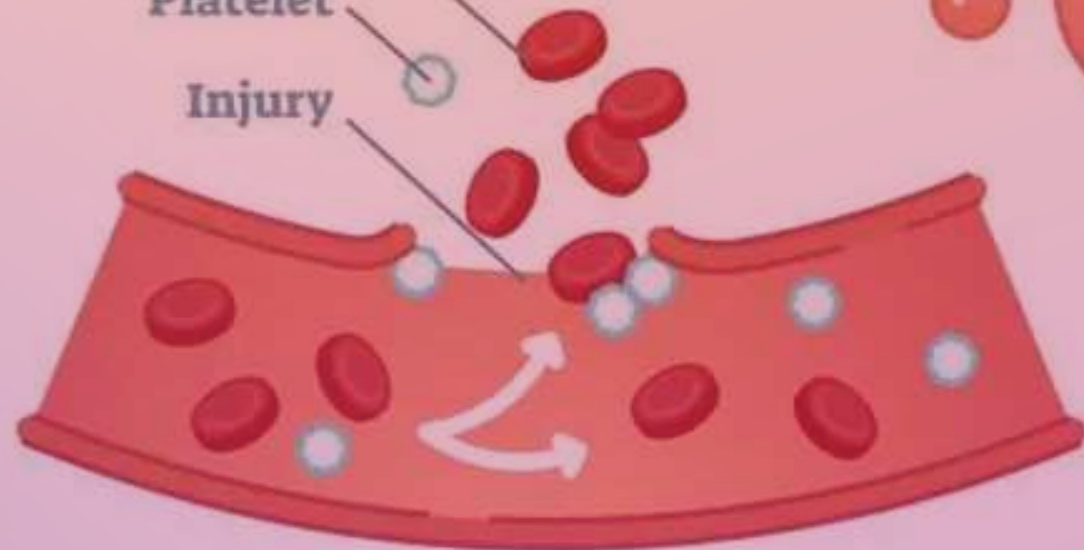


**Damaged Blood Vessel Wall**

**Red Blood Cells**

**Platelet**

**Injury**



**Platelets Attach to the  
Blood Vessel Wall**

**Activated Platelets**

**Fibrin**

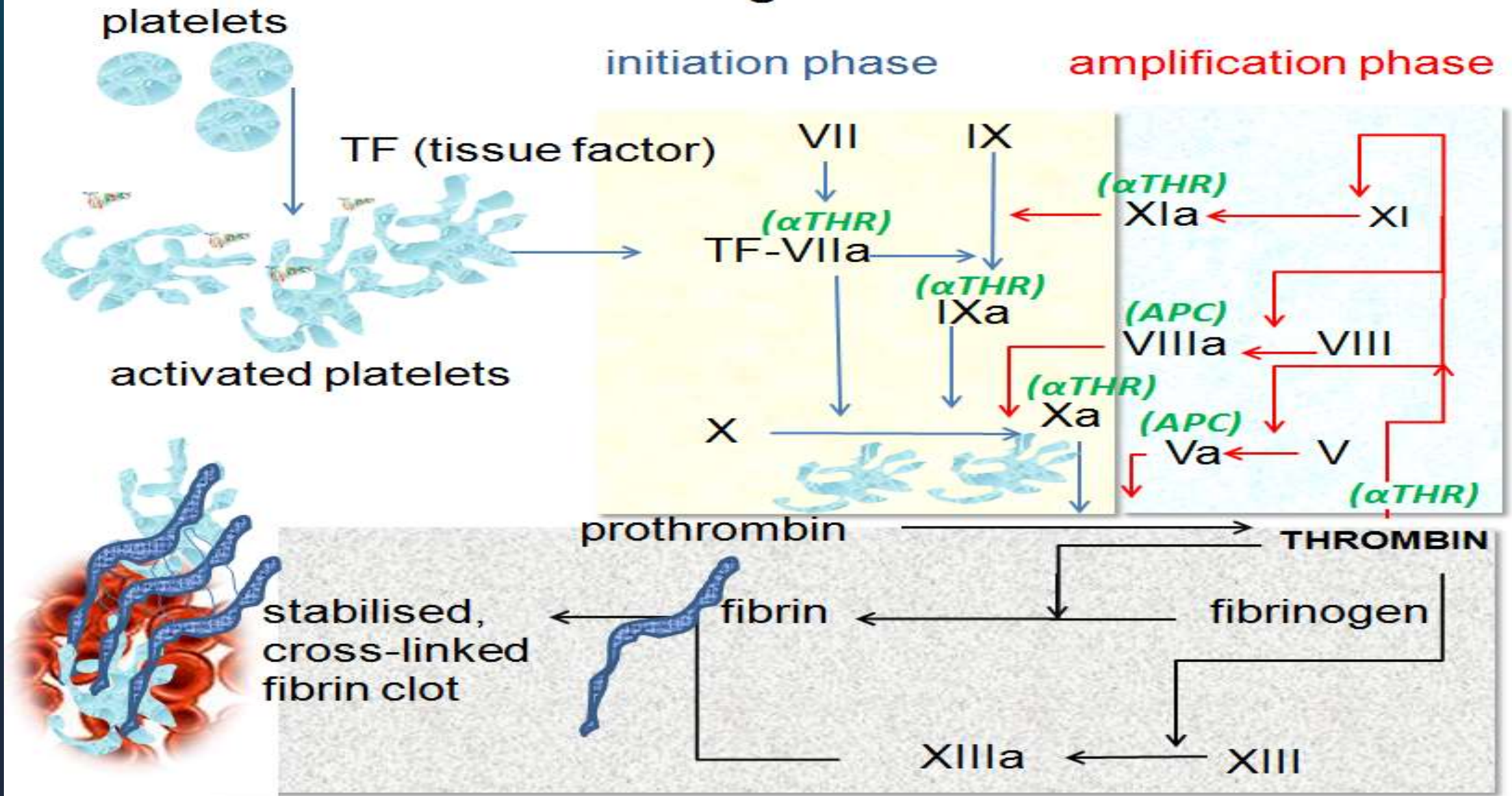
**Blood Clot**



**Platelets Release Fibrin and  
Seal the Blood Vessel Wall**



## Blood coagulation *in vivo*





# Disorders

- Hemosiderosis:

- Hereditary Hemosiderosis due to inheritance of certain mutant gene (absorption of too much iron from iron overlong period of time)
- Repeated blood transfusion in patients with hemolytic anemia.

## Complications of excessive iron

- Skin pigmentation
- Pancreatic damage  
.....br  
onze diabetes
- Liver cirrhosis
- Treatment: Iron chelating agents

# Anemia

- It is a decrease in oxygen carrying capacity of the blood due to decrease no. of RBCs or dysfunction of RBCs.
- **Decrease in the number of RBCs:**
  - < 4.5 million/ microlitre males
  - < 3.9 million/ microlitre females
- **Decrease in Hb content:**
  - < 13.5 g/dl in males
  - < 11.5 g/dl in females.

# Hemolytic anemia

- Abnormal breakdown of red blood cells (RBCs), either in the blood vessels (intravascular hemolysis) or elsewhere in the human body.
- Hemolytic anemia is a disorder in which red blood cells are destroyed faster than they can be made.
- The destruction of red blood cells is called hemolysis.
- Red blood cells carry oxygen to all parts of your body. If you have a lower than normal amount of red blood cells, you have anemia.
- When you have anemia, your blood can't bring enough oxygen to all your tissues and organs. Without enough oxygen, your body can't work as well as it should.

# What causes hemolytic anemia?

1–**Inherited**

2–**Acquired:**

- Certain infections, which may be viral or bacterial
- Medicines: penicillin, antimalarial medicines, sulfa medicines, or acetaminophen.
- Blood cancers
- Autoimmune disorders: rheumatoid arthritis, ulcerative colitis
- Certain tumors
- An overactive spleen (hypersplenism)
- A severe reaction to a blood transfusion



# What are the symptoms of hemolytic anemia?

- Yellowish skin, eyes, and mouth (jaundice)
- Dark-colored urine
- Fever
- Weakness
- Dizziness
- Confusion
- Can't handle physical activity
- Enlarged spleen and liver
- Increased heart rate (tachycardia)

# How is hemolytic anemia diagnosed?

- **Complete blood count (CBC).** This test measures many different parts of your blood.
- **Bone marrow aspiration or biopsy.** This involves taking a small sample of bone marrow fluid (aspiration) or solid bone marrow tissue (called a core biopsy). The sample is usually taken from the hip bones. It is checked for the number, size, and maturity of blood cells or abnormal cells.

The treatment for hemolytic anemia will vary depending on the cause of the illness. Treatment may include:

- Blood transfusions
- Corticosteroid medicines
- Treatment to strengthen your immune system (using intravenous immune globulin)

## **2-Iron deficiency anemia**

- a condition in which blood lacks adequate healthy red blood cells. Red blood cells carry oxygen to the body's tissues.
- Iron deficiency anemia is due to insufficient iron.
- Without enough iron, your body can't produce enough of a substance in red blood cells that enables them to carry oxygen (hemoglobin).
- As a result, iron deficiency anemia may leave you tired and short of breath.

- **Iron deficiency anemia signs and symptoms may include:**

- Extreme fatigue
- Weakness
- Pale skin
- Chest pain, fast heartbeat or shortness of breath
- Headache, dizziness



## Causes

- 1-**Blood loss:** loss of blood during menstruation, GIT bleeding.
- 2-**A lack of iron in your diet.**
- 3-**An inability to absorb iron:** if part of your small intestine has been bypassed or removed surgically, that may affect your ability to absorb iron and other nutrients.
- 4-**Vegetarians.**

# Complications

- **Heart problems:** Iron deficiency anemia may lead to a rapid or irregular heartbeat.
- **Problems during pregnancy**
- **Growth problems:** In infants and children, severe iron deficiency can lead to anemia as well as delayed growth and development.

# Prevention

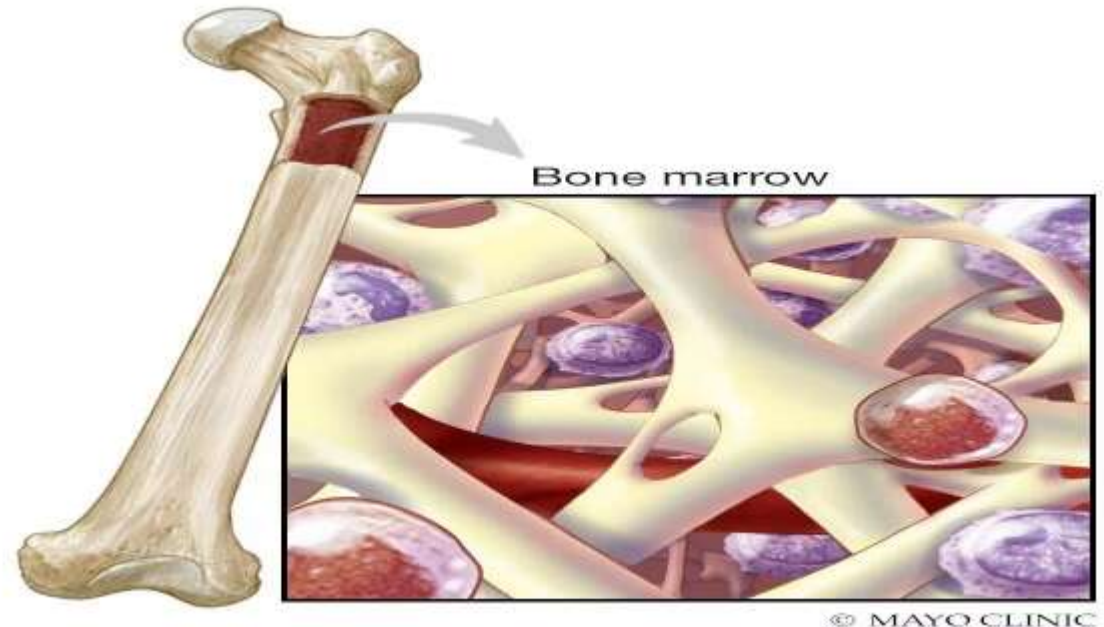
- **Choose iron-rich foods:** meat, bean, seafood
- **Choose foods containing vitamin C to enhance iron absorption.**
- **Preventing iron deficiency anemia in infants:** To prevent iron deficiency anemia in infants, feed your baby breast milk or iron-fortified formula for the first year.

### 3-Aplastic anemia

- Aplastic anemia is a condition that occurs when the body stops producing enough new blood cells.
- Treatment for aplastic anemia might include medications, blood transfusions or a stem cell transplant, also known as a bone marrow transplant.

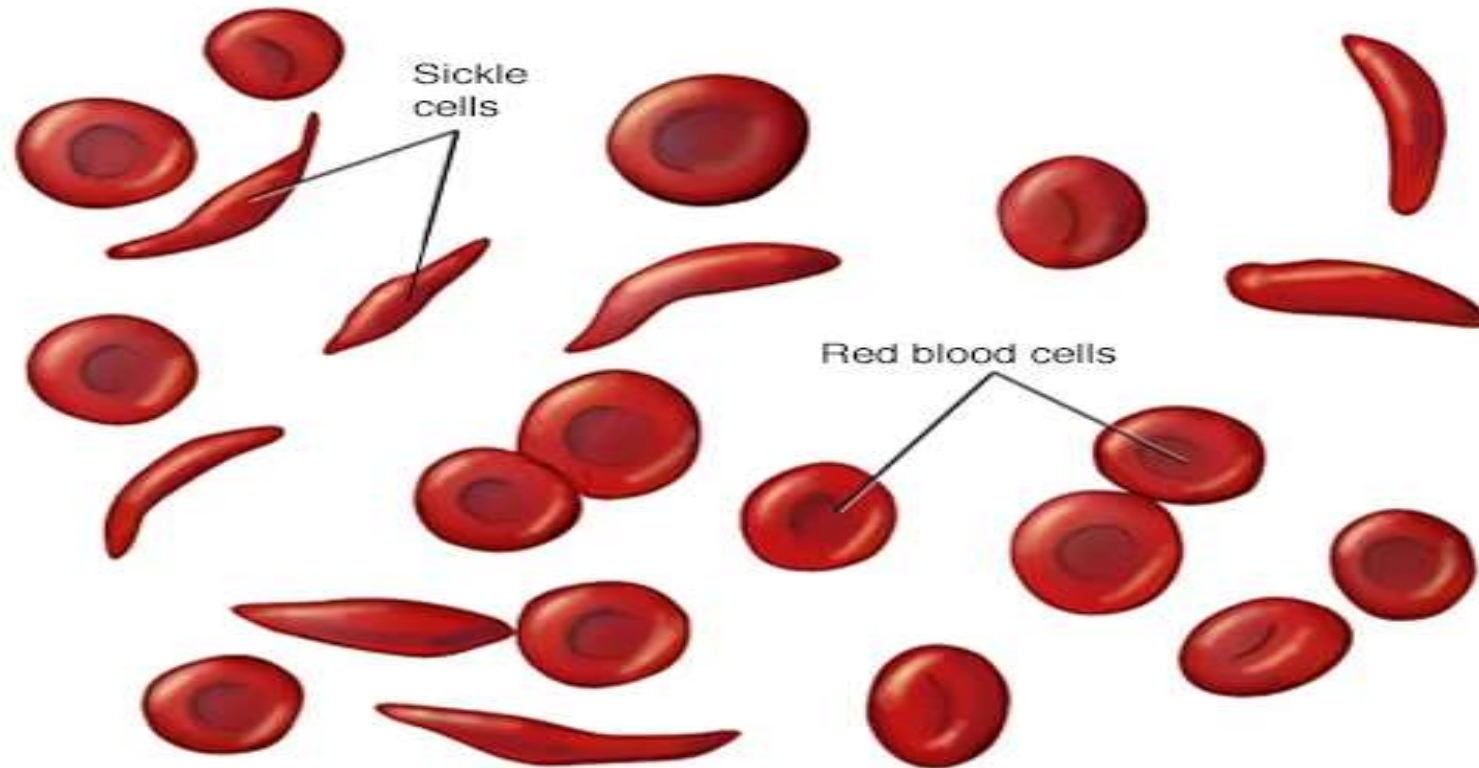
# Causes

- Stem cells in the bone marrow produce blood cells : red cells, white cells and platelets.
- In aplastic anemia, stem cells are damaged.
- As a result, the bone marrow is either empty (aplastic) or contains few blood cells (hypoplastic).



- The most common cause of aplastic anemia is from the **immune system attacking the stem cells** in your bone marrow.
- **Radiation and chemotherapy treatments.**
- **Exposure to toxic chemicals:** pesticides and insecticides, and benzene
- **Use of certain drugs:** drugs used for treatment of rheumatoid arthritis and some antibiotics.
- **Autoimmune disorders**
- **Viral infections** that affect bone marrow: HIV

# Sickle cell anemia



## 4-Sickle cell anemia

- Red blood cells are usually round and flexible, so they move easily through blood vessels.
- In sickle cell anemia, some red blood cells are shaped like sickles or crescent moons.
- These sickle cells also become rigid and sticky, which can slow or block blood flow.



Cause :

- Genetic disease due to single nucleotide substitution.
- Glutamate is replaced by valine in beta chain.
- Hydrophobic nature of valine produces protein form sticky patches in the beta chain.

# Symptoms

- **Anemia.**
- **Episodes of pain:** pain crises, are a major symptom of sickle cell anemia.
- **Swelling of hands and feet.** Sickle-shaped red blood cells block blood circulation in the hands and feet, which can cause them to swell.
- **Frequent infections.** The spleen is important for protecting against infections. Sickle cells can damage the spleen, raising the risk of developing infections.

- **Delayed growth or puberty.** Red blood cells provide the body with the oxygen and nutrients needed for growth.
- **Vision problems.** Tiny blood vessels that supply blood to the eyes can become plugged with sickle cells.

This can damage the portion of the eye that processes visual images(retina), and lead to vision problems.

# Complications

- **Stroke:** Sickle cells can block blood flow to the brain.
- Signs of stroke include seizures, weakness or numbness of the arms and legs, sudden speech difficulties, and loss of consciousness.
- **Acute chest syndrome:** A lung infection or sickle cells blocking blood vessels in the lungs can cause this life-threatening complication. Symptoms include chest pain, fever and difficulty breathing.
- **Avascular necrosis:** Sickle cells can block the blood vessels that supply blood to the bones. When the bones don't get enough blood, joints may narrow and bones can die. This can happen anywhere but most often happens in the hip.

# Thalassemia

- It is an inherited blood disorder that causes the body to have less hemoglobin than normal.
- Hemoglobin enables red blood cells to carry oxygen.
- Thalassemia can cause anemia, leaving you fatigued.

# **Causes**

- Thalassemia is caused by mutations in the DNA of cells that make hemoglobin.
- Hemoglobin molecules are made of chains called alpha and beta chains that can be affected by mutations.
- In thalassemia, the production of either the alpha or beta chains are reduced, resulting in either alpha-thalassemia or beta-thalassemia.

# Complications

- **Iron overload:** People with thalassemia can get too much iron in their bodies, either from the disease or from frequent blood transfusions. Too much iron can result in damage to the heart, liver and endocrine system.
- **Infection:** People with thalassemia have an increased risk of infection.
- This is especially true if you've had your spleen removed.

- **Bone deformities:**

- Thalassemia can make the bone marrow expand, which causes the bones to widen.
- This can result in abnormal bone structure, especially in the face and skull.
- Bone marrow expansion also makes bones thin and brittle, increasing the chance of broken bones.
- **Enlarged spleen:** The spleen helps the body fight infection and filter unwanted material, such as old or damaged blood cells.
- Thalassemia is often accompanied by the destruction of a large number of red blood cells.



- **Heart problems:**

- Congestive heart failure and abnormal heart rhythms can be associated with severe thalassemia.

- **Management:**

- Blood transfusion
- Bone marrow transplantation

# Megaloblastic anemia

- Megaloblastic anemia is a form of macrocytic anemia. Macrocytic anemia is a blood disorder that causes the bone marrow to make abnormally large red blood cells.
- It's also a type of vitamin deficiency anemia ( Vit B12, vit B9)

# What causes vitamin B12 deficiency?

- **Pernicious anemia**: This autoimmune disorder keeps the body from absorbing vitamin B12.
- **Gastrectomy**: This surgery removes part of the stomach, which may affect vitamin B12 absorption.

- **Fish tapeworm infestation:** You can get a tapeworm infection or infestation by eating infected fish that was undercooked.
- Tapeworms feed on vitamin B12.
- **Pancreatic insufficiency:** This condition affects the pancreas' ability to make enough digestive enzymes to break down food, which means you may not get all the nutrients you need, including enough vitamin B12 or vitamin B9.

# What causes vitamin B9 (folate) deficiency?

- **Digestive system diseases:** [Crohn's disease](#) or [celiac disease](#).
- **Excessive alcohol use**
- **Overcooking vegetables**
- **Certain medications:** Some antiseizure drugs and ulcerative colitis drugs interfere with the proper absorption of folate.

# Abnormalities of hemostasis

## 1-Conditions that cause excessive bleeding:

### 1-Thrombocytopenia purpura:

- Platelet deficiency ( $< 50000/\text{mm}^3$ )
- Defective platelets function: causes subcutaneous hemorrhage
- leading to: prolongation of bleeding time.



## 2- Vitamin K deficiency:

- Vit K is fat soluble vitamin.
- Formed by bacterial flora.
- **Function:** essential for formation of factors :II, VII, IX, X, protein C and S by the liver.
- **Causes of deficiency:**
- Absence of bacterial flora in newborn infants.
- Prolonged treatment with antibiotics



# 3-Hemophilia

- Sex-linked recessive disease ( x-chromosome)
- Carried by female to their males' sons.
- **There are 3 types:**
- Hemophilia A: Absence of factor **VIII**  
.....most common.
- Hemophilia B: absence of **IX**
- Hemophilia C: absence of **XI**
- Characterized by episodes of hemorrhage in joints, internal organs after minor trauma
- Prolonged clotting time.

GOOD  
LUCK

The image features the words "GOOD" and "LUCK" in a white, rounded, sans-serif font. The text is set against a dark green, cloud-like or bubble-like background. A yellow horseshoe is positioned to the left of the word "LUCK", and two green shamrocks are located to the right of the word "GOOD". The entire graphic is centered on a light gray and white checkerboard background.

• Answer the following questions:

1-Anemia is..... C

A-increase RBCs  
platelets count

b-increase

C-decrease in RBCs

d-Increase in WBCs

2-The RBCs count in females is more the males. B

A-True

b-False

3-pH of the blood is..... C

A-6

b-7

c-7.4

d-13

4-pH of the blood is..... C

A-Acidic

b-Alkaline

c-

Slightly alkaline

5-Blood consists of.....  
D

A-WBCs                      b-RBCs                      c-Platelets                      d-All of  
them

6-Plasma of the blood represents.....  
C

A-13%                      b-23%                      c-55%                      d-45%

7-Platelets count .....A

A-5000/mm3                      b-2000/mm3                      c-200000/mm3

8-.....is responsible for thrombus formation.      C

A-WBCs                      b-RBCs                      c-Platelets

9-.....can carry oxygen in the blood.      B

A-Platelets                      b-RBCs                      c-WBCs                      d-Phagocytes

10-Which of the following is ( are the correct function of the blood? D

A-forming blood clots to prevent excess blood loss.

B-carrying cells and antibodies that fight infection.

C-bringing waste products to the kidneys and liver, which filter and clean the blood.

D-All of the above

11-Haemoglobin binds to carbon dioxide to become oxyhaemoglobin, which is a red pigment. B

A-True

b-False

12- Red blood cells contain.....A

A-Hemoglobin

b-Mitochondria

c-Nucleus

d-

All of them

13-Phagocytosis is the act of engulfing pathogens. A  
A-True b-False

14-RBCs are true cells. B  
A-True b-False

15-RBCs contain nucleus. B  
A-True b-False

16-Each hemoglobin molecule can bind  
to..... D  
A-One oxygen atom b-Two oxygen atoms  
C-Five oxygen atoms d-Eight oxygen atoms

17- Hemophilia A is due to absence  
of..... B  
A-Factor 4 b-Factor 8 c-Factor 11 d-  
Factor 2

18- Varicose vein leads to excessive intravascular bleeding. A

A-True

b-False

19- Hemophilia C is due to absence of..... C

A-Factor 7

b-factor 9

c-factor 11

20- Vitamin K deficiency leads to.....  
A

A-prolonged bleeding time  
time

b- prolonged clotting

C- Both a and b

21- Vitamin k is..... B

A-Water soluble vitamin

b-Fat soluble vitamin

22-Hemophelia is..... (XXXXX)

23-Thrombocytopenia purpura is due to..... A

A-Deficiency in vitamin K  
platelets count

b-Decrease

C-Deficiency in Vit B12

d-All of them

24-Crohn's disease leads to decrease in.....

A-Vitamin A      b-Vitamin C      C- Vitamin B12      d-Vitamin B9

25- Megaloblastic anemia is a form of macrocytic anemia. A

A-True

b-False

26-Thalassemia is an inherited blood disorder that causes the body to have less hemoglobin than normal. A

A-true

b-False

27-The sickle cells also become rigid and sticky, which can slow or



28-Which of the following can bind with oxygen? A

A-ferrus            b-ferric            c-Hematin            d-All of them

29-Clotting factors are produced by.....A

A-intestinal flora            b-Viruses            c-a and b

30-Deficiency of vitamin k leading to..... B

A-Decreases bleeding time            b-Increases bleeding time

C-Decreases clotting time            d-Increases of clotting time

31- Roughness of the endothelium is caused by.....

- A-Decrease the bacterial flora
- b-Bleeding
- C-Bacterial infection
- d-Atherosclerosis

32- Varicose vein leads to.....

- A-Excessive intravascular bleeding
- B-Excessive extravascular clotting
- C-Excessive intravascular clotting

33-Thrombocytopenia purpura leads to.....

- A-Prolonged the bleeding time
- B-decreased the bleeding time

34-Celiac disease leads to.....

- A-Vitamin B12 deficiency
- B9 deficiency
- b-Vitamin
- C-Vitamin A deficiency
- d-
- Vitamin K deficiency

35-Vitamin B12 deficiency is caused by.....

- A-Pernicious anemia
- B-Gastrectomy
- C-Zollinger-Ellison syndrome
- D-Blind loop syndrome
- E-All of them

36- in Hemoglobin C disease:

A-Glutamate is replaced by valine

B-Glutamate is replaced by histidine

C-Glutamate is replaced by glycine

D-Glutamate is replaced by lysine

37- Megaloblastic anemia is a type of vitamin deficiency anemia.

A-True

b-False

38- normal platelets count is.....

A-2000-4000      b-5000-7000      c-200000-400000      d-500-1000

39-Free radicals lead to Hb C disease.

A-true

b-False

40-Thalassemia is an inherited blood disorder that causes the body to have less hemoglobin than normal.

A-true

b-False

41-.....is essential for clotting. C

A-hemoglobin      b-RBCS      c-Platelets      d-WBCS

42-.....binds with oxygen and forms oxyhemoglobin which has red pigment.

A-Hemoglobin      b-RBCs      c-WBCs      d-All of them

43-Hemolysis of .....leads to hemolytic anemia. A

a-RBCs      b-WBCs      c-Platelets      d-Vitamin K

44- Vitamin K essential for formation of factors .....  
A

A-II, VII, IX, X      b-III, VI, IX      c-  
X, VIII, III

45- vitamin B12 deficiency is caused by..... D

A-Pernicious anemia      b-Tapeworm infections

C-Pancreatic insufficiency      d-All of them

46-RBCs become crescents in shape in case of.....  
D

A-Aplastic anemia                      b-Iron deficiency anemia

C-Hemolytic anemia              d-Sickle anemia

47-Defective platelets function causes subcutaneous hemorrhage and leading to prolongation of bleeding time. A

A-True    b-False

48-Macrocytic anemia is a blood disorder that causes the bone marrow to make abnormally large red blood cells. A

A-True    b-False

49-Gastrecomy which may affect vitamin B12 absorption. A

A-True    b-False

50-RBCs count in anemic males is..... C

## Short essay questions:

- 1-Mention the different functions of blood?
- 2-Compare between hemolytic anemia and aplastic anemia?
- 3-Discuss different types of anemia?
- 4-Mention the different components of the blood.
- 5-Discuss the causes and symptoms of Thrombocytopenia purpura?
- 6-Discuss the different types and causes of Hemophilia?
- 7-How hemolytic anemia is diagnosed?
- 8-What is Hemosiderosis and mention its complications?

good  lucke



The image features the phrase "good lucke" written in a flowing, cursive script. The word "good" is in a warm orange-brown color, while "lucke" is in a vibrant purple. A light blue heart symbol is positioned between the two words. The text is embellished with several small, five-pointed stars in various colors: orange, pink, purple, and blue. Long, elegant flourishes extend from the beginning and end of the word "good", and a shorter flourish extends from the end of "lucke". The entire design is set against a plain white background, which is itself framed by a solid purple border.