Q1. Write a note on any five human Physiological parameters.

Ans:

1. Heart rate/Heartbeat:

The heart beats to circulate blood, delivering oxygen and nutrients. Heart rate is the frequency of the heartbeat measured by the number of contractions of the heart per minute. A healthy human heart beats, on average, 60 to 100 times per minute while at rest. Variation in heartbeat reflects in or results in Dizziness, Fainting, Heart failure, Stroke, Sudden cardiac death to name a few. Persistent or significant irregularities signify autonomic nervous system and underlying heart conditions.

2. Blood pressure:

Blood pressure is due to the force of circulating blood against the walls of arteries. It is measured in millimetres of mercury (mm Hg). It is represented by two numbers namely, systolic (normal -- 120 mm Hg) and diastolic (normal -- 80 mm Hg). Systolic pressure is when heart beats and pumps blood and Diastolic pressure is when heart rests between beats. Elevated BP has Systolic value in the range 120-129 and diastolic value is lesser 80 mm Hg. High Blood Pressure called as hypertension has two stages namely, Stage 1 if Systolic range is 130-139 or diastolic range is 80-89 mm Hg and Stage 2 if Systolic pressure is >= 140 or diastolic pressure is >= 90 mm Hg. Hypertensive Crisis is if Systolic > 180 and/or if diastolic >120 mm Hg. Low Blood Pressure or Hypotension is when Blood pressure < 90/60 mm Hg. It can be normal for some individuals. But a sudden drop in pressure can be dangerous.

3. Body temperature:

Body temperature is one of the most basic biomarkers linked with various aspects of human health, including metabolic health, sleep, stress, etc. Normal human body temperature range is 36.5–37.5 °C (97.7–99.5 °F). The average normal body temperature is 98.6 degrees Fahrenheit (37°C).The primary source of human body temperature is metabolism, the chemical reactions that occurs within the body's cells to sustain life. These metabolic processes release heat as a by-product, and the liver is a major contributor to this heat production. Human body temperature depends on sex, age, time of day, exertion level, health status, what part of the body the measurement is taken at, state of consciousness like waking, sleeping, sedated, and emotions. Body temperature is kept in the normal range by a homeostatic function known as thermoregulation, in which adjustment of temperature is triggered by the central nervous system. Body temperature undergoes significant fluctuation over the course of a day. This is called diurnal variation. Disorders resulting from abnormally high or low body temperature result in neurologic dysfunction.

4. Blood sugar:

Normal blood glucose levels are typically between 70-100 mg/dL while fasting and less than 180 mg/dL after eating. Diabetes is a chronic disease where the body either doesn't produce enough insulin or can't effectively use the insulin it produces, leading to high blood sugar levels. Insulin, a hormone, regulates blood glucose (sugar). When insulin is insufficient or ineffective, glucose builds up in the bloodstream, potentially causing damage to various organs over time. Over time, this can damage blood vessels, nerves, eyes, kidneys, and other organs. The medical term for high blood sugar is hyperglycemia. Types of diabetes are Type 1

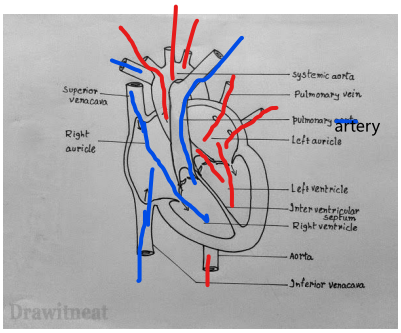
diabetes and Type 2 diabetes. Some of the symptoms of high blood sugar are increased thirst and urination, unexplained weight loss, blurred vision, fatigue, slow-healing sores, increased infections, etc.

5. Oxygen saturation in blood:

Oxygen saturation is the fraction of oxygen-saturated haemoglobin relative to total haemoglobin (unsaturated + saturated) in the blood. Oxygen saturation measures how much oxygen is bound to haemoglobin. The human body requires and regulates a very precise and specific balance of oxygen in the blood. Normal arterial blood oxygen saturation levels in humans are 96–100%. If the level is below 90 percent, it is considered low and called hypoxemia. Continued low oxygen levels may lead to respiratory or cardiac arrest. Oxygen saturation is commonly measured using a pulse oximeter, a non-invasive device that clips onto a fingertip and uses light to estimate oxygen levels. Using the respiratory system, red blood cells, specifically the haemoglobin, gather oxygen in the lungs and distribute it to the rest of the body. Low oxygen levels can cause symptoms like shortness of breath, dizziness, confusion, and bluish skin color.

Q2. Explain the parts and working of human heart.

Ans:



A human heart is a four chambered organ and weighs about 250 to 350 grams. The four chambers are left atrium and right atrium (upper chambers) and, left ventricle and right ventricle (lower chambers). The left ventricle has thicker walls than the right due to the greater force needed to pump blood systemically. A wall of muscle called the septum separates the left and right sides, preventing the two types of blood from mixing. Four valves ensure blood flows in one direction by opening and closing with each heartbeat.

The heart beats to circulate blood, delivering oxygen and nutrients. Heart rate is the frequency of the heartbeat measured by the number of contractions of the heart per minute. A healthy human heart beats, on average, 60 to 100 times per minute while at rest.

The pumping action is controlled by an electrical system called "cardiac conduction system". Myocytes (cardiac cells) are the specialized cells responsible for pacemaking, transmission and contraction. Cardiac conduction system includes the sinus node, the atrioventricular node (AV node), and specialized pathways called the Bundle of His and Purkinje fibers.

The sinus node acts as the heart's natural pacemaker, generating electrical impulses that cause the heart muscle to contract. These signals travel through the heart's chambers, causing them to contract in a specific sequence. First, the atria (upper chambers) contract and then the ventricles (lower chambers) contract. The contraction of the heart chambers creates pressure that pushes blood out of the heart and into the arteries.

The right atrium receives oxygen-poor blood from the body and sends it to the right ventricle, which pumps it to the lungs through pulmonary artery to make blood oxygen-rich. The left atrium receives oxygen-rich blood from the lungs through pulmonary veins and sends it to the left ventricle, which pumps it to the rest of the body. As the heart relaxes, blood flows back into the chambers, preparing for the next beat.

Q3. Explain Sources of human body temperature, its normal range and significance.

Body temperature is one of the most basic and key biomarkers linked with various aspects of human health, including metabolic health, sleep, stress and almost every other bodily function. Normal human body temperature range is 36.5–37.5 °C (97.7–99.5 °F). The average normal body temperature is 37°C (98.6 degrees Fahrenheit).

The primary source of human body temperature is metabolism, the chemical reactions that occur within the body's cells to sustain life. These metabolic processes release heat as a by-product, and the liver is a major contributor to this heat production. Metabolism is a series of chemical processes in each cell transforming the calories into fuel. These processes sustain life and everyday functioning. They include breaking down food and drink to energy and building or repairing our bodies. Metabolism is the rate at which the body converts food into energy, plays a crucial role in maintaining body temperature. Metabolic rate is the rate at which a body utilises energy. Metabolic rate is influenced by many factors, including age, gender, muscle-to-fat ratio, amount of physical activity and hormone function.

Human body temperature depends on sex, age, time of day, exertion level, health status, what part of the body the measurement is taken at, state of consciousness like waking, sleeping, sedated, and emotions. Body temperature is kept in the normal range by a homeostatic function known as thermoregulation, in which adjustment of temperature is triggered by the central nervous system. Thermoregulation is controlled by the hypothalamus in the brain. When the internal temperature changes, sensors in the central nervous system (CNS) send messages to the hypothalamus. In response, it sends signals to various organs and systems in the body that trigger different mechanisms to raise or reduce body temperature.

Body temperature can also serve as a marker of metabolic activity because it is linked to energy expenditure and correlates with muscle mass, thyroid activity and metabolic regulation of compounds like glucose, fats and so on. Body temperature is a measure of how well an organism is able to generate and get rid of heat. The normal body temperature, which changes throughout the day, varies by person, age, time of day and activity level. Body temperature undergoes significant fluctuation over the course of a day. This is called diurnal variation. The human body generates heat capable of raising body temperature by approximately 1°C per hour. Disorders resulting from abnormally high or low body temperature result in neurologic dysfunction. Temperature regulation in the body is affected by elevated glucose level, stress, sleep, metabolic health, etc.

Q4. Explain human respiratory system, respiratory rate and oxygen saturation in blood.

Ans:

The human respiratory system facilitates the process of gas exchange. Oxygen is brought into the body and carbon dioxide is expelled. The key components of human respiratory system includes the nose, mouth, larynx (voice box), trachea (windpipe), bronchi, and lungs, where gas exchange occurs in tiny air sacs called alveoli. Breathing is driven by muscles like the diaphragm, which expands and contracts the chest cavity to allow air to enter and exit the lungs.

Using the respiratory system, red blood cells, specifically the haemoglobin, gather oxygen in the lungs and distribute it to the rest of the body. The needs of the body's blood oxygen may fluctuate such as during exercise when more oxygen is required or when living at higher altitudes. A blood cell is said to be saturated when carrying a normal amount of oxygen. Both too high and too low levels can have adverse effects on the body.

Respiration is the process by which living organisms convert biochemical energy from nutrients into adenosine triphosphate (ATP). It involves a series of chemical reactions, some occurring in the cytoplasm and some in the mitochondria that break down glucose and other molecules, releasing energy. This energy is then used in various cellular activities.

Respiratory rate is the number of breaths taken per minute. It's a vital sign used to assess a person's overall health, particularly their respiratory and cardiovascular systems. A normal respiratory rate for adults at rest is typically between 12 and 20 breaths per minute. Respiratory rate is measured by counting the number of breaths (one inhalation and one exhalation) a person takes in one minute while at rest. For infants, the normal range is 30-60 breaths per minute. It is set and controlled by the respiratory centre of the brain.

Several factors can influence a person's respiratory rate, including Age, Activity level, Health conditions (e.g., lung diseases, heart conditions), and certain medications. Changes in respiratory rate can be an early indicator of various health issues, including respiratory distress, infections, and other medical conditions.

Oxygen saturation is the fraction of oxygen-saturated haemoglobin relative to total haemoglobin (unsaturated + saturated) in the blood. Oxygen saturation measures how much oxygen is bound to haemoglobin, a protein in red blood cells responsible for carrying oxygen throughout the body. Normal arterial blood oxygen saturation levels in humans are 96–100%. If the level is below 90 percent, it is considered low and called hypoxemia. Lower levels can indicate a problem with oxygen transport. Arterial blood oxygen levels below 80 percent may affect the function organs such as the brain and heart. Continued low oxygen levels may lead to respiratory or cardiac arrest.

Oxygen saturation is commonly measured using a pulse oximeter, a non-invasive device that clips onto a fingertip and uses light to estimate oxygen levels. Various factors such as lung diseases, high altitude, and certain medical conditions can affect blood oxygen levels. Low oxygen levels can cause symptoms like shortness of breath, dizziness, confusion, and bluish skin color.

Q5. Explain roles of different types of hormones.

Ans:

Human hormones are produced by endocrine glands. They are released directly into the bloodstream. They are circulated the blood to reach their specific target cells or organs, which have the proper receptors to receive the hormone.They are chemical messengers. They regulate and control metabolism, growth and development, sexual function and reproduction, sleep cycles, mood, and the body's response to stress. They maintain homeostasis, control heart rate, blood sugar, appetite and, bone health. When a hormone binds to its target cell, it alters the cell's activity, triggering a specific response or initiating a cascade of hormonal reactions.

Hormones and their functions are as follows:

1. **Insulin** produced in **pancreas** regulates blood sugar levels by helping cells absorb glucose.
2. **Glucagon** produced in **pancreas** works with insulin to keep blood sugar levels stable by signalling the liver to release stored glucose.
3. **Thyroxine** produced in **thyroid gland** controls metabolism, which is how the body gets energy from food.
4. **Growth Hormone** produced in **pituitary gland** stimulates growth and development in children and adolescents.
5. **Antidiuretic** Hormone produced in **pituitary gland** helps the body retain water by signalling the kidneys to absorb more water.
6. **Adrenaline** produced in **adrenal glands** prepares the body for "fight-or-flight" by increasing heart rate, breathing, and blood flow.
7. **Cortisol** produced in **adrenal glands** helps the body adapt to long-term stress and also helps regulate metabolism.
8. **Estrogen, Testosterone, and Progesterone** produced **ovaries and testes** are essential for sexual development, fertility, pregnancy, and the menstrual cycle.
9. **Melatonin** produced in **pineal gland** helps regulate the body's sleep-wake cycle.

Q6. What is diabetes? Explain its types and symptoms.

Ans:

Normal blood glucose levels are typically between 70-100 mg/dL while fasting and less than 180 mg/dL after eating. Insulin, a hormone, is crucial for regulating blood glucose (sugar) by allowing it to enter cells for energy. When insulin is insufficient or ineffective, glucose builds up in the bloodstream, potentially causing damage to various organs over time. Insulin, produced by the pancreas, acts like a key that unlocks cells to allow glucose (sugar) from the blood to enter and be used for energy. Over time, this can damage blood vessels, nerves, eyes, kidneys, and other organs.

Hyperglycaemia: If the sugar level is higher than 70-100 mg/dL range, then the condition is called as hyperglycemia. Hyperglycemia means having high blood sugar (glucose) levels in the bloodstream. It's a condition often associated with diabetes, where the body either doesn't produce enough insulin or can't properly use the insulin it produces, leading to a buildup of glucose. Hyperglycemia occurs when blood sugar levels are consistently higher than these normal ranges. For example, a fasting blood glucose level above 125 mg/dL is considered hyperglycemic.

Symptoms of hyperglycemia can include increased thirst, frequent urination, unexplained weight loss, blurred vision, fatigue, slow-healing sores, increased infections, headaches etc. Other Causes of hyperglycemia can be illness, certain medications, and stress.

Hypoglycemia: Hypoglycemia, also known as low blood sugar, is a condition where the level of glucose in your blood drops below 70 mg/dL. Hypoglycemia occurs when the glucose level in your blood falls below the level needed to properly fuel your body's cells and organs. Hypoglycemia can also occur in people without diabetes due to various factors. Hypoglycemia may lead to mild to moderate Shakiness, sweating, hunger, anxiety, irritability, dizziness, confusion, and difficulty concentrating.

Diabetes or Hyperglycemia is a chronic disease where the body either doesn't produce enough insulin or can't effectively use the insulin it produces, leading to high blood sugar levels.

Diabetes is classified as Type 1 and Type 2 diabetes. In Type 1 diabetes, the body's immune system mistakenly attacks and destroys the insulin-producing cells in the pancreas, usually diagnosed in childhood or young adulthood. In Type 2 diabetes, the body doesn't produce enough insulin or the cells become resistant to its effects, often developing in adulthood. A temporary form of diabetes, Gestational diabetes, can develop during pregnancy.

Q7. What is blood pressure? Explain its normal range and the effects of high and low blood pressure.

Ans:

Blood pressure is the force of circulating blood against the walls of arteries. It's measured in millimeters of mercury (mm Hg) and is typically represented by two numbers, systolic (120 mm Hg) and diastolic (80 mm Hg). Systolic pressure represents the pressure when your heart beats and pumps blood. Diastolic pressure represents the pressure when your heart rests between beats.

Blood Pressure Categories:

i. Normal: 120/80 mm Hg.

ii. Elevated: Systolic between 120-129 and diastolic less than 80 mm Hg.

iii. High Blood Pressure (Hypertension):

- Stage 1: Systolic --130-139 or diastolic -- 80-89 mm Hg.
- Stage 2: Systolic -- 140 or higher or diastolic 90 or higher mm Hg.
- Hypertensive Crisis: Systolic > 180 and/or diastolic > 120 mm Hg.

High blood pressure does not have any frequent symptoms until significant damage has occurred. High blood pressure is caused by lifestyle factors like diet, lack of exercise, and smoking. Medical conditions like kidney disease or diabetes are some causes of hypertension. Increased risk of heart disease, stroke, and kidney failure are some consequences of hypertension.

High blood pressure can be managed by good lifestyle with controlled diet, regular exercise, managing body weight, ceasing to smoke and limiting alcohol consumption and proper medication.

iv. Low Blood Pressure (Hypotension): Blood pressure below 90/60 mm Hg is generally considered as low blood pressure. But, can be normal for some individuals. Low blood pressure can be a normal condition for some, but sudden drops in pressure can be dangerous. Dizziness, light headedness, fainting, blurred vision, nausea, and fatigue are some of the symptoms of low blood pressure. Causes of hypotension are dehydration, heart problems, endocrine disorders, and certain medications. Low blood pressure can be managed in general by increasing fluid intake, wearing Compression stockings, and adjusting medications.

Q8. Explain the types of human muscle and their functions.

Ans:

Muscle is a soft tissue and is one of the four basic types of animal tissues. There are three types of muscle tissue in vertebrates:

1. Skeletal muscle,
2. Cardiac muscle, and
3. Smooth muscle.

These muscle types differ in their structure, location, and function.The different muscle types vary in their response to neurotransmitters and hormones.

Skeletal muscle contracts voluntarily, under the influence of the central nervous system. Reflexes are a form of non-conscious activation of skeletal muscles, but nonetheless arise through activation of the central nervous system. Smooth and cardiac muscle contract involuntarily, without conscious intervention. Skeletal muscle is attached to bones and enables movement and responsible for voluntary movements like walking, running, and lifting objects. It is striated (striped) in appearance, has multinucleated cells, and is under conscious control. Skeletal muscle tissue contains special contractile proteins called actin and myosin which interact to cause movement. Skeletal muscle tissue consists of elongated, multinucleate muscle cells called muscle fibers ranging from 3-8 micrometers in width and from 18 to 200 micrometers in breadth, tendons and perimysium. Skeletal muscle is anchored by tendons or sometimes by aponeuroses to bones, and is used to effect skeletal movement such as locomotion and to maintain posture. Postural control is generally maintained as an unconscious reflex, but the responsible muscles can also react to conscious control. The body mass of an average adult man is made up of 42% of skeletal muscle, and an average adult woman is made up of 36%.

Cardiac muscle tissue is found only in the walls of the heart as myocardium, and it is an involuntary muscle controlled by the autonomic nervous system. Cardiac muscle tissue is striated like skeletal muscle, containing sarcomeres in highly regular arrangements of bundles. While skeletal muscles are arranged in regular, parallel bundles, cardiac muscle connects at branching, irregular angles known as intercalated discs.

Smooth muscle tissue is non-striated and involuntary. Smooth muscle is found within the walls of organs and structures such as the esophagus, stomach, intestines, bronchi, uterus, urethra, bladder and blood vessels. It controls involuntary movements like digestion, blood pressure regulation, and organ contractions. It has single nucleus per cell.

Muscle strength is the ability of a muscle or muscle group to exert force against resistance. It's the capacity to generate force to perform movements and maintain stability. This can involve lifting weights, pushing against an immovable object, or performing movements against resistance. Muscle strength is fundamentally about the maximal force a muscle can produce.

Q9. Explain the components and working of human nervous system.

Ans:

Nervous System is the combination of organs which integrate activities of other systems, conduct impulses around the body and permit internal and external sensitiveness activities. It consists of central nervous system and peripheral nervous system.

The central nervous system consists of Brain & Spinal cord. The peripheral nervous system consists of Nerves (cranial nerves & spinal nerves) and Autonomic nervous system (sympathetic & parasympathetic nervous system). There are 12 pairs of cranial nerves which are attached to the brain which supply the head & neck. 31 pairs of spinal nerves are attached to spinal cord which supply the rest of the body.

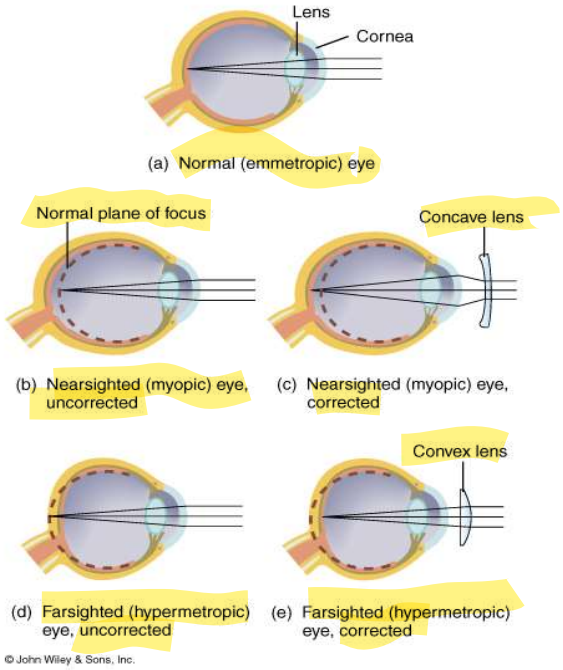
A neuron is the structural and functional unit of nervous system. It is an excitable cell which is concerned with the reception, integration, transformation and onward transmission of coded information. The coded information is called 'impulse'. Neuron consists of a cell body and processes. The processes are of two types- dendrites and axons. Dendrites carry information to the cell body and Axon, usually single, carries information away from the cell body. Depending upon the number of processes the neurons are classified into unipolar neurons, bipolar neurons and multipolar neurons. Intermediate stage between bipolar and unipolar neurons is called pseudounipolar neurons.

Neural signals are electrochemical pulses called action potentials, generated by the flow of ions across a neuron's membrane, that travel along the axon. At junctions between neurons, the signal is transmitted to the next cell, either electrically or chemically via neurotransmitters. This process allows neurons to relay information from sensory organs to the brain and back to the body, coordinating responses.

At rest, a neuron maintains a negative charge inside relative to the outside due to the uneven distribution of ions like sodium (Na^+), potassium (K^+), and chloride (Cl^-) across its membrane. If the neuron receives a stimulus, the cell membrane becomes more permeable to positive ions. Positive ions, particularly sodium, rush into the cell, making the inside of the membrane less negative and eventually positive. This is called as depolarisation. If this depolarization reaches a certain threshold, it triggers an action potential. The membrane then quickly restores its negative charge by allowing potassium ions to exit the cell. This is called as repolarisation. This rapid change in membrane potential is the action potential. The action potential travels down the neuron's axon, a long tendril that conducts the signal to the next cell. When the action potential reaches the end of the axon (axon terminal), it triggers the release of chemical messengers called neurotransmitters. Neurotransmitters are packaged in vesicles and released into the synaptic cleft, a tiny gap between neurons. These neurotransmitters diffuse across the cleft and bind to specific receptors on the postsynaptic neuron (the receiving neuron). This binding causes a change in the postsynaptic neuron, potentially triggering a new action potential if the overall stimulus is excitatory. This sequence of events forms the basis of neural communication, enabling rapid relay of information throughout the body. Signals flow from sensory organs to the brain, which then sends instructions back to muscles and other organs via these electrochemical signals, facilitating sensory perception and complex body responses.

Q10. Explain short sight (myopia) and long sight (hyperopia) conditions and formation of images under normal, short sight and long sight conditions in a human eye ball.

Ans:



In normal vision, light focuses precisely on the retina, forming a clear image as shown in fig.(a).

Near-sightedness or short-sightedness (myopia) is sometimes an inherited genetic condition, and is marked by the eyeball stretching and growing too long or sometimes the cornea has too steep a curve. The incoming light focuses in front of the retina [fig.(b)], instead of on it. Short-sightedness occurs when the eye's shape causes light to focus in front of the retina, rather than on it, leading to blurred distant vision. Genetic factors and environmental influences, such as insufficient time outdoors and prolonged close-up work, also increase the risk of developing myopia.

In far-sightedness (hyperopia), light focuses behind the retina [fig.(d)]. Two primary causes of long-sightedness (hyperopia) are having an eyeball that is shorter than normal or having a cornea that is too flat or the lens has insufficient focusing power, causing nearby objects to appear blurry. Long-sightedness is often inherited but can also result from the lens becoming stiffer with age.

Q11. Which are the parts of a human ear? Explain the working of a human ear.

Ans:

Parts of the Human Ear:

1. Outer Ear:
   - Pinna (Auricle) -- The visible, flap-like part that collects sound waves and directs them into the ear canal.
   - Auditory Canal -- A tunnel that carries sound waves from the pinna to the eardrum, containing glands that secrete earwax for protection.
2. Middle Ear:
   - Eardrum (Tympanic Membrane) -- A thin, vibrating membrane that separates the outer ear from the middle ear.
   - Ossicles -- Three tiny bones—the malleus (hammer), incus (anvil), and stapes (stirrup)—that amplify vibrations from the eardrum.
   - Eustachian Tube: A tube that connects the middle ear to the back of the throat, equalizing pressure between the middle ear and the outside environment.
3. Inner Ear:
   - Cochlea -- A spiral-shaped organ filled with fluid and tiny hair cells that convert mechanical vibrations into electrical nerve impulses.
   - Vestibular System (Semicircular Canals and Vestibule): Structures that detect head movement and position, providing information about balance and body posture.
   - Auditory Nerve: Carries the electrical signals from the cochlea to the brain.

Working of Human Ear:

Sound waves are gathered by the pinna and travel through the auditory canal to the eardrum. The sound waves cause the eardrum to vibrate. These vibrations are transmitted and amplified by the ossicles in the middle ear. The stapes pushes on the fluid in the cochlea, creating waves that stimulate the hair cells within the cochlea. The hair cells bend, converting these movements into electrical signals. The auditory nerve sends these electrical impulses to the brain, where they are processed and interpreted as sound.

Q12. Explain the types and functions of human Bone. Write the major constituents of a bone. Write a short note on bone elasticity and strength.

Ans:

Based on the shape, bones in the human body are categorized into long, short, flat, irregular, and sesamoid. Long bones primarily support weight and enable movement. Short bones, such as the wrist and ankle bones, are cube-shaped and provide support and flexibility. Flat bones including the skull, ribs, and sternum, are thin and broad. They offer protection to internal organs. Irregular bones like the vertebrae, have complex shapes that help protect organs and tissues. Sesamoid bones are small bones embedded in tendons, like the kneecap which protect tendons from stress and wear.

Bones are made of a complex extracellular matrix that has both organic and inorganic components. The inorganic matrix consists of calcium-phosphate minerals like hydroxyapatite, and the organic matrix consists of Type I collagen protein. Together they provide hardness and flexibility to bone. Type I collagen protein fibers form a flexible framework for the mineral components to deposit on. The organic matrix also contains non-collagenous proteins, glycoproteins, and growth factors.

Bone elasticity is the ability to deform and return to its original shape, allowing it to withstand impact, while bone strength is its resistance to fracturing under stress, derived from both the mineral components' rigidity and the collagen's tensile strength, creating a material that is strong, stiff, and somewhat flexible. The collagen provides the inherent elasticity, while the mineral component adds stiffness to this elastic framework. This elasticity is crucial for the skeleton's ability to absorb energy and withstand impact, preventing fractures during activities that involve shock and stress.

Bone strength is its resistance to breaking when subjected to various mechanical loads. The inorganic hydroxyapatite minerals contribute to bone's stiffness and resistance to compressive forces, while the collagen provides resistance to tensile (pulling) forces.