

Values of kerckering → villi → microvilli

glycocalyx

Date:	Khetagan
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Intestine : Intestine is characterised by the presence of permanent folds known as Plicae circulares formed of mucosa and (values of kerckering) submucosa.

* [Brush border is formed by numerous microvilli] They are similar to rugae but formed by rather than longitudinal folds. They are most developed in jejunum and characterised of this part. They cannot be completely flattened out by distension of intestine unlike stomach. "In add", small leaf like or finger like villi are seen which are projections of mucous membrane. Villi are covered with the ap^o and hv central core of lamina propria. They are leaf-shaped in duodenum, club-shaped in jejunum and finger-like in ileum.

B/w the bases of villi are small opening of intestinal glands also called crypts of Lieberkuhn. These glands extend through the thickness of muscularis almost reach to each of muscularis mucosa but do not penetrate it except duodenum where they extend to submucosa to form submucosal glands known as Brunner's gland. These glands not so closely packed as gastric gland.

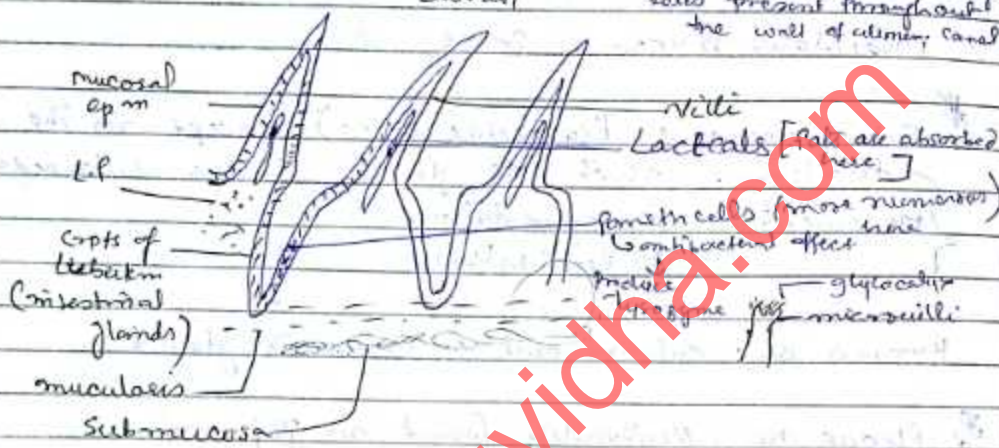
To further the S.A, microvilli are present, forming a brush or striated border on the apical region of individual columnar cells. Each microvilli has dense gly-cocalyx that contain several enzymes for the final process of digestion.

Intestine: Types of cells found in mucosal epm :-

- ① Enterocytes or intestinal cells (most numerous) - columnar
- ② Goblet cells → produce mucus
- ③ Paneth cells → control intestinal microbial flora
- ④ Argentaffin cells or Enterochromaffin cells → produce hormones

Lumen

↓
cells present throughout the wall of intestine canal



- G-cells or Gastrin cells → pyloric stomach
 ↓
 pyloric antrum → produce gastrin which stimulates parietal for "acid production"
- S-cells - produce hormone. Secretions found in duodenum and rest of small intestine. They stimulate pancreas to secrete H_2O and enzymes (alkaline secretions)
- CCK → found in small intestine or duodenum
 ↓
 cholecystokinin → stimulate pancreas to produce the secretion which is rich in digestive enzymes
- lamina propria (L.P) is rich in lymphoid tissue.

Just below the epm, there's a zone rich in antibody producing lymphoid cells which form MALT (mucosa associated lymphoid tissue) → acts as a barrier for the infection or bacteria invasion.

- Muscularis mucosa - same

* Submucosa: (connective tissue) except in the duodenum which has glands in the submucosa.
Movements - (1) Segmentation
(2) Peristalsis

Known as submucosal or Brunner's gland.

* Plicae are primarily found in jejunum.

- Ileum - Peyer's patches [group of lymphoid nodes]

in submucosa or sometimes in lamina propria.

- In Peyer's patches - abt. 10-70 lymphatic nodules in a Peyer's patch and takes ovoid shape.

- External muscle layer - same.

MMC - Migratory Motility Complex

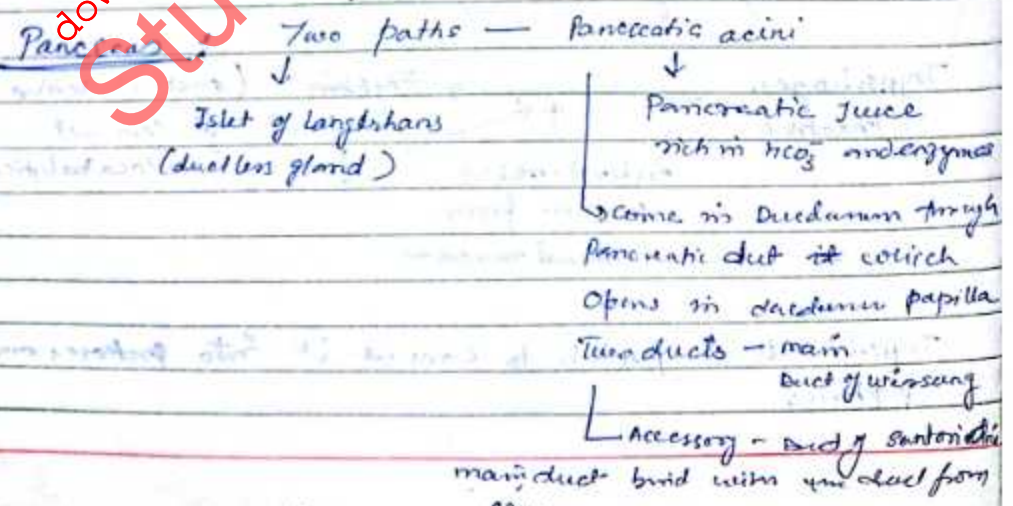
- ↳ related to peristalsis
- ↳ responsible for passage of food from oesophagus to stomach, intestine etc.

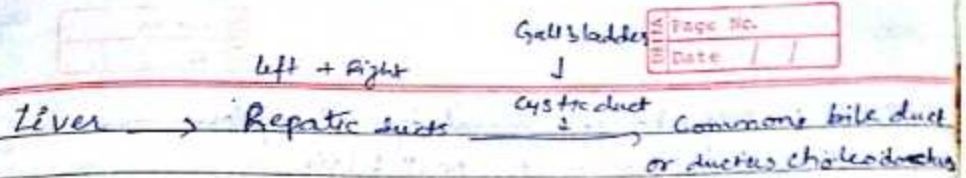
- These are ducts from the liver and pancreas. alkaline bile from pancreas and duodenum secretion also produce alkaline secretion which neutralise the acidic food.

↓
- Glycocalyx produce enzyme → which are dissaccharidases and peptidases these enzymes found on glycocalyx or microvilli of small intestine.

Liver :- accumulates nutrients, transforms and stores

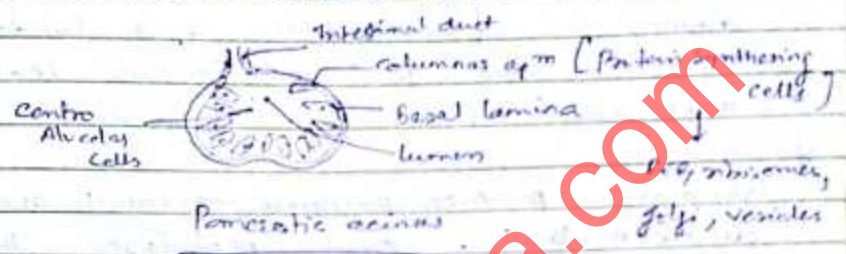
- Bile is a excretory product of liver
↳ multiplication of fats
- fats are absorbed in lactals not in microvilli.
(Lipid)





out of mirsbury → ↓
duodenal papilla

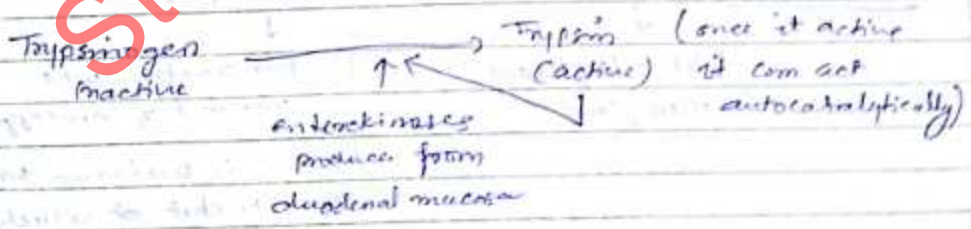
HCO_3^- to neutralise acidic chyme from stomach and make medium alkaline.



Enzymes produced in pancreatic secretion

- 1) Digestion of proteins -
- a) Trypsin
 - b) Chymotrypsin
 - c) Carboxy peptidases

o Acute pancreatitis - in which inactive form of enzyme becomes active within the glands and it starts digesting its own cells.



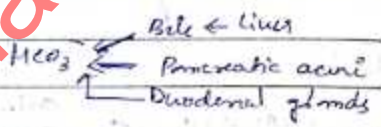
Trypsin acts on protein to convert it into proteases and peptides

- Chymotrypsinogenases (inactive) $\xrightarrow[\text{trypsin}]{\text{By the action of}}$ Chymotrypsin (active)
- Procarboxypeptidase (inactive) $\xrightarrow[\text{trypsin}]{\text{By the action of}}$ Carboxypeptidase (active)

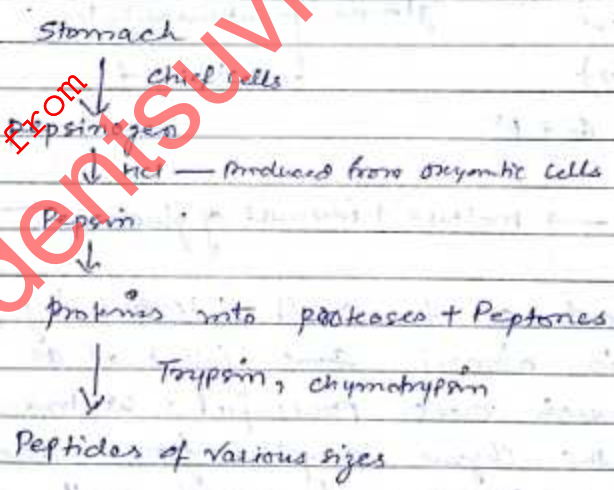
By the action of α_1 protease \rightarrow amino acids & peptides (small)

cleaves the peptide bonds from carboxyl end.

HCO_3^- produced by the cells lining of pancreatic ducts. These enzyme in the inactive form produce in pancreatic cells and pass thro to duodenum where duodenal mucosa produce enterokinases and activate them.



Protein digestion



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Carbohydrate

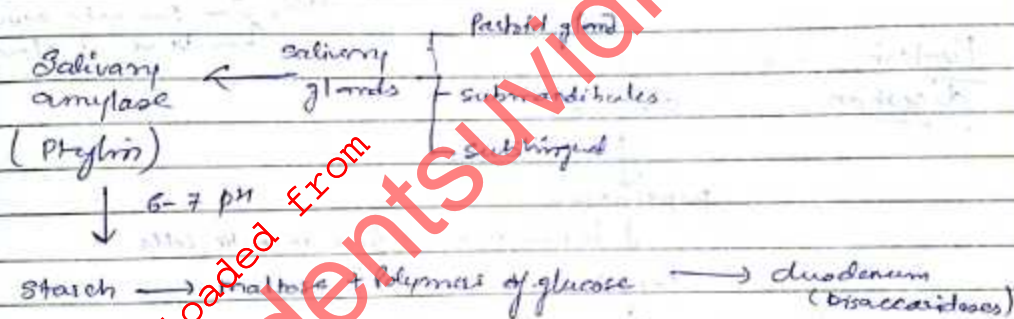
pancreatic amylase

Polysacc. like starch

Disacc. → like sucrose

absent in the form of monosacc. like glucose, fructose & Galactose

Starts in mouth by the action of salivary amylase produced by salivary glands - there are 3 glands
 ① parotid, they produce secretions rich in amylase
 ② submandibular gland produce enzymes and mucus
 ③ sublingual gland produce mucus and very less amt of enzyme.



It starts in small intestine by pancreatic amylase which is almost same identical as salivary amylase but much more powerful - within 10-15 min after the chyme empties from the stomach into duodenum and mixed with

Virtually all the carb. become digested. The carb^t are totally converted into maltose and smaller polymer of glucose before passing into upper jejunum or duodenum.

Carb. → Maltase
↓
maltose → Glucose + Glucose

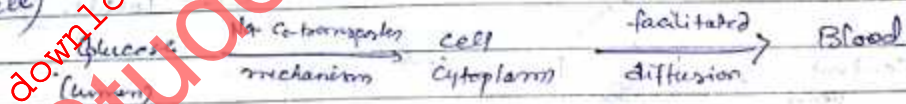
Lactase
↓
Lactose → glucose + galactose

Sucrose
↓
sucrose → glucose + fructose

Digestion of fat

- ① Pancreatic lipase →
- ② cholesterol est acetylase → hydrolysis into fatty acids & glycerol
- ③ Phospholipases

• Glucose & galactose transported in same manner through Na⁺-co-transporter mechanism which is from lumen to cell (absorptive) • (Glucose from lumen to cell)



Transporter proteins can bind to 2 Na⁺ ions and 1 glucose molecule, when all the sites are filled then it moves to cell cytoplasm. Inside the cell Na⁺ ion concⁿ will ↓

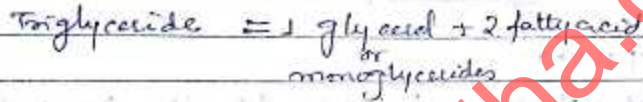
• facilitated diffusion takes place with the help of carrier protein

11th Proteases and a/h are also absorbed by Na-co transport mechanism or 2^o active transport mechanism and at basal by facilitated diffusion.

Fructose is transported by facilitated diffusion or active transport only.

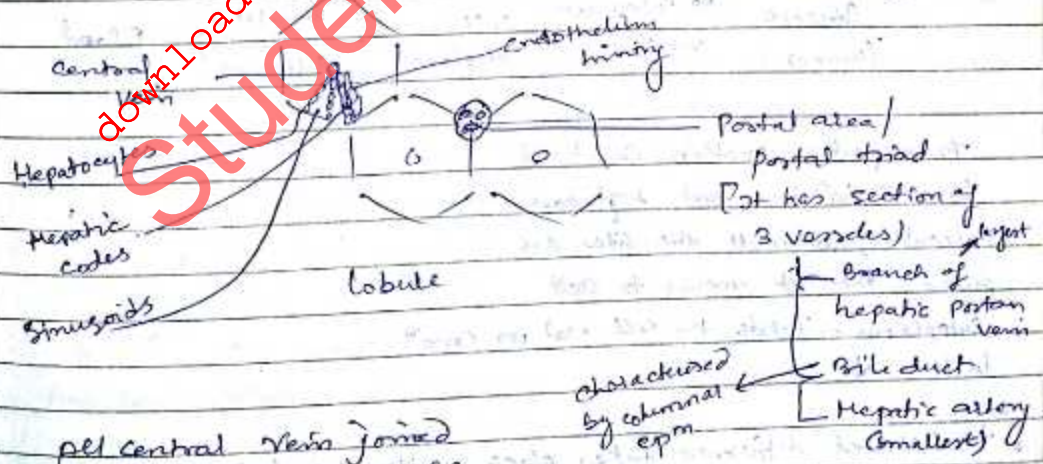
Fat digestion and absorption

- occurs in intestine



④ Emulsification

Bile salts \leftarrow liver is [divided into lobes and each lobes divided into lobule]



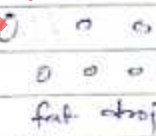
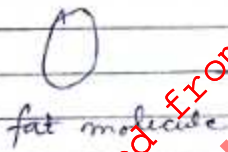
All central vein joined to form sublobular vein

- Endothelium is the flat squamous lining of blood vessels
- mesothelium is a serous membrane which lines the body cavity like (serosa)
- Bilirubin is the excretory part of liver which is a haem part when Fe^{2+} molecule goes for its work

Emulsification

- ① Lipid droplets
- ② micelles (1-2mm) contain monoglyceride, phospholipid
- ③ chylomicrons

④ Lecithin is a phospholipid



(to 1st SA so that lipase can act upon it)

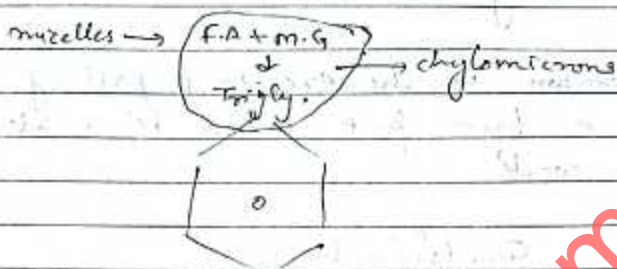
Bile help to prevent the formation of fat molecule again from fat droplets.

Colipase : attaches to lipase from one end & attaches to fat molecule from another end.

fatty acid & monoglyceride forms the core of micelle. It is not a permanent structure.

within the cell there is enzyme which again form triglycerides from fatty acids & monoglycerides which are called chylomicrons which are triglyceride

chyle which are absorbed by lacteals.



Composition of Bile :

- Bile salt
- Bile acid
- Bilirubin (excreted as stercobilin)
- Phospholipids
- H_2O & ions

Neural & hormonal

- ① motility
- ② Glandular secretion

Enteric reflex [enteric means within]

Stimulation can be of two types
long and short

regulate the motility within the cells by themselves.

Organs and organ system

organs are composed of the four kinds of tissues -

- ① Epithelial cells
- ② blood vessels, whose walls contain varying quantities of smooth muscle and connective tissue.
- ③ extensions from nerve cells that end near the muscle and ep^l cells.
- ④ a loose network of connective tissue elements.

Organ	Exocrine Secretions	Functions
① Mouth & Pharynx		<ul style="list-style-type: none"> • chewing begin; initiation of swallowing reflex.
② Salivary gland	<ul style="list-style-type: none"> • Salt & water, • mucus • Amylase 	<ul style="list-style-type: none"> • moisten food • lubrication • Polysac. - digesting enzyme
③ Esophagus	<ul style="list-style-type: none"> • mucus 	<ul style="list-style-type: none"> • Move Food to Stomach by Peristaltic waves • lubrication
④ Stomach	<ul style="list-style-type: none"> • HCl • Pepsins • Mucus 	<ul style="list-style-type: none"> • store, mix, dissolve & continue digestion of food, regulate emptying of dissolved food into small intestine. • solubilization of food particles, kill microbes, activation of pepsinogen • Protein - digesting enzyme • Lubricate & protect ep^l surface
⑤ Pancreas	<ul style="list-style-type: none"> • Enzymes • Bicarbonate 	<ul style="list-style-type: none"> • Secretion of enzymes & bicarbonate; also has nondigestive endocrine part • Digest carbohydrates, fats, proteins and nucleic acid • Neutralize HCl entering small intestine from stomach.

⑥ Liver

- Bile Salts
- Bicarbonate
- Organic waste products & trace metals

- Secretion of bile; many other non-digestive functions
- solubilize water-insoluble fats
- Neutralize HCl entering small intestine from stomach
- Elimination in feces

⑦ Gallbladder

- Store & concentrate bile b/w meals

⑧ Small intestine

• Enzymes

• Salt & H_2O

• Mucus

- Digestion & absorption of most substances; mixing and propulsion of contents
- Food digestion
- maintain fluidity of luminal contents
- Lubrication

⑨ Large intestine

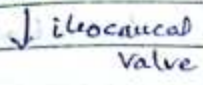
• Mucus

- Storage & compactⁿ of undigested matter; absorption of H_2O & salt; mixing and propulsion of contents; defecation
- Lubrication

Large Intestine :

- ① Caecum ② Colon ③ Rectum - anal canal Anus

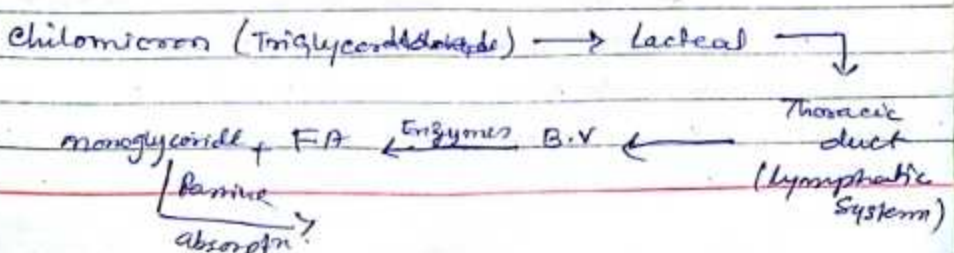
- Ileum
- have small appendages called vermiform appendix
- has 3 parts
 - ascending
 - Transverse
 - descending



- In large intestine, Plicae circularis and villi are absent
- Intestinal glands are more numerous and closely packed in large intestine
- Goblet cells are numerous
- Produces large amt of mucus to lubricate the wall of intestine



- Another function is absorption
- There is no digestion process except colon bacteria digest polysaccharides fibres & chain fatty acid into small fatty acids



- Flat thickenings are called Teniae coli or Lirae coli

- outer longitudinal muscle layer has 3 equidistant flat (muscle) thickenings in which b/w of which are thin strands of muscles. The tonic contraction of these assist in the formation of Haustra. The Haustra movement is imp't in large intestine for the movement of faeces faeces

Absorption and certain secretion :

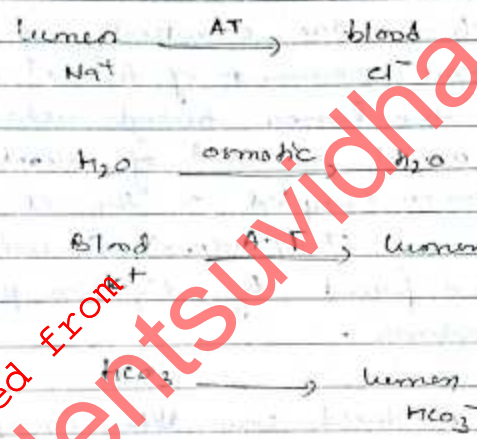
The primary absorptive process is the active transport of the sodium ions from the lumen to the blood and water also osmotically move into it. There is a net movement of Na^+ ions from the blood to the lumen through active pump. There is also a net movement of bicarbonate ion into the lumen coupled to the Cl^- absorption from the lumen. They help in neutralising the fatty acids that are formed by digestion process by HCO_3^- bicarbonate.

Bacteria also produced some Vitamin especially Vit K which is absorbed in the blood. Also produce certain gases which are known as flatus mainly CO_2 and H_2 and a small amt of CH_4 methane and hydrogen sulphide (H_2S).

Movement & motility in large intestine

mass movement - motility
mass movement is a wave of intense contraction where unlike peristaltic wave smooth muscle remains contracted for some time after mass movement

It occurs 3-4 times / day after every meal. It is a segmentation motion of very slow rhythm. The circular muscle may contract after every 30 min. Food remains in large intestine for about 18-24 hrs which provides time for the bacteria to grow and multiply. Parasympathetic Nervous system of the Segmentation contraction while sympathetic nervous system is for Colonic contraction.



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