chapter

# 2 Nutrition in Animals

You have learnt in Chapter 1 that plants can prepare their own food by the process of photosynthesis but animals cannot. Animals get their food from plants, either directly by eating plants or indirectly by eating animals that eat plants. Some animals eat both plants and animals. Recall that all organisms including humans require food for growth, repair and functioning of the body. Animal nutrition includes nutrient requirement, mode of intake of food and its utilisation in the body.

**In this chapter, we will learn about :**

1. How different organisms eat their food?
2. How is food digested in our body?

## HOLOZOIC NUTRITION

Holozoic nutrition takes place in those organisms which take solid or liquid food through the mouth inside their body. Examples of organisms having holozoic mode of nutrition are human beings, dog, cat, lion, deer, crow, frog and fish, etc. This process takes place in following steps:

### 1. Ingestion

The process of taking food inside the body is called ingestion.

### 2. Digestion

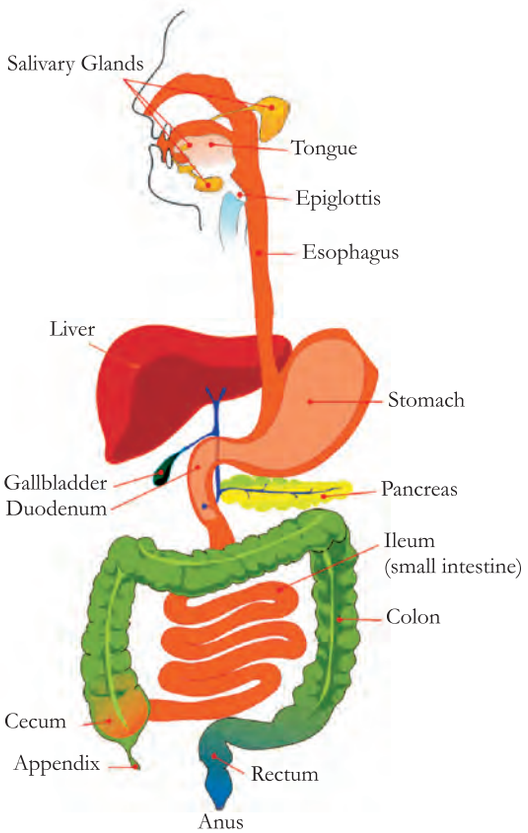
In digestion, the ingested food is converted into simple form with the help of digestive enzymes.

### 3. Absorption

In this stage, the food digested in second step is absorbed into the cells of body.

### 4. Assimilation

Assimilation is the process of utilizing the food absorbed in third step by various cells of the body.



### 5. Egestion

Egestion is the final step of holozoic nutrition in which the undigested food is removed from the body.

## DIFFERENT WAYS OF TAKING FOOD

Different organisms have different ways of eating food.

1. Human beings use their hands to put food into their mouth and swallow the food after chewing.
2. Snakes swallow the animals they prey upon without chewing them.
3. Spiders weave sticky web in which small insects get stuck.
4. A humming bird sucks nectar of plants.
5. Amoeba, a unicellular animal, engulfs tiny particles of food by using pseudopodia. Amoeba surrounds the food by pseudopodia and then makes a food vacuole to engulf the food.
6. A frog captures a prey with its sticky tongue.

Different animals have different methods of eating food

7. Infants of human and many other animals feed upon their mother's milk by sucking.
8. In multicellular organisms, such as hydra there are numerous tentacles around their mouth. Hydra uses tentacles to surround its prey and kill them with its stinging cells. Then the food is pushed inside the body cavity.
9. Some aquatic animals filter tiny particles floating nearby and feed upon them.
10. An Earthworm uses its muscular pharynx to swallow its food.

### Digestion

The energy required for all the processes and activities that take place in our bodies is derived from the foods we ingest. The digestive system allows us to utilize food from such diverse sources as meat from an animal and the roots of a plant and utilize them as an energy source. Whether it is the ability to coordinate the chewing of the food without injuring our tongue and lips or the propulsion of the food from the stomach into the duodenum while releasing the appropriate enzymes, our digestive system allows us to manage the process without much thought and often while performing other tasks.

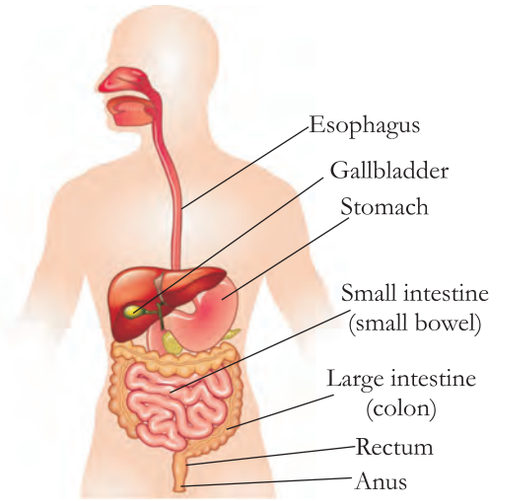
The process of digestion is a fascinating and complex one that takes the food we place in our mouth and turns it into energy and waste products. This process takes place in the gastrointestinal

tract, a long, connected, tubular structure that starts with the mouth and ends with the anus. The food is propelled forward within the system, altered by enzymes and hormones into usable particles and absorbed along the way. Other organs that support the digestive process are the liver, gallbladder and pancreas. The time it takes for food to travel from entering the mouth to be excreted as waste is around 30 to 40 hours.

## DIGESTION IN HUMANS

The digestion process is a series of reactions of food with the digestive hormones and juices. This starts right from the oral cavity. It is an important process that breaks down the proteins, fats, carbohydrates, vitamins, minerals into simpler forms so that it can be absorbed easily into the body cells. During this process, proteins are converted into amino acids, carbohydrates are converted into simple sugars and fats are broken down into fatty acids and glycerol. Many digestive enzymes and hormones act on food, at various stages during the process of digestion. The whole process occurs in a sequential manner.

To help you understand how the many parts of the digestive system work together, here is an overview of the structure and function of this complex system.

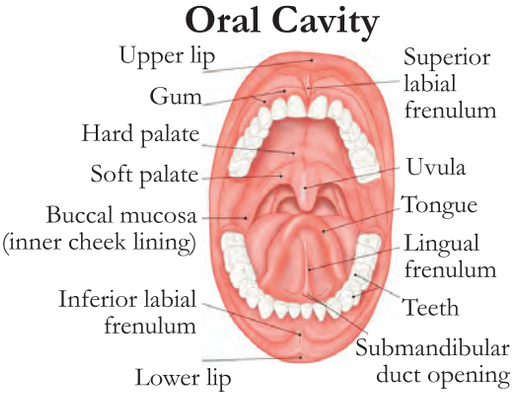



Digestive System

### Mouth

The mouth is the beginning of the digestive tract; and in fact, digestion starts here when taking the first bite of food. Chewing breaks the food into pieces that are more easily digested, while saliva mixes with food to begin the process of breaking it down into a form your body can absorb and use.

### Salivary Glands




There are three pairs of main salivary glands and between 800 to 1,000 minor salivary glands, all of which mainly serve the digestive process and also play an important role in the maintenance of dental health and general mouth lubrication, without which speech would be impossible. The main glands are all exocrine glands, secreting via ducts. All of these glands terminate in the mouth. The largest of these are the parotid glands, their secretion is mainly serous. The next pair is underneath the jaw, the submandibular glands, these produceboth serous fluid and mucus. The serous fluid is produced by serous glands in the salivary glands which also produce lingual lipase. They produce about 70% of the oral cavity saliva. The third pair is the sublingual glands located underneath the tongue and their secretion is mainly mucous with a small percentage of saliva.

**Interesting Fact**

It is estimated that about 1.0–1.5 litres of saliva is produced by a normal human in a day.

Within the oral mucosa and also on the tongue, palates and floor of the mouth, are the minor salivary glands; their secretions are mainly mucous and they are innervated by the facial nerve. The glands also secrete amylase, a first stage in the breakdown of food, acting on the carbohydrates in the food to transform the starch content into maltose. There are other glands on the surface of the tongue that encircle taste buds on the back part of the tongue and these also produce lingual lipase. Lipase is a digestive enzyme that catalyses the hydrolysis of lipids (fats). These glands are termed Von Ebner's glands which have also been shown to have another function in the secretion of histatins which offer an early defense (outside of the immune system) against microbes in food, when it makes contact with these glands on the tongue tissue. Sensory information can stimulate the secretion of saliva providing the necessary fluid for the tongue to work with and also to ease swallowing of the food.

## Tongue

Food enters the mouth where the first stage in the digestive process takes place, with the action of the tongue and the secretion of saliva. The tongue is a fleshy and muscular sensory organ and the very first sensory information is received via the taste buds in the papillae on its surface. If the taste is agreeable, the tongue will go into action, manipulating the food in the mouth which stimulates the secretion of saliva from the salivary glands. The liquid quality of the saliva will help in the softening of the food and its enzyme content will start to break down the food whilst it is still in the mouth. The first part of the food to be broken down is the starch of carbohydrates (by the enzyme amylase in the saliva).

Tongue

The tongue is attached to the floor of the mouth by a ligamentous band called the frenum and this gives it great mobility for the manipulation of food (and speech); the range of manipulation is optimally controlled by the action of several muscles and limited in its external range by the stretch of the frenum. The tongue's two sets of muscles, are four intrinsic muscles that originate in the tongue and are involved with its shaping and four extrinsic muscles originating in bone that are involved with its movement.

## Taste

Taste is a form of chemoreception that takes place in the specialised taste receptors, contained in structures called taste buds in the mouth. Taste buds are mainly on the upper surface (dorsum) of the tongue. The function of taste perception is vital to help prevent harmful or rotten foods from being consumed. There are also taste buds on the epiglottis and upper part of the esophagus. The taste buds are innervated by a branch of the facial nerve, the chorda tympani, and the glossopharyngeal nerve. Taste messages are sent via these cranial nerves to the brain. The brain can distinguish between the chemical qualities of the food. The five basic tastes are referred to as those of saltiness, sourness, bitterness, sweetness and umami. The detection of saltiness and sourness enables the control of salt and acid balance. The detection of bitterness warns of poisons– many of a plant's defences are of poisonous compounds

**Interesting Fact**

A baby is born with about 10,000 taste buds but as a person grows, some of his or her taste buds die. (An old person may only have 5,000 taste buds).

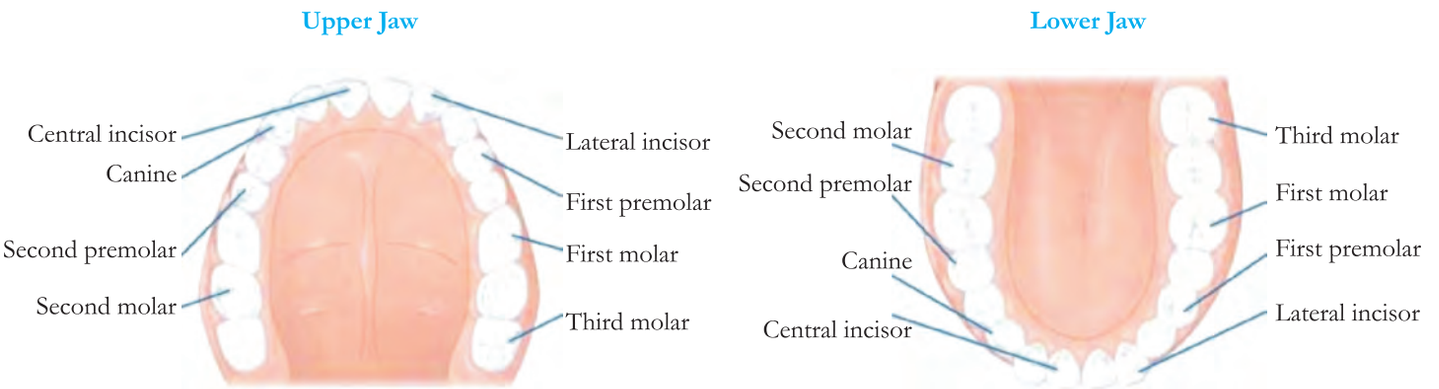
that are bitter. Sweetness guides to those foods that will supply energy; the initial breakdown of the energy-giving carbohydrates by salivary amylase creates the taste of sweetness since simple sugars are the first result. The taste of umami is thought to signal protein-rich food. Sour tastes are acidic which is often found in bad food. The brain has to decide very quickly whether the food should be eaten or not. It was the findings in 1991, describing the first olfactory receptors that helped to prompt the research into taste. The olfactory receptors are located on cell surfaces in the nose which bind to chemicals enabling the detection of smells. It is assumed that signals from taste receptors work together with those from the nose, to form an idea of complex food flavours.

## Teeth

Teeth are complex structures made of materials specific to them. They are made of a bone-like material called dentin, which is covered by the hardest tissue in the body—enamel. Teeth have different shapes to deal with different aspects of mastication employed in tearing and chewing pieces of food into smaller and smaller pieces. This results in a much larger surface area for the action of digestive enzymes. The teeth are named after their particular roles in the process of mastication.

**Interesting Fact**

Improper oral health may lead to defects in teeth and may cause disease.




## Incisors

Incisors are often the first adult teeth that grow in after our primary teeth, or baby teeth and make up most of our smile. There are eight incisors in the mouth; four in the top-center of our mouth and four in the bottom-center. These teeth are characteristically thin, flat-bottom teeth that help us to make the initial bite on our food. We bite into food with our incisors, tugging and pulling into our mouths. Incisors have a narrow-edge and are adapted for cutting. The incisors are situated between the cuspids, or canines and are often referred to as anterior teeth or front teeth because of their prevalence in smiling and talking.

## Cuspids / Canines

Cuspids, also known as canines, are the closest link between the human mouth and that of a carnivorous predator, like a tiger or wolf. Mirroring the pointed teeth we associate with predatory animals and vampires, these are sharp, pointed teeth on either side of our incisors that are used to do exactly what they look like, they are meant to do tear into food and rip it apart. These pointed teeth usually come in permanently around the ten year mark, with the bottom cuspids arriving just before the upper cuspids. One feature of cuspids or canine teeth is the fact that they are our longest teeth,

with a pointed end and surprisingly, only one implanted root. Canines rip food, but their position on either side of the mouth help guide the mouth and other teeth into the best biting position.

## Molars

Molars are our main masticators that is, molars are the teeth we most commonly associate with chewing. While many may only recognize three types of teeth rather than five, the discrepancy comes in distinguishing between different types of molars.

Molars are simply large teeth with a flatter surface that are used to chew food into small, easily consumable pieces. Let's look at the different types of molars below.

## Premolars / Bicuspids

Premolars, or first molars, are our first molar teeth that tend to come in around twelve or thirteen years of age. Premolars sit next to the cuspids in the mouth and are the foremost molars in the mouth.

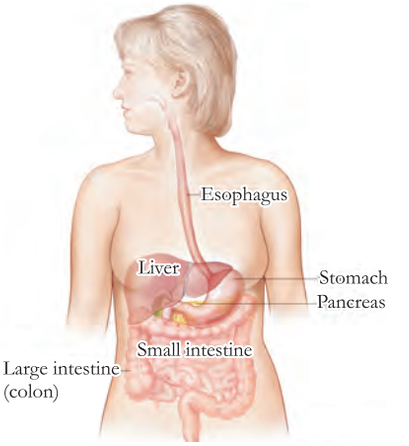
## Wisdom Teeth / Third Molars

Wisdom teeth, or third molars, are often referred to as third molars because they are the last teeth to come into the mouth. Many often get their wisdom teeth removed; these teeth sit so far back in the jaw that they can often cause issues if not removed.

## Esophagus

The esophagus, commonly known as the foodpipe or gullet, consists of a muscular tube through which food passes from the pharynx to the stomach. The esophagus is continuous with the laryngopharynx. It passes through the posterior mediastinum in the thorax and enters the stomach through a hole in the thoracic diaphragm, the esophageal hiatus, at the level of the tenth thoracic vertebra. Its length averages 25 cm, varying with height. It is divided into cervical, thoracic and abdominal parts. The pharynx joins the esophagus at the esophageal inlet which is behind the cricoid cartilage.

At rest, the esophagus is closed at both ends, by the upper and lower esophageal sphincters. The opening of the upper sphincter is triggered by the swallowing reflex so that food is allowed through. The sphincter also serves to prevent back flow from the esophagus into the pharynx. The esophagus has a mucous membrane and the epithelium, which has a protective function and is continuously replaced due to the volume of food that passes inside the esophagus. During swallowing, food passes from the mouth through the pharynx into the esophagus. The epiglottis folds down to a more horizontal position to direct the food into the esophagus and away from the trachea.




Once in the esophagus, the bolus travels down to the stomach via rhythmic contraction and relaxation of muscles known as peristalsis. The lower esophageal sphincter is a muscular sphincter surrounding the lower part of the esophagus. The junction between the esophagus and the stomach (the gastroesophageal junction) is controlled by the lower esophageal sphincter, which remains constricted at all times other than

during swallowing and vomiting to prevent the contents of the stomach from entering the esophagus. As the esophagus does not have the same protection from acid as the stomach, any failure of this sphincter can lead to heartburn. The esophagus has a mucous membrane of epithelium which has a protective function as well as providing a smooth surface for the passage of food. Due to the high volume of food that is passed over time, this membrane is continuously renewed.

## Diaphragm

The diaphragm is an important part of the body's digestive system. The muscular diaphragm separates the thoracic cavity from the abdominal cavity where most of the digestive organs are located. The suspensory muscle attaches the ascending duodenum to the diaphragm. This muscle is thought to be of help in the digestive system in the way that its attachment offers a wider angle to the duodenojejunal flexure for the easier passage of digesting material. The diaphragm also attaches to and anchors the liver at its bare area. The esophagus enters the abdomen through a hole in the diaphragm at the level of tenth thoracic vertebra.


## Stomach

The stomach is a hollow organ, or 'container', that holds food while it is being mixed with enzymes that continue the process of breaking down food into a usable form. Cells in the lining of the stomach secrete a strong acid and powerful enzymes that are responsible for the breakdown process.

## Digestion in the Stomach

When food reaches the stomach, it stays for approximately 4 to 5 hours. There are various gastric glands in the mucosa lining of the stomach. The mucus neck cells secrete mucus. The Peptic Cells secrete the proenzyme pepsinogen. The Parietal or Oxyntic Cells secrete HCl (Hydrochloric acid) and intrinsic factor that is essential for vitamin B12 absorption.

Food in the stomach gets mixed thoroughly with the gastric juices through the churning movements of the stomach muscle. This mass of food that is semi-digested, acidic and pulpy is called the chyme. It is mostly the proteins that get digested in the stomach. The mucus and the bicarbonates of the gastric juice help in protecting the mucosal epithelium from the highly acidic HCl. Mucus also helps in lubricating the food.

The different chemical reactions that take place in the stomach are summarised as follows.

### 1. Gastric Juices and Enzymes

(i) HCl provides the acidic pH.

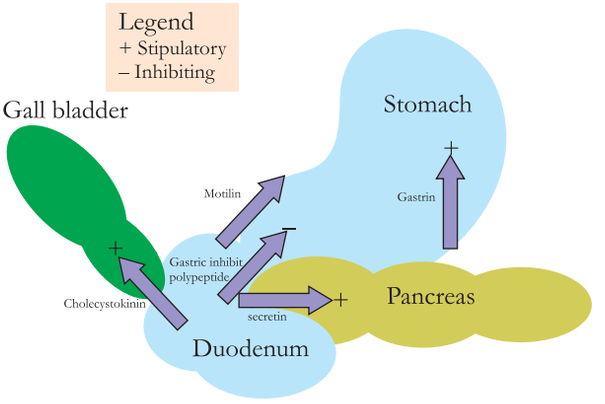
(ii) Pepsinogen(proenzyme) is converted into Pepsin by HCl.

(iii) Pepsin, in turn, converts protein into peptones and proteoses.

(iv) Prorenin (proenzyme) is converted into Renin by HCl.

(v) Casein (milk protein) is converted into peptides by Renin.

After the action of the gastric juices and enzymes, food then enters the small intestine.




## Small Intestine

Made up of three segments—the duodenum, jejunum and ileum—the small intestine is a 22-feet long muscular tube that breaks down food using enzymes released by the pancreas and bile from the liver. Peristalsis also is at work in this organ, moving food through and mixing it with digestive secretions from the pancreas and liver. The duodenum is largely responsible for the continuous breaking-down process, while the jejunum and ileum are mainly responsible for absorption of nutrients into the bloodstream.

## Digestion in the Small Intestine

In the small intestine, further digestion takes place. Due to the various movements of this organ, the chyme is further mixed and churned. There are many enzymes that are secreted into the small intestine from organs such as pancreas, liver; apart from the intestinal juices. All these react with the food particles and digest them into smaller particles that can be absorbed into the bloodstream.

The different chemical reactions that occur are summarised below:

### 2. Pancreatic Juices

(i) Amylase converts starch into Maltose.

(ii) Enterokinase converts Trypsinogen into Trypsin.

(iii) Trypsin converts proteins into Dipeptides.

(iv) Trypsin converts Chymotrypsinogen into Chymotrypsin.

(v) Chymotrypsin converts peptones into Dipeptides.

(vi) Trypsin converts Procarboxypeptidase into Carboxypeptidase.

(vii) Carboxypeptidase converts proteoses into Dipeptides.

(viii) Trypsin converts Proelastase into Elastase.

(ix) Elastase converts elastin into Dipeptides.

(x) Pancreatic amylase converts polysaccharides (Starch) into Disaccharides.

(xi) Nucleases in the pancreatic juice, act on nucleic acids and form nucleotides and nucleosides.

### 3. Intestinal Juices

(i) Maltase converts maltose into glucose.

(ii) Sucrase converts sucrose into glucose and fructose.

(iii) Lactase converts lactose into glucose and galactose.

(iv) Aminopeptidases convert peptides into amino acids.

(v) Dipeptidases convert dipeptides into amino acids.

$$\text{Dipeptides} \xrightarrow{\text{Dipeptidase}} \text{Amino acids}$$

$$\text{Maltose} \xrightarrow{\text{Maltase}} \text{Glucose} + \text{Glucose}$$

$$\text{Lactose} \xrightarrow{\text{Lactase}} \text{Glucose} + \text{Galactose}$$

$$\text{Sucrose} \xrightarrow{\text{Surcrase}} \text{Glucose} + \text{Fructose}$$

$$\text{Nucleotides} \xrightarrow{\text{Nucleotidases}} \text{Nucleosides} \xrightarrow{\text{Nucleosidases}} \text{Sugars} + \text{Bases}$$

$$\text{Di and Monoglycerides} \xrightarrow{\text{Lipases}} \text{Fattyacids} + \text{Glycerol}$$

### 4. Bile

Bile converts fat globules into fat droplets through a process called emulsification. Fats are broken down into diglycerides and monoglycerides.

### 5. Pancreatic Lipase

It converts triglycerides into fatty acids and glycerol.

The biomacromolecules are broken down in the duodenum region. All the simpler forms of the digested food are absorbed in the jejunum and ileum regions. Any leftover undigested, unabsorbed food particles are then passed on to the large intestine.

## Pancreas

The pancreas secretes digestive enzymes into the duodenum, the first segment of the small intestine. These enzymes break down protein, fats and carbohydrates. The pancreas also makes insulin, secreting it directly into the bloodstream. Insulin is the chief hormone for metabolizing sugar.

## Liver

The liver has multiple functions, but its main function within the digestive system is to process the nutrients absorbed from the small intestine. Bile from the liver secreted into the small intestine also plays an important role in digesting fat. In addition, the liver is the body's chemical "factory." It takes the raw materials absorbed by the intestine and makes all the various chemicals the body needs to function. The liver also detoxifies potentially harmful chemicals. It breaks down and secretes many drugs.

## Gallbladder

The gallbladder stores and concentrates bile and then releases it into the duodenum to help absorb and digest fats.

## Colon (large intestine)

The colon is a 6-feet long muscular tube that connects the small intestine to the rectum. The large intestine is made up of the cecum, the ascending (right) colon, the transverse (across) colon, the descending (left) colon and the sigmoid colon, which connects to the rectum. The appendix is a

small tube attached to the cecum. The large intestine is a highly specialized organ that is responsible for processing waste so that emptying the bowels is easy and convenient.

**Interesting Fact**

With in the colon a typical person harbours more than 400 distinct species of bacteria.

Stool, or waste left over from the digestive process, is passed through the colon by means of peristalsis, first in a liquid state and ultimately in a solid form. As stool passes through the colon, water is removed. Stool is stored in the sigmoid (S-shaped) colon until a "mass movement" empties it into the rectum once or twice a day. It normally takes about 36 hours for stool to get through the colon. The stool itself is mostly food debris and bacteria. These bacteria perform several useful functions, such as synthesizing various vitamins, processing waste products and food particles and protecting against harmful bacteria. When the descending colon becomes full of stool, or feces, it empties its contents into the rectum to begin the process of elimination.

### Rectum

The rectum (Latin for "straight") is an 8-inch chamber that connects the colon to the anus. It is the rectum's job to receive stool from the colon, to let the person know that there is stool to be evacuated and to hold the stool until evacuation happens. When anything (gas or stool) comes into the rectum, sensors send a message to the brain. The brain then decides if the rectal contents can be released or not. If they can, the sphincters relax and the rectum contracts, disposing its contents. If the contents cannot be disposed, the sphincter contracts and the rectum accommodates so that the sensation temporarily goes away.

### Anus

The anus is the last part of the digestive tract. It is a 2-inch long canal consisting of the pelvic floor muscles and the two anal sphincters (internal and external). The lining of the upper anus is specialized to detect rectal contents. It lets you know whether the contents are liquid, gas, or solid. The anus is surrounded by sphincter muscles that are important in allowing control of stool. The pelvic floor muscle creates an angle between the rectum and the anus that stops stool from coming out when it is not supposed to. The internal sphincter is always tight, except when stool enters the rectum. It keeps us continent when we are asleep or otherwise unaware of the presence of stool. When we get an urge to go to the bathroom, we rely on our external sphincter to hold the stool until reaching a toilet, where it then relaxes to release the contents.

## DIGESTION IN GRASS EATING ANIMALS

**Interesting Fact**

A cow makes 40,000-60,000 jaw movements in a day.

Grass eating animals (herbivores) like the cow, deer, ox, buffalo and sheep swallow the food without chewing. After feeding, they bring the food from the stomach back into the mouth and chew it. This process is called rumination and such animals are called ruminants. Though their main diet is plants, they are unable to digest, because of lack of cellulose breaking enzymes. For this, they maintain a symbiotic relation with microorganisms. Microbes help in breaking down of cellulose (constituent of plant cell wall). Ruminants have one stomach with four compartments or chambers for digestion of food.

**Rumen (First Chamber) :** The largest organ, that allows for bacterial and chemical breakdown of fiber.

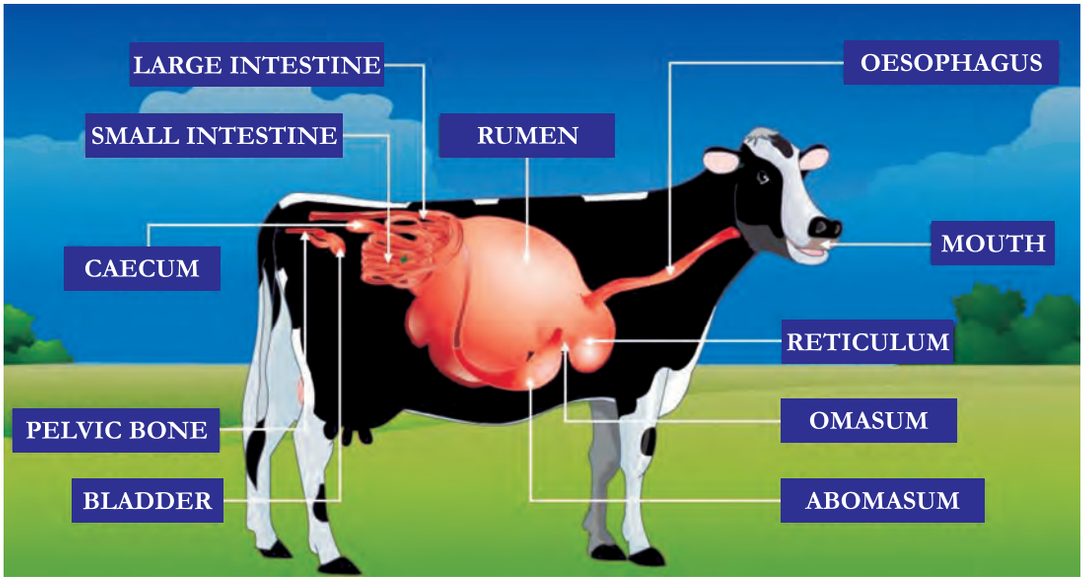
**Interesting Fact**

In an adult cow, the rumen has a capacity of more than 250 litre. In an adult cow the digestion takes approximately 60-100 hours whereas in humans it takes 3-4 hours.

**Reticulum (Second Chamber) :** Called as the "honeycomb" because of the honeycomb appearance of its lining. It collects smaller particles and moves them into the omasum, while the larger particles remain in the rumen for further digestion. It also traps any foreign material that the animal may picks up. It stores foreign objects and prevents the damaging items entering into digestive tract.

**Omasum (Third Chamber) :** Helps in the absorption of water, magnesium and the volatile fatty acids produced by rumen fermentation, that have not been absorbed into the bloodstream yet.

**Abomasum (Fourth Chamber) :** This is called true stomach, most similar to a stomach in a non-ruminant. Majority of chemical breakdown of food material occurs here with the help of digestive enzymes (pepsin, rennin, bile, etc.) and hydrochloric acid. The abomasum secretes mucous to protect its wall from acid damage.



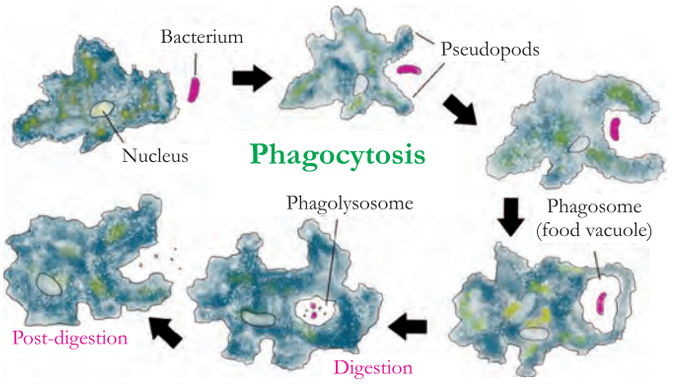

## FEEDING AND DIGESTION IN AMOEBA

Do you ever wonder how the amoeba eats its food even though it does not have a mouth? It has several finger-like projections called pseudopodia that help it take in the food.

Amoeba is a microscopic unicellular organism. It mostly resides in places like pond water. It's structure consists of the following basic components:

- A cell membrane
- A nucleus

- Cytoplasm, endoplasm and ectoplasm
- Small food vacuoles ( these look like small bubbles )
- Finger-like projections called pseudopodia (also known as 'false feet' )



Process of Phagocytosis in Amoeba

With the help of pseudopodia, this unicellular organism can not only change its size and shape but also capture its food! Amoeba possesses a holozoic mode of nutrition and process is known as "phagocytosis". The basic processes involved in the nutrition include:

**Ingestion :** Amoeba takes in its food through this process. Initially, it pushes out its pseudopodia so that it can encircle the food. After this, it engulfs the food, thus forming a bag-like structure called food vacuole. The process is known as "phagocytosis".

**Digestion :** This step follows ingestion. The food vacuoles are rich in various digestive enzymes. These enzymes break down large insoluble foodstuffs consequently yielding simple soluble molecules.

**Absorption :** It is the process of absorption of the digested food material into the cytoplasm leaving behind the undigested food material. Sometimes the amoeba absorbs large quantities of food. What happens to the excess food? Well, the excess food gets stored in the form of glycogen as well as lipids.

**Assimilation :** This is the "utilization" process. During this process, the absorbed food is utilized for energy production, growth, repair as well as for multiplication.

**Egestion :** Finally, the cell membrane gets ruptured so that the undigested food material is thrown out of the body.

INGESTION ⇒ DIGESTION ⇒ ABSORPTION ⇒ ASSIMILATION ⇒ EGESTION

## Key Words

| | | |
|---|---|---|
| **Pseudopodia** | : | The false feet of an amoeba |
| **Holozoic nutrition** | : | A mode of nutrition involving ingestion, digestion, absorption, assimilation and egestion |
| **Bile** | : | A secretion from the liver |
| **Rumen** | : | The part of a ruminant's stomach which helps to digest cellulose |

## Important Points

1. Animal nutrition includes nutrient requirement, mode of intake of food and its utilisation in the body.
2. The modes of feeding vary in different organisms.
3. The human digestive system consists of the alimentary canal and secretory glands. It consists of the (i) buccal cavity, (ii) oesophagus, (iii) stomach, (iv) small intestine, (v) large intestine ending in rectum and (vi) anus. The main digestive glands which secrete digestive juices are (i) the salivary glands. (ii) the liver and (iii) the pancreas. The stomach wall and the wall of the small intestine also secrete digestive juices.
4. Nutrition is a complex process involving : (i) ingestion, (ii) digestion, (iii) absorption, (iv) assimilation and (v) egestion.
5. The absorbed substances are transported to different parts of the body. Water and some salts are absorbed from the undigested food in the large intestine.
6. The grazing animals like cows, buffaloes and deer are known as ruminants. They quickly ingest, swallow their leafy food and store it in the rumen. Later, the food returns to the mouth and the animal chews it peacefully.
7. Amoeba ingests its food with the help of its false feet or pseudopodia. The food is digested in the food vacuole.
8. Digestion of carbohydrate, like starch, begins in the buccal cavity. The digestion of protein starts in the stomach. The bile secreted from the liver, the pancreatic juice from the pancreas and digestive juice from the intestinal wall complete the digestion of all components of food in the small intestine. The digested food is absorbed in the blood vessels from the small intestine.
9. The undigested and unabsorbed residues are expelled out of the body as faeces through the anus.

## Exercise

### Multiple Choice Questions (MCQs)

**A. Tick (✓) the correct option :**

1. Saliva contains an enzyme called :
   (a) trypsin ☐ (b) pepsin ☐ (c) amylase ☐ (d) none of these ☐
2. The food that we eat is pushed down the oesophagues to the stomach by :
   (a) peristaltic movement ☐ (b) diastole ☐ (c) locomotion ☐ (d) pumping ☐
3. How many compartments do plant eating animals such as cows and buffaloes have?
   (a) One ☐ (b) Two ☐ (c) Three ☐ (d) Four ☐
4. Intake of food is also known as :
   (a) Ingestion ☐ (b) Nutrition ☐ (c) Egestion ☐ (d) Digestion ☐
5. The function of incisors is :
   (a) tearing ☐ (b) crushing ☐ (c) biting ☐ (d) grinding ☐
6. Which of the following glands secrets bile ?
   (a) Pancreas ☐ (b) Intestinal gland ☐ (c) Liver ☐ (d) Salivary gland ☐

7. The longest part of the human digestive system is the :
   (a) small intestine ☐ (b) rectum ☐ (c) oesophagus ☐ (d) large intestine ☐
8. The first chamber of a ruminant's stomach is the :
   (a) reticulum ☐ (b) abomasum ☐ (c) omasum ☐ (d) rumen ☐
9. In which of the following organs digestion of food does not take place?
   (a) Small intestine ☐ (b) Large intestine ☐ (c) Mouth ☐ (d) Stomach ☐

## B. Fill in the blanks :

1. The alimentary canal along with the digestive gland is known as _____.
2. There are _____ molars in each jaw.
3. _____ is the first organ of the alimentary canal.
4. The mode of nutrition in amoeba is _____.
5. Starch is broken into simple sugar with the help of _____ enzyme.
6. Food pipe is also called _____.
7. In the amoeba, _____ are used to capture food.
8. Saliva contains an enzyme called _____.
9. Bile is the digestive juice secreted by the _____.

## C. Match the following :

| Column A | Column B |
|---|---|
| 1. ruminant | (a) lipase |
| 2. salivary glands | (b) liver |
| 3. bile juice | (c) ptyalin |
| 4. fat | (d) rumen |

## D. Very Short Answer Questions :

1. What a fleshy muscular organ found in mouth is called?
2. What is the name of the digestion juice secreted by the liver?
3. Name the teeth that appear between the age of 18 and 20.
4. What is the process of breaking down of food into simpler compounds is called?
5. Name the smallest chamber in the cow's stomach.
6. Mention the location of taste buds.
7. In which part of the alimentary canal is water absorbed from food?
8. Name the largest chamber of a ruminant's stomach.

## E. Short Answer Questions :

1. Name the different organs that form the alimentary canal.
2. What is peristaltic movement?
3. Name the chambers present in stomach of ruminants.
4. What do you mean by the term digestion?

5. Differentiate between :
   (a) Absorption and Assimilation
   (b) Ingestion and Egestion
6. What are the functions of tongue?
7. What is mastication?
8. How do ruminants digest cellulose?

**F. Long Answer Questions :**

1. What are four types of teeth in humans? What are their functions?
2. Name the various types of enzymes, the food they act upon and the substance produced.
3. Draw a well labelled diagram of the human alimentary canal.
4. How digestion takes place in a ruminant?
5. Discuss briefly the human digestive system.
6. Describe nutrition in an amoeba by a labelled diagram.
7. Explain the process of digestion in ruminants.
8. What are the steps of holozoic nutrition? Explain each of them.

## Project Work

**A. Read the passage and answer the following questions.**

Carbohydrates are the basic source of energy for all animals. Animals obtain their carbohydrates from the external environment (compared with plants, which synthesize carbohydrates by photosynthesis). About one-half to two-thirds of the total calories every animal consumes daily are from carbohydrates. Glucose is the carbohydrate most often used as an energy source. This monosaccharide is metabolized during cellular respiration and part of the energy is used to synthesize adenosine tri phosphate (ATP). Other useful carbohydrates are maltose, lactose, sucrose and starch.

1. What is the basic source of energy for animals?
2. Write the percentage of calories that animals consume from carbohydrates.
3. Write the name of carbohydrates most often used as an energy sources.
4. Write the full name of ATP.

### Project

1. Collect pictures of the skulls of different animals like dog, cow, sheep, lion and alligator, from books or the internet. Study their teeth. See how they differ from human teeth. Based on this, try to guess what kind of food each animal eats.
2. Collect information about one animal living on land, one in water and one in air, how it feeds and how it digests food.