

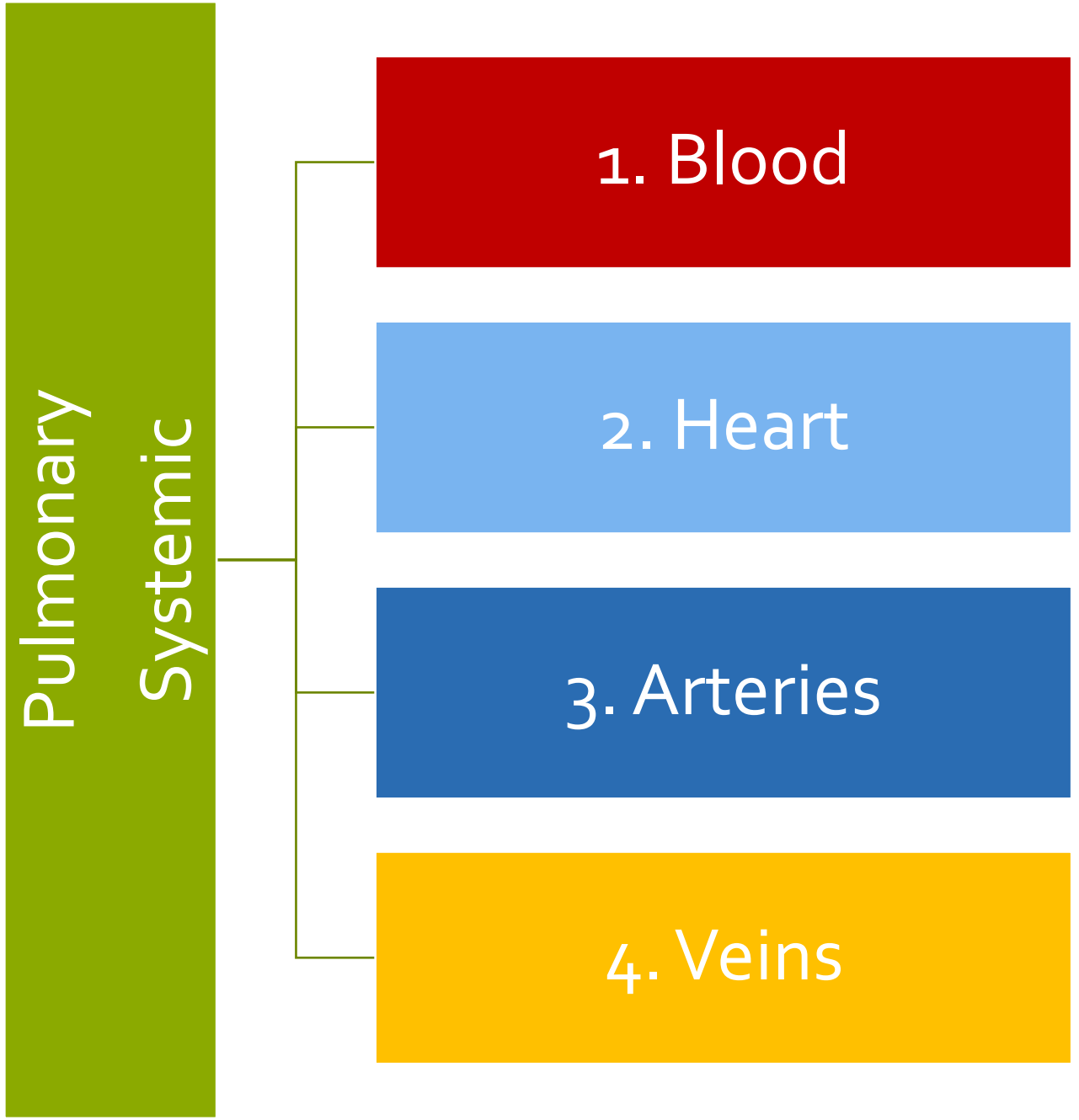
Module 4: Cardiovascular system







What is the cardiovascular system?

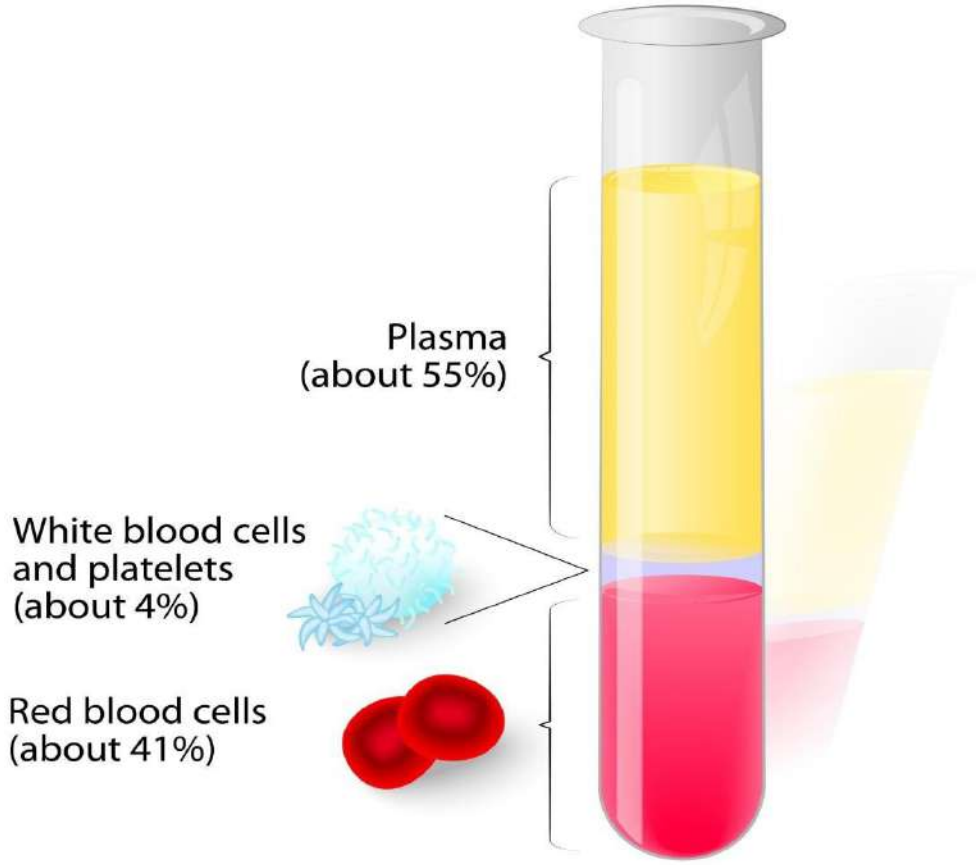


Learning Objectives

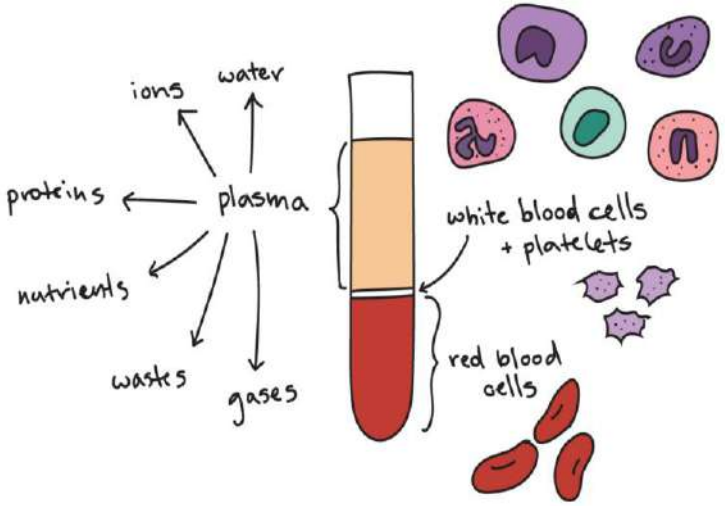
1. What is blood?
2. Structure of the circulatory system
3. Function of the circulatory system
4. Location of main arteries & veins
5. Blood pressure
6. Blood clotting
7. Pathologies of the cardiovascular system

1. What is blood?

- Fluid **connective tissue**
- Made up of plasma and cells (RBC / WBC / platelets)
- Adults approx. 4-5 litres / babies 300mls
- Ph 7.4 (alkaline)
- Functions:
  - Transport O2, nutrients, hormones and enzymes to the tissues
  - Carry CO2 and waste out of the body
  - Fight infection
  - Prevent loss of body fluids via clotting
  - Regulate body temperature



Plasma

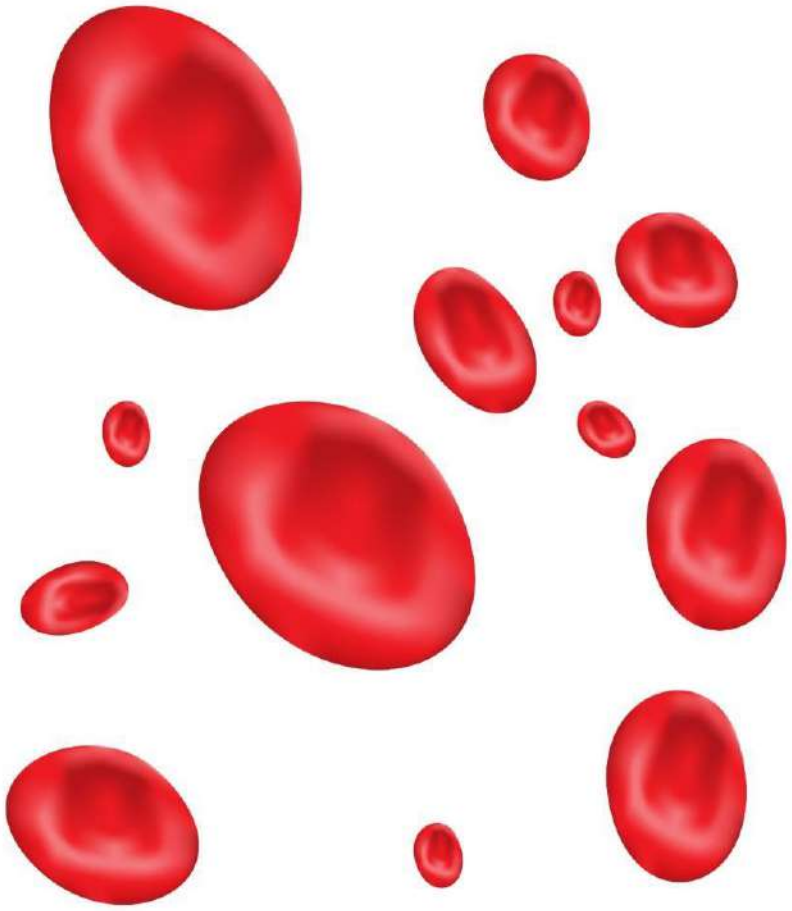


- 55% of blood volume
- Straw-coloured – mainly water, then plasma proteins
- Transport function:

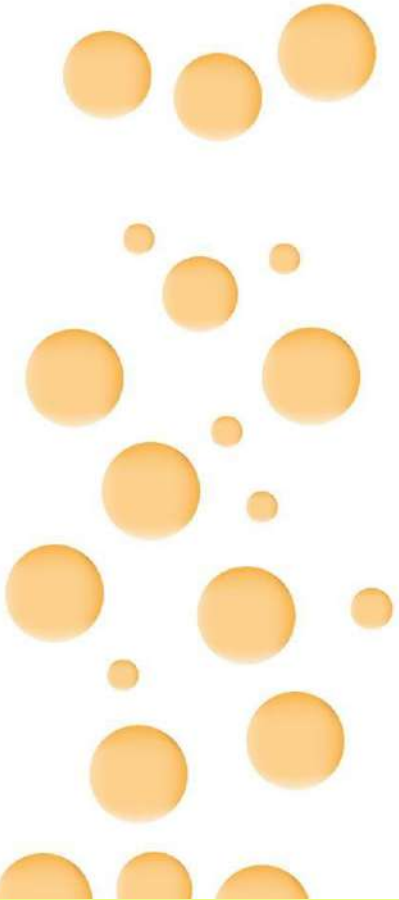
1. **Mineral salts** (e.g. sodium chloride) for nerve conduction and maintaining acid balance
2. **Nutrients** (e.g. amino acids, fatty acids, glucose etc) for cell repair and maintenance
3. **Waste** (e.g. urea) to the liver for breakdown and kidneys for excretion
4. **Hormones** produced by endocrine glands to the organs
5. **Enzymes** to assist chemical reactions within the body
6. **Gases** (e.g. O_2 and CO_2)
7. **Antibodies** in response to viruses and bacteria

Blood

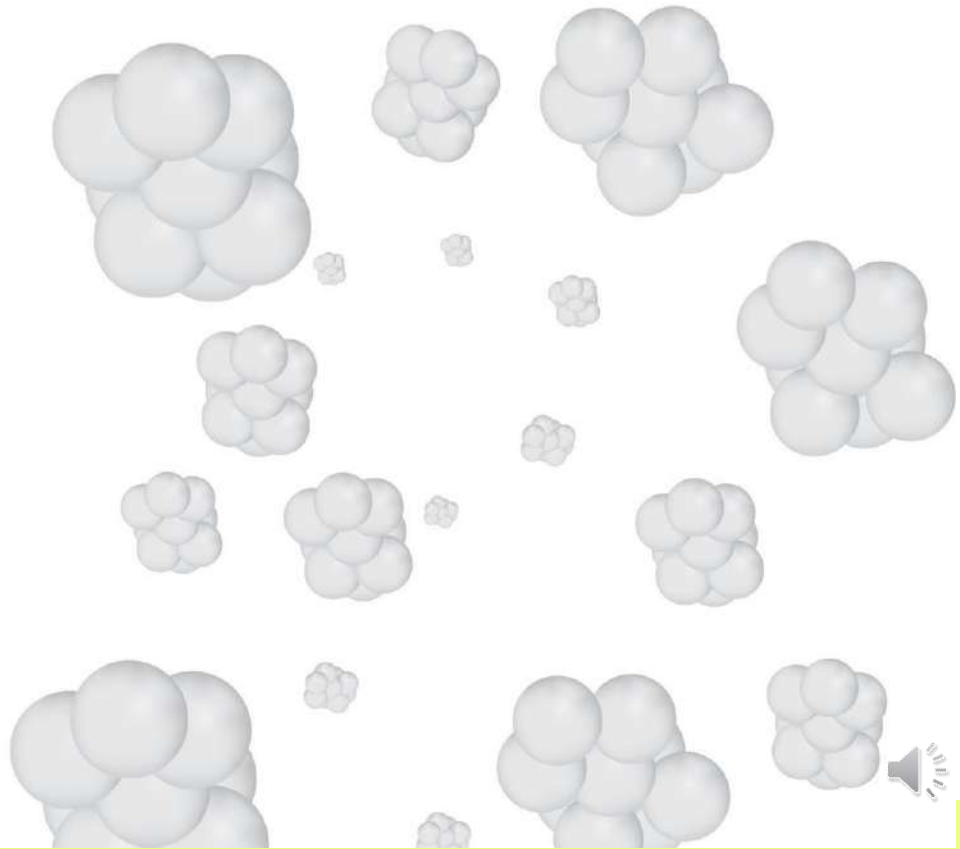
Red Blood Cells



Platelets

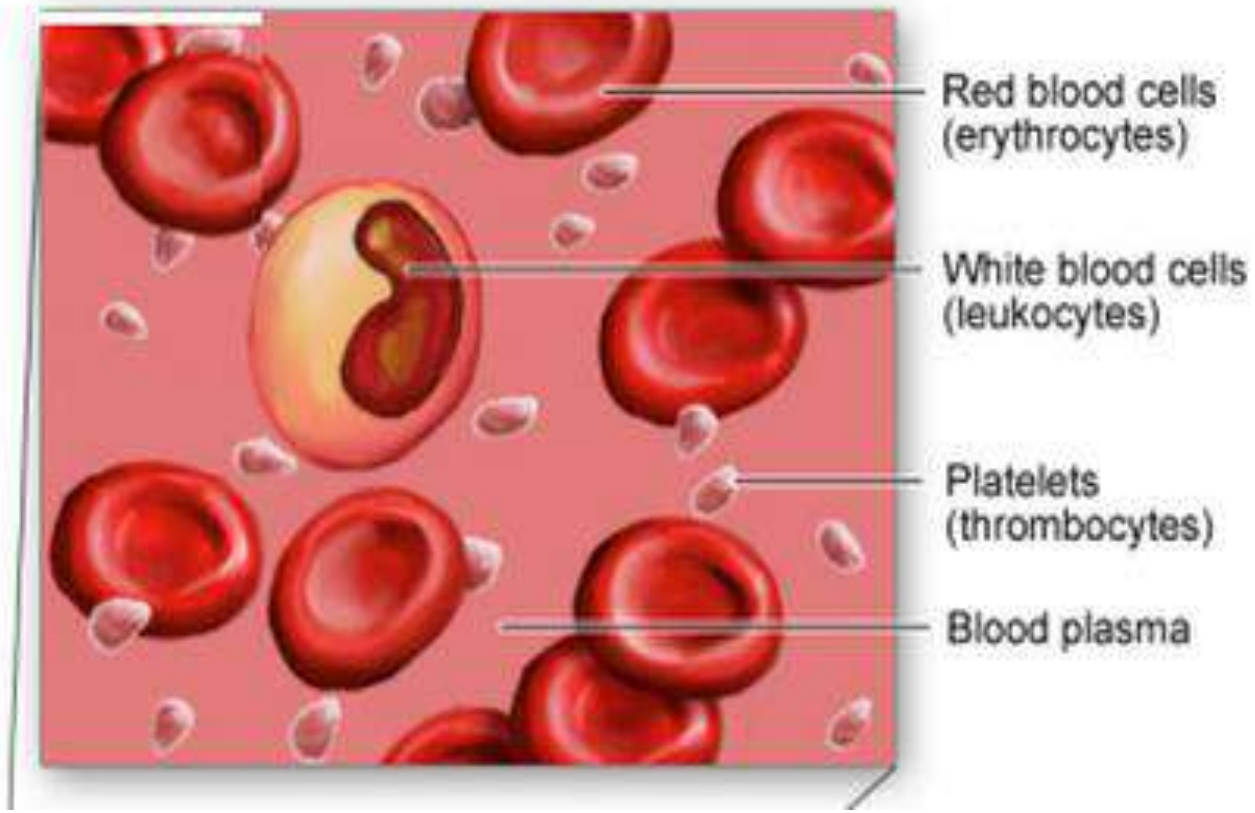


White Blood Cells

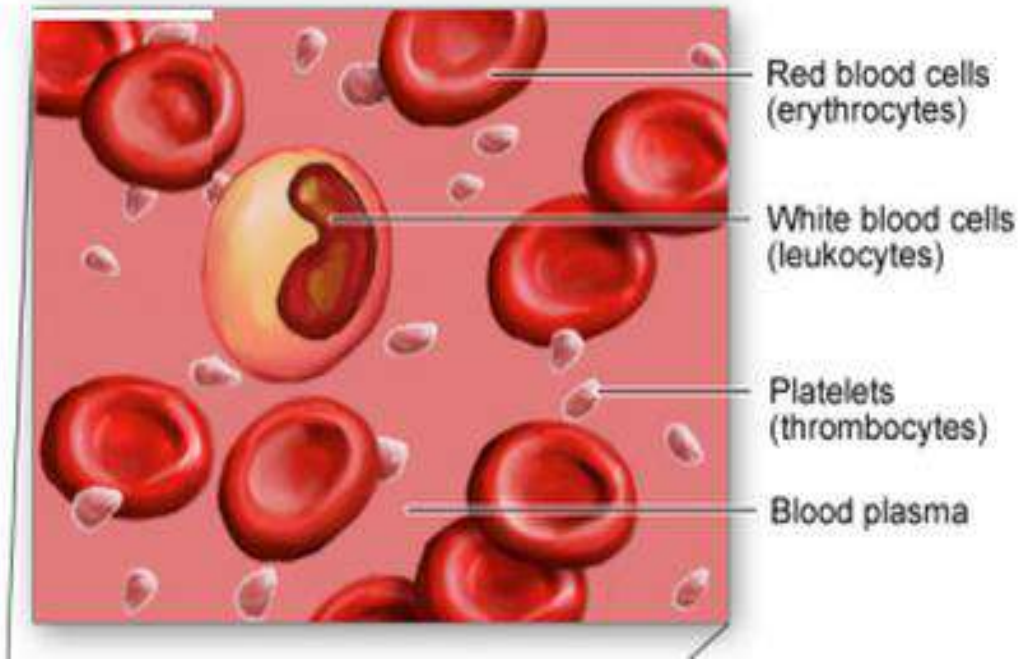


Types of blood cells

1. **Red blood cells (erythrocytes)**
   - Small cells with no nucleus
   - Approx. 5m/ml
   - Transport oxygen from the alveoli of the lungs to the tissues of the body
   - Iron and B12 required to bind to haemoglobin
   - Haemoglobin gives blood its red colour
   - Produced in bone marrow and broken down in the spleen and liver
   - Life span approx. 120 days



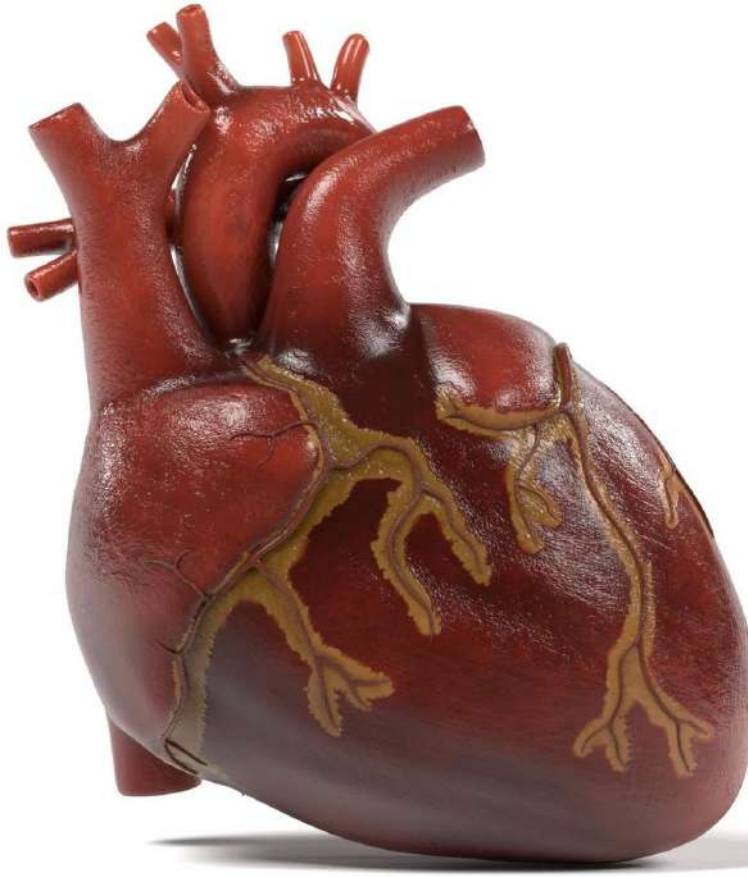
2. **White blood cells (leukocytes)**
   - Large, nucleated cells
   - Approx 8,000/ml
   - Form the immune system, provide defence against infection
   - Produced in bone marrow
   - Life span varies



3. **Platelets (thrombocytes)**
   - Clot formation during wound healing
   - Small cells with mitochondria but no nucleus
   - Approx 250k/ml
   - Life span approx. 10 days

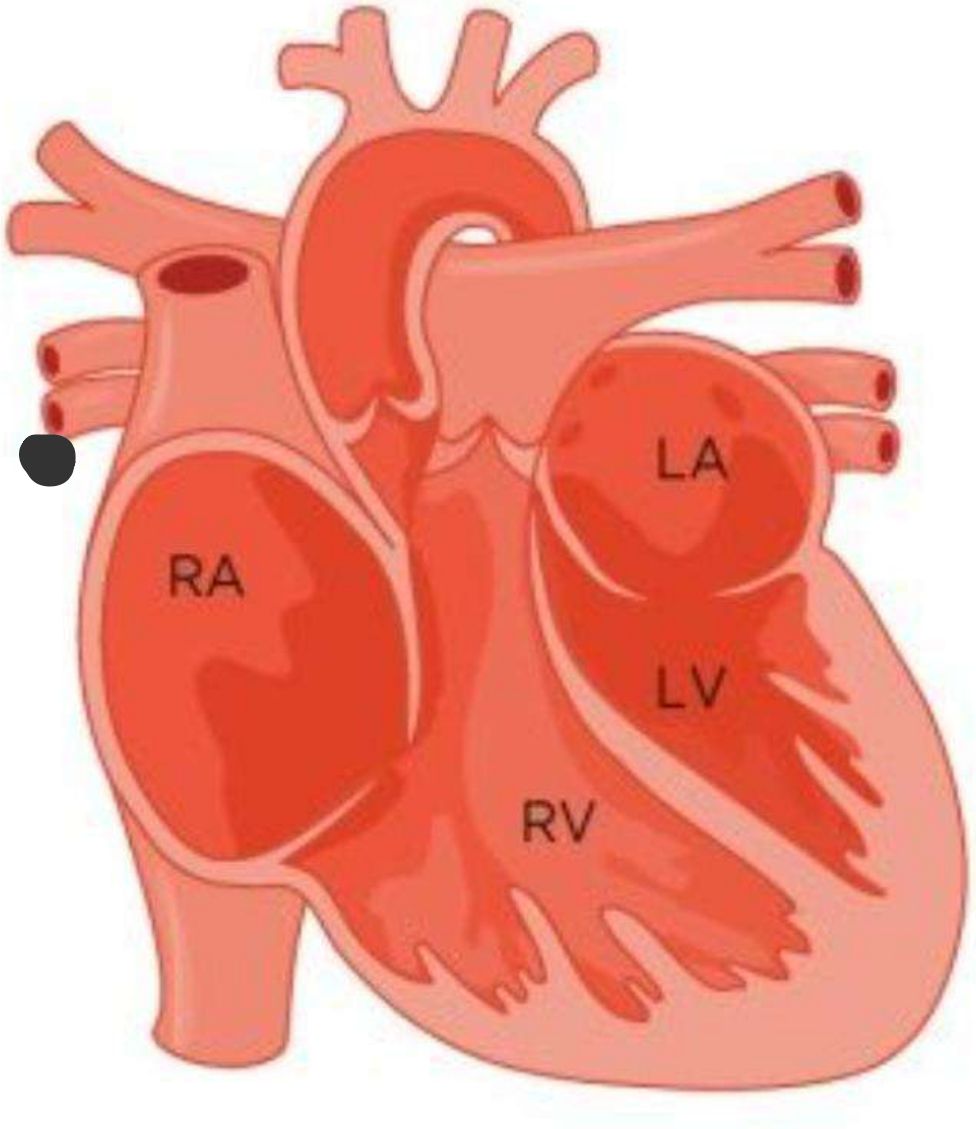
2. What is the heart?

- A pump - continuous circulation of blood in the body
  - Blood brings O_2 and nutrients to the tissues and removes CO_2 and waste products
- Weighs approx 350g, roughly fist-sized
- Located between the lungs, extends downwards on the left between 2^{nd} & 5^{th} intercostal space



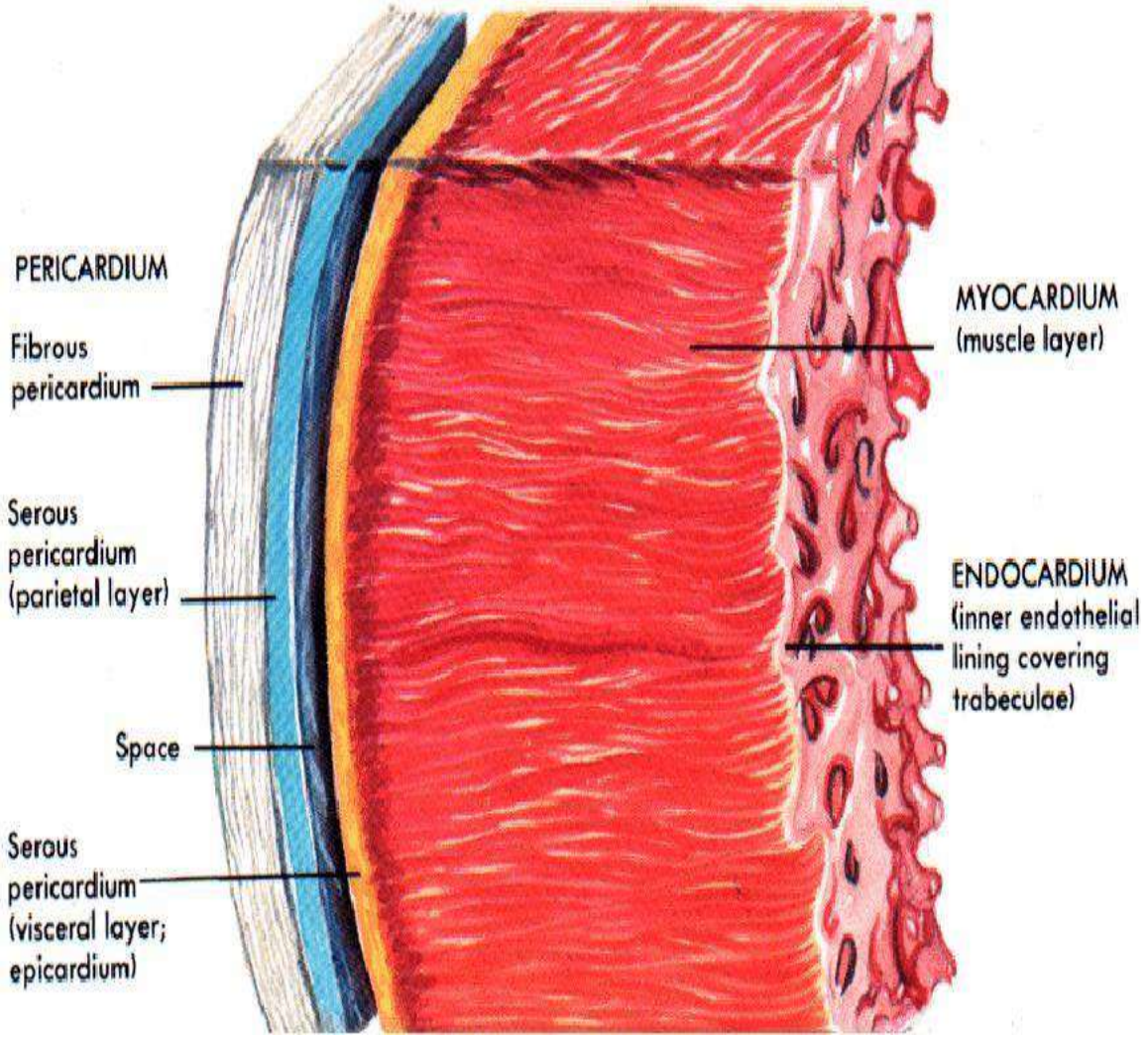
Structure of the heart

- Divided into 4 chambers – R/L **atria** (upper and R/L **ventricles** (lower)
- **Septum** is a thick muscular wall which separates R & L sides
  - It prevents oxygenated blood on the righ side from coming into contact with deoxygenated blood on the left side
- Atria and ventricles are separated by valve which regulate the passage of blood

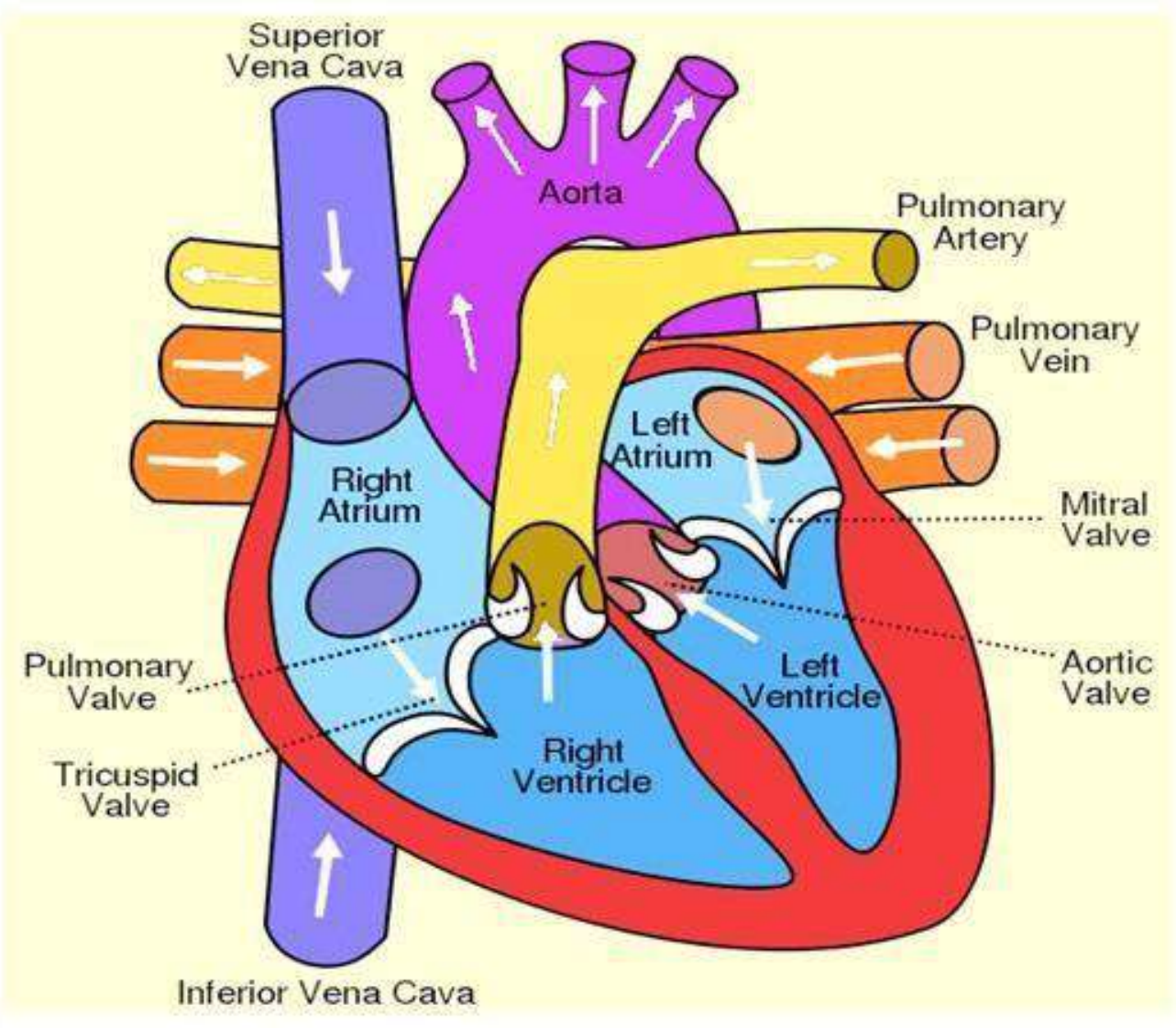


3 layers of the heart

- **Endocardium** – inner thin lining made of serous membrane
- **Myocardium** - middle thick muscular layer, made up of cardiac muscle cells
- **Pericardium** – double-walled sac containing the heart
  - Provides protection and anchors heart inside the thorax



BODY


Superior
Vena Cava
Aorta
Pulmonary
Artery
Pulmonary
Vein
Left
Atrium
Right
Atrium
Mitral
Valve
Pulmonary
Valve
Aortic
Valve
Left
Ventricle
Right
Ventricle
Tricuspid
Valve
Inferior Vena Cava

LUNGS

Valves of the heart

- **Atrioventricular (AV) valves -** located between atrial and ventricular chambers on each side. They prevent backflow into the atria when the ventricles contract
  1. **Left side: Bicuspid (mitral) valve** - two flaps of endocardium
  2. **Right side: Tricuspid valve -** three flaps
- **Semilunar valve:**
  - Pulmonary valve
  - Aortic valve
  - Prevent backflow to the aorta or pulmonary artery

- **First heart sound.** The first heart sound, **"lub"**, is caused by the closing of the AV valves.
- **Second heart sound.** The second heart sound, **"dub"**, occurs when the semilunar valves close

What is a heartbeat?

- Heart muscles contract and relax in a rhythmic pattern - also known as **cardiac cycle**
- Begins in sino-atrial (SA) node in the upper wall of the right atrium (sinus rhythm)
- **Heartbeat -** contraction and relaxation of the atria and ventricles
  - **Diastole** -heart **relaxation**
  - **Systole -**heart **contraction**
- After one cycle of contraction and relaxation, the heart momentarily rests
- During the resting period, the heart dilates and refills with blood
- The average heart beats approximately 75 times per minute, so the length of the cardiac cycle is normally about **0.8 seconds** (babies approx. 130 / min)

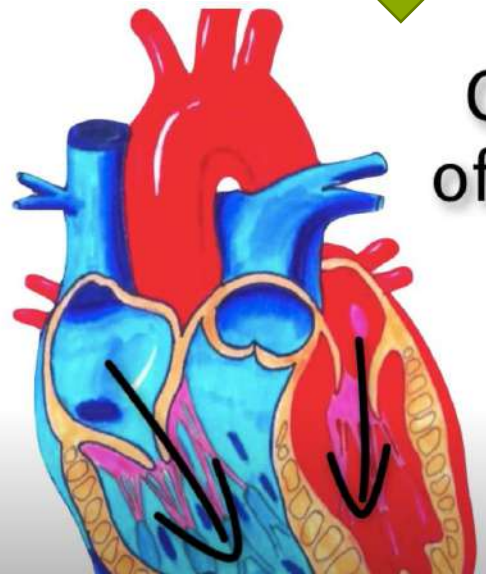
Heart is Relaxed
Diastole



Blood fills both Atria.



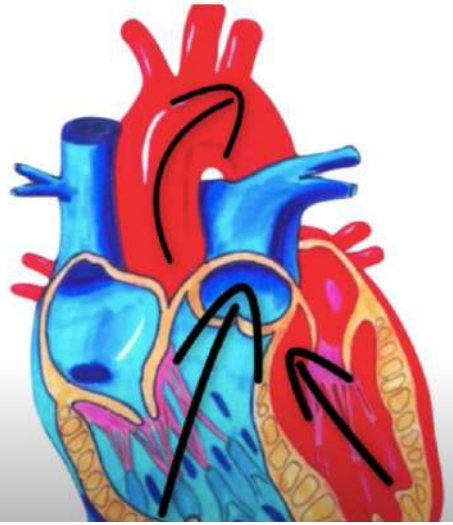
Contraction
of Atrial Walls



Ventricular
Systole



Blood is forced out of both ventricles into the Arteries.



What is a pulse?

- The number of times the heart beats in 1 minute is known as heart rate
- Pulse is the rate at which your heart is pumping blood through the circulatory system – i.e. the swelling and contraction of the vessel walls
- Heart rate can be affected by many factors including:
  - Exercise
  - Age
  - Stress
  - Size of your heart
  - Heart disease

Check your heart rate

- You can tell how fast your heart is beating by feeling your pulse
- This is the rate at which the heart pumps blood through the
- circulatory system (a wave of artery wall distension)
- Your heart-rate is the amount of times your heart beats in one minute.
- You will need a watch with a second hand
- Place your index and middle finger of your hand on the inner wrist of the other arm, just below the base of the thumb
- You should feel a tapping or pulsing against your fingers
- Count the number of pulses you feel in 10 seconds
- Multiply that number by 6 to find out your heart-rate for one minute

