# HUMAN BODY SYSTEMS

## Animal Tissues

In all the animals, tissues develop from the embryonic germ layers during the blastula (early stage of embryonic development) phase. On the basis of germ layers, all animals except Porifera and Protozoa; there are either two or three germ layers.

The animals which develop from two germ layers (ectoderm and endoderm) are called Only Ctenophores (comb jellies) and Cnidarians (Hydra, Corals, Sea Anemones, Jelly Fishes, Sea Pens) have this feature.

The animals which develop from three germ layers viz. ectoderm, mesoderm and endoderm are called triploblastic. All animals from Platyhelminthes to Humans are triploblastic.

## Types of Animal Tissues

There are 4 categories of animal tissues viz. Epithelial Tissue, Connective Tissue, Muscular Tissue and Nervous Tissue.

## Epithelial Tissue

Epithelial tissue makes the covering of the internal organs as well as our body. This is the simplest and non-specialized tissue. Epithelial tissue originates from all the three embryonic layers viz. Ectoderm, Mesoderm and Ectoderm.

## Connective Tissue

The tissues that bind several tissues in the body are called connective tissues. They do the function of supporting the organs and packaging of the organs. Please note that except muscles all the connective tissue is derived from the mesoderm of the embryonic blastula. 30% of the body by mass is composed of connective tissue. This tissue includes connective tissue proper, skeletal issue and fluid tissue.

**COLLECTIVE TISSUE PROPER INCLUDES THE BELOW TWO TYPES:**

Collagen fibres which make tendons that connect muscles to bones. We note here that Vitamin C helps in synthesis of Collagen and lack of vitamin C causes a deficiency of connective tissue called "Scurvy".

Yellow elastic fibres which make ligaments that connect bones to bones. Yellow elastic fibres are also present in arteries to provide elasticity to them. We note here that Yellow Elastic Fibre is resistant to chemical change, though it loses elasticity with aging. Resistance to chemical change is also evident from the fact that when mummies are dissected, arteries are among the internal organs that might be found in most intact condition!

Skeletal Tissue is derived from the mesoderm of embryonic blastula {this question is frequently asked in UPSC and state exams}. There are two types of skeletal tissues viz. cartilage and bone.

Cartilage is softer, elastic tissue that makes joints between bones, rib cage, ear, nose, bronchial tubes, intervertebral discs etc.

Bone is a highly mineralized tissue in which connective tissue part is 1/3rd while mineral part is 2/3rd portion.

Fluid Connective Tissue includes Blood, Lymph and Cerebrospinal fluid(CSF). Blood and Lymph circulate in the body and help in transportation of the metabolites. They have a common matrix called plasma. They have various kinds of cells which are called "corpuscles. There are no fibers or matrix in fluid connective tissue.

**NERVOUS TISSUE**

Nervous Tissue is the main component of brain; spinal cord and peripheral nerves. It helps in the regulation and control of body functions and activities and allows us to see and perceive the world. It is made of neurons {nerve cells}, and Neuroglia, which helps in propagation of the nerve.

**MUSCULAR TISSUE**

These tissues are made of muscle fibres whose contractions and relaxations provoke the movement and locomotional activities.

### Digestive System

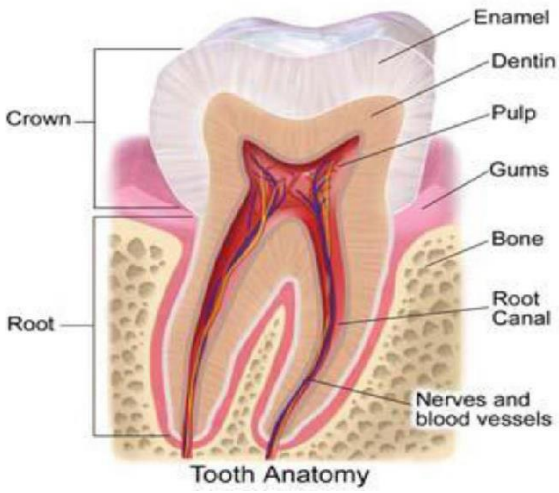
The digestive system is made up of the digestive tract and other organs that help the body break down and absorb food. Organs that make up the digestive tract include mouth, oesophagus, stomach, small intestine, large intestine (also known as colon rectum) and anus. Inside these hollow organs is a lining called the mucosa.

### Mouth / Oral Cavity

The oral cavity has a number of teeth and a muscular tongue.

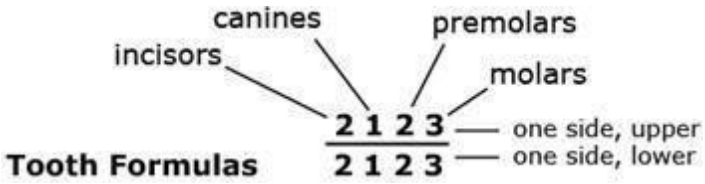
### Teeth

Each tooth is embedded in a socket of jaw bone. Most of the animals including humans have two sets of teeth during their life. First set is of temporary milk or deciduous teeth, which is replaced by a set of permanent or adult teeth. Adult human has 32 permanent teeth which are of four different types viz. Incisors, Canines, Premolar and Molars.


Incisors are the eight front teeth (4 up, 4 down). Canines are another four teeth on either side of incisors in both sides (2 up, 2 down). Beyond canines are eight premolars (4 up, 4 down). These teeth have two pointed cusps on their biting surface and are sometimes referred to asbicuspids. Beyond Premolars are 12 molars (6 up and 6 down) thus making a set of 32 teeth in humans. The three pairs of molars in upper or lower jaw are denoted as first, second and third molars. Third molar is also known as wisdom

teeth that come up in 30s. The above system is arranged in the form of a dental formula, which is 2123/2123 in humans.

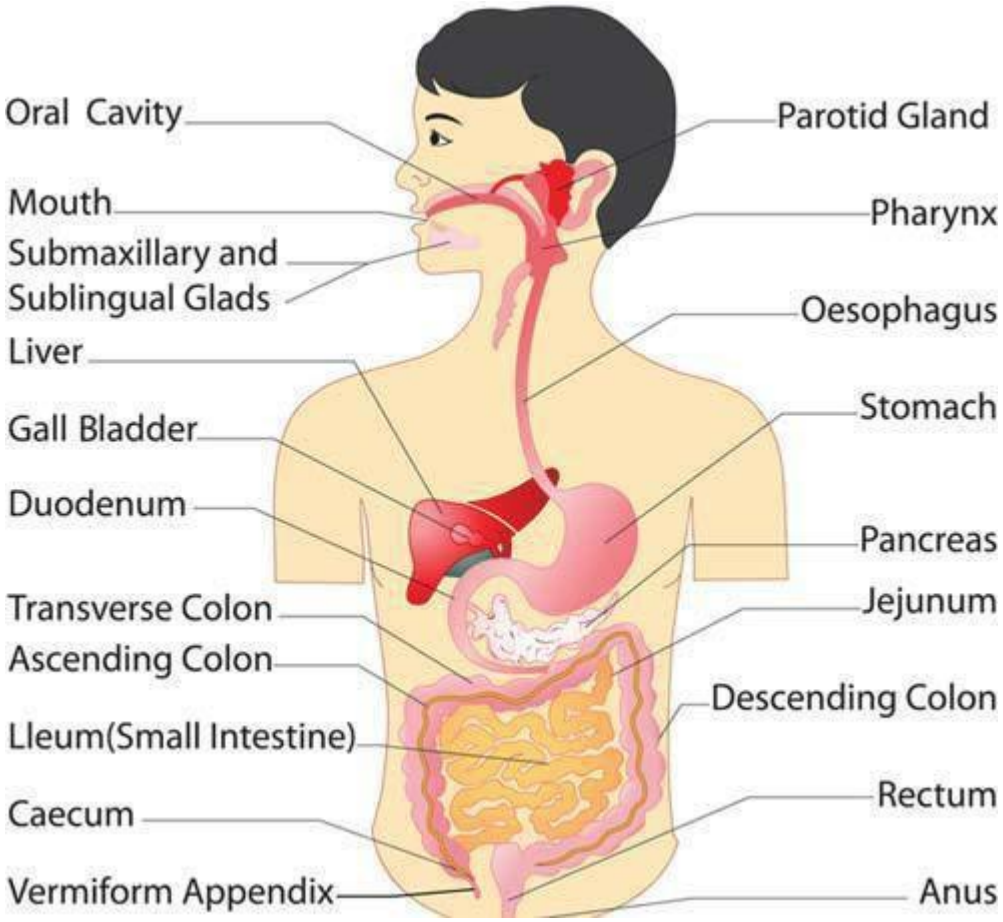



In children, there are only 20 deciduous teeth or milk teeth. They begin to develop before birth and begin to fall out when a child is around 6 years old. The dental formula for milk teeth is2102. We note here that Children don't have premolars. Their premolar is called by dentists as first molars rather. These baby molars are replaced by adult premolars.

Human teeth are made up of four different types of tissues viz. pulp, dentin, enamel, and cementum. Pulp is the innermost portion of the tooth and consists of connective tissue, nerves, and blood vessels, which nourish the tooth. Pulp is surrounded by Dentin, a hard yellow substance that makes up most of the tooth and is as hard as bone. Enamel which covers the dentin ishardest tissue in the body and forms the outermost layer of the crown. A bony layer of cementum covers the outside of the root, under the gum line, and holds the tooth in place within the jawbone. Cementum is also as hard as bone.

#### STEPS IN DIGESTION

The digestive system performs four functions viz. ingestion, digestion, absorption and elimination. Ingestion is intake of food. Digestion is of two types viz. mechanical (food is broken down into smaller pieces, this begins as soon as we put food in our mouth) and chemical (use of enzymes and acids to break down consumed food). Absorption is the assimilation of digested food in cells while elimination is passing out of what we cannot digest. The entire digestive system is made of alimentary canal and accessory digestive organs. Alimentary canal is made of salivary glands, Pharynx, Oesophagus, stomach, small intestine and large intestine. Accessory digestive organs are liver, gallbladder and pancreas.




**DIGESTION IN MOUTH CAVITY**

Salivary glands release saliva in mouth cavity which contains Salivary Amylaze enzyme that digests starch into sugars. Further, another enzyme called lingual lipase also begins digestion of the lipids / fats in mouth cavity only. Thus, while digestion of carbohydrates and lipids begins in mouth cavity, digestion of proteins begins only in stomach in highly acidic environment. Mouth cavity leads to pharynx that is common passage for food and air. When we swallow the food, the windpipe is closed by a flap of cartilage behind the root of the tongue. This flap is called epiglottis. Beyond epiglottis is Oesophagus, a food pipe which ends in stomach. At the junction of the oesophagus and stomach, there is a

ring like muscle, called the oesophageal sphincter that relaxes and allows the food to pass through to the stomach. No digestion takes place in oesophagus.

### Digestion In Stomach

The Stomach has three mechanical tasks. To store the swallowed food, to mix up the food, liquid, and digestive juice produced by the stomach and to empty its contents slowly into the small intestine. Digestion of carbohydrates, proteins as well as fats takes place in stomach. We note here that least time is needed to digest carbohydrates, more for protein and maximum for fats.

### Key Enzymes In Stomach

The main gastric enzyme is Pepsin which is secreted in inactive form called Pepsinogen. It is activated by stomach acid (HCl). It breaks protein into peptide fragments and amino acids. Here, Hydrochloric acid plays role to denture the proteins and kill any bacteria or viruses in the food. Another stomach enzyme is Gastric lipase. It works in acidic environment {other lipases such as pancreatic lipase work in alkaline environment} digests fats and lipids.

### How Stomach Saves Itself From Acids Secreted?

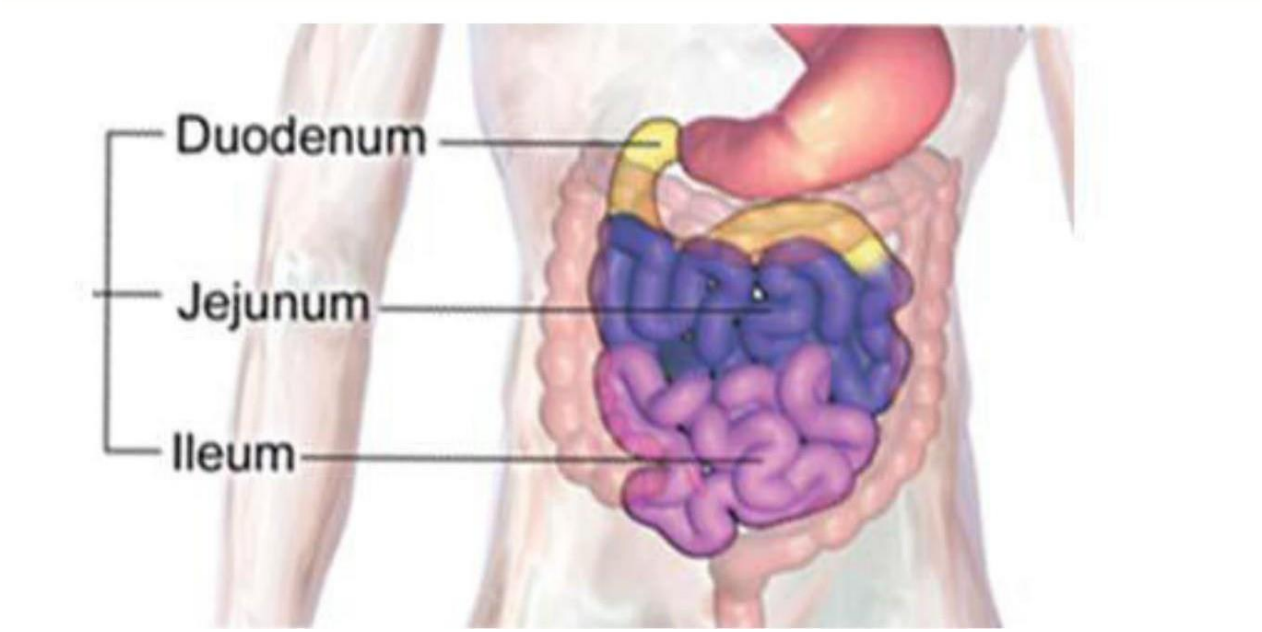
Stomach has highly acidic environment. To protect its own lining from digestion by digestive juices, it secrets Mucin and carbonate from its mucous cells. This is one way to save its own cells. Another way is a high turnover of stomach cells.

### Function of Gastrin Hormone

Gastrin is an important hormone of G-cells of stomach. It stimulates stomach cells to produce hydrochloric acid (HCl) and another chemical called Intrinsic factor (IF).

### Digestion in Small Intestine

Small intestine is largest part of digestive system (around 6 meters) and divided into three parts viz the duodenum, jejunum and ileum.




By the time food is ready to leave the stomach, it has been processed into a thick liquid called chyme. A walnut-sized muscular valve at the outlet of the stomach called thepylorus keeps chyme in the stomach until it reaches the right consistency to pass into the small intestine. Once entered into duodenum, the chyme comes into contact with pancreatic juice with a pH of approximately 8.5. Thus, the hitherto acidic environment of stomach (pH near 2) is turned into alkaline environment. Here we note that the neutralization of the acidity of the chyme is necessary for the functioning of the digestive enzymes that act in the duodenum. Further, without neutralization of the acidity of the chyme, mucous membrane of the intestine would be damaged.

What happens here is that the acidity of chyme stimulates production of a hormone called secretin in the duodenum. Secretin stimulates the pancreas to release pancreatic juice and also signals the gallbladder to expel bile in the duodenum. The pancreatic secretion, rich in bicarbonate ions, is released in the duodenum and neutralizes the chyme acidity; this acidity is also neutralized by the secretion of bile in the duodenal lumen. Further, most of the chemical digestion of fats begins only in duodenum via so calledemulsification process.

### Role of Liver: Bile Juice and Emulsification

Bile, an emulsifier liquid, is made by the liver and later stored in the gallbladder and released in the duodenum. Bile is composed of bile salts, cholesterol and bile pigments. Bile salts are detergents, amphiphilic molecules, or rather, molecules with a polar water-soluble portion and a non-polar fat-soluble portion. This feature allows bile salts to enclose fats inside water-soluble micelles in a process called emulsification. Through this process, fats come into contact with intestinal lipases, enzymes that break them down into simpler fatty acids and glycerol.

### Why Patients With Gall Stones Are Not Allowed To Take Fatty Foods?

Bile is concentrated and stored in the gallbladder. When foods high in fat are ingested, the gallbladder contracts to release bile into the duodenum. This is the reason why patients with gallstones are advised to not to eat fatty foods, because the reactive contraction of the gallbladder may move some of the stones to the point of blocking the duct that drains bile into the duodenum, causing pain and other complications.

### Other functions of Liver

Apart from making bile for releasing in small intestine, Liver is also a site for storing, processing and inactivating poisons in food. This work is done by a network of veins in the liver called mesenteric circulation. Liver also polymerizes glucose and stores it as Glycogen. It stores many vitamins and the iron absorbed in the intestine. It detoxifies poisonous substances such as alcohol, nicotine, drugs etc.

### Role of Pancreas

The pancreas produces enzymes that help digest proteins, fats, and carbohydrates. It also makes a substance that neutralizes stomach acid. The pancreatic juice is released into the mixture that contains the following enzymes to help chemically digest fats and carbohydrates:

Pancreatic Lipase breaks apart fat molecules into fatty acids and glycerol.