Unit 3- How do organisms Sustain Themselves:

Chapter 3

GLOBAL CONTEXT – ***Personal and cultural expression***

STATEMENT OF INQUIRY

Systems *in living organisms transfer* ***energy*** *and nutrients from the* ***environment*** *to cells, where they are used to maintain the* ***balance*** *of life. Diets can be affected by* ***personal and cultural choices.***

STUDENT PROGRESS

✓ - I fully understand

O - I partly understand

X - I don't understand

How do organisms sustain themselves?

Subtopic	Self	Objectives	Self	Peer
Balanced diet		• Discuss the need for a balanced diet to sustain a healthy body • Outline the main nutrients required by an organism with the functions • List examples of foods containing the major nutrients • State the monomers of carbohydrates, lipids and proteins • Distinguish between saturated and unsaturated fats		
Digestion		• Label the parts of the digestive system • Describe the functions of the parts of the digestive system • Outline the function of bile • State the location and pH requirements of the digestive enzymes • Distinguish between mechanical and chemical digestion		
Respiratory/ Breathing system		• Draw and label the structure of the breathing system • Explain the mechanism of ventilation • Suggest how the alveoli are adapted for gas exchange • State that gases are exchanged by diffusion and outline the process		
Circulatory system		• Define: deoxygenated, oxygenated, vessel • Label the structure of the heart • Outline the flow of blood through the heart • Compare and contrast arteries, veins, capillaries		
Homeostasis		• Define: Homeostasis, vasodilation, vasoconstriction, piloerection • List the parameters controlled through homeostasis • Explain the mechanism of maintaining blood glucose level • Compare Type 1 and Type 2 diabetes		
Plant structure, transpiration and reproduction		• Label and annotate the parts of a flowering plant • Outline the process of transpiration in plants • State the name of equipment used to measure transpiration in plants • Describe sexual reproduction in flowering plants with regard to pollination, fertilization and seed dispersal.		
Objective sheet checked by teacher		**Extension toward DP level** • Explain how the villi are adapted for absorption • Explain the electrical control of a heartbeat (e.g. pacemaker etc.) • Deduce the causes and consequences of lung cancer and/or emphysema • Describe how plants transport sugars in the phloem		

APPROACHES TO LEARNING UTILISED

Thinking □ **Social** □ **Communication** □ **Self-management** □ **Research** □

Balanced Diet:

Importance/Need for a Balanced Diet:

1. **Nutrient Requirement**: The body requires a variety of nutrients, including carbohydrates, proteins, fats, vitamins, and minerals, to function properly. A balanced diet ensures that the body receives these essential nutrients in adequate amounts to support various biological functions.
2. **Cellular Function**: Cells require nutrients to carry out metabolic processes, maintain structure, and perform specific functions. Carbohydrates provide energy for cellular activities, proteins are essential for building and repairing tissues, and fats are integral components of cell membranes.
3. **Energy Balance**: Consuming a balanced diet provides the body with the right amount of calories needed for energy production and metabolic processes. Proper energy balance helps maintain a healthy body weight and prevents metabolic disorders such as obesity and diabetes.
4. **Immune Function**: Certain nutrients, such as vitamins and minerals, play key roles in supporting immune function and protecting the body against infections and diseases. A balanced diet ensures an adequate intake of these nutrients, which are essential for maintaining a strong immune system.
5. **Disease Prevention**: A balanced diet rich in fruits, vegetables, whole grains, and lean proteins provides antioxidants and other bioactive compounds that help prevent chronic diseases such as heart disease, diabetes, and cancer. These nutrients support cardiovascular health, regulate blood sugar levels, and reduce inflammation.

Main Nutrients Required for Organisms to live:

1. **Minerals**:
    - Functions:
        - Serve as cofactors for enzymatic reactions, supporting various metabolic processes.

    - Important for bone health, muscle function, nerve transmission, and fluid balance.
    - Essential for the formation of hemoglobin in red blood cells (iron) and the regulation of blood pressure (calcium, potassium).
2. **Carbohydrates**:
    - Functions:
        - Primary source of energy for the body.
        - Provide fuel for cellular activities, including metabolism and physical activity.
        - Play a role in maintaining blood glucose levels for brain function and energy.
3. **Proteins**:
    - Functions:
        - Essential for building and repairing tissues, including muscles, organs, and skin.
        - Serve as enzymes, hormones, and antibodies involved in various physiological processes.
        - Provide a source of energy when carbohydrates and fats are insufficient.
4. **Fats**:
    - Functions:
        - Serve as a concentrated source of energy, providing more than twice as many calories per gram as carbohydrates or proteins.
        - Important for cell membrane structure and function, as well as the synthesis of hormones and other signaling molecules.
        - Aid in the absorption of fat-soluble vitamins (A, D, E, K) and contribute to satiety.
5. **Vitamins**:

- Functions:
    - Act as coenzymes or cofactors for enzymatic reactions involved in metabolism, growth, and immune function.
    - Essential for maintaining normal vision, skin health, bone health, and blood clotting.
    - Antioxidant vitamins (e.g., vitamin C, vitamin E) help protect cells from damage caused by free radicals.

Examples of Food Containing the above Nutrients:

1. **Carbohydrates**:
    - Examples: Bread, rice, pasta, cereals, potatoes, fruits, vegetables, legumes (beans, lentils, chickpeas).
2. **Proteins**:
    - Examples: Meat (beef, chicken, pork), fish, eggs, dairy products (milk, cheese, yogurt), tofu, tempeh, legumes (beans, lentils, chickpeas), nuts, seeds.
3. **Fats**:
    - Examples: Avocado, nuts (almonds, walnuts, cashews), seeds (chia seeds, flaxseeds, pumpkin seeds), fatty fish (salmon, mackerel, sardines), olive oil, coconut oil, butter, cheese.
4. **Vitamins**:
    - Examples:
        - Vitamin A: Carrots, sweet potatoes, spinach, kale, broccoli, liver, eggs.
        - Vitamin C: Citrus fruits (oranges, lemons, limes), strawberries, kiwi, bell peppers, broccoli.
        - Vitamin D: Fatty fish (salmon, mackerel, tuna), fortified dairy products, fortified plant-based milk, eggs.
        - Vitamin E: Nuts (almonds, hazelnuts, sunflower seeds), seeds (sunflower seeds, pumpkin seeds), vegetable oils.

    - Vitamin K: Leafy greens (spinach, kale, collard greens), broccoli, Brussels sprouts, green peas.

5. **Minerals**:
    - Examples:
        - Iron: Red meat, poultry, fish, tofu, lentils, beans, spinach, fortified cereals.
        - Calcium: Dairy products (milk, yogurt, cheese), leafy greens (kale, collard greens, bok choy), fortified plant-based milk, tofu.
        - Potassium: Bananas, oranges, potatoes, sweet potatoes, tomatoes, spinach, avocados.
        - Magnesium: Nuts (almonds, cashews, peanuts), seeds (pumpkin seeds, sesame seeds, sunflower seeds), leafy greens, whole grains.
        - Sodium: Table salt, processed foods, canned soups, deli meats, cheese, salty snacks.

Monomers:

Monomers are the building blocks of larger molecules called polymers. They are small, simple molecules that can bond chemically to form larger, more complex structures. In biological systems, monomers are often organic molecules such as carbohydrates, lipids, proteins, and nucleic acids.

They can be found in:

1. **Carbohydrates**:
    - Monomer: Monosaccharides
    - Examples: Glucose, fructose, galactose
2. **Lipids**:
    - Monomer: Fatty acids and glycerol

- Examples:
    - Fatty acids: Saturated fatty acids, unsaturated fatty acids
    - Glycerol: A three-carbon alcohol molecule

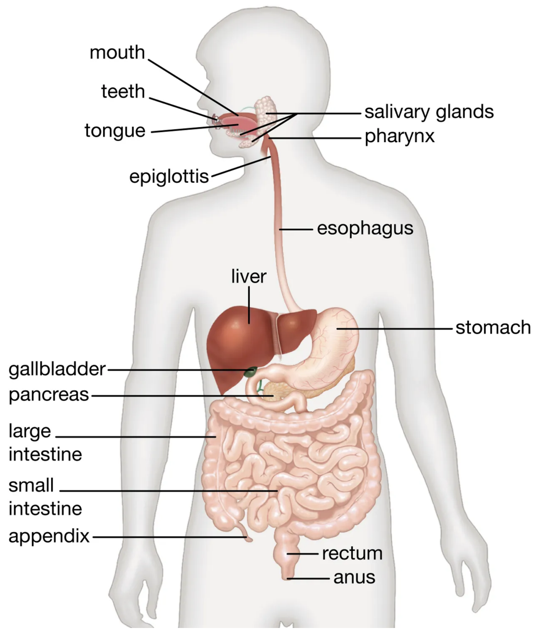
3. **Proteins**:
    - Monomer: Amino acids
    - Examples: Alanine, valine, leucine, lysine, glycine, etc.

Saturated and Unsaturated Fats:

Saturated Fats	**Unsaturated Fats**
Saturated fat is a type of dietary fat that is composed primarily of saturated fatty acids. These fatty acids have no double bonds between the carbon atoms of their hydrocarbon chains, resulting in each carbon atom being saturated with hydrogen atoms.	Unsaturated fat is a type of dietary fat that contains one or more double bonds between the carbon atoms of its hydrocarbon chain. These double bonds create kinks or bends in the molecular structure, preventing the carbon atoms from being fully saturated with hydrogen atoms.
Contains a single bond.	Contains at least one double bond.
Not to be consumed more than 10 percent of total calories per day.	Not to be consumed more than 30 percent of total calories per day.
Excessive consumption leads to heart diseases.	Good for consumption, but excessive may increase cholesterol.
Increases low- density lipoproteins (LDL), which is called as bad cholesterol.	Increases High-density lipoprotein (HDL), which is commonly known as good cholesterol and also reduce low-density lipoproteins (LDL).
Would not spoil quickly.	Spoil quickly.
Foods sources of saturated fats are whole milk, butter, cheese, margarine, coconut oil, vegetable oil, meat, peanut, fried foods, etc.	Foods sources of unsaturated fats are walnuts, flax, avocado, sunflower oil, soybean oil, fish oil, canola oil, red meat, etc.
High melting point.	Low melting point.

Solid state in room temperature.	Liquid state in room temperature.

Digestion:



The digestive system is a complex system within the body responsible for breaking down food into smaller molecules that can be absorbed and used by cells for energy, growth, and repair.

Key components of the digestive system include the mouth, esophagus, stomach, small intestine, large intestine (colon), liver, gallbladder, and pancreas. Digestion begins in the mouth, where food is chewed and mixed with saliva, which contains enzymes that start breaking down carbohydrates. The food then travels down the esophagus to the stomach, where it is further broken down by stomach acid and enzymes.

In the small intestine, most of the digestion and absorption of nutrients occur. Enzymes from the pancreas and bile from the liver and gallbladder help break down fats, proteins, and carbohydrates into smaller molecules that can be absorbed through the intestinal lining into the bloodstream.

The remaining undigested food moves into the large intestine, where water and electrolytes are absorbed, and waste products are formed into feces for elimination through the rectum and anus.

Parts of the Digestive System:

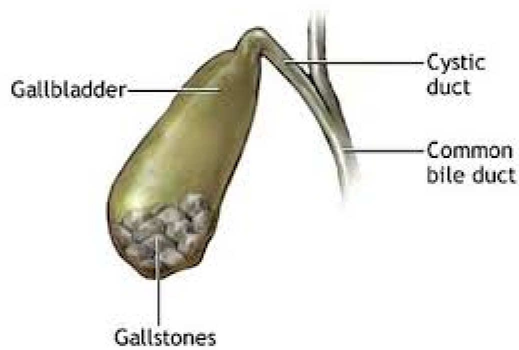
1. **Mouth**:
    - Functions: Begins the process of mechanical digestion by chewing food and mixes it with saliva, which contains enzymes (such as amylase) that start breaking down carbohydrates.
2. **Esophagus**:
    - Functions: Acts as a muscular tube that transports food from the mouth to the stomach through a series of rhythmic contractions called peristalsis.
3. **Stomach**:
    - Functions: Continues the process of mechanical digestion by churning food and mixing it with gastric juices, which contain hydrochloric acid and enzymes (such as pepsin) that break down proteins.
4. **Small Intestine**:
    - Functions: Main site of chemical digestion and nutrient absorption. Enzymes from the pancreas and bile from the liver and gallbladder break down fats, proteins, and carbohydrates into smaller molecules. Nutrients are absorbed through the intestinal lining into the bloodstream.
5. **Large Intestine (Colon)**:
    - Functions: Absorbs water and electrolytes from undigested food, forming feces. Houses beneficial bacteria that aid in digestion and produce certain vitamins (such as vitamin K). Stores feces until they are eliminated from the body.
6. **Liver**:
    - Functions: Produces bile, which helps emulsify fats for digestion and absorption. Metabolizes and detoxifies nutrients and drugs. Stores and releases glucose as needed for energy.
7. **Gallbladder**:

- Functions: Stores and concentrates bile produced by the liver. Releases bile into the small intestine to aid in fat digestion when needed.

8. **Pancreas**:

   - Functions: Secretes pancreatic enzymes (such as lipase, protease, and amylase) into the small intestine to further break down fats, proteins, and carbohydrates. Also secretes bicarbonate to neutralize stomach acid in the small intestine.

Gall Bladder and Bile:



The gallbladder is a small, pear-shaped organ located beneath the liver. Its primary function is to store and concentrate bile produced by the liver. When food containing fats enters the small intestine, hormonal signals trigger the release of bile from the gallbladder into the small intestine through the common bile duct.

Bile is a digestive fluid produced by the liver and stored in the gallbladder. It consists of bile salts, bile pigments (such as bilirubin), cholesterol, water, and electrolytes. Bile plays a crucial role in the digestion and absorption of fats in the small intestine.

Functions of Bile:

1. **Emulsification of Fats**:

- Bile contains bile salts that break down large fat globules into smaller droplets, known as emulsification.
- Emulsification increases the surface area of fats, making it easier for digestive enzymes to access and break them down.

2. **Facilitation of Absorption**:
    - Emulsified fats form micelles, aiding the absorption of fatty acids, glycerol, fat-soluble vitamins, and other lipids across the intestinal lining into the bloodstream.
3. **Neutralization of Stomach Acid**:
    - Bile contains bicarbonate ions that help neutralize acidic chyme from the stomach, creating a favorable pH for pancreatic enzymes to function and protecting the intestinal lining.

Digestive Enzymes:

1. **Mouth**:
    - Enzymes: Salivary amylase (ptyalin)
    - pH Requirement: Slightly acidic to neutral (pH 6.7-7.0)
2. **Stomach**:
    - Enzymes: Pepsin (active form)
    - pH Requirement: Acidic (pH 1.5-3.5)
3. **Small Intestine**:
    - Enzymes:
        - Pancreatic enzymes (amylase, lipase, protease)
        - Intestinal enzymes (brush border enzymes: maltase, sucrase, lactase)

    pH Requirement: Slightly alkaline (pH 7.0-8.5)

Mechanical and Chemical Digestion:

- Mechanical digestion: Involves physical processes that physically break down food into smaller pieces, aiding in its digestion. Examples include chewing by teeth and the churning of food in the stomach through muscular contractions.
- Chemical digestion: Enzymatic breakdown of complex food molecules into simpler forms that can be absorbed by the body. It occurs through the action of digestive enzymes secreted by various organs along the digestive tract, such as the mouth, stomach, pancreas, and small intestine. These enzymes catalyze chemical reactions that break down carbohydrates, proteins, and fats into their constituent monomers, allowing for absorption and utilization by the body.

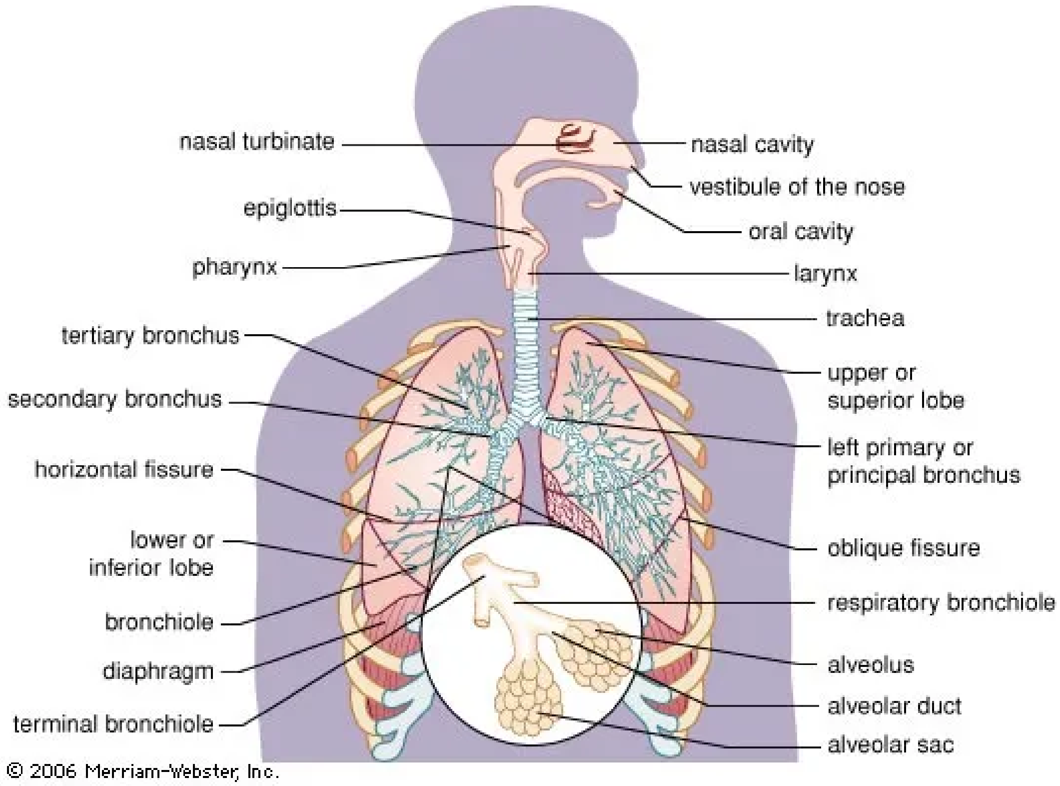
Respiratory System:

Respiration:

Respiration is the process by which organisms exchange gases with their environment, typically involving the intake of oxygen and the release of carbon dioxide. In humans and many other animals, respiration can be divided into two main processes: external respiration and internal respiration.

The respiratory system is the anatomical system responsible for the process of respiration. It consists of various organs and structures involved in breathing and gas exchange, including the lungs, trachea (windpipe), bronchi, bronchioles, diaphragm, and respiratory muscles.

These components work together to facilitate the intake of oxygen and the removal of carbon dioxide from the body, ensuring the proper functioning of cells and tissues.



How does it Work:

Video: https://www.youtube.com/watch?v=nCxN-k9bK5w

1. **Breathing Mechanism**:

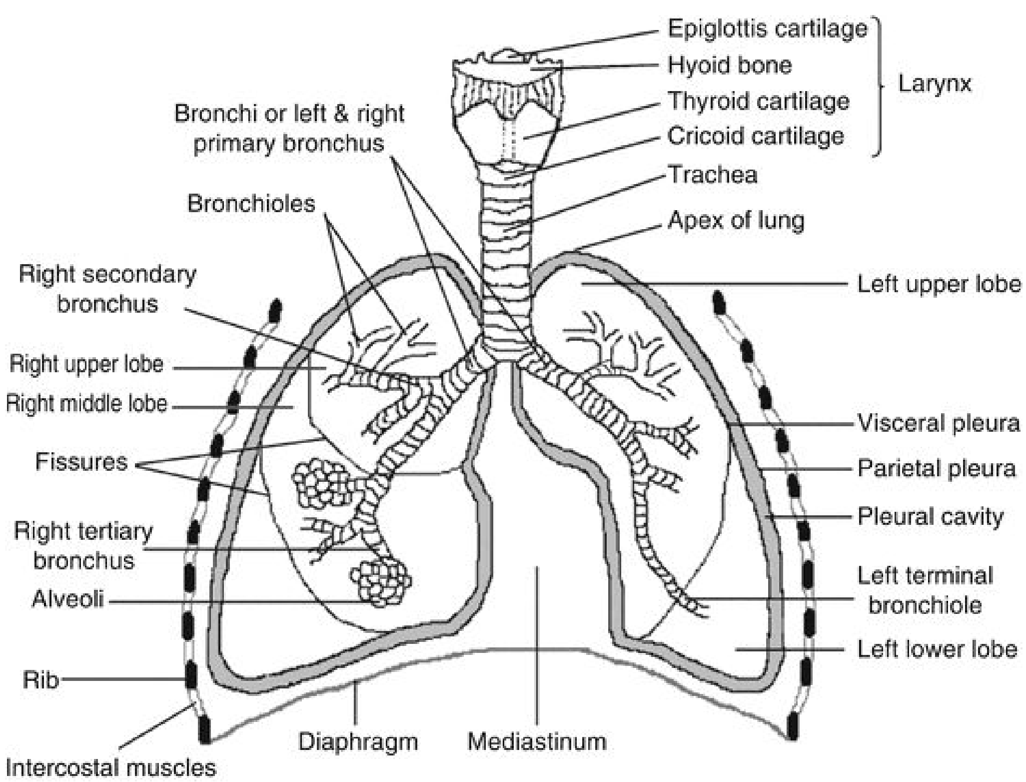
   - The process of breathing, also known as ventilation, involves the inhalation of oxygen-rich air and the exhalation of carbon dioxide-rich air.
   - When we inhale, the diaphragm and intercostal muscles contract, causing the chest cavity to expand and the lungs to inflate. This creates a negative pressure within the lungs, drawing air in through the nose and mouth, down the trachea, and into the bronchial tubes of the lungs.
   - During exhalation, the diaphragm and intercostal muscles relax, causing the chest cavity to decrease in size and the lungs to deflate. This increases the pressure within the lungs, forcing air out of the respiratory system.

2. **Gas Exchange in the Lungs**:
   - Once air reaches the lungs, it enters the alveoli, tiny air sacs surrounded by capillaries. Here, oxygen diffuses across the thin walls of the alveoli and into the bloodstream, where it binds to hemoglobin in red blood cells for transport to cells throughout the body.
   - Simultaneously, carbon dioxide diffuses from the bloodstream into the alveoli and is expelled from the body during exhalation.
3. **Transport of Gases**:
   - Oxygen-rich blood travels from the lungs to the heart, where it is pumped to tissues and organs throughout the body via the circulatory system.
   - Carbon dioxide produced by cellular metabolism diffuses into the bloodstream and is transported back to the lungs for elimination from the body during exhalation.
4. **Cellular Respiration**:
   - Within cells, oxygen is used in cellular respiration to produce ATP, the primary energy currency of cells. This process generates carbon dioxide as a byproduct, which is transported back to the lungs for removal from the body.
5. **Regulation of Breathing**:
   - Breathing is controlled by the respiratory center in the brainstem, which receives input from sensors that monitor levels of oxygen, carbon dioxide, and pH in the blood and cerebrospinal fluid.
   - Changes in these parameters trigger adjustments in breathing rate and depth to maintain homeostasis and ensure an adequate supply of oxygen to tissues and organs.

Lungs:

The lungs are vital organs of the respiratory system responsible for the exchange of gases between the body and the external environment.

1. **Location**: The lungs are located within the thoracic cavity of the chest, on either side of the heart. They are protected by the rib cage and separated from the abdominal cavity by the diaphragm.
2. **Structure**:
    - Each lung is divided into lobes: the right lung has three lobes (upper, middle, and lower), while the left lung has two lobes (upper and lower). These lobes are further divided into smaller segments.
    - The lungs are composed of spongy, elastic tissue surrounded by a double-layered membrane called the pleura. The inner layer (visceral pleura) covers the surface of the lungs, while the outer layer (parietal pleura) lines the inner surface of the chest cavity.



The alveoli are tiny air sacs located within the lungs. They are clustered at the ends of the smallest air passages called bronchioles. The alveoli are surrounded by a dense network of capillaries and are the primary sites of gas exchange in the respiratory system, where oxygen from inhaled air diffuses into the bloodstream and carbon dioxide diffuses from the bloodstream into the alveoli to be exhaled from the body.

Adaptations of the Alveoli:

1. **Large Surface Area**: The alveoli's numerous tiny air sacs greatly increase the surface area available for gas exchange. This extensive surface area provides ample opportunity for oxygen to diffuse into the bloodstream and for carbon dioxide to diffuse out of the bloodstream into the alveoli.
2. **Thin Membrane**: The walls of the alveoli are composed of a single layer of epithelial cells, which are extremely thin. This thin membrane reduces the diffusion distance for gases, allowing oxygen and carbon dioxide to move quickly and efficiently across the alveolar wall.
3. **Rich Blood Supply**: Alveoli are surrounded by a dense network of capillaries, ensuring close proximity between alveolar air and blood. This arrangement facilitates rapid exchange of gases by maintaining a steep concentration gradient, allowing oxygen to diffuse from the alveoli into the blood and carbon dioxide to diffuse from the blood into the alveoli.
4. **Presence of Surfactant**: Surfactant is a substance produced by specialized cells within the alveoli called type II pneumocytes. It reduces the surface tension of the alveolar fluid, preventing the alveoli from collapsing during exhalation and ensuring that they remain open for gas exchange. This surfactant is particularly crucial for maintaining lung compliance and preventing atelectasis (lung collapse).

5. **Elasticity**: Alveoli possess elastic properties that allow them to stretch and recoil with each breath. This elasticity enables the alveoli to expand during inhalation, allowing air to enter the lungs, and to recoil during exhalation, helping to expel air from the lungs. This dynamic movement of the alveoli facilitates the efficient exchange of gases by constantly refreshing the air in the lungs.

Circulatory System:

The circulatory system is a complex network of organs and blood vessels responsible for transporting vital substances throughout the body. It ensures the delivery of oxygen and nutrients to cells while removing waste products and carbon dioxide.

The heart acts as the central pump, continuously circulating blood through the vessels to maintain tissue perfusion and support metabolic processes.

Parts of the Circulatory System:

1. **Heart**:
    - Location: Located in the chest cavity, slightly left of the midline.
    - Function: Acts as a muscular pump that contracts rhythmically to propel blood throughout the body.
2. **Blood Vessels**:
    - Arteries:
        - Location: Carry oxygen-rich blood away from the heart to various tissues and organs.
        - Function: Transport oxygen, nutrients, and other essential substances to tissues.
    - Veins:

    - Location: Carry oxygen-poor blood back to the heart from the body's tissues and organs.
    - Function: Return deoxygenated blood to the heart for oxygenation.
  - Capillaries:
    - Location: Microscopic blood vessels that connect arteries and veins.
    - Function: Facilitate the exchange of gases, nutrients, and waste products between the bloodstream and tissues.
3. **Blood**:
  - Location: Circulates throughout the body within blood vessels.
  - Function: Transports oxygen, nutrients, hormones, and waste products to and from cells throughout the body.

Functions of the Circulatory System:

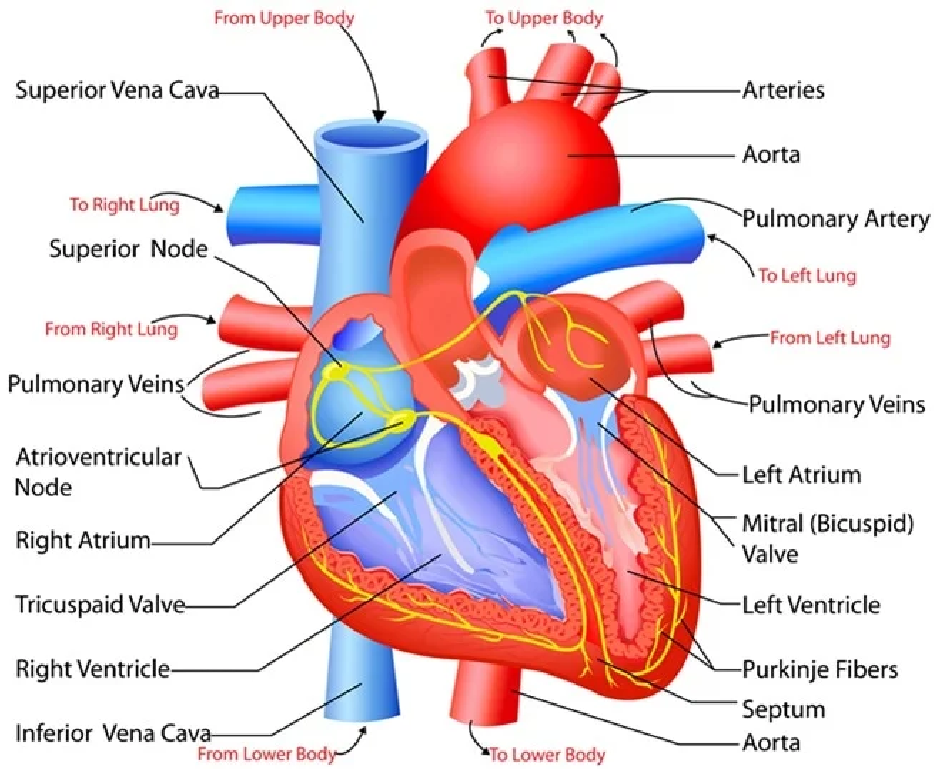
1. **Transportation**: Transports oxygen from the lungs to tissues and organs, and carbon dioxide from tissues to the lungs for exhalation. Also transports nutrients, hormones, and waste products to and from cells.
2. **Gas Exchange**: Facilitates the exchange of oxygen and carbon dioxide between the bloodstream and tissues through the respiratory system.
3. **Nutrient Distribution**: Delivers nutrients absorbed from the digestive system to cells throughout the body for energy production and cellular processes.
4. **Waste Removal**: Carries metabolic waste products, such as urea and carbon dioxide, away from cells to be eliminated from the body through the urinary and respiratory systems, respectively.

5. **Immune Response**: Transports white blood cells and antibodies to sites of infection or injury to defend against pathogens and foreign invaders.

Terms:

1. **Deoxygenated**: Deoxygenated refers to blood that has released its oxygen to tissues and organs and is returning to the heart and lungs to replenish its oxygen supply. This blood is typically low in oxygen and high in carbon dioxide. Deoxygenated blood appears darker in color, often a bluish-red, due to the presence of deoxygenated hemoglobin.
2. **Oxygenated**: Oxygenated refers to blood that has been oxygenated in the lungs, where it picks up oxygen molecules and releases carbon dioxide. This oxygen-rich blood is pumped from the heart to tissues and organs throughout the body to supply oxygen for cellular respiration. Oxygenated blood appears bright red in color due to the presence of oxygen-bound hemoglobin.

Flow of Blood through the Heart:



1. **Right Atrium**:
   - Deoxygenated blood returns to the heart from the body via the superior and inferior vena cavae and enters the right atrium.
   - The right atrium contracts, pushing blood through the tricuspid valve into the right ventricle.
2. **Right Ventricle**:
   - The right ventricle contracts, pumping deoxygenated blood through the pulmonary valve into the pulmonary artery.
   - From the pulmonary artery, blood is transported to the lungs for oxygenation.
3. **Lungs**:
   - In the lungs, blood picks up oxygen and releases carbon dioxide through the process of gas exchange.

- Oxygenated blood returns to the heart via the pulmonary veins and enters the left atrium.

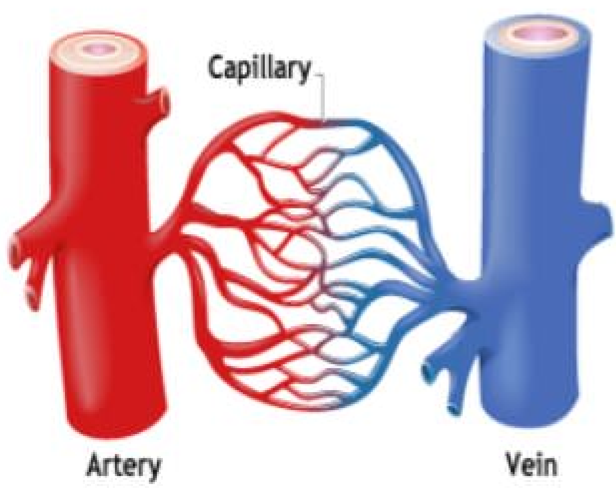
4. **Left Atrium**:
    - Oxygenated blood from the lungs enters the left atrium and passes through the mitral valve into the left ventricle.
5. **Left Ventricle**:
    - The left ventricle contracts, pumping oxygenated blood through the aortic valve into the aorta.
    - From the aorta, oxygenated blood is distributed to the rest of the body to supply oxygen to tissues and organs.

Valves and Heart Sounds:

- The tricuspid valve separates the right atrium from the right ventricle, and the mitral valve separates the left atrium from the left ventricle. These valves prevent the backflow of blood from the ventricles to the atria during ventricular contraction.
- The pulmonary valve separates the right ventricle from the pulmonary artery, and the aortic valve separates the left ventricle from the aorta. These valves prevent the backflow of blood from the arteries to the ventricles during relaxation.
- Heart sounds, known as "lub-dub," are produced by the closing of heart valves during the cardiac cycle. The first heart sound ("lub") is caused by the closure of the tricuspid and mitral valves during ventricular contraction. The second heart sound ("dub") is caused by the closure of the pulmonary and aortic valves during ventricular relaxation.

Arteries vs. Veins vs. Capillaries:

Artery	**Vein**	**Capillary**
It is a blood vessel having a thick wall.	It is a blood vessel having a thin wall.	It is a very narrow blood vessel that has very thin walls.
It carries blood from the heart to different parts of the body.	It brings blood from different parts of the body to the heart.	It forms a network throughout the body in all living cells connecting arteries to veins.
It doesn't contain any valve.	It contains valves that allow the blood to flow in one direction toward the heart.	It doesn't have any valve.
All arteries carry oxygenated blood except the pulmonary artery.	All veins carry deoxygenated blood except the pulmonary vein.	As the capillaries are much thinner so, the artery becomes arterioles and the vein becomes venules when they need to exchange substances with the cells.



Homeostasis:

Homeostasis is the body's ability to maintain stable internal conditions despite changes in the external environment. It involves the regulation of various physiological variables such as body temperature, blood pH, blood pressure, fluid balance, and hormone levels within narrow ranges, known as set points.

Homeostatic mechanisms work through feedback loops involving sensors, control centers (often in the brain), and effectors (such as muscles or glands). When internal conditions deviate from the set point, feedback mechanisms trigger responses to restore equilibrium. These responses can be either negative feedback, which opposes changes to restore stability, or positive feedback, which amplifies changes.

Maintenance of Homeostasis:

1. **Feedback Mechanisms**: Body maintains stability through feedback loops involving sensors, control centers, and effectors.
2. **Negative Feedback**: Counters deviations from set points to restore stability. Example: sweating to lower body temperature.
3. **Positive Feedback**: Amplifies changes to facilitate specific processes. Example: blood clotting.
4. **Regulation of Physiological Variables**: Body regulates variables like temperature, blood pressure, and glucose levels.
5. **Organ Systems**: Various systems, including nervous, endocrine, and cardiovascular, work together to monitor and regulate internal conditions.

Key Terms:

1. **Vasodilation**: Vasodilation is the widening of blood vessels, particularly arteries and arterioles. This process increases blood flow to tissues and organs by reducing vascular resistance, often mediated by relaxation of smooth muscle in vessel walls.

2. **Vasoconstriction**: Vasoconstriction is the narrowing of blood vessels, primarily arteries and arterioles. This phenomenon decreases blood flow to tissues and organs by increasing vascular resistance, typically mediated by contraction of smooth muscle in vessel walls.
3. **Piloerection**: Piloerection, or goosebumps, is the involuntary erection of hair follicles in response to cold, emotional stimuli, or sympathetic nervous system activation. It results from contraction of arrector pili muscles, causing hairs to stand erect.

What does Homeostasis exactly maintain?

1. **Body Temperature**:
    - Controlled through thermoregulation mechanisms.
    - Sensors in the skin and hypothalamus detect temperature changes.
    - Responses include sweating (to cool the body) or shivering (to generate heat).
2. **Blood Pressure**:
    - Controlled through cardiovascular regulation.
    - Baroreceptors in blood vessels detect changes in blood pressure.
    - Responses include vasodilation or vasoconstriction and changes in heart rate.
3. **Blood Glucose Levels**:
    - Controlled through glucose regulation.
    - Insulin and glucagon hormones regulate glucose levels.
    - Insulin lowers blood glucose by promoting its uptake by cells, while glucagon raises blood glucose by stimulating its release from storage.
4. **pH Levels**:
    - Controlled through acid-base balance.
    - Buffers in body fluids regulate pH.

- Respiratory and renal systems adjust pH by excreting or retaining acids and bases.

5. **Fluid Balance**:
    - Controlled through fluid regulation.
    - Kidneys regulate water balance through urine production.
    - Hormones like antidiuretic hormone (ADH) and aldosterone help regulate fluid balance by controlling water reabsorption in the kidneys.
6. **Electrolyte Levels**:
    - Controlled through electrolyte balance.
    - Kidneys regulate electrolyte levels by excreting excess ions in urine.
    - Hormones like aldosterone and parathyroid hormone help regulate electrolyte balance.
7. **Oxygen and Carbon Dioxide Levels**:
    - Controlled through respiratory regulation.
    - Chemoreceptors in the brain and blood vessels detect changes in oxygen and carbon dioxide levels.
    - Breathing rate and depth adjust to maintain appropriate gas exchange in the lungs.

Blood Glucose (More In-Depth):

Homeostasis regulates blood glucose levels through a coordinated process involving insulin and glucagon. When blood glucose levels rise after a meal, insulin is released from pancreatic beta cells, promoting glucose uptake into muscle, fat, and liver cells, as well as the storage of excess glucose as glycogen in the liver.

Conversely, when blood glucose levels drop between meals, glucagon is released from pancreatic alpha cells, stimulating the breakdown of glycogen into glucose (glycogenolysis) and the synthesis of new glucose molecules from non-carbohydrate sources (gluconeogenesis) in the liver. This process helps to raise blood glucose levels and maintain energy supply to cells.

The release of insulin and glucagon is tightly regulated by negative feedback mechanisms to prevent hypoglycemia or hyperglycemia, ensuring blood glucose levels remain within a narrow range essential for cellular function and overall health.

Diabetes:

Diabetes is a chronic metabolic disorder characterized by high blood glucose levels (hyperglycemia) resulting from either inadequate insulin production, ineffective insulin action, or both. There are several types of diabetes, including type 1 diabetes, type 2 diabetes, gestational diabetes, and other less common forms.

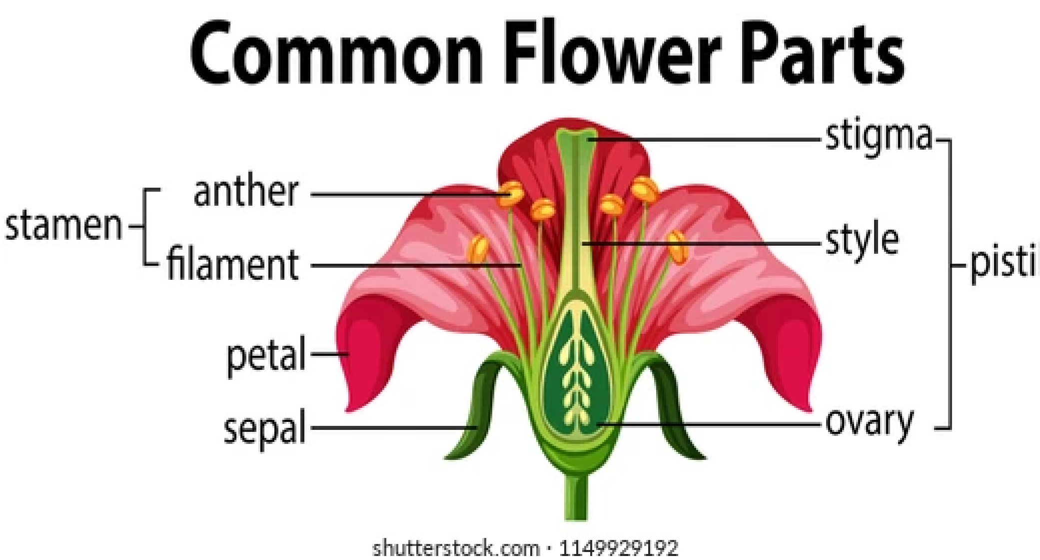
In type 1 diabetes, the immune system attacks and destroys the insulin-producing beta cells in the pancreas, leading to insulin deficiency. Type 2 diabetes occurs when the body becomes resistant to insulin or when the pancreas fails to produce enough insulin to meet the body's needs.

Parameters	Type 1 Diabetes	Type 2 Diabetes
Definition	Beta cells in pancreas are being attacked by body's own cells and therefore can't produce insulin to take sugar out of the blood stream. Insulin is not produced.	Diet related insulin release is so large and frequent that receptor cells have become less sensitive to the insulin. This insulin resistance results in less sugar being removed from the blood.
Diagnosis	Genetic, environmental and auto-immune factors, idiopathic	Genetic, obesity (central adipose), physical inactivity, high/low birth weight, GDM, poor placental growth, metabolic syndrome
Commonly Afflicted Groups	Children/teens	Adults, elderly, certain ethnic groups
You have this when	Your body makes too little or no insulin.	Your body can still produce insulin but does not use it properly (insulin resistance)
Cure	None	There is no cure for type 2 diabetes, although sometimes gastric surgery

		and/or lifestyle/medication treatment can result in remission. Physical exercise, healthy loss of weight & diet control are advised.
Treatment	Insulin Injections, dietary plan, regular check up of blood sugar levels, daily exercise Goals: optimal glucose, prevent/treat chronic complications, enhance health with food/PA, individual nutrition needs	Diet, exercise, weight loss, and in many cases medication. Insulin Injections may also be used, SMBG

Plant Structure, Transpiration and Reproduction:

Structure:



1. **Roots**:
    - Anchor the plant in the soil and absorb water and nutrients.
    - Types of roots include taproots (main root) and fibrous roots (network of thin roots).

2. **Stem**:
   - Supports the plant and transports water, nutrients, and sugars between roots and leaves.
   - Contains vascular tissues (xylem and phloem) responsible for conducting fluids.
3. **Leaves**:
   - Main site of photosynthesis, where sunlight, carbon dioxide, and water are converted into sugars.
   - Typically flat and thin to maximize surface area for light absorption.
4. **Flowers**:
   - Reproductive structures responsible for producing seeds.
   - Comprise various parts, including:
     - **Sepals**: Green leaf-like structures that protect the flower bud.
     - **Petals**: Often colorful structures that attract pollinators.
     - **Stamens**: Male reproductive organs consisting of anther (produces pollen) and filament.
     - **Pistil**: Female reproductive organ consisting of stigma (receives pollen), style, and ovary (contains ovules).
5. **Fruits**:
   - Develop from the ovary of a flower after fertilization and contain seeds.
   - Protect and aid in the dispersal of seeds through various means, such as wind, animals, or water.
6. **Seeds**:
   - Embryonic plant enclosed within a protective seed coat.
   - Contain stored food (endosperm) to support germination and initial growth of the plant.

Transpiration:

Transpiration is the process by which water moves from the roots of a plant, through its vascular system, and exits the plant through small pores called stomata on the surface of leaves.

1. **Water Uptake**: Water is absorbed by the plant's roots from the soil through osmosis and root pressure. This water is then transported upward through the plant's xylem vessels to the leaves.
2. **Water Vaporization**: Water molecules inside the plant's leaves evaporate from the surfaces of cells within the leaf mesophyll. This process is driven by solar energy, which heats the leaf surfaces and increases the kinetic energy of water molecules, allowing them to escape from liquid form to vapor form.
3. **Stomatal Opening**: Stomata are small pores located primarily on the underside of leaves. They regulate gas exchange and water loss. When the plant has sufficient water and favorable environmental conditions, stomata open to allow the exchange of gases (oxygen and carbon dioxide) for photosynthesis. This opening also allows water vapor to exit the leaf through a process called transpiration.
4. **Water Vapor Release**: Water vapor diffuses from the moist air spaces within the leaf to the drier air outside the leaf through the open stomata. This creates a concentration gradient that drives water vapor movement out of the leaf.
5. **Water Transport**: As water vapor exits the leaf through transpiration, it creates a negative pressure gradient (tension) within the leaf. This negative pressure pulls water molecules upward through the plant's xylem vessels, a process known as cohesion-tension theory.
6. **Water Replacement**: As water is lost through transpiration, it is replaced by water absorbed from the soil through the plant's roots, completing the cycle.

Importance of Transpiration:

1. **Water Transport**: Transpiration creates a pull on water molecules, facilitating the upward movement of water from the roots to the leaves through xylem

vessels. This helps transport water and dissolved nutrients throughout the plant, essential for photosynthesis, growth, and development.

2. **Cooling Mechanism**: Transpiration helps regulate leaf temperature by releasing excess heat through the evaporation of water from leaf surfaces. This cooling effect is vital for preventing overheating and maintaining optimal conditions for photosynthesis and cellular processes.
3. **Nutrient Uptake**: Transpiration creates a flow of water from the soil to the roots, enhancing the uptake of essential nutrients and minerals by plant roots. This process is critical for maintaining plant health and supporting metabolic functions.
4. **Maintaining Turgor Pressure**: Transpiration maintains turgor pressure in plant cells, ensuring that cells remain rigid and upright. This pressure helps support the structure of the plant and prevents wilting, especially in leaves and stems.
5. **Gas Exchange**: Transpiration creates a flow of air through the stomata, facilitating the exchange of gases such as oxygen and carbon dioxide between the plant and its environment. This exchange is essential for photosynthesis, respiration, and the regulation of internal carbon dioxide levels.

Measurement of Transpiration:

The name of the instrument used to measure transpiration in plants is a "potometer" or "transpirometer." This device measures the rate of water uptake or loss by a plant as an indirect measure of transpiration. It typically consists of a sealed chamber connected to a stem or leaf of the plant through a capillary tube.

The potometer allows for the measurement of water movement or changes in water level within the chamber, which can be correlated with the rate of transpiration. Additionally, other equipment such as a balance or graduated cylinder may be used to measure the amount of water lost by the plant over a specific time period, providing further insights into transpiration rates.

Ganong's Potometer:

Reproduction:

1. **Pollination**:
    - Pollination is the transfer of pollen grains from the male reproductive organs (anthers) to the female reproductive organs (stigma) of the same or another flower.
    - This transfer can occur through various agents, including wind, water, insects, birds, or other animals.
    - Once pollen grains land on the stigma, they may germinate and produce pollen tubes, which grow down through the style to reach the ovules.
2. **Fertilization**:
    - After pollen tubes reach the ovules, they release sperm cells, which fertilize the egg cell inside the ovule.
    - This fusion of the male and female gametes results in the formation of a diploid zygote, which will develop into a new plant embryo.
    - Fertilization typically occurs within the ovule, which is housed within the ovary of the flower.
3. **Seed Formation**:
    - Following fertilization, the zygote develops into an embryo, and the ovule matures into a seed.

- The seed contains the embryonic plant, along with a protective seed coat and stored nutrients (endosperm or cotyledons) to support germination and early growth.
- The ovary of the flower may also develop into a fruit, which protects the seeds and aids in their dispersal.

4. **Seed Dispersal**:
    - Mature seeds are dispersed from the parent plant by various means, such as wind, water, animals, or gravity.
    - Dispersal mechanisms ensure that seeds are spread away from the parent plant, reducing competition for resources and increasing the chances of successful germination in new locations.
    - Some seeds have adaptations for dispersal, such as wings, hooks, or fleshy fruits that attract animals for consumption and subsequent dispersal.

    Video:https://www.youtube.com/watch?v=R8_ScKzLAfE