

INGESTION, DIGESTION, ABSORPTION AND ASSIMILATION IN HUMANS

5



SYLLABUS

1. Types of teeth and their functions — in human beings.
Care of the teeth.
The pattern of teeth in herbivores, carnivores and omnivores.
2. The digestive system/process in human beings — drawing a simple, labelled diagram of the alimentary canal.
3. Absorption and assimilation in human beings.
 - * Observing their own teeth (E).
 - * Learning to brush teeth correctly (E).
 - * Observing the digestive system on a model, if available (D).

You have already learnt in the previous chapter that the food we eat includes seven categories of substances: *carbohydrates, proteins, fats, mineral salts, vitamins, water* and *roughage*. Out of these, the first five, namely the carbohydrates, proteins, fats, mineral salts and vitamins are called **nutrients**. Water and roughage though not included in the category of nutrients, play a very important role in our body.

Nutrient is any substance required by an organism as food for growth and body activities.

Water is essential for carrying out various life processes. It is also needed to dissolve substances so that they are transported in the body.

Roughage is the **indigestible** portion of food. It largely consists of cellulose of the plants. The fruits, vegetables and the outer coats of the seeds and grains are particularly rich in roughage. The roughage enables the food to move easily through the intestines.

The whole process of nutrition is conducted in five steps.

- (i) ingestion
- (ii) digestion
- (iii) absorption
- (iv) assimilation and
- (v) egestion

The process of **ingestion** starts when food is taken into the mouth cavity. The main organs in this cavity are the **teeth, tongue** and **salivary glands**. The food is cut into small pieces by the teeth which is helped by a movable muscular tongue. While the food is being chewed, it is mixed with saliva produced by the salivary glands.

When a part of the food has been chewed, the tongue gives it the shape of a spherical mass, called the **bolus**. The tongue pushes this mass into the pharynx to be swallowed into the oesophagus. This pushing process is called **ingestion**.

The food, after reaching the oesophagus, is pushed into the stomach by **peristalsis**. Peristalsis is a wave of constrictions in the circular muscles in the wall of the alimentary canal to push the food further into it.

Peristalsis occurs through all regions of the alimentary canal.

When the food reaches the stomach and small intestine, it is broken down (**digested**) into simpler substances. During **digestion**, the large complex molecules of food are broken down into simpler forms with the help of enzymes.

Later on, **absorption** of the digested food from the small intestine into the blood takes place.

The blood transports the absorbed food to all parts of the body, where it is utilised to provide energy as well as the substances needed for the growth and the functioning of the body. This process of utilisation of the food is known as **assimilation**.

Some portion of the food remains undigested and is expelled out of the body. The removal of undigested food from the body through anus is called **egestion**. We will learn more about digestion, absorption,

assimilation and egestion in the later part of this chapter.

DIGESTIVE SYSTEM IN HUMANS

The food we eat passes through the **food canal** (also called **alimentary canal**). It is a long, muscular and coiled tube. It starts from the **mouth** and ends at the **anus**.

Some glands, such as **liver**, **salivary glands**, and **pancreas** are associated with the food canal. The food canal together with these glands forms the **digestive system**.

Different constituents of the digestive system are as follows :

Alimentary Canal consists of mouth (with teeth and tongue), oesophagus, stomach, small intestine, large intestine and rectum.

Digestive glands consist of salivary glands, liver and pancreas.

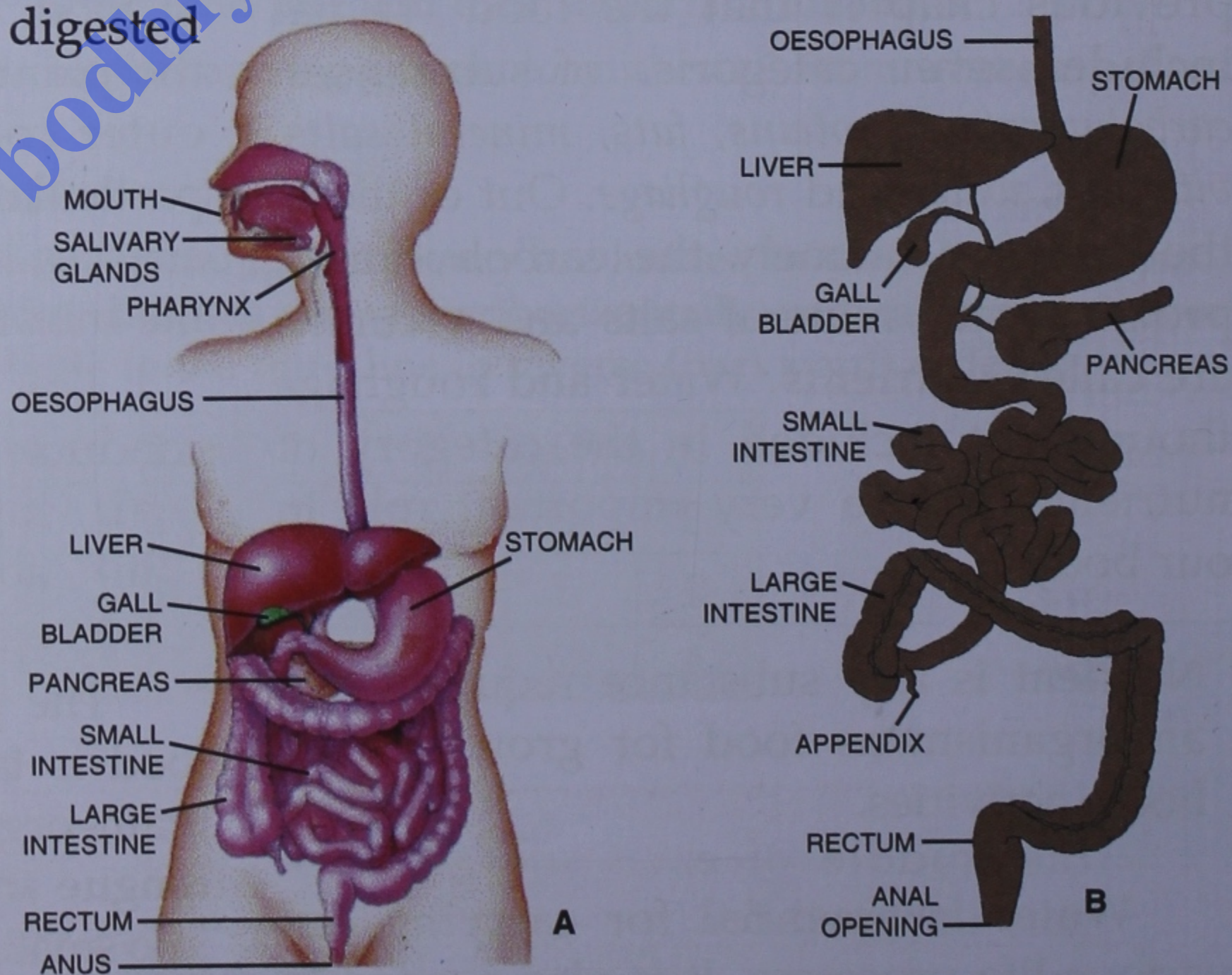


Fig. 5.1 A—Human alimentary canal and associated glands
B—The same diagrammatically stretched out to show the parts more clearly

The Mouth

The mouth is bordered by upper and lower lips. The lips help in closing the mouth during swallowing.

Types of Teeth

There are two types of teeth in bony animals.

(a) **Homodont Teeth** (*homo* : similar, *dont* : teeth) : In animals like fishes, frogs, reptiles, etc., all the teeth are **similar in size and shape**. They are homodont teeth. These teeth are not meant for biting or grinding the food, but they simply help in capturing the prey.

(b) **Heterodont Teeth** (*hetero* : different) : Mammals including humans, have heterodont teeth. These teeth are different in their size, shape and functions. Some teeth are used for biting, some for tearing and some for crushing and chewing. These teeth vary according to the nature of food of the animal, e.g. herbivorous animals like cows feed on plant matter for which they have flat and broad cutting teeth. Carnivorous animals like dogs and cats feed on the flesh of other animals for which they have large, pointed teeth to tear the flesh.

The Human Teeth

Based on their different shapes and functions, human teeth are of *four* kinds (Fig. 5.2) :

1. **Incisors** are the four front teeth at the middle of each jaw. They are chisel-shaped for **biting** and **cutting**.
2. **Canines** are one on either side of the incisors in each jaw. They are pointed for **tearing** the food.

3. **Premolars** are two on each side of canines in each jaw. They help in **crushing** and **grinding** the food.

4. **Molars** are the last three teeth on each side in each jaw. They have broad uneven surface for finer **crushing** and **grinding**.

The last molar on each side in each jaw is called the **Wisdom Tooth**. The wisdom tooth appears at the age of 17-20 years. In some people, one or more wisdom teeth may not come out of the gums at all.

The human teeth develop in two sets during the life-time. The first set called the **milk teeth** or the **temporary teeth**, consisting of 20 teeth (8 incisors, 4 canines and 8 premolars only), appear in young children. The temporary teeth start falling out around the age of 5-6 years to be replaced by the **permanent set** by about 12-13 years of age. The molars appear only once in the permanent set.

An adult human normally has 32 teeth in all, 16 in each jaw. You as a child may have a fewer (usually 28). The **teeth** cut and break the food into smaller pieces and also grind the food into a pulp so that it can be swallowed easily. The teeth also help in speaking.



ACTIVITY 1

- Stand against a mirror fitted on a wall. Wide open your mouth, and observe your teeth.
- Observe your teeth in the upper jaw.

(contd.)

➤ The front four teeth are chisel-shaped. These are the *incisors* meant for biting and cutting.

➤ Look at one tooth on either side of the incisors in each jaw. Observe their shape and note how they differ from the incisors? Are they pointed. Yes/No.....

These teeth are known as *canines*. These are meant for tearing the food.

➤ Two teeth on either side of canines are the *premolars* meant for crushing and grinding the food.

➤ Observe the teeth behind the premolars. These are again broad in shape with an uneven flat surface. These are also meant for **grinding** and **crushing** the food. These are *molars*.

➤ Count the number of teeth in **one half of each jaw** :

Upper jaw	Incisors	=
	Canines	=
	Premolars	=
	Molars	=
Lower jaw	Incisors	=
	Canines	=
	Premolars	=
	Molars	=

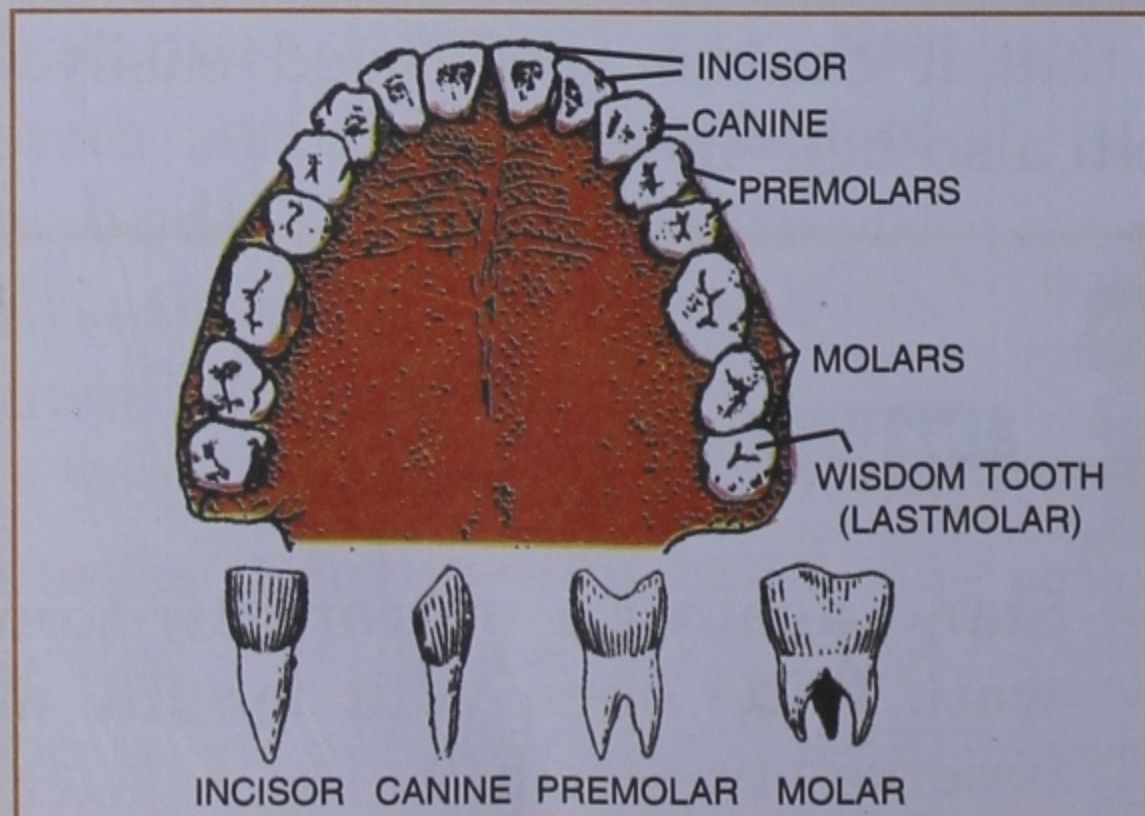


Fig. 5.2 Different kinds of teeth in the upper jaw

Structure of a Tooth (Fig. 5.3)

The top portion of the tooth which can be seen is called the **crown**. The white, hard layer which surrounds the crown is called the **enamel**. Enamel is the hardest substance in the body. **Dentine** is the bone-like hard substance just below the enamel. It supports the tooth. Dentine has a hollow space filled with a soft material called the **pulp**. It has nerves and blood vessels. The **root** is the lower part of the tooth which is fixed in the jaw and is surrounded by **cement**.

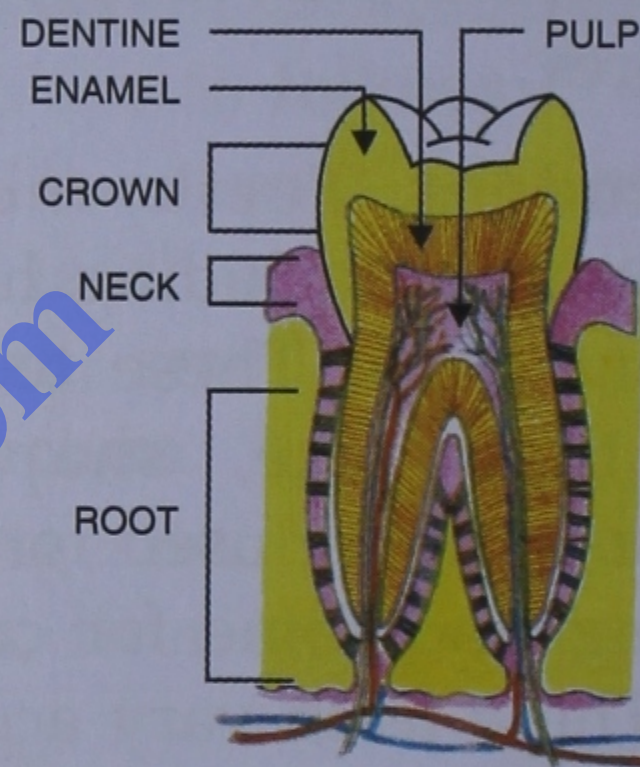


Fig. 5.3 Structure of a grinding tooth

The Aching Tooth

Oral hygiene is essential for good health. If you do not clean your teeth properly, bacteria present in the mouth act on the food particles trapped between



Fig. 5.4 The aching tooth

the teeth. The acid produced by the bacteria slowly corrodes the enamel of the teeth and forms cavities known as **caries** (Fig. 5.5). The bacteria enter the pulp through these holes and start spreading. This process gives out a foul smell and causes toothache.

When the food is swallowed, the bacteria enter the stomach along with the food and cause indigestion.

Small bits of food get stuck between the teeth. A yellow, sticky substance called **plaque** forms on the teeth. It has sugar and bacteria. Hardened plaque is called **tartar**.



Fig. 5.5 Tooth decay

A tooth ache can be very painful. Sometimes, if the bacteria invade the gums, the tooth has to be pulled out.

If you take good care of your teeth, they can last a life-time. Sparkling white teeth add charm to your face and your smile.

Care of the Teeth

One should brush one's teeth and gums twice a day – once in the morning and then before going to bed (Fig. 5.6).

We eat, drink and speak during the day. This constant movement slows down the growth of bacteria. When you

sleep at night, the undisturbed bacteria can damage your teeth. So, it is important to brush your teeth before going to bed everyday.

You must rinse your mouth after each meal. Very hot and very cold things should be avoided.

Chocolates and sweets promote the growth of bacteria in the teeth. Extra care should be taken to rinse the mouth after eating too much of sweets or too many chocolates.



UP AND DOWN

BACK AND FORTH



INSIDE

Fig. 5.6 The correct method of brushing the teeth

The pattern of teeth in (i) herbivores, (ii) carnivores and (iii) omnivores.

The pattern of teeth differs in different mammals in relation to their type of food.

(a) The **herbivores** like the cows, horses, sheep (Fig. 5.7), etc. eat grasses and other herbs which need lot of chewing. For this they have large molars with **broad and flat grinding surface**.

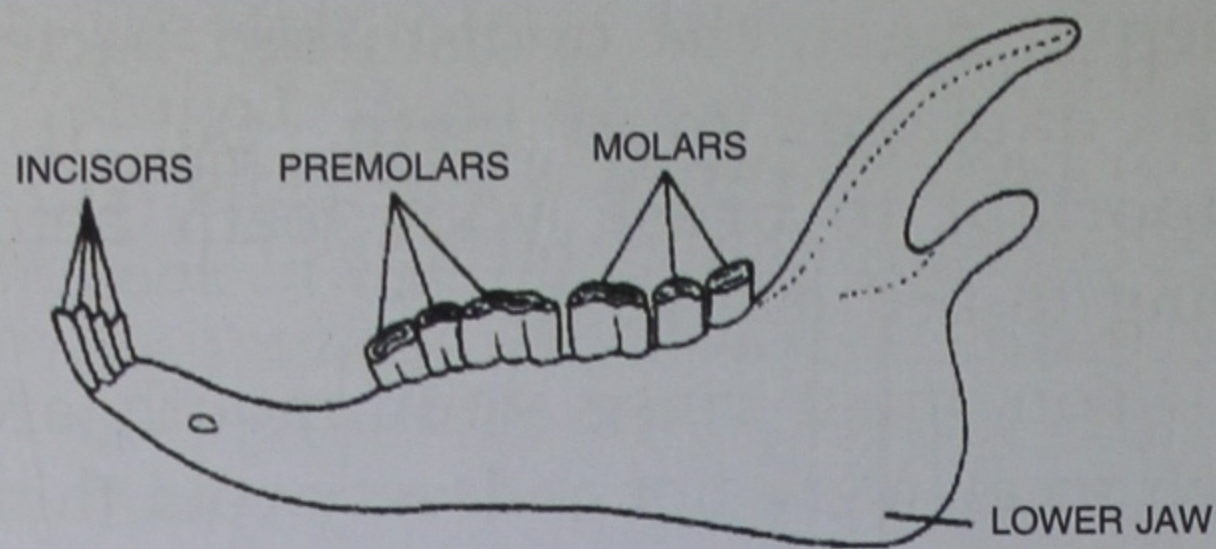


Fig. 5.7 Sheep (herbivore)

(b) The **carnivores** or meat eaters like the dog (Fig. 5.8) and tiger, have long and powerful canines to tear flesh. Their molars carry **raised conical projections** to cut their food (like scissors) into smaller pieces.

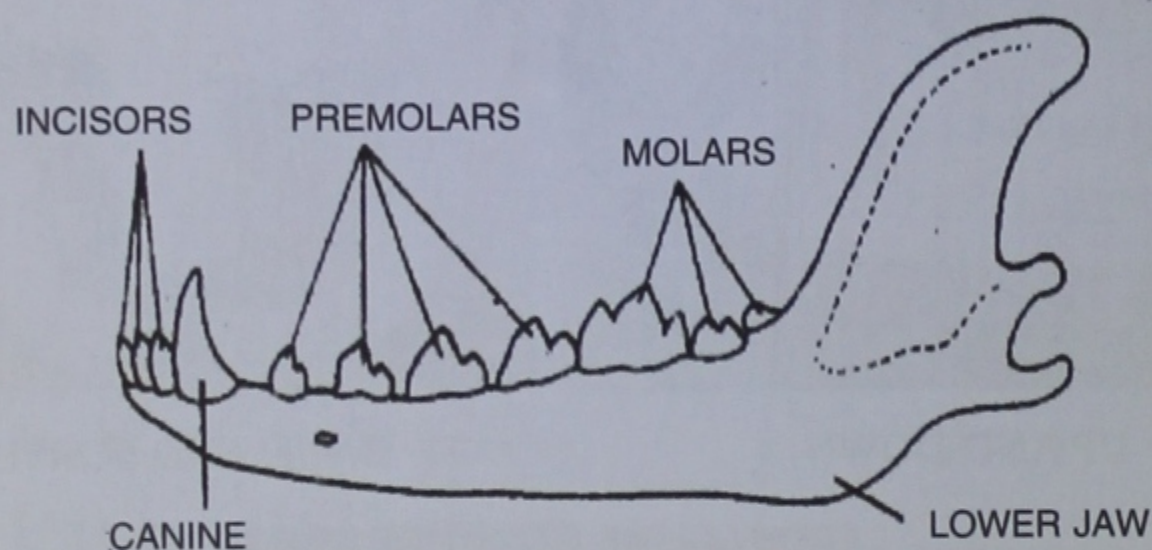


Fig. 5.8 Dog (carnivore)

(c) The **omnivores** or "all type" eaters like the humans, have all types of well developed teeth — incisors for biting and cutting, canines for tearing and premolars and molars, both for crushing and grinding (see Fig. 5.2.)

Tongue

The tongue is a fleshy muscular organ attached at the back to the floor of the buccal cavity.

The tongue helps in several ways :

1. Manipulates the food while chewing.
2. Helps in tasting the food.
3. Helps in mixing the watery secretion (saliva) with the food.

4. Helps in cleaning the teeth.
5. Helps in speaking.



ACTIVITY 2

Locating the taste buds on the tongue

1. Take the following solutions separately in four different test-tubes. (a) Sugar solution, (b) salt solution, (c) lemon juice and (d) crushed neem leaf.
2. Blindfold one of your classmates and ask her/him to take out the tongue and keep it in straight and flat position.
3. Take clean toothpicks to put the above samples one by one on different areas of the tongue as shown in the figure given here. Use a new toothpick for each sample.
4. Ask the classmate which areas of the tongue could detect the sweet, salty, sour and bitter substances (Fig. 5.9).

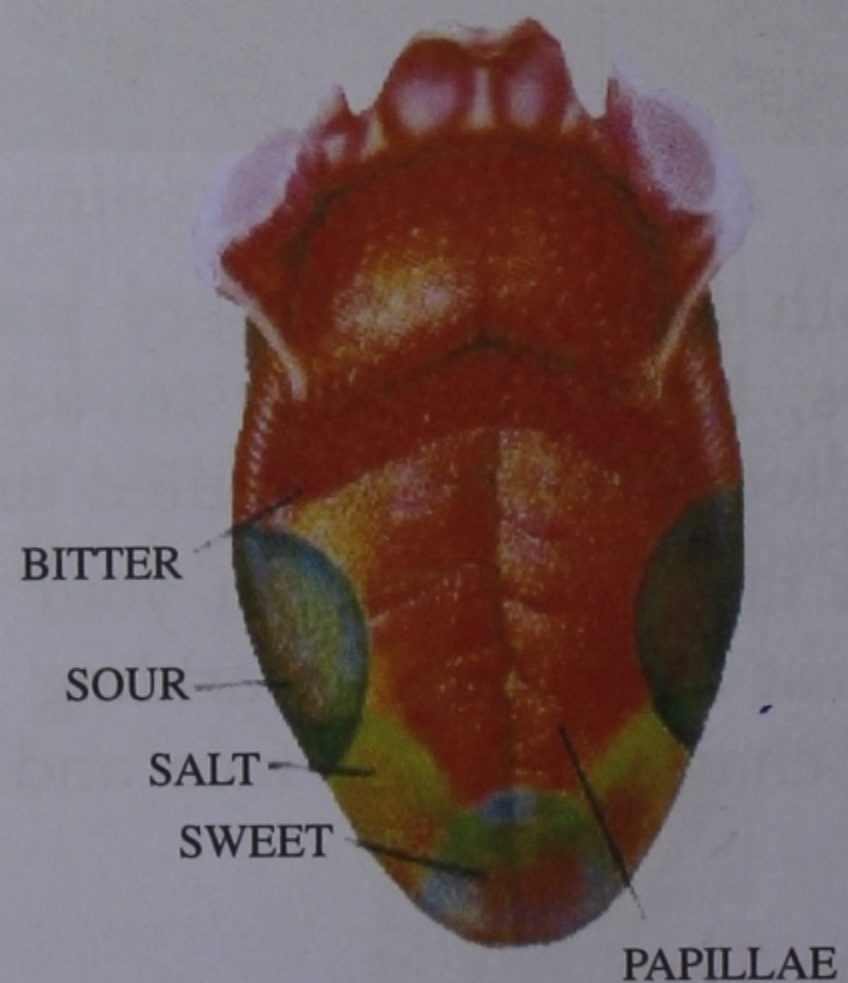


Fig. 5.9 Tongue for different tastes

The Salivary Glands

What you call the watering of the mouth is actually a secretion of salivary glands in your mouth.

The saliva is secreted by three pairs of salivary glands (one below the tongue, second at the base of the ear, and third on the inner side of the angles of the lower jaws (Fig. 5.10).

Saliva is a fluid containing water, salts and a slimy mucus. It also contains a substance (an enzyme) called amylase which convert starch into maltose.

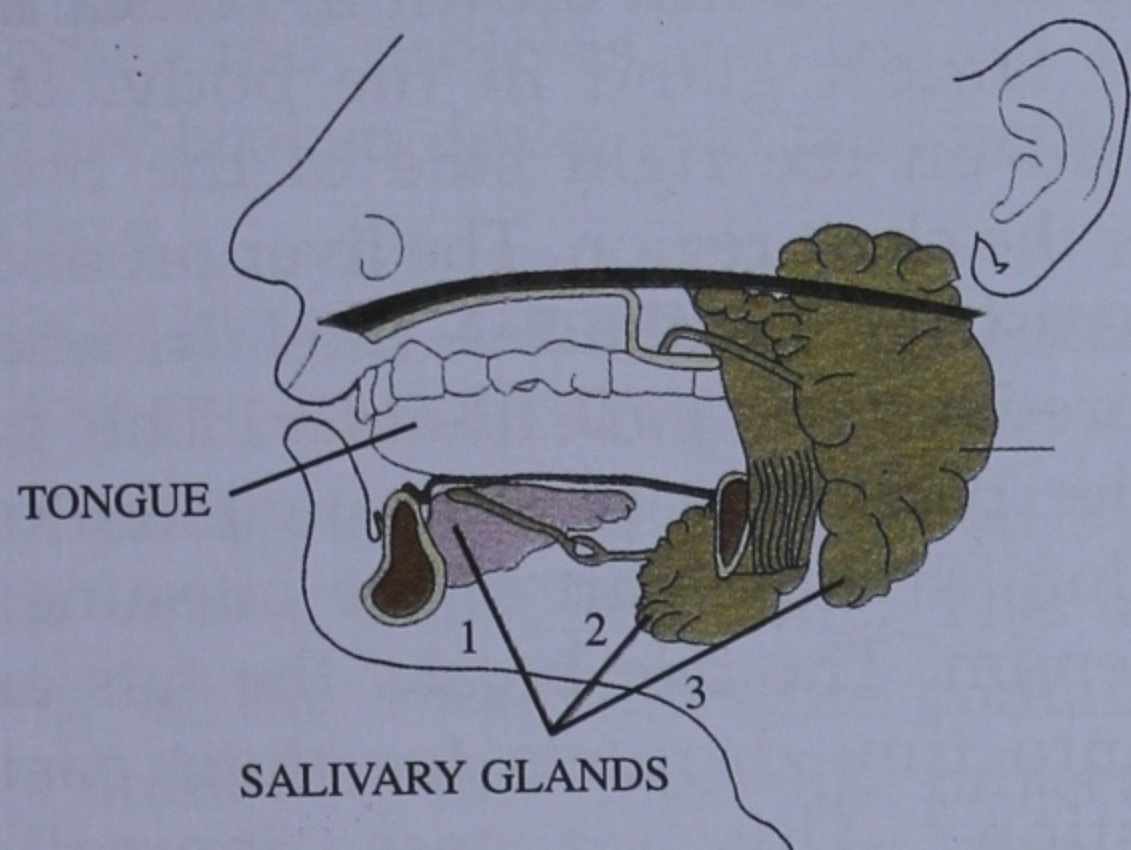


Fig. 5.10 Salivary glands



ACTIVITY 3

Stand in front of a mirror. Open your mouth and lift the tongue upwards. Look at the two tiny openings below the tongue. You can see the watery fluid oozing out from these apertures. This is the **saliva**.

Functions of Saliva

1. It moistens and lubricates the mouth cavity and the tongue to make speaking and swallowing easy.
2. It acts as a solvent, dissolving some part of food to stimulate taste.
3. It cleans the mouth and destroys germs.
4. It initiates digestion by converting

starch into a simpler form — the maltose.

A piece of bread or boiled rice when chewed thoroughly starts tasting sweet. The tasteless starch changes into sweet maltose.

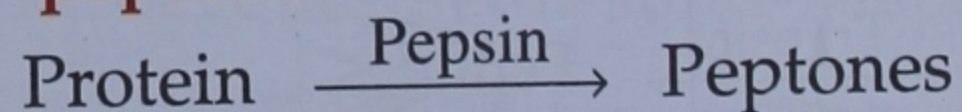
The Oesophagus (food pipe)

The oesophagus or the food pipe is a tube which runs from the back of the throat, down through the chest to open into the stomach. No digestion occurs in the oesophagus.

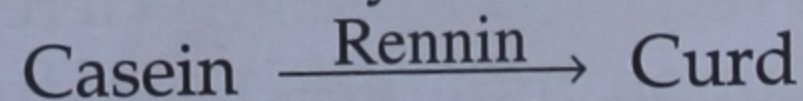
The Stomach

The stomach is an elastic bag. Its walls are highly muscular. It churns the food thoroughly to mix the digestive juice secreted by the glands situated in its walls.

The digestive juice given out by the gastric glands (glands in the stomach wall) contains **water, hydrochloric acid** and a digestive enzyme **pepsin**. The acid kills the germs (which may have entered along with the food), and it activates the enzyme **pepsin**. Pepsin converts proteins into **peptones**.



The protein **casein** present in the milk is converted into curd by the help of another enzyme, the **rennin**.



The food remains in the stomach for about 3-4 hours and changes into a pulp-like thick paste called **chyme**. The chyme moves into the first part of the small intestine.

The Small Intestine

The small intestine is a coiled tube about 7 metres long. The short upper

part of the small intestine, next to the stomach, called **duodenum** receives a duct that brings secretion from the liver called the "bile" and from the pancreas called the "pancreatic juice". The inner lining of the small intestine contains glands which secrete the **intestinal juice**.

The food remains in the small intestine for about 3-5 hours for digestion and absorption.

The food in the first part of the small intestine *i.e.*, duodenum, is acted upon by secretions from three sources — **liver, pancreas** and the **intestinal glands**.

The juices secreted by these glands contain the enzymes namely amylase, trypsin and lipase.

- **Amylase** acts on the starch which remains undigested by the salivary amylase, converting it into maltose.
- **Trypsin** converts proteins into peptides.
- **Lipase** converts fats into fatty acids and glycerol.

Starch	$\xrightarrow{\text{Pancreatic Amylase}}$	Maltose
Proteins	$\xrightarrow{\text{Trypsin}}$	Peptides
Fats	$\xrightarrow{\text{Lipase}}$	Fatty acids and glycerol

The semi-digested food enters the next part (ileum) of the small intestine. Here the food is acted upon by **erepsin, maltase, sucrase** and **lactase**. In the ileum, the digestive process gets completed.

- Peptides are converted into amino acids by the enzyme **erepsin**.
- Maltose is broken down into glucose by **maltase**.
- Sucrose is changed into glucose and fructose by **sucrase**.

- Lactose is converted into glucose and galactose by **lactase**.

Peptides	$\xrightarrow{\text{Erepsin}}$	Amino acids
Maltose	$\xrightarrow{\text{Maltase}}$	Glucose
Sucrose	$\xrightarrow{\text{Sucrase}}$	Glucose and fructose
Lactose	$\xrightarrow{\text{Lactase}}$	Glucose and galactose

The Liver

Liver is reddish brown in colour and is the largest gland in the body. It is situated on the right side of the body, below the chest region. The liver produces a greenish yellow fluid — the **bile**, which is stored in the **gall bladder**. The gall bladder pours the bile through the bile duct into the first part of the intestine or duodenum. The bile breaks the fats and oils into tiny droplets for their easier digestion. This process is called **emulsification of fat**. The bile also contains sodium bicarbonate which neutralises the acid of the food coming from the stomach and makes it alkaline.

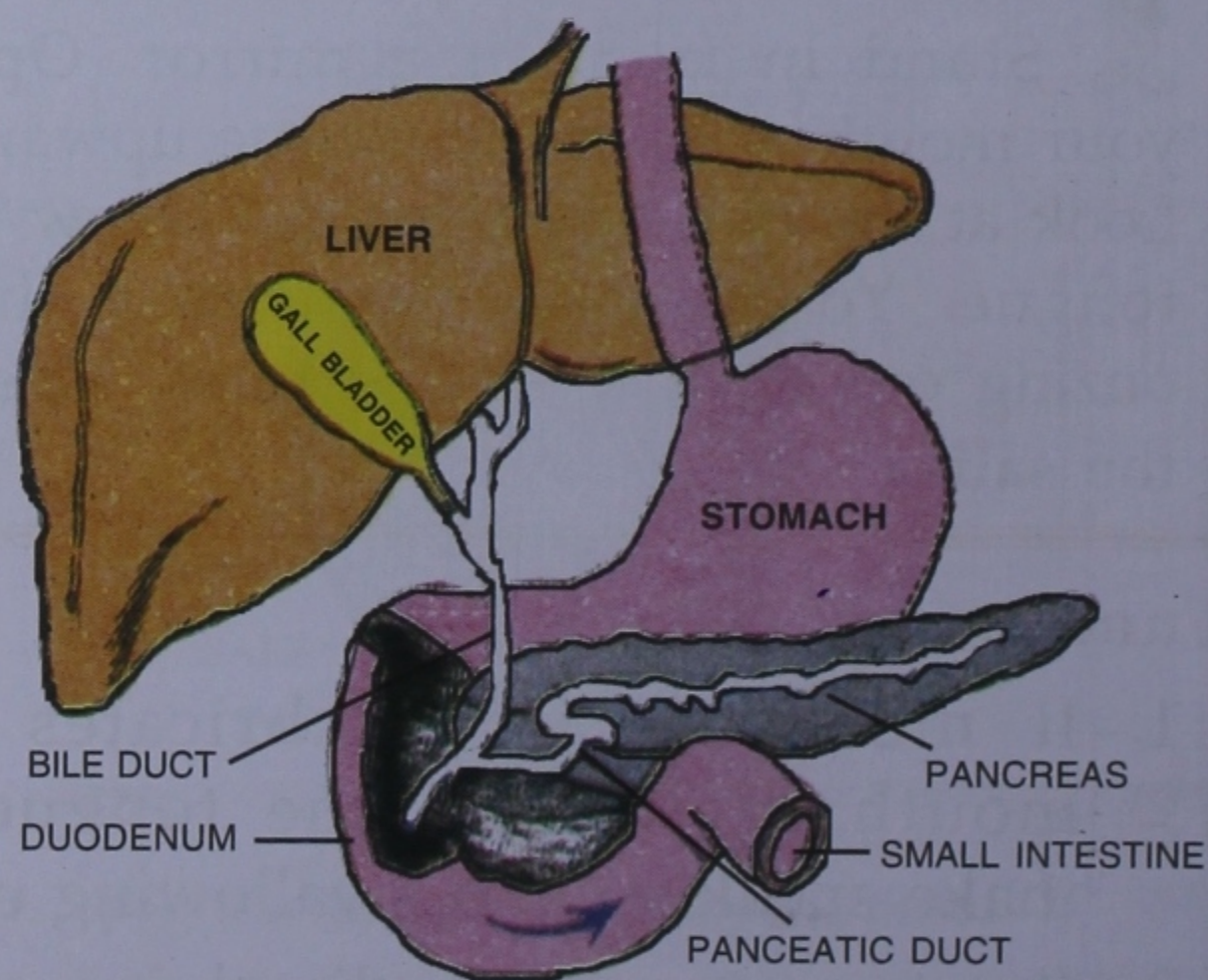


Fig. 5.11 Liver, pancreas and gall bladder

The Pancreas

The pancreas is a large whitish coloured gland situated behind the

stomach. The pancreatic juice is poured into the intestine along with the bile. The pancreatic juice contains three enzymes :

- (i) **Amylase** — Starch-digesting
- (ii) **Trypsin** — Protein-digesting
- (iii) **Lipases** — Fat-digesting

Enzymes act on carbohydrates and proteins and change them into simpler forms. The carbohydrates get broken into glucose, and proteins into amino acids. Fats are broken down into fatty acids and glycerol.

ABSORPTION OF DIGESTED FOOD IN SMALL INTESTINE

The digested food is absorbed by the walls of the small intestine. The inner lining of the small intestine contains a large number of tiny finger-like projections called **villi** (singular **villus**) (Fig. 5.12). The villi greatly increase the inner surface area for absorption of the digested food. Each villus has a network of thin and small blood vessels close to its surface.

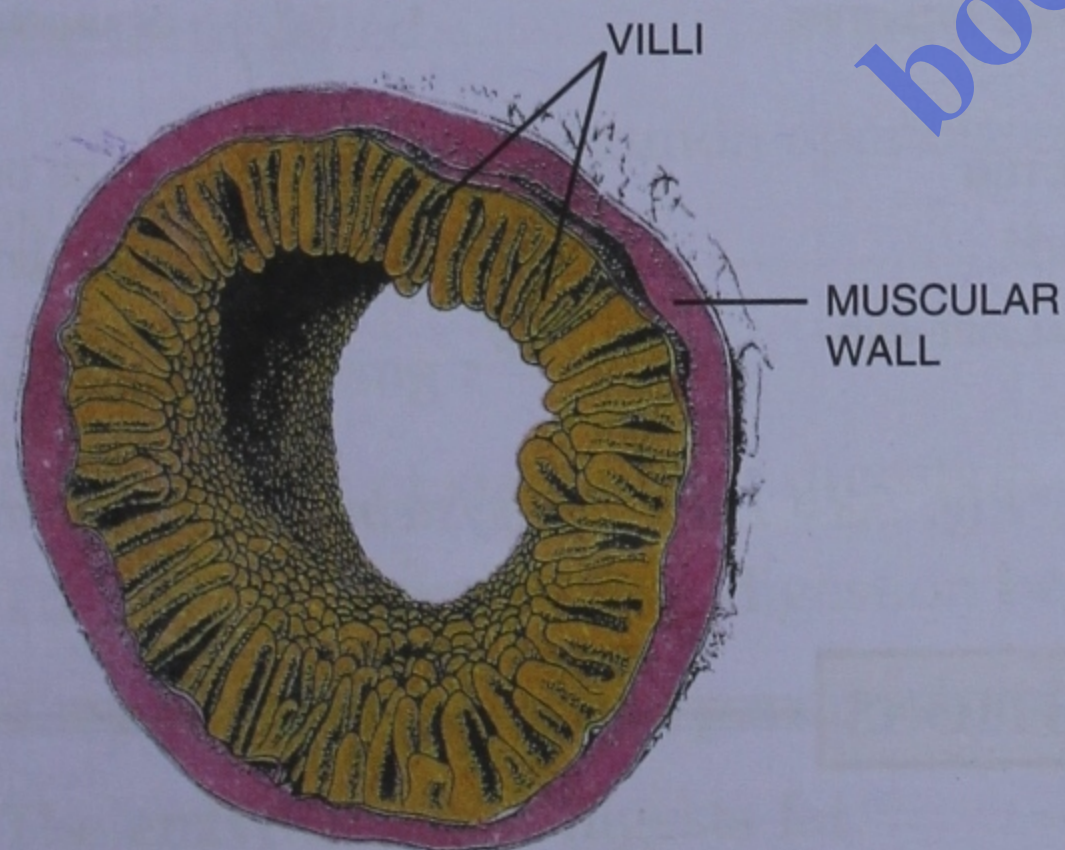


Fig. 5.12 Villi in the wall of intestine (in section)

The surface of the villi absorbs the amino acids and glucose to pass them on to the blood system, and the fatty acids pass into lymph vessels inside the villi.

Vitamins and mineral salts are mostly

soluble in water and are directly absorbed through the walls of the intestine.

The small intestine serves both for digestion and absorption of the digested food.

THE LARGE INTESTINE

The large intestine is about 1.5 metre long and consists of 3 regions : the **caecum**, the **colon** and the **rectum** (Fig. 5.13).

The **caecum** is a small blind pouch at the junction of the small and large intestines.

The **colon** is much wider than the small intestine and is about one metre long with three sharp bends.

The **rectum** is the last part, about 15 cm long. It opens at the anus. The anus has a circular muscle (**sphincter**) to keep it closed. This muscle relaxes to open the anus to pass out the bowels.

The large intestine does not secrete any enzyme. It **mainly absorbs water** from the undigested food. After much water is absorbed, the contents of the rectum become semi-solid faeces. The

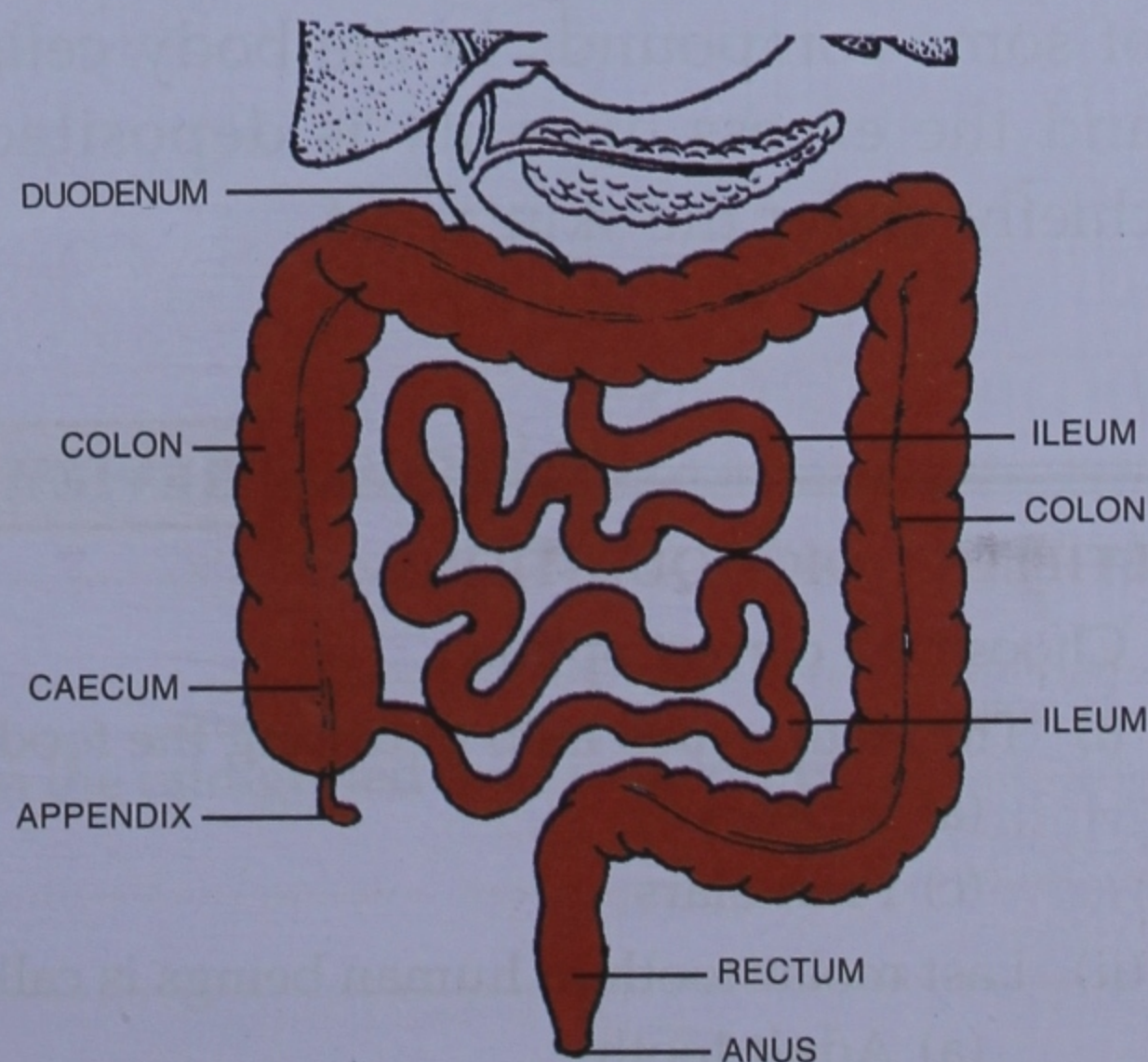


Fig. 5.13 Large intestine in humans

faecal matter is then ejected out of the body through the anus. It contains the undigested food and roughage. The process of eliminating the undigested food is called **egestion**.

UTILISATION OF DIGESTED FOOD : ASSIMILATION

The digested and absorbed nutrients are utilised by our body as follows :

1. Glucose, amino acids, vitamins and minerals are transported to the liver. Glucose is continuously used in the body as source of energy for so many actions going on. The liver converts excess glucose into insoluble glycogen, and stores it. When needed, liver reconverts the glycogen into its usable form glucose.
2. The amino acids circulate in the body and are used in the production of proteins for the growth and repair of tissues.
3. The fatty acids are used in the synthesis of some compounds in the body cells and the excess quantity is deposited chiefly under the skin as fat.

The various parts of the digestive system and their functions are summarised in the diagram given below :

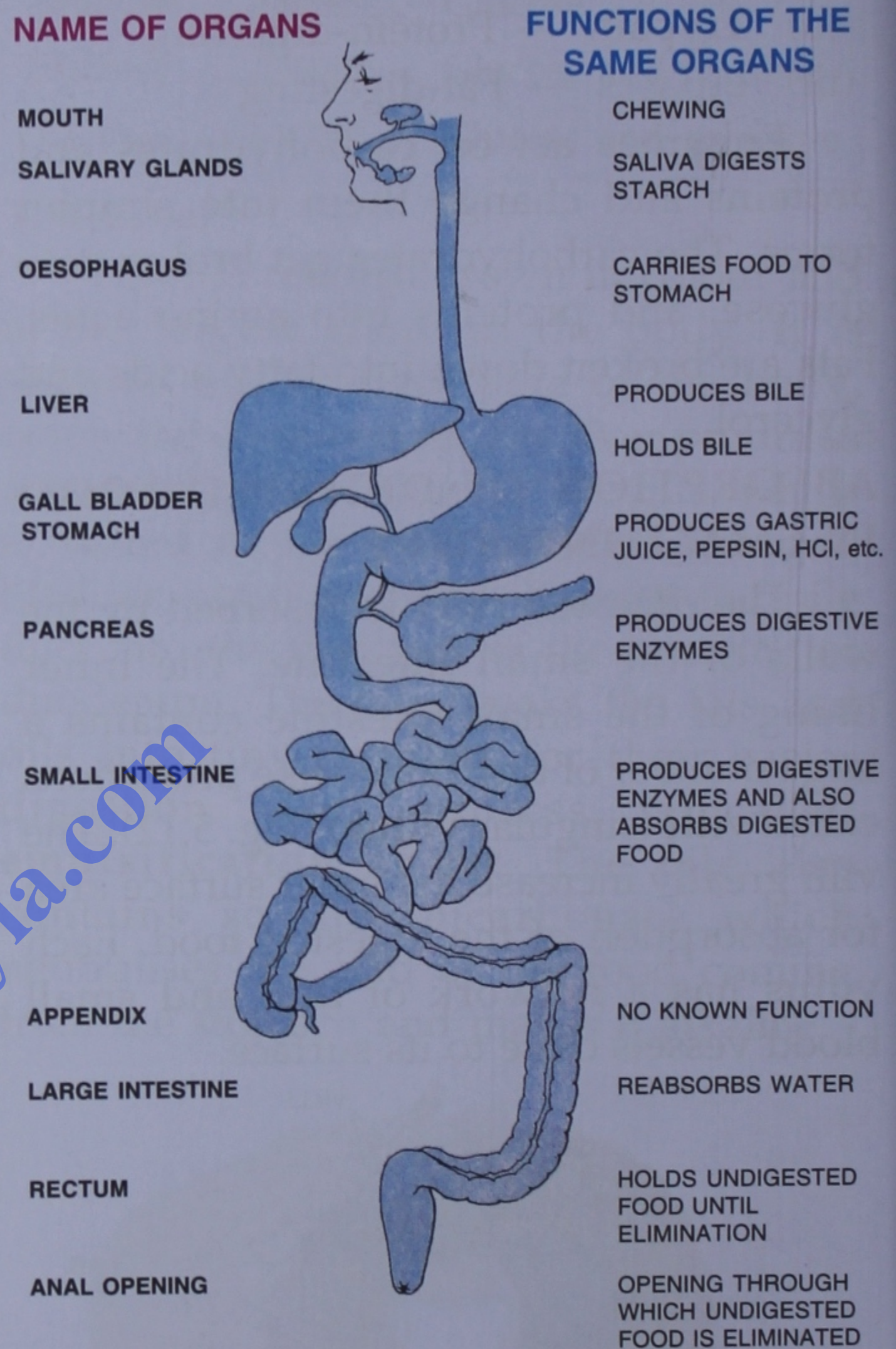


Fig. 5.14 Digestive system : different organs and their functions

REVIEW QUESTIONS

MULTIPLE CHOICE QUESTIONS

1. Choose the correct option :

(i) The teeth which help in tearing the food are the :

- (a) Incisors
(c) Premolars

- (b) Canines
(d) Molars

(ii) Last molar tooth in human beings is called :

- (a) Adult tooth
(c) Child tooth

- (b) Wisdom tooth
(d) Elder's tooth

(iii) Which of the following is the hardest substance in our body ?

(a) Dentine

(b) Bone

(c) Cement

(d) Enamel

(iv) Saliva converts starch into :

(a) Glucose

(b) Sucrose

(c) Maltose

(d) Lactose

(v) Proteins of the milk are converted into curd by the enzyme :

(a) Trypsin

(b) Rennin

(c) Pepsin

(d) Steapsin

(vi) Bile juice is produced by :

(a) Stomach

(b) Liver

(c) Pancreas

(d) Gall bladder

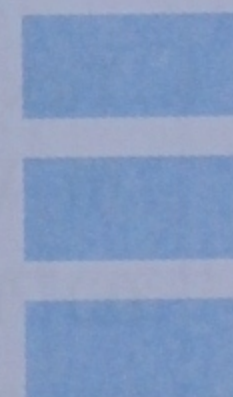
SHORT ANSWER QUESTIONS

1. Write *True* or *False* in the following statements. Correct the false statements by changing the first or the last word only :

(i) Homodont teeth are found in mammals.

(ii) Carbohydrates are digested into glucose.

(iii) Proteins are digested into fatty acids.



2. Fill in the blanks :

(i) The teeth called are a total of four in number on the sides of incisors.

(ii) is a common opening of food pipe and wind pipe.

(iii) Molars are meant for the food.

3. Name the following :

(i) End product of starch after digestion.

(ii) The organ where protein digestion begins.

(iii) The organ into which the pancreatic juice and the bile juice are poured.

(iv) The enzyme which digests fat.

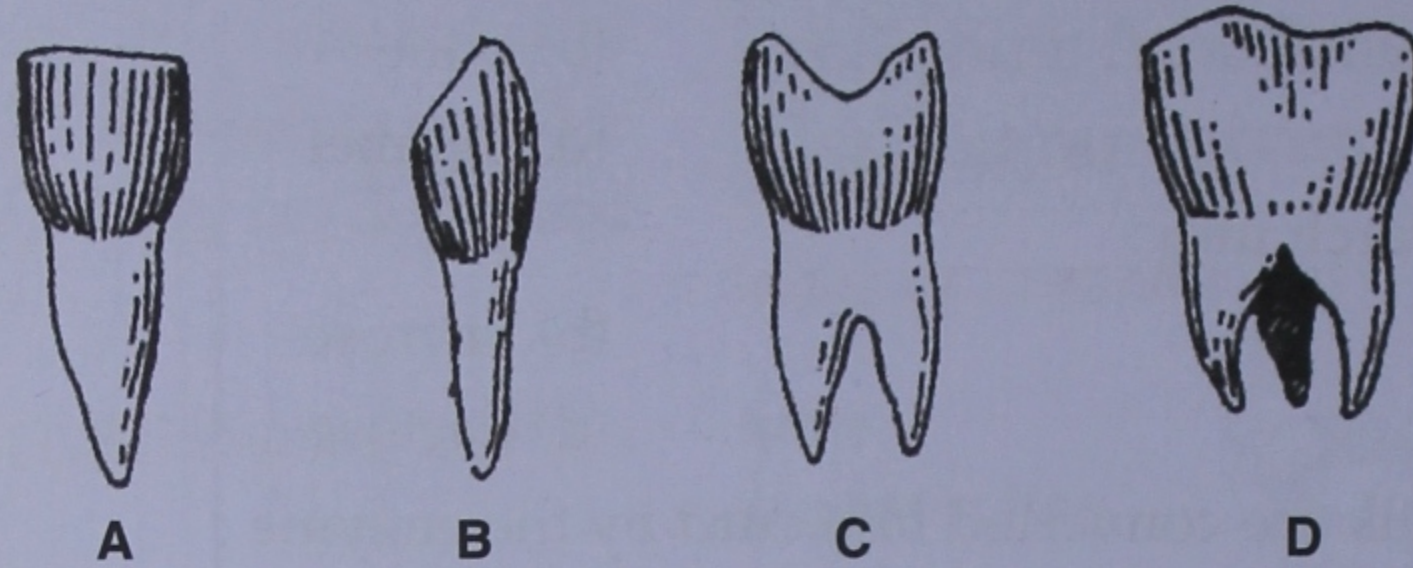
(v) The simplest form of carbohydrates.

(vi) The part of alimentary canal where water from the undigested food is absorbed.

(vii) The end-product of proteins after digestion

.....

4. Name the *four* types of teeth shown below and give their functions.



5. Fill in the blanks to complete the following sentences :

- (i) Incisors are used for and the food.
- (ii) The are used for tearing the food.
- (iii) The and are used for crushing and grinding the food.
- (iv) In an adult human, there are a total of teeth.
- (v) The human teeth appear in two sets, the first set is called which consists of only teeth.

6. Tick (✓) mark the *correct* statements.

- (i) Wisdom tooth appears at the age of 5-6 years when the child starts going to school.
- (ii) The temporary set of teeth includes incisors, canines and premolars only.
- (iii) The ducts from the salivary glands open into the duodenum.
- (iv) Saliva changes starch into maltose.

7. Fill in the blanks in the table (1-5) by selecting the suitable names of substances from the list given below :

[steapsin, peptones, fatty acids, proteoses, protein].

Digestive enzyme s	acts on	to convert into
(i) Pepsin	(2).....	(3)..... and (4).....
(ii)(1).....	fats(5).....

- 8. (i) Name the juice secreted by the liver
- (ii) Name the organ where this juice is temporarily stored
- (iii) What is the main function of this juice ?

9. Name the *three* enzymes found in pancreatic juice.

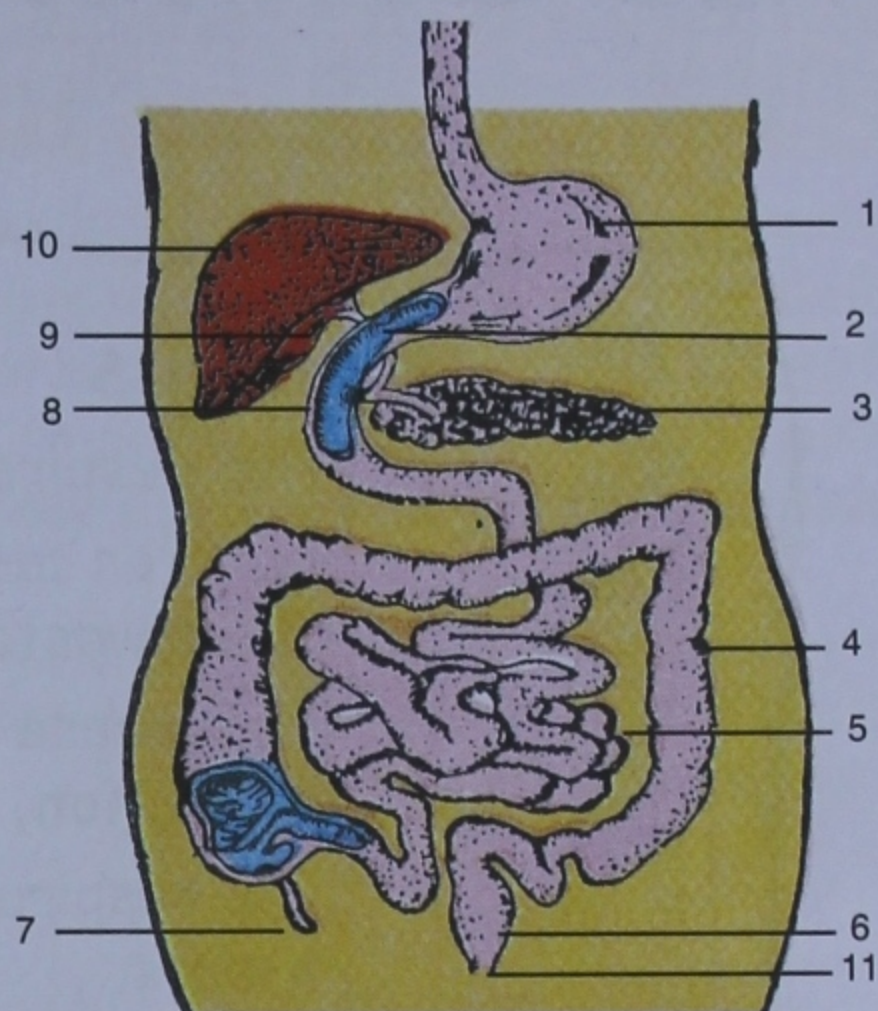
- (i) _____
- (ii) _____
- (iii) _____

10. Name the **three** regions of the large intestine.

11. Given alongside is the diagram of the human alimentary canal.

(i) Name the parts 1-11 indicated by guidelines.

1. _____ 2. _____ 3. _____
4. _____ 5. _____ 6. _____
7. _____ 8. _____ 9. _____
10. _____ 11. _____



(ii) State the function of the juice secreted by the part 1.

(iii) State the function of the **three** enzymes found in the juice secreted by part 3.

LONG ANSWER QUESTIONS (Write the answers in your notebook)

1. What is nutrition? Into how many types do you classify living beings on the basis of nutrition?
2. What is the role of liver and pancreas respectively in the digestion of food?
3. Name the digestive juice secreted by the stomach and give its function.
4. Answer the following questions :
 - (i) What is meant by heterodont teeth?
 - (ii) Name the types of teeth found in mammals.
 - (iii) How is the small intestine best suited for the digestion and absorption of food?
 - (iv) What do you mean by absorption of food?
5. Define the following terms : Egestion, digestion, assimilation.
6. Rewrite the following parts of the human alimentary canal in their correct sequence :
Stomach, Oesophagus, Large intestine, Small intestine, Pharynx.
7. Name the digestive gland found in our mouth.
8. What is the fate of excess glucose in our body?
9. Define the term 'digestion'.
10. State the **four** ways in which saliva is useful to us.