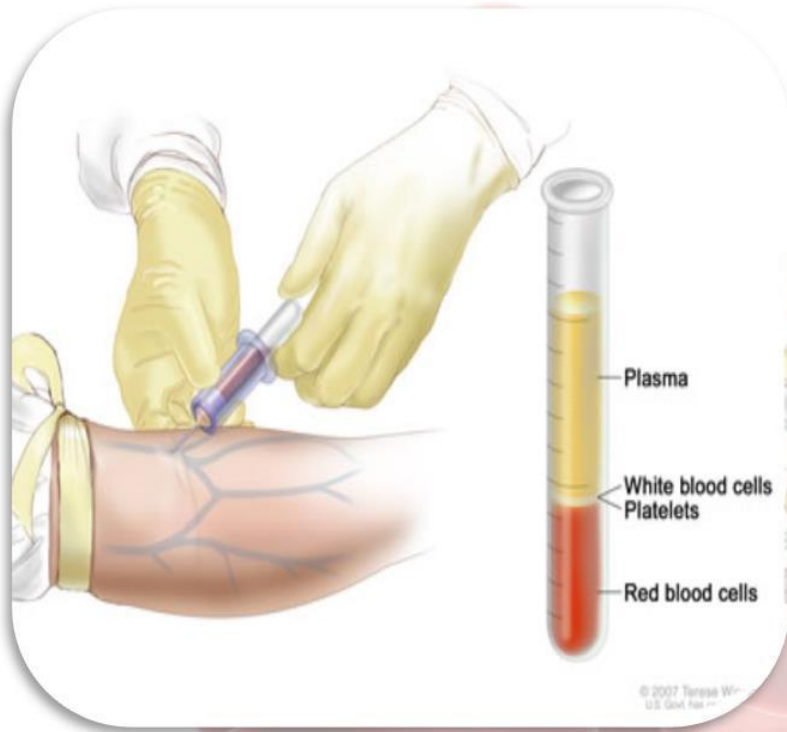


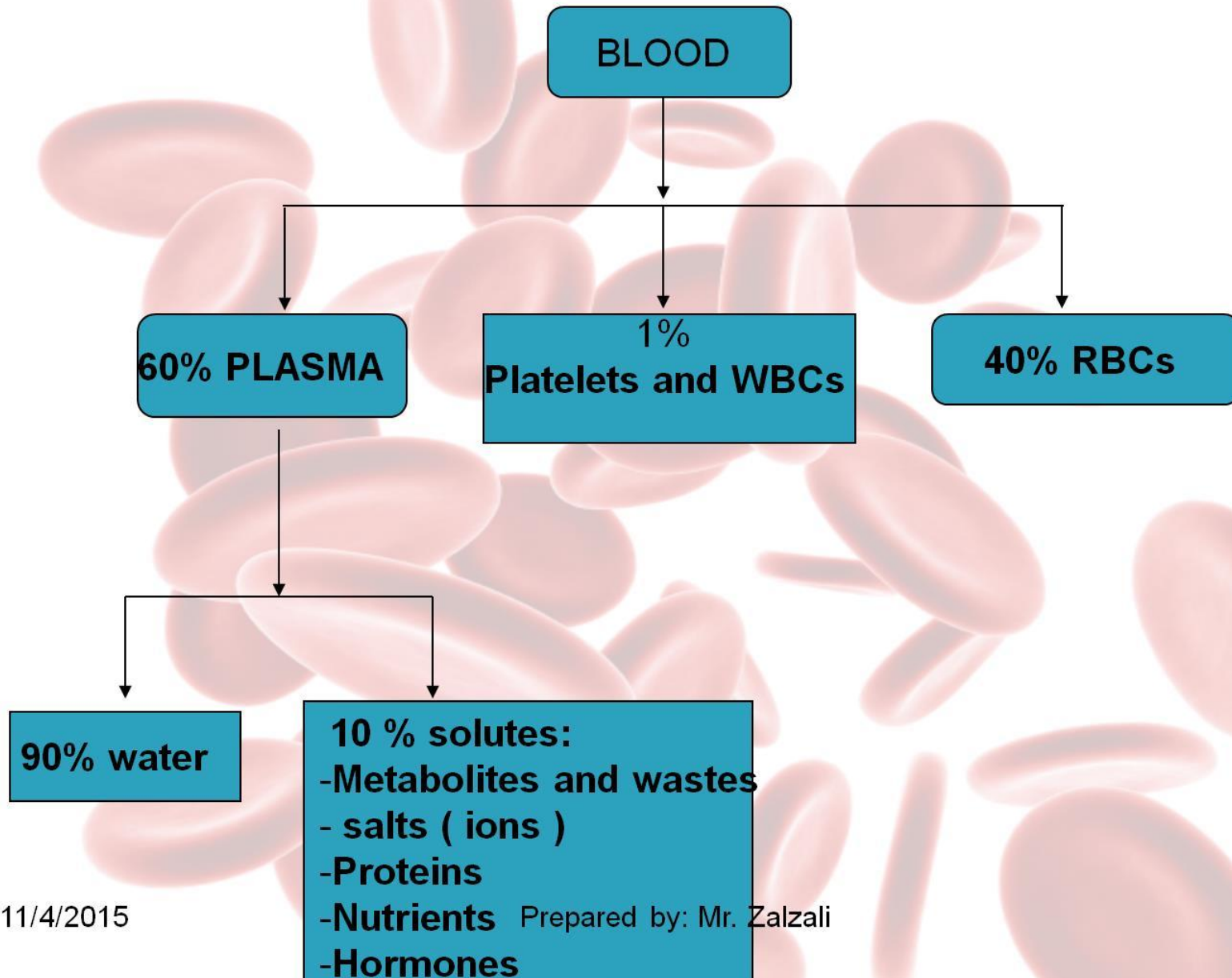
Blood components





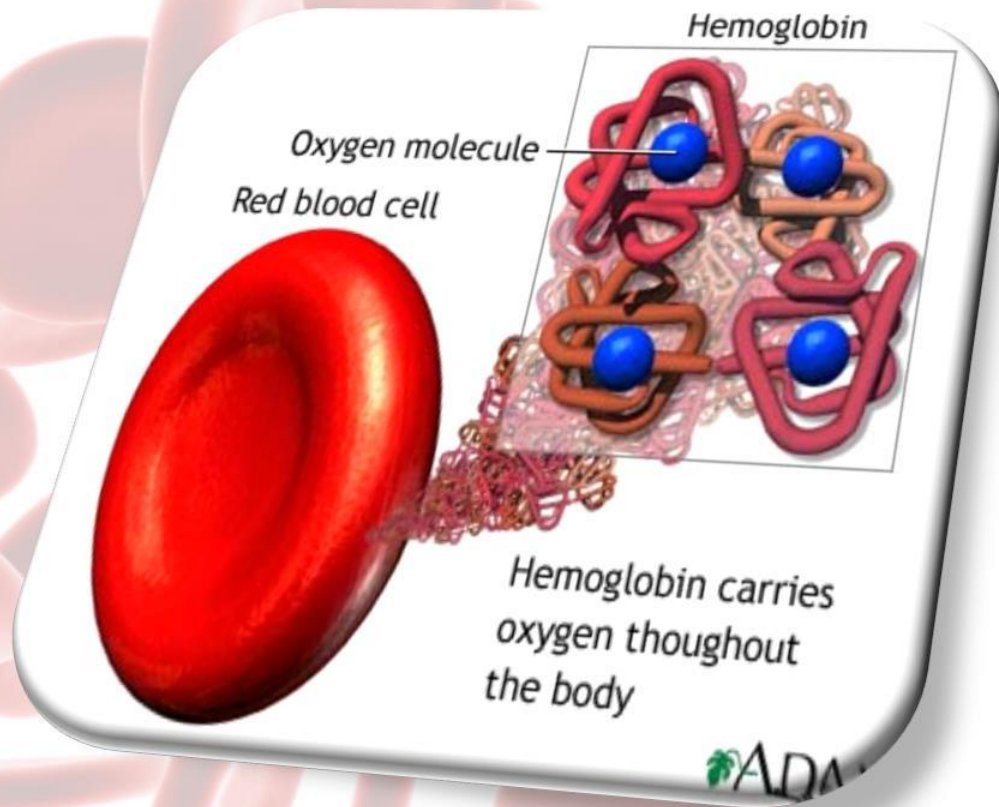
- **Plasma**
- **Blood cells → WBCs & RBCs**
- **Cell fragments → platelets**

Blood components



-RBCs: {erythrocytes}

-Contain protein called **hemoglobin** that can bind to oxygen and CO₂.

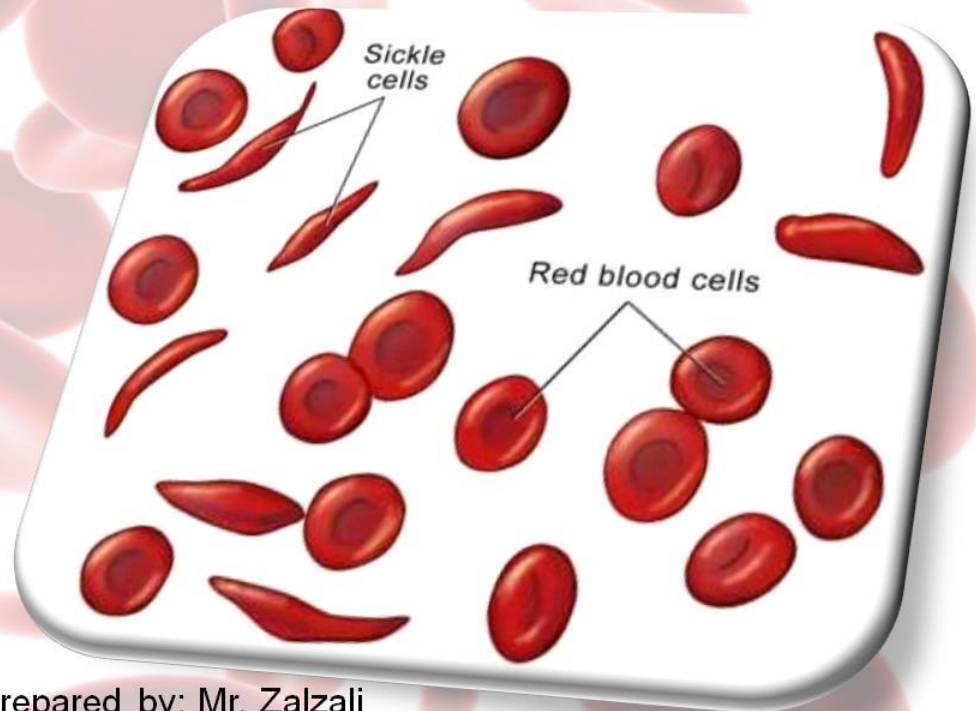


■ RBCs:

- Contain protein called **hemoglobin** that can bind to oxygen.
- Mature RBCs don't have nucleus, so they can't repair themselves → short life span.

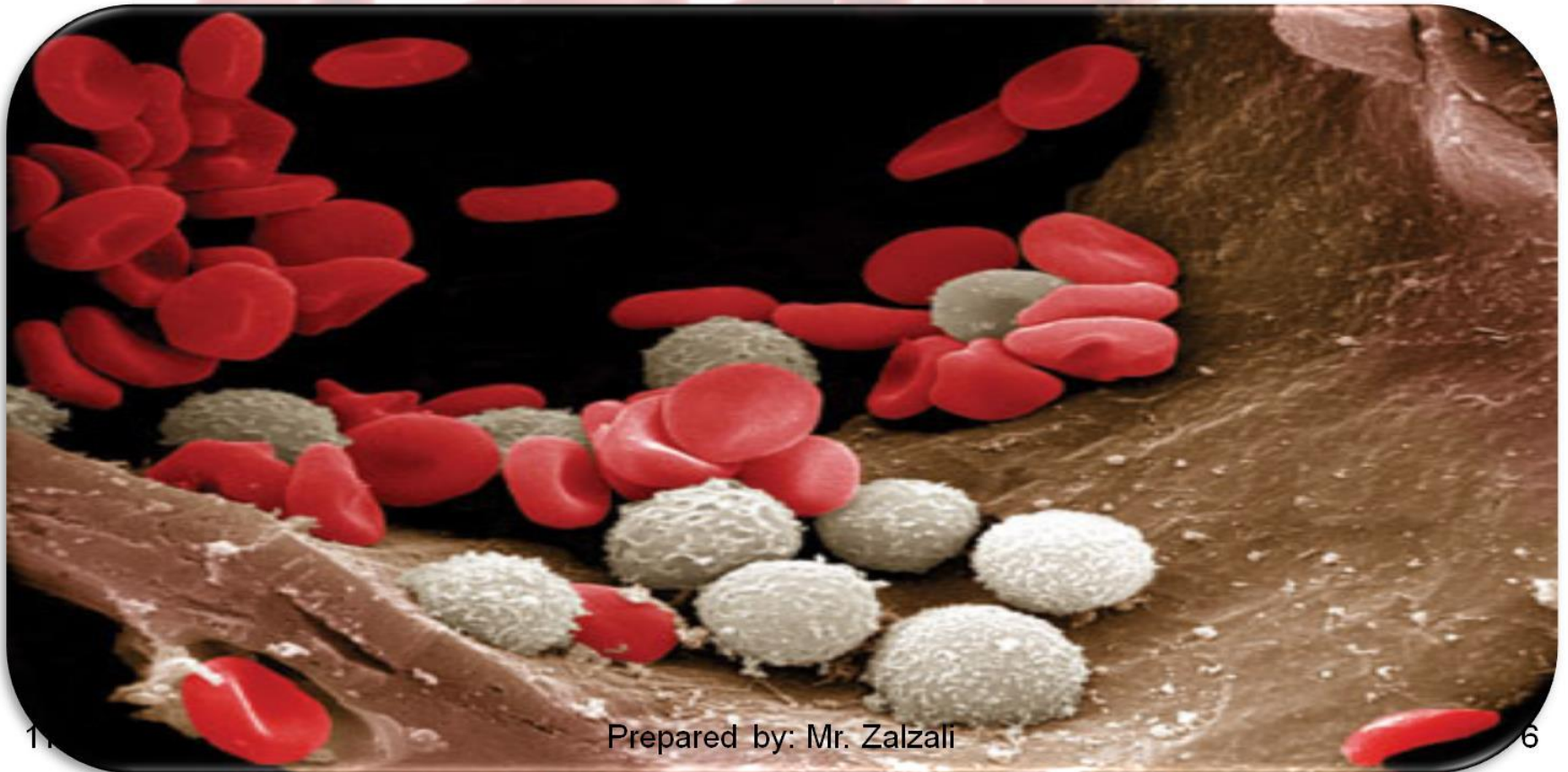
■ Anemia:

- Occur when oxygen carrying ability of blood is reduced.
- Caused by:
 - Blood loss.
 - Nutritional deficiencies.
 - Abnormal (Sickle) RBCs.



■ WBCs: {Leukocytes}:

- Circulate in blood and in between cells and tissues to defend body against diseases.
- Larger than RBCs
- Contain nuclei.



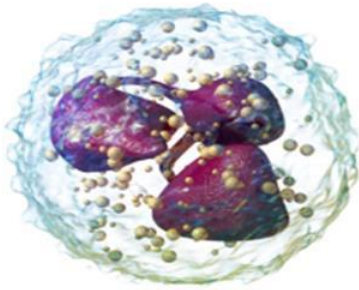
Differences Between RBC and WBC:

	RBC (Erythrocytes)	WBC (Leukocytes)
Physical features	RBCs are bi-concave disc shaped, and have no nucleus. size is roughly approximately 6-8 μm	WBCs are irregular in shape, but have a nucleus and an outer buffer coat.
Life span	120 days.	4-30 days depending on body
Types	There is only one type of RBCs found in the blood.	There are various types of WBCs with distinct functions in the blood: neutrophils, T lymphocytes, B lymphocytes (plasma cell) monocytes (macrophage), eosinophils, basophils.
Circulatory system	Cardiovascular system	Cardiovascular and lymphatic systems.
Total count RBC 700:1 WBC	- Males 4.6 million - 6.2 million per cubic mm. - Females 4.2 million-5.4 million per cubic mm.	4000 - 11000 per cubic mm
Functions	Supplies oxygen to different parts of the body and carries carbon dioxide and other waste products.	Producing antibodies to develop immunity against infections. Some are phagocytic
Presence in blood	Makes up 36-50% of our blood depending on sex, height & weight	Close to 1% of the blood.

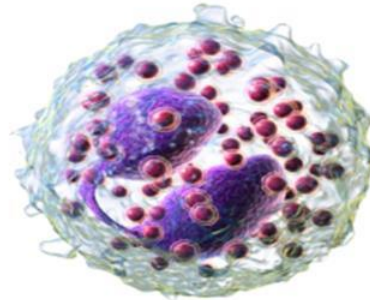
Differences	RBC	WBC
Components	Hemoglobin	Antibodies with MHC antigen cell markers.
Production	Produced in red bone marrow.	Produced in lymph nodes, spleen, etc.
Movement	they move in blood vessels eventually squeezing through capillaries giving O ₂ and nutrients to body cells.	they leave the blood vessels and move to the injury site. Capable of diapedesis-squeeze between cells of blood vessel walls to exit circulation.
Significance of irregularity in count	A very low RBC count will result in anemia.	The WBC count goes up significantly when there is any infection present.
Nuclei	RBC do not have nuclei in humans	WBC have nuclei in humans
Shape	Biconcave disc	Have different kinds of shapes and don't change shape when multiplied
11/4/2015	Prepared by: Mr. Zalzali	

Leukocytes Types & Functions

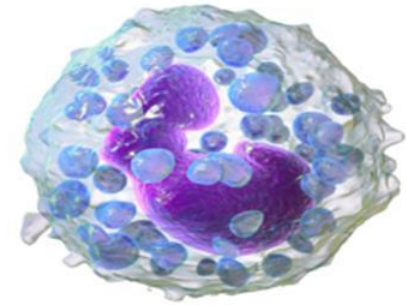
1. Granulocytes: (Eosinophils, Basophils, Neutrophils)
2. Monocytes
3. Lymphocytes



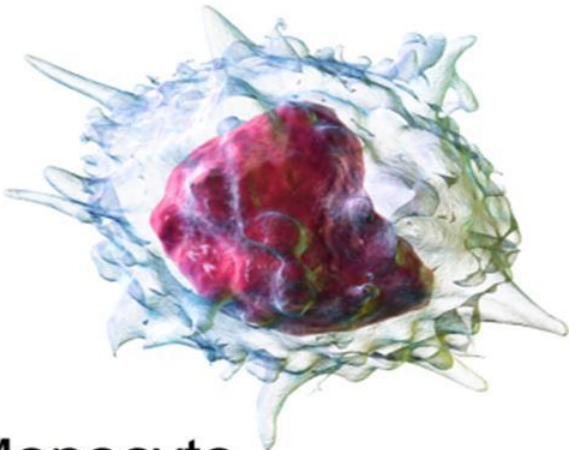
Neutrophil



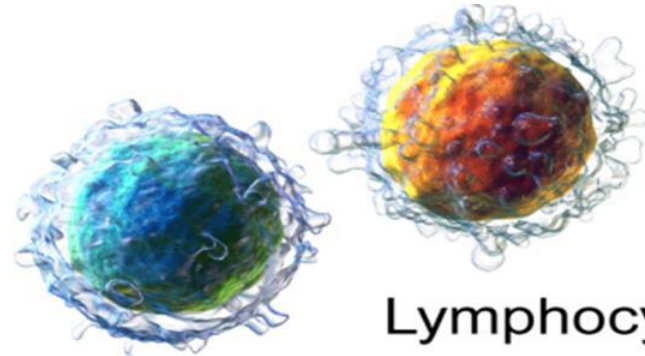
Eosinophil



Basophil



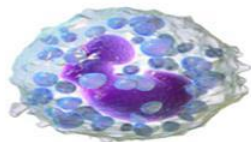
Monocyte



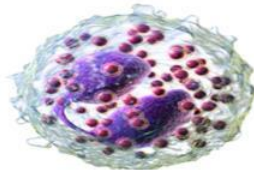
Lymphocytes

1. Granulocytes

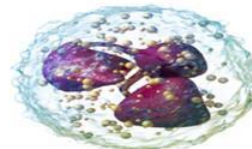
- There are three different forms of granulocyte :**Neutrophils, Eosinophils and Basophils.**
 - Granulocytes are phagocytes, that is they are able to ingest foreign cells such as bacteria, viruses and other parasites.
 - Granulocytes are so called because these cells have **granules** of enzymes which help to digest the invading microbes. Granulocytes account for about **60% of our white blood cells.**
- **Neutrophils make up the largest amount of leukocytes in the body.**



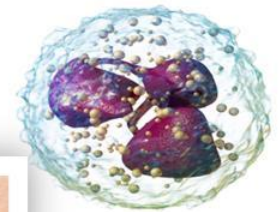
Basophil



Eosinophil



Neutrophil



Neutrophil



- **Neutrophils functions:**

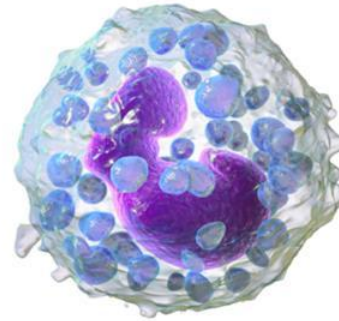
- Target: **Bacterial and fungal** infections
- Travel around in the blood looking for their main target.
- Are **phagocytes**, capable of ingesting microorganisms or particles

- Note:

- The pus that you see in an infection is made up of these neutrophils that have died during this process.

• Basophils function:

- Get involved in inflammatory reactions like **allergic symptoms**.
- Release **histamine** which is a vasodilator that increase the blood flow to the site of infection, which helps to trigger inflammation,
- Release **heparin**, which prevents blood from clotting.
- Detect invaders in the body and **make antibodies**.
- Call other leukocytes to come help in the fight.

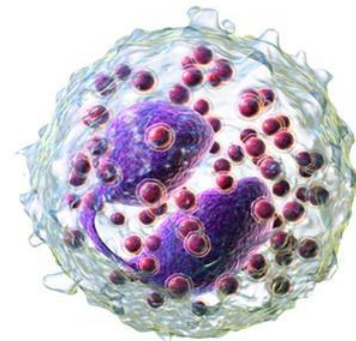


Basophil



• Eosinophils functions:

- Gets involved in **allergic reactions**
- Attack multicellular parasites such as worms.
- Targets are only bacteria and parasites.,
- Kill without having to know the specific invader.(Non Specific)
- Help out in some organ formation (e. g. mammary gland development), and tissue repair.



Eosinophil

2- Monocytes:

- Monocytes can also produce cytokines.
- Cytokines are proteins that help other white blood cells (and other cells) communicate with each other.
- Can develop into two types of cell:

1- Dendritic cells

- Are antigen-presenting cells which are able to mark out cells that are antigens (foreign bodies) that need to be destroyed by lymphocytes (B and T).
- Act as messengers between the innate (non-specific) and the adaptive (specific) immune systems.
- Present in those tissues that are in contact with the external environment, such as the skin and the inner lining of the nose, lungs, stomach and intestines..



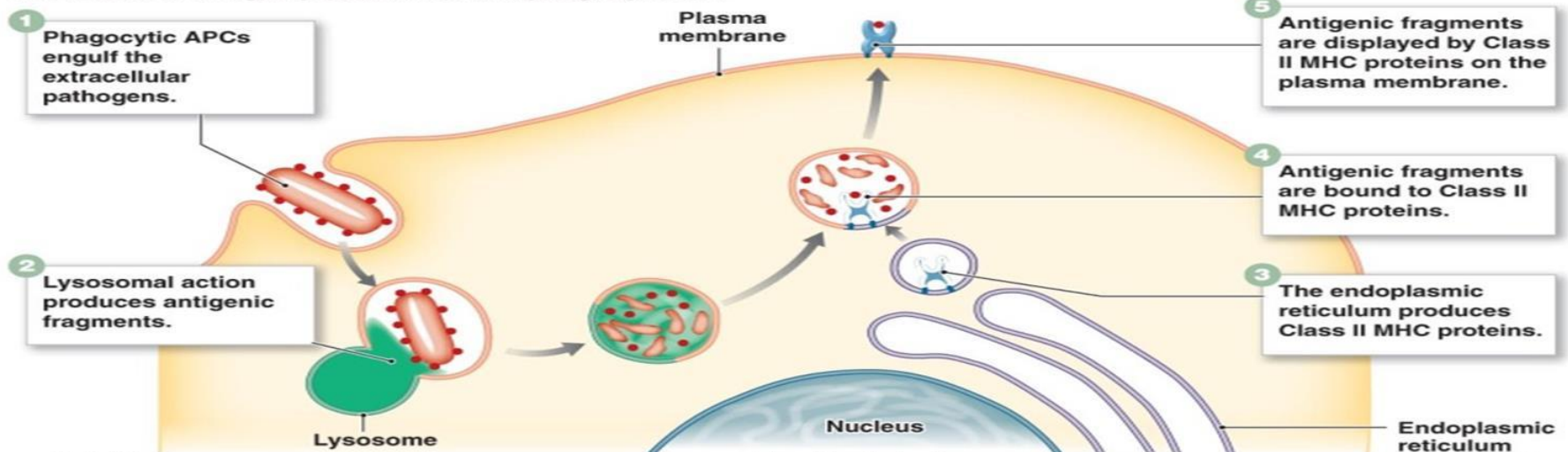
• Macrophages :

- Are **phagocyte** cells which are larger and live longer than neutrophils.
- Macrophages are also able to act as antigen-presenting cells.

• Functions:

- Surrounding and engulfing bacteria (a process known as phagocytosis).
- Contain enzymes in their bodies that kill and break down the germs into pieces.
- Macrophage serve as part of what is known as the innate immune system of all mammals, meaning that it immediately defends the body against infectious agents in a general way.

The events of antigen presentation in a phagocytic cell



3 -Lymphocytes:

- Natural killer cells (NK cells).
- T cells
- B cells

Natural Killer Cells (NK cells):

- Part of the innate immune (non-specific) system.

Function:

- Defend from both tumors and virally infected cells.
- Distinguish infected cells and tumors from normal and uninfected cells by recognizing changes of a surface molecule called MHC (major histocompatibility complex).
- Release cytotoxic (cell-killing) granules which then destroy the altered cells.



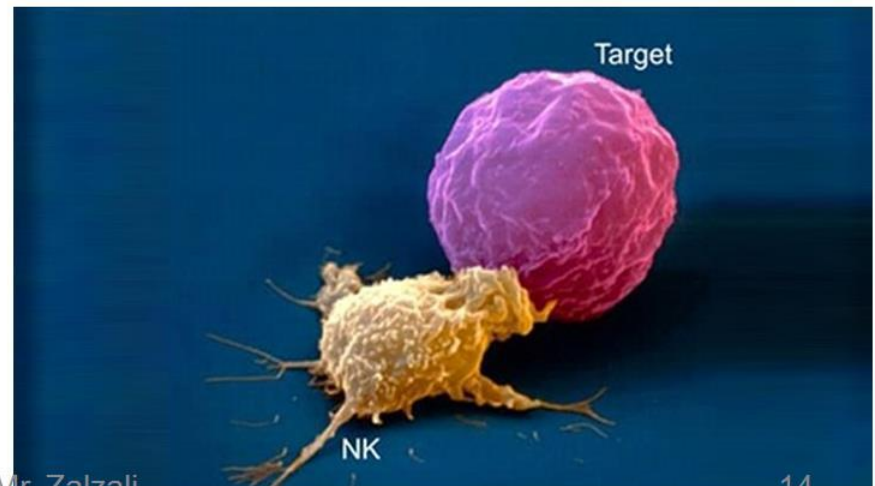
Why Are NK Cells so important?

They target:

**TUMOR CELLS
CANCER CELLS
INFECTED CELLS**

The protect against a wide variety of

INFECTIOUS MICROBES
(viruses, bacteria, parasites & fungi)

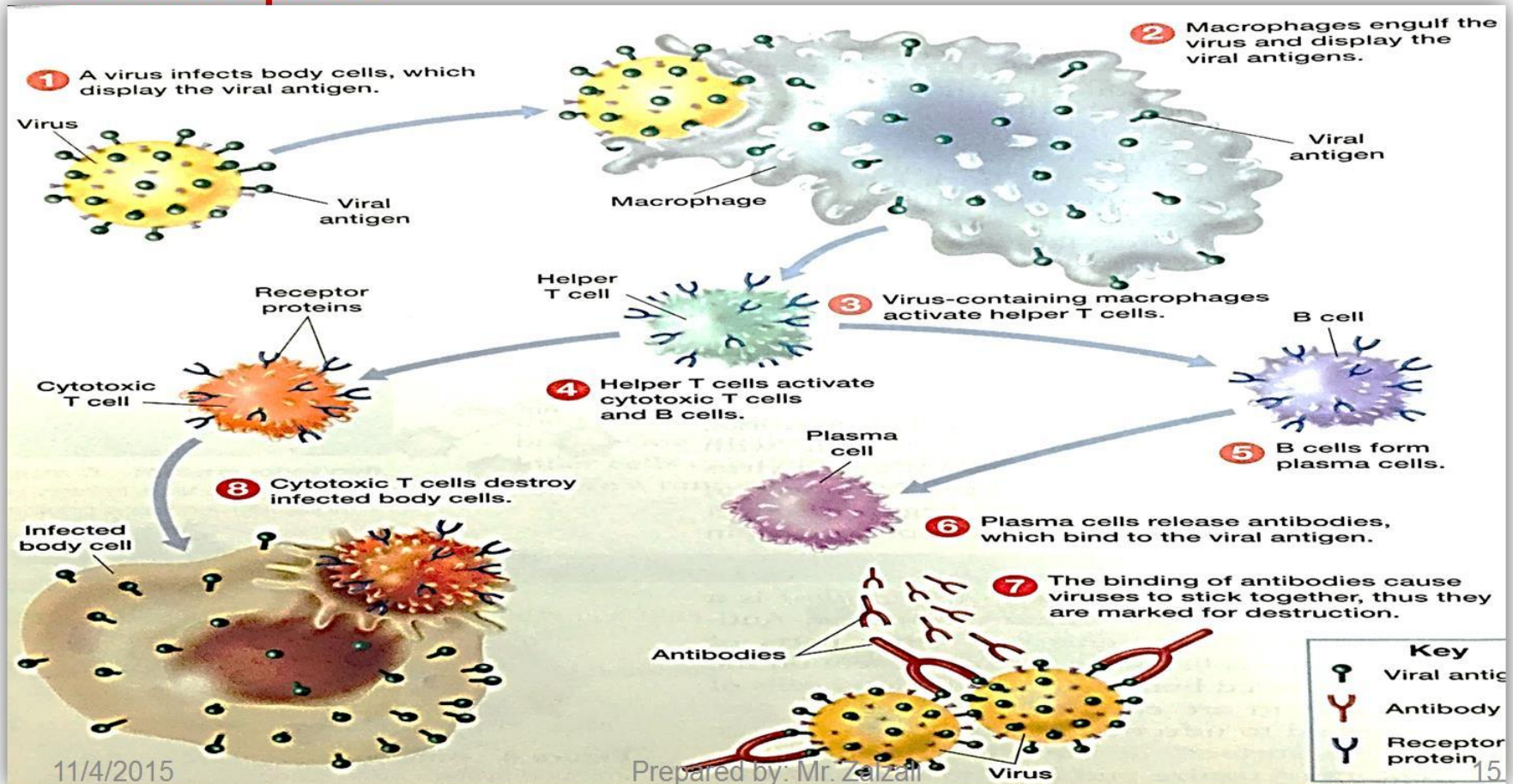


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-T and B cells:

- Are the major cellular components of the adaptive immune response (Specific)
- Recognize specific "non-self" antigens, during a process known as antigen presentation.
- T cells are involved in cell-mediated immunity (Direct contact with infected cells thru antibodies.)
- B cells are primarily responsible for humoral immunity (relating to antibodies).

• Immune Response:

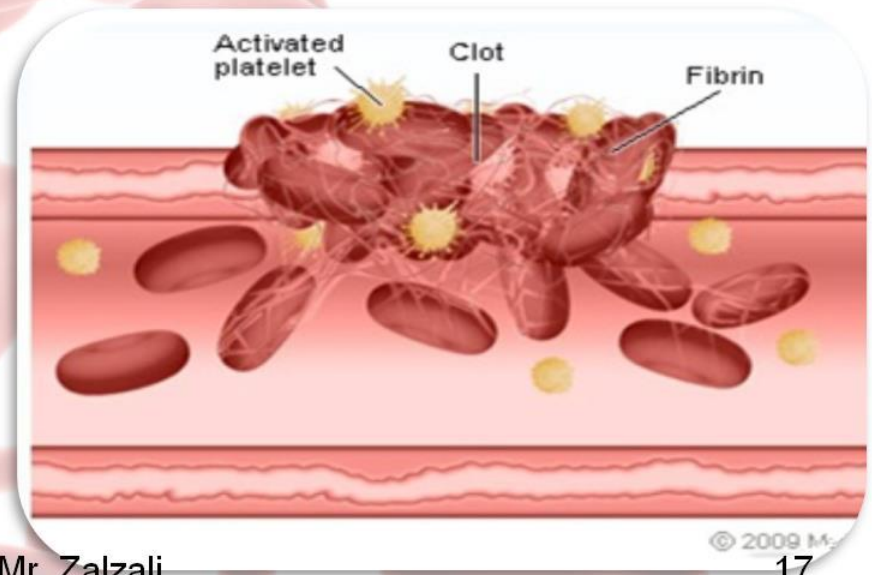
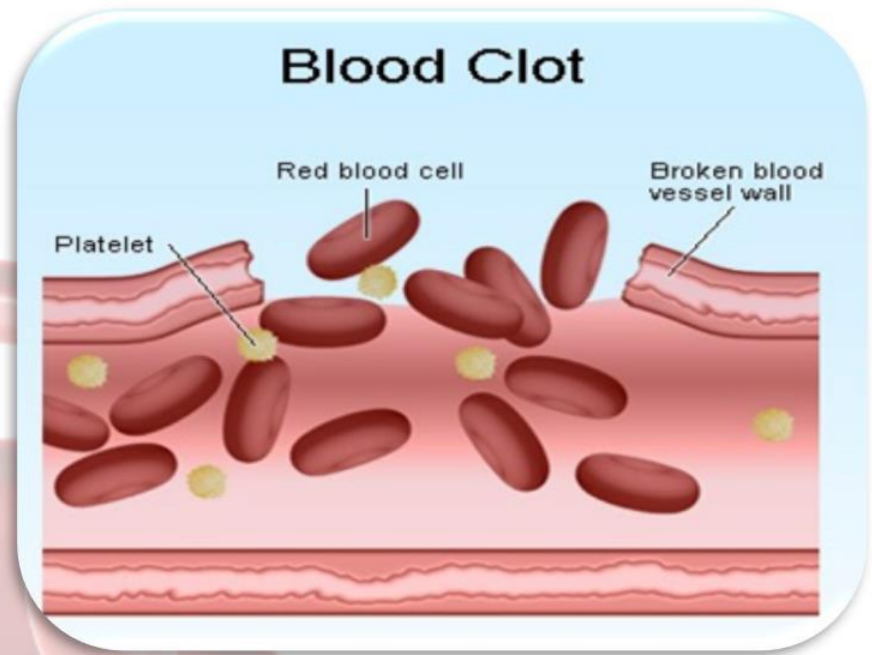


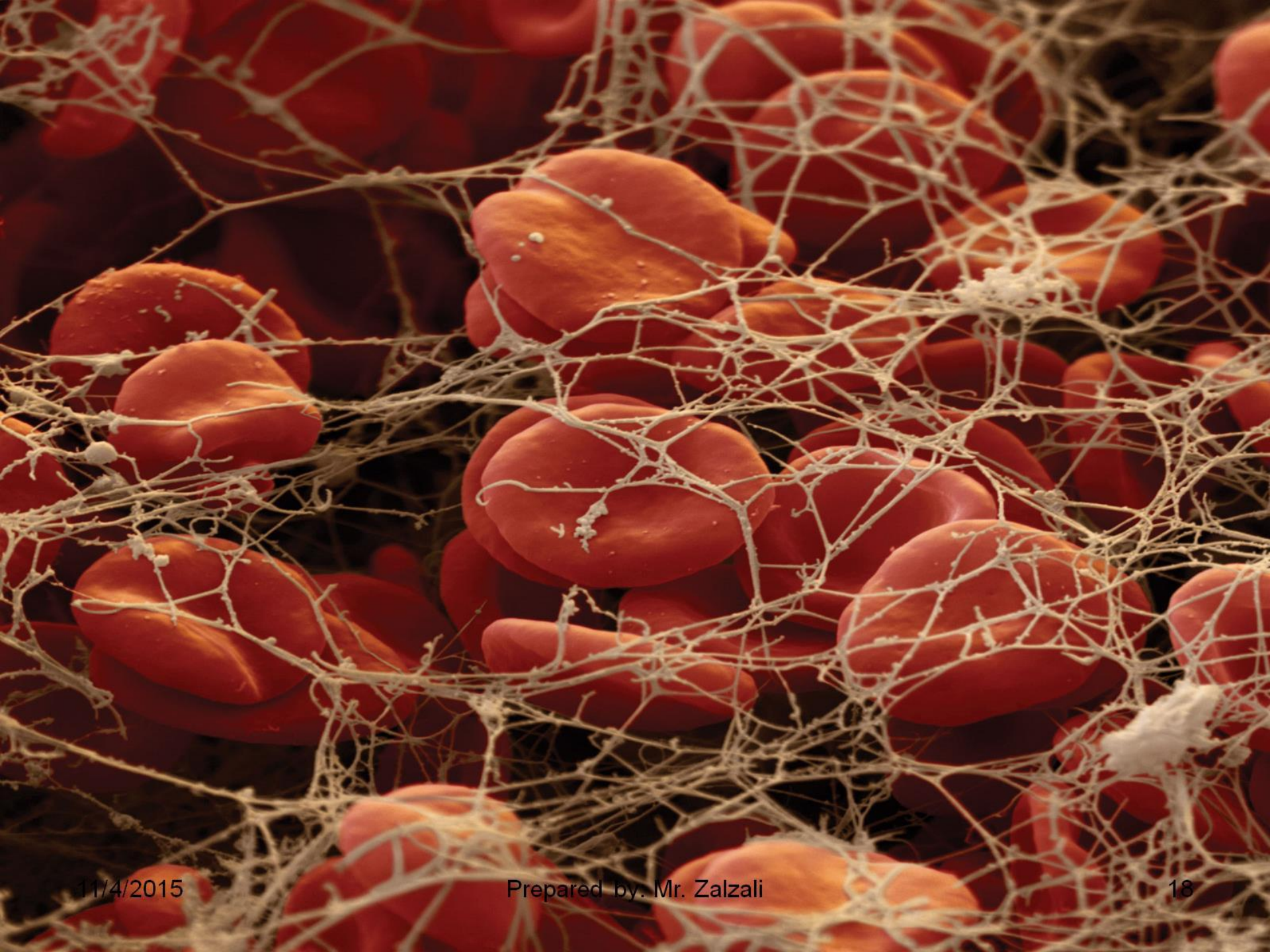
- **Cell fragments: {platelets}:**
 - Play major role in blood clotting



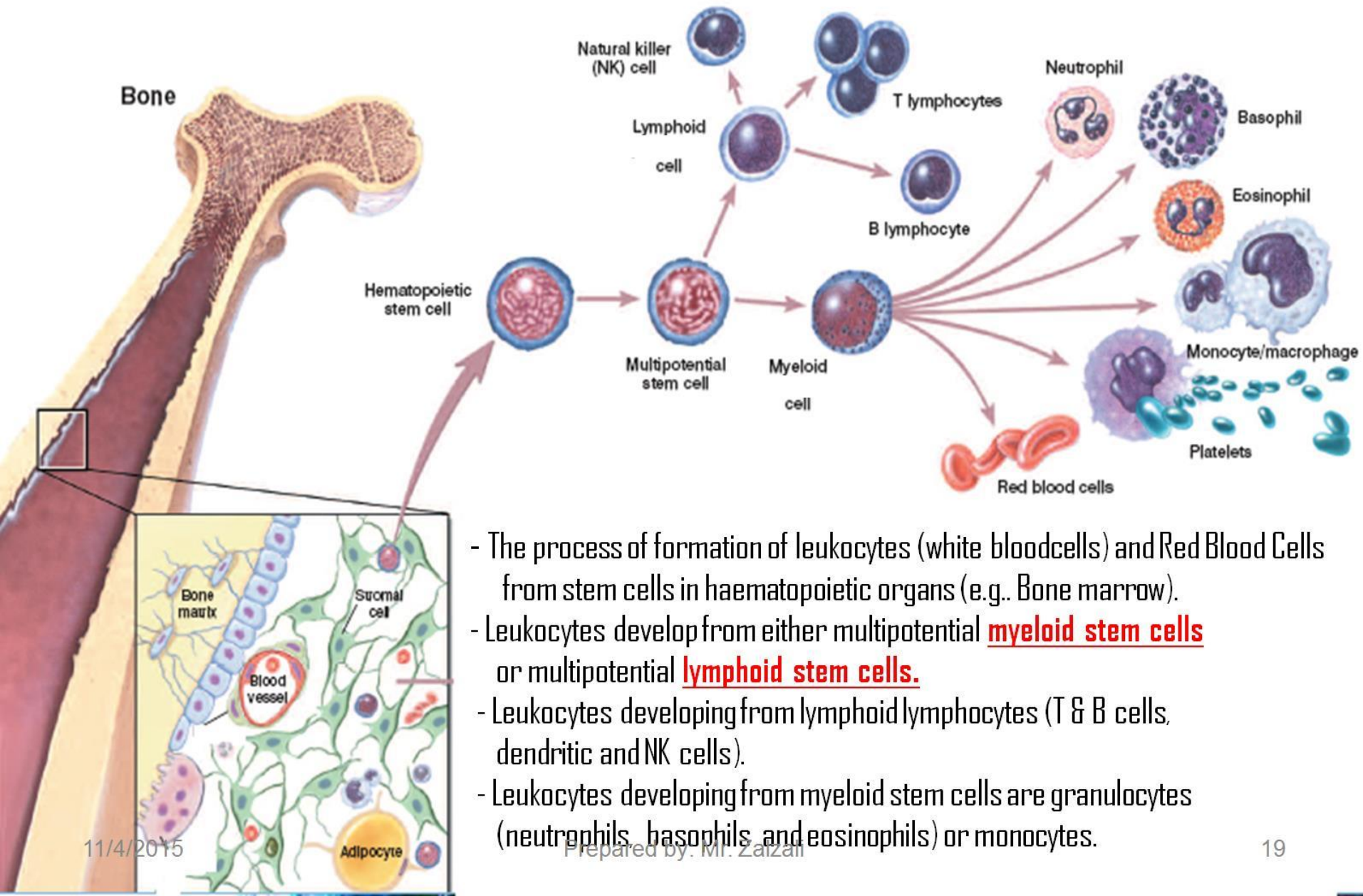
Blood clotting:

- 1- blood vessels damage.
- 2- RBCs and plasma: bleeding washes out any pathogens that may enter into blood stream.
- 3- Phagocytes (WBCs) gather near the wound to attack pathogens that may enter.
- 4-platelets start releasing clotting enzymes.
- 5 -enzymes activate chemical reaction that will lead to the formation of protein called **fibrin**.
- 6- fibrin form a net that trap blood cells.
- Blood clot is formed.



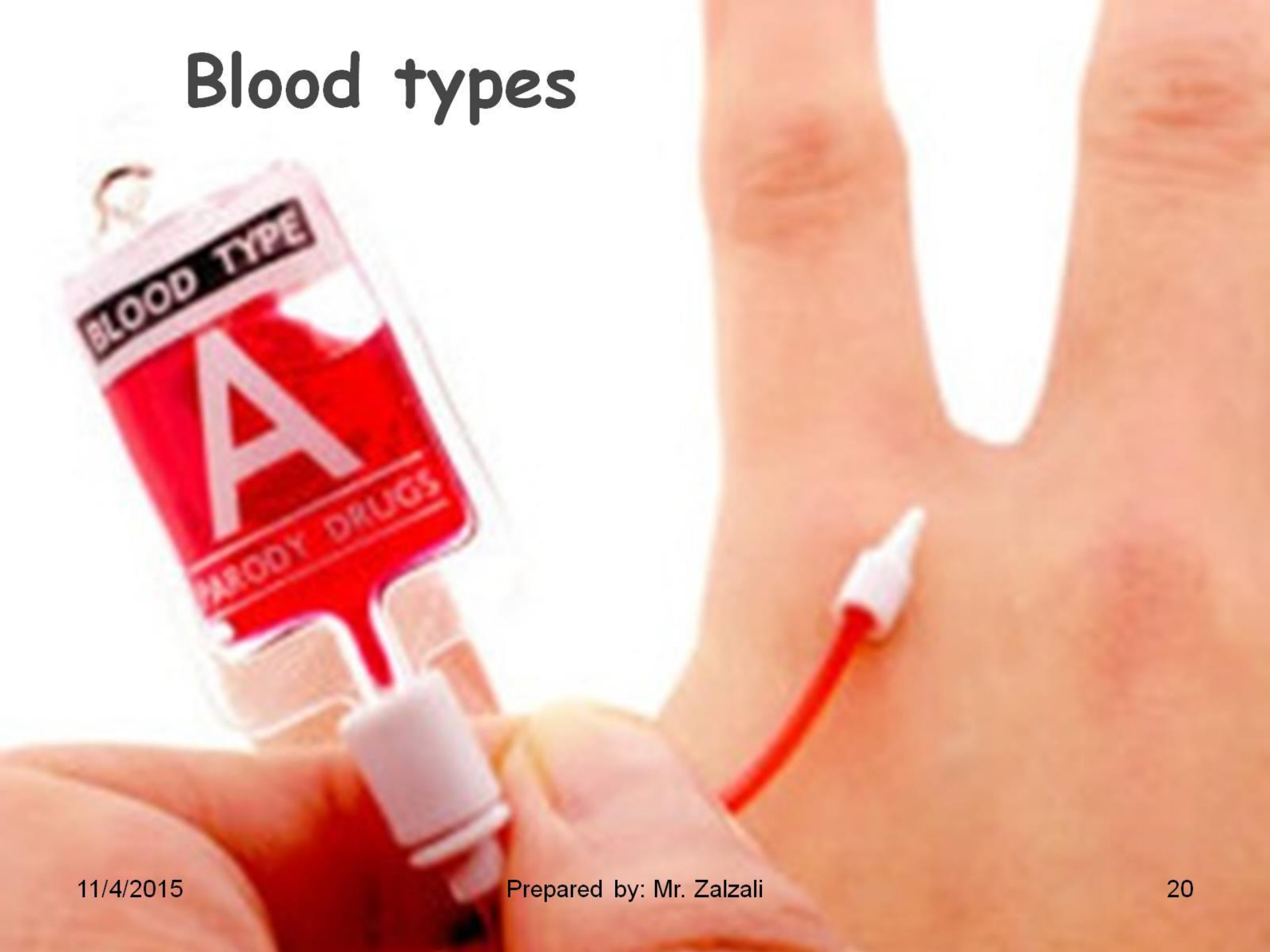


Leukopoiesis and Erythropoiesis



- The process of formation of leukocytes (white bloodcells) and Red Blood Cells from stem cells in haematopoietic organs (e.g.. Bone marrow).
- Leukocytes develop from either multipotential **myeloid stem cells** or multipotential **lymphoid stem cells**.
- Leukocytes developing from lymphoid lymphocytes (T & B cells, dendritic and NK cells).
- Leukocytes developing from myeloid stem cells are granulocytes (neutrophils, basophils and eosinophils) or monocytes.

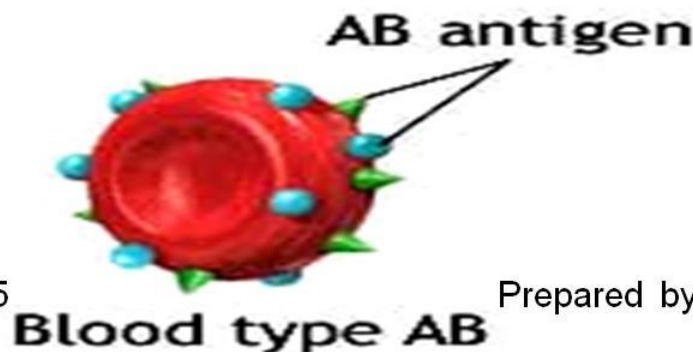
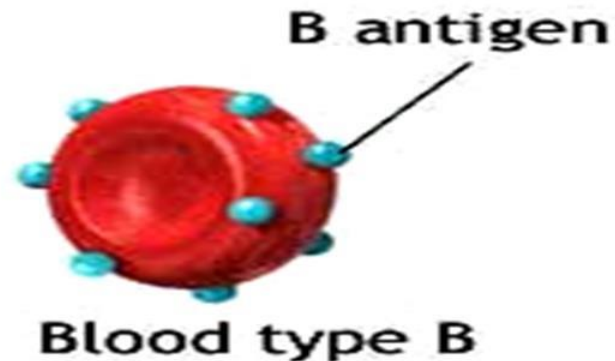
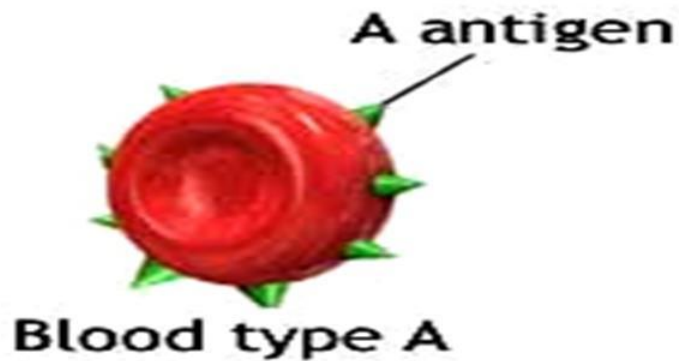
Blood types



Blood types

→ ABO blood group system.

→ Determined according to the kind of protein (**antigen**) found on the surface of RBCs.



Blood types








→ In Plasma :

→ Other proteins are found called **antibodies**



**Anti-A and anti-B
antibodies**

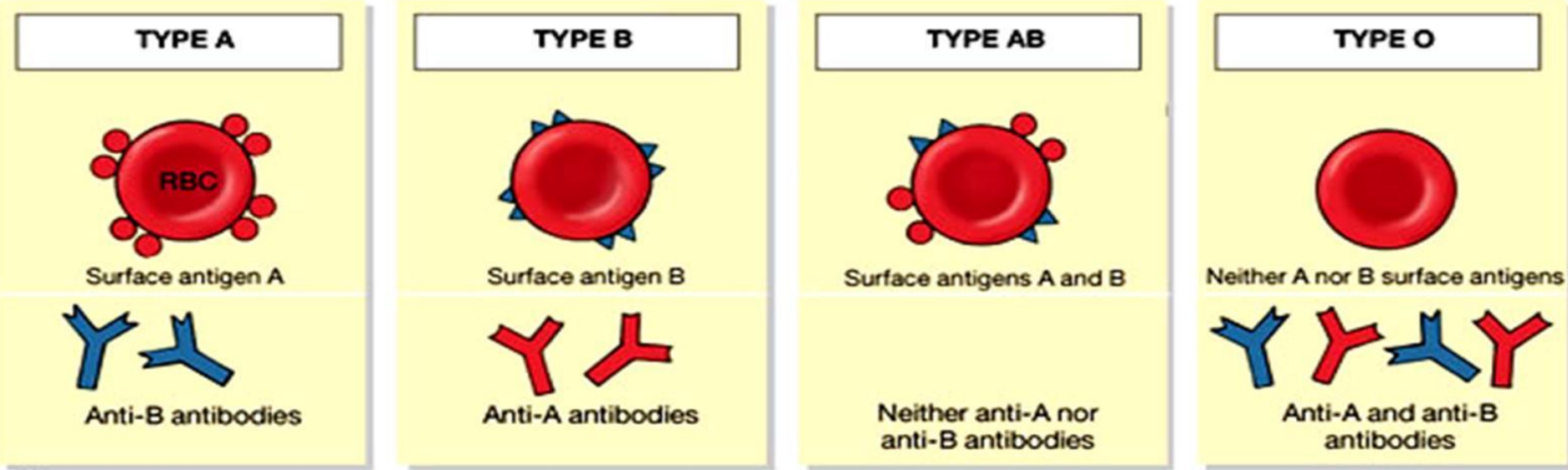
ABO system

Blood Type	Antigen (RBC membrane)	Antibody (plasma)	Can receive blood from	Can donate blood to
A	 <p>RBC</p> <p>Surface antigen A</p>	 <p>Anti-B antibodies</p>		
B	 <p>Surface antigen B</p>	 <p>Anti-A antibodies</p>		
AB	 <p>Surface antigens A and B</p>	<p>Neither anti-A nor anti-B antibodies</p>		
O (46%)	 <p>Neither A nor B surface antigens</p>	 <p>Anti-A and anti-B antibodies</p>		

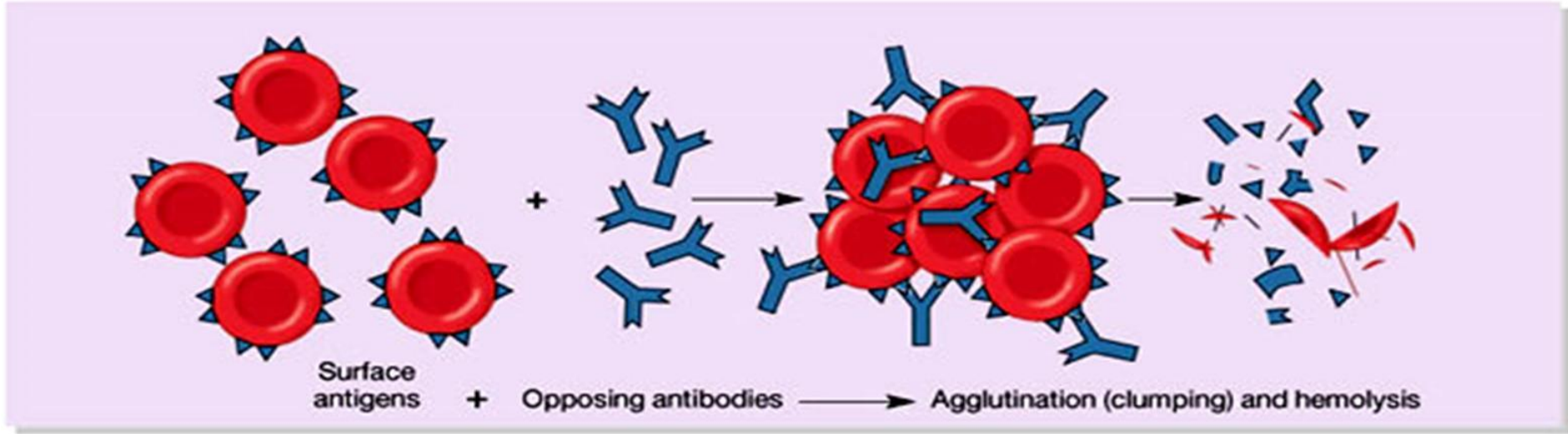
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(a)

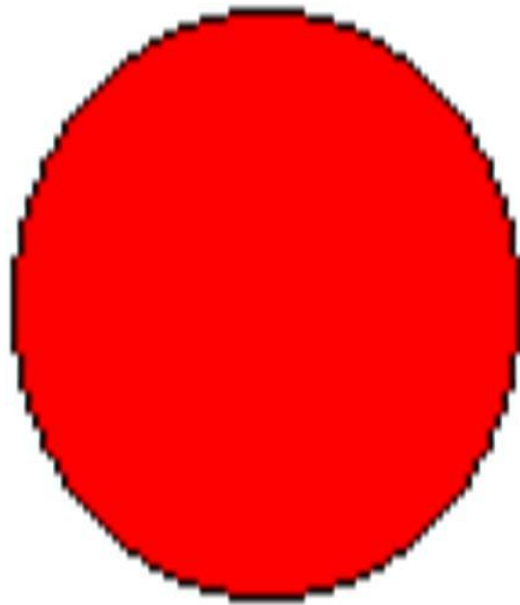


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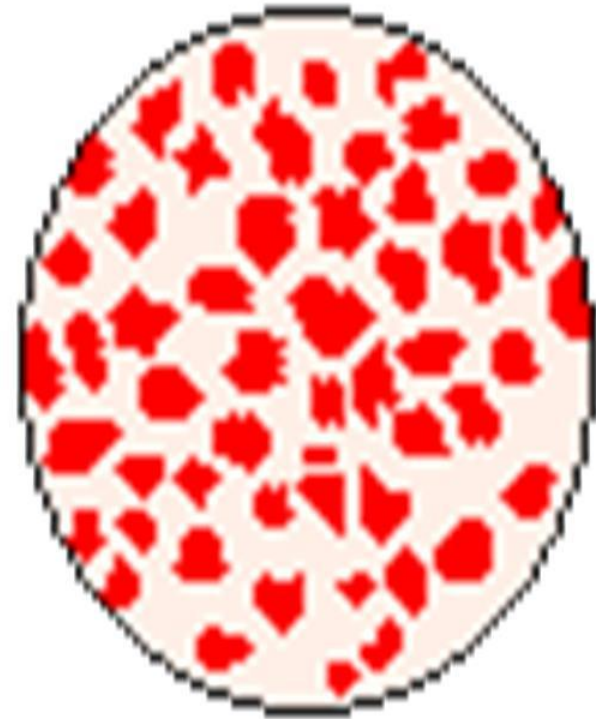
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If antibodies matches with antigens(lock and key) then agglutination (clumping)/ clotting will occur

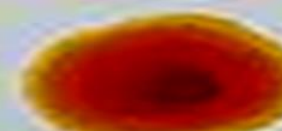
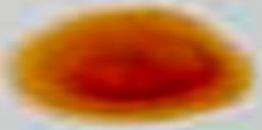
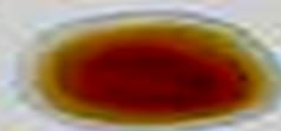
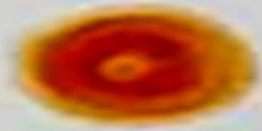
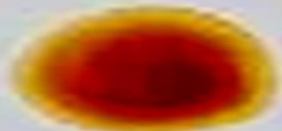
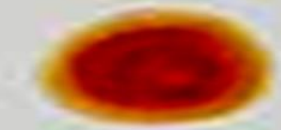
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Blood



Blood agglutination (clotting)



Blood types

- In a blood transfusion:
 - Recipient must receive blood from a donor that is compatible with their blood type.
 - AB :
 - universal recipient.
 - Coz they don't have antibodies
 - O :
 - universal donor.
 - Coz they don't have antigens.

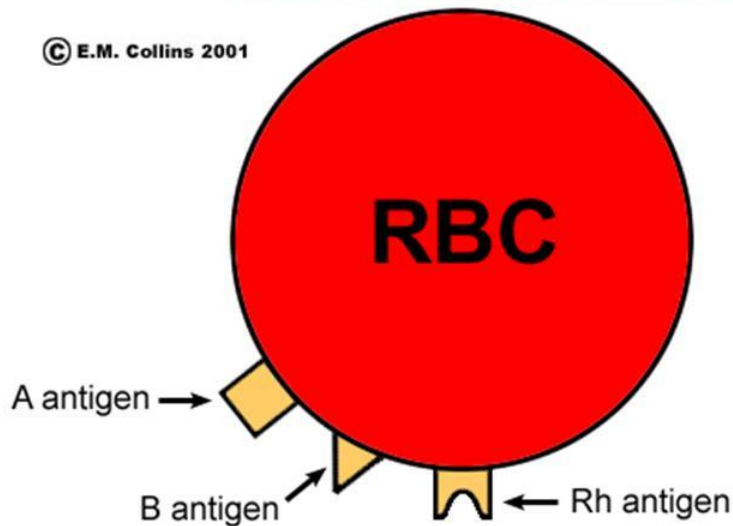
Blood types

→ Rhesus (Rh) Factor:

→ RBCs with Rh antigen → Rh⁺

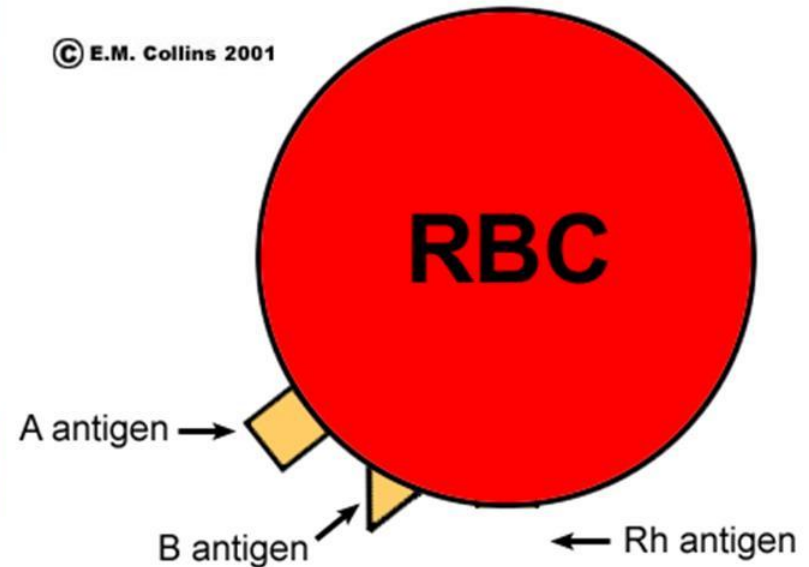
RBCs **without** Rh antigen → Rh⁻

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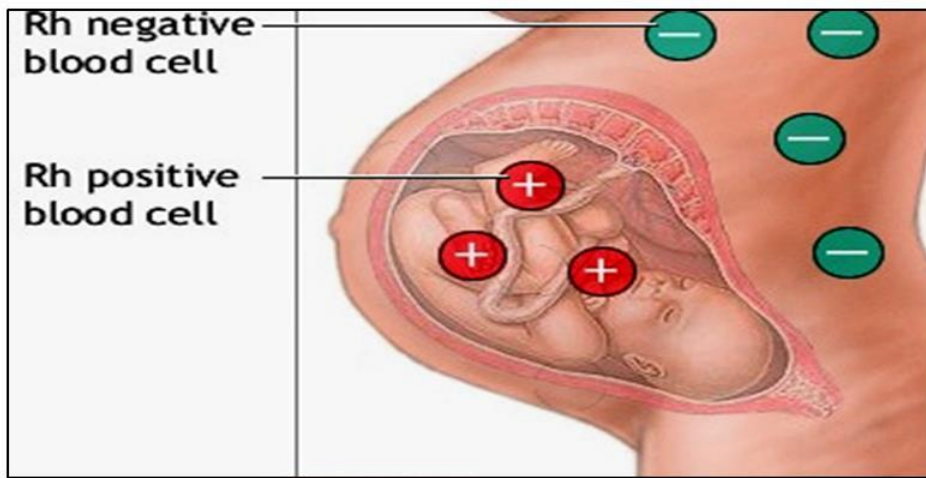
AB

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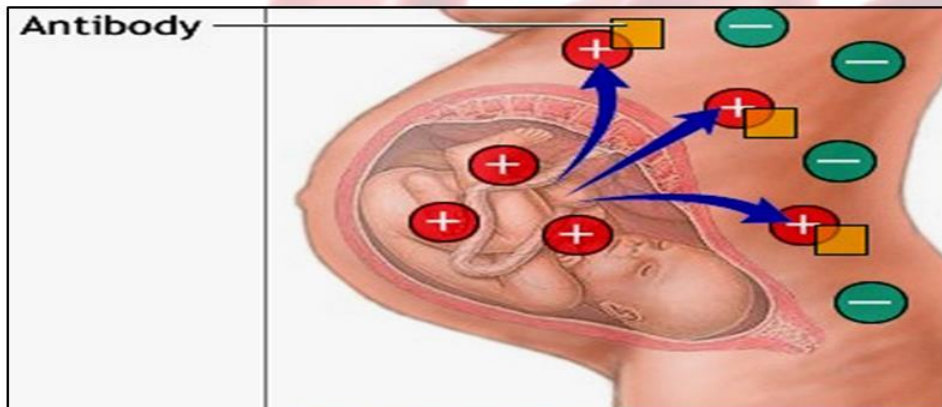


AB

Rh factor

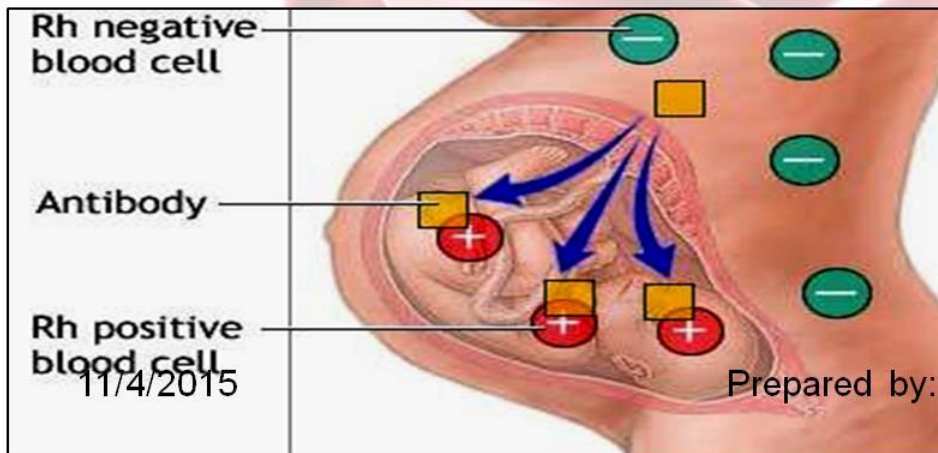


→ when **Rh⁻** mother gives birth to an **Rh⁺** fetus



→ The **Rh⁻** mother begins to make anti-Rh antibodies

→ The antibodies may attack fetus **Rh⁺ RBCs** and lead to fetal death



→ The antibodies will stay in the mother's bloodstream, so the next baby will also be in **danger** if he/she was **Rh⁺**

CARDIOVASCULAR SYSTEM

