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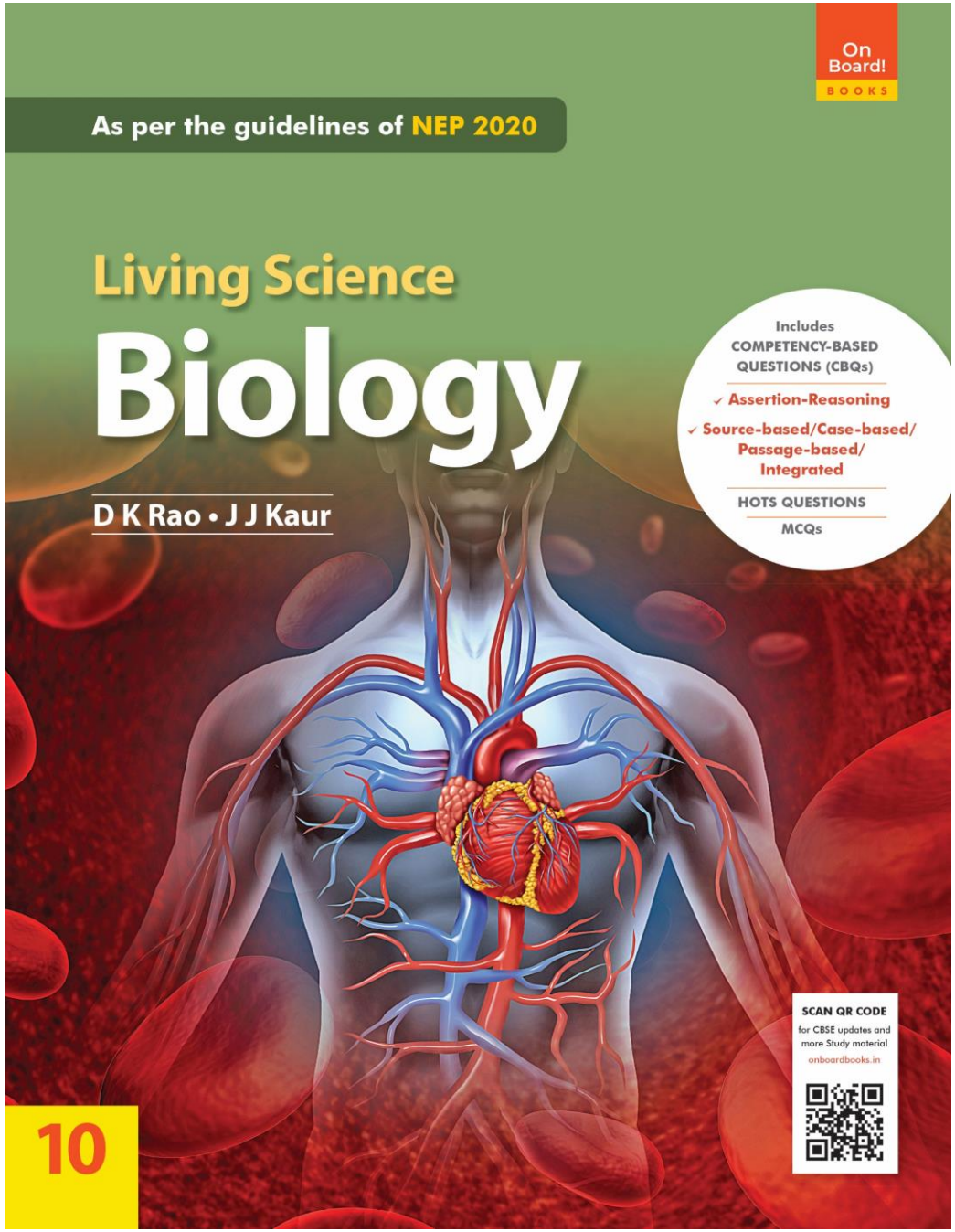
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D K Rao • J J Kaur
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CBSE
Living Science
Biology

Class 10

Chapter 1 Life Processes
Unit 1: Nutrition

LEARNING OBJECTIVES

What are Life Processes?

Modes of Nutrition

- ❖Autotrophic nutrition
- ❖Heterotrophic nutrition
- ❖Saprophytic nutrition
- ❖Parasitic nutrition
- ❖Holozoic nutrition

How do Simple Organisms like *Amoeba* Obtain their Nutrition?

Nutrition in Plants – Photosynthesis

- ❖ Raw materials for photosynthesis

The Mechanism of Photosynthesis

Nutrition in Human Beings

Overview of the Human Digestive System

The various organs of the alimentary canal

- ❖ The mouth and buccal cavity
- ❖ Salivary glands
- ❖ Pharynx
- ❖ Oesophagus
- ❖ Stomach
- ❖ Small intestine
- ❖ Large intestine

Steps in Feeding and Digestion

- ❖ Ingestion
- ❖ Digestion
- ❖ Digestion
- ❖ Absorption of food
- ❖ Assimilation of digested food
- ❖ Egestion of undigested food

Summary of digestion of food in the human body

What are Life Processes?

The activities by which living organisms take in food, derive energy, remove waste material from their body and respond to changes in the environment are called life processes.

Nutrition

The process of intake of food, its digestion, absorption, and distribution to different parts of the body for utilization is known as nutrition. In other words, nutrition is the process of acquiring energy and materials for growth.

What are nutrients?

Food substances such as proteins, carbohydrates, fats, minerals, etc. which support the growth of organisms and provide raw materials for the biosynthesis of body constituents are called nutrients. Nutrients are broadly divided into three groups namely:

1. energy-yielding (carbohydrates and fats),
2. body-building (proteins), and
3. growth-regulating or protective (vitamins and minerals).

Why do organisms need food?

Organisms need food for:

- growth and to get energy for carrying out various life activities,

- repair of damaged cells and tissues,
- producing enzymes and hormones which are essential to carry out and maintain proper life activities, and develop resistance against diseases.

Modes of Nutrition

Modes of nutrition means methods of procuring food or obtaining food by an organism. Organisms differ from each other in their modes of nutrition. On the basis of mode of obtaining food, organisms are classified into two types, namely autotrophs and heterotrophs. Thus, there are mainly two modes of nutrition:

1. autotrophic nutrition, and heterotrophic nutrition.

Autotrophic Nutrition

Autotrophic nutrition can be defined as a type of nutrition in which organisms synthesize organic material (i.e. food) from simple inorganic sources (i.e. carbon dioxide and water) with the help of sunlight. Autotrophs are also called producers. For example, all green plants and some bacteria have autotrophic mode of nutrition.

Heterotrophic Nutrition

Heterotrophic nutrition can be defined as a type of nutrition in which an organism cannot make or synthesize its own food from simple inorganic materials and

energy is obtained from the intake and digestion of the organic substances derived from plants or animals. A heterotrophic organism cannot prepare its own food but depends upon other organisms for its food. Thus, heterotrophs are consumers as they are dependent directly or indirectly on producers. All animals, most bacteria, fungi and some non-green flowering plants, are heterotrophs.

Types of Heterotrophic nutrition

Heterotrophic nutrition can be of three types –

1. saprophytic nutrition
2. parasitic nutrition and
3. holozoic nutrition.

1.Saprophytic nutrition: Organisms which get their food supply from dead or decaying organic matter are known as saprophytes and the mode of nutrition is known as saprophytic nutrition. Saprophytic nutrition is also called saprotrophic nutrition.

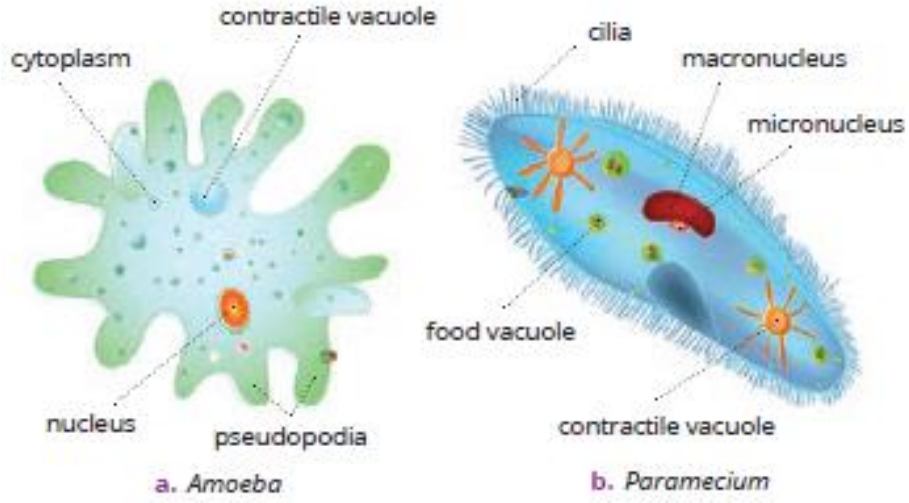
a. Bacteria

b. *Agaricus* (mushroom)

2. Parasitic nutrition: Parasite is an organism which lives outside or inside the body of another organism (called the host) and derives its nourishment from the host. The mode of nutrition by which parasites get their food from the body of other living organisms (host) without killing them is known as parasitic nutrition.

Cuscuta

3. Holozoic nutrition: The nutrition in which an organism takes in complex organic matter by the process of ingestion, which is subsequently digested and absorbed is called holozoic nutrition. Organisms like *Amoeba*, *Paramecium*, frogs and human beings show this type of nutrition.

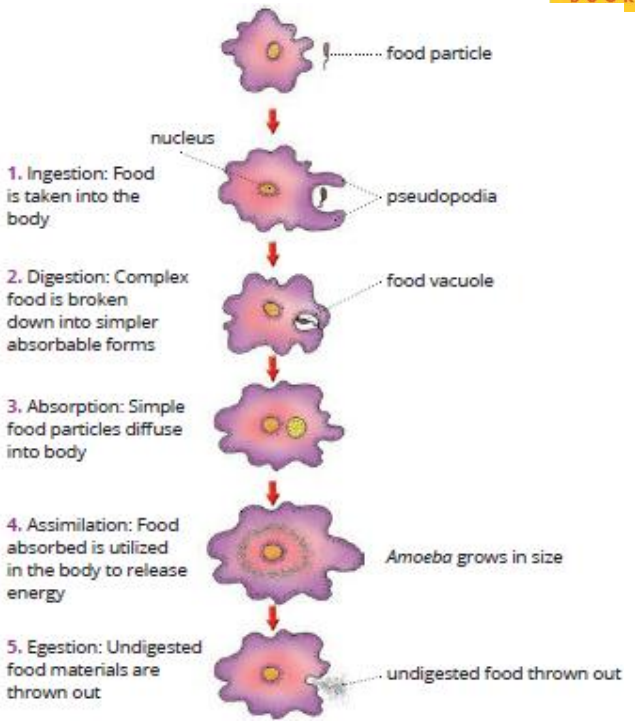


On the basis of food habits, holozoic animals can be further classified into four types – **herbivores**, **carnivores**, **omnivores** and **carrion feeders** or **scavengers**

How do Simple Organisms like *Amoeba* Obtain their Nutrition?

Unicellular organisms like *Amoeba* feed on microscopic plants and animals present in water (such as algae and bacteria) and decaying food particles. Intracellular digestion (digestion within the cell) takes place in *Amoeba*.

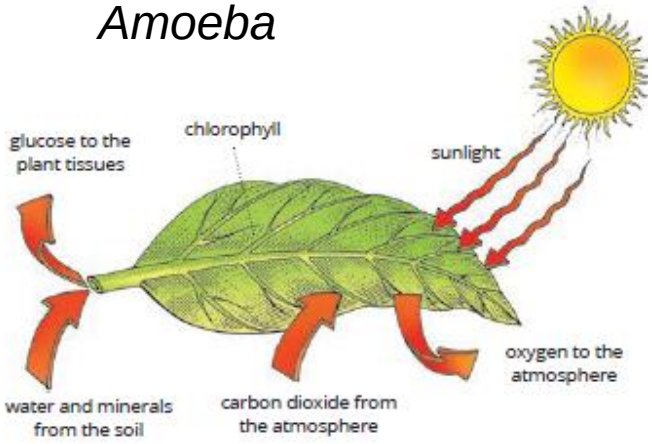
The mode of nutrition in *Amoeba* is holozoic and the process of obtaining food by it is termed phagocytosis.



Process of nutrition in *Amoeba*

Nutrition in Plants – Photosynthesis

The process by which inorganic substances in green plants are converted into organic substances is called photosynthesis (*photo* means light, *synthesis* means combination). Thus, photosynthesis may be defined as a biochemical process by which plants manufacture their own food (glucose) using inorganic substances (carbon dioxide and water) as raw materials in the presence of sunlight and chlorophyll.



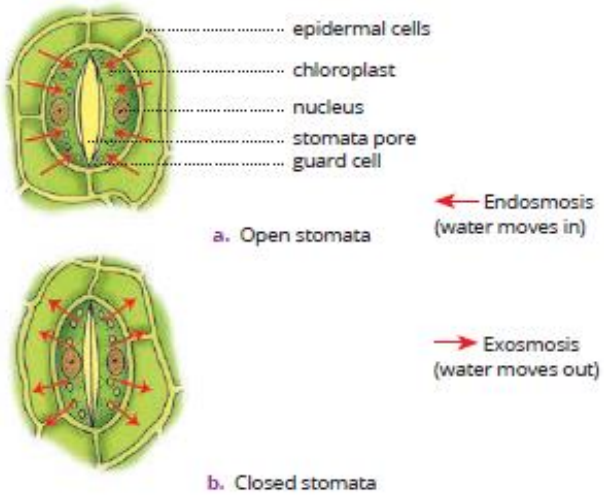
Raw materials for photosynthesis

Carbon dioxide (CO_2) and **water** (H_2O) are the raw materials for photosynthesis. **Light** serves as a source of energy. The process of photosynthesis takes place in chloroplasts (containing chlorophyll).

Stomata

The green plants have special organs in their green tissues (mostly leaves) for gaseous exchange. These are known as stomata. **Stomata** (singular – stoma) are minute pores present either on lower or both the surfaces of leaves to facilitate exchange of gases (CO_2 and O_2) between leaf and the atmosphere.

Each stoma is surrounded by a pair of guard cells. The guard cells control the opening and closing of stomatal pores. When water enters into the guard cells, they become turgid and swell. As a result, they become curved and stomata open. When the guard cells lose water, they shrink and become straight. As a result, the stomatal pores close.

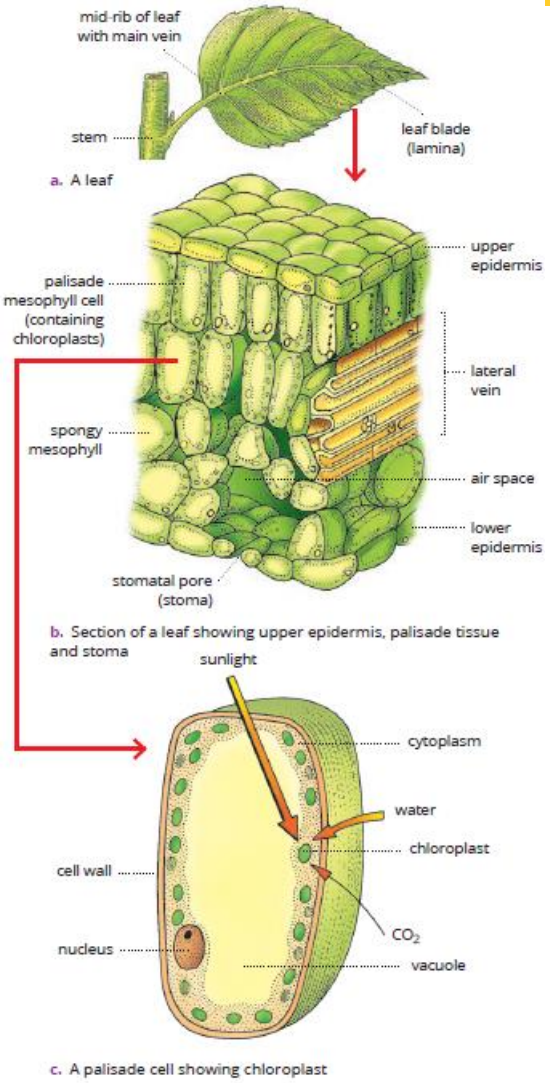


Note: Refer to Activity 1-2 on P 14-15 for the presence of starch in a leaf and how carbon dioxide is necessary for photosynthesis.

Chlorophyll – the pigment for photosynthesis
Chlorophyll, a green pigment is present in the cell organelles called **chloroplasts** (green dot-like structures). Chloroplast is a photoreceptor molecule.Therefore, chloroplasts are the site of photosynthesis.

Leaf as a photosynthetic organ
Chloroplasts are mostly present in green leaves**.** That is why leaves are called **photosynthetic organs**. Chloroplasts are found in the mesophyll cells of leaves. The green colour of plants is due to the presence of chlorophyll.

Sunlight is absorbed by the chlorophyll.
By using this energy, carbon dioxide and water are combined in the chloroplast with the help of a number of enzymes to yield sugar which is readily converted into a storable form of food, that is starch. The oxygen formed in the reaction diffuses out of the cells and is released into the atmosphere through the stomata.



Journey into a leaf

Note: Refer to Activity 3-4 on P 16 to show how sunlight and chlorophyll are necessary for photosynthesis.

The Mechanism of Photosynthesis

The different steps involved in the process of photosynthesis can be summarized as follows:

1.*Capturing light energy from the sunlight by chlorophyll:* Leaf is the principal site of photosynthesis. Sunlight is absorbed by the chlorophyll of mesophyll tissue of leaf.

2. *Transformation of light energy into chemical energy, and splitting of water into hydrogen and oxygen:* Water is transported into mesophyll tissue by osmosis and carbon dioxide diffuses in from the atmosphere.

3. *Reduction of carbon dioxide by hydrogen ions to form glucose (a carbohydrate) by utilizing the chemical energy. Hydrogen ions are produced by photolysis of water as under:*

$$2H_2O \xrightarrow{\text{light}} 4H^+ + O_2\uparrow + 4e^-$$

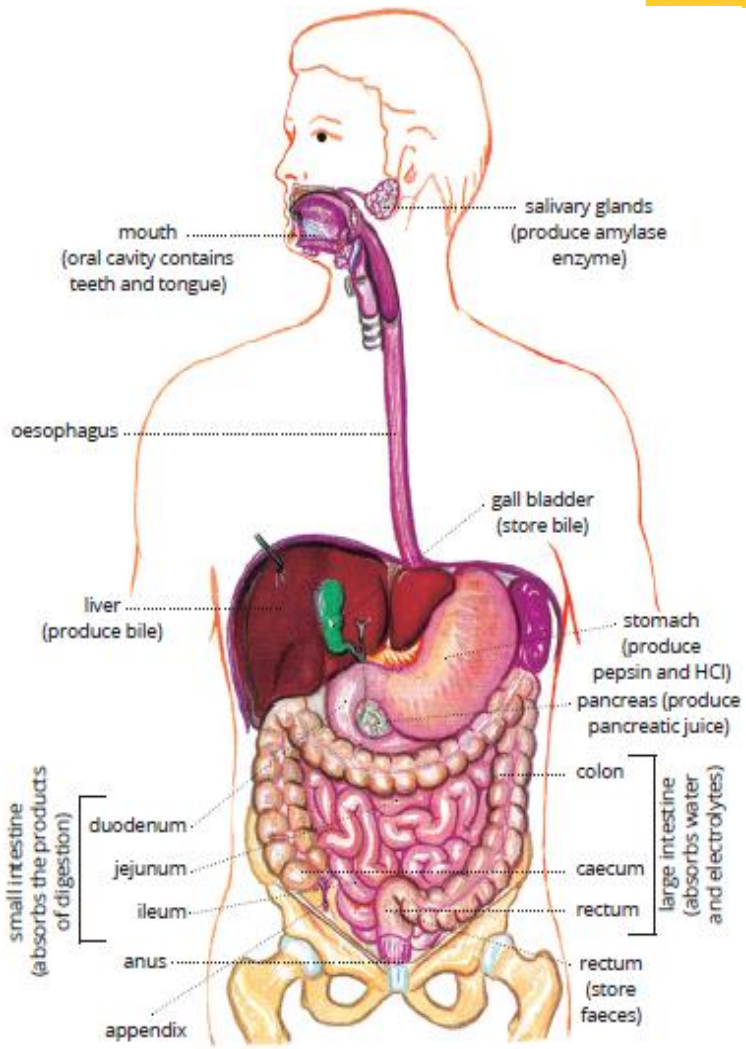
By using light energy from sunlight, carbon dioxide and water are combined in the chloroplast to yield sugar. It is readily converted into a storable form, starch.

4. Oxygen is given out: The oxygen evolved in the process is given out in the atmosphere through stomata. The overall equation of photosynthesis is

$$\underset{\text{carbon dioxide}}{6CO_2} + \underset{\text{water}}{12H_2O} \xrightarrow{\text{chlorophyll/ sunlight}} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{water}}{6H_2O} + \underset{\text{oxygen}}{6O_2}$$

Nutrition in Human Beings

The food that we consume contains highly complex substances like proteins, carbohydrates and fats. These substances cannot be utilized as such by our body. They must be broken down into simpler absorbable forms so that they can be easily absorbed and transported to various parts of our body through blood. This task is carried out by the digestive system.



Overview of the Human Digestive System

The human digestive system consists of two parts – **alimentary canal** (gastrointestinal tract) and **associated digestive glands** (accessory organs).

The alimentary canal is a long, muscular tube, about 6.5 to 9 metres long that passes through the body cavity from mouth to the anus. It consists of mouth, buccal cavity, oesophagus, stomach, small intestine, large intestine and anus .

The alimentary canal consist of mucus-coated epithelial lining facing the lumen and is specialized at various points to carry out the process of digestion and absorption.
In addition, there are many digestive glands such as salivary glands, liver and pancreas that are associated with it. The glands supply fluids and enzymes to break down the food.

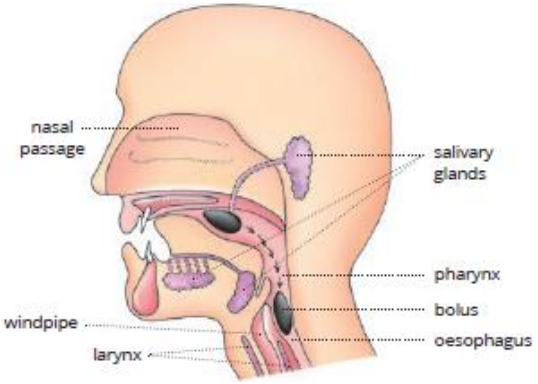
The various organs of the alimentary canal

The mouth and buccal cavity

The mouth is the first part of the alimentary canal. It opens into a large buccal cavity. Its main function is to receive food and start **mechanical digestion** by chewing up the food.

Salivary glands – a secretory gland associated with mouth

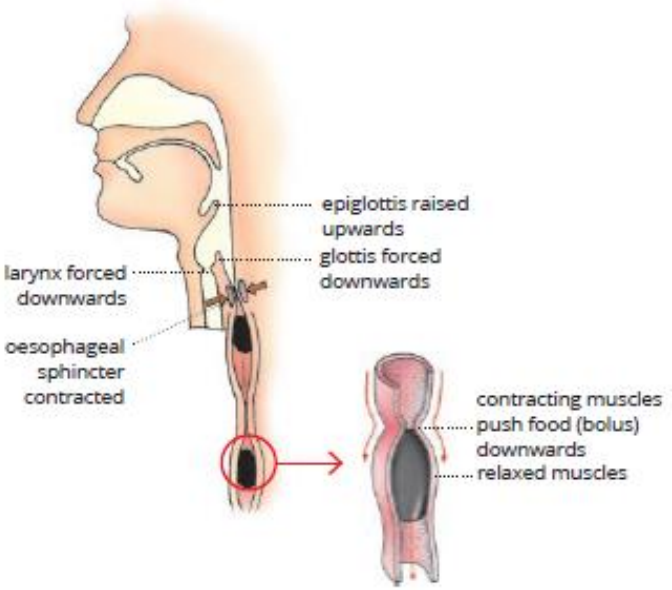
There are three pairs of salivary glands in humans. They secrete saliva which is a slightly acidic fluid.Saliva contains water, salts, mucus, a buffer (HCO_3^-) and enzymes called salivary amylase (also known as **ptyalin**) and lysozyme.
The salivary amylase present in saliva begins the **chemical digestion of carbohydrates** by breaking down some starch into maltose. That is why when we chew boiled rice (that contain starch), it taste sweet. Thus, **carbohydrate digestion begins in the mouth**.



Pharynx

The next part is the pharynx. The pharynx is a funnel-shaped passage at the back of the throat that connects the buccal cavity with the oesophagus.

Passage of food through pharynx



Oesophagus

It is a tube-like structure about 25 cm in length, extending from the pharynx to the stomach. Food passes through oesophagus by peristalsis. Peristalsis is the rhythmic contraction of the oesophageal wall that pushes the food from the oesophagus to the stomach.

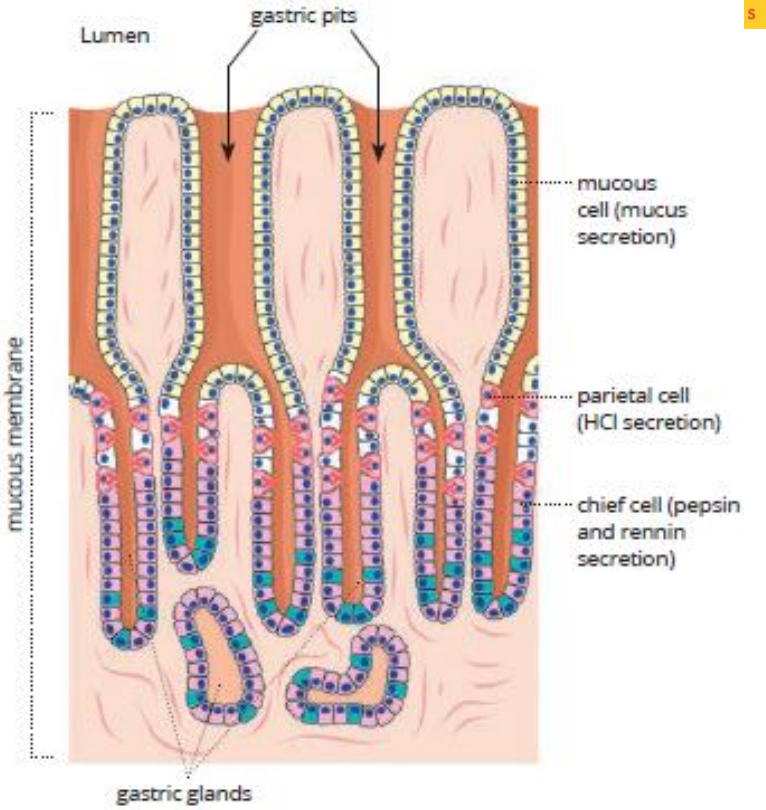
Stomach

The oesophagus opens into stomach. The stomach is a J-shaped muscular, stretchable sac placed below the diaphragm on the left side of abdomen. It receives and mixes food with digestive juices, and propels food to the small intestine.

Gastric secretions in stomach: Gastric glands present in the walls of stomach generally contain three types of secretory cells.

1.Mucous cells produce mucus that protects the stomach lining from the action of hydrochloric acid (HCl).

2. Parietal cells secrete hydrochloric acid. Due to presence of hydrochloric acid, the gastric juice is acidic in nature. The gastric juice kills the bacteria that may have entered along with the food.



3. Chief cells secrete pepsinogen (inactive form of pepsin) to digest protein which is activated when it comes in contact with hydrochloric acid. It also secretes rennin which helps in digestion of milk protein.

Small intestine

The small intestine is a tube-like structure and the longest part (about 7 metres long) of alimentary canal. It lies coiled and folded in the abdomen. It is divisible into an anterior part called the **duodenum**, the middle part called **jejunum** and the posterior part known as the **ileum**.

Functions of the small intestine: Small intestine completes digestion of the nutrients in chyme, absorbs the products of digestion, and transports the remaining residues to the large intestine.

Pancreas – a digestive gland associated with small intestine

The pancreas has an exocrine function of producing pancreatic juice that aids in digestion. The pancreas is closely associated with the small intestine.

Liver – a digestive gland associated with small intestine

Liver is the largest gland in the human body and weighs about 1.5 kg in an adult human being. It is located in the upper right side of the abdominal cavity.

Digestive functions of the liver

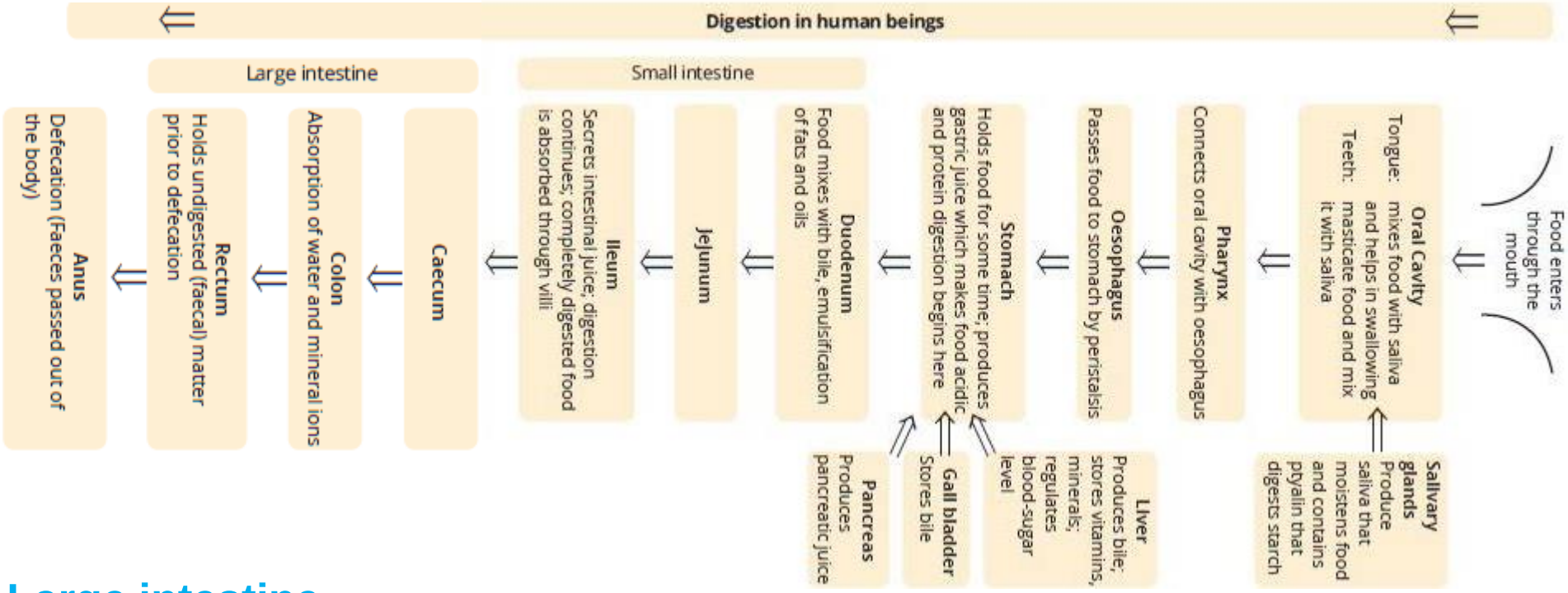
It secretes a fluid called bile. Bile juice plays an important role in emulsification of fats and creating an alkaline medium which is essential for the action of pancreatic enzymes.

Liver regulates blood-sugar level in the body by retaining the excess glucose and converting it into glycogen which is stored in the liver cells.

It **produces red blood cells in the embryo**.

It **removes excess amino acids** by the process of deamination.

Layout and working of the digestive system in human beings



Large intestine

The large intestine is about 1.5–1.8 metres long and is wider than small intestine. It absorbs water and electrolytes. After absorption it forms and stores faeces. It has three parts – the caecum, colon and rectum.

Functions of the large intestine: The large intestine does not digest or absorb nutrients, but it does secrete mucus. It absorbs electrolytes. After absorption of water, the remaining semi-solid mass is expelled out through the anus.

Steps in Feeding and Digestion

Step I: Ingestion

The digestion of food in human beings begins by ingestion in the mouth, and breaking it down in the buccal cavity.

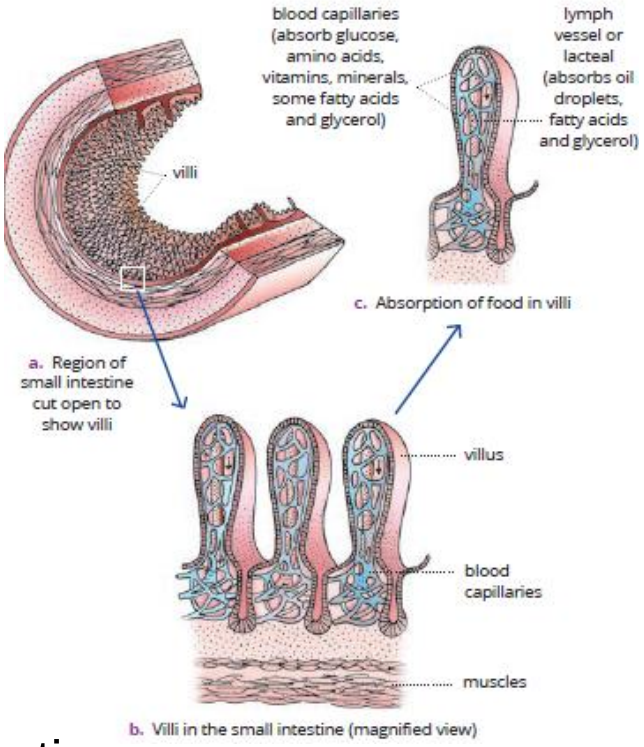
Step II: Digestion

Digestion occurs in four steps: Digestion in buccal cavity, Digestion in stomach, Digestion in the small intestine, Digestion in the large intestine

Step III: Absorption of food

The digested food is absorbed mainly in the small intestine.

The intestinal lining is provided with finger-like projections called **villi** . Each villus is supplied with blood capillaries and a lymph vessel or **lacteal**. In villi, monosaccharides, peptides and amino acids are absorbed either by diffusion or active transport into the blood capillaries. Fatty acids, glycerol, water, inorganic salts and vitamins are also absorbed in the small intestine.



Internal structure of the wall of small intestine

Step IV: Assimilation of digested food

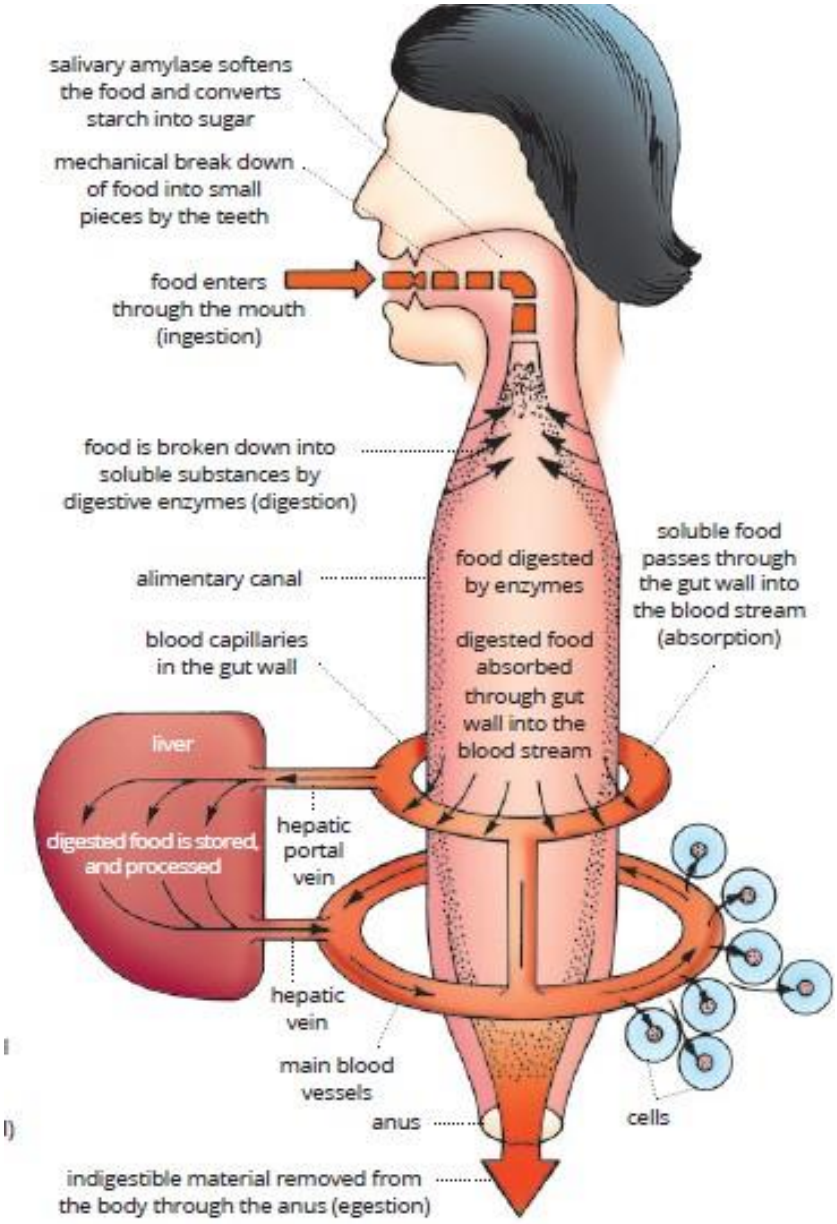
The food material which is absorbed, is utilized in various ways to release energy, growth of new tissues and repair of damaged tissues.

Step V: Egestion of undigested food

The undigested food is passed to the large intestine. In the colon, extra water is absorbed and the remaining material becomes a semi-solid mass to form faeces. Faeces are stored in the rectum temporarily and egested out through the anus.

Summary of digestion of food in the human body

A complete overview of the process of digestion and the role of various parts of the alimentary canal and associated glands are given in the Figure.



SUMMARY...

- There are mainly two modes of nutrition – autotrophic and heterotrophic nutrition. Heterotrophic nutrition can be of three types – saprophytic, parasitic and holozoic.
- Parasite is an organism that lives inside or outside the body of another organism and derives its nourishment from it.
- All green plants prepare their own food, hence they are called producers or autotrophs.
- Photosynthesis provides food for living things directly or indirectly, produces oxygen and provides the energy for all living organisms.
- Leaves contain chlorophyll in the chloroplast. Chlorophyll receives energy from the sun and brings about splitting of water during photosynthesis.
- As a result of photosynthesis, glucose, water and oxygen are produced. Glucose is either immediately used up by cells or is stored in the form of starch. Oxygen diffuses out into atmosphere which is used by living beings for respiration.
- In human beings, the alimentary canal is a muscular tube, about 9 metres long that passes through the body cavity. The food passes forward by peristalsis in the alimentary canal.

- The food is ingested through mouth, it passes through oesophagus to reach stomach where gastric juice of stomach acts on it and starts digesting the proteins.
- Digestion is brought about by enzymes, which have several characteristics.
- Digestion of food takes place in the mouth, stomach and the small intestine. The bulk digestion takes place in the small intestine. Bile from liver and pancreatic juice from pancreas are poured into the duodenum, and they help in the digestion of starch, proteins and fats, respectively.
- As a result of digestion, proteins are finally converted into amino acids, fats into fatty acids and glycerol, and carbohydrates into monosaccharides.
- The digested food is mainly absorbed in the small intestine, through small finger-like projections in it called villi.
- Undigested food is temporarily stored in the rectum, which is defecated through anus.

THANK YOU