

ABSORPTION IN GIT

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Objectives

- Explain the mechanisms by which end products of digestion of protein, carbohydrate, and fat are absorbed into and through the cells lining alimentary canal
- Explain the factors which determine whether a molecule is absorbed into the blood or into the lymph

A Summary of Digestion of Carbohydrates, Proteins and Lipids

	(a) Carbohydrate digestion	(b) Protein digestion	(c) Nucleic acid digestion	(d) Fat digestion
Oral cavity, pharynx, esophagus	Polysaccharides (starch, glycogen) ↓ Salivary amylase Smaller polysaccharides, maltose			Lingual lipase
Stomach		Proteins ↓ Pepsin Small polypeptides		Gastric lipase
Lumen of small intestine	Polysaccharides ↓ Pancreatic amylases Maltose and other disaccharides	Polypeptides ↓ Trypsin, Chymotrypsin Smaller polypeptides ↓ Aminopeptidase, Carboxypeptidase Amino acids	DNA, RNA ↓ Nucleases Nucleotides	Fat globules ↓ Bile salts Fat droplets (emulsified) ↓ Lipase colipase Glycerol, fatty acids, glycerides
Epithellum of small intestine (brush border)	↓ Disaccharidases Monosaccharides	Small peptides ↓ Dipeptidases, Aminopeptidase Amino acids	↓ Nucleotidases Nucleosides ↓ Nucleosidases Nitrogenous bases, sugars, phosphates	

ABSORPTION OF NUTRIENTS

· Absorption of Carbohydrates

proximal part
of colon.

(simple) (disac) → Zyg but not with Na
with H^+
AA

Glucose Try active with
Galactose Na

fructose simple diffusion

- form of monosaccharides - small fraction are absorbed as disaccharides

Distal
+ storage.

- Glucose Is Transported by a Sodium Co-Transport Mechanism

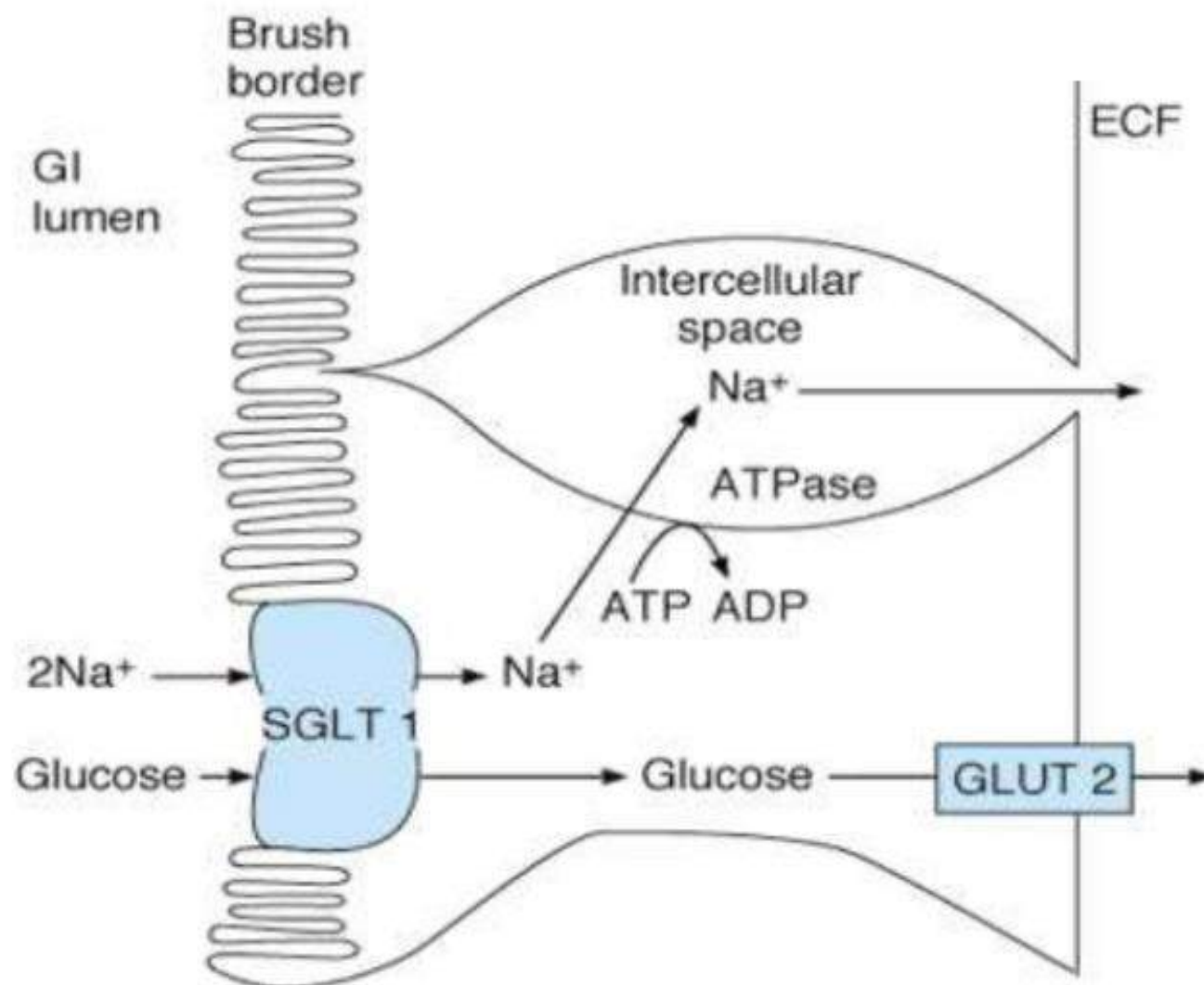
- First is active transport of sodium ions through the basolateral membranes of the intestinal epithelial cells into the blood, thereby depleting sodium inside the epithelial cells

ABSORPTION OF GLUCOSE

- Second, decrease of Na inside the cells causes Na from the intestinal lumen to move through the brush border of the epithelial cells to the cell interiors by a process of *facilitated diffusion*
- Na ion combines with a *transport protein*, but the transport protein will not transport the Na to the interior of the cell until the protein itself also combines with some other substance such as *glucose*

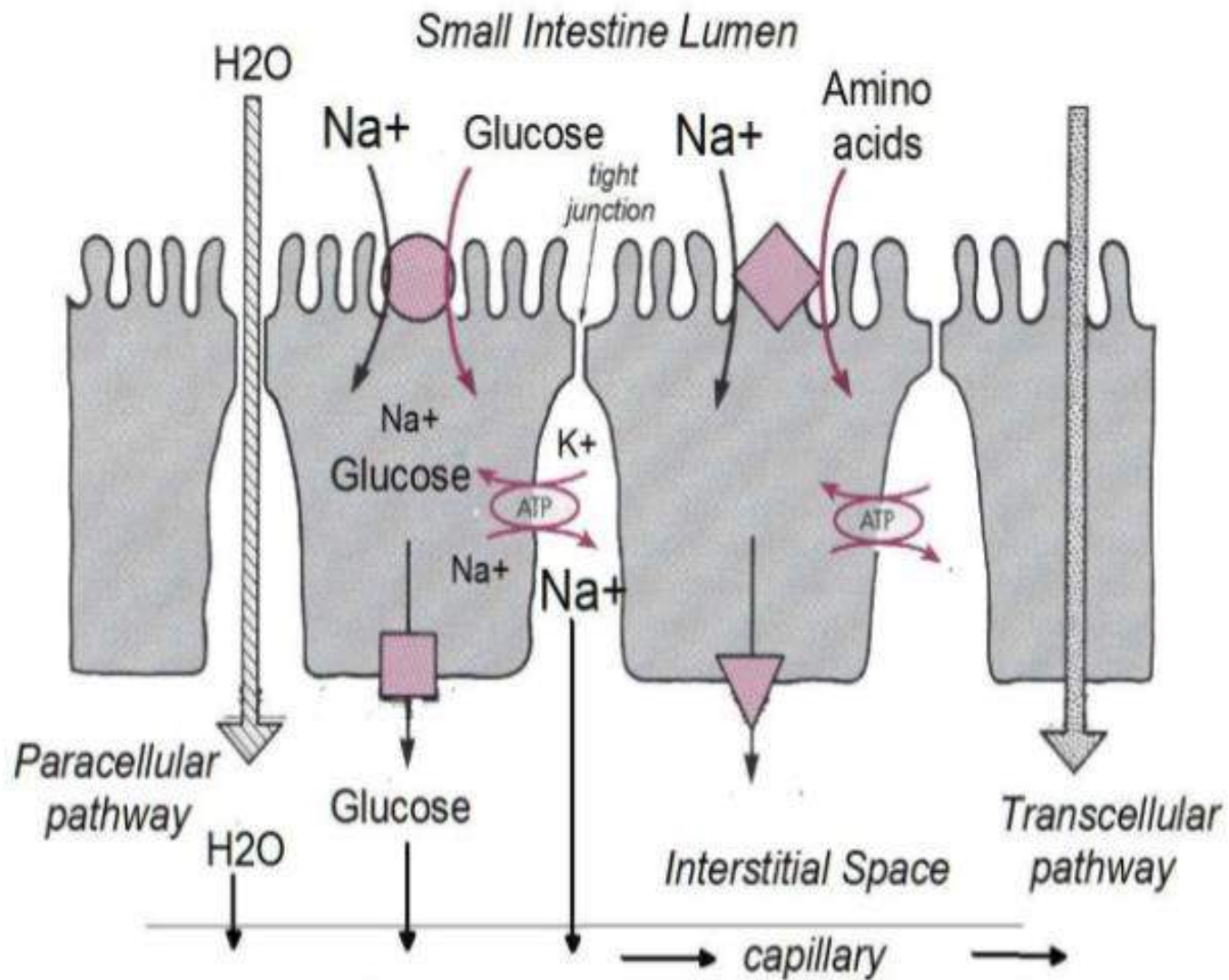
ABSORPTION OF GLUCOSE

- the low concentration of sodium inside the cell literally “drags” sodium to the interior of the cell and along with it the glucose at the same time
- Once inside the epithelial cell, transport proteins and enzymes cause facilitated diffusion of the glucose through the cell's basolateral membrane into the paracellular space and from there into the blood
- Galactose – same as glucose
- Fructose – facilitated diffusion

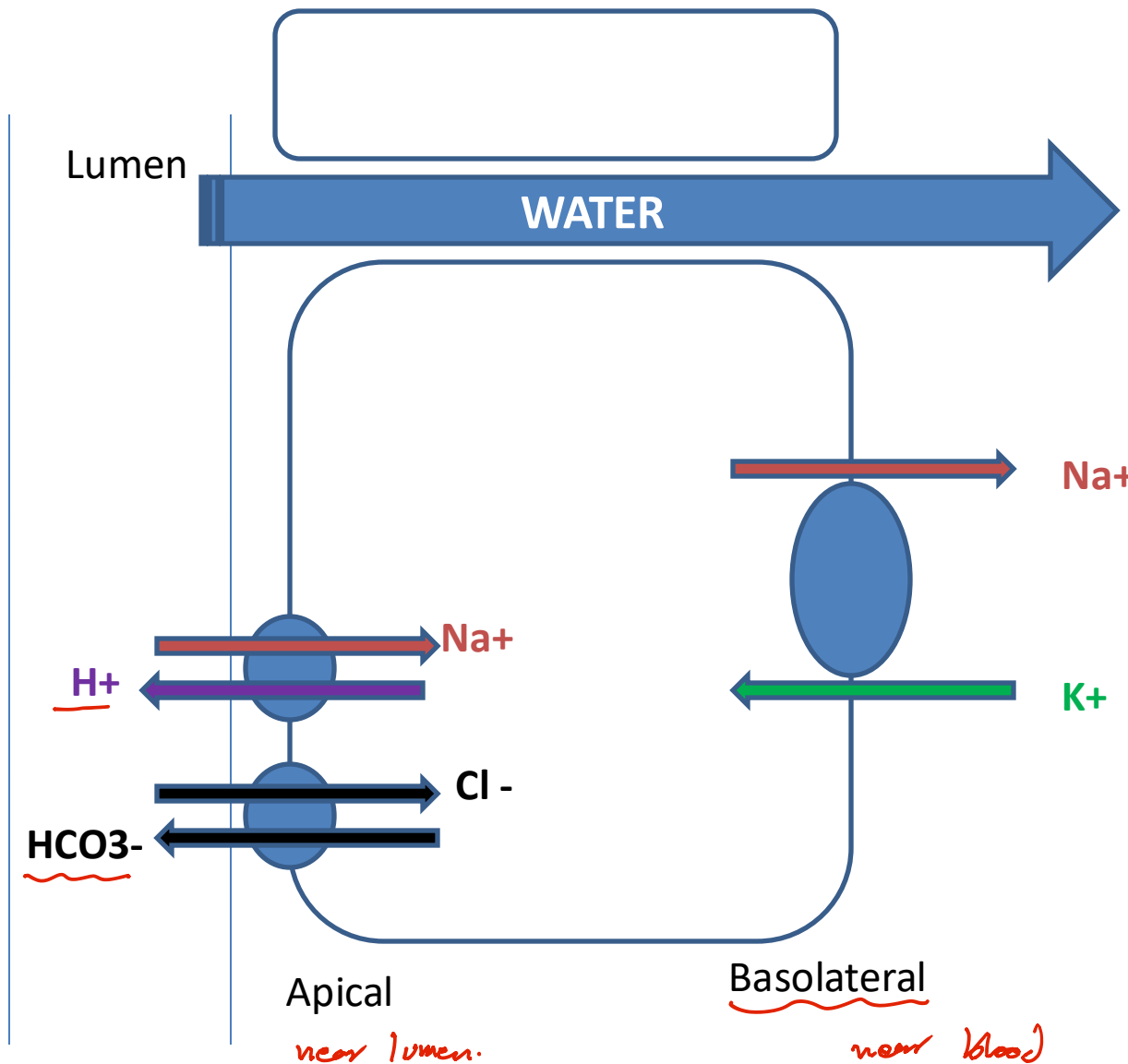


ABSORPTION OF PROTEINS

- in the form of dipeptides, tripeptides & free amino acids
- **sodium co-transport mechanism**
- *secondary active transport*
- *Few amino acids via **facilitated diffusion***
- **five types of transport proteins** for transporting amino acids and peptides have been found in the luminal membranes of intestinal epithelial cells



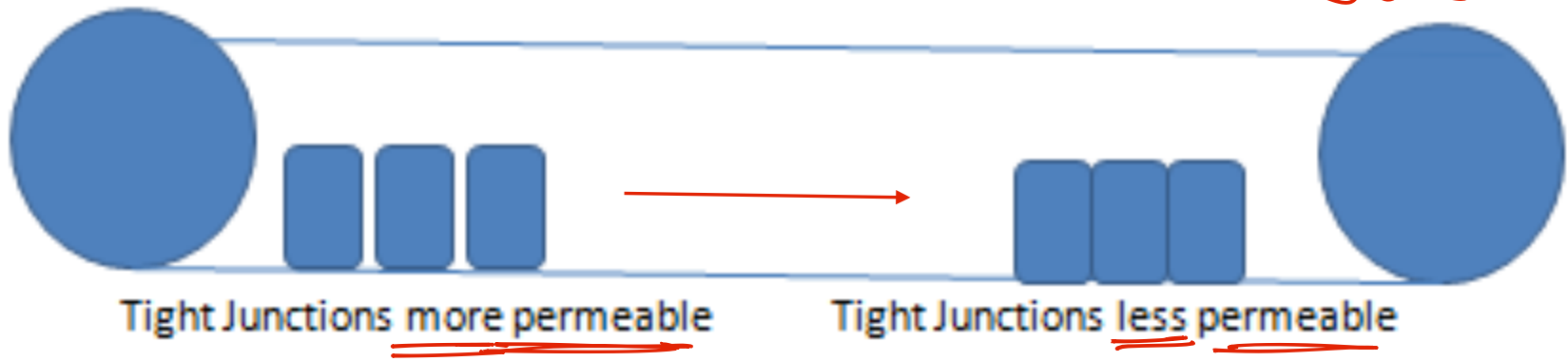
آبی
نکته
extra



osmolality of
blood ↑↑

* Proximal Small Intestine

Colon



Absorption:

- * Nutrients
- * Vitamins
- * Minerals
- * Salt and Water

Absorption:

Sodium
Water

Mechanisms of Transcellular Transport

	Mechanism	Example
Primary Active Transport	Utilizes energy (ATP) to drive ion against electrochemical gradient	Na-ATPase
Secondary Active Transport	Co-Transport of molecules with (ATP-driven) ion transport	Na-GLUC cotransporter
Facilitated Diffusion	Specific transporters facilitate passive transport across epithelial layer	Glut-5 (fructose)

ABSORPTION OF FATS

- the micelles perform a “ferrying” function that is highly important for fat absorption
- In the presence of an abundance of bile micelles, about **97 per cent** of the fat is absorbed
- in the absence of the bile micelles, only **40 to 50 per cent** can be absorbed

ABSORPTION OF FATS

After entering the epithelial cell, the fatty acids and monoglycerides are taken up by the cell's **smooth ER**



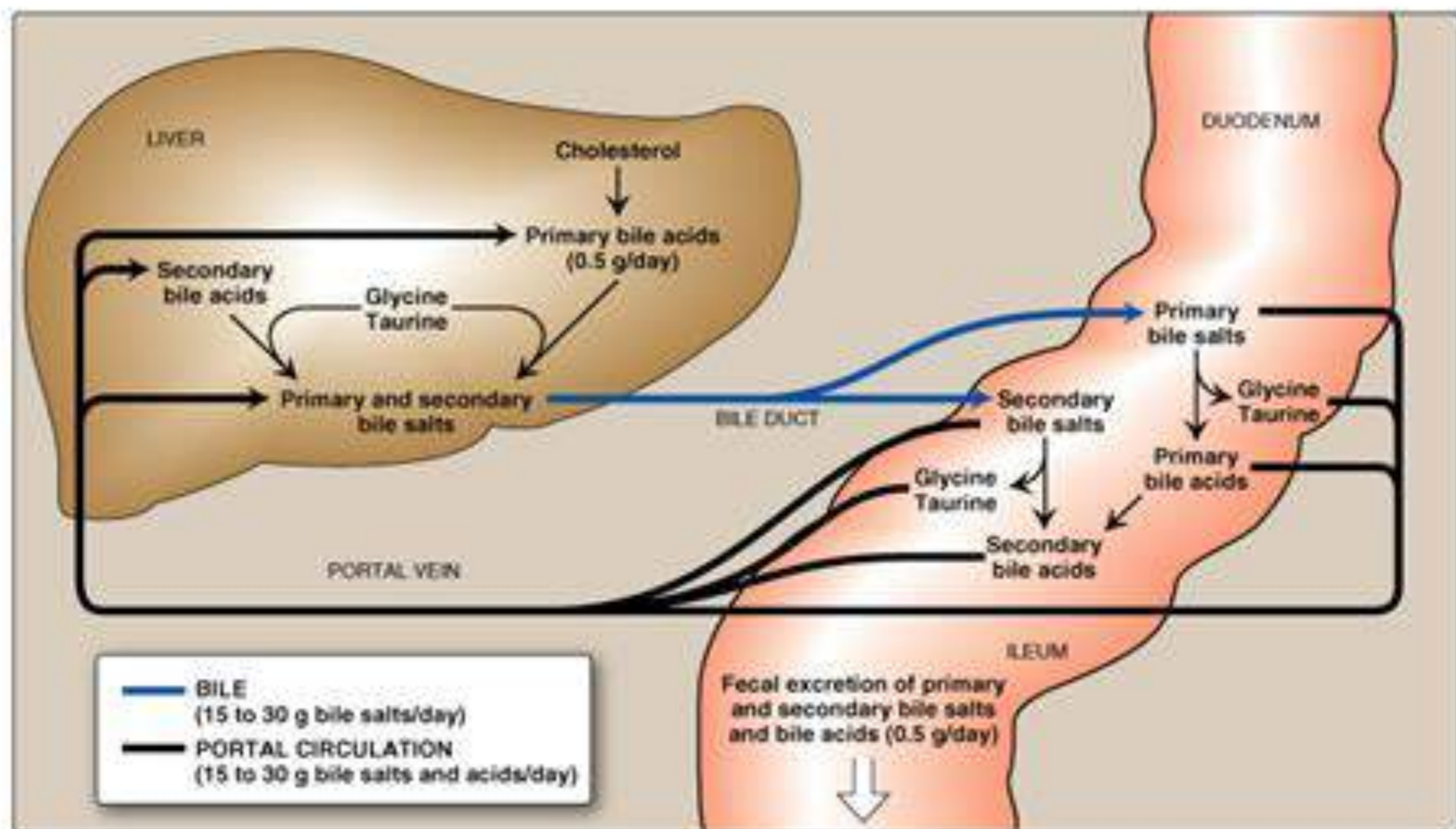
they are mainly used to form **new triglycerides** that are subsequently released in the form of **chylomicrons** through the base of the epithelial cell,



flow upward through the **thoracic lymph duct** and empty into the circulating blood

- **short and medium chain fatty acids** (more **water-soluble**) are absorbed directly into the portal blood

Enterohepatic Circulation



Conjugated bilirubin

1. In the liver, bilirubin is conjugated with glucuronic acid by the enzyme glucuronyltransferase, making it soluble in water
2. Conjugated bilirubin is not absorbed and instead passes into the colon
3. There, colonic bacteria deconjugate and metabolize the bilirubin into colorless urobilinogen, which can be oxidized to form urobilin and stercobilin
4. Urobilin is excreted by the kidneys to give urine its yellow color and stercobilin is excreted in the feces giving stool its characteristic brown color
5. A trace (~1%) of the urobilinogen is reabsorbed into the enterohepatic circulation to be re-excreted in the bile

ABSORPTION IN LARGE INTESTINE

- About **1500 milliliters of chyme** normally pass through the ileocecal valve into the large intestine each day
- Most of the water and electrolytes in this chyme are absorbed in the colon, usually leaving **less than 100 milliliters of fluid to be excreted** in the feces
- Proximal half of the colon - absorbing colon
- Distal colon - storage colon

ABSORPTION IN LARGE INTESTINE

- active absorption of sodium - electrical potential gradient created by absorption of the sodium causes chloride absorption
- *tight junctions* between the epithelial cells of the large intestinal epithelium - prevents significant amounts of **back diffusion of ions**
- absorb **sodium** ions more completely - aldosterone
- Secretion of HCO_3 - absorption of **Cl**

ABSORPTION IN LARGE INTESTINE

- Absorption of NaCl → water by osmosis

- large intestine can absorb a maximum of 5 to 8 liters of fluid and electrolytes each day – when more than this – excess as diarrhea

Lat of line

Defect in digestion + absorption

Lat in stool = Osmotic diarrhea.

hyper

Na
Cl
:

* Cholera

* secretory diarrhea.

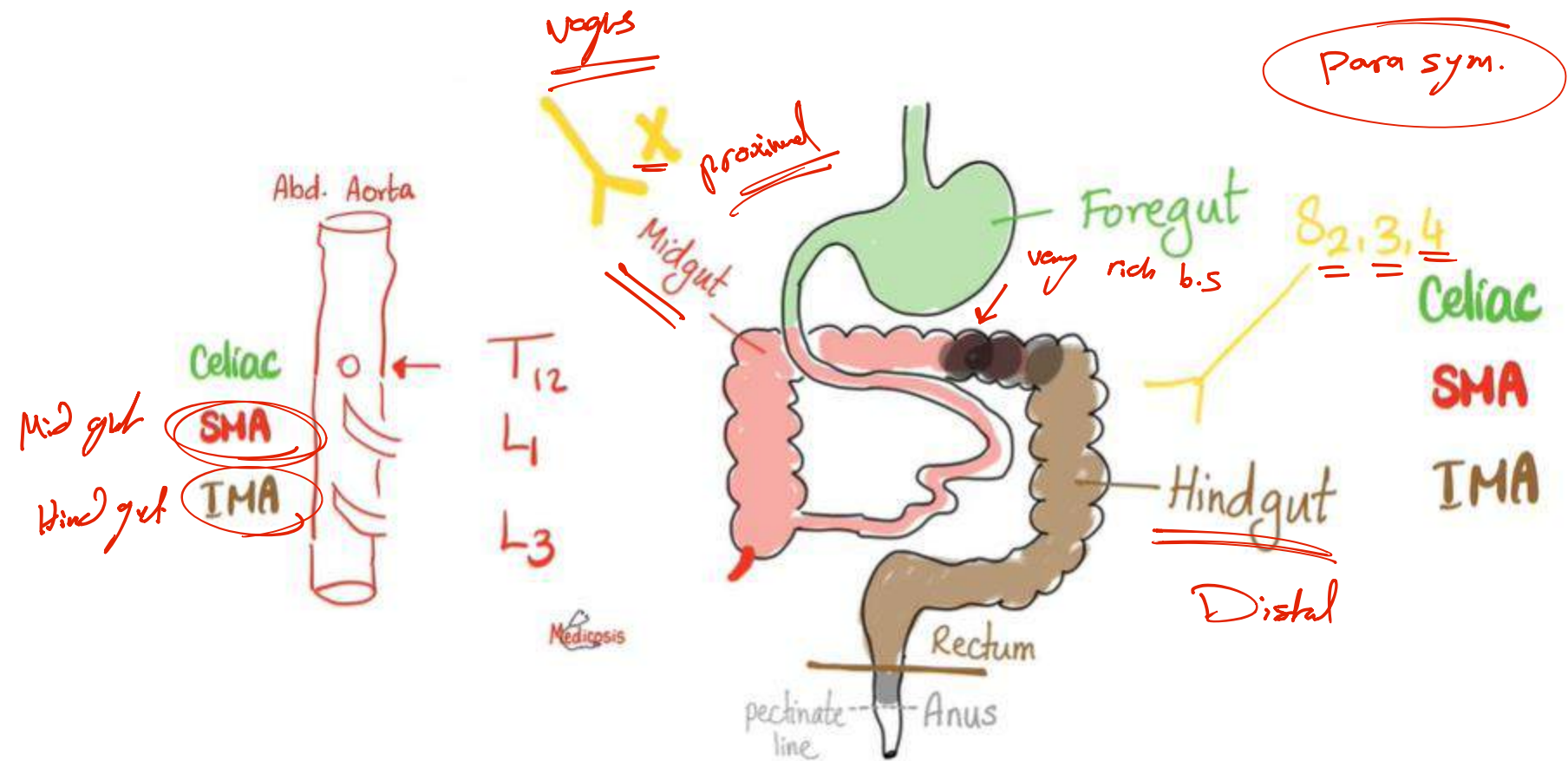
COMPOSITION OF THE FECES

- $3/4^{\text{th}}$ water
- $1/4^{\text{th}}$ solid
- 30 per cent dead bacteria,
- 10 to 20 per cent fat,
- 10 to 20 per cent inorganic matter,
- 2 to 3 per cent protein,
- 30 per cent undigested fiber from the food, bile pigment and sloughed epithelial cells

② Colour due to stercobilin

Sym : greater splanchnic n.
lesser splanchnic n.

Para sym.



abd. of hemorrhage (loss of blood)

ischemics (1st happen in the junction) midgut and hindgut

The Defecation Reflex

Stimulus

Receptor

* Afferent

Center

* Efferent

Effector organ

Response

"roughage"
Presence of stool @ rectum →

Mechanical Receptors @ rectal wall

Pelvic nerve

S_{2,3,4} @ spinal cord.

Pelvic nerve

Smooth Muscles of the colonic wall

Contraction of Smooth Muscles of the colonic wall
expulsion of feces

$$P = \frac{F}{A}$$



para sympathetic.

By learning & training, your Cerebral cortex will only allow Defecation

→ voluntary

Clinical Pearls

fresh blood.

lower GI bleed



Melena
(upper GI)

or lower



Hemolysis

black
hemolysis of RBCs
upper part GIT.



Urobilin

Stercobilin

Normal
Stool

* Cholera toxin

↳ makes your intestine secrete > 10 liters of H₂O

osmotic diarrhea

Steatorrhea

Greasy, fatty, foul-smelling
Floats, difficult to flush.

↓ vit. (K, E, D, A)

causes of steatorrhea:

* Liver/
bile
problem

* Pancreatic
problem

* Bowel
problem

(no absorption)
no digestion.

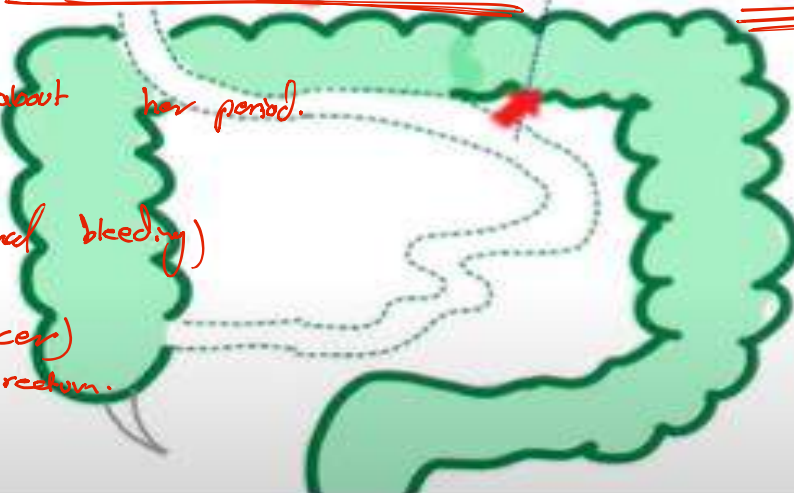
- Obstructive jaundice
- Hepatocellular jaundice

	* Proximal	Distal
Nerve Supply	Vagus n. (CN X)	Pelvic nerves
Function	<u>Absorption</u>	<u>Storage</u>
CRC	<u>Bleeds</u> iron deficiency anemia	<u>Obstructs</u> <u>Constipation</u>

* Female → Q about her period.

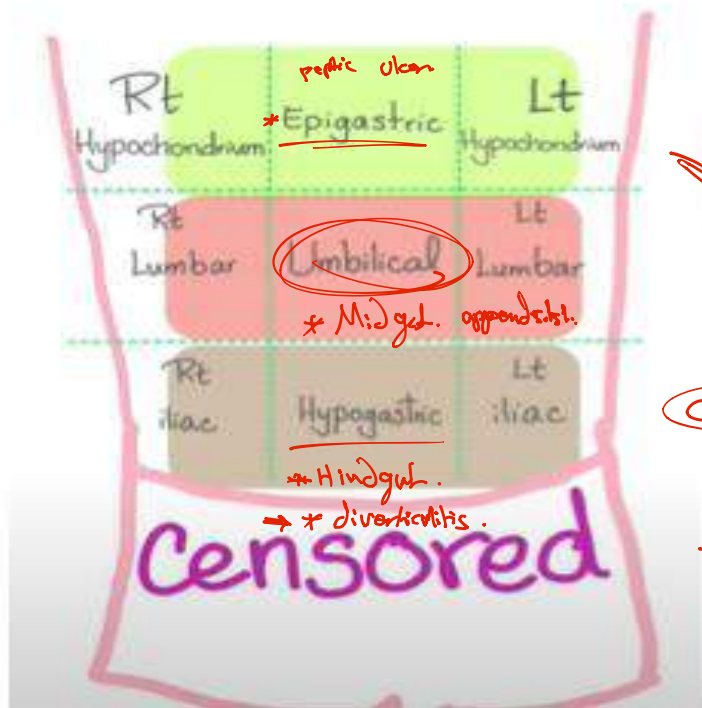
* male → GIT
(internal bleeding)

* old P. → (cancer)
in rectum.

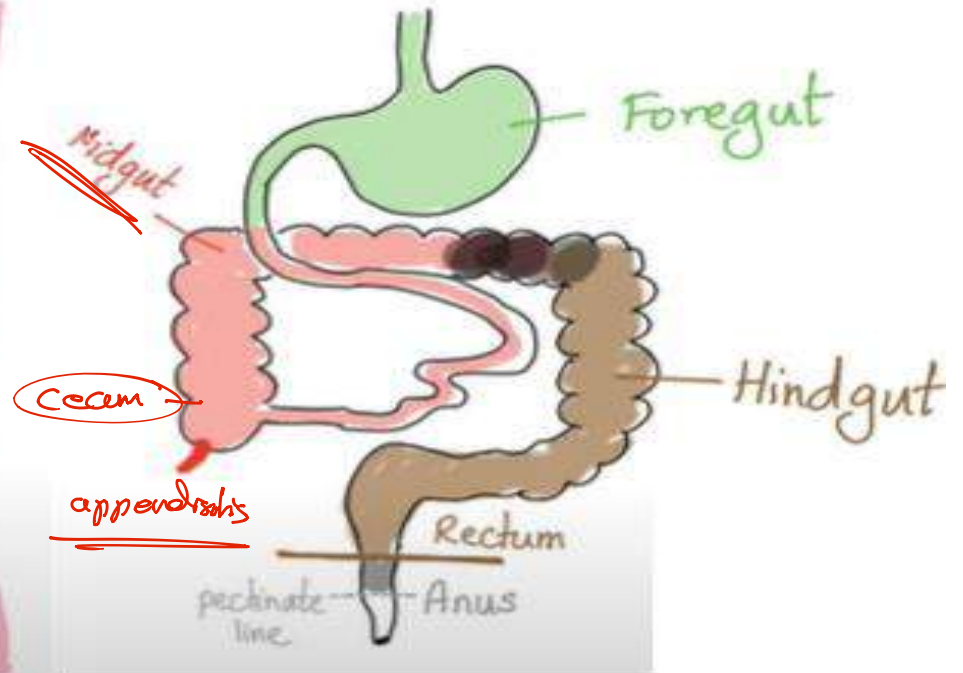


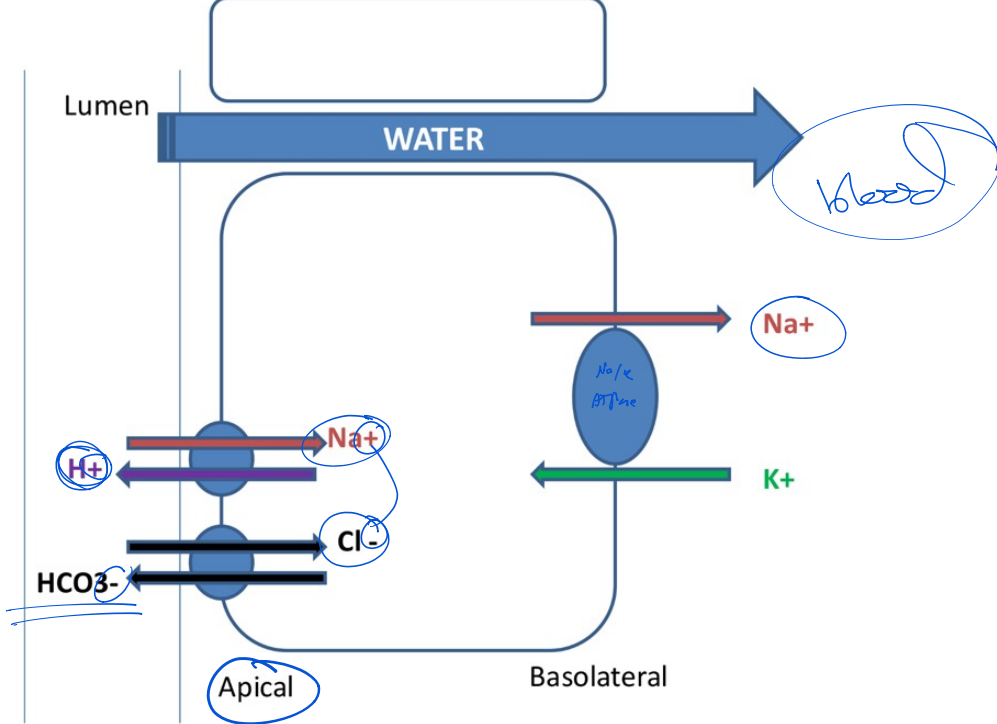
الم حاد غير متعلق.

Abdominal Regions



Abdominal Quadrants





In the intestine, sodium and chloride are absorbed into the blood, and water follows due to osmotic pressure, helping to keep the body hydrated.

Title: Sodium and Water Absorption Mechanism

1. Sides of the Cell:

- **Apical side:** faces the lumen (inside of the tubule or intestine).
- **Basolateral side:** faces the blood/interstitial fluid.

2. Transporters on the Apical Membrane:

Function	Transporter
Na ⁺ enters the cell, H ⁺ is secreted into the lumen.	Na⁺/H⁺ exchanger
Cl ⁻ enters the cell, HCO ₃ ⁻ exits into the lumen.	Cl⁻/HCO₃⁻ exchanger

3.

Function	Transporter
Pumps Na ⁺ out to the blood and brings K ⁺ into the cell using ATP.	Na⁺/K⁺ ATPase pump
Allows K ⁺ to exit to maintain balance.	K⁺ channel

4. Water Movement:

- As Na⁺ and Cl⁻ are absorbed into the blood, **water follows passively** due to **osmosis**.

Summary Sentence (for exam):

This diagram shows how sodium is absorbed into the epithelial cell from the lumen using exchangers and then pumped into the blood by the Na⁺/K⁺ pump, which creates an osmotic gradient that allows water to follow passively.