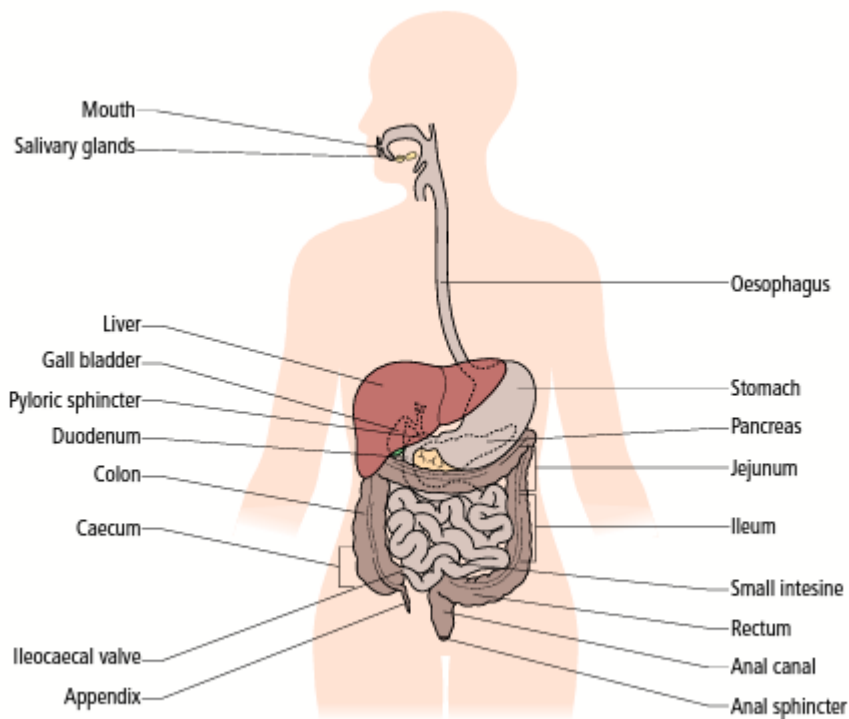


# Digestive system

The digestive system consists of a number of organs and structures that are involved with the process of taking in food and making it available to the body for absorption. The digestion system is coordinated by the hypothalamus of the brain, hormones and nerves.

All the energy the body needs and the raw materials for growth and repair of body structures come from the ingestion of food and drink. The food and fluids are processed by the digestive organs into small nutrient molecules that can be absorbed from the intestine and circulated around the body for use by the organs, tissues and cells to perform their individual functions. Any materials left after absorption that cannot be ingested become waste material or faeces and are eliminated from the body by defecation.



△ Structures of the digestive system

## Process of digestion

The process of digestion can be divided into the following stages:

- **Ingestion:** the journey of food along the alimentary canal begins in the mouth. Here, mechanical digestion takes place with the food being broken into small pieces by mastication (chewing). Chemical digestion also begins by the action of saliva which wets and softens the food ready for swallowing.
- **Digestion:** once in the stomach, digestion begins and involves both the mechanical and chemical breakdown of the food stuffs ready for absorption. The stomach and accessory organs produce juices which contain enzymes that break down the food into its constituent parts, while churning the contents to ensure that the food stuffs and juices are thoroughly mixed.
- **Absorption:** the contents of the stomach are periodically released into the small intestine so that the digested food can pass through the walls into the surrounding blood and lymph capillaries for circulation round the body to be used by cells and tissues.
- **Elimination:** food substances which have been eaten but cannot be digested and absorbed are excreted by the bowel.

## Structures of the digestive system

The structures of the digestive system can be divided into two parts – the alimentary canal and the accessory organs. The alimentary canal is made up of:

- mouth
- pharynx
- oesophagus
- stomach
- small intestine
- large intestine.

The accessory organs involved with digestion are:

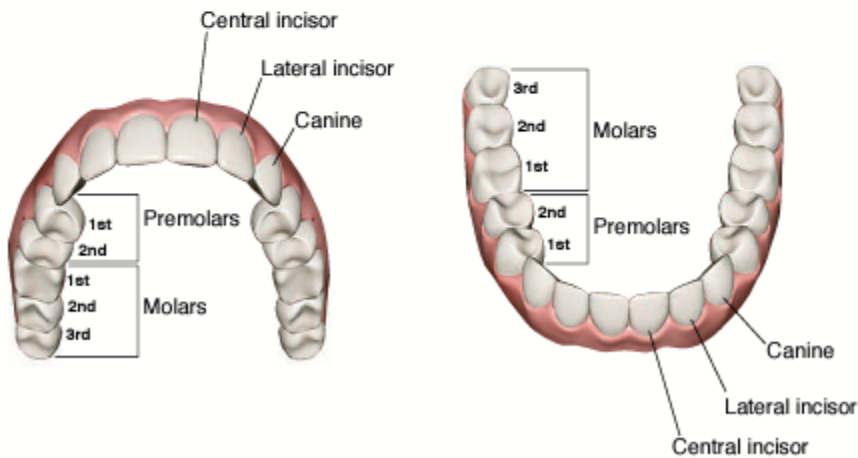
- liver
- gall bladder
- pancreas.

# Mouth

The tongue, teeth and salivary glands all have a part to play in the digestive processes that occur in the mouth. The tongue is used to move and mix the food, presenting it to the teeth for mastication.

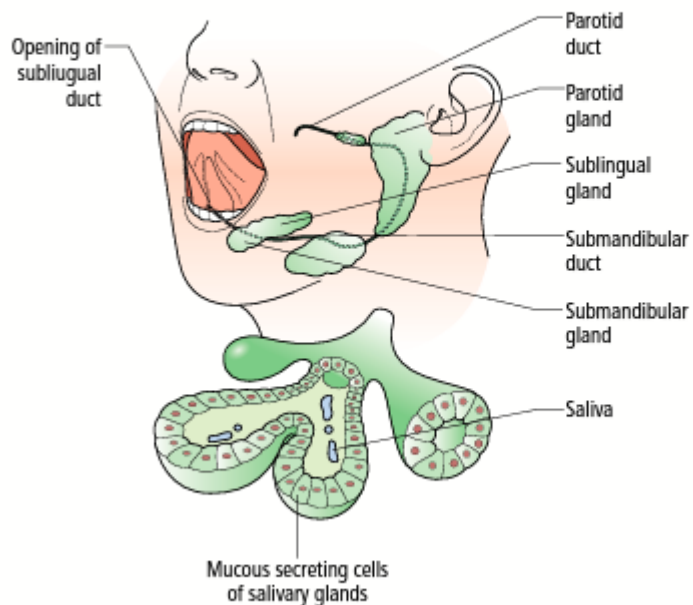
The teeth perform the tearing off and breaking down of the food into smaller particles that are easier to swallow and are assisted by the muscles of mastication that provide the force needed. There are different types of teeth, each performing different functions within this mechanical digestion process.

The incisor and canine teeth are used for biting off pieces of food and have sharp edges for this purpose. The premolars and molars have broad, flat surfaces and are used for grinding and chewing the food into smaller pieces.



△ Different types of permanent teeth

The saliva glands in the mouth provide the chemical digestion part of the process. The glands produce saliva, which serves two functions: first, it moistens the food, making it easier to swallow and then it begins the breakdown of carbohydrates (mainly starch).



△ Salivary glands

## Pharynx

After sufficient chewing and mixing with saliva the ball of food is forced to the back of the mouth by the tongue into the pharynx or throat, where it is swallowed by the action of the muscles of the pharynx.

## Oesophagus

The oesophagus is a tube that links the mouth and throat to the stomach. Involuntary muscle tissue within the walls of the oesophagus contract in a wave-like motion called peristalsis to move the ball of food into the stomach.

## Stomach

The stomach is positioned to the left-hand side of the abdominal cavity underneath the diaphragm and is a strong muscular hollow structure into which the ball of food from the mouth enters via the cardiac sphincter. The inner lining of the stomach is made of specialised epithelial cells that secrete gastric juices that break down the food ball into its chemical constituent parts, namely the enzyme pepsin, which acts upon proteins in the food and hydrochloric acid, which is needed to activate the pepsin. The latter also destroys the micro-organisms present in and on food. The muscular walls of the stomach contract to churn and mix the gastric juices and the food together to ensure thorough break down into its chemical parts so that they can be absorbed by the body. Alcohol and water are absorbed through the stomach wall into the blood stream. Food can remain in the stomach for 4–5 hours and is released in phases into the small intestine via the pyloric sphincter.

## Liver

The liver has several important functions within the body and assisting in the digestion of food is just one. It is a large organ situated in the upper abdominal cavity to the right of the stomach and produces an alkaline substance called bile. Bile is stored in the gall bladder and released into the small intestine to neutralise the acidic contents of the stomach. The other functions of the liver include:

- storage of vitamins A, B and D, iron and other minerals
- detoxification of the blood, e.g. removal of drugs, including alcohol
- conversion of carbohydrates into fats to be stored elsewhere in the body.

## Gall bladder

The gall bladder is a small organ connected to the liver and the small intestine and stores the bile until it is needed.

## Pancreas

The pancreas is situated behind the stomach and serves a digestive and endocrine function. To aid digestion, it produces pancreatic juice containing several enzymes which act upon fats, carbohydrates and proteins in the food to break them down into their chemical components so they can be absorbed.

## Small intestine

The small intestine is a hollow tube about 7 metres long that winds around to fill the abdominal cavity. It has numerous folds or projections into the centre of the tube called villi which increase its surface area and facilitate the absorption of the chemical parts of the food ball being broken down by the action of enzymes. It has three distinct parts:

- Duodenum: the first part of the small intestine and is about 25–30cm long. The bile and pancreatic ducts open out into the duodenum and intestinal juice is produced by special cells in the lining to digest the food, further acting upon fats, carbohydrates and proteins.
- Jejunum: about 2.5 metres long and follows on from the duodenum.
- Ilium: about 4.2 metres long and follows on from the jejunum. It empties into the large intestine via the ileo-caecal sphincter. Absorption of the nutrients from the food has mostly been completed, including the re-absorption of water, and what remains is a hardened mass of undigested material. Present also at the junction of the ilium with the large intestine is the appendix, a small projection about 8cm long made of lymphatic tissue.

## Large intestine

The large intestine is about 1.5 metres long and is often called the colon. It has three parts

- Ascending colon: runs from the lower right-hand side of the abdomen upwards towards the ribs.
- Transverse colon: runs across the upper abdominal cavity from right to left.
- Descending colon: runs down the left-hand side of the abdominal cavity.

The hardened undigested material or faeces is pushed through the large intestine by the action of its muscular walls into the rectum and finally excreted out of the anus.



## Dietary components

The foods we eat are a complex and varied mix of the following dietary components and it is the job of the digestive system to break these down into chemical components that are small enough to be absorbed and utilised by the body. The main dietary components are:

- carbohydrates
- fats
- proteins
- vitamins
- minerals
- fibre
- water.

Dietary component	Common food sources	Chemical components	Use in the body
Carbohydrates including starch, sugar and cellulose	Cereals, confectionary, potatoes, pasta and rice, fruit and milk and milk products	Glucose; fructose; sucrose; lactose	Prime source of energy in the body but can be converted into body fat when eaten in excess
Fats	Meat, milk and milk products, crisps and peanuts, biscuits and chocolate	Fatty acids	Used for energy and insulation to maintain body temperature but stored when eaten in excess
Proteins	Meat, chicken, fish, pulses	Amino acids	Growth and repair of body tissues; can be used for energy if carbohydrates and fats are not available
Vitamins A, B, C, D, E and K	Variety of fresh foods such as meat and fish, fruit and vegetables	N/A	Healthy functioning of the body's organs
Minerals such as calcium, sodium, iron, etc.	Meat and fish, cereals and grains, fruit and vegetables	N/A	Healthy functioning of the body's organs
Fibre	Wholegrain cereals, pulses, fruit and vegetables	Unchanged by digestion	Insoluble fibre adds bulk to the faeces; soluble fibre reduces blood cholesterol levels
Water	Found in many of our foods as well as in the fluids we drink	Unchanged by digestion	Essential for life; needed by many of the body's processes

## Disorders of the digestive system

Disease/disorder	Cause	Description
Crohn's disease	Caused by a genetic disposition to the immune system reacting to its environment. Foods, stress and some drugs including cigarette smoking are thought to be aggravating factors	Inflammation of the digestive tract with a variety of symptoms from abdominal pain, diarrhoea, vomiting and weight loss
Gall stones	Deposits such as cholesterol accumulate in the gall bladder; exacerbated by diabetes, liver dysfunction, organ transplant or rapid weight loss associated with 'crash' dieting	Hard, stone-like accumulations found within the gall bladder, varying in size from as small as a grain of sand to a table-tennis ball. Symptoms include pain in the abdomen, fever and jaundice
Hiatus hernia	Obesity, pregnancy, heavy lifting, excessive coughing or sneezing, constipation	A weakness in the diaphragm allows a part of the stomach to protrude through into the thoracic cavity, leading to dull pain in the chest, shortness of breath and heart palpitations
Irritable bowel syndrome (IBS)	Cause is unknown but stress is thought to be a contributing factor; also certain foods can aggravate the condition	Symptoms include pain and discomfort, bloating and bouts of diarrhoea and constipation