**Paper : Human Physiology I**

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**Bs radiology .**

**Q1 : A**

**Ans :** Before you begin to study the different structures and functions of the human body, it is helpful to consider its basic architecture; that is, how its smallest parts are assembled into larger structures. It is convenient to consider the structures of the body in terms of fundamental levels of organization that increase in complexity: subatomic particles, atoms, molecules, organelles, cells, tissues, organs, organ systems, organisms and biosphere .

## **The Levels of Organization**

To study the chemical level of organization, scientists consider the simplest building blocks of matter: subatomic particles, atoms and molecules. All matter in the universe is composed of one or more unique pure substances called elements, familiar examples of which are hydrogen, oxygen, carbon, nitrogen, calcium, and iron. The smallest unit of any of these pure substances elements is an atom. Atoms are made up of subatomic particles such as the proton, electron and neutron. Two or more atoms combine to form a molecule, such as the water molecules, proteins, and sugars found in living things. Molecules are the chemical building blocks of all body structures.

A **cell** is the smallest independently functioning unit of a living organism. Even bacteria, which are extremely small, independently-living organisms, have a cellular structure. Each bacterium is a single cell. All living structures of human anatomy contain cells, and almost all functions of human physiology are performed in cells or are initiated by cells.

A human cell typically consists of flexible membranes that enclose cytoplasm, a water-based cellular fluid together with a variety of tiny functioning units called **organelles**. In humans, as in all organisms, cells perform all functions of life. A **tissue** is a group of many similar cells though sometimes composed of a few related types that work together to perform a specific function.

An **organ** is an anatomically distinct structure of the body composed of two or more tissue types. Each organ performs one or more specific physiological functions.

**An organ system** is a group of organs that work together to perform major functions or meet physiological needs of the body.

This book covers eleven distinct organ systems in the human body Assigning organs to organ systems can be imprecise since organs that “belong” to one system can also have functions integral to another system. In fact, most organs contribute to more than one system.

**Q1 : B**

## **Ans : Positive Feedback**

In positive feedback, there is a direct positive correlation between the concentration and the process rate. One good example is how the endocrine system regulates the release of its hormones. Particularly, oxytocin is a hormone released by the pituitary gland during child birth. It is crucial in labor and normal delivery. As the contractions increase, more oxytocin is being produced until the child is born. Also, this chemical has been associated with social bonding. For instance, hugging someone stimulates the release of oxytocin. Someone who gets and gives lots of hugs also experiences an enhanced production of the said hormone.

The following enumeration outlines the phases involved in a negative feedback:

1. A stimulus disturbs the originally controlled variables.
2. Receptors detect the change.
3. The information travels through the system’s pathway towards the control center.
4. The control center determines the appropriate action and sends information to effector cells.
5. The initial deviation is intensified.

## **Negative Feedback**

Negative feedback controls the process rate to prevent substance accumulation. Contrary to positive feedback, it reflects a negative correlation between the concentration and process rate. Most homeostatic procedures involve negative feedback as most mechanisms achieve equilibrium by going back to their original states. When the brain detects an internal disruption, it sends messages via the nervous system that activate pertinent organs to return the values within normal range.

This mechanism is often likened to a heating system which gets turned up if the perceived temperature is too low and vice versa. For example, the pancreas releases two hormones with opposite functions. Insulin lowers down blood sugar levels while glucagon raises it up. When the body detects that it has too much sugar, the pancreas is prompted to release insulin and only stops when balance is achieved; hence, negative feedback. Likewise, the pancreas is prompted to release glucagon when it senses that the body has very low sugar and only stops when the body has returned to its usual state.

The following enumeration outlines the phases involved in a negative feedback:

1. The original state is disturbed.
2. Receptors detect the change.
3. The information travels through the system’s pathway towards the control center.
4. The control center determines the appropriate action.
5. Equilibrium is restored by counteracting the excessive production rate.

As compared to positive feedback, negative feedback occurs more frequently among the body’s homeostatic mechanisms as many diseases is caused by the disruption of the original systemic state. It is then more familiar while positive feedback is less observed as it is less intuitive.

**Q2 : A**

## **Ans : Cell Organelles**

The cellular components are called the Cell Organelles. These cell organelles are membrane-bound, present within the cells and are distinct in their structures and functions. They coordinate with their functions efficiently for the normal functioning of the cell. Few of them functions providing shape and support, whereas some are involved in the locomotion and reproduction of a cell. There are various organelles present within the cell and are classified into three categories based on the presence or absence of membrane.

**Organelles without membrane:**The Cell wall, Ribosomes, and Cytoskeleton are membrane-bound cell organelles. They are present both in [**prokaryotic cell**](https://byjus.com/biology/prokaryotic-cells/) and the eukaryotic cell.

**Single membrane-bound organelles:**Vacuole, Lysosome, Golgi Apparatus, Endoplasmic Reticulum are single membrane-bound organelles present only in a eukaryotic cell.

**Double membrane-bound organelles:**Mitochondria and chloroplast are double membrane-bound organelles present only in a eukaryotic cell.

Let us learn more in detail about the different cell organelles in brief.

## **List of Cell Organelles and their Functions**

### **Plasma Membrane**

The plasma membrane is also termed as a Cell Membrane or Cytoplasmic Membrane. It is a selectively permeable membrane of the cell, which is composed of a lipid bilayer and proteins.

The plasma membrane is present both in plant and animal cell, which functions as the selectively permeable membrane, by permitting the entry of selective materials in and out of the cell according to the requirement. In an animal cell, the cell membrane functions by providing shape and protects the inner contents of the cell. Based on the structure of the plasma membrane, it is regarded as the fluid mosaic model. According to the fluid mosaic model, the plasma membrane are subcellular structures, made of a lipid bilayer in which the protein molecules are embedded.

Also refer to the [Difference Between Cell Membrane and Plasma Membrane](https://byjus.com/biology/difference-between-cell-membrane-and-plasma-membrane/)

### **Cytoplasm**

The cytoplasm is present both in plant and animal cells. They are jelly-like substances, found between the cell membrane and nucleus.  They are mainly composed of water,  organic and inorganic compounds. The cytoplasm is one of the essential components of the cell, where all the cell organelles are embedded. These cell organelles contain enzymes, mainly responsible for controlling all metabolic activity taking place within the cell and are the site for most of the chemical reactions within a cell.

**Nucleus**

The nucleus is a double-membraned organelle found in all eukaryotic cells. It is the largest organelle, which functions as the control centre of the cellular activities and is the storehouse of the cell’s DNA. By structure, the nucleus is dark, round, surrounded by a nuclear membrane. It is a porous membrane (like cell membrane) and forms a wall between cytoplasm and nucleus. Within the nucleus, there are tiny spherical bodies called nucleolus. It also carries another essential structure, called chromosomes.

Chromosomes are thin and thread-like structures which carry another important structure called a gene. Genes are a hereditary unit in organisms i.e., it helps in the inheritance of traits from one generation (parents) to another (offspring). Hence, the nucleus controls the characters and functions of cells in our body.  The primary function of the nucleus is to monitor cellular activities including [**metabolism**](https://byjus.com/biology/metabolism/) and growth by making use of DNA’s genetic information. Nucleoli in the nucleus are responsible for the synthesis of protein and RNA.

Also read about [the Nucleus](https://byjus.com/biology/the-nucleus/)

### **Endoplasmic Reticulum**

The Endoplasmic Reticulum is a network of membranous canals filled with fluid. They are the transport system of the cell, involved in transporting materials throughout the cell.  
There are two different types of Endoplasmic Reticulum:

1. **Rough Endoplasmic Reticulum** – They are composed of cisternae, tubules, and vesicles, which are found throughout the cell and are involved with protein manufacture.
2. **Smooth Endoplasmic Reticulum** – They are the storage organelle, associated with the production of lipids, steroids, and also responsible for detoxifying the cell.

**Q2 : B**

## **Ans : 1 Nucleus**

Known as the cell’s “command center,” the [nucleus](https://www.britannica.com/science/nucleus-biology) is a large organelle that stores the cell’s [DNA](https://www.britannica.com/science/DNA) deoxyribonucleic acid. The nucleus controls all of the cell’s activities, such as growth and metabolism, using the DNA’s genetic information. Within the nucleus is a smaller structure called the nucleolus, which houses the RNA ribonucleic acid. RNA helps convey the DNA’s orders to the rest of the cell and serves as a template for protein synthesis.

## . **2 Ribosomes**

[Ribosomes](https://www.britannica.com/science/ribosome) are the protein factories of the cell. Composed of two subunits, they can be found floating freely in the cell’s cytoplasm or embedded within the endoplasmic reticulum. Using the templates and instructions provided by two different types of RNA, ribosomes synthesize a variety of proteins that are essential to the survival of the cell.

## **3 Endoplasmic reticulum**

The [endoplasmic reticulum](https://www.britannica.com/science/endoplasmic-reticulum) ER is a membranous organelle that shares part of its membrane with that of the nucleus. Some portions of the ER, known as the rough ER, are studded with ribosomes and are involved with protein manufacture. The rest of the organelle is referred to as the smooth ER and serves to produce vital lipids fats.

## **4 Golgi apparatus**

If the proteins from the rough ER require further modification, they are transported to the [Golgi apparatus](https://www.britannica.com/science/Golgi-apparatus) or Golgi complex. Like the ER, the Golgi apparatus is composed of folded membranes. It searches the protein’s amino acid sequences for specialized “codes” and modifies them accordingly. These processed proteins are then stored in the Golgi or packed in vesicles to be shipped elsewhere in the cell.

**Q3 : A**

**Ans : physiology of digestion**

### **1. Ingestion**

* The entry of food into the alimentary canal through the mouth is called ingestion. Simply put, the act of eating and drinking is called ingestion.

### **2. Propulsion**

* Propulsion refers to the movement of food through the digestive tract.
* It includes both the voluntary process of swallowing and the involuntary process of peristalsis.
* Peristalsis consists of sequential, alternating waves of contraction and relaxation of alimentary wall smooth muscles, which act to propel food along.
* These waves also play a role in mixing food with digestive juices. This both mixes and moves the contents along the alimentary tract.
* Also, the act of swallowing, the last voluntary act until defecation, is an example of propulsion.

### **3. Mechanical Digestion**

* Digestion is a purely physical process that does not change the chemical nature of the food.
* Instead, it makes the food smaller to increase both surface area and mobility.
* It includes mastication, or chewing, as well as tongue movements that help break food into smaller bits and mix food with saliva.
* The mechanical churning of food in the stomach serves to further break it apart and expose more of its surface area to digestive juices, creating an acidic “soup” called chyme.
* Segmentation, which occurs mainly in the small intestine, consists of localized contractions of circular muscle of the muscularis layer of the alimentary canal. These contractions isolate small sections of the intestine, moving their contents back and forth while continuously subdividing, breaking up, and mixing the contents.
* By moving food back and forth in the intestinal lumen, segmentation mixes food with digestive juices and facilitates absorption.

### **4. Chemical digestion**

* Chemical digestion of food by enzymes present in secretions produced by glands and accessory organs of the digestive system.
* In chemical digestion, starting in the mouth, digestive secretions break down complex food molecules into their chemical building blocks (for example, proteins into separate amino acids).
* These secretions vary in composition but typically contain water, various enzymes, acids, and salts. The process is completed in the small intestine.

### **5. Absorption**

* This is the process by which digested food substances pass through the walls of some organs of the alimentary canal into the blood and lymph capillaries for circulation around the body.
* It takes place primarily within the small intestine.
* There, most nutrients are absorbed from the lumen of the alimentary canal into the bloodstream through the epithelial cells that make up the mucosa.

### **6. Elimination**

* Food substances that have been eaten but cannot be digested and absorbed are excreted by the bowel as feces.

## **In the Oral Cavity**

* After ingestion, the food is chewed and mixed with saliva, which contains enzymes that begin breaking down the carbohydrates in the food plus some lipid digestion via lingual lipase.
* Saliva contains the enzyme amylase that begins the breakdown of complex sugars, reducing them to the disaccharide maltose.
* Chewing by the teeth increases the surface area of the food and allows an appropriately sized bolus to be produced.
* Food leaves the mouth when the tongue and pharyngeal muscles propel it into the esophagus.

## **Pharynx and Esophagus**

* The presence of the bolus in the pharynx stimulates a wave of peristalsis which propels the bolus through the esophagus to the stomach.
* The walls of the esophagus are lubricated by mucus which assists the passage of the bolus during the peristaltic contraction of the muscular wall.
* The cardiac sphincter guarding the entrance to the stomach relaxes to allow the descending bolus to pass into the stomach.

## **In the Stomach**

* When a meal has been eaten the food accumulates in the stomach in layers, the last part of the meal remaining in the fundus for some time.
* Numerous gastric glands are situated below the surface in the mucous membrane of the stomach. They consist of specialized cells that secrete gastric juice into the stomach.
* Gastric juice has an acidic pH and consists of water, mineral salts, mucus secreted by goblet cells, hydrochloric acid secreted by parietal cells, intrinsic factor, and inactive enzyme precursors: pepsinogens secreted by chief cells in the glands.
* The hydrochloric acid present in the juice acidifies the food and stops the action of salivary amylase, kills ingested microbes, and provides the acid environment needed for effective digestion by pepsins.
* Further, pepsinogens are activated to pepsins by hydrochloric acid and by pepsins already present in the stomach. They begin the digestion of proteins, breaking them into smaller molecules.
* Mixing with gastric juice takes place gradually and it may be some time before the food is sufficiently acidified to stop the action of salivary amylase.
* Gastric muscle contraction consists of a churning movement that breaks down the bolus and mixes it with gastric juice and peristaltic waves that propel the stomach contents towards the pylorus.
* When the stomach is active the pyloric sphincter closes.
* Strong peristaltic contraction of the pyloric antrum forces gastric contents, after they are sufficiently liquefied, through the pylorus into the duodenum in small spurts.
* By slowing the emptying rate of the stomach, the contents of the duodenum become more thoroughly mixed with bile and pancreatic juice.

## **In the Small Intestines**

* When acid chyme passes into the small intestine it is mixed with pancreatic juice, bile, and intestinal juice, and is in contact with the enterocytes of the villi.
* When a meal has been eaten the hormone CCK is secreted by the duodenum during the intestinal phase of secretion of gastric juice. This stimulates the contraction of the gall bladder and relaxation of the hepatopancreatic sphincter, enabling the bile and pancreatic juice to pass into the duodenum together.

## **Digestion by Pancreatic Juice**

* Pancreatic juice enters the duodenum at the hepatopancreatic ampulla. Pancreatic juice is alkaline (pH 8) because it contains significant quantities of bicarbonate ions, which are alkaline in solution.
* When acid stomach contents enter the duodenum they are mixed with pancreatic juice and bile and the pH is raised to between 6 and 8. This is the pH at which the pancreatic enzymes, amylase, and lipase, act most effectively.
* **Digestion of proteins.** Trypsinogen and chymotrypsinogen are inactive enzyme precursors activated by enterokinase (enteropeptidase), an enzyme in the microvilli, which converts them into the active proteolytic enzymes trypsin and chymotrypsin. These enzymes convert polypeptides to tripeptides, dipeptides, and amino acids.
* **Digestion of carbohydrates.**Pancreatic amylase converts all digestible polysaccharides (starches) not acted upon by salivary amylase to disaccharides.
* **Digestion of fats.**Lipase converts fats into fatty acids and glycerol. To aid the action of lipase, bile salts emulsify fats.

## **Digestion by Bile Juice**

* Bile, secreted by the liver has a pH of 8 and between 500 and 1000 ml are secreted daily. It consists of water, mineral salts, mucus, bile salts, bile pigments (mainly bilirubin), and cholesterol.
* The bile salts, sodium taurocholate, and sodium glycocholate emulsify fats in the small intestine. The breakdown of fat globules in the duodenum into tiny droplets, which provides a larger surface area on which the enzyme pancreatic lipase can act to digest the fats into fatty acids and glycerol is called bile emulsification.
* Fatty acids are insoluble in water, which makes them very difficult to absorb through the intestinal wall. Bile salts also make fatty acids soluble, enabling both these and fat-soluble vitamins (e.g. vitamin K) to be readily absorbed.

## **Digestion by Intestinal juice**

* Alkaline intestinal juice (pH 7.8 to 8.0) assists in raising the pH of the intestinal contents to between 6.5 and 7.5.
* Enterokinase activates pancreatic peptidases such as trypsin which convert some polypeptides to amino acids and some to smaller peptides. The final stage of breakdown to amino acids of all peptides occurs inside the enterocytes.
* Lipase completes the digestion of emulsified fats to fatty acids and glycerol partly in the intestine and partly in the enterocytes.
* Sucrase, maltase, and lactase complete the digestion of carbohydrates by converting disaccharides such as sucrose, maltose, and lactose to monosaccharides inside the enterocytes.
* The intestinal glands are simple tubular glands situated below the surface between the villi. The cells of the glands migrate upwards to form the walls of the villi replacing those at the tips as they are rubbed off by the intestinal contents.
* During migration, the cells form digestive enzymes that lodge in the microvilli and, together with intestinal juice, complete the chemical digestion of carbohydrates, protein, and fats.
* Thus, in the small intestine the digestion of all the nutrients is completed:
  + carbohydrates are broken down to monosaccharides
  + proteins are broken down to amino acids
  + fats are broken down into fatty acids and glycerol.

## **In the Large Intestines**

* The large intestines are joined to the end of the small intestine at the cecum, via the ileocecal valve.
* The contents of the ileum which pass through the ileocaecal valve into the caecum are fluid, even though some water has been absorbed in the small intestine.
* In the large intestine absorption of water continues until the familiar semisolid consistency of feces is achieved.
* Mineral salts, vitamins, and some drugs are also absorbed into the blood capillaries from the large intestine.
* The large intestines descend to the rectum and its endpoint at the anal canal.
* After the absorption of useful materials, the remaining waste material is stored as feces before being removed by defecation through the anus.
* Defaecation involves involuntary contraction of the muscle of the rectum and relaxation of the internal anal sphincter.
* Contraction of the abdominal muscles and lowering of the diaphragm increases the intra-abdominal pressure Valsalva’s maneuver and so assists the process of defaecation.

**THE END**

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