Circulation And Blood

• Cells in our body build their own membranes and organelles
• Make their own ATP
• Assemble their own enzymes and other proteins
• And may manufacture substances used elsewhere in the body

Circulation And Blood

• To do these things, cells need ENERGY and OXYGEN; they must dispose of CARBONDIOXIDE and other wastes
• Large animals utilize a specialized circulatory system to help with circulation

Circulation And Blood

• In humans, the circulatory system consist of the:
  – Heart (the pump)
  – Blood vessels (the transport tubes)
    • Example: Arteries
    • Veins
    • Capillaries
  – Blood (the transport fluid)
  – Lymph, and lymphatic vessels

Circulation And Blood

• What is the function of the cardiovascular system?
• Transport
  – Gases
  – Nutrients (to each cell of the body)
  – Hormones
  – Wastes
  – Antibodies & other immune system molecules
  – Distributes body heat

Blood

• Blood is the circulatory fluid
• Blood is a fluid connective tissue composed of water, dissolve solutes and blood cells
• Blood consists of cells suspended in the plasma
• blood cells are produced by stem cells in the bone marrow,
• also platelets, white blood cells, & red blood cells
Blood

- There are many types of blood cells
- Example: Red blood cells (RBC)
- The main function of the red blood cell is to transport oxygen
- Shape suits its function
  - Disk shape, thinner in the middle
  - No nucleus and also missing several organelles
- Red blood cells are filled with the protein hemoglobin, abbreviated \( Hb \), which picks up and transports oxygen

Blood

- As red blood cells pass through the lungs, they pick up oxygen
  - Oxygen binds to iron atoms in the Hb molecule
  - Generally, red blood cells circulate about (120 days) 3-4 months before they wear out
  - 180 million new RBC enter the circulatory system each minute to replace worn out cells
  - Worn out RBCs are broken down in the spleen.
  - Enzymes digest their hemoglobin and recycle their amino acids to make other proteins

Cooperative Activity 3-2

- A person suffering from anemia will have either too few RBC or not enough hemoglobin. In both cases, the amount of \( O_2 \) being transported around the body may be insufficient to meet the cell’s needs. \( O_2 \) is needed for ATP formation, therefore, ATP formation will decrease and cells will not have enough energy to function at their normal level. This will make you tired. If the immune system does not have enough energy to function properly, you may have difficulty fighting off invading pathogens and be sick more often

Blood

- White blood cells (WBC)
- There are several types of white blood cells
- They all function as part of the immune system

Platelets

- Platelets are bits of cytoplasm pinched off from large cells in the bone marrow
- They function (help) in blood clotting
- The repair mechanism includes platelets and clotting proteins found in the plasma
- Clotting proteins are always present in our blood but are not active unless there is an injury

Platelets

- When an injury occurs, the clotting proteins are activated and form long sticky threads that trap the platelets and form a clot
Circulation And Blood

- **Blood vessels**: Pipes that deliver the blood
  - **Arteries**: Arteries carry blood away from the heart
    - Arteries have thick, muscular walls
    - Arteries carry blood under high pressure from the heart
    - A thick layer of smooth muscle tissue allows arteries to regulate blood flow by changing the blood vessel diameter

- **Blood vessels**
  - **Capillaries**: Capillaries are the site of exchange between body cells and the blood
    - Capillaries form branching networks where oxygen, nutrients, and wastes are exchanged between the blood and body cells

- **Blood vessels**
  - **Capillaries**: There are many more capillaries than small arteries; as the blood is divided into these numerous small channels, it slows down
    - Capillaries have very thin walls and are only wide enough for cells to pass through single file allowing diffusion to take place
**Circulation And Blood**

- **Blood vessels:**
  - Capillaries:
    - The capillaries that allow cells to pass in single file slows the flow of blood down within them
    - Blood moves slowly, allowing time for tissue cells to pick up oxygen from the bloodstream and release carbon dioxide

**Blood Pressure**

- Blood pressure results from pressure in the heart as blood is pumped into the arteries
- Every time the heart beats – blood flows into the blood vessels (systolic pressure)
- Relaxation between beats the blood pressure decreases (Diastolic pressure)
- Systolic/diastolic
- 140/90 – hypertension

**Circulation And Blood**

- **Blood vessels:**
  - Veins:
    - Veins carry blood toward the heart
    - Blood in the veins exerts less pressure than the blood that is found in arteries
    - The blood loses most of its propulsive force after it circulates through the tissues; blood is only able to return to the heart because of the action of skeletal muscles
    - Most veins have valves – function prevent blood from moving backwards

**Blood Pressure**

- Blood pressure in veins is much lower than in arteries
- When an artery is cut the blood comes out fast because the blood pressure is greater than in the veins
- Blood exposed to oxygen becomes bright red, as in a cut – in the veins it is dark red due to low oxygen content in the veins.
Circulation And Blood

- **Lymphatic vessels:**
  - Some fluid leaks out of the blood vessels into the surrounding tissues
  - Lymph capillaries and lymph veins collect this fluid all over the body and return it to the veins
  - Lymph vessels are connected to numerous lymph nodes throughout the body; lymph nodes act as filters to remove microorganisms from the body fluids
  - Numerous white blood cells in the lymph nodes destroy these microorganisms as part of the immune system defense
  - Lymph veins have valves prevent lymphatic fluid from moving backwards

Cooperative Activity 3-3

- **Red blood cell** Type of blood cell that plays a role in the respiratory system
- **Fibrin threads** Holds platelets in position over an injury
- **Plasma** Comprises the largest percentage of the blood volume
- **White blood cell** Type of blood cell that plays a role in the immune system

Cooperative Activity

- **Red blood cell** Most numerous type of blood cell
- **Hemoglobin** Lack of this protein will decrease oxygen supply to body tissue
- **Hypertension** Diastolic pressure above 90
- **Veins** Carries blood towards the heart
- **Veins** Blood vessels containing one-way valves
- **Lymph nodes** May become swollen due to an infection

Cooperative Activity

- **Plasma** That part of the blood which transports salts, glucose and amino acids
- **Blood pressure** Force exerted by the blood against the walls of the arteries
Structure of the Heart

- The heart has **four** chambers
- The upper chambers are called **atria** (right atrium and left atrium)
- Atria have thin walls
  - They receive blood from the veins
  - They send blood to the ventricles

- The lower two chambers are called **ventricles**
- Ventricles are thick walled and muscular
- They pump blood out of the heart into the arteries

- The heart is two separate pumps housed within one organ
- The right and left sides are separated by a wall (septum)
- The right side of the heart sends blood to the **lungs**; this is called the pulmonary circuit

- The left side sends blood to the **body tissues**; this is called the systemic circuit
- Valves keep blood flowing in a forward direction; there are valves between the atrium and ventricle on each side of the heart
- Valves prevent backflow into the ventricles and the blood vessels
Structure of the Heart

- The heartbeat is highly coordinated
- The timing of the heart beat begins with special pacemaker cells called sinoatrial (S-A) node
- The atroventricular node transmits the stimulus to contract to the ventricles
- The atria contract together, then the ventricles both contract

Heart Attack

- Plaque formation and atherosclerosis contribute to heart attacks
- Heart attack occurs when the blood supply to an area of the heart muscle is reduced or blocked
- What is a stroke?

Heart Attack

- **Heart attack prevention:**
  - Diet and exercise
  - Low doses of aspirin
- **Treatments for blocked arteries**
  - Blood clot dissolvers
  - Balloon angioplasty
  - Coronary bypass surgery
Coronary bypass operation

grafted veins carry arterial blood

blocked vessels

Angioplasty

a. Closed artery.
b. Balloon is released.
c. Balloon is inflated.

Heart transplant operation