Ratna Sagar

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Education, Our Mission

As per the latest ICSE syllabus

Rama Sagar
Education, Our Mission!

Revised and Updated

LIVING SCIENCE BIOLOGY

D K Rao • J J Kaur

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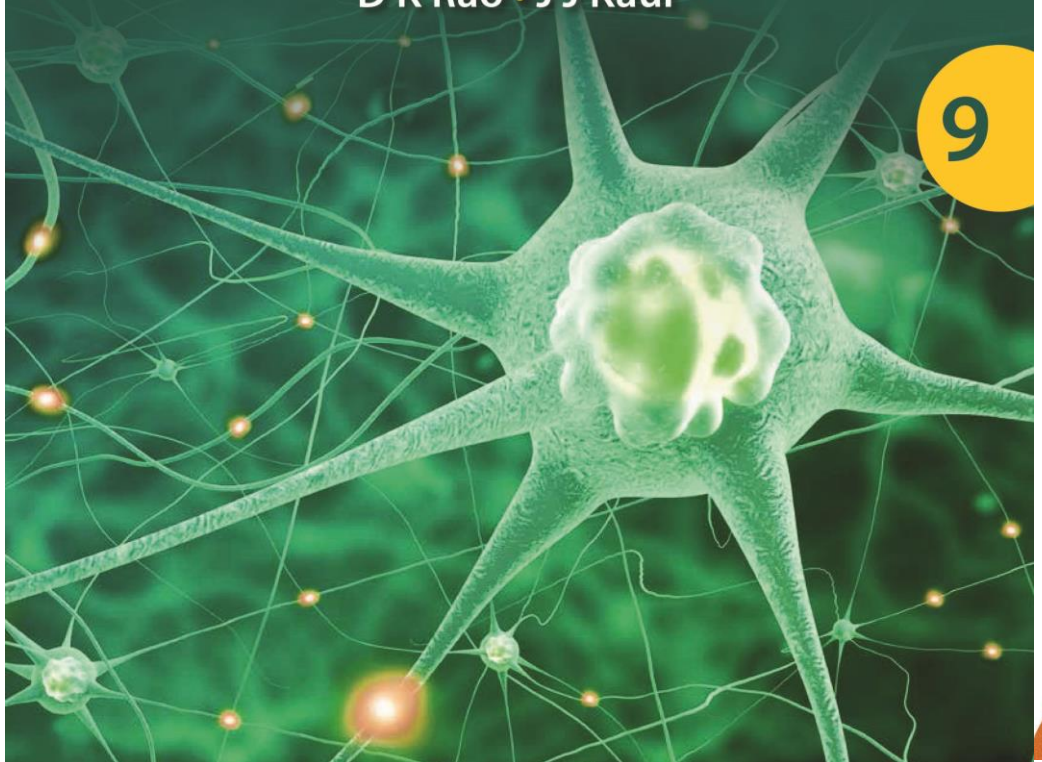


ICSE
Living Science
Biology

Class 9

Chapter 11 Digestive System

LEARNING OBJECTIVES

Alimentary canal and associated digestive glands

- Mouth
- Salivary glands – associated with mouth
- Pharynx
- Oesophagus
- Stomach
- Small intestine
- Large intestine

Physiology of Digestion

Steps in Feeding and Digestion

- Step I: Ingestion
- Step II: Digestion
- Step III: Absorption of food
- Step IV: Assimilation of digested food

Step V: Egestion of undigested food

What is the task of digestive system?

The food contains highly complex substances like proteins, carbohydrates and fats. They must be broken down into simpler soluble absorbable forms so that they can be easily absorbed by blood and transported to various parts of our body. This task is done by the digestive system.

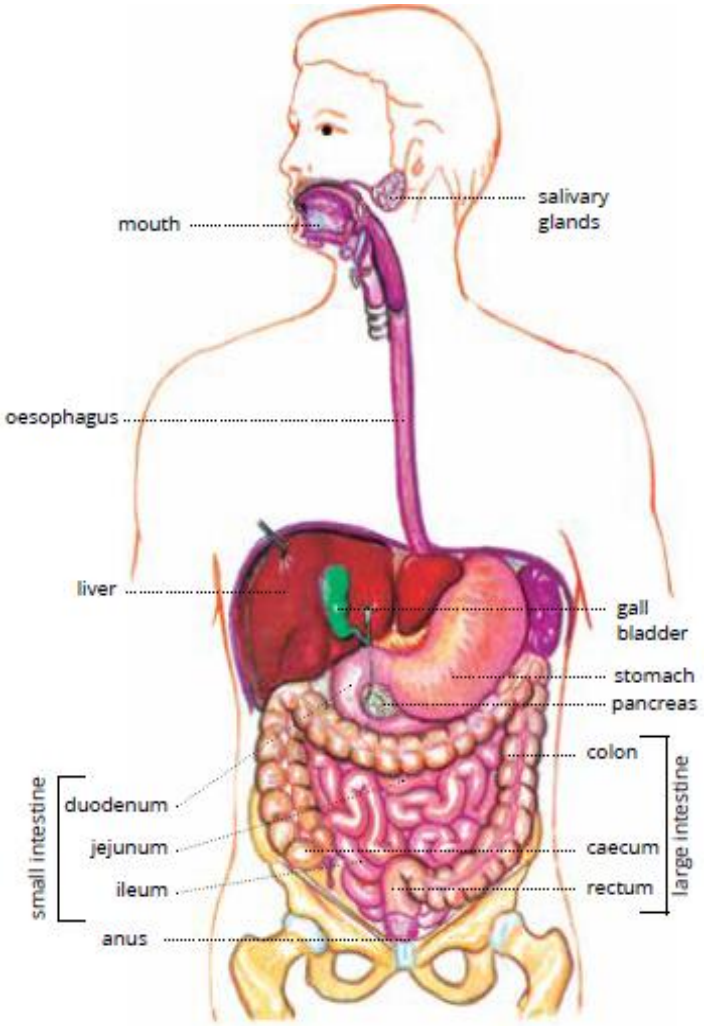
Digestive system

The human digestive system consists of:

- ❖ Alimentary canal
- ❖ Associated digestive glands

Alimentary canal and associated digestive glands

In human beings, the alimentary canal is a muscular tube, about 6.5 to 9 metres long. It starts at the mouth and ends at the anus. It is specialized at various points along its length, with each region designed to carry out a different role in the overall process of digestion and absorption. In addition, there are many digestive glands that are associated with it – salivary glands, liver and pancreas.



Mouth

The mouth is the first part of the alimentary canal. Its main function is to receive food and start mechanical digestion by chewing and softening of the food by mixing saliva.

Functions of saliva

❖ Saliva **moistens food particles** and **lubricates the tongue and the mouth cavity** to facilitate swallowing of food.

❖ It **binds the food particles** together in the form of **bolus** for being swallowed as a mass.

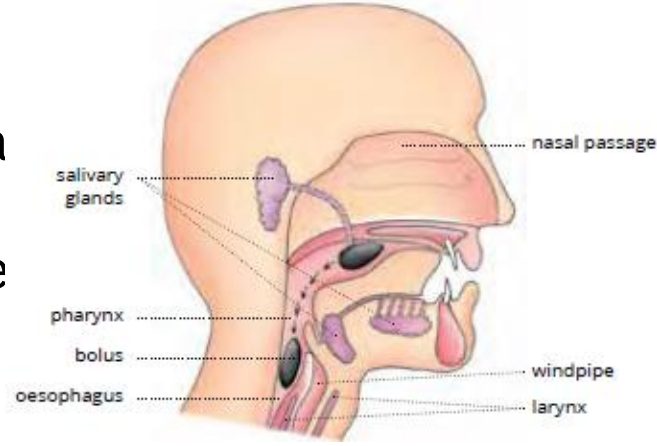
❖ It helps to **cleanse the mouth and teeth**, and the **salivary amylase** present in the saliva **kills bacteria** and thus, **prevents tooth decay**.

❖ The **salivary amylase** present in saliva **begins the chemical digestion of carbohydrates** by breaking down some **starch into maltose** (disaccharide). That is why when we chew boiled rice (that contains starch), they taste sweet.

❖ It helps in water balance in the body by sending signals of thirst when the mouth gets dried up.

Pharynx

The next part is the pharynx. The **pharynx** is an area at the back of the throat that **connects** the nasal and oral cavities with the **larynx and oesophagus**. In the pharynx, the digestive and the respiratory systems cross each other



Oesophagus

The next part is oesophagus. It is a tube extending from the pharynx to the stomach. Food passes through oesophagus by **peristalsis**. Mucous glands are scattered throughout the oesophagus and produce mucus to moisten and lubricate the inner lining of the tube.

Stomach

The stomach is a J-shaped muscular bag-like structure placed below the diaphragm. It receives and mixes food with digestive juices, and propels food to the small intestine. In an adult man, it can hold 2–3 litres of food. It is divided into **cardiac**, **fundic** and **pyloric** regions.

Gastric secretions in stomach

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

- **Mucous cells produce mucus** that protects the stomach lining from the action of hydrochloric acid.
- **Chief cells secrete pepsin** as inactive pepsinogen, which is activated when it comes in contact with hydrochloric acid. It also secretes rennin.
- **Parietal cells** secrete hydrochloric acid. Due to HCl, the gastric juice kills germs that may have entered along with the food.

Small intestine

The small intestine is a tube of about 7 metres long and about 2.5 cm wide. 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.

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. The pancreatic and bile ducts join and empty into 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. Blood from the hepatic portal vein carries blood rich in nutrients to the liver. Secretions from hepatic cells are collected in bile canals that converge to become hepatic ducts and finally form the common hepatic duct.

Large intestine

The large intestine absorbs water and electrolytes and forms and stores faeces. In humans, it is about 1.5–1.8 m long and about 6.5 cm in diameter. 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. **The large intestine absorbs electrolytes and water.**

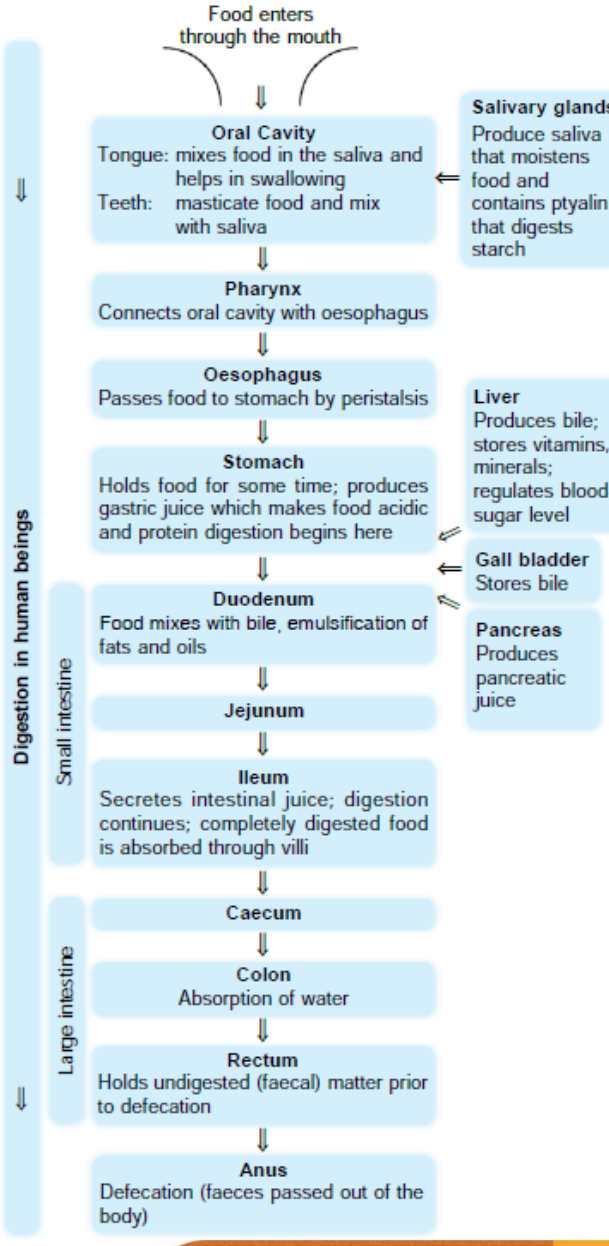
Physiology of Digestion

Digestion is a series of physical and chemical changes by which the complex food is converted into simple and absorbable forms by the action of enzymes. Digestion takes place in three regions, namely the buccal cavity, stomach and intestine.

Steps in Feeding and Digestion

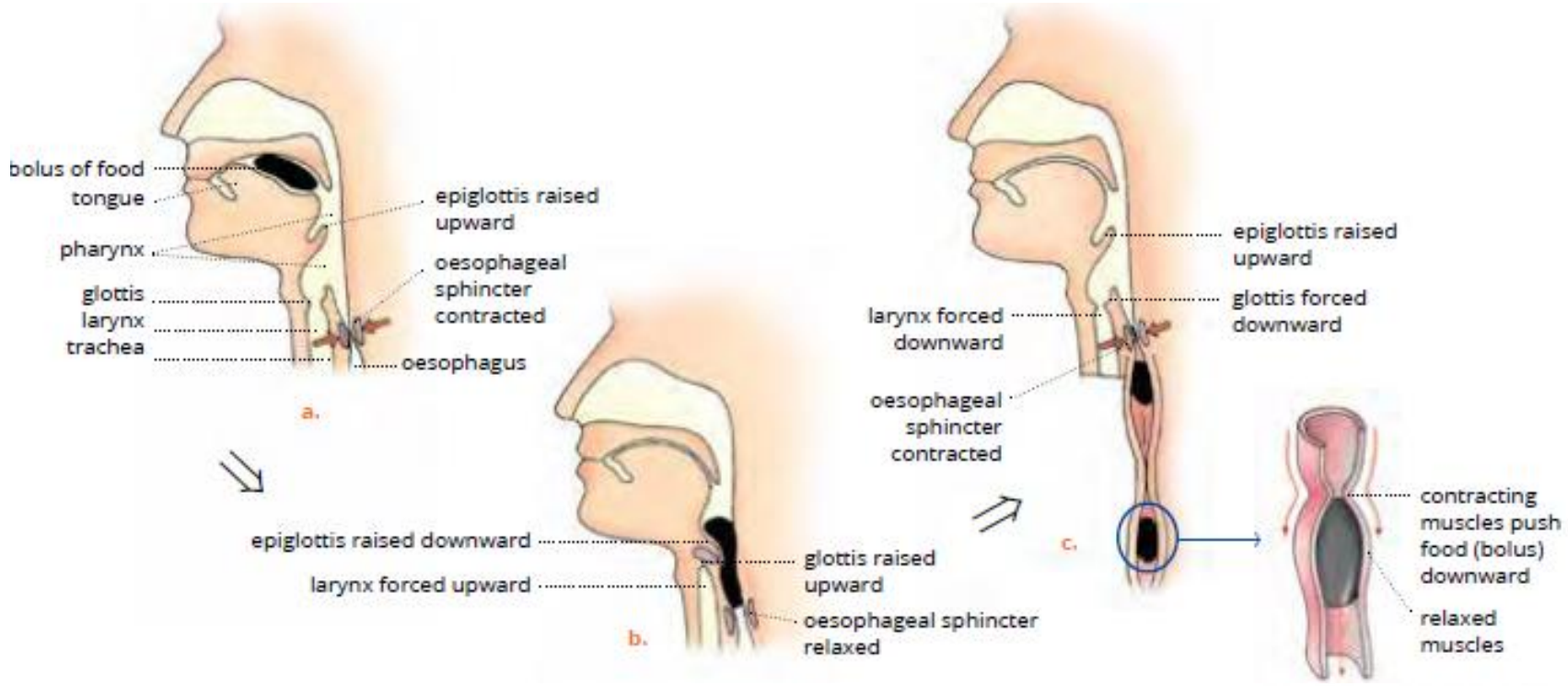
Step I: Ingestion

The digestion of food in human beings begins by ingestion in the mouth, to the buccal cavity.



Here, the teeth chew and **masticate** the food into smaller pieces. This is called **mechanical digestion**. The tongue has taste buds on it. It helps in tasting food.

Food is mixed with saliva and the bolus is voluntarily forced into the pharynx with the tongue. As the tongue moves food into the pharynx, it presses down on a small flap of cartilage called the **epiglottis**. When the epiglottis is lowered, it closes the entrance to the respiratory tract and guides the food down the digestive tract.



Step II: Digestion

Digestion in the mouth

The three pairs of **salivary glands** pour saliva in the mouth cavity. The saliva contains an enzyme **salivary amylase** or **ptyalin**, which breaks starch and complex carbohydrates into maltose. The food is passed to the oesophagus. **Oesophagus** is lined internally with mucous-secreting cells. Mucus helps in slipping the food down.

Food remains in the stomach for about three hours. The partial digestion of food in the stomach makes food to a paste-like form, called **chyme**.
As the acidity level of food reaches a certain level, the pyloric sphincter opens and chyme passes at intervals in small portions into the duodenum (a part of small intestine)

Digestion in the small intestine

In the intestine, the food is digested and absorbed completely. **The digestion and absorption of food take place in the small intestine.** In the small intestine, food mixes with bile juice, pancreatic juice and intestinal juice. By this time, the food is completely digested and converted into a liquid form called **chyle** which is further subjected to **absorption** in the small intestine.

Digestion in the large intestine

The food is finally passed into the large intestine. Practically, **no digestion takes place in the large intestine**. The mucous cells secrete mucus which lubricates the intestinal lining. It helps in the easy passage of the undigested food.

Step III: Absorption of food

The digested food is absorbed mainly in the small intestine. The intestinal lining is provided with fingerlike 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. These blood capillaries converge to form the **hepatic portal vein**, which delivers the absorbed food to the liver. Fatty acids, glycerol, water, inorganic salts and vitamins are also absorbed in the 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.

❖ **Carbohydrates and amino acids** are both absorbed into the bloodstream surrounding the small intestine, and passed to the liver via the hepatic portal vein.

❖ Most of the glucose is stored in the liver or in the muscles as glycogen and fats.

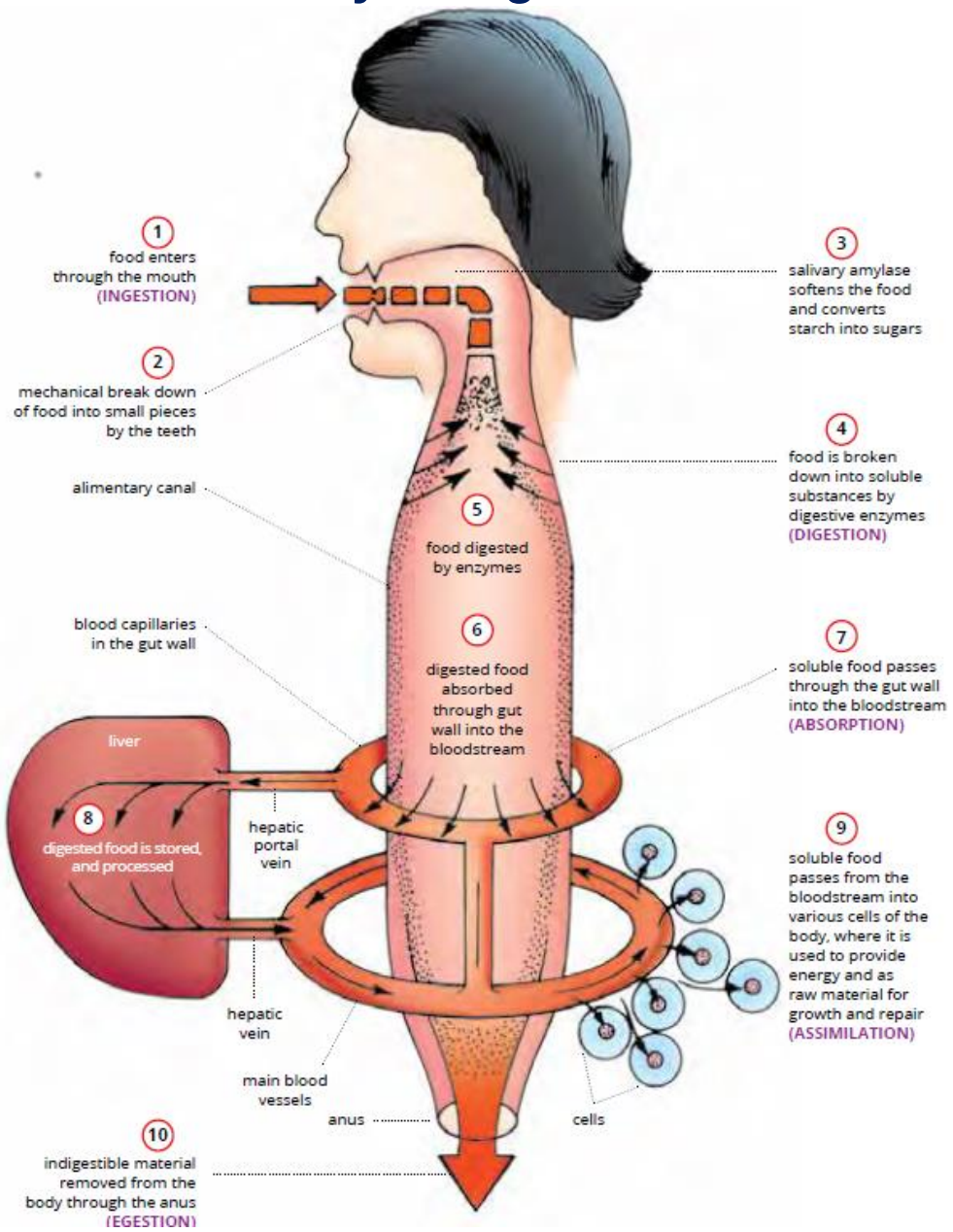
❖ The fats in the body are oxidized during respiration. If more energy is required in-between meals, glycogen can be reconverted to glucose and transported by the blood to different parts of the body.

❖ **Amino acids** are used for the synthesis of new proteins and the repair of damaged cells. Excess amino acids are deaminated in the liver as they cannot be stored. These are then excreted out of the body through the urine.

Step V: Egestion of undigested food

The undigested food is passed to the rectum where it is temporarily stored. Extra water is absorbed and the remaining material becomes a semi-solid mass to form faeces. A special reflex called **defecation reflex** causes emptying of the rectum and the faeces is passed out through the anus by the relaxation of **sphincter muscles**.

Summary of digestion of food in the human body



Refer to
ACTIVITY 1
To test for the presence of sugar in food.
ACTIVITY 2
To test for the presence of starch in food.
ACTIVITY 3
To test for the presence of fats in different food items.
ACTIVITY 4
To test for the presence of proteins in food.

SUMMARY...

- In human beings, the alimentary canal is a muscular tube, about 6.5 to 9 metres long, that passes through the body's ventral cavity. The food passes forward by peristalsis in the alimentary canal.
- Mouth, pharynx, oesophagus, stomach, small intestine and large intestine are various parts of the alimentary canal, while salivary glands, pancreas and liver are the associated digestive glands.
- 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 of food takes place in the mouth, stomach and the small intestine. The bulk of 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, which is provided with small finger-like projections called villi.
- Undigested food is temporarily stored in the rectum, which is defecated through anus. A special reflex called defecation reflex causes the emptying of the rectum and the undigested food is egested through the anus.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