

DIGESTIVE SYSTEM

NEED FOR DIGESTIVE SYSTEM

The food that we eat cannot be utilized as such in the body. It must be changed into a soluble absorbable form to get absorbed by the blood for distribution in the body. Certain foods, like cane sugar are already soluble in water, but they require a breaking down of their molecules into smaller units so that they could pass through the cell membranes of the wall of the gut.

Digestion is the break-down of naturally occurring foodstuffs into diffusible form.

* OR *

Digestion is any change which makes the foods soluble and of such chemical nature that they can be absorbed through living membranes.

ENZYMES

Enzymes are biocatalysts. They play a key role in the digestion of food. There are hundreds of enzymes in addition to those involved in digestion, but the general characteristics of all enzymes are same.

Characteristics of an enzyme

- 1. It is a protein and is, therefore, destroyed by heating.*
- 2. It acts only on one kind of substance called the substrate i.e. it is specific.*
- 3. It always forms the same end-product(s) from the substrate.*
- 4. It only affects the rate of a chemical reaction and always speeds up the reaction.*
- 5. Like a catalyst it can be used again and again.*
- 6. It acts best within a narrow temperature range, usually between 35° and 40°C which is also called **optimum temperature**.*

THE DIGESTIVE SYSTEM

The digestive system consists of :

A) Alimentary canal

The alimentary canal is a muscular tube which starts with the mouth and ends at the anus. It is about 9 metres long and is highly coiled in certain regions especially in the small intestine.

B) Digestive glands

Two large digestive glands, the liver and pancreas, three salivary glands.

The various organs of the digestive system are described as follows:

The Mouth

The mouth or the oral cavity is the space where the food is chewed and mixed with saliva. Its front limits are formed by the upper and lower lips.

Functions of LIPS : The lips help in

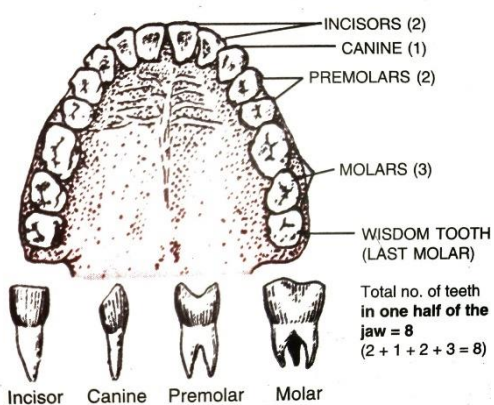
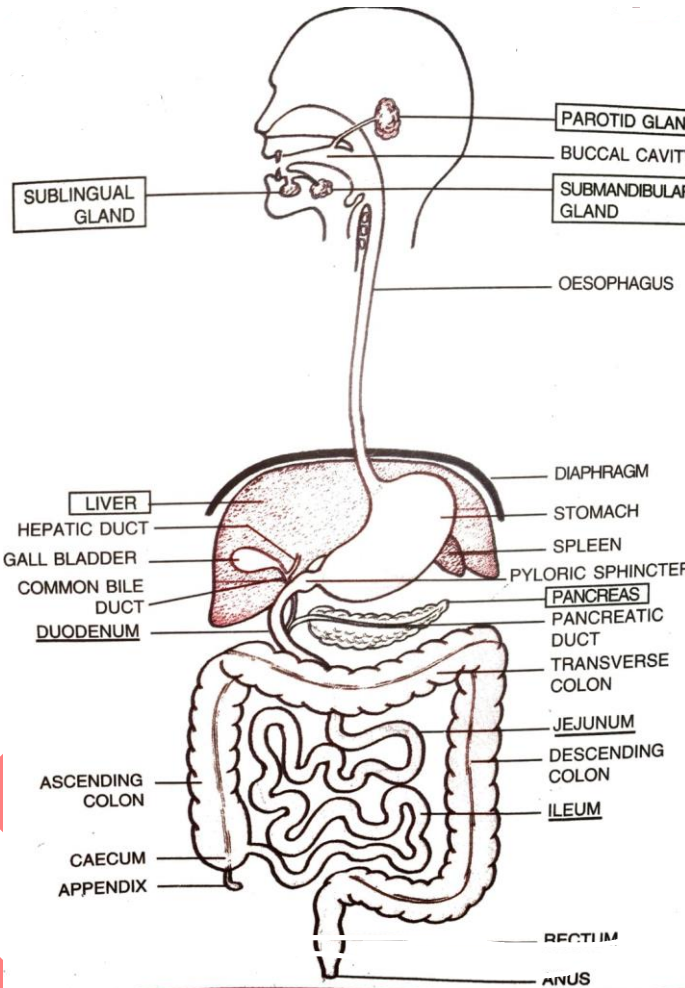
- (i) closing the mouth,
- (ii) sucking and sipping liquids,
- (iii) speaking and also in
- (IV) perceiving certain sensations, especially those of touch and heat.

Functions of Tongue: A muscular tongue helps in :

- (i) manipulating the food while chewing and mixing it with saliva,
- (ii) tasting,
- (iii) cleaning the food particles from the teeth after eating and also in
- (iv) speaking.

The teeth "Dentition"

Functions of Teeth



The teeth have a very special role - they cut and break the food into smaller bits.

The small-sized bits have a relatively larger surface area for the enzymes to act on for better digestion.

Teeth also add to facial beauty.

*An adult human normally has **32 teeth**. These teeth are different in shape and perform different functions as follows:*

(a) Incisors are the four front teeth in the centre of each jaw. Their cutting edges are broad and sharp like a chisel. They are used for biting and cutting.

(b) Canines are one on either side of the incisors in each jaw. These are conical and sharply pointed for holding and tearing the food.

(c) Premolars are two on each side in each jaw next to the canines. Each premolar has two hill-like projections or cusps on its surface, and hence known as **bicuspid.**

(d) Molars are the last three teeth on each side in each jaw. The last molar of each side in each jaw is called **wisdom tooth**. The wisdom teeth are so called because they appear last at an age of about 17-20 years when the human body is reaching maturity.

Structure Of A Tooth

*The general structure of all types of teeth is the same. Each tooth consists of a **crown** or the part exposed above the gum and the **root** or the part embedded in a cup-like socket of the jaw bone. **The neck** is a slight constriction between the root and the crown.*

In a vertical section, a tooth shows the following parts:

Enamel or the "ivory" is the material which covers the crown. It **is the hardest substance in the body.**

Dentine forms the bulk of the tooth. It is harder than bone but not as much as the enamel. It has minute canals through which run the strands of cytoplasm of the cells in pulp cavity.

Cement is another bone-like structure covering and fixing the root in position.

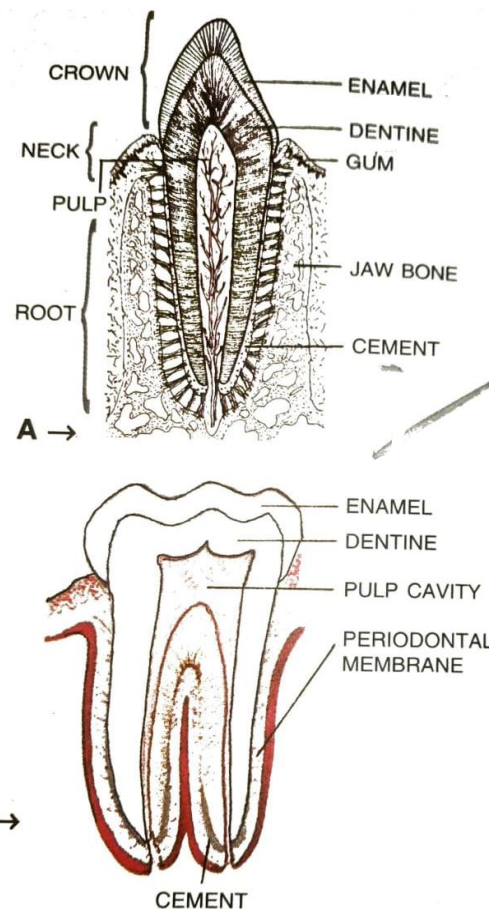
Pulp is the soft connective tissue contained in the central space of the tooth. It consists of blood capillaries, lymph vessels and nerve fibres which are continuous below those of the body through the opening of the pulp cavity at the base of the root.

The Salivary Glands

- The saliva is secreted by three pairs of salivary glands,
- Parotid glands located just in front of and beneath each ear, submandibular glands lying close to the inner side of the lower jaw on each side,
- Sublingual glands below the tongue.

Saliva is very slightly acidic (pH 6.8) fluid containing water (about 99%), salts, mucus and an enzyme salivary amylase (also called ptyalin)

Functions of Saliva:



Internal structure of tooth
A-incisor or canine (biting or piercing), with one root
B-Premolar (grinding) with two roots.

1. Moistens and lubricates the inner lining of the moral cavity and the surface of the tongue to facilitate speaking and swallowing.
2. Moistens and lubricates food which again helps in swallowing.
3. Acts as a solvent, dissolving some food particles to stimulate taste buds of the tongue.
4. Helps food particles to stick together to form bolus so that they can be swallowed in a mass.
5. Digests starch. Its enzyme ptyalin (amylase) converts starch into maltose. This explains why if boiled rice is chewed very well it begins to taste sweet.

Starch → Ptyalin/Salivary amylase / (Saliva) → Maltose (disaccharide)

6. Cleans the mouth and tends to destroy germs to prevent tooth decay.

Swallowing And Peristalsis

In swallowing, there are several simultaneous actions.

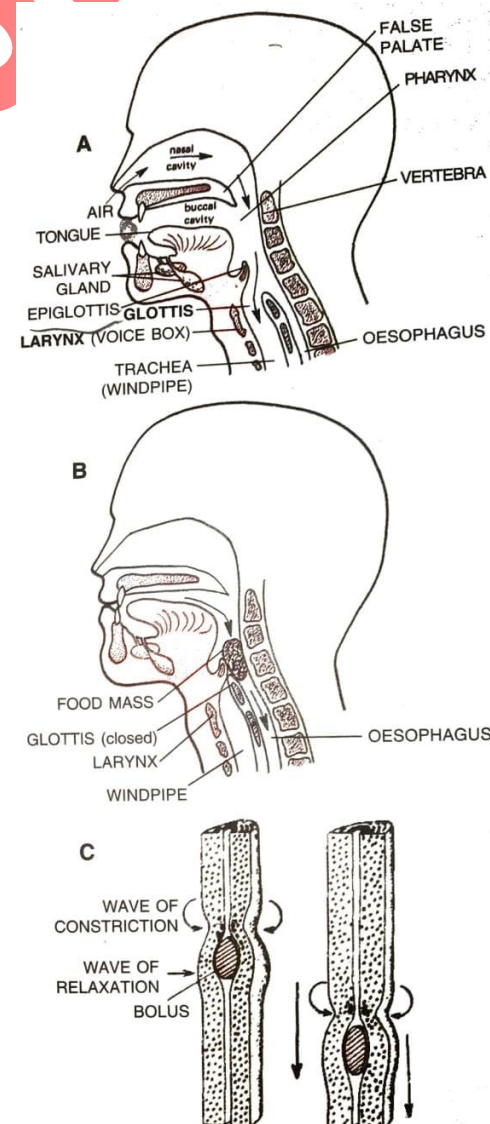
- The tongue presses upward and back against the roof of the mouth and this forces the bolus into the throat or the pharynx.
- The back part of the roof of the mouth cavity closes the opening between the throat and the nasal passage.
- The larynx which is located at the entrance of the windpipe is pulled upward to bring it close to the back of the tongue when a flap called epiglottis closes its opening.

Oesophagus

Oesophagus is a tube which simply conducts the food from the throat to the stomach. It passes through the diaphragm close to the backbone.

Stomach

The stomach is an elastic bag located below the diaphragm. The opening of the stomach into the intestine is called **pylorus**. It has a ring of muscles to keep the opening closed like a valve to prevent food passing from the stomach until it is thoroughly churned up.



VOMITING: Sometimes when the stomach is overloaded or disturbed, vomiting occurs in which the cardiac sphincter opens and a reverse wave of muscular contraction is caused throwing the contents out through the mouth.

Gastric juice is secreted by the inner lining of the stomach. It is a colourless highly acidic liquid containing water, some salts, hydrochloric acid and an enzyme called pepsin. **Two functions of Hydrochloric Acid**

- (i) it kills any germs which may have entered along with the food, and
- (ii) it activates pepsin to act on proteins.

The Small Intestine

The small intestine is a tube about 7 metres long and about 2.5 cm wide. It is coiled and folded in the abdomen. Its three sub-regions are as follows:

(i) Duodenum: Short upper part next to stomach. ("duodenum" means 12, i.e. twelve finger widths in length, duo: two, deni : ten). The common bile duct opens into this part.

(ii) Jejunum: Next short-region of about 2 metres. ("jejunum" means empty, because it is nearly always empty after death as found in dissections or in post-mortems.)

(iii) Ileum : About 4 metres. ("ileum" means to twist/roll, referring to the twisting movements of this part). It contains following Enzymes:

Erepsin-Protein-Amino Acid

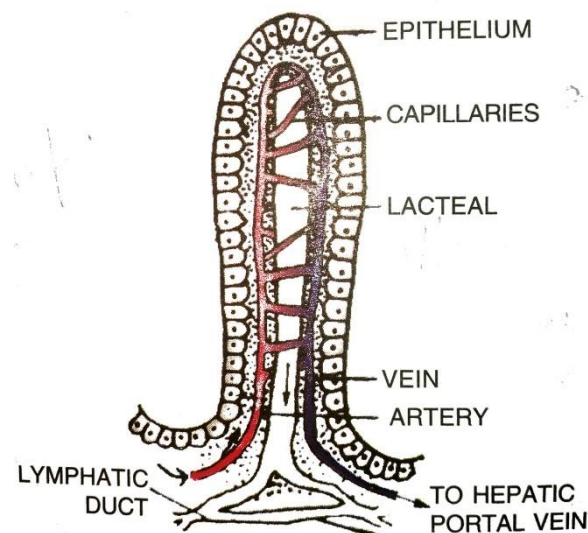
Maltase-Maltose-glucose

Sucrase-Sucrose-Glucose and Fructose

Lactase-Lactose-Glucose and Galactose

Lipase-Fats-Fatty Acids and Glycerol

The inner lining of the ileum is made into a great number of tiny finger-like projections **called villi**. The villi enormously increase the inner surface

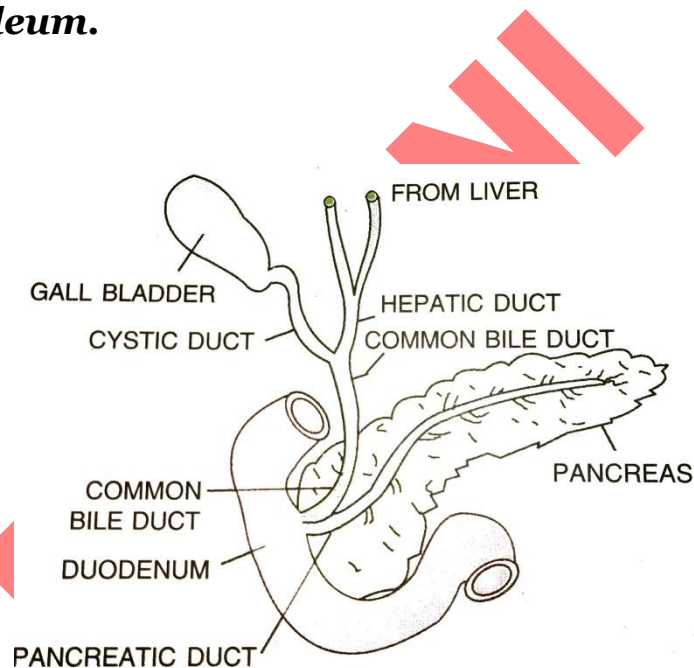


area of the intestines which facilitates the absorption of digested food.

The small intestine serves both for digestion and absorption. It receives two digestive juices; (i) the bile and (ii) the pancreatic juice in the duodenum and its own walls secrete the intestinal juice in the ileum.

(1) **BILE.** This is a yellowish green watery fluid produced in the **liver**, which is transported through the hepatic duct. The colour of the bile is due to certain pigments (biliverdin and bilirubin) produced by the breakdown of the dead and worn-out red blood cells.

(2) **PANCREATIC JUICE.** This is produced in a whitish gland, **pancreas**, located behind the stomach. The pancreatic duct opens into the duodenum by an aperture common to that of the bile duct.



The pancreatic juice contains three kinds of enzymes ----

(i) **Amylopsin (pancreatic amylase) digests leftover starch into maltose,**

(ii) **Trypsin acts on the remaining proteins and polypeptides to produce smaller peptides and amino acids.**

(iii) **Steapsin which acts on emulsified fats split them into fatty acids and glycerol.**

The Large Intestine

The large intestine is about 1.5 metres long. It has three parts caecum, colon and rectum.

1. **The caecum** is a small blind pouch situated at the junction of the small and large intestines. From its blind end projects a narrow worm shaped tube called **vermiform appendix** and today it is a functionless organ.

2. **The colon** is much broader than the ileum and is a little more than a metre long. It passes up the abdomen on the right, crosses to the left just below the stomach and down on the left side.

3. **The rectum** is the last part, about 15 cm long which opens at **the anus**. The anus has circular muscles to keep it closed except when passing bowels.

Functions. The large intestine secretes no enzyme. It absorbs much water but very little water digested food from the contents which mainly consist of undigested material.

The expulsion of the undigested remains of the food from the alimentary canal is called **defaecation**.

• The faeces are normally composed of nearly:

75% water ,25% solid matter which again consists of: dead bacteria, fat, proteins, roughage.

ASSIMILATION OF FOOD

Assimilation is the conversion of the absorbed digested food into body material.

• The liver converts any excess glucose into insoluble glycogen which can be temporarily stored. This process is known as **glycogenesis**.

• When needed the liver reconverts the glycogen into glucose. This process is known as **glycogenolysis** and puts it back in blood circulation.

• The amino acids cannot be stored. Any excess amino acids are broken down in the liver by a process called **deamination** in which the nitrogen-containing amino group is removed and converted into urea for excretion and the remaining part forms glucose which can be utilized.

• The fatty acids and glycerol absorbed by the **gut** are transported mainly through the intestinal villi and lymphatic system.

LIVER

The liver is the largest gland of the body weighing about 1500 gm on an average. It is a reddish brown organ located in the upper right side of the abdomen just below the diaphragm.

Practical Work on Food Tests

- 1. Test of Starch-** *If food contain starch on adding Iodine Blue Black.*
- 2. Test of Glucose-** *If food contains Glucose put Fehling's Solution and heat it. The colour changes from blue green to deep brick red.*
- 3. Test of Protein-** *put drops of Dil. Nitric Acid on boiled Egg white. Heat it and rinse it with water then add Ammonium Hydroxide. Colour changes from white-yellow- orange.*
- 4. Test of Fats and Oils-** *Rub a piece of groundnut on a piece of paper. It turns translucent.*

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