Chapter 9

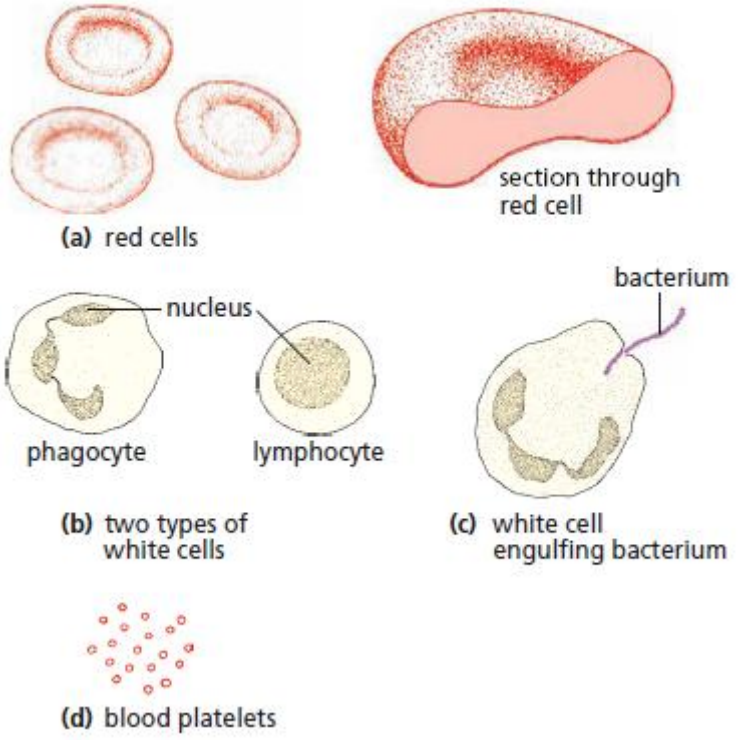
Animal transport/part 1

The blood circulatory system consists of:

- The Blood.
- The heart.
- The blood vessels.

The blood

- Blood consists of red cells (RBCs,) white cells (WBCs) and platelets floating in a liquid called plasma.
- The are about 5 to 6 litters of blood in body of an adult.



Red blood cells

Feature	Adaptation/Importance
They contain haemoglobin;	Haemoglobin enables red blood cells to transport oxygen;
They are tiny dislike biconcave cells;	This provides a large surface area to absorb more oxygen;
They have elastic cell membrane;	They are flexible and can squeeze through narrow capillaries;
They have no nucleus;	They leave more space for haemoglobin.

Number

- There are 5 million RBCs per mm3 of blood.

Life span

- Each RBC lives for about 4 months. About 200,000 million RBCs wear out and are replaced each day.
- Old and dead RBCs, are destroyed in the liver and spleen.

Origin

- New RBCs are formed in the red bone marrow.

What is Haemoglobin?

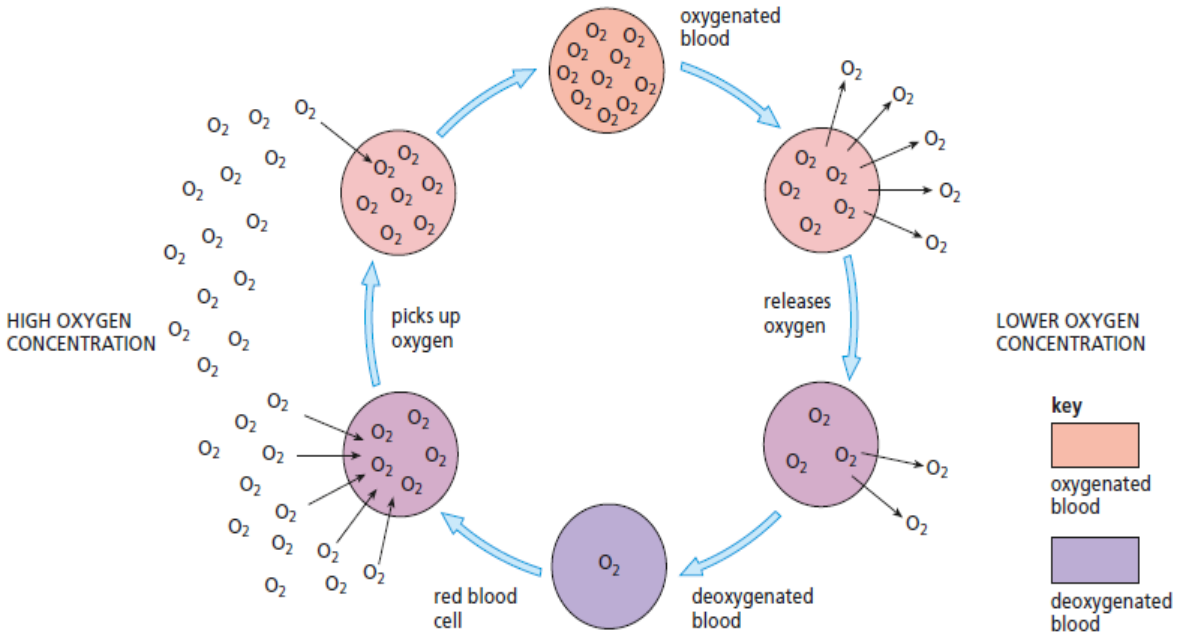
- Haemoglobin is a red pigment found in the cytoplasm of RBCs.
- Haemoglobin is made of protein combined with iron.

Function of RBCs (or haemoglobin)

- Haemoglobin enables red blood cells to transport oxygen from lungs to respiring tissues.

Explanation

- Haemoglobin combines with oxygen to form an unstable compound called oxyhaemoglobin. This occurs in the lungs where oxygen concentration is high;
- Oxyhaemoglobin breaks down and releases oxygen in respiring tissues where oxygen concentration is low.



White Blood cells

Description

- They have irregular shape.
- They have nucleus.

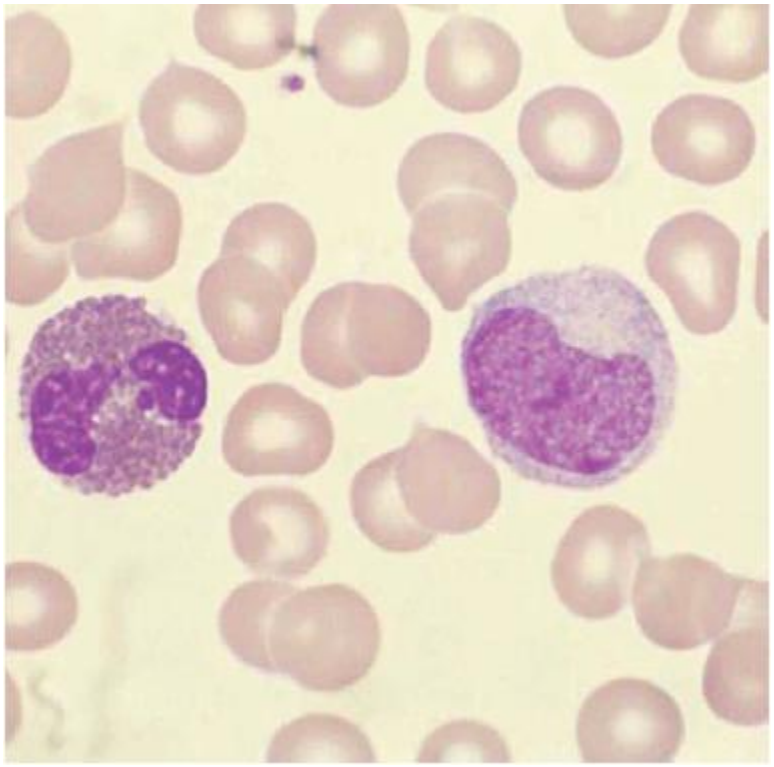
Number

- There are7000 – 8000 WBCs per mm^3 of blood.

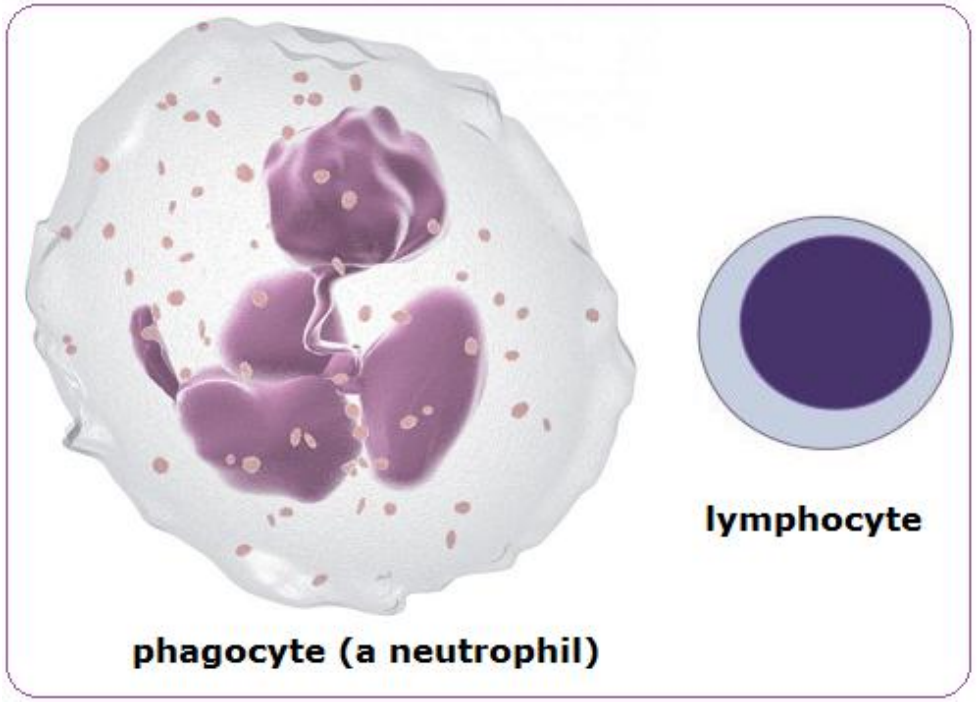
- Note: RBCs are smaller in size than WBCs, but RBCSs are more numerous (each WBC stands for 600 RBCs).

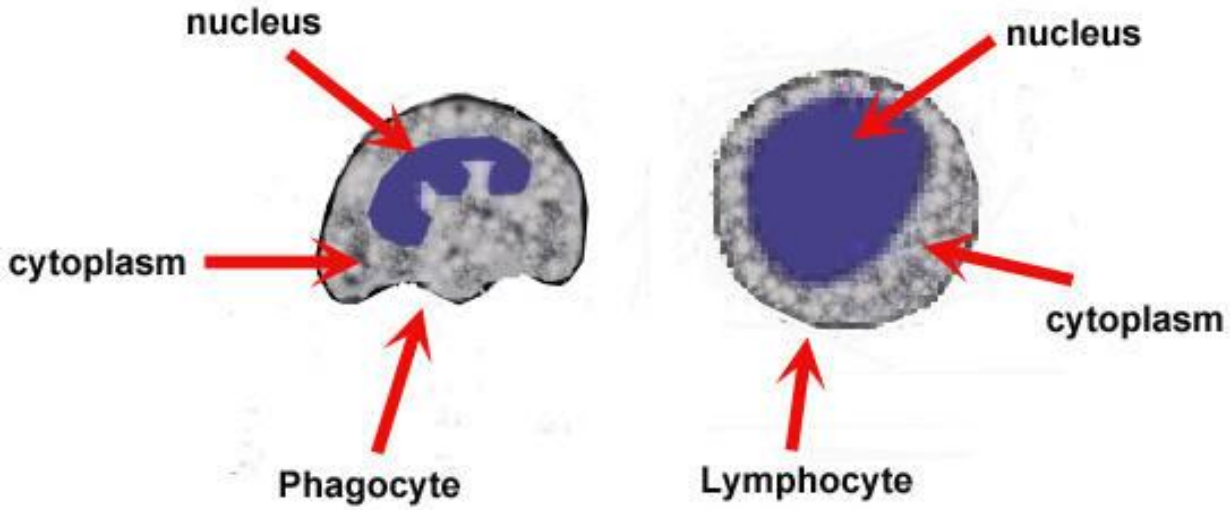
Origin

- WBCs are formed in the bone marrow but some develop in the thymes:



The main types of white blood cells





WBC	Feature	Function
Phagocyte	Irregular shaped nucleus allows cell to squeeze out through gaps in walls of capillaries.	Engulf and digest bacteria and cell debris by enzymes they produce.
Lymphocyte	Large nucleus contains many copies of genes for the control of antibody protein production.	Secrete antibodies which kill bacteria or antitoxins to neutralize bacterial toxins.

Phagocytosis (action of phagocytes)

Contact stage

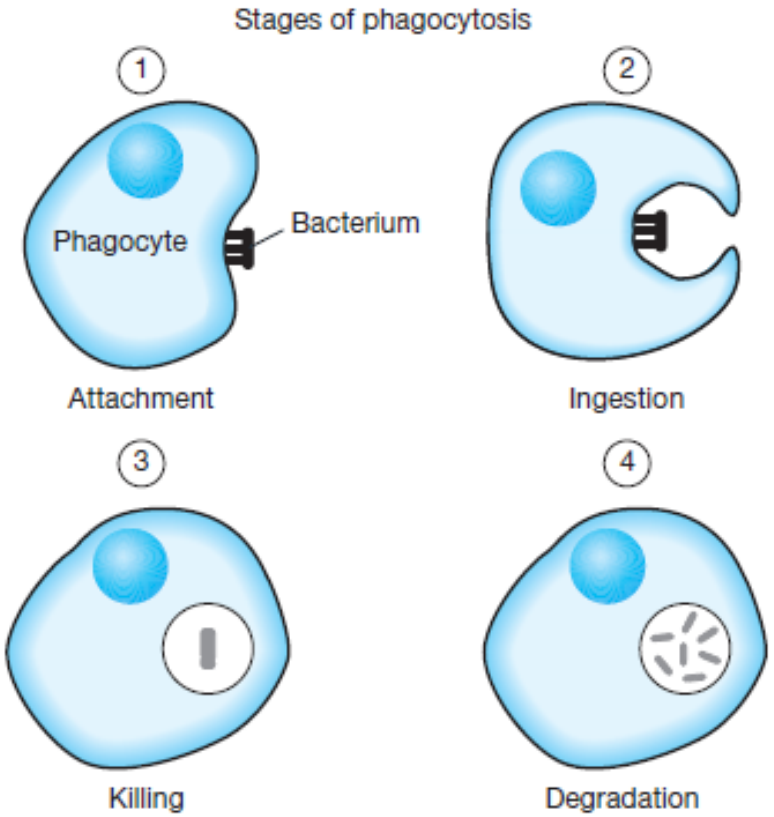
- Phagocytes move to the site of infection;

Ingesting and engulfing stage

- The phagocyte surrounds the bacterium forming a small depression. The depression increases in size and finally cuts off forming a vesicle called phagocytic vesicle.

Digesting stage

- Enzymes attack and digest the bacterium inside the vesicle .



Platelets

Description

- Platelets are fragments of cells.

Origin

- platelets are produced by budding in the red bone narrow.

Number

- 250,000 platelets/mm^3 of blood.

Function

- Platelets help to clot the blood at wounds and so stop further bleeding .

Plasma

Plasma is the liquid part of the blood. It is mainly made of water and substances dissolved in it.

Example of dissolved substances :

- Salt,
- proteins ,
- nutrients such as glucose, amino acids and lipids,
- hormones,
- urea,
- oxygen gas and carbon dioxide dissolved in the plasma.

Examples of plasma proteins:

- Fibrinogen (for blood clotting)
- Albumin (for osmotic pressure)
- Antibodies.

Note

- The blood transports substances dissolved in plasma.

Function of blood

1. Transport
2. Defense against infection
3. Homeostasis

Tranpsort

Substance	From	To
Oxygen	Lungs	Respiring tissues
Carbon dioxide	Respiring tissues	Lungs
Urea	Liver	Kidneys
Hormones	Endocrine glands	Target organs
Nutrients (digested food)	Small intestine	Whole body
Heat	Liver and muscles	Whole body mainly cold organs

Defense against infection

Phagocytes

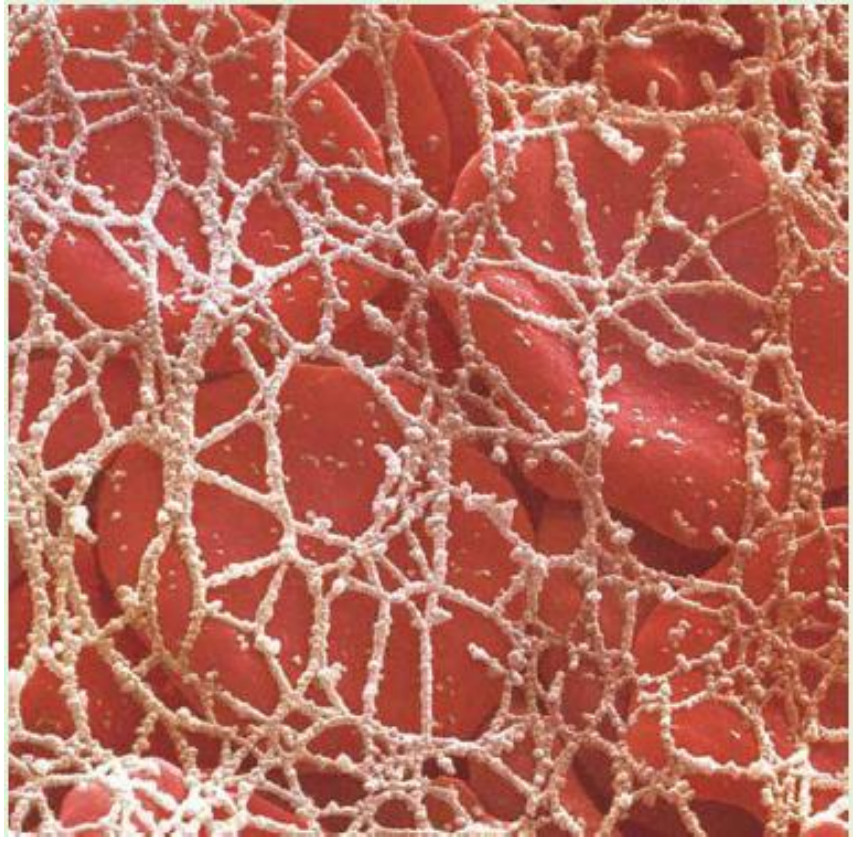
- They engulf and digest bacteria in blood circulation or other tissues. phagocytes can leave blood circulation by squeezing themselves out through the wall of blood capillaries.

- Lymphocytes produce antibodies. Antibodies attack antigens (foreign substances).

- Note: Each antibody is specific, this means the antibody that attacks a typhoid bacterium cannot attack pneumonia bacteria.

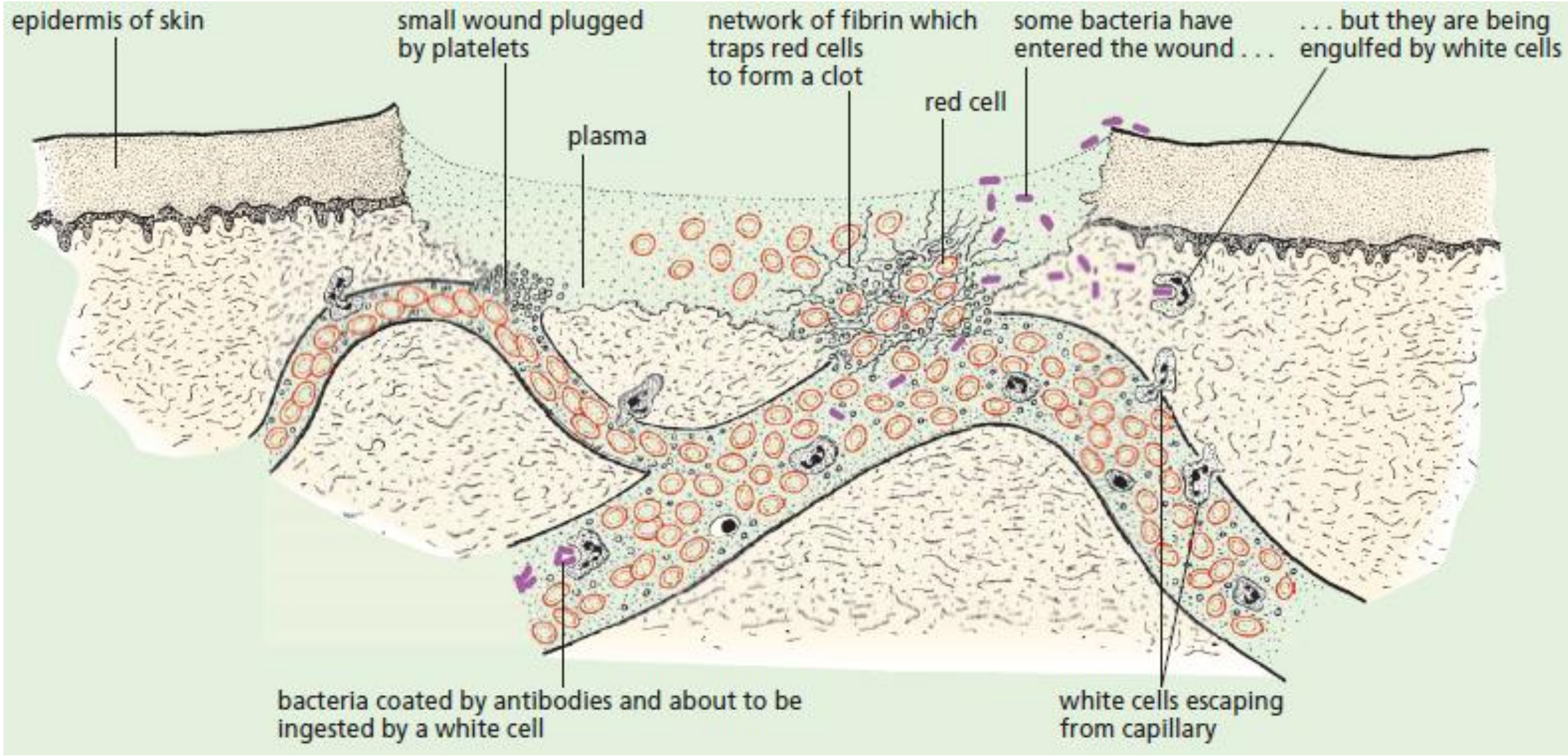
Clotting

- When tissues are damaged and blood vessel are cut, platelets gather and block the smaller capillaries.
- Platelets at the wound produce a substance, and in the presence of calcium ions and other clotting factors, act through a series of enzymes, which act on fibrinogen changing it to insoluble fibrin which forms a network of fibers trapping red blood cells and forming a clot.



Function of clot at a wound

- Stops further loss of blood.
- Prevents the entry of harmful bacteria.


epidermis of skin
small wound plugged by platelets
network of fibrin which traps red cells to form a clot
some bacteria have entered the wound . . .
. . . but they are being engulfed by white cells
red cell
plasma
bacteria coated by antibodies and about to be ingested by a white cell
white cells escaping from capillary

Homeostatic Function

- The blood plays a homeostatic function by delivering oxygen and nutrients to the tissue fluid and removing the excretory products.
- In turn the tissue fluid supplies the cells with nutrients and oxygen.
- It is also removes unwanted substances produced by cells metabolism.
- The composition of blood plasma is regulated by the homeostatic organs, the liver, the kidneys and the lungs.