10. Functions of blood
1) Transport oxygen and nutrients
2) Transport of carbon dioxide and waste
3) Protection against disease causing micro-organisms
4) Clotting of blood vessels to prevent blood loss
5) Distributes heat and maintains body temperature
6) Maintenance of pH of bodily fluids
7) Transport of hormones
8) Maintenance of water and ion concentration of bodily fluids

11. Chambers, valves, vessels in the heart

* See table on following page for functions
* See Arrows for blood flow
### Structure and Function

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inferior vena cava</td>
<td>Carries deoxygenated blood to the heart. From the lower body.</td>
</tr>
<tr>
<td>Superior vena cave</td>
<td>Carries deoxygenated blood to the heart from the upper body</td>
</tr>
<tr>
<td>Right Atrium</td>
<td>Hollow chamber that receives deoxygenated blood from the body</td>
</tr>
<tr>
<td>Tricuspid valve (atrioventricular valve)</td>
<td>Prevents the back flow of blood into the atria when the ventricles contract</td>
</tr>
<tr>
<td>Right Ventricle</td>
<td>Hollow chamber that pumps deoxygenated blood to the pulmonary artery to the lungs</td>
</tr>
<tr>
<td>Semilunar valve</td>
<td>Prevents the back flow of blood into the ventricles when it pumps</td>
</tr>
<tr>
<td>Pulmonary trunk/pulmonary arteries</td>
<td>Carry deoxygenated blood from the right ventricle to the lungs</td>
</tr>
<tr>
<td>Pulmonary veins</td>
<td>Carry oxygenated blood from lungs to left atria</td>
</tr>
<tr>
<td>Left atrium</td>
<td>Receives oxygenated blood from the lungs (via the pulmonary veins)</td>
</tr>
<tr>
<td>Bicuspid valve (atrioventricular valve)</td>
<td>Prevents the back flow of blood into the atria when the ventricles contract</td>
</tr>
<tr>
<td>Left ventricle</td>
<td>Pumps oxygenated blood to the body via the aorta</td>
</tr>
<tr>
<td>Aorta</td>
<td>Carries oxygenated blood to the body</td>
</tr>
<tr>
<td>Septum</td>
<td>Separates left and right ventricles</td>
</tr>
<tr>
<td>Pericardium</td>
<td>The membrane which encloses the heart, it holds the heart in place and prevents over stretching.</td>
</tr>
</tbody>
</table>

13. **Distinguish between the pulmonary circulation and systemic circulation**

**Pulmonary system**
- Passage of blood from the heart to the lungs to the heart
- Role  
  - > To remove CO2 from the blood
  - > Pick up O2

**Systemic system**
- Passage of blood from heart to organs/tissues to heart
- Role  
  - > Deliver O2
  - > Collect CO2

![Diagram of blood circulation](image_url)
14. Stages of the Cardiac Cycle
Sequence of events in one complete heart beat

2 Parts

<table>
<thead>
<tr>
<th>Systole</th>
<th>Diastole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chamber contracts</td>
<td>Chamber relaxes</td>
</tr>
<tr>
<td>Pushes blood out of chamber</td>
<td>Chamber fills with blood</td>
</tr>
</tbody>
</table>

Both sides of the heart contract at the same time, the average heart beat takes 0.8 secs
Meaning the average heart rate is 72 bpm

1) Atrial Systole
- Forces blood through the AV valves into ventricles

Ventricular Diastole
- Ventricle fills with blood

Takes around 0.1 seconds

2) Ventricular systole
- Forcing the blood out of the ventricles into arteries through the semilunar valve

AV valve slams shut
- Creating the “lub” part of the heart beat

Atrial diastole
- Atria filling with blood

Takes around 0.3 seconds

3) Atrial and Ventricular Diastole
- Relaxed and filling with blood
- “dub” sound of heart beat

Semilunar valve slams shut
- Elastic recoil of arteries forces it to close

Takes around 0.4 seconds
15/16. Components of the blood

Plasma (55%)
- 91% water
- 9% dissolved substances (nutrients and ions)

Formed elements (45%)
- Erythrocytes: Red blood cells
- Leucocytes: White blood cells
- Thrombocytes: Platelet

<table>
<thead>
<tr>
<th>Formed elements</th>
<th>Drawing/Description</th>
<th>Role</th>
<th>Timespan</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythrocytes Red Blood Cells</td>
<td>Biconcave discs, thinner in the middle than at the edges</td>
<td>Haemoglobin combines with oxygen and transports it to cells around the body. Collects CO₂ for transportation out of the body</td>
<td>120 days</td>
<td>- Produced in the bone marrow&lt;br&gt; - Destroyed in the liver and spleen&lt;br&gt; - No nucleus more room for haemoglobin&lt;br&gt; - High Surface Area</td>
</tr>
<tr>
<td>Leucocytes White Blood Cells</td>
<td>Granulocytes Have a granular cytoplasm and lobed nucleus</td>
<td>Remove dead or injured cells and invading micro-organisms</td>
<td>From a few minutes to years</td>
<td>- Larger but fewer than Erythrocytes</td>
</tr>
<tr>
<td></td>
<td>Monocytes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lymphocytes, spherical nucleus a-granular cytoplasm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thrombocytes Platelets</td>
<td>Small cell fragments 1/3 of the size of an erythrocyte</td>
<td>Clot blood and prevent excessive bleeding</td>
<td>7 Days</td>
<td>- No nucleus&lt;br&gt; - Formed in red bone marrow</td>
</tr>
</tbody>
</table>

17. Transport of O₂
3% is carried in solution in plasma
97% carried in erythrocytes- Haemoglobin: Iron, Globular protein

\[
\text{Hb} + \text{O}_2 \rightleftharpoons \text{HbO}_2 \\
\text{Haemoglobin} + \text{O}_2 \rightleftharpoons \text{Oxyhaemoglobin} \\
\longrightarrow \text{High Concentration of O}_2 \text{ (alveoli in lungs)} \\
\leftarrow \text{Low Concentration of O}_2 \text{ (Respiring body tissues)}
\]

17. Transport of CO₂
7-8% dissolved in plasma
22% combines with the protein (globin) part of haemoglobin
Carbon dioxide + haemoglobin <———> Carbaminohemoglobin

70% - HCO₃⁻  
- Bicarbonate ions in plasma

CO₂ + H₂O <———> H₂CO₃ Carbonic Acid <———> H⁺ + HCO₃⁻ (Dissociates)
———> At respiring cells
<——— At Alveoli

Other things transported in the blood
Metabolic waste- Urea
Organic nutrients- Glucose, Vitamins
Ions- Na⁺, Ca²⁺, K⁺, Cl⁻

18. How are nutrient and water transported in the blood?
Nutrients is dissolved in the plasma and then pass out through the 1 cell thick capillary walls.

19. Arteries, Arterioles, Veins, Venules, Capillaries

<table>
<thead>
<tr>
<th>Capillary</th>
<th>Vein</th>
<th>Artery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connect Arteries and veins</td>
<td>Carry blood towards the heart</td>
<td>Carry blood away from the heart</td>
</tr>
<tr>
<td>Carry deoxygenated and oxygenated blood</td>
<td>Carry deoxygenated blood</td>
<td>Carry Oxygenated blood</td>
</tr>
<tr>
<td>No Valves</td>
<td>Valves to stop back flow of blood</td>
<td>No Valves</td>
</tr>
<tr>
<td>Walls are very thin</td>
<td>Thin layer of muscle</td>
<td>Have a thick layer of muscle</td>
</tr>
<tr>
<td>Tiny vessels in close contact to cells</td>
<td>More space inside</td>
<td>Less space inside</td>
</tr>
<tr>
<td>Low blood pressure and slow speed to allow exchange of materials</td>
<td>Blood flows at constant pressure</td>
<td>Blood flows at changing pressure due to the action of the heart</td>
</tr>
</tbody>
</table>
Arteries

Vaso constriction
- Muscles in arteries restrict blood flow to organs
- Change blood flow on the basic needs of the body

Vaso dilation
- Muscles in arteries dilate to allow more blood flow to organs
- Change blood flow on the basic needs of the body

20. The relationship between the circulatory system and respiratory system

Respiratory system supplies the blood with oxygen in order for the blood to deliver it to all parts of the body.

Circulatory System transports blood and oxygen from the lungs to tissues in the body.

21. Functions
- Drain away excess tissue fluid and return it to your circulatory system
- To defend the body against diseases caused by microorganisms (bacteria and Viruses)

22. Components of the lymphatic system

As blood enters the capillaries it has high pressure, forcing some fluid through the capillary walls into tissue

- Blind ended lymph capillaries
  - Larger and more permeable than blood capillaries
  - Epithelial tissue
  - Remove excess tissue fluid

Lymph Vessels
- Merged lymph capillaries

Lymph nodes/glands
- Found along the vessels
- Found in neck, armpits, groin
- Surrounded by connective tissue
- Phagocytic cells in the lymph nodes destroy the particles through phagocytosis, they engulf the infectious cells
- When infections occur they swell and become tender

Lymph ducts
- Lymph drains back into the circulatory system

* 1 way system
* No pump (ie. Heart)
* Have valves
<table>
<thead>
<tr>
<th>Circulatory system</th>
<th>Lymphatic system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributes oxygen and nutrients to entire body</td>
<td>Responsible for removing excess tissue fluid from the tissues</td>
</tr>
<tr>
<td>Closed continuous loop, via arteries, capillaries and veins</td>
<td>Blind ended, open circuit from tissues to lymph vessels to veins in one direction</td>
</tr>
<tr>
<td>Blood is pumped by heart</td>
<td>Lymph is passively moved by contraction of muscles</td>
</tr>
<tr>
<td>Blood consists of plasma, red and white blood cells</td>
<td>Lymph is excess tissue fluid and other wastes and white blood cells</td>
</tr>
<tr>
<td>Blood is filled by kidney</td>
<td>Lymph is filtered by lymph nodes</td>
</tr>
</tbody>
</table>