Circulation in animals

Bio 11
Circulatory systems in animals

- Blood
- Blood vessels
- Heart
Exception to the rule
gastrovascular cavity and sponges
Open circulatory system

- Tubular heart
- Pores
Closed circulatory system

- Arteriole
- Capillary beds
- Artery (O₂-rich blood)
- Vein
- Venule
- Atrium
- Ventricle
- Heart
- Gill capillaries
- Artery (O₂-poor blood)
Roles of the circulatory system

- Transportation of oxygen and carbon dioxide
- Nutrients from the digestive system
- Waste and toxic substances
- Distributes hormones
- Regulates body temp
- Prevents blood clots
- Immune system
Vocabulary

- Atrium
- Ventricle
- Arterioles
- Capillary beds
- Venules
- Veins
Evolution of the circulatory system - fish

- Gill capillaries
- Heart:
  - Ventricle (V)
  - Atrium (A)
- Systemic capillaries
Evolution of the circulatory system - amphibian
Evolution of the circulatory system - bird or mammal
Human heart

- Right side of the heart (smaller side) is for pulmonary circulation.
- Left side of the heart (larger side) is for systemic circulation.
- Cardiac cycle - alternating contractions of the atria and ventricles
- Systolic pressure - ventricle contractions
- Diastolic pressure - resting
Human heart

- Atrioventricular valves
- Semilunar valves
Human heart

- Right atrium
- Semilunar valve
- Atrioventricular (AV) valve
- Right ventricle
- Left atrium
- Semilunar valve
- Atrioventricular (AV) valve
- Left ventricle
Cardiac cycle

1. Heart is relaxed. AV valves are open.
2. Atria contract.
3. Ventricles contract. Semilunar valves are open.

Diastole
Systole

0.1 sec
0.3 sec
0.4 sec
Pacemaker

- Sinoatrial (SA) node
- Atrioventricular (AV) node delays the signal 0.1 sec.
- Fibrillation - uncoordinated heartbeat.
Pacemaker

1. Pacemaker (SA node)
2. AV node
3. Specialized muscle fibers
4. Apex

ECG
Blood pressure

1. Blood pressure 110 systolic 70 diastolic (to be measured)
2. Rubber cuff inflated with air
3. Artery closed
4. Pressure in cuff above 110
5. Pressure in cuff at 110
6. Pressure in cuff at 70
7. Sounds audible in stethoscope
8. Sounds stop

Artery
Overview of human circulation
Structure and function of blood vessels
Blood pressure in the various vessels
Structure and function of blood vessels
capillaries

- Capillaries leak due to the high pressure they are under.
- Interstitial fluid bathes the cells.
- Because of the diameter of the capillaries cells are single file.
- Capillaries also pick up the waste products.
Movement in and out of capillaries
Pumping blood in veins due to small muscular wall
Regulating blood flow in capillaries

- Not all capillaries have blood in them.
- Open and close in response to the need of the tissue.
Sphincters relax

Precapillary sphincters

Thoroughfare channel

Capillaries

Arteriole

Venule
Sphincters contracts

2 Sphincters contracted

Arteriole

Thoroughfare channel

Venule
Lymph system

- Closely associated with circulatory system.
- Removes excess fluid leaking from capillaries
- Transports fats
- Important in the immune system.
Blood

- Plasma
- Cells (45% of the total blood volume)
Plasma

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Major functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Solvent for carrying other substances</td>
</tr>
<tr>
<td>Salts (Ions)</td>
<td>Osmotic balance, pH buffering, and nerve and muscle function</td>
</tr>
<tr>
<td>Sodium, Potassium, Calcium, Magnesium, Chloride, Bicarbonate</td>
<td></td>
</tr>
<tr>
<td>Plasma proteins</td>
<td>Osmotic balance and pH buffering</td>
</tr>
<tr>
<td>Fibrinogen</td>
<td>Clotting</td>
</tr>
<tr>
<td>Immunoglobulins (antibodies)</td>
<td>Immunity</td>
</tr>
<tr>
<td>Substances transported by blood</td>
<td>Nutrients (e.g., glucose, fatty acids, vitamins)</td>
</tr>
<tr>
<td></td>
<td>Waste products of metabolism</td>
</tr>
<tr>
<td></td>
<td>Respiratory gases (O₂ and CO₂)</td>
</tr>
<tr>
<td></td>
<td>Hormones</td>
</tr>
</tbody>
</table>

Centrifuged blood sample
### Cellular elements

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>Number per μL (mm³) of blood</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythrocytes (red blood cells)</td>
<td>5–6 million</td>
<td>Transport of oxygen (and carbon dioxide)</td>
</tr>
<tr>
<td>Leukocytes (white blood cells)</td>
<td>5,000–10,000</td>
<td>Defense and immunity</td>
</tr>
<tr>
<td>Basophils</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eosinophils</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lymphocytes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutrophils</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monocytes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platelets</td>
<td>250,000–400,000</td>
<td>Blood clotting</td>
</tr>
</tbody>
</table>

---

Centrifuged blood sample
Blood clotting

1. Platelets adhere to exposed connective tissue
2. Platelet plug forms
3. Fibrin clot traps blood cells
Clot forms