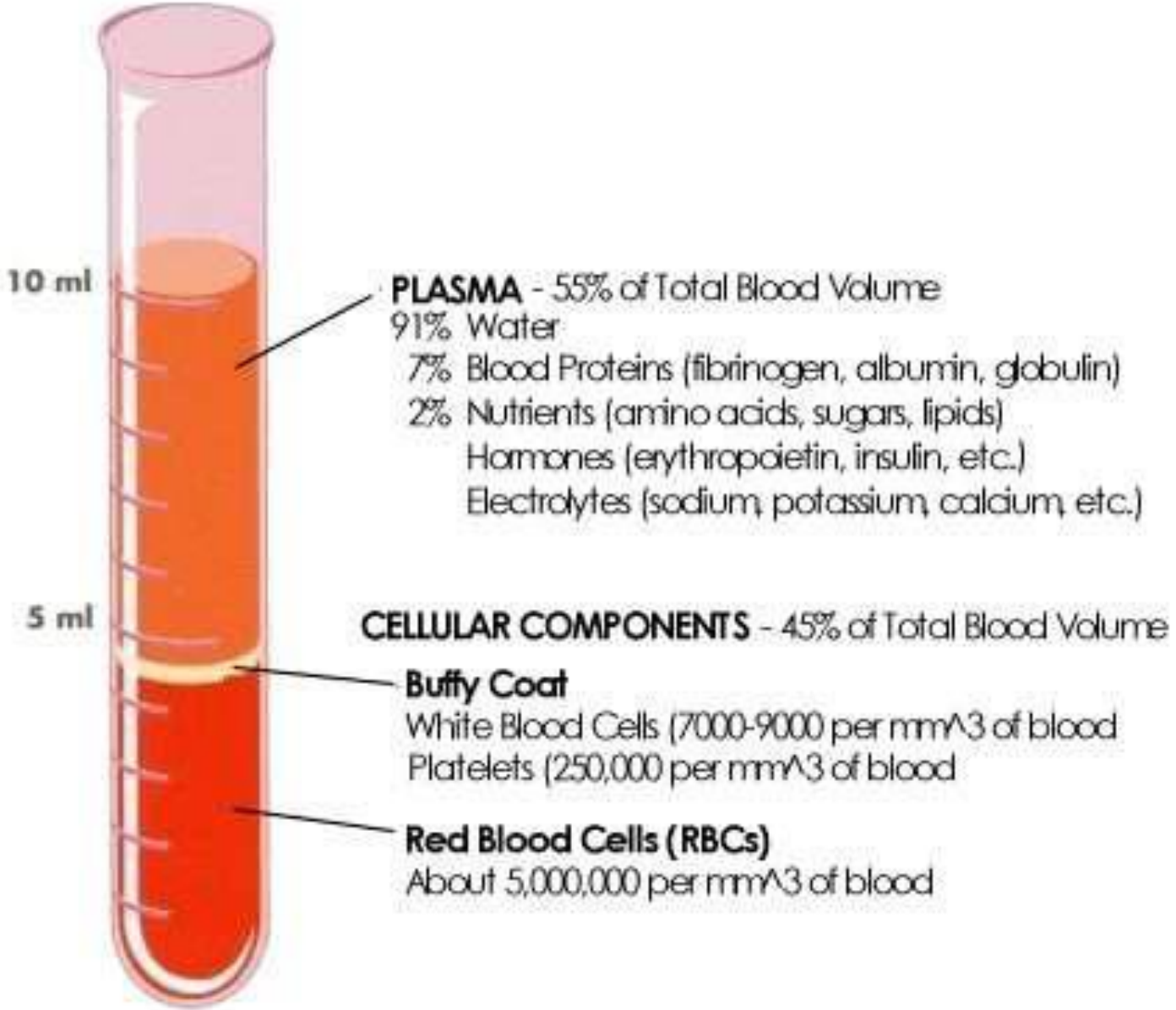
Circulatory system

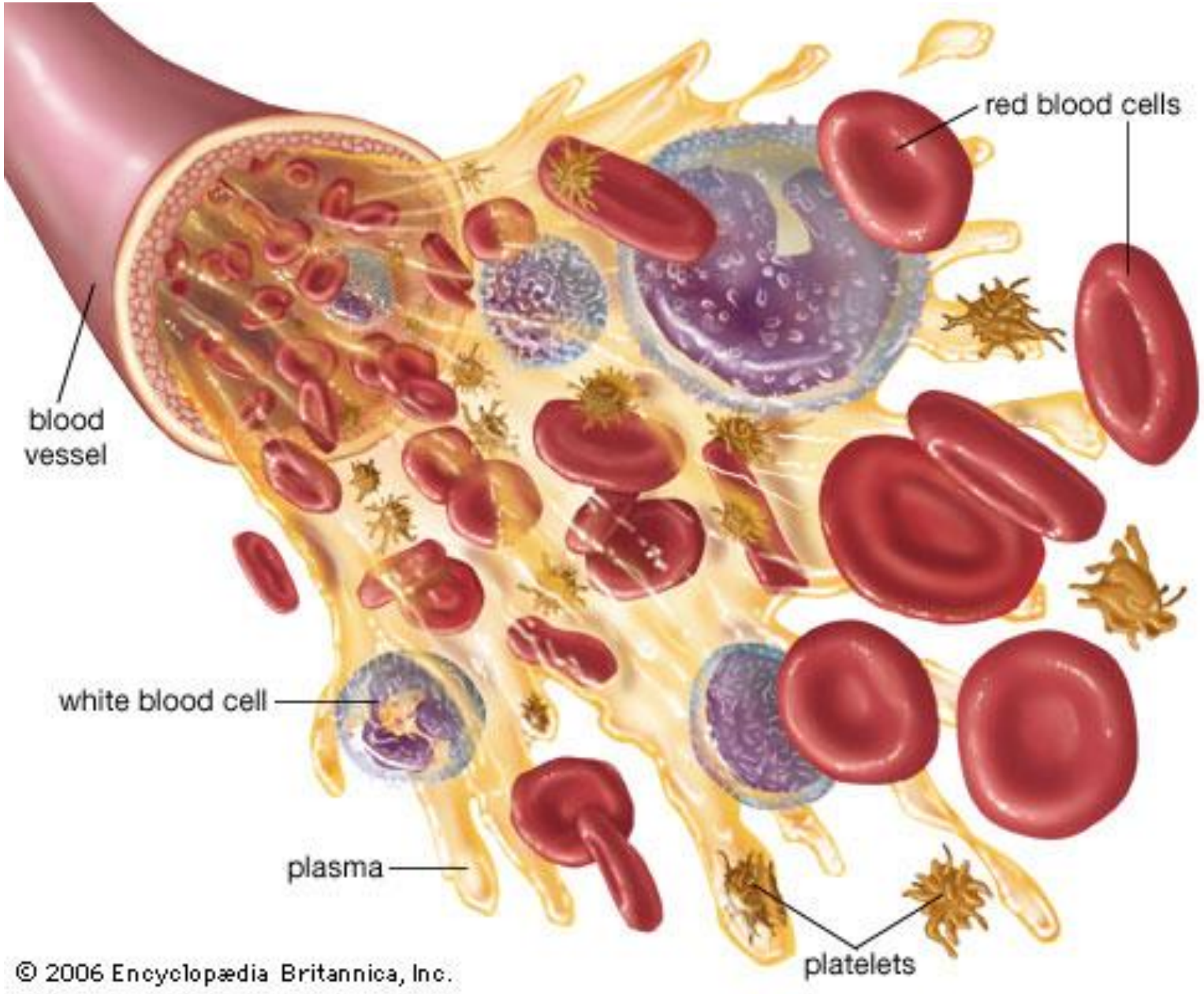
COMPOSITION OF BLOOD

- RED CELLS
- WHITE CELLS
- PLATELETS

floating in a liquid called PLASMA

Blood composition




red blood cells
blood vessel
white blood cell
plasma
platelets
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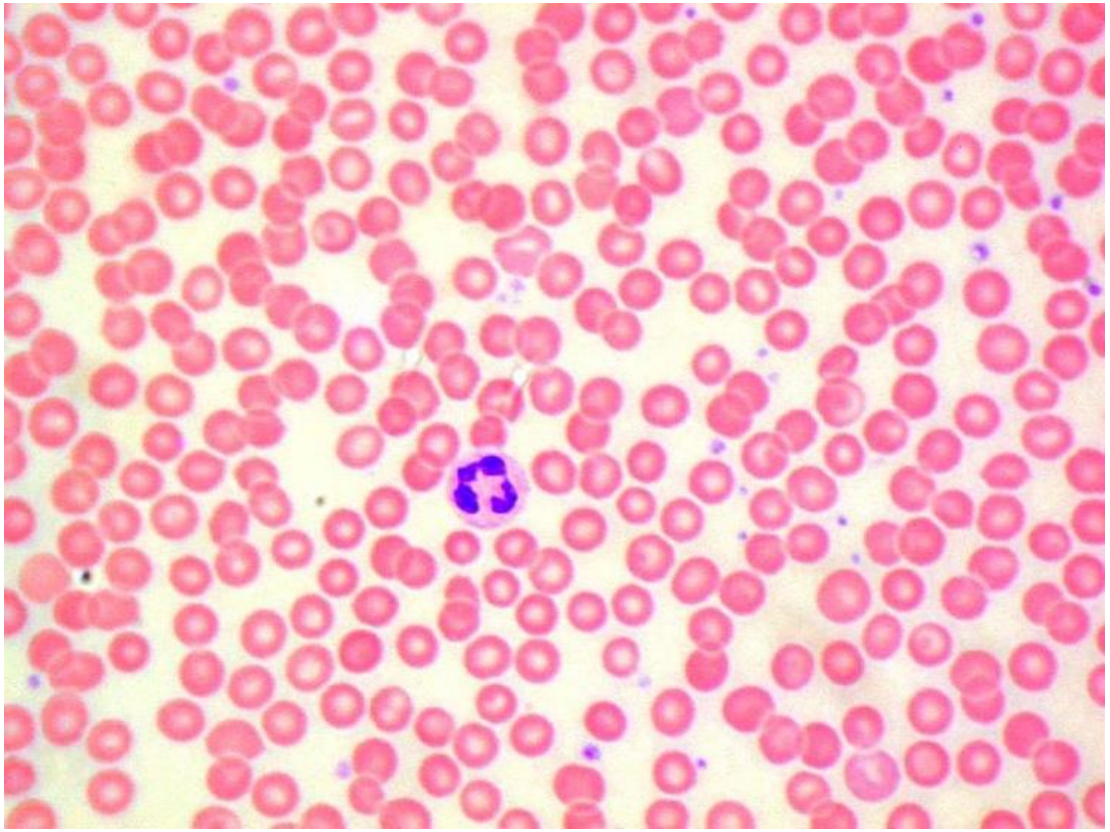
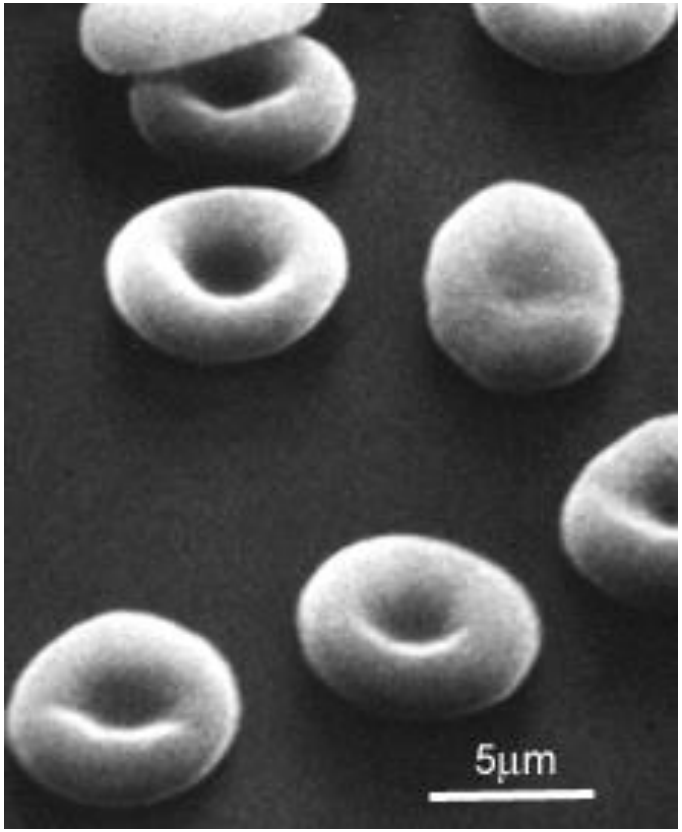
RED BLOOD CELLS

- Biconcave discs
- No nuclei
- Spongy cytoplasm enclosed in an elastic cell membrane
- Red pigment called **haemoglobin**

Are made by the red bone marrow of certain bones in the skeleton: ribs, vertebrae and breastbone

Red blood cells: morphology

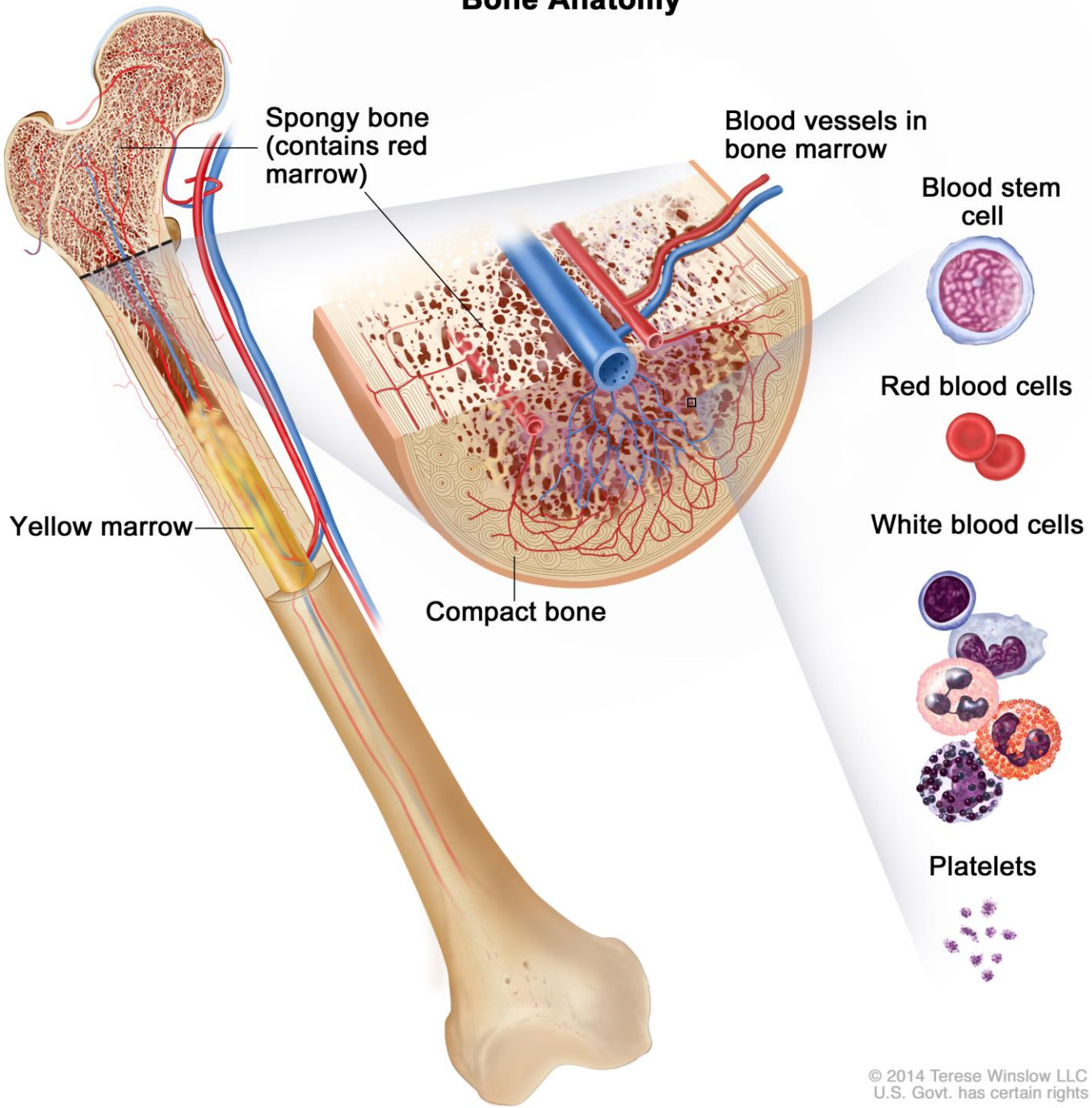




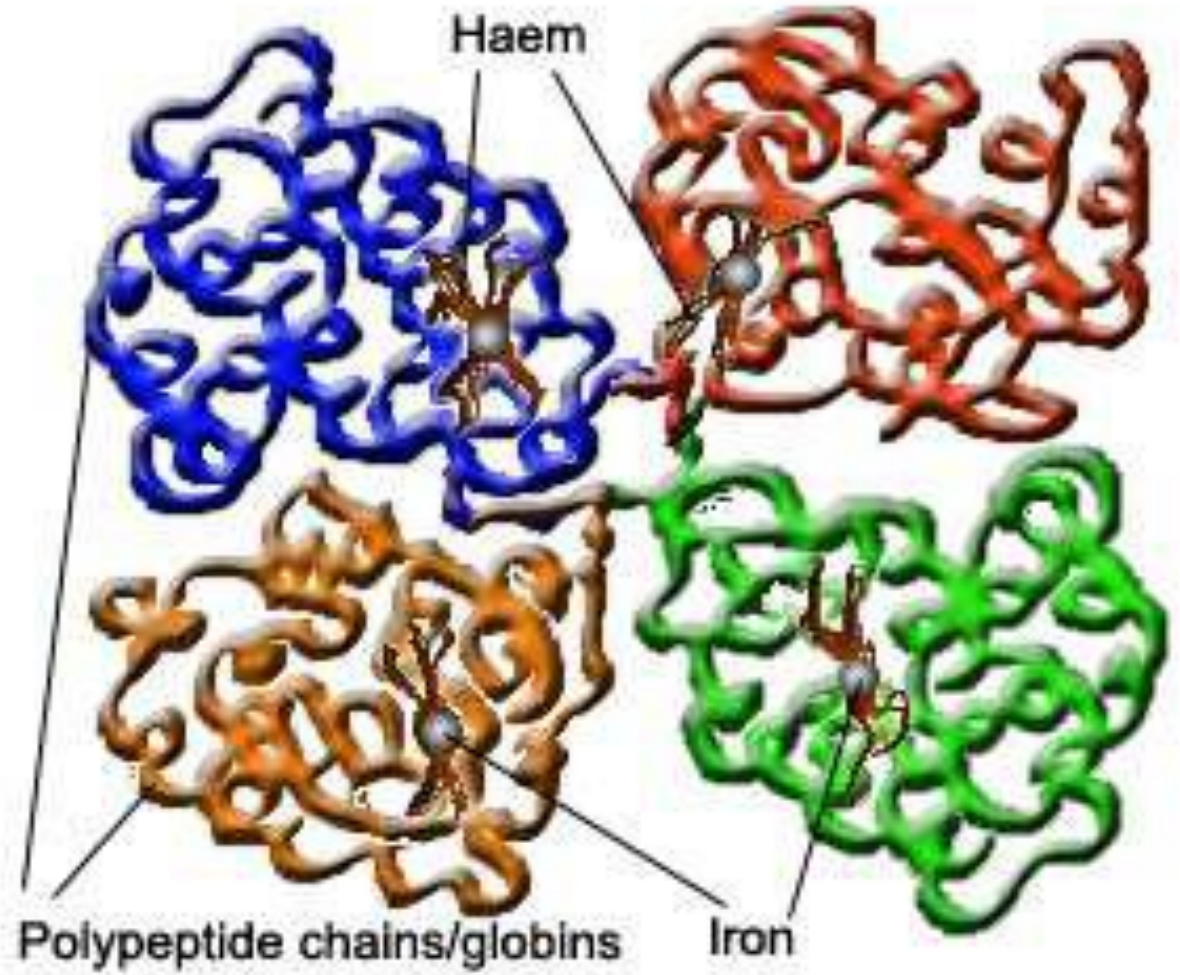
http://www.histology.leeds.ac.uk/blood/assets/blood_scanem.gif

https://i.pinimg.com/736x/7c/b2/48/7cb2484c0bdb6fcf78fd5f2bc0dfe1f3--coagulation-red-blood-cells.jpg

Bone Anatomy



Haemoglobin



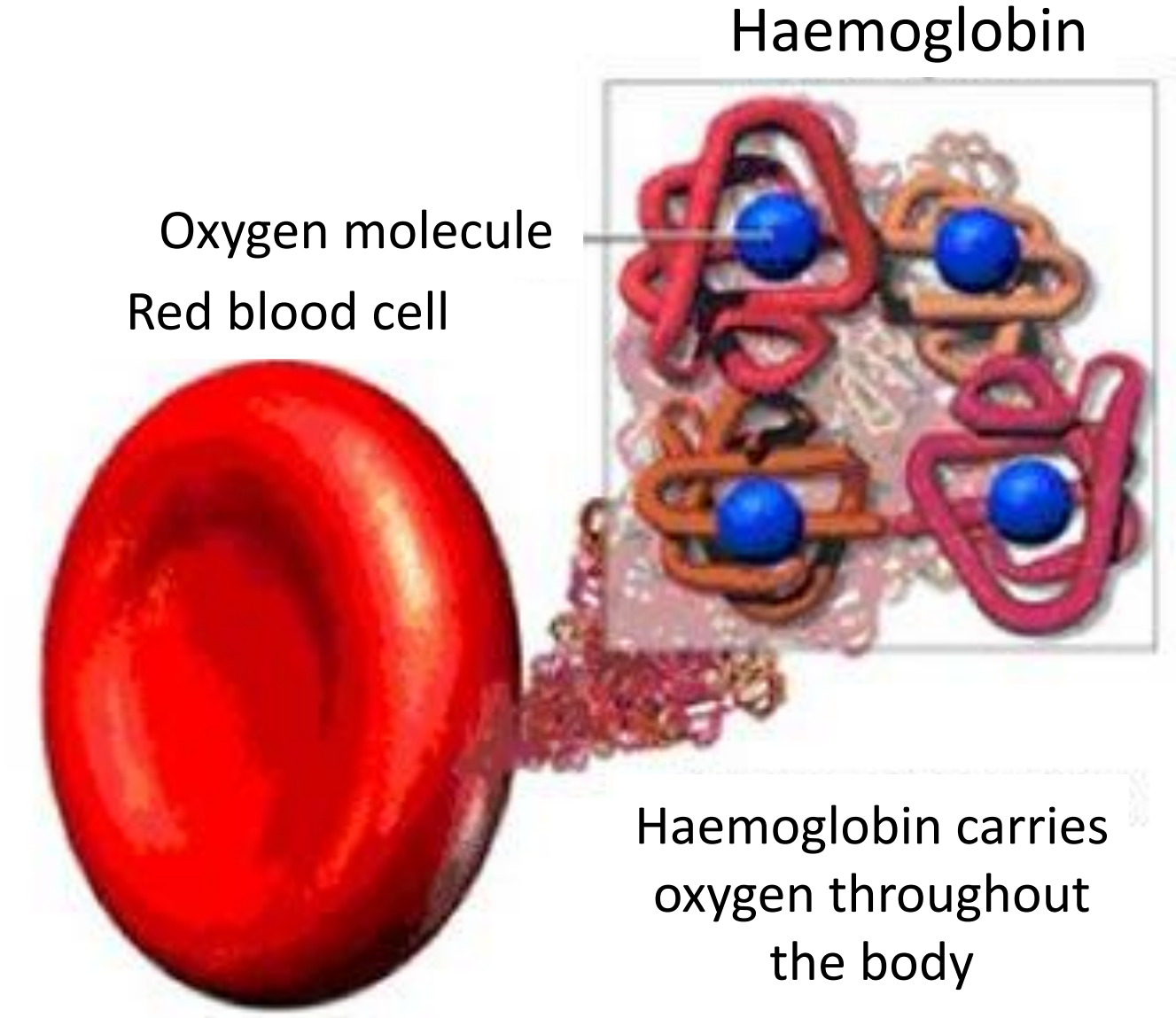
Haemoglobin (Hb)

- Hb + O_2 oxyhaemoglobin (OHb)

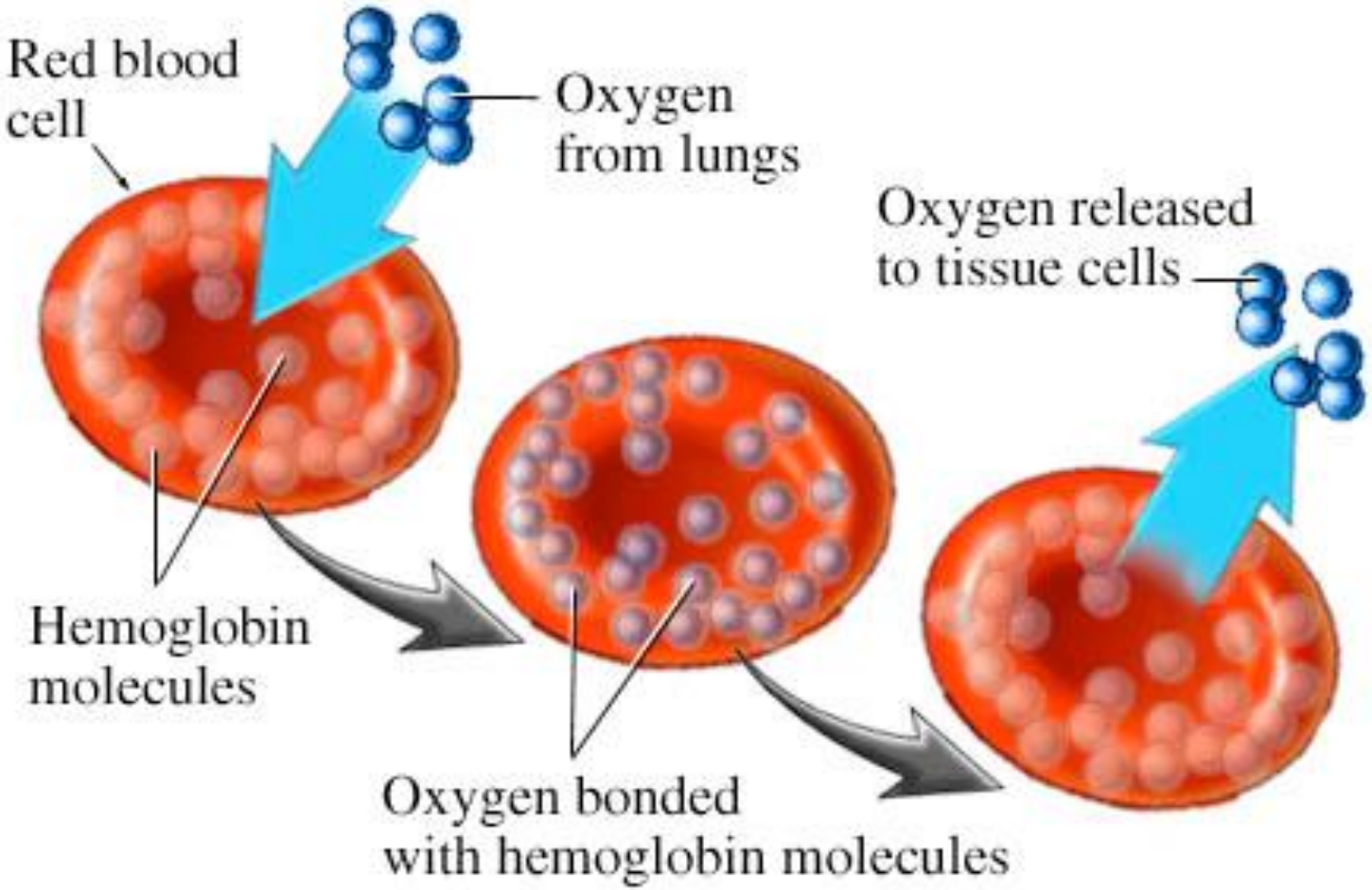
In places where the O_2 concentration is low, OHb breaks down
and releases its O_2. Where??

- **Oxygenated blood :** contains mainly OHb.
- **Deoxygenated blood :** with little OHb.

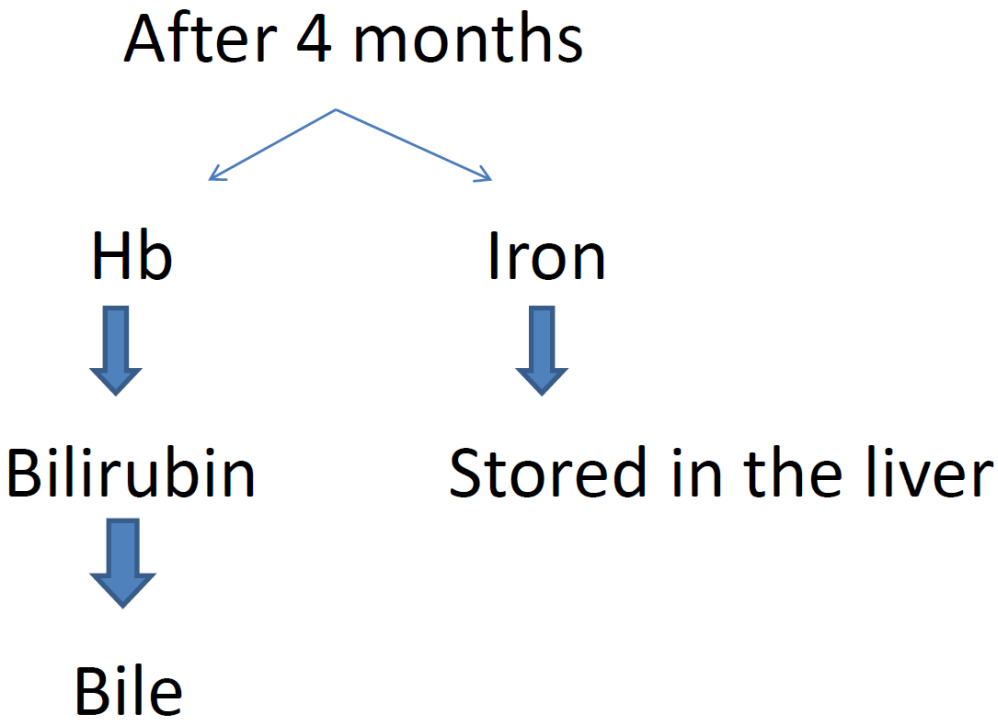
Oxyhaemoglobin



Haemoglobin carries oxygen throughout the body

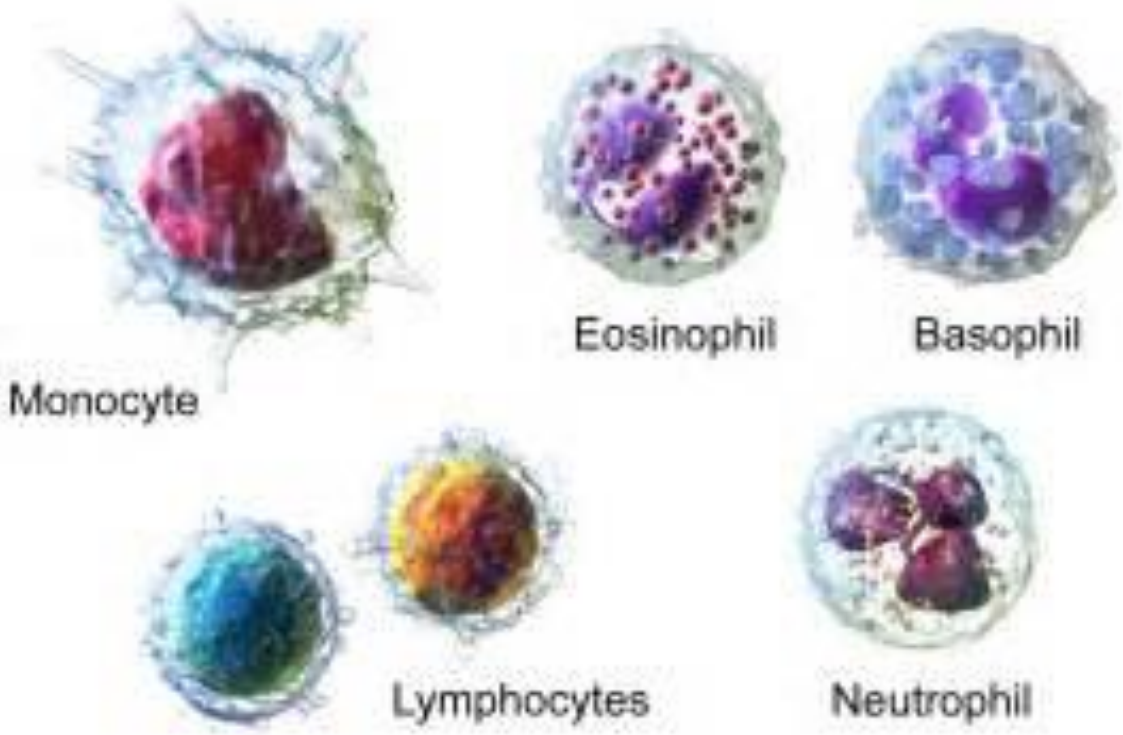

Red blood cell
Oxygen from lungs
Oxygen released to tissue cells
Hemoglobin molecules
Oxygen bonded with hemoglobin molecules

Red blood cells



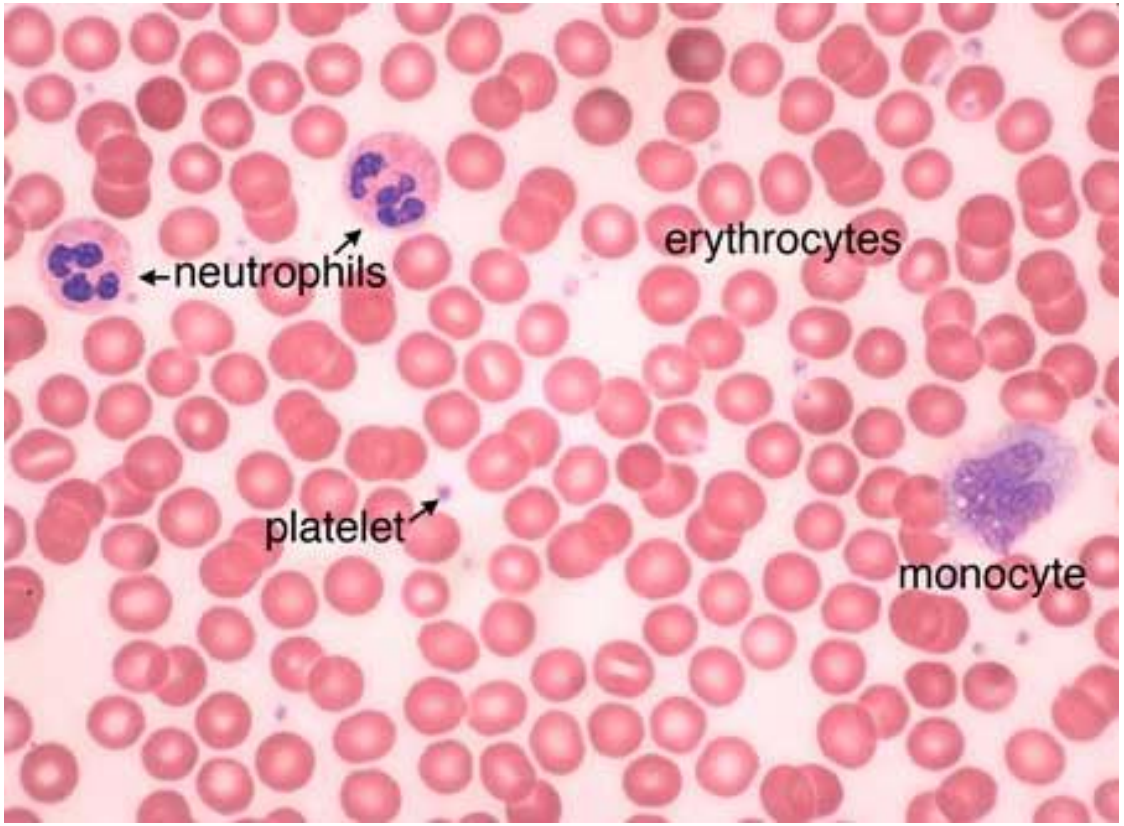
WHITE CELLS

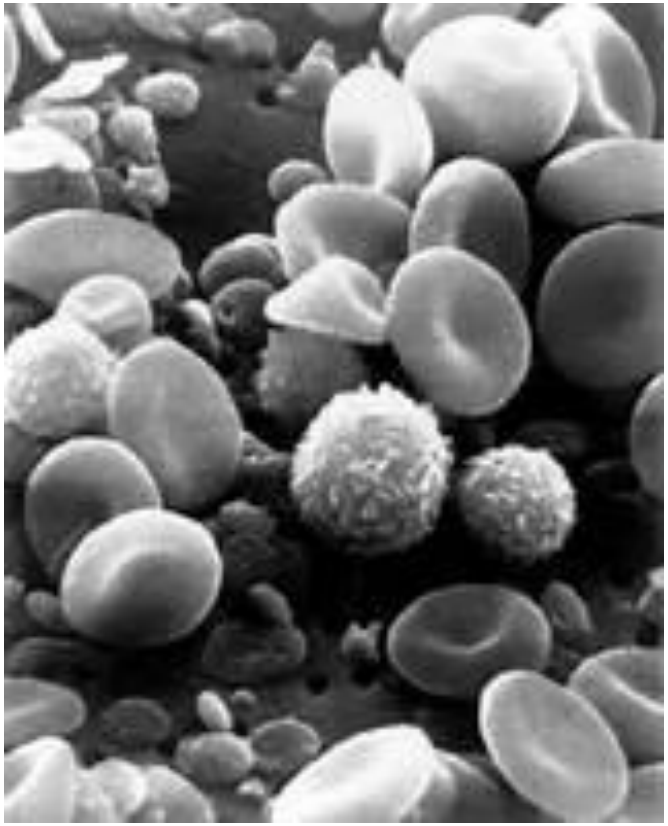
- Different types
- Larger than red cells
- They have nuclei
- They are made in the same bone marrow that red cells
- The two more numerous types are:
  - **Phagocytes**
  - **Lymphocytes**



White Blood Cells

White blood cells: morphology



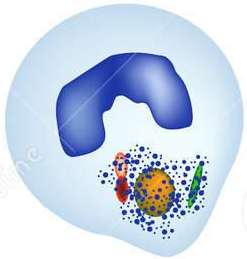


White blood cells: **Phagocytes**

- They collect at the site of an infection, engulfing (ingesting) and digesting harmful bacteria. They prevent the spread of infection through the body.

Phagocytosis

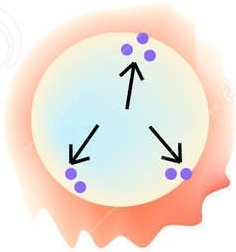
Leukocyte absorbs bacteria



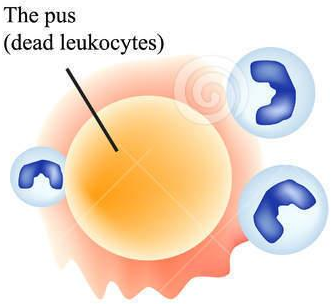
Leukocyte ingests bacteria

Leykocyte expends from ingestings f large numbers of bacteria

and lyses

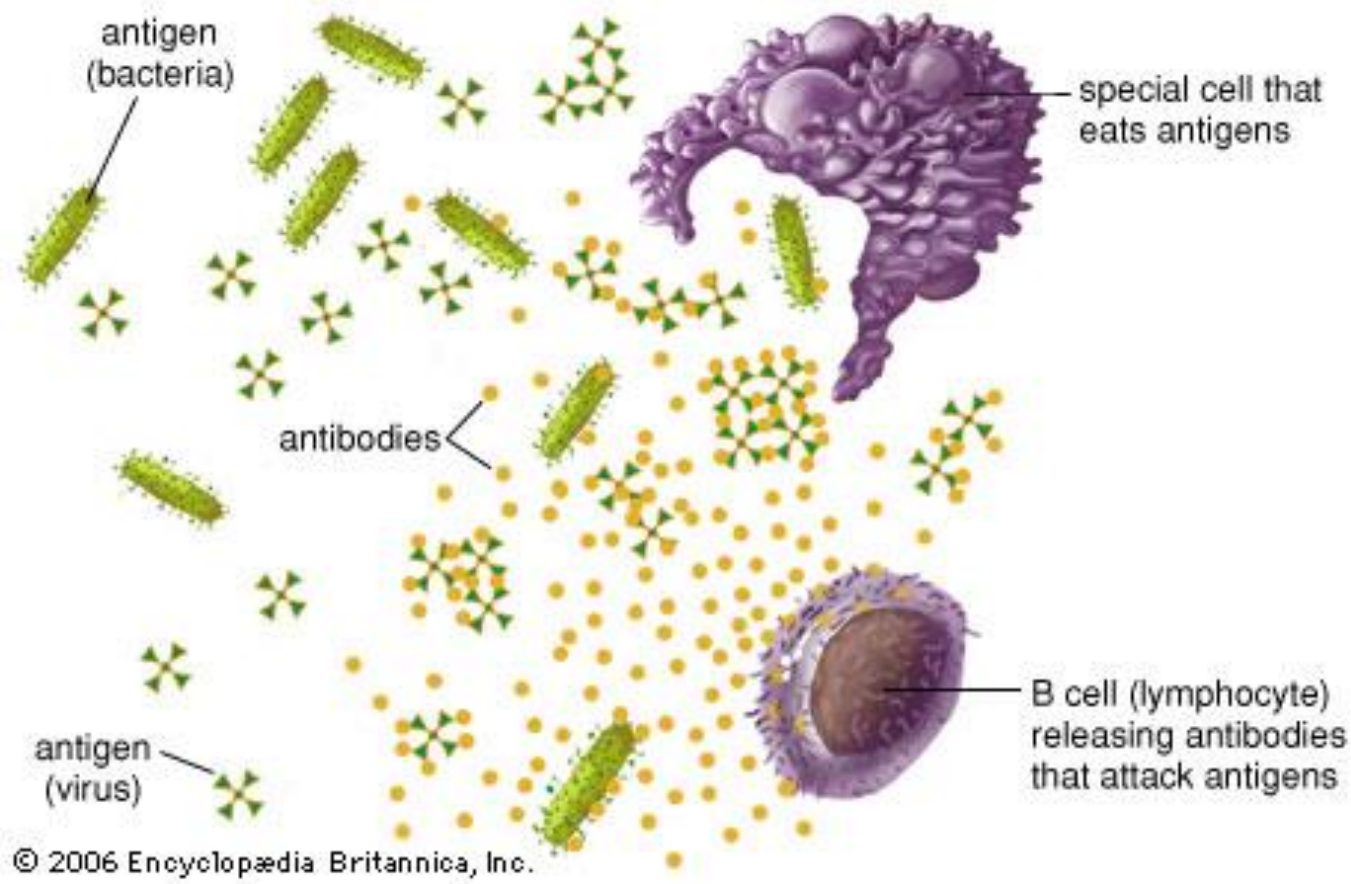


White blood cells are lyses releasing cytokines (chemikal signal) which cause local inflammatory reaction (cascading) including swelling, redness and fever



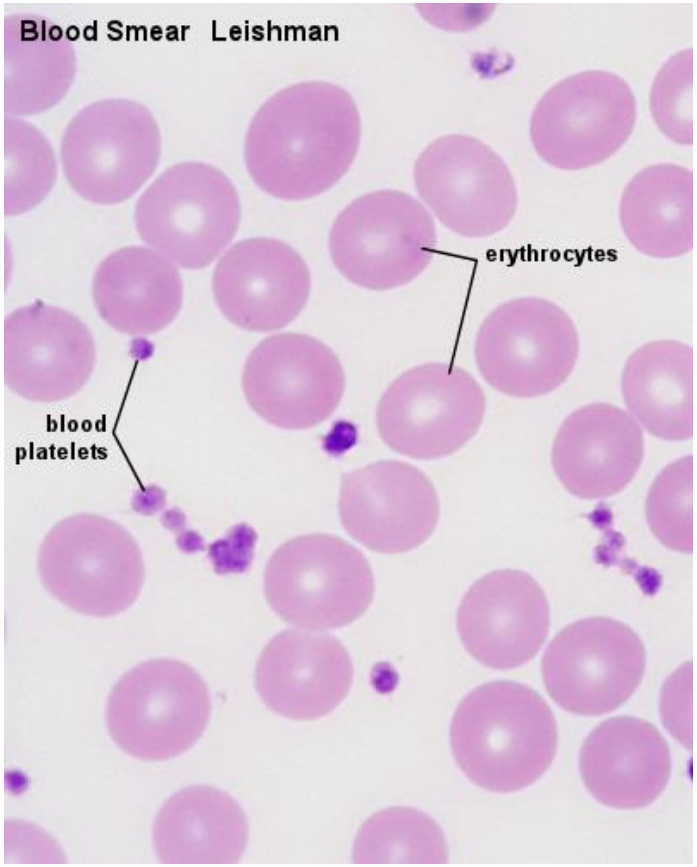
Cytokines attract new leucocytes to fight bacteria

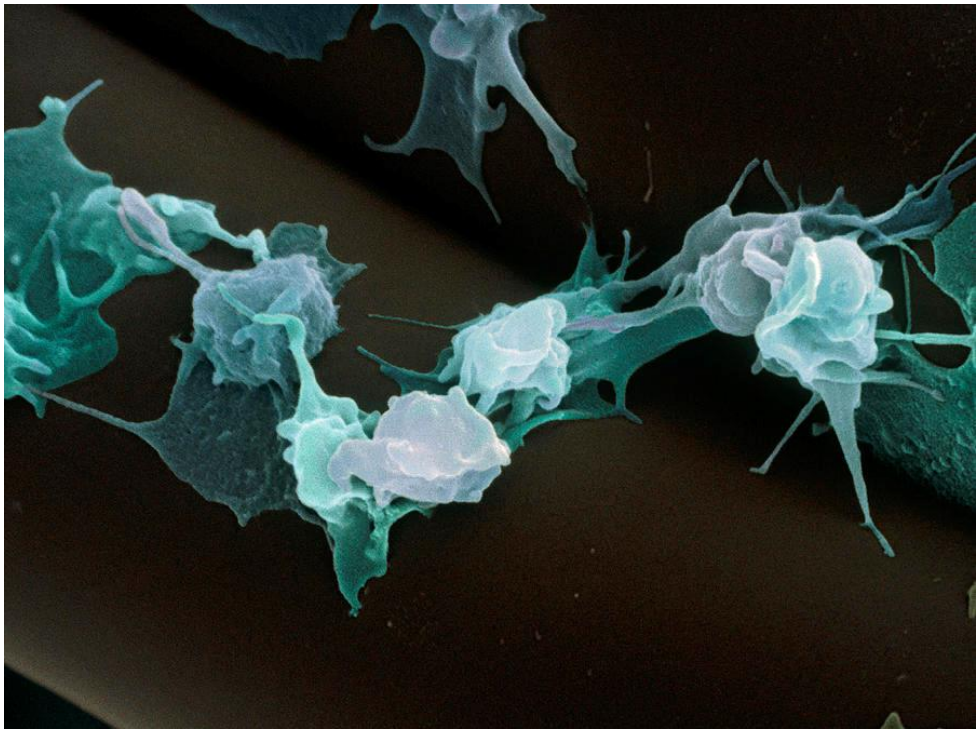
White blood cells: **Lymphocytes**
Production of antibodies (proteins)



PLATELETS

They help to clot the blood





PLASMA

- **Ions**: sodium, potassium, calcium, chloride, hydrogen carbonate.
- **Proteins**: fibrinogen (clotting), albumin and globulins (antibodies).
- **Food substances**: aa, glucose and fats.
- **Hormones**
- **Urea**

Functions of the blood

- Homeostatic functions
- Transport
- Defence against infections
    - Clotting
    - White cells

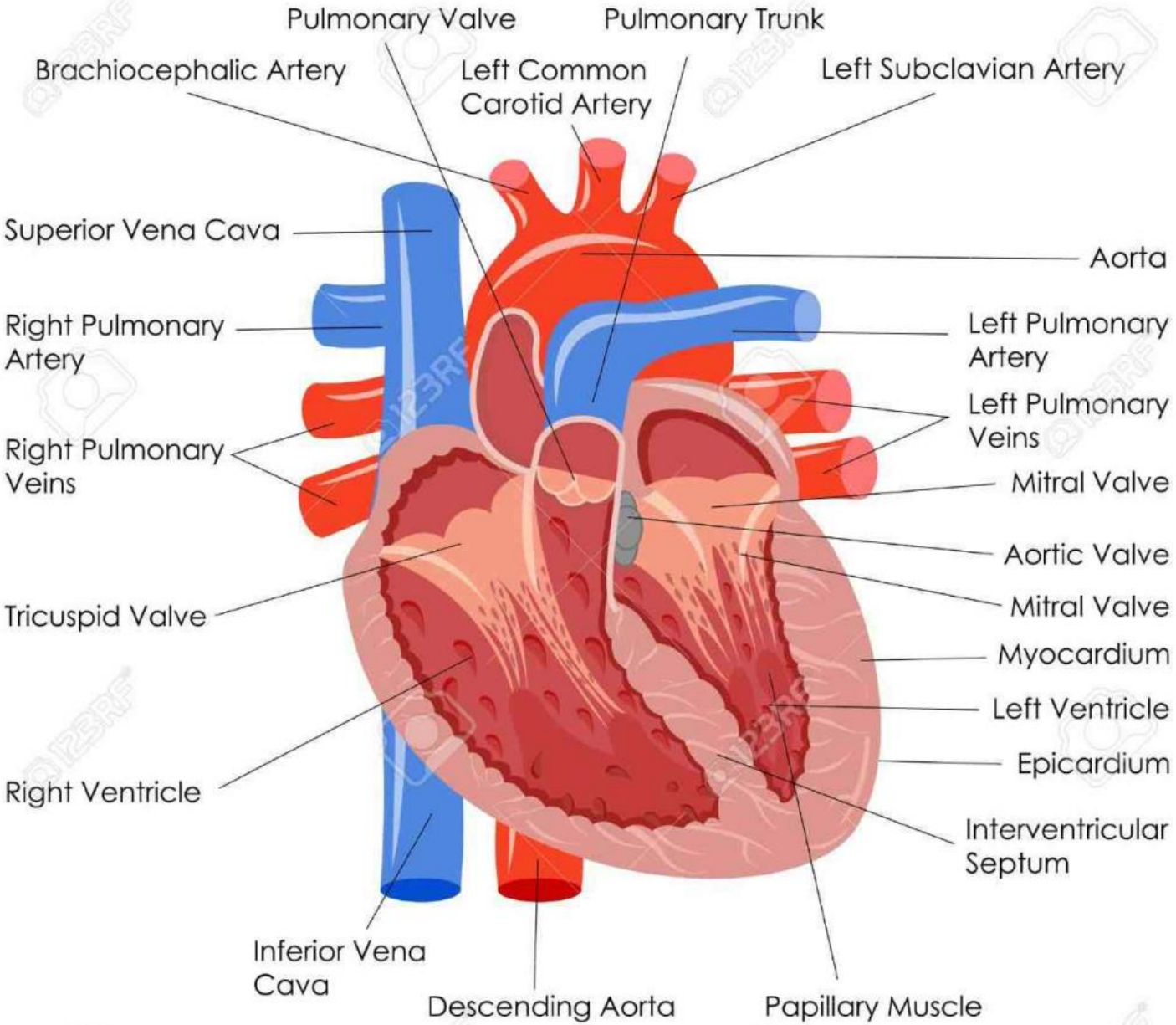
Functions of blood: **Transport**

Substance	From	To
Oxygen	Lungs	Whole body
Carbon dioxide	Whole body	lungs
Urea	liver	kidneys
Hormones	glands	Target organs
Digested food	intestine	Whole body
Heat (opening and closing of blood vessels)	Abdomen and muscle	Whole body

Heart

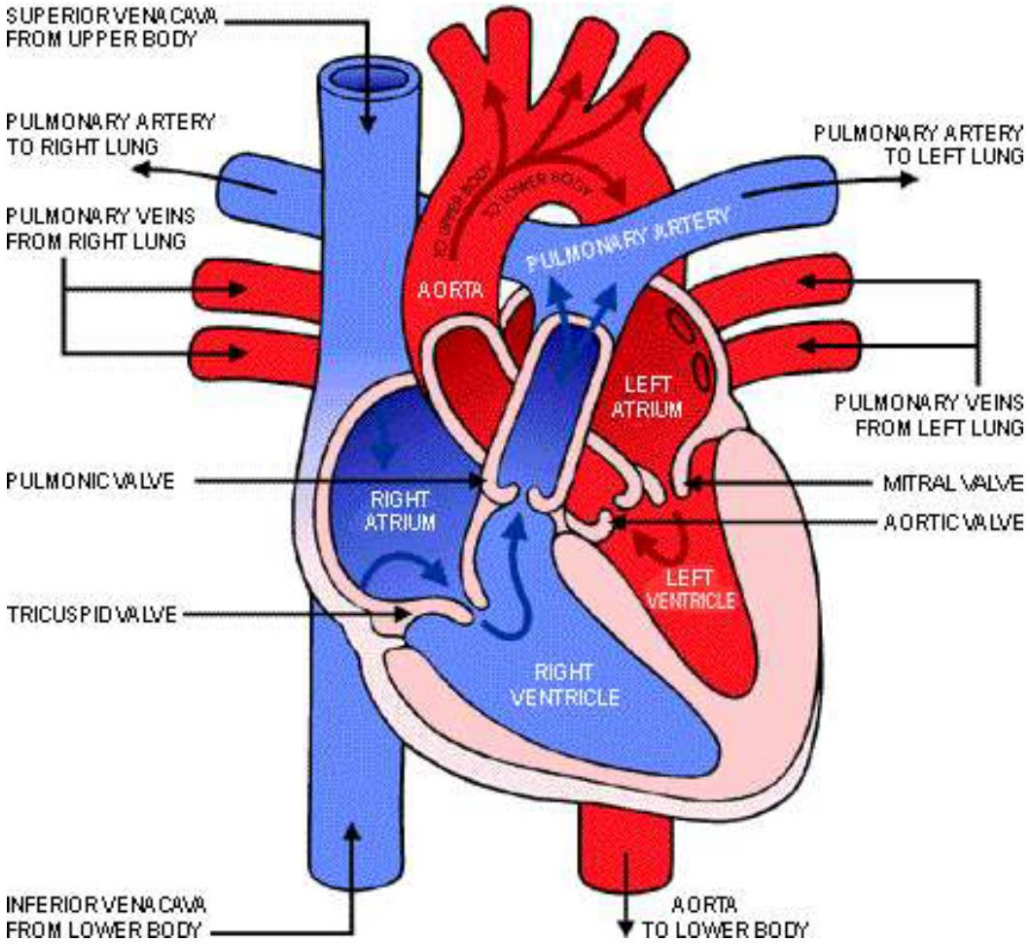
Human Heart

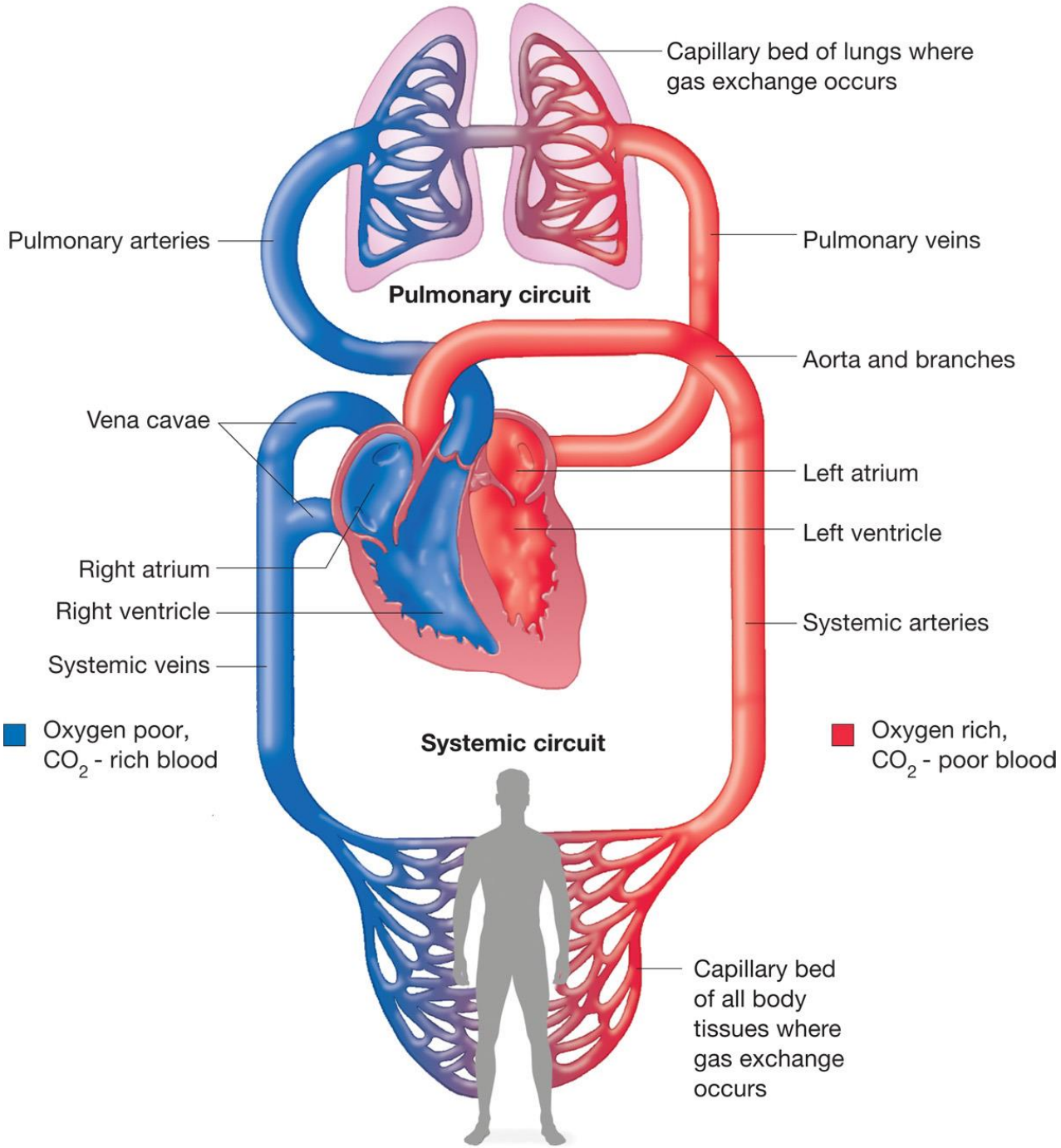
- 4 chambers:
  - 2 atria (thin-walled)
  - 2 ventricles (thick- walled)
- Veins: deoxygenated blood except pulmonary vein
- Arteries: Oxygenated blood except pulmonary artery
- Valves: They stop blood flowing backwards.
- Coronary arteries: They supply the heart muscle with food and oxygen.


Pulmonary Valve
Pulmonary Trunk
Brachiocephalic Artery
Left Common Carotid Artery
Left Subclavian Artery
Superior Vena Cava
Aorta
Right Pulmonary Artery
Left Pulmonary Artery
Left Pulmonary Veins
Right Pulmonary Veins
Mitral Valve
Aortic Valve
Tricuspid Valve
Mitral Valve
Myocardium
Left Ventricle
Epicardium
Right Ventricle
Interventricular Septum
Inferior Vena Cava
Descending Aorta
Papillary Muscle

Human Heart

Human heart


SUPERIOR VENA CAVA
FROM UPPER BODY
PULMONARY ARTERY
TO RIGHT LUNG
PULMONARY VEINS
FROM RIGHT LUNG
PULMONIC VALVE
TRICUSPID VALVE
INFERIOR VENA CAVA
FROM LOWER BODY
PULMONARY ARTERY
TO LEFT LUNG
PULMONARY ARTERY
AORTA
LEFT
ATRIUM
PULMONARY VEINS
FROM LEFT LUNG
MITRAL VALVE
AORTIC VALVE
RIGHT
ATRIUM
LEFT
VENTRICLE
RIGHT
VENTRICLE
AORTA
TO LOWER BODY


Capillary bed of lungs where gas exchange occurs
Pulmonary arteries
Pulmonary veins
Pulmonary circuit
Aorta and branches
Vena cavae
Left atrium
Left ventricle
Right atrium
Right ventricle
Systemic arteries
Systemic veins
Oxygen poor, CO_2 - rich blood
Systemic circuit
Oxygen rich, CO_2 - poor blood
Capillary bed of all body tissues where gas exchange occurs

CONTROL OF THE HEART BEAT

- At rest: normal heart rate, 50-100 beats per minutes.
- During exercise: 200 beats/min
- The heart beat is initiated by the **pacemaker,** a small group of specialized muscles cells at the top of the right atrium.

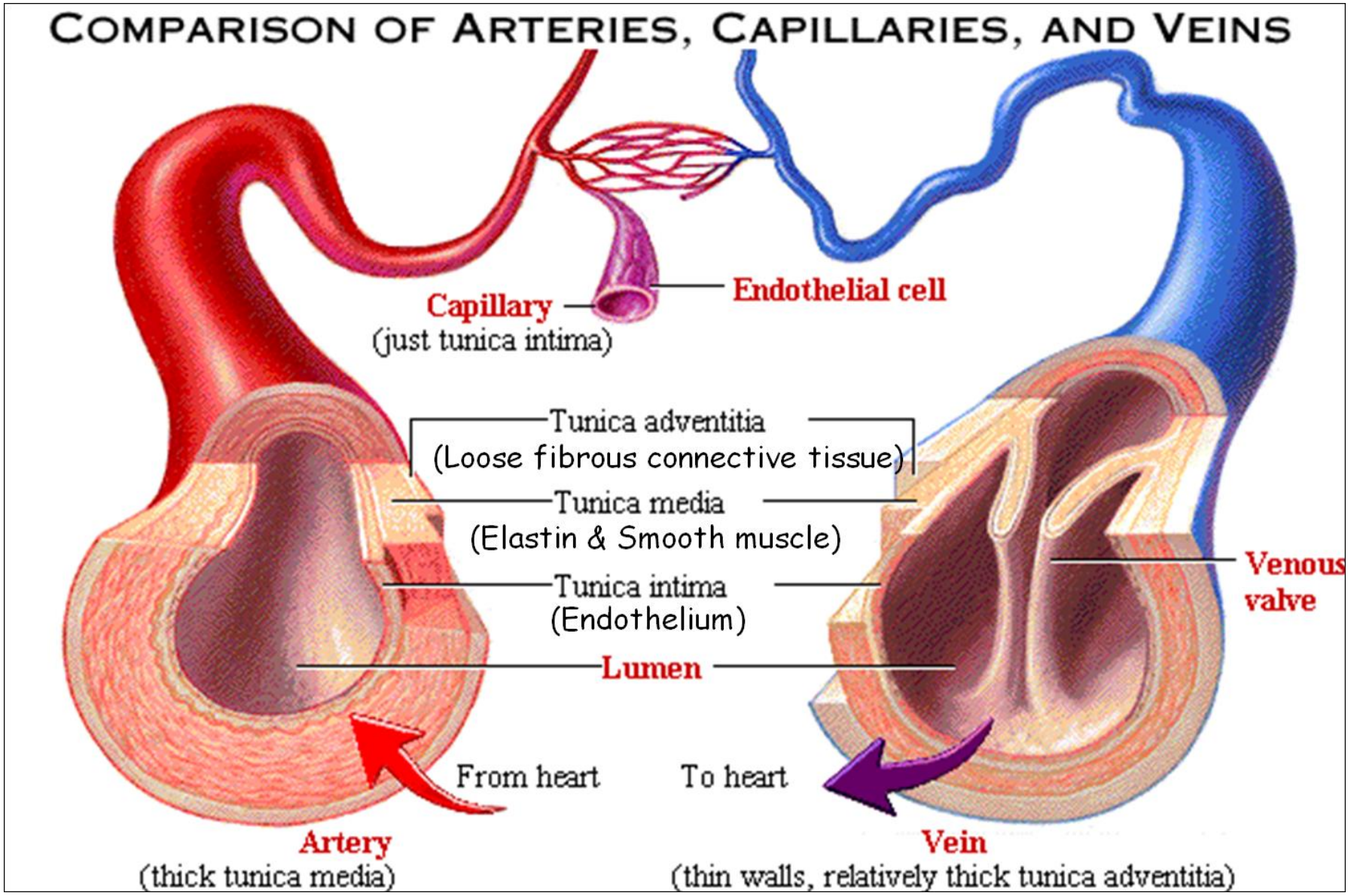
Control of the heart beat

- Blood pressure ↑ → ↓ heart rate

- Blood pressure ↓ → ↑ heart rate

- ↓ O_2 concentration
- ↑ CO_2 concentration
- Hormone adrenaline

Comparison of Arteries, Capillaries, and Veins



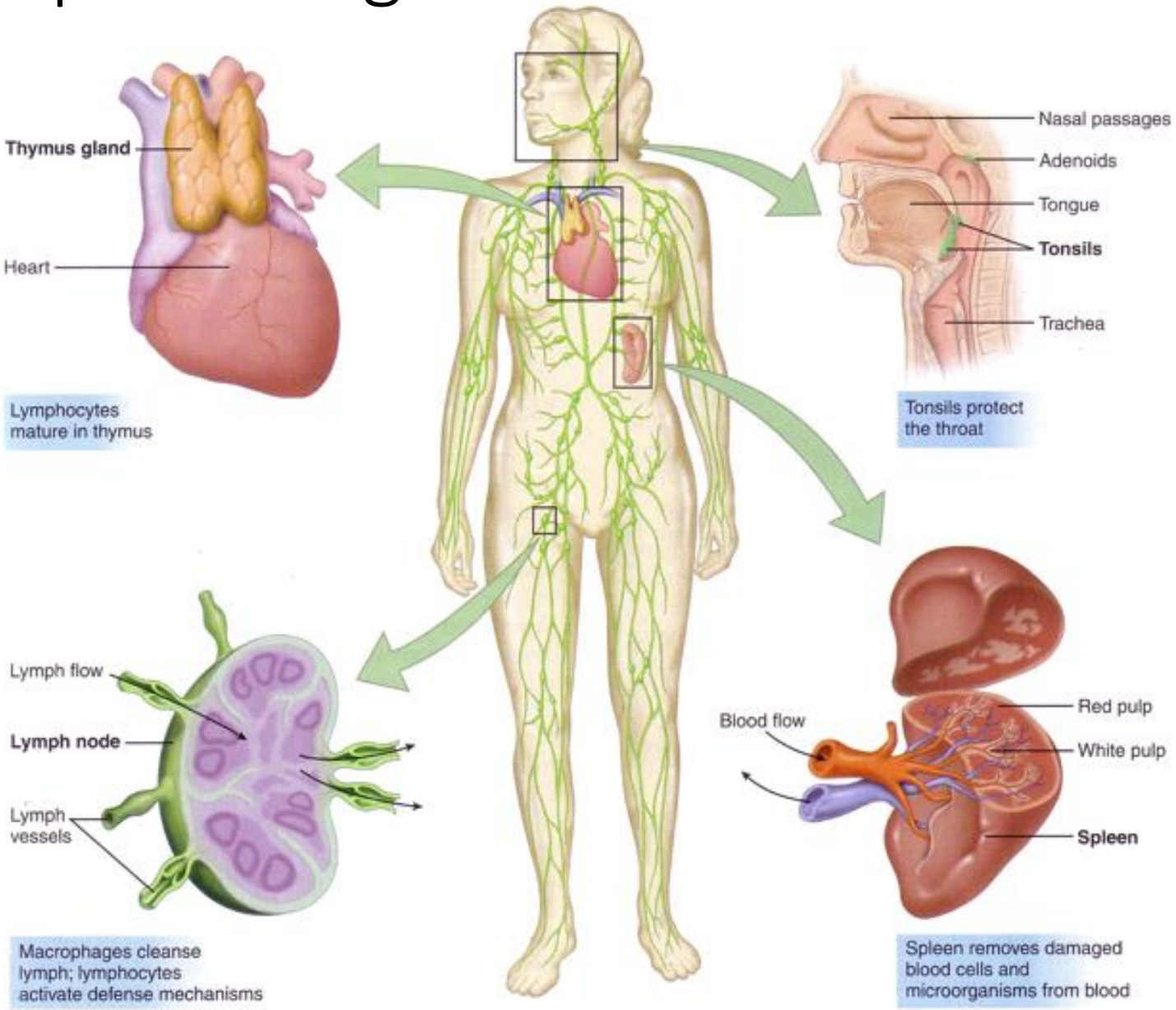
Blood vessels

	Function	Structure of wall	Width of lumen
ARTERIES	Carry blood away from the heart	Thick and strong, containing muscles and elastic tissue.	Relatively narrow, it varies with heart beat, as it can stretch and recoil.
CAPILLARIES	supply all cells with their requirements and take away waste products.	Very thin, only one cell thick.	Very narrow, just one cell can pass through.
VEINS	Return blood to the heart	Quite thin, containing less muscle and elastic tissue.	Wide, contains valves

Lymphatic system

- Thin-walled vessels called **lymphatics.**
- They empty their contents into the blood system.
- The fluid is called **lymph.**
- Most of the lymph flow results from the vessels being compressed when the body muscles contract in movements such as walking or breathing**.**
- There are valves, which force the fluid in one direction: towards the heart.
- **Lymph nodes:** storage of lymphocytes. There are also phagocytes.
- Lymphatic organs: **Spleen** and **thymus**

Lymphatic organ



SPLEEN: functions

- Remove worn-out red cells, bacteria and cell fragments from the blood.
- Produce lymphocytes and antibodies.

THYMUS: functions

- Particularly important lymphoid organ in the **newborn**:

  - controls the development of the spleen and the lymph nodes.

  - produces lymphocytes (immunity)

- **After puberty** , important immunological organ, although it becomes smaller.

  - storage of white cells

  - production of a large population of lymphocytes T.

Blood functions: **DEFENCE AGAINST INFECTIONS**

- **WHITE CELLS**:

  - Phagocytes: - at the sites of a wound
    - in the blood capillaries
    - in lymph nodes

  ingest harmful bacteria and stop them entering the general circulation

  - Lymphocytes: Production of antibodies

- **CLOTTING**

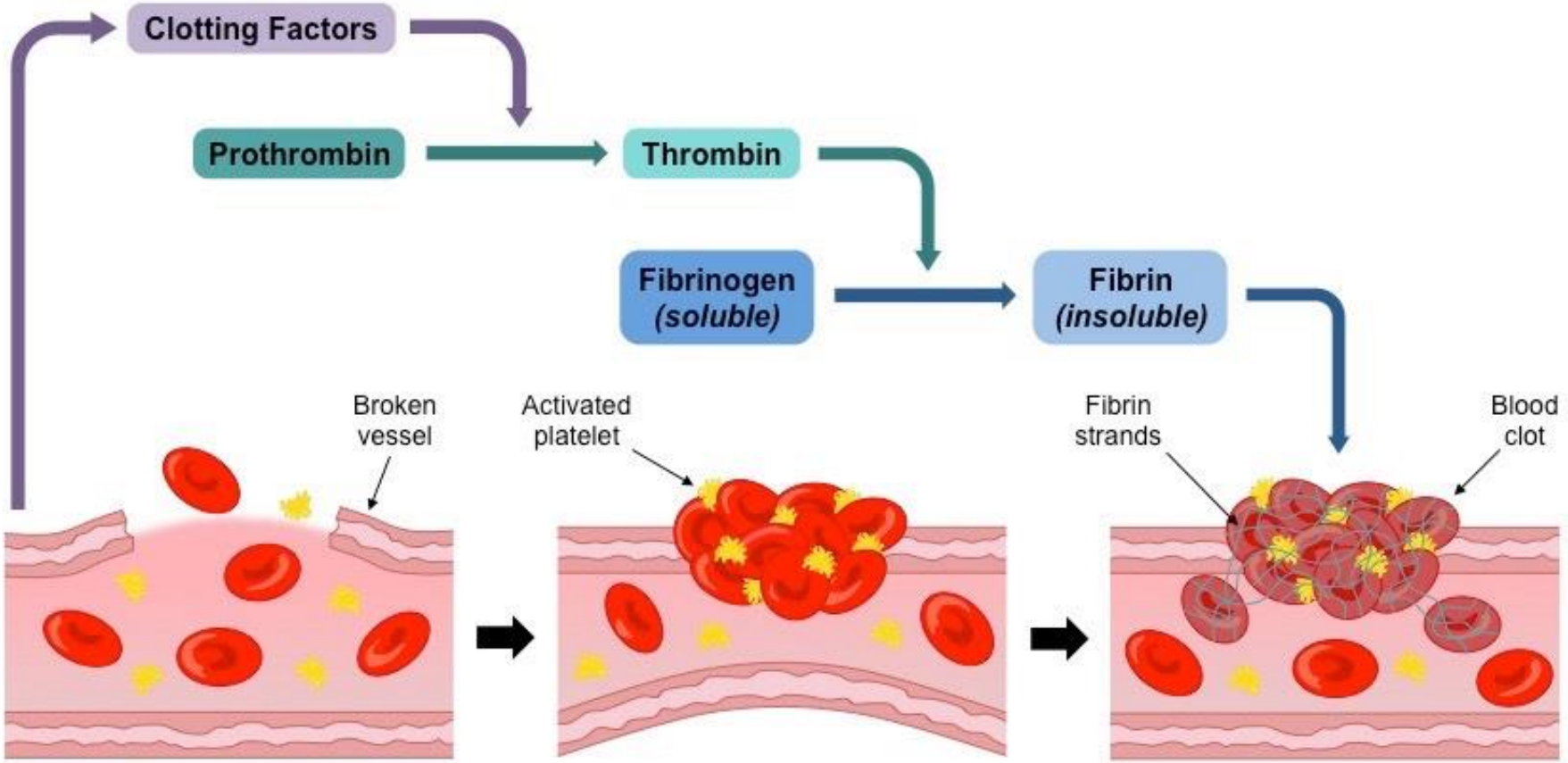
CLOTTING

- When tissue is damaged and blood vessels cut
- Platelets clump together and block the smaller capillaries.
- **Fibrinogen** → **fibrin** (network of fibres across the wound)
- Red cells become trapped in this network and form a **blood clot.**

↓

prevents → entry of harmful bacteria

prevents → further loss of blood



Damaged Blood Vessel
Injury to vessel lining triggers the release of clotting factors

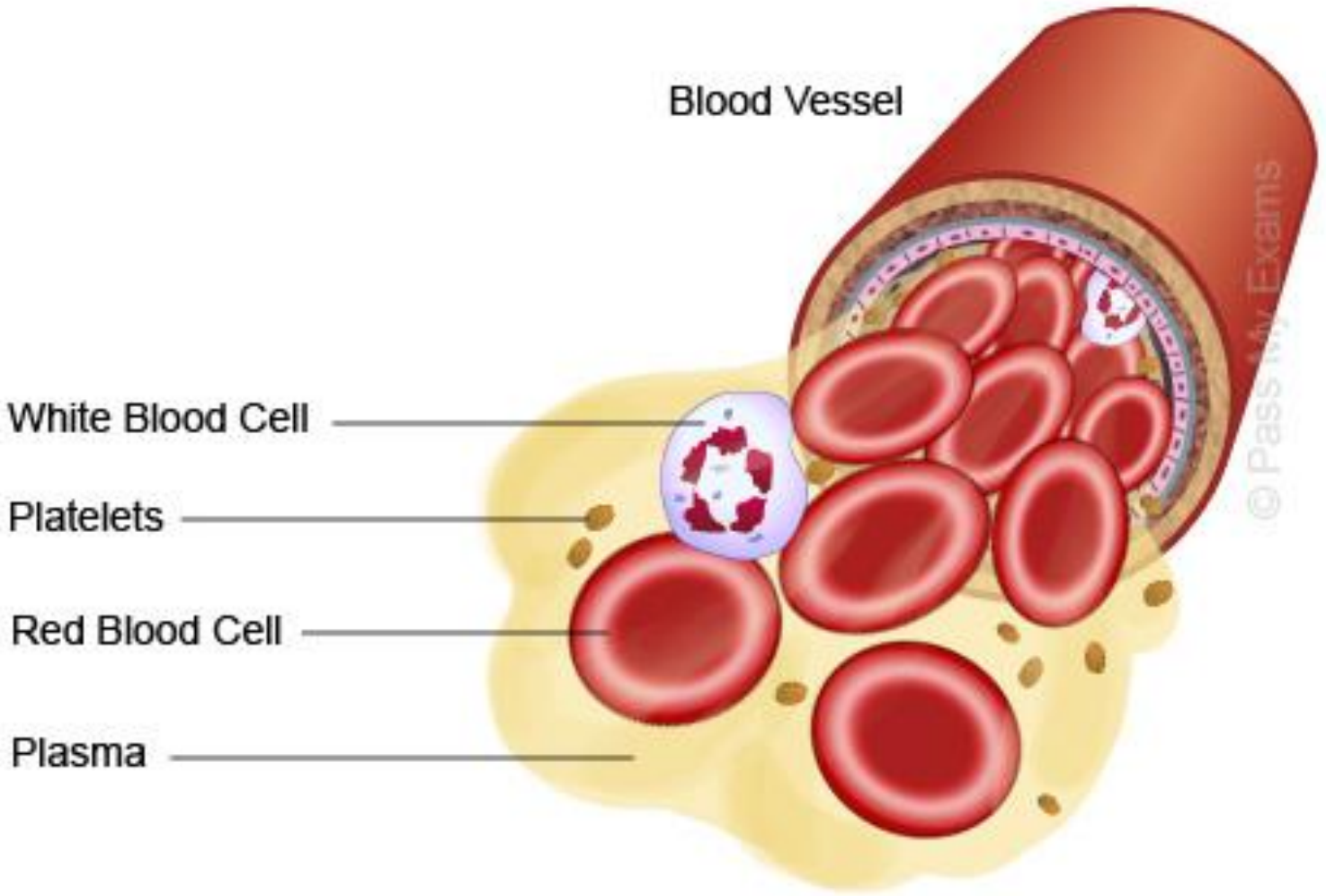
Formation of Platelet Plug
Vasoconstriction limits blood flow and platelets form a sticky plug

Development of Clot
Fibrin strands adhere to the plug to form an insoluble clot

Possible causes of coronary heart diseases

- SMOKING
- FATTY DIET
- STRESS
- LACK OF EXERCISE

How 3 Hours Of Sitting Can Damage Your Blood Vessels


Blood Vessel
White Blood Cell
Platelets
Red Blood Cell
Plasma