Circulation Continued

1. List the three ways fetal blood circulation differs from adult circulation?

a. Foramen Ovale: an opening between the atria that helps to bypass the lungs
(an easy way to remember this is the O in ovale stands for opening!)
b. Ductus Arteriosis: connects the pulmonary artery to the aorta
(think Arteriosis → artery)
c. Ductus Venosus: shunts blood away from the capillaries in the liver to the vena cava
(venosus → hepatic portal vein )

- all of these methods help to keep the fetal work to a minimum… think about it! Why would the baby need to send its blood to the lungs with it gets oxygenated blood from the mother? No need to store nutrients in the liver, baby gets everything it needs from mom

2. Compare fetal and adult hemoglobin

Fetal Hb has 2 alpha and 2 gamma chains while adult Hb has 2 alpha and 2 beta chains. What's the difference? Fetal Hb has a higher affinity for oxygen than adult so the fetus can get the oxygen from the mothers blood (because the fetus has a higher affinity for the oxygen it "pulls" the oxygen from the mothers blood)

Immunology
Part I: Blood

3. Complete the chart with the components of blood

| Blood Plasma (55%) | |
|---|---|
| Component | Function |
| Water | Solvent |
| Sodium<br>Potassium<br>Calcium<br>Magnesium<br>Chloride<br>Bicarbonate | Osmotic balance, pH buffering, and regulation of membrane permeability (i.e: Na/K pump) |
| Plasma Proteins:<br>Albumin<br>Fibrinogen<br>Immunoglobulins | <br>Osmotic balance, pH buffering<br>Clotting<br>Defense |

4. Describe the cellular components of blood and list their function

a. Erythrocytes: most numerous, concave shape to increase SA to carry oxygen, lack nuclei and organelles to make more room for oxygen, made in the bone marrow of flat bones

- low oxygen stimulates the kidneys to make erythropoietin which travels to the bone marrow and stimulates it to send out more blood cells

b. Leukocytes: white blood cells, function in fighting infections,

c. Platelets: cell fragments that function in blood clotting

5. How does the process of blood clotting occur?
   1. When there is an injury collagen fibers are exposed
   2. Platelets see these  and send out a sticky substance that attracts other platelets
   - these are called clotting factors
   3. Clotting factors stimulate release of zymogens from liver: Prothrombin and Fibrinogen
   4. Thrombin can activate itself or activate fibrin which creates fibers (produces a clot)
   5. Plasmin breaks down the clot

6. Describe how stem cells differentiate

stem cells can become lymphoid stem cells or myeloid stem cells
- lymphoid stem cells become b and t cells (lymphocytes)
- myeloid stem cells become red and white blood cells

7. Complete the chart with the function of each leukocyte

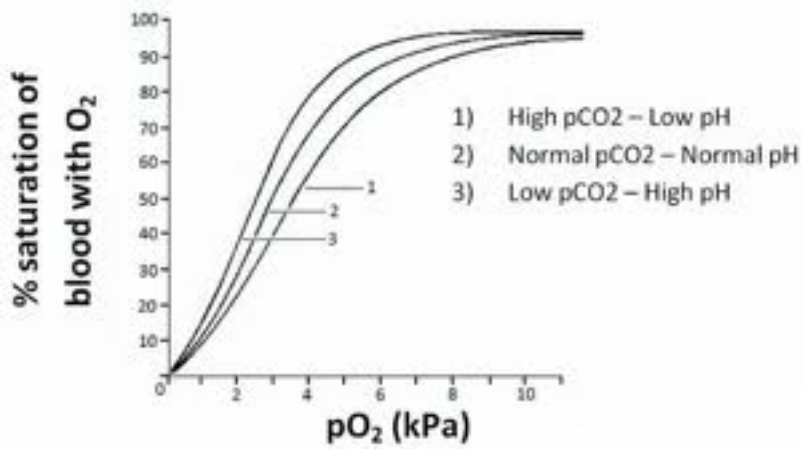
| WBC | Function/ Structure |
|---|---|
| Neutrophils | Phagocytic, monocyte |
| Eosinophils | Function in allergic reactions and parasitic invasions |
| Basophils | Release histamine during inflammation |

8. Describe carbon dioxide transport in the blood

CO2 is made as a by-product during cellular respiration. It moves by diffusion from tissues, then into interstitial fluids, next into the capillary, and lastly into the RBC. CO2 combines with water to form carbonic acid (H2CO3) and then breaks down into bicarbonate and hydrogen ion. Bicarbonate travels through the blood plasma → THIS IS THE MAJOR WAY CO2 IS TRANSPORTED IN THE BODY. The hydrogen ion (H+) is a negative allosteric modulator for hemoglobin. The increase in H+ concentration, which correlates to a drop in pH (more acidic), causes the hemoglobin molecule to change shape and release oxygen

In the lungs, bicarbonate enters the RBC again and forms with H+ to make carbonic acid. Carbonic acid breaks down into CO2 and water. CO2 diffuses into the lungs

9. Draw a graph with the general shapes of the two conditions:
   a. One curve showing hemoglobin dissociation at pH 7.4
   b. Second curve showing hemoglobin dissociation at acidic pH




10. What is happening in the graph you drew?
Bohr shift! Hemoglobin releases MORE oxygen at neutral pH than it does at the acidic pH

Part II: Lymphatic system
11. How does the lymphatic system get rid of excess fluid?
Fluid pushed out of capillaries enters the lymphatic system.
Lymphatic and thoracic duct → right lymphatic duct → fluid dumped into large subclavian veins in the chest

Part III: Types of Immunity

12. Describe the components of the two types of immunity

| Innate Immunity | Acquired Immunity |
|---|---|
| Barrier defenses:<br>Skin with bacteria<br>Mucous membranes trap and slow invaders down<br>Secretions contain enzymes and pH conditions that can kill some invaders<br><br>Internal defenses:<br>Phagocytic cells contain lysozymes that will break invaders down<br>Antimicrobial proteins<br>Inflammatory response<br>Natural Killer Cells | Humoral response:<br>Antibodies released to fight<br><br>Cell-mediated response:<br>Cytotoxic t-cells fight the infection |

| | |
|---|---|
| | |

- Phagocytic cells:
    - Neutrophils are the first on the scene
    - Eosinophils attack big things
    - Dendritic cells play a role in acquired immunity
    - Basophils release histamine
    - Macrophages bridge the gap between innate and acquired immunity
- Toll Like Receptors
    - Present on the surface of our white blood cells. These receptors look for things like flagellin and other bacteria specific things like lipopolysaccharide and RNA as genetic material
- Antimicrobial proteins
    - Ex: interferons released in response to viruses

13. Describe the process of the inflammatory process

1. Something enters your tissue that brings in bacteria (for example)
2. Basophils enter through the blood stream and release histamine
(mast cells also release histamine)
3. Histamine causes vasodilation (the direct effect)
This increase in blood flow allows more phagocytic cells to enter the area
4. Increased blood flow leads to indirect effects like: redness, leakiness of valves, swelling, heat
5. Chemical signals cause stimulate neutrophils to leave the blood vessel and enter tissue
6. Neutrophils kill or digest the pathogen

14. What is the complement system?
It bridges the gap between innate and acquired immunity. This system contains zymogens that when activated poke holes in cells and cause them to lyse

15. How does our body generate a fever?
Macrophages send out the peptide Interleukin1 which travels to the brain and stimulates the hypothalamus to crank up the heat. The increase in temperature decreases circulating iron levels. Because microorganisms need iron to function the viral activity is decreased