DIGESTION

Digestion is the breakdown of large insoluble macromolecules into smaller soluble micromolecules

Major components of food- proteins, lipids, carbohydrates, etc…

Major organs=Mouth-Buccal Cavity-pharynx-Oesophagus-Stomach-Small Intestine-Large intestine-Anus

Mouth-Digestion starts in mouth. Contains-Teeth & Tongue

Dentition (Refers the number, kinds and arrangement of teeth)

Human dentition is

Thecodont, -Teeth are placed in jaw sockets

Diphyodont- Teeth appear twice in the whole life.

1. Milk or desiduous teeth

2. Permenant or adult teeth

HETERODONT- Teeth are different types or dissimilar inhuman namely **Incisors , Canine, Premolars, Molars**

Human dental formula

The kind and number of teeth are explained in the form of formula is called dental formula.
I - 2/2 C - 1/1 P - 2/2 M - 3/3 = 16 x 2 = 32
I = incisors, C = canines, P = premolars and M = molars

- **Milk Dentition Formula I-2/2, C- 1/1 Pm 0/0 M 2/2=20**

TONGUE- Attached to the floor of the buccal cavity by frenulum

The upper surface with numerous papillae or taste buds.

PHARYNX

- A common passage for food and air
- food goes into oesophagus

- Air goes to glottis(opening of the larynx)
- Glottis closes with epiglottis when we swallow food
- **Oesophagus-** A thin long tube
- **Peristalsis**- Involuntary wave-like muscle contractions which move food along the digestive tract
- A muscular **oesophageal sphincter** regulates the opening to the stomach from oesophagus
- Stomach- Three parts
- 1.Cardiac,
- 2.Fundus,
- 3. Pylorus
- The inner layer of stomach forms irregular folds –**Rugae**

  Food mixes and grind thoroughly in stomach & it is called – **CHYME**

  Then food goes into the duodenum, the first part of the small intestine
- The opening of the duodenum is guarded by a sphincter- **PYLORIC Sphincter**
- **SMALL INTESTINE-** Long, highly coiled, narrow tube,Seven meters long
- Divided in to 3 parts
- **1.DUODENUM,'**U' shaped, Area of digestion
- Receives common opening of the bile and pancreatic duct**.**
- **, 2. Jejunum-** Coiled and longer
- **3.ileum-**Highly coiled , Area of absorption
- Opens into the large intestine
- **LARGE INTESTINE** 1.5 metres long, Differentiated into
- **1. Caecum** ,

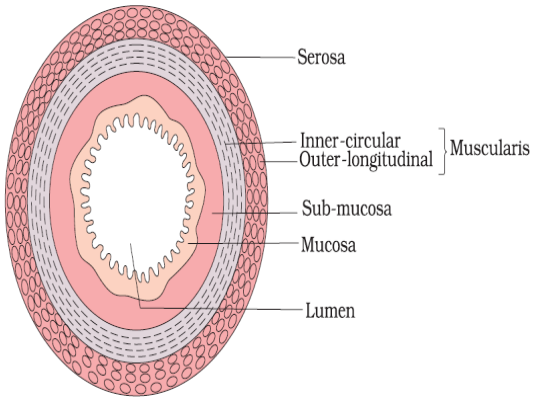
- Small blind sac, No absorption,It hosts some symbiotic microorganisms.
- Bears Vermiform Appendix (A small finger like projection from caecum with unknown function)

2. Colon with 3 parts

- Ascending
- Transverse
- Descending
- **3 Rectum** -Temporary storage of faeces
- Rectum opens out by Anus**.**

Wall of Alimentary canal

- **4 layers**
  - **1.Serosa (Thin mesothelium**
  - **2.Muscularis (Smooth muscles)**
  - **3.Sub-mucosa (Loose connective tissue with nerves, blood and lymph vessels)**
  - **4.Mucosa (includes Villi in intestine and Rugae in stomach)**



Mucosal layer forms small finger like folding- **Intestinal villi-**

- **Lacteal-** Lymph vessel in the center of the villus
- Each villus has numerous microvilli.
- **Crypts of lieberkuhn-**Glandular cells present at the base of the villi
- Function of the villi-Increases the surface area for digestion and absorption of food

Digestive glands and enzymes

1.Salivary glands

2. Gastric glands

3. Liver

4. Pancreas

5. Intestinal Glands

1.Salivary Glands

3 pairs ofsalivary glands -1. **Sub mandibular**(On lowerjaw)

- 2. **Sublingual** (below toungue)
- 3. **Parotid** (on cheek)
- Produces **saliva**
- pH-6.8

Contains-1.Mucus- **helps in lubrication**

- 2.Lysozyme-**act as an antibacterial agent**
- 3.Enzyme-**Salivary Amylase-** Converts **Starch to Maltose**

2.GASTRIC GLANDS

- Found on the wall of stomach
- Formed of three kinds of cells

  1. Mucous cells

  2. Chief cells or Zymogen cells

  3. Oxyntic cells or Parital cells

- Secretes Gastric juice
- pH=1.5 to 2.5 Acidic in nature & Contains.
- **Contains 1. Mucous 2. HCl 3.Enzymes**

  Mucous--protects stomach wall from proteolytic enzymes and action of HCL Produces by the Globet cells of stomach

- **HCl** - Kills micro organism
- Lowers the pH of the stomach (1.5 to 2.5)
- Activate inactive pepsinogen to active pepsin.
- Produces by the Oxyntic cells or Parietal cells.

Enzymes 1.Pepsin

- 2.Rennin
- 3.lipase

- Enzymes are produces by the chief cells or zymogen cells
- Pepsinogen(Inactive form) $\xrightarrow{HCl}$ Pepsin (Active form)

  Pepsin breaks down large proteins into Proteoses
- Proteins $\xrightarrow{Pepsin}$ Proteoses
- **Rennin** -helps in digestion of milk proteins

3.LIVER

- Largest gland in the human body
- Bi lobed
- Secrete bile
- Contains numerous hepatic lobules- the functional units.
- Each lobule is formed of hepatic cells
- bile is secreted by hepatic cells
- Each lobule is covered by a sheath called Glisson's capsule

Gall bladder- Bile is stored and Concentrated in a thin muscular sac called gall bladder

- Duct from liver –hepatic duct
- Duct from gall bladder-Cystic duct
- Cystic duct + hepatic duct= common bile duct

- Bile duct + pancreatic duct = hepato pancreatic duct opens to duodenum
- The common hepato - pancreatic duct, is guarded by a sphincter called sphincter of Oddi.

BILE- Bile is a bitter, greenish-yellow alkaline fluid,

Contains 1.**Bile pigments**(Bilirubin, biliverdin)

- 2.**Bile salts**
- 3.**Cholestero**l
- but contains **no enzymes**

Function-1.Bile **emulsifies** lipids

- 2.It neutralises the acid food from the stomach.

Emulsification

- Bile helps emulsify the fats.
- Convert the fat into smaller micelles to make their surface area larger**.**
- So that the lipase can digest quicker. (act like detergents to breakup fats.)

4.PANCREAS

- Second largest glands
- Heterocrine gland (both exocrine &endocrine)
- opens into the duodenum along with bile duct
- Secrete pancreatic juice.
- Enzymes of pancreatic juice

Contains 1.Typsin ,

- **2.Chymotrypsin,**
- **3 Carboxypeptidase**
- **4.pancreatic amylase,**

- **5.pancreatic lipase**
- **And 6. Nucleases**

  Functions of pancreatic enzymes

- **Carboxypeptidase, chymotrypsin and trypsin** are produced as their inactive forms **Trypsinogen, chymotrypsinogen, and pro-carboxypeptidase** respectively**.**
- **Trypsinogen is activated by enterokinase secreted from intestine**

- Trypsinogen $\xrightarrow{\text{enterokinase}}$ Trypsin
- Trypsin activates the chymotrypsinogen and Procarboxypeptidases

- Chymotrypsinogen $\xrightarrow{\text{Trypsin}}$ Chymotrypsin
- Procarboxypeptidases trypsin $\xrightarrow{\text{Trypsin}}$ carboxypeptidase

lipase

- It breaks down lipids into monoglycerides.
- **Nucleases**
- They digests nucleic acid into nucleotides and nucleosides
- **Amylases**
- converts polysaccharides to Disaccharides
- **5.INTESTINAL GLANDS**
- Produces intestinal juice or Succus Entericus
- Intestinal juice contains 1.maltase,
- 2. sucrase,
- 3.lactase
- 4.dipeptidase,

- 5.nucleotidase,
- 6.Nucleosidase and
- 7. lipase.
- **Action of Dipeptidases**
- Dipeptides $\xrightarrow{\text{Dipeptidase}}$ Amino Acids
- **Actions of Amylases**
- Maltose $\xrightarrow{\text{Maltase}}$ Glucose+Glucose
- Lactose $\xrightarrow{\text{lactase}}$ Glucose+Galactose
- Sucrose $\xrightarrow{\text{Sucrase}}$ Glucose+Fructose
- **Action of nucleases**

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

  Action of Lipases

  Di and Monoglycerides $\xrightarrow{\text{Lipases}}$ Fatty acids +Glycerol
- The teeth and tongue +saliva-- masticate and mix up the food into bolus.

The bolus enter into pharynx and then to oesophagus by swallowing or deglutition

- The stomach stores the food 4-5 hrs.
- The food mixes with acidic gastric juice to form paste.- **Chyme**
- **CARBOHYDRATE DIGESTION**
- Buccal cavity
- **Starch** $\xrightarrow{\text{Salivary amylase}}$ **Maltose**

  Stomach

  No carbohydrate digestion

Small Intestine

Starch $\xrightarrow{\text{Amylase}}$ Maltose

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

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

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

- DIGESTION AND ABSORPTION
- **The teeth and tongue + saliva masticate and mix up the food into bolus.**
- **The bolus is enter in to pharynx and then to oesophagus by swallowing or deglutition.**
- The stomach stores the food 4-5 hrs. The food mixes with acidic gastric juice to form paste.- **Chyme**
- Complete digestion takes place in the duodenum.
- The fully digested semi fluid food is known as **Chyle**

Absorption is carried out by

- Passive transport
- Facilitated transport
- Active transport-
- **Passive transport**-Glucose, amino acids , Cl- are generally absorbed by simple diffusion
- **Facilitated transport**-Fructose and some amino acids are absorbed with the help of carrier ions like sodium
- **Active transport** -Requires energy
- Against the concentration gradient
- Eg Amino acids, glucose, electrolytes like Na^+.
- **ABSORPTION OF FAT**
- Fatty acids and glycerol are insoluble in water,so they cannot be absorbed directly into blood.

- They enter into intestinal mucosa
- There they are formed into protein coated globules called **chylomicrones**
- They are transported into lymph vessels
- **LARGE INTESTINE** -No significant digestion occurs in the large intestine
- Absorption of water, minerals and certain drugs
- The undigested food enters into the caecum
- **Defecation- The ejection of faeces to the outside through the anal opening**
- **DISORDERS OF DIGESTIVE SYSTEM**
- Infections of the digestive system are caused by bacteria, virus, parasites like tape worm, thread worm, round worm, hook worm, pinworm etc.
- **VOMITING**- It is the ejection of stomach content through the mouth
- **DIARRHOEA-** The abnormal frequency of bowel movement and increased liquidity of faecal discharge is known as diarrhoea**.**
- It reduces the absorption of food.
- **JAUNDICE-** The liver is affected, skin, eyes turn yellow due to the deposition of bile pigments
- **CONSTIPATION-** The faeces are retained within the rectum as the bowel movement occurs irregularly.
- **INDIGESTION-** The food is not properly digested leading to the feeling of fullness.
- The causes of indigestion are inadequate enzyme secretion, anxiety, food poisoning, overeating and spicy food.

QUESTIONS

1.Explain the process of Protein digestion in various parts of alimentary canal? Score-3

2. Digestive enzymes, particularly proteases are secreted in an inactive from, reffered as zymogen, what is an advantage of this ? 2
3. Ramu ate boiled rice, what are the changes that it undergoes before being absorbed in the small intestine (1×2=2)
4. Give below in bracket are the names of some digestive enzymes group them in to A– Gastric, B – Pancreatic and C – Intestinal
(Trypsin, Dipeptidase, Rennin, Maltase, Pepsin, Chymotrypsin, Nuclease, Amylase) (score: 2)
5.The intestinal juice helps in digestion. Write two enzymes and their actions. (2 score)
6. What happens when Hydrocholric acid is not secreted in our stomach ?
(2 score)
7)Major Enzymes are enlisted below
(Amino peptidase, Ptyalin, Pepsin, Nucleosides, Pancreatic lipase, Trypsin)
a) Arrange the above Enzymes in groups based on their functions
b) Bile contains no digestive Enzymes but it is essential for digestion
8.Fill in the blanks to complete the equations showing carbohydrate digestion in man.
In Oral cavity
Starch ----------> Maltose
In Intestine
Starch ----------> Maltose
Glycogen ----------> Glucose
Sucrose ----------> Glucose + ...