

Handwritten Notes on Digestive System

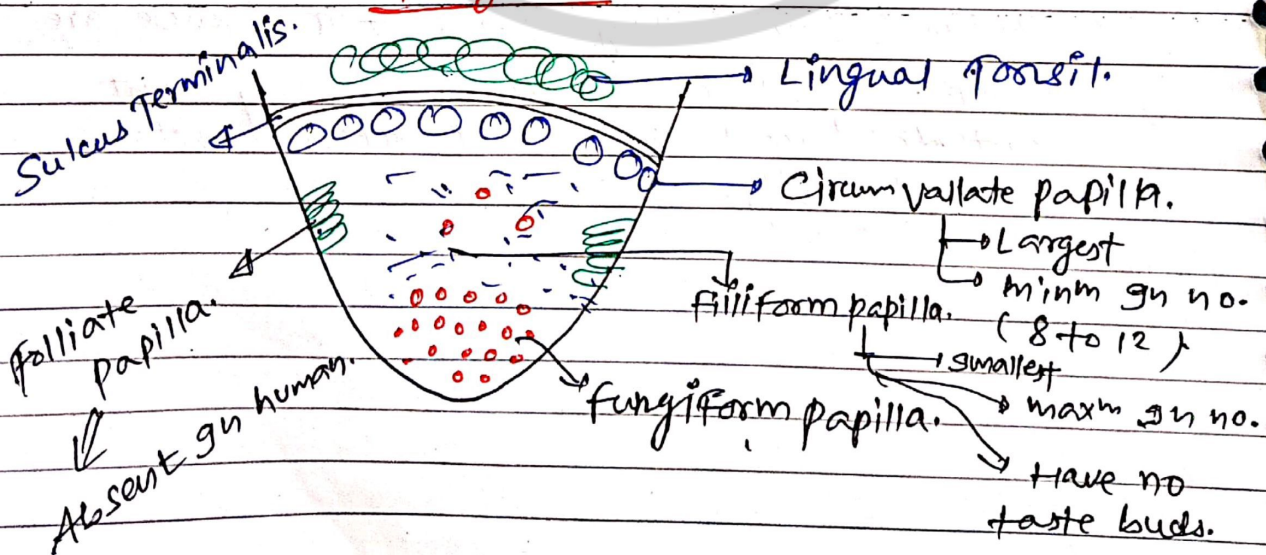


S.No.	Salivary glands	Location	Duct name.
1.	Parotid gland. (largest)	<u>In cheek.</u>	Stenson's duct.
2.	Sublingual gland. (smallest)	Below the Tongue.	Duct of Rivinus.
3.	Submaxillary. (submandibular)	<u>In lower jaw</u>	Warton's Duct.

* Salivation is stimulated by \rightarrow parasympathetic and inhibited by sympathetic nervous system.

* Saliva contains electrolytes (Na^+ , K^+ , Cl^- , HCO_3^-), Iga antibody, digestive enzyme Salivary amylase (ptyalin), Antibacterial enzyme Lysozyme.

Tongue.



Teeth.

* Ventral surface of tongue is connected to floor buccal cavity by thin membrane called frenulum linguae.

* on the dorsal surface of tongue papilla + vt which contains taste buds.

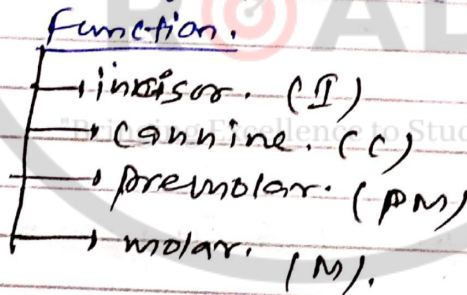
Teeth.

* Origin = ectomesodermal.

* Teeth forming cell = Odontoblast cell.

* Mammalian teeth are :-

- ① Thecodont = teeth embedded in bony sockets
- ② Diphyodont teeth → teeth appear twice time.
- ③ Heterodont = teeth are differ in ~~str~~ str. & function.



* Diphyodont → milky/Deciduous/Temporary teeth. (20)
→ permanent teeth. (32)

* 12 teeth are monophyodont.

** All premolars + last molar teeth are monophyodont.

Alveoli → (socket Bone).
↳ Longitudinal unit.
↳ mammary glands.

- * upper jaw made up of maxilla bone.
- * lower " " " " " mandible bone.

⊛ Incisor and canines have 1, 1 root.

* Dental formula of adult = $\frac{2123}{2123}$

* Dental " " " child = $\frac{2102}{2102}$

- * tusk of elephant is a upper incisor.
- * these are root less teeth.

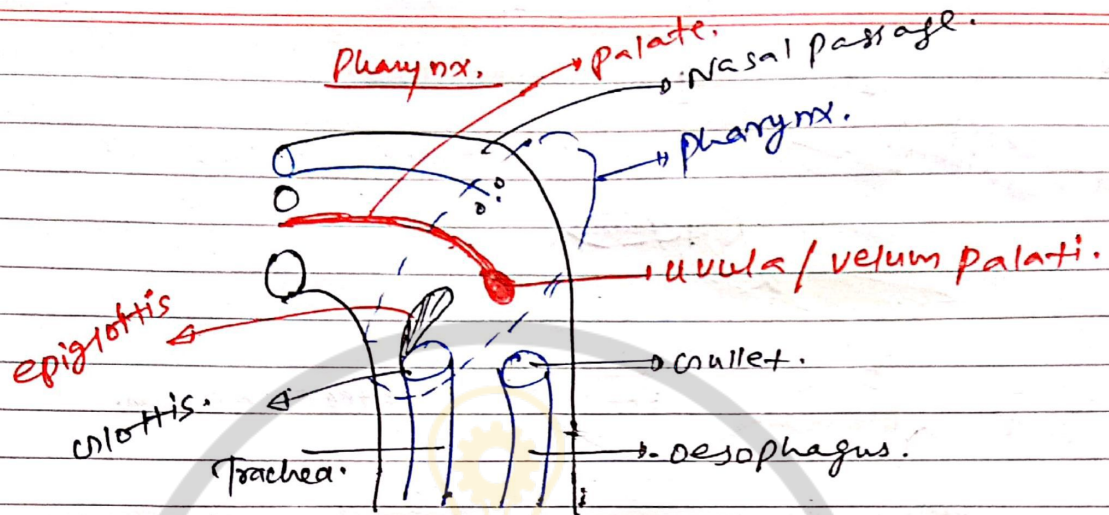
Enamel

↳ hardest substance: (96% inorganic salt) of animal kingdom.
↳ Ectodermal.

* **Dentine**

↳ contain 69% inorganic salt.
↳ mesodermal.
↳ secreted by odontoblast cells.

* cavity of tooth is called pulp cavity which is lined by odontoblast cell.



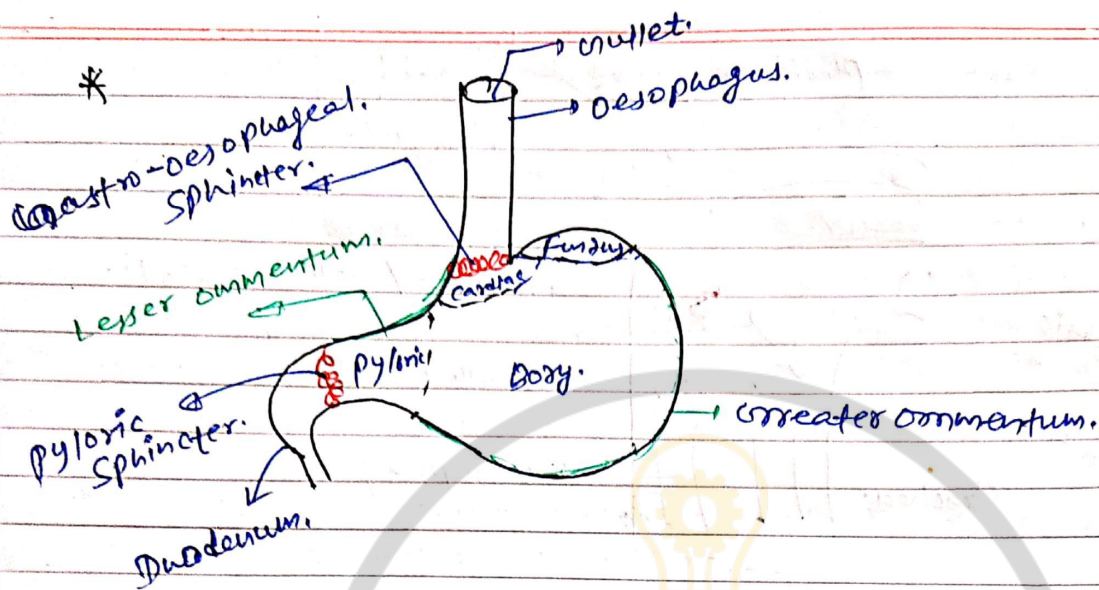
* Common passage of food and air is pharynx.

* A cartilagenous flap (epiglottis) prevent the entry of food into larynx.

* During swallowing breathing rate zero.

* Min^m breathing during sleeping.





* In oesophagus only mucus gland +nt; no digestive gland.

* Oesophagus has voluntary and involuntary both muscles.

* Oesophagus open into muscular bag stomach through gastro-oesophageal sphincter / cardiac sphincter.

* Stomach open into Duodenum through pyloric sphincter.

* Stomach is J-shaped, widest part.

* Stomach has 4 parts: Cardiac + Fundus + Body + Pyloric.

* Muscular contraction in stomach wall called Churning movement.

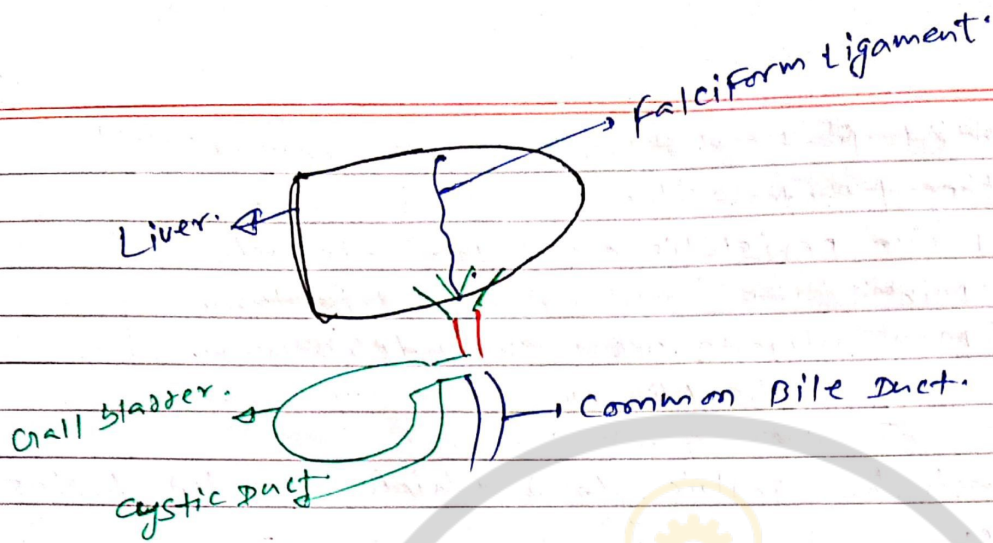
* Empty stomach has longitudinal folds called gastric rugae.

* Vit B₁₂ → RBC count ↑

- * 1. Widest part = stomach.
2. Longest part = ileum.
3. Max^m peristalsis occur in → stomach.
4. Min^m " " " → Rectum.
5. Max^m digestion occur in → duodenum.
6. Max^m absorption " " → Jejunum.

Stomach has gastric gland which secretes gastric juice.

S.No.	Cells of gastric gland.	Secretion.
1.	Mucous cell. (goblet cell).	Mucous.
2.	Oxyntic cell. (parietal cell)	HCl + ECF.
3.	Chief cell/peptic cell/ zymogen cell.	→ pepsinogen. → pro-reunin- → Gastric Lipase.
4.	Argentaffin cell. (a) G-cell →	→ Gastrin hormone.
	(b) D-cell →	→ Somatostatin.
	(c) EC-cell →	→ Histamine & Serotonin.



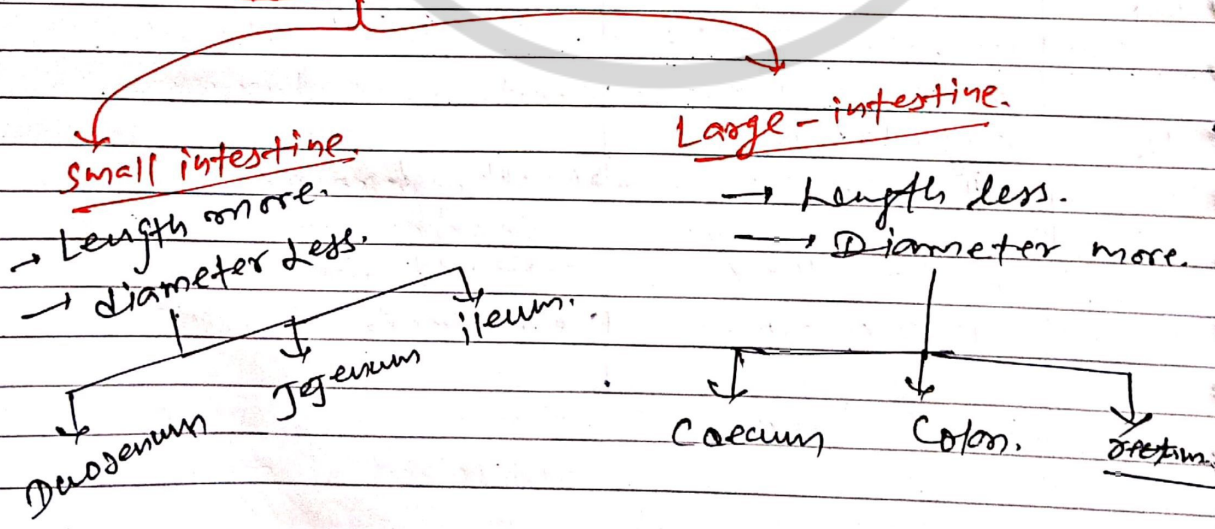
* C.I.F (Castell's Intrinsic factor) is essential for absorption of vit-B₁₂.

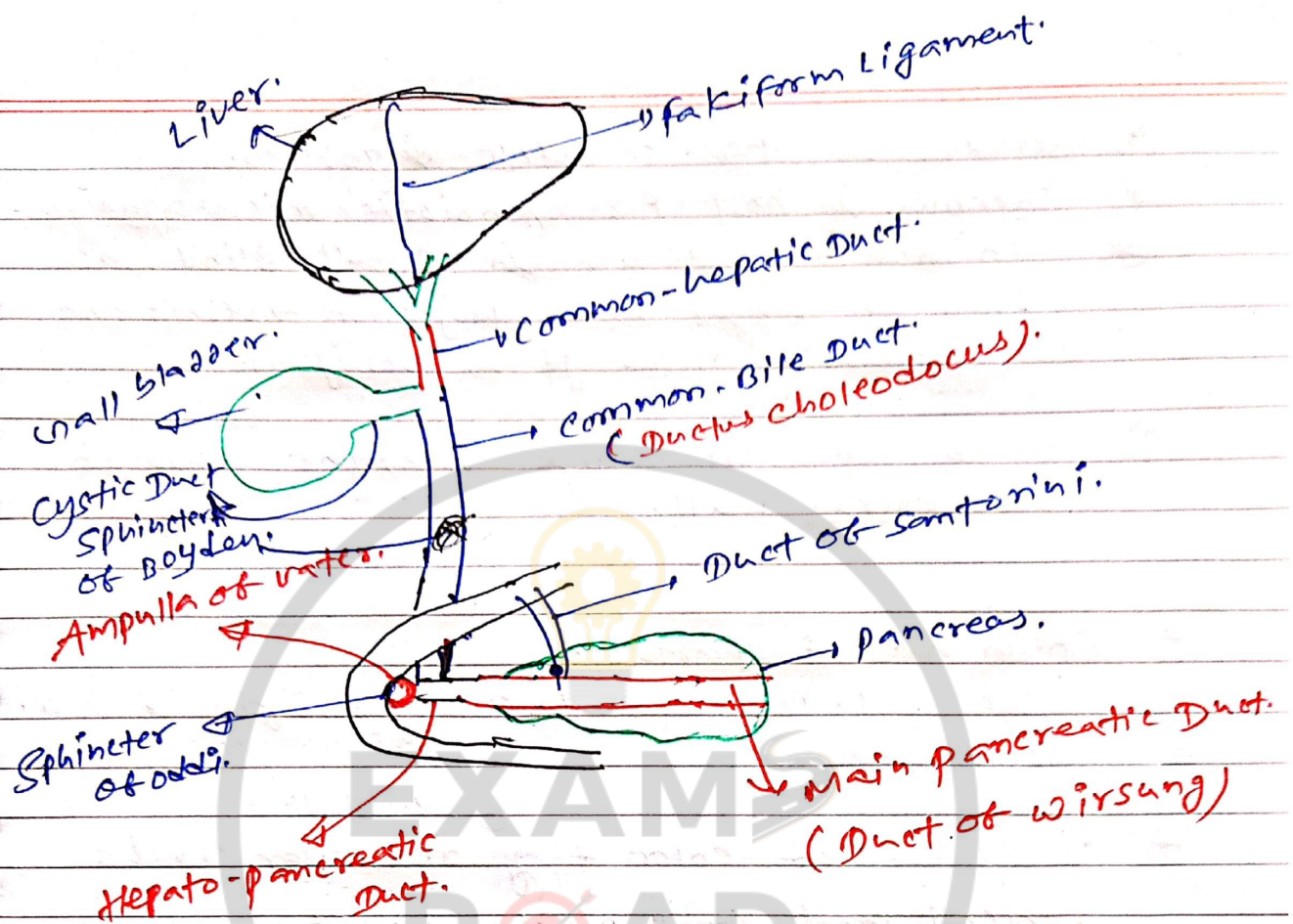
* Vit-B₁₂ is required for RBC maturation.

* Gastric juice contain 3 enzymes: →

✓ pepsinogen + prorennin + gastric Lipase.

Intestine.





* Duodenum is C-shape, in this Bile juice and pancreatic juice are carried by hepato pancreatic duct.

✓ * Opening of hepato pancreatic duct is guarded by sphincter of Oddi.

* Small bladder is for storage and concn of bile-juice. its duct is called cystic duct.

* Contractn in gall-bladder is stimulated by cck hormone.

* Gall-stone is due to accumulation of cholesterol.



- ① Caecum is for cellulose digestion.
- ② Caecum is host for symbiotic micro-organisms.
- ③ In human caecum is small-blind sac from it finger like projection + vermiform appendix arise. It is vestigial.
- ④ Ileum open into large intestine through ileo-caecal wall.

* Colon has 4 parts: →
Ascending, Transverse, Descending & sigmoid colon.

* In the wall of colon ^{3 longitudinal} muscular bands
Tonicoli and small pouches haustra are.

* Gaseal, haustra increase water absorption surface area.

* Rectum is for storage of excreta. muscular movement in rectum is called bowl movement

* Due to enlargement of rectal vein causes piles/Haemorrhoids. (Bleeding with excreta).

* If bowl movement irregular then constipation.

* If " " " abnormal frequently then Diarrhoea.

Histology of Alimentary Canal :- ^{The wall of} A.C made up of 4 layers.

(A) Serosa → Visceral peritoneum.
→ Areolar connective.

(B) Muscularis layer
Contain. (Smooth muscle) → outer → LML (Longitudinal muscle layer)
→ inner → CML (Circular muscle layer)

(C) Submucosa → It consist of loose connective tissue.
This layer contain Blood vessels, nerve, Lymph vessels.

(D) Mucosa = inner layer. consist of 3 sublayer.
→ Muscularis mucosa = thin layer of smooth muscle.
→ Lamina propria = made up of RFTCT (Reticular fibrous connect. tissue)
→ Epithelium → It lines the lumen.

* In a pharynx, buccal cavity, oesophagus stratified squamous epith. + nt. but in a stomach + intestine simple columnar epithelium + nt.

* 2 nerve plexis + nt in the wall of Aliment. canal.

(i) Auerbach's plexus. (~~Meissner's~~ plexus)
↓ Myenteric.
+ nt b/w (LML and CML).

It control peristalsis.

(ii) Submucosal plexus. (Meissner's plex.) →
+nt b/w CML and Sub-mucosa layer.
It control secretion of GIT.

* Activity of GIT regulated by ANS.

* Parasympathetic system stimulate peristalsis
and secretion of GIT.

* Sympathetic system inhibited peristalsis
and secretion.

* Modifications: →

(i) In oesophagus outer layer is not visceral
peritonium. It is tunica adventitia.

(ii) In stomach extra/oblique muscle layer
+nt.

(iii) In the submucosa of Duodenum, multi-
cellular, Brunner's gland +nt.

Its secretion is alkaline.

In its secretion no enzyme +nt.

(iv) In small intestine epithelium form
transverse and longitudinal folds.

Small transverse fold = plica circularis/valvulae
Conniventes/
Folds of Kerkring.



* Long longitudinal fold = villi.

* Cells of villi have. Brush Border of microvilli.

* Villi + microvilli + plica circularis = increase, absorption surface area.

* each villi has single lymph capillary in centre and a network of Blood capillary.

* B/w 2 villi epithelium invaginate and formed crypts of Lieberkühn. Which secrete intestinal juice "succus entericus."

These crypts are lined by paneth cell. which secrete enzymes.

* In ileum region Payer's patches / guttural tonsils +nt which secrete lymphocyte.

Word.

Location.

(1) tunica adventia. → Oesophagus.

(2) Oblique muscles. → Stomach.

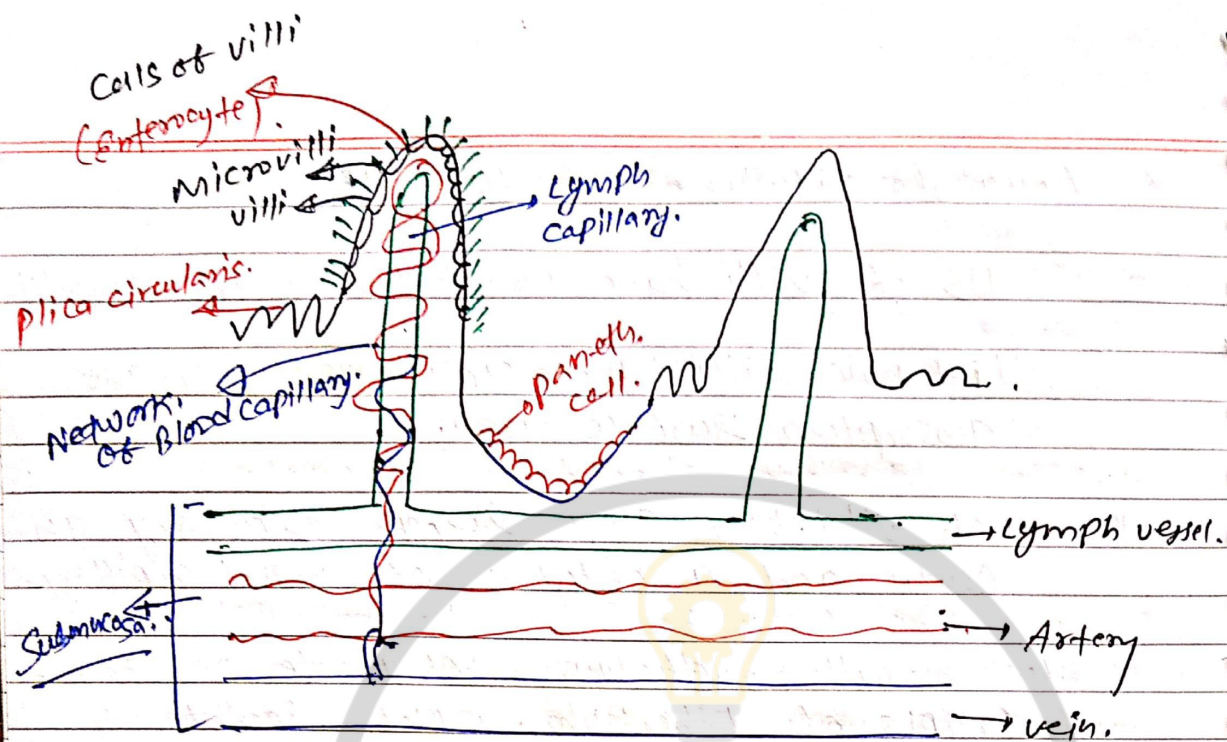
(3) Brunner's gland. → duodenum.

(4) Payer's patches. → ileum.

(5) Taenia & Haustra. → Colon.

(6) max^m vill → Jejunum.





* Physiology of Digestion.

(A) Digestion in Buccal cavity: →

Buccal cavity perform 2 major functⁿ.

- (1) Mastication of food. (↑ surface area with enzyme that particle $5 \mu \rightarrow 5 \mu$)
- (2) Facilitation of swelling.

** Saliva is mixed with food in buccal cavity. In saliva, starch digestive enzyme = salivary amylase / ptyalin +nt.

** About 30% starch is hydrolysed in Buccal cavity into maltose by salivary amylase enzyme at optimum PH 6.8.

Some single input

- * Salivary amylase is activated by Cl^- . If pH of Buccal cavity fall than Ptyalin activity reduce.
- * In Buccal cavity only carbohydrate digestion occur.
- * Saliva mix masticated food is called Bolus. Which enter into oesophagus through pharynx. ~~From~~ Buccal cavity is called, Deglutition.
- * In oesophagus no digestion.

Digestion in Stomach.

- (B) * Due to relaxation of Gastro-oesophageal Sphincter Bolus enter into stomach.
- (*) Contraction in muscular wall of stomach is called churning movement. due to this gastric juice mixed into food.
- (*) Relaxation of Gastroesophageal Sphincter at regular interval during churning movement is called Gastroesophageal relaxation disorder / Heart-Burn Disease.
- (*) If this sphincter do not open properly than food accumulate in oesophagus this is cardiac achlasia disease.



* Gastric juice contain HCl + Cl⁻ + mucous + enzymes
(pepsinogen +
prorennin +
gastric lipase.)

* mucous + Bicarbonate protect epithelium of stomach from HCl.

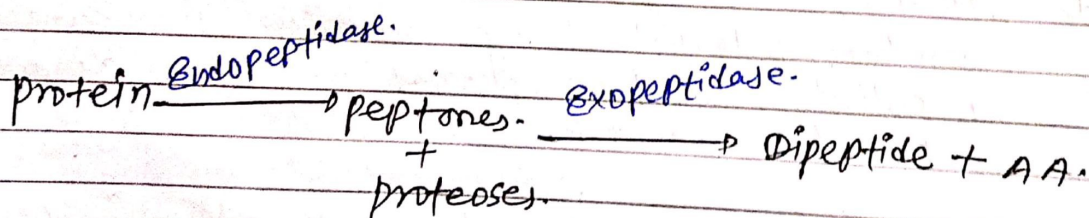
* HCl convert Fe⁺³ of food into Fe⁺² form. जो HCl convert नहीं होता उसका Fe⁺² absorb नहीं हो पाता duodenum में जाता।

⇒ So, no secretion of HCl causes * Iron deficiency anaemia.
(Achloroidea)

group of protein digestive enzymes are called

proteolytic enzymes. these are of 2 types

- Endopeptidase, exopeptidase



* Main function of HCl is activation of enzyme.

* Pepsinogen activated by HCl. It is endopeptidase enzyme in acidic medium.

* Pepsinogen $\xrightarrow{\text{HCl}}$ pepsin ~~protein~~

protein $\xrightarrow[\text{pH} = 2-3]{\text{pepsin}}$ peptides + proteases

* Gastric lipase is secreted in small amount. It acts on only 1% emulsified fat.

** Rennin is activated by HCl. It is for milk protein coagulation. So help in milk protein digestion.

The initial step of milk protein digestion is rennin. It is found only in infant (mammalian child). It is absent in adult.

Prorennin $\xrightarrow{\text{HCl}}$ Rennin.

Casein (milk protein) $\xrightarrow[\text{Rennin}]{\text{Ca}^{++}}$ Ca-paracaseinate.

pepsin.
↓
peptides + proteases.

Enzymes
Salivary /
peptic
gastric
pancreatic

Juice → Saliva + Peptic juice + Bile juice + Pancreatic juice.

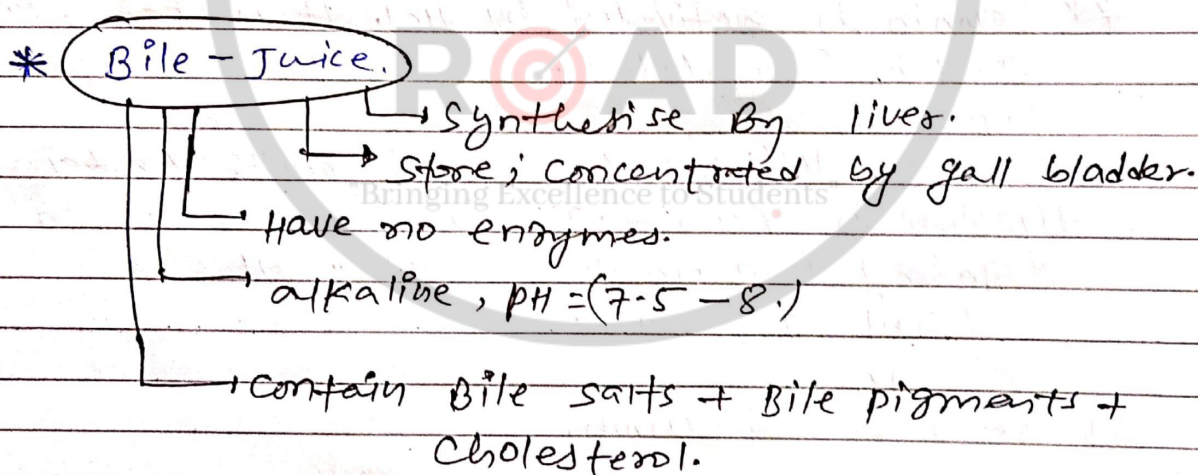
* Stomach is main site for protein digestion.

* After activity of gastric juice acidic food is called chyme.

Digestion in Small intestine.

Bile juice, pancreatic juice and intestinal juice mixes with food in small intestine.

* Bile juice and pancreatic juice released into duodenum but intestinal juice " "



* Bile salts → inorganic → NaCl, NaHCO₃.

→ organic → Na-taurate, Na-glycolate.

(1) Emulsification of fat.

(2) make food medium alkaline.

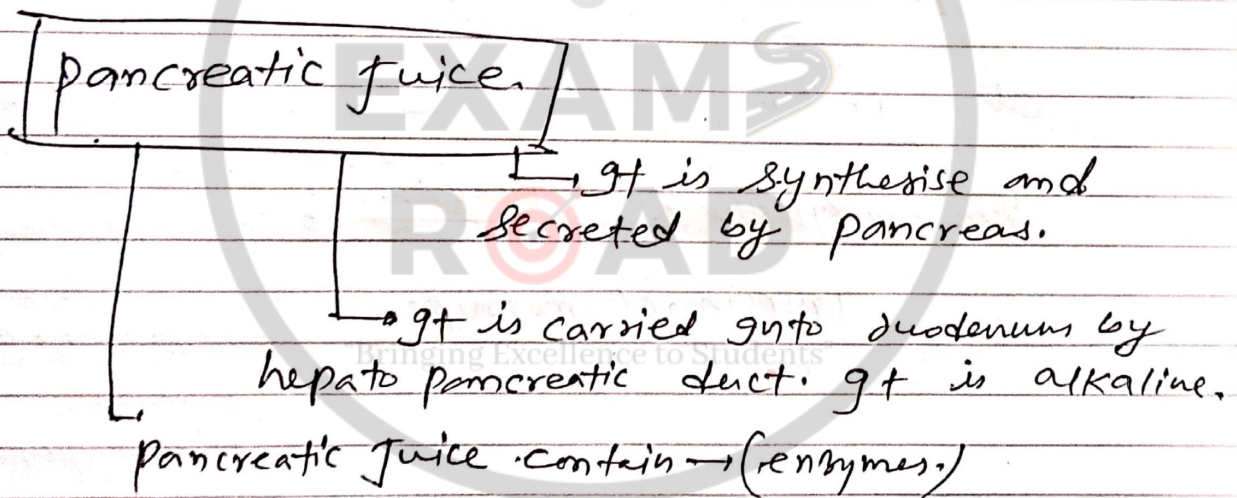


(3) Help in absorption of fat and fat soluble vitamin.

(4) Activation of Lipase enzyme.

* Conversion of large fat globules into small one is called emulsification.

* If Bile-Duct is blocked, fat digestion is affected.



- (1) Trypsinogen.
- (2) Chymotrypsinogen.
+
Procarboxipeptidase.
+
Amylase.
+
Lipase.
+
Nuclease.
+
Nucleotidase.

* Trypsinogen is activated by Enterokinase enzyme. It is secreted by intestinal Brush-Boarder epithelium.

* Trypsin and chymotrypsin is Endopeptidase in alkaline med^m but Carboxy peptidase is Exopeptidase.

* Chymotrypsin and Carboxy peptidase are activated by Trypsin enzyme.

Trypsinogen $\xrightarrow{\text{Enterokinase}}$ Trypsin.

Chymotrypsinogen $\xrightarrow{\text{Trypsin}}$ Chymotrypsin.

Pro-carboxy peptidase $\xrightarrow{\text{Trypsin}}$ Carboxy peptidase.

* protein $\xrightarrow[\text{pH} = 7 \text{ to } 8]{\text{Trypsin, chymotrypsin}}$ peptides + protease.
↓
Carboxy peptidase
↓
Dipeptide.

* In adult human chymotrypsin also help in milk protein digestion.



ase → लता के enzyme का नाम लेकर
(फलिते नाम कर रहा था)

* 70% starch $\xrightarrow[\text{pH} = 7.8]{\text{Amylase}}$ Maltose.

* Emulsified fat $\xrightarrow[\text{pH} = 7.8]{\text{Lipase}}$ Monoglyceride + Diglyceride

* Nucleic acid $\xrightarrow[\text{(DNAse + RNAse)}]{\text{Nucleases}}$ Nucleotide.

nucleotidase.
↓
Nucleoside.

Intestinal Juice.

↳ It is also called Sucus Intestinalis.

- ⊛ It is secreted by Krypts of Liberkuhn.
- ⊛ It is alkaline fluid.
- ⊛ It contains enzyme.

Dipeptidase.
Maltase.
Lactase.
Sucrase.
Lipase.
Nucleotidase.
nucleosidase.



(*) Dipeptide $\xrightarrow[\text{PH} = 7.528]{\text{Dipeptidase}}$ ~~2~~ Amino Acid.

(*) Maltose $\xrightarrow{\text{Maltase}}$ Glucose + Glucose.

(*) Lactose $\xrightarrow{\text{Lactase}}$ Glucose + Galactose.
(Milk sugar)

(*) Sucrose $\xrightarrow[\text{Invertase}]{\text{Sucrase}}$ Glucose + Fructose.

(*) Monoglyceride + Diglyceride $\xrightarrow{\text{Lipase}}$ Fatty acid + Glycerol.

(*) Nucleotides $\xrightarrow{\text{Nucleotidase}}$ Nucleosides.

(*) Nucleosides $\xrightarrow{\text{Nucleosidase}}$ N₂ base + pentose sugar.

(**) After activity of pancreatic juice alkaline food is called chyle.

(**) End product of digestion = AA + glucose.
+ Fructose + Galactose
+ Fatty acid + Glycerol.

Absorption

process by which end product of digestion move into blood or lymph through epithelium of gut.

⊛ Absorption occur by simple diffusion, facilitated transport and active transport.

⊛ Some glucose, some AA, Cl^- by → Passive Transport.
(Simple diffusion)

⊛ Some glucose, some AA, Fructose by facilitated transport with the help of carrier protein.

* major part of glucose and AA, Na^+ , K^+ by active transport.

* Part of gut:

Absorbed Substance.

1. Mouth,
(Buccal cavity)

- Some chemicals/Drugs absorbed by lower side of tongue.

2. Stomach.

= water, Electrolyte, Drugs, simple sugar, alcohol.

3. Duodenum.

. Fe^{++} , Ca^{++} ,

4. jejunum.

principle organ for absorption of nutrients - (glucose, AA, vitamins)
+ most of water and electrolyte.



5. ileum = Fatty acid + vit B₁₂ + glycerol.

6. Colon. = water, electrolyte, vitamins.
(Large intestine)

All substances are absorbed into blood. Except → long chain fatty acid
+
glycerol.
+
Fat soluble vitamins.

*

Fatty acids and glycerol being insoluble so can't absorb into blood. they incorporate with bile salt and formed fat droplets called micelles. These micelles enter into epithelial cell of villi. they are reformed into very small protein coated fat droplets called chylomicrons. these chylomicron diffused into lymph of lymph capillary / lacteals.

* fat is absorb by Lacteals, in the form of Chylomicrons.



① Jaundice.

Disorders: → (i) Liver is affected.

(ii) In this skin, eyes turn yellow due to accumulation of Bile-pigments.

* ② Constipation.

③ Diarrhoea.

④ Indigestion: →

* In this food is not properly digested so filling of fullness.

Reason of indigestion = overeating, Spicy food, Anxiety, food poisoning, improper secretions of enzymes.

* ⑤ Vomiting: → Content of stomach expelled out through mouth is called vomiting.

Vomiting centre located on medulla oblongata.

* PEM (protein energy malnutrition)

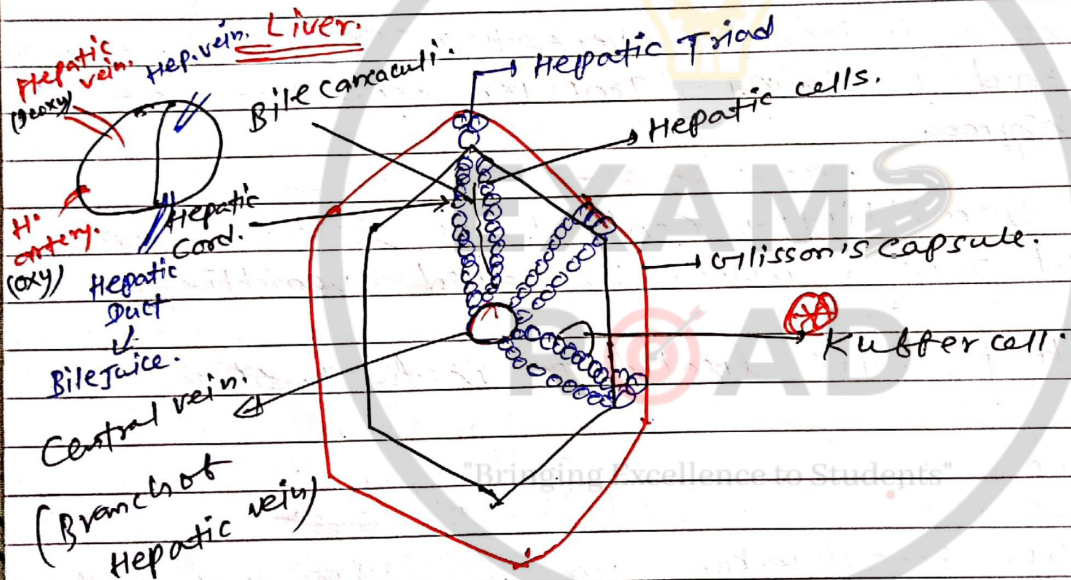
In this kwashiorkor and marasmus. Disease including.

* (i) Marasmus is produced by deficiency of protein and calorie. It occurs in infants less than 1 year age. It's skin become dry, thin, wrinkled. No swelling on body, No fat below the skin, growth rate and body weight declines, ribs are prominent.



Kwashiorker produce by deficiency of proteins in diet. It occur in child more than 1 year age. In this swelling on Body (Oedema condition), occur. In this some fat is still left on the skin, their skin is normal, failure of Body growth and Brain development.

Digestive glands :-



- * Largest gland.
- * Endodermal.
- * Weight 1.2 - 1.5 kg.
- * Triangular shape, bilobed, Right lobe is larger than left.
- * each lobe made up of many hepatic lobules.

* Structural & Functional unit of Liver = Hepatic lobules.

* Each lobule is covered by connective tissue sheath called Gillson's capsule.

* Each lobule contain many hepatic cells which synthesise and secrete Bile juice.

* Hepatic cells arrange in radial rows, called hepatic cord.

(*) B/w 2 hepatic cord, blood sinus present called hepatic sinusoid which is *Lined by Kubler cells.
these are phagocytic cells.

* Hepatic portal vein carry deoxygenated blood from intestine to liver.

* Heart - Lungs, Liver receive both oxygenated and de-oxygenating blood.

* Liver synthesise

- Urea.
- Yolk.
- Bile-juice.
- Plasma-protein.
- clotting factor.
- Heparin.
- vit-A from β -carotene.



* Detoxification of alcohol done by → Liver

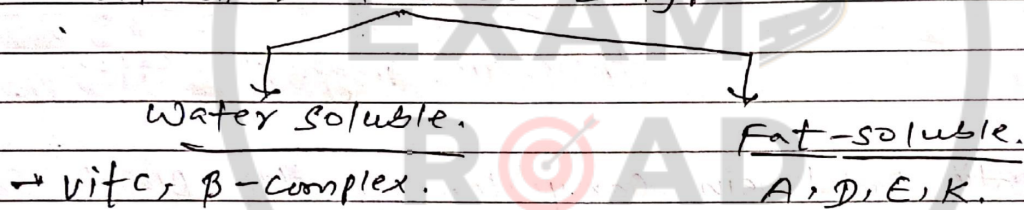
* In alcohol addict person liver damage due to accumulation of fatty acid.

Vitamins.

① → Organic substance which are not synthesized by body.

→ Vit-D (in skin) and Vit-K, B₁₂ in colon, are formed by body.

* Vitamins are of 2 types.



<u>Vit.</u>	<u>Chemical name.</u>	<u>Deficiency Diseases.</u>
A	<u>Retinole.</u>	- Night Blindness. → <u>xerophthalmia.</u>
D.	<u>Calciferol.</u>	(Sunshine vitamin.) ↳ osteomalacia in adult. ↳ Rickets in child.
E	<u>Tocopherol.</u> (Antiangi vitamins). remove scars.	sterility.
K.	<u>phyloquinone.</u> (Nepthoquinone).	(Haemorrhagia) Continuous Bleeding



Ic pm

C.	Ascorbic acid. (work as co-factor)	Scurvey (Bleeding in gums)
B1	Thiamine.	Beri-Beri.
B12 co-ant ⁱⁿ _{ity}	Cyanocobalmine. (RBC maturation)	pernicious anaemia.

* Vit-K is essential for formation of prothrombin in Liver, so it help in Blood coagulation.

* in milk, Bread, egg vit-c absent.

* Watermelon → (B12)