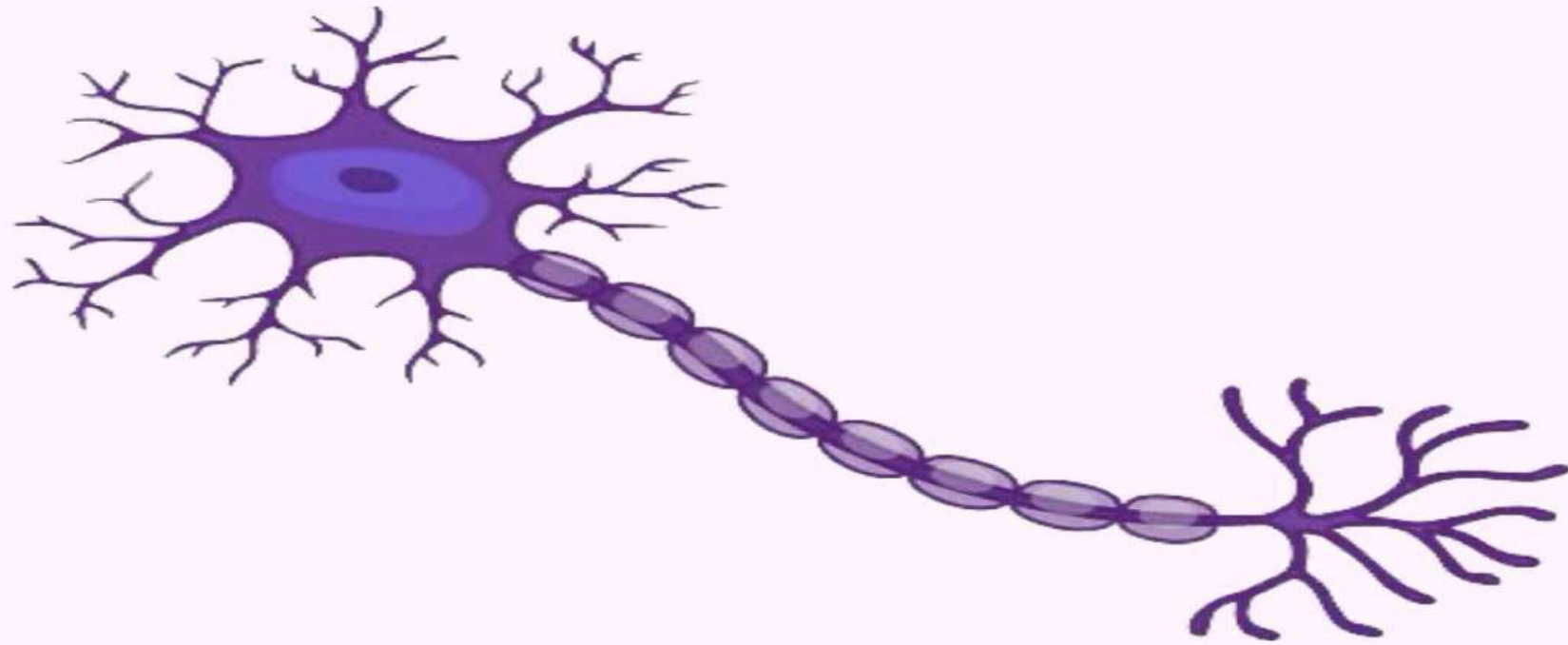




PHYSIOLOGY



LEC NO. : 19 + 20 .

DONE BY : Nour Al-amoush.

وَقُلْ رَبِّ زِدْنِي عِلْمًا

- الجهاز الهضمي

Digestive System

By d Gehan el wakeel

عَلِيَّةُ الصَّغِيرِ
Digestion is the breakdown of food & nutrients into smaller particles that can be absorbed in the small intestine.
الامتصاص

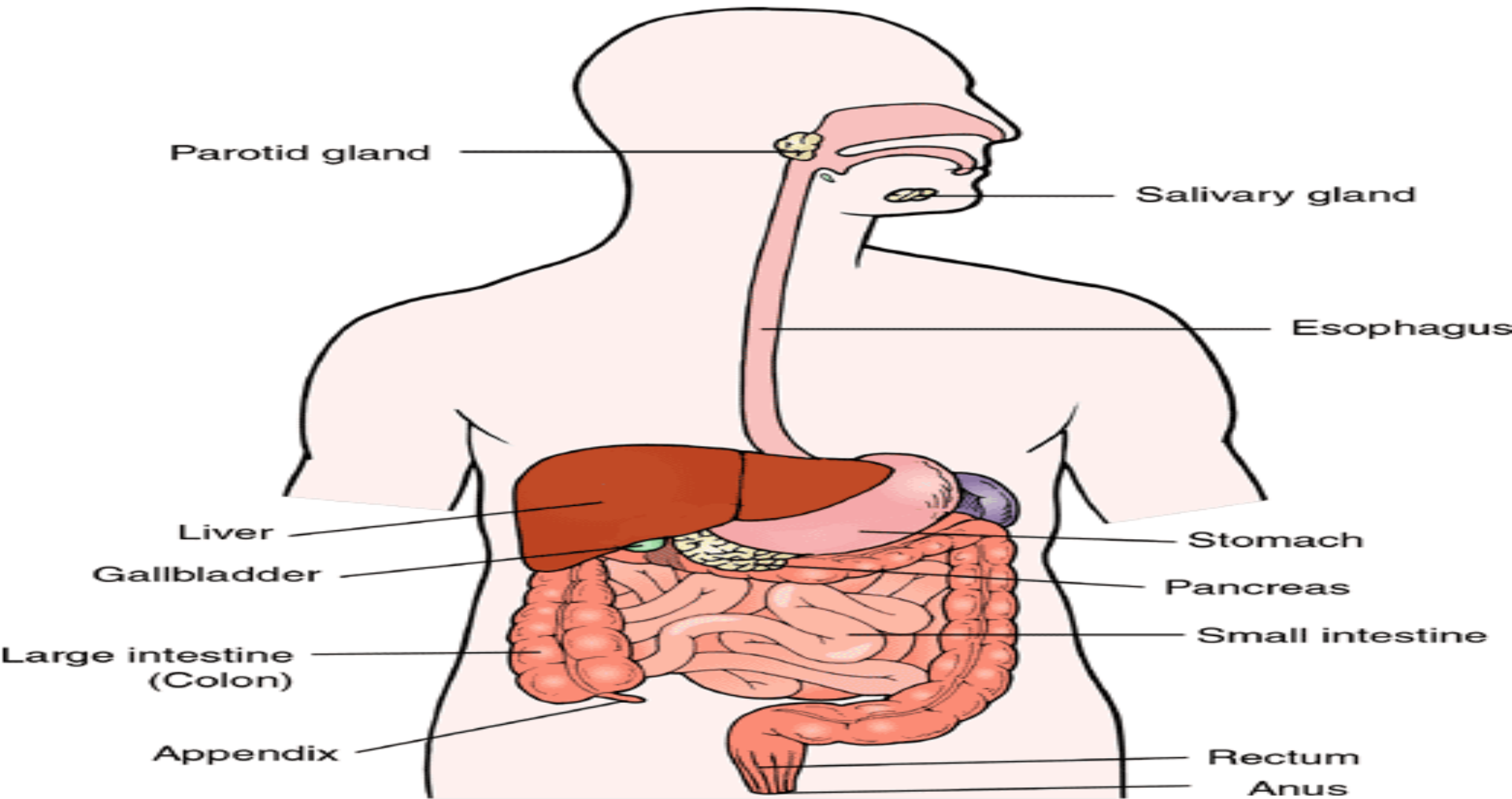
The digestive system consists of:

1. Alimentary canal (gut):

- It is a muscular tube about 4.5 meters long extending from the mouth to the anus.
start end
- It consists of buccal cavity, pharynx, esophagus, stomach, duodenum, and small and large intestine.
oral (mouth) المريء المعدة
الاثنا عشر الدقيقة الخليظة

2. Digestive glands → salivary glands, liver and pancreas.

Digestive System



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Fig.: Digestive system

General functions of the digestive system

1. **Motility** الحركية
2. **Secretion of digestive juices** عصارات هاضمة
3. **Digestion of food** هضم
4. **Absorption** امتصاص

Salivary Secretion

Principal Salivary Glands: ^① Parotid, ^② submandibular and ^③ sublingual glands.

b) Histology:

حاجه مجوفه تحتوي على إفرازات

- Each gland is formed of **group of secretory acini called salivons.**
- The salivons consists of acinus and ducts
- The acinar cells include 2 types;
 - large in volume*
 - a. Serous cells which secrete **watery secretion rich in amylase enzyme**
 - لزوج*
 - b. Mucous cells which secrete **viscid secretion rich in mucin**

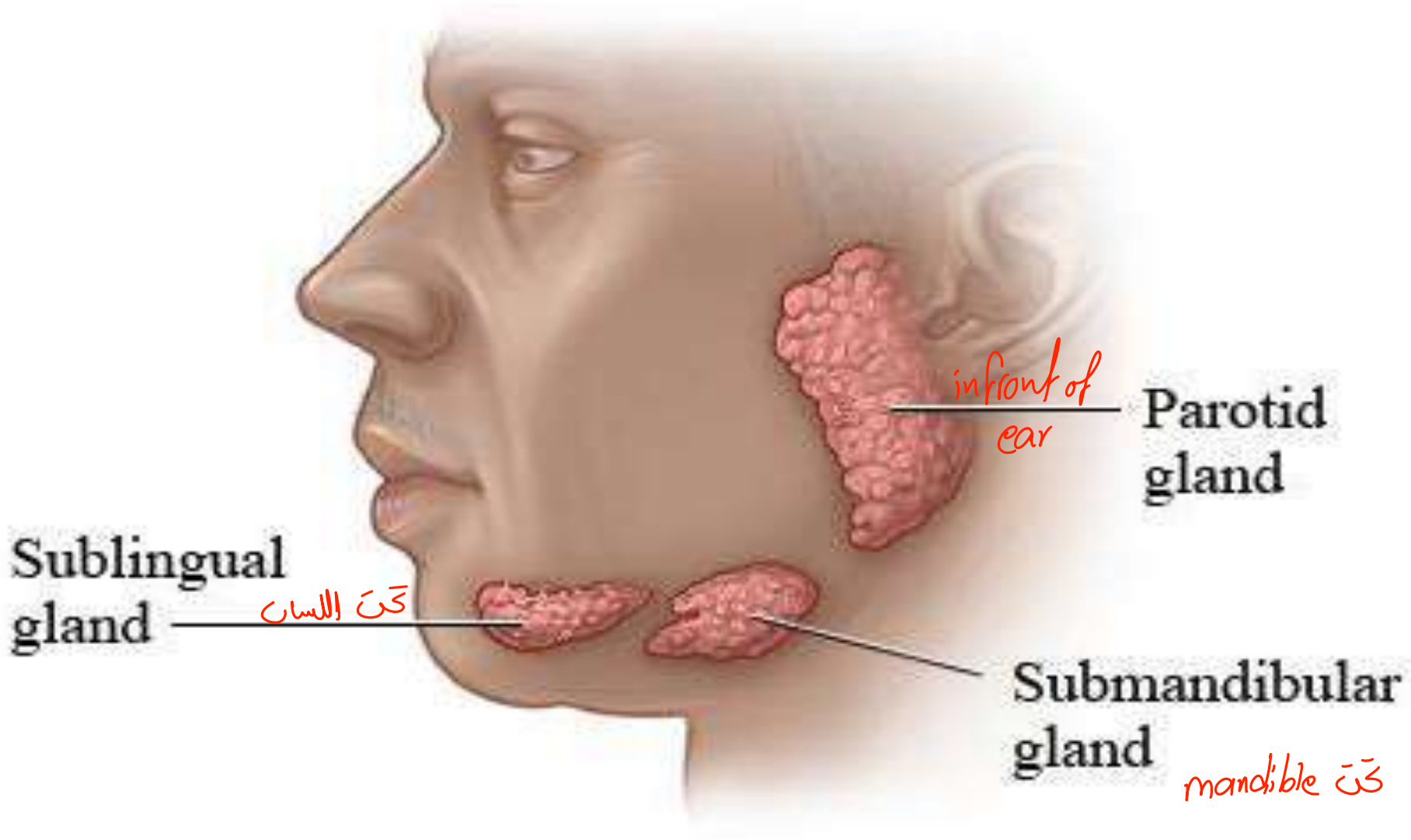
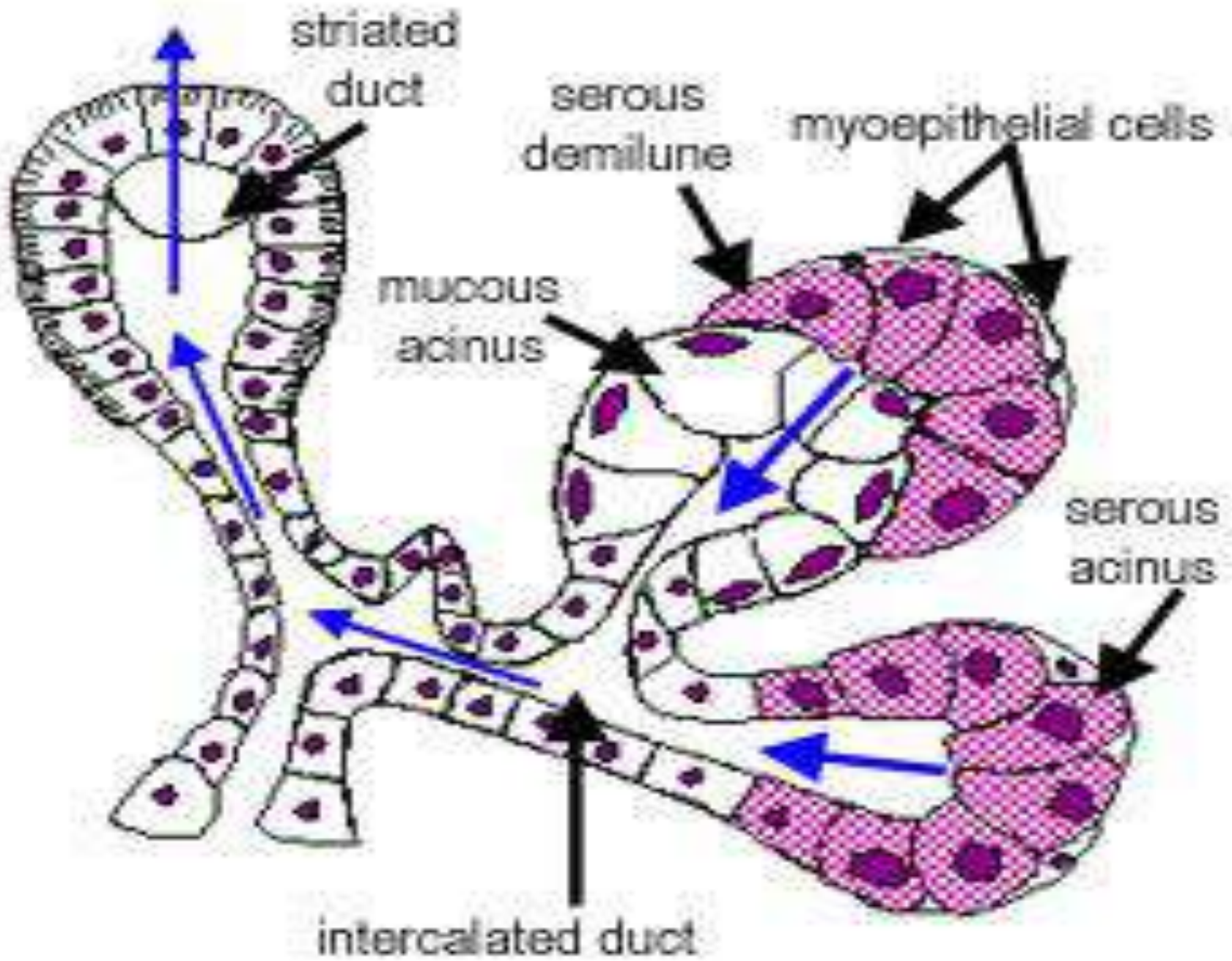


Fig. : Salivary Glands



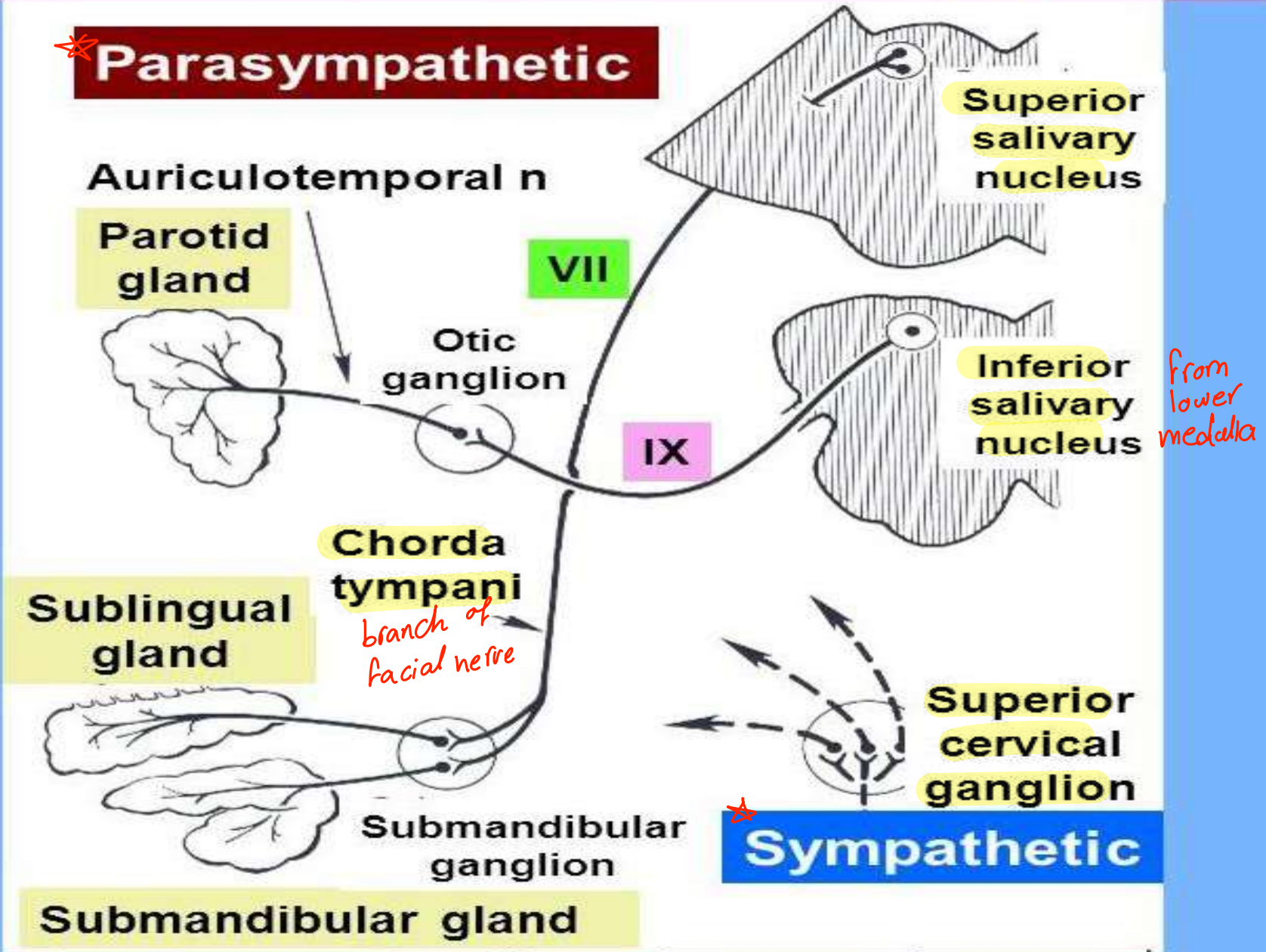
d) Innervation of salivary glands:

The salivary glands are innervated by sympathetic and parasympathetic nerve

	Sympathetic Supply	Parasympathetic Supply
Origin	LHCs of T1 and T2 ↓ lateral horn cell	-Facial nerve ^{7 رقم} → submandibular and sublingual glands -Glossopharyngeal nerve ^{9 رقم} → parotid
Functions	1-Trophic secretion: is small in volume and rich in enzymes and mucin. 2- Vasoconstriction.	1- True secretion: is large in volume, watery in consistency & rich in electrolytes 2- Marked vasodilatation (V.D.)

Innervation of salivary gland

* Parasympathetic



Saliva

Saliva Volume:

800-1500

ml/day. Composition: Saliva is composed of:

1. **99.5 % water** → الماء الأساسي

2. **0.5 % solids;** are:

simple

• **Inorganic: Na, K, Cl & HCO₃** which act as **buffers** and **activators.** → of enzymes in saliva

a) **Organic:** *Complexed*

saliva $\text{H}_2\text{CO}_3 \rightleftharpoons \text{HCO}_3^- + \text{H}^+$

- **Enzymes:**

• **Digestive enzymes (α -amylase and lingual lipase).**

digestion of lipids

• **Lysozyme** which attacks walls of the bacteria. → in immunity

- **Mucin.** *مخاط*

- **IgA.** → Immune globulin A
(Anti body)

Functions of Saliva

1-Digestion: It contains **α -amylase enzyme** which starts the **digestion of the starches.**

النشويات

2-Deglutition: It contains **mucin** which acts a lubricant **to facilitate swallowing.**

عليه البلع

- يجعل على ترطيب الأكل لتسهيل البلع

3-Diluting medium: It acts as a diluting medium for irritating **substances.**

اشي مؤرقة

- يقلل من سمية المواد مثل

4-Speech: It keeps the **buccal cavity wet**; which aids speech **by facilitating movements of lips and tongue.**

يجعل على ترطيبا .

5-Solvent: It acts as solvent for food particles **to be an effective stimulus to taste receptors.**

عنا بالفم مستقبلات الذوق وهي ما يتشغل على الاشئ solid لازم يكون ذائب

6-Buffering action:

- It **keeps the PH of the mouth about 7.**
- This **alkalinity** ^{- حافظ على} preserves calcium in the teeth.
- **Acidity** of the buccal cavity (e.g. by bacterial action on food remnants) will cause dissolving of Ca from teeth. → ^{- يصل تسوس}
- Loss of Ca from teeth will lead to dental caries.

7. Oral hygiene:

- The flow of saliva washes away the pathogenic bacteria.** ^{oral cavity} ^{يجدها عن}
- Saliva contains IgA which defends against bacteria and viruses.
- Thiocyanate ions which are bactericidal.** → ^{تقتل البكتيريا}
- Lysozyme

Mastication (Chewing)

عَلِيَّةُ الْمَضْغِ

Definition

- It is the act by which food is broken down to small particles to be swallowed easily
- It involves movements of the mandible, lips, cheeks and tongue.
- Teeth grind and break down food. →

تطحن

كل ما كان food اذ يخرج يكون
أسهل للبلع، وصولاً إلى أنزيمات
تشتغل على surface area

Functions of Mastication:

1. Breakdown of the food into small particles to be easily swallowed
2. Chewing is important for digestion of all types of food, but it is especially important for digestion of fruits and raw vegetables.

السييلولوز

Deglutition (Swallowing)

عِلْمُ الْبَلْغِ

Definition - It is the act of transfer of food from the mouth cavity to the stomach.

Phases:

- It is divided into three stages (phases).

إِرَادِيَّة

A) Buccal (voluntary) stage:

- During it, the food is pushed into the pharynx by the tongue.
- It is done by the upward and backward movement of the tongue

لا إرادي

B) Pharyngeal (involuntary) stage:

- It takes 1- 2 seconds
- Presence of food in the back of the mouth → stimulate swallowing receptor in pharynx → which causes;
 - a) Closure of the posterior nasal opening by soft palate
 - b) Closure of the laryngeal opening by vocal cords and epiglottis. الأحبال الصوتية لسان المزمار
 - c) Stop of breathing during swallowing.
 - d) Relaxation of the upper esophageal sphincter → the food moves to the esophagus.
 - e) Relaxation of the lower esophageal sphincter and stomach to receive the food

سريع جداً



هون عنا مشكلة ممكن تواجهني انه الاكل يرجع لل mouth لكن بصير continuous contraction
 of tongue فارجع الى الفم و upward & backward فارجع يضل مسكر فتحة الفم و
 يمنع دخول ال bolus للفم برضو في مشكلة عنا ال pharynx الة فتحتين وحدة على الحنجرة و وحدة على كمل الوادي
 nasel cavity بحيث انه ما يدخلها الاكل
 فارجع الى الفم و upward & backward فارجع يضل مسكر فتحة الفم و
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 nasel cavity بحيث انه ما يدخلها الاكل

Figure 14.14a-b

C) Esophageal Stage (Motor function of esophagus):

- It takes 8- 10 seconds
 - The food move into esophagus by peristalsis
- اكثره زلدرية

Stomach

Anatomy

- The stomach is formed of 3 parts: **fundus, body and antrum or pylorus.**

Gastric Glands: → موجود في الغشاء المخاطي للمعدة

- The gastric mucosa contain **three types** of cells

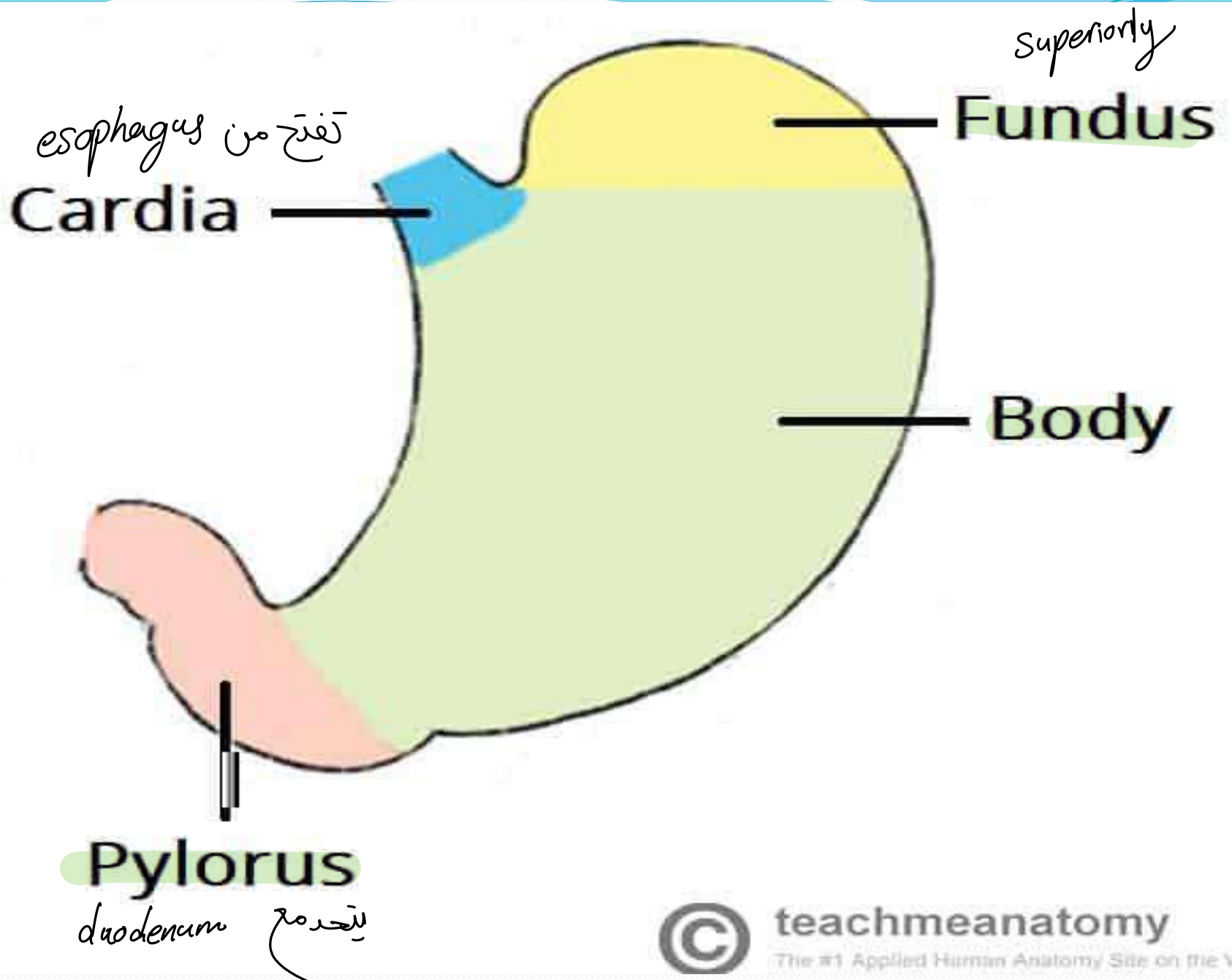
a. **Parietal (oxyntic) cells** → **secrete HCl and intrinsic factor.**

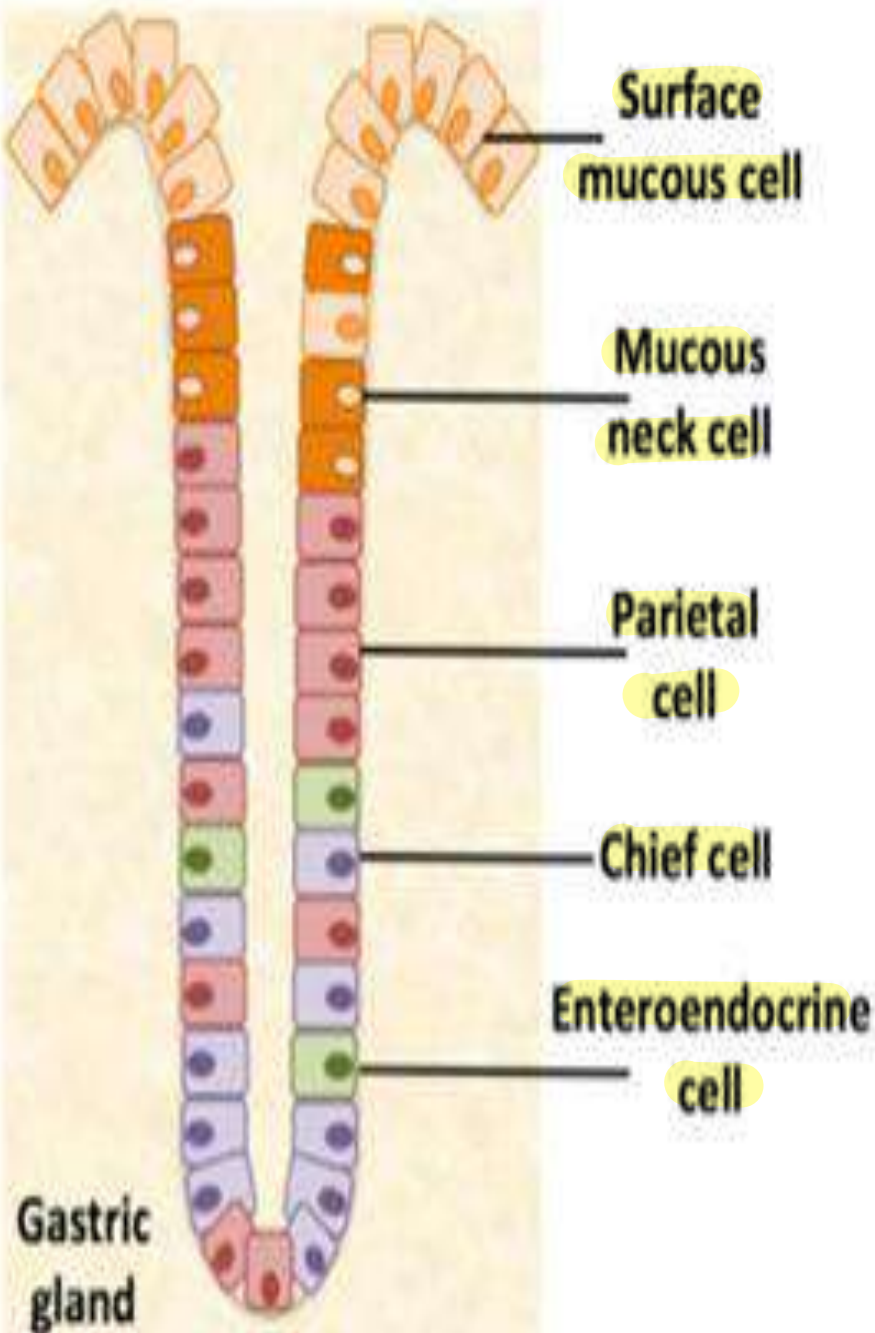
b. **Peptic (chief) cells** → secrete proteolytic enzymes

vit B12
↓
لعضيم

pepsinogens. → يساعد في هضم البروتين

c. **Mucous cells** → **secrete mucous.** → lining up the wall of stomach to avoid **ulcers**
لتهقجة المعدة





Cells of the gastric glands	Secretory products
Surface mucous cells	Mucin in an alkaline fluid HCO_3^- مكتسبة
Mucous neck cells	Mucin in an acidic fluid لأنها قريبة من parietal
Parietal cells	HCl & intrinsic factor
Chief cells	مضغ البروتين ↑ Pepsinogen & lipase ↓ مضغ الدهون
G cells/enteroendocrine cells	Gastrin → يساعد في خروج HCl

Nerve supply: Autonomic Nervous system

A) Sympathetic supply ثَبِّطْ عِلَّ الْمَعِدَةِ

- 1- causes **relaxation of the wall of the stomach and contraction of pyloric sphincter** → delayed emptying
- 2- Stimulate mucous secretion.
- 3- **V.C. of gastric blood vessels.**

B) Parasympathetic supply - كَفِّرِ الْمَعِدَةَ إِذَا تَسْتَعْمَلُ

- 1- Causes **contraction of the wall of the stomach and relaxation of pyloric sphincter** → rapid emptying.
- 2- stimulate secretion of HCL and pepsin
- 3- **V.D. of gastric blood vessels.**

Gastric Juice

- PH is ① → **the most acidic fluid in the body.** → Because of HCl
- The volume is 3 L/day.

Composition: a. Water 99%. b. HCl 0.5%
0.5% other substances

i. **Inorganic constituents** → **0.1%. e.g. Na, K, Ca, Mg.**

ii. **Organic constituents** → 0.4%. e.g.

إنزيمات هاضمة

- **Enzymes: pepsinogens, gastric lipase, gelatinase and**

↓
pepsin يتحول إلى
← مضم النشا **gastric amylase.**

- **Mucous.**

- **Intrinsic factor.**

Functions of HCL

1. It ^{inactive form} **activates pepsinogens into pepsin** ^{active form} and provides the acidic medium needed for their actions.
2. **It kills many ingested bacteria.** → قتل أي بكتيريا ضارة
3. It helps Ca and iron absorption.
4. **Together with pepsin, it helps milk clotting.** → مثل لبن موجود بالبر

Pepsin functions → دھضم البروتينات

- The active pepsin is a proteolytic enzyme which acts on **polypeptides** to form **peptides** and peptones. → Amino acids الصورة التي يمتص بها البروتين
- It needs a highly acidic medium.

Intrinsic Factor

parietal cells

- It is secreted by the oxyntic cells.
- It is essential for absorption of vitamin B12.
- Vitamin B12 is essential for maturation of RBCs, so lack of intrinsic factor causes pernicious anaemia

Mucous Secretion

a) Is important for lubrication & mixing chime

عشان ما تجرح جدار المعدة

b) Form a gel coat that protect the gastric mucosa from HCl

& mechanical erosion by food

- تمنى المعدة من القرحة وغيرها

HCl (hydrochloric acid)

Source :

The **parietal (oxyntic) cells**, which is characterized by :

- Presence of large number of mitochondria → تحطيرها الطاقة عشان تصنع Hcl
- Presence of system of **canaliculi** → يتم فيها تصنيع Hcl فقط

Their surface contain **5** types of receptors

	Acts by (2nd messenger)	Stimulated by (1st messenger)	Inhibited by	Effect
1- Muscarinic R.	↑ intracellular Ca ⁺⁺	Acetyl choline	Atropine (drug) <small>بستخدمة بجلاج قرحة المعدة</small>	↑ HCl
2- Gastric R	↑ intracellular Ca ⁺⁺	Gastrin	Somatostatin	↑ HCl
3- Histamine R	↑ ing C-AMP <small>↓ cyclic</small>	Histamine	Somatostatin	↑ HCl
4- Prostaglandins	↓ ing C-AMP	PGS	Anti-inflammatory drugs <small>مثل الأسبرين ف لازم ما آخذنه على معدة فاضنة</small>	↓ HCl
5- Somatostatin	↓ ing C-AMP	Somatostatin		↓ HCl

increase HCl

decrease HCl

N.B

- Patients taking anti-inflammatory drugs complain of hyperacidity and peptic ulcer because these drugs \downarrow PGS \rightarrow \uparrow HCl.

Cellular mechanism for HCL secretion

ATP

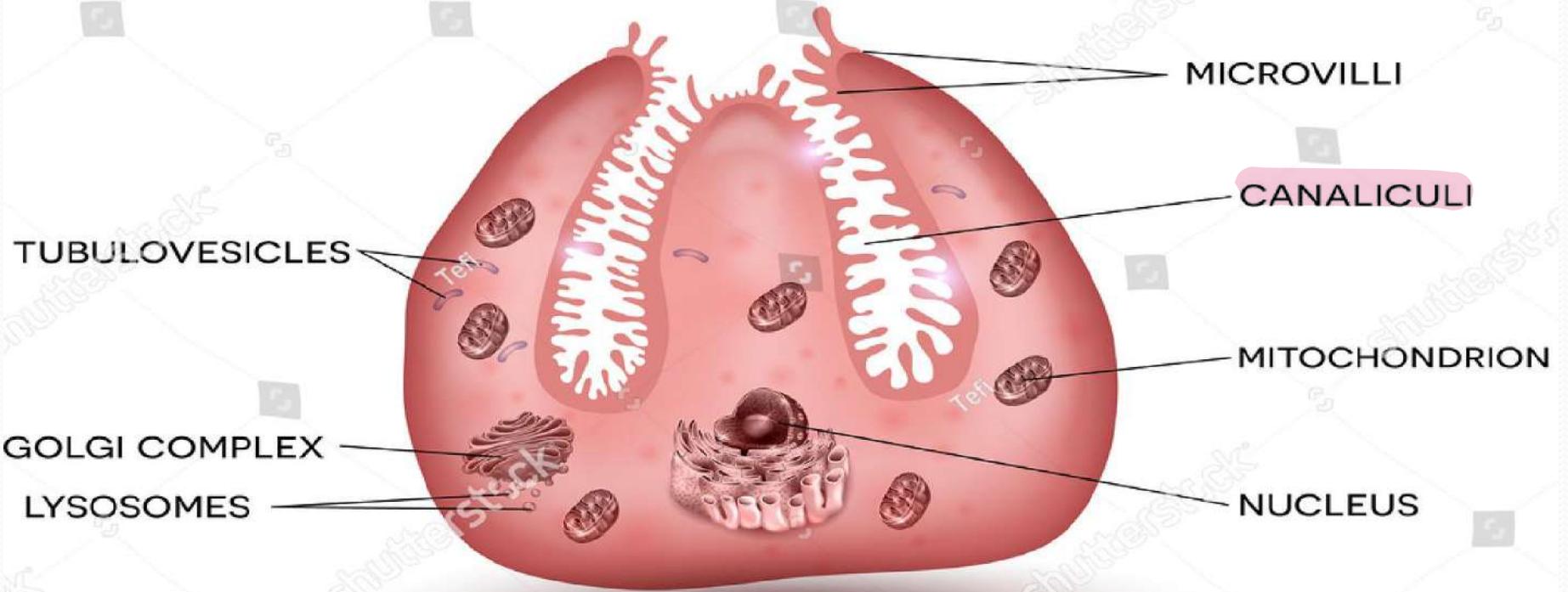
1. **Cl⁻ is actively secreted into the lumen, this creates \ominus ve potential**
2. **K⁺ then diffuses to the lumen attracted by the $-ve$ potential**
3. **H⁺ is pumped into the lumen in exchange with K⁺ through the H⁺-K⁺ pump (proton pump).**
4. **HCO₃⁻ then diffuses to the extracellular fluid causing **temporal alkalosis** (alkaline tide).** \rightarrow **تأثير قاعدي**
5. **Water then diffuses to the lumen by osmosis**

الخلية هون تحتوي على ميتوكوندريا تقوم بتكسير الاكل عن طريق الأوكسجين و تطلع Co₂ ، هاد co₂ يتحد مع H₂O ف بعمل H₂CO₃ بوجود carbonic anhydrase ف رح يتحلل و يعطيني hco₃⁻ و H هاي ال hco₃⁻ رح يطلع و يروح للدم و يدخل بداله cl عشان يعوض الشحنة السالبة، و هو قاعدي بعد ما الشخص ياكل و يتم افراز HCl، لو أخذنا عينة دم رح نلاقي القاعدية زابدة لانه Hco₃⁻ دخل بكمية كبيرة يدخل cl ب active transport يعني محتاج الى طاقة، بضل عنا H⁺ و هاد عشان يدخل لازم يمر بداله شحنة موجبة زييه، يلي هو K⁺ و هو يجذب لل Cl⁻، رح يدخل H⁺ عن طريق hydrogen potassium atpase هاد يستخدم الطاقة الناتجة من تكسير atp يدخل ال h و يطلع k

→ شرح الرسمة بـ 28 سلايد

PARIETAL CELL

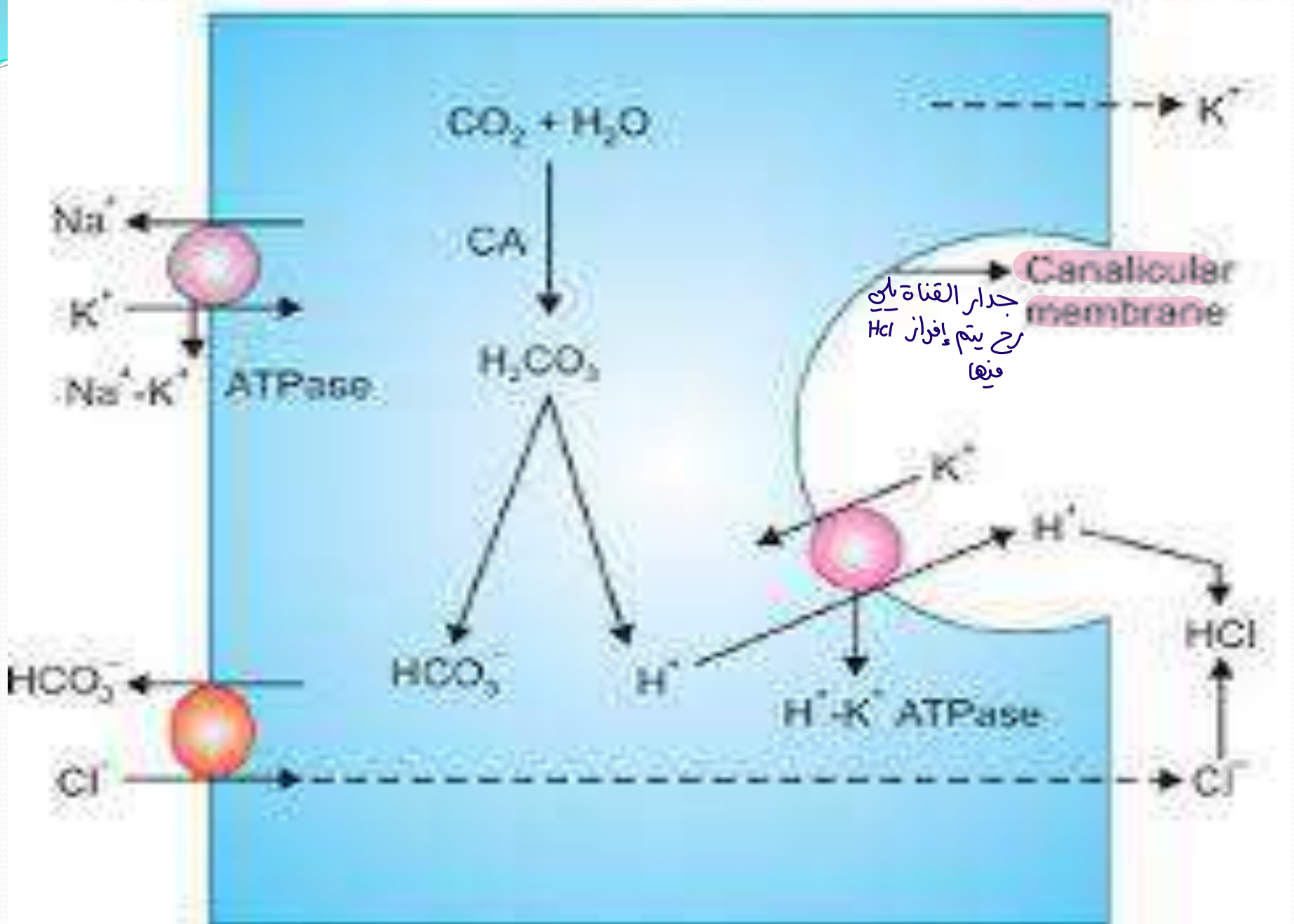
CELL TYPE OF THE STOMACH WALL



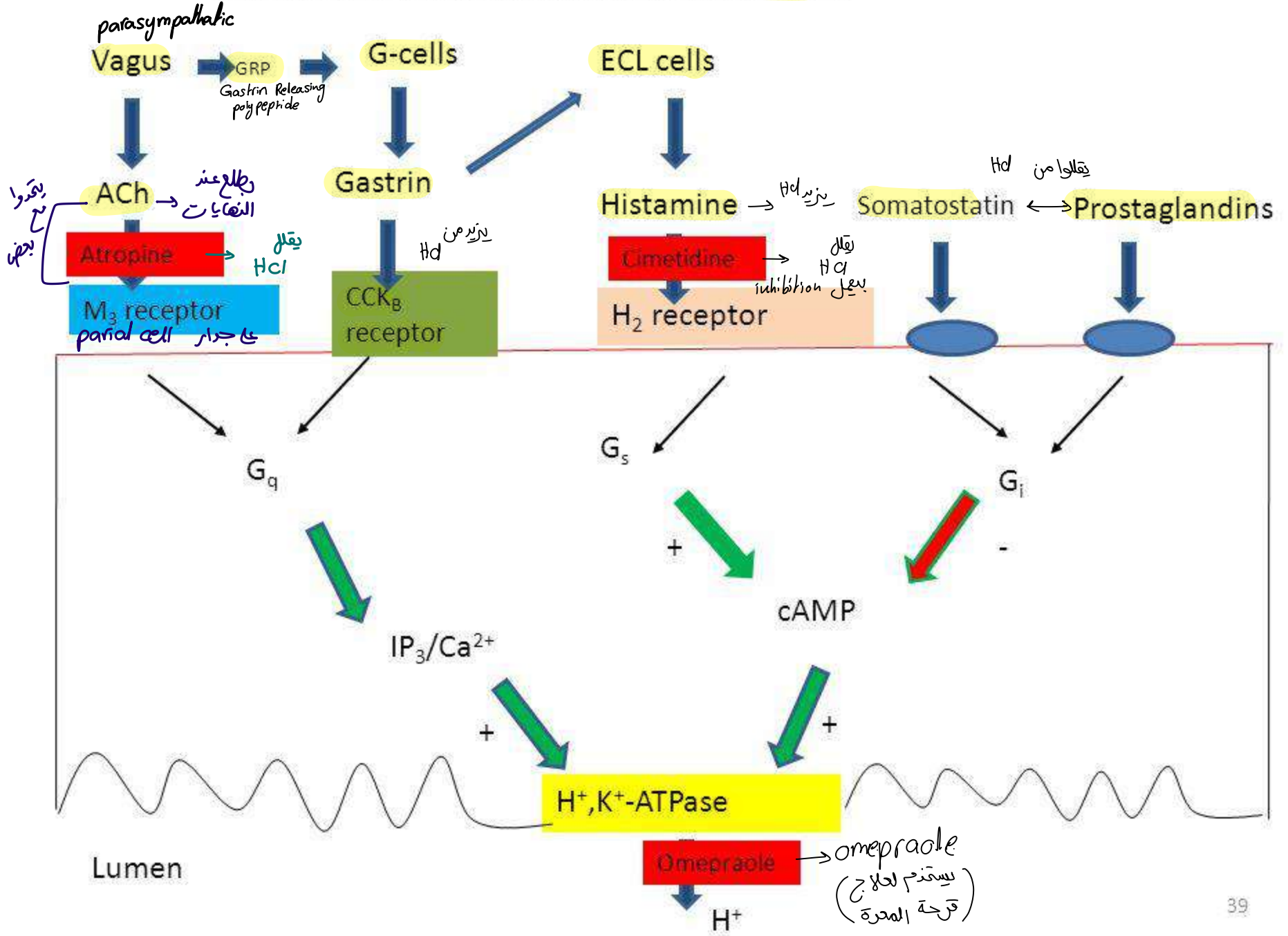
ISF

Parietal cell

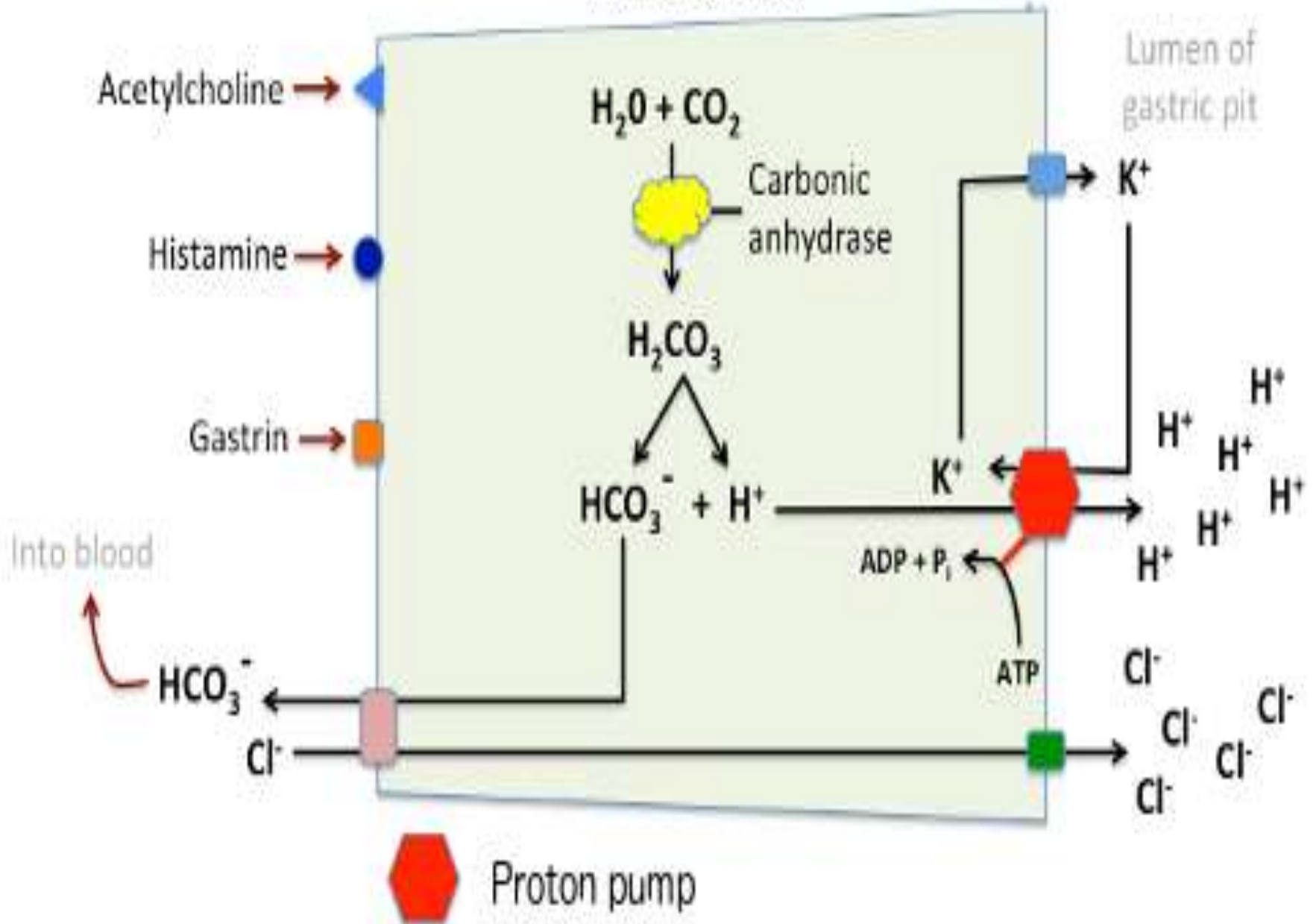
Gastric lumen



Control of H⁺ secretion by gastric parietal cells



Parietal Cell



Control of HCl secretion

a) Stimulators محفّز

1. Acetylcholine
2. Histamine
3. Gastrin
4. Anger & hostility

b) Inhibitors مكثّط

1. PGS
2. ↑ acidity in the stomach
3. Somatostatin, GIP, VIP
4. Fear & depression
↓ الخوف ↓ الاكتئاب

Functions of HCl

1. **Activate pepsinogens into pepsins.**
2. **Provide the acidic medium needed for the activity of pepsins.**
3. **Kills the ingested bacteria**
4. **Help iron & ca^{++} absorption**
5. **Help milk clotting.**
6. **Controls the rate of gastric emptying** so that \uparrow duodenal acidity $\rightarrow \downarrow$ emptying.
7. **Stimulates bile flow & pancreatic juice by increasing CCK &**

تفريغ مكونات المعدة

secretin.

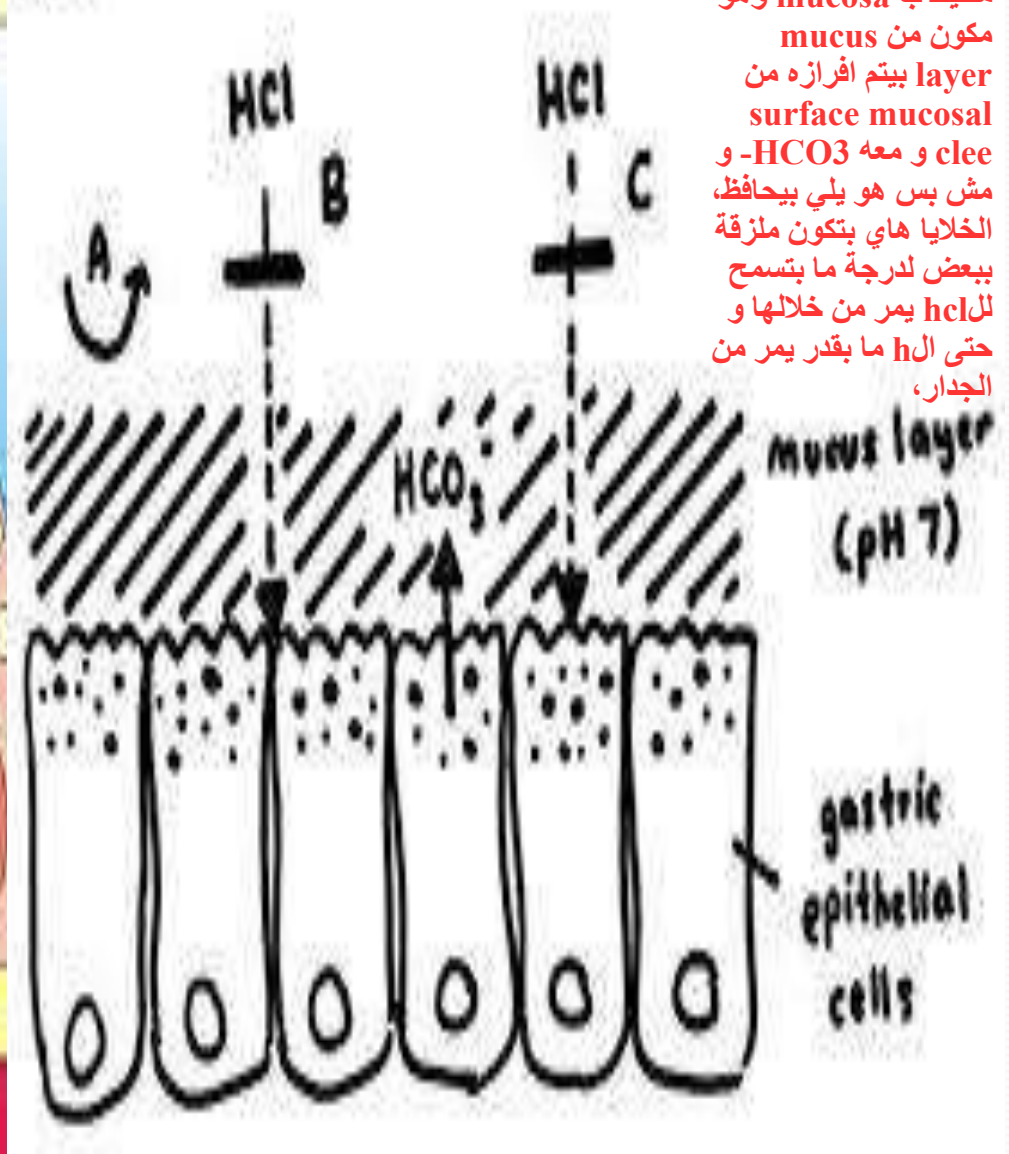
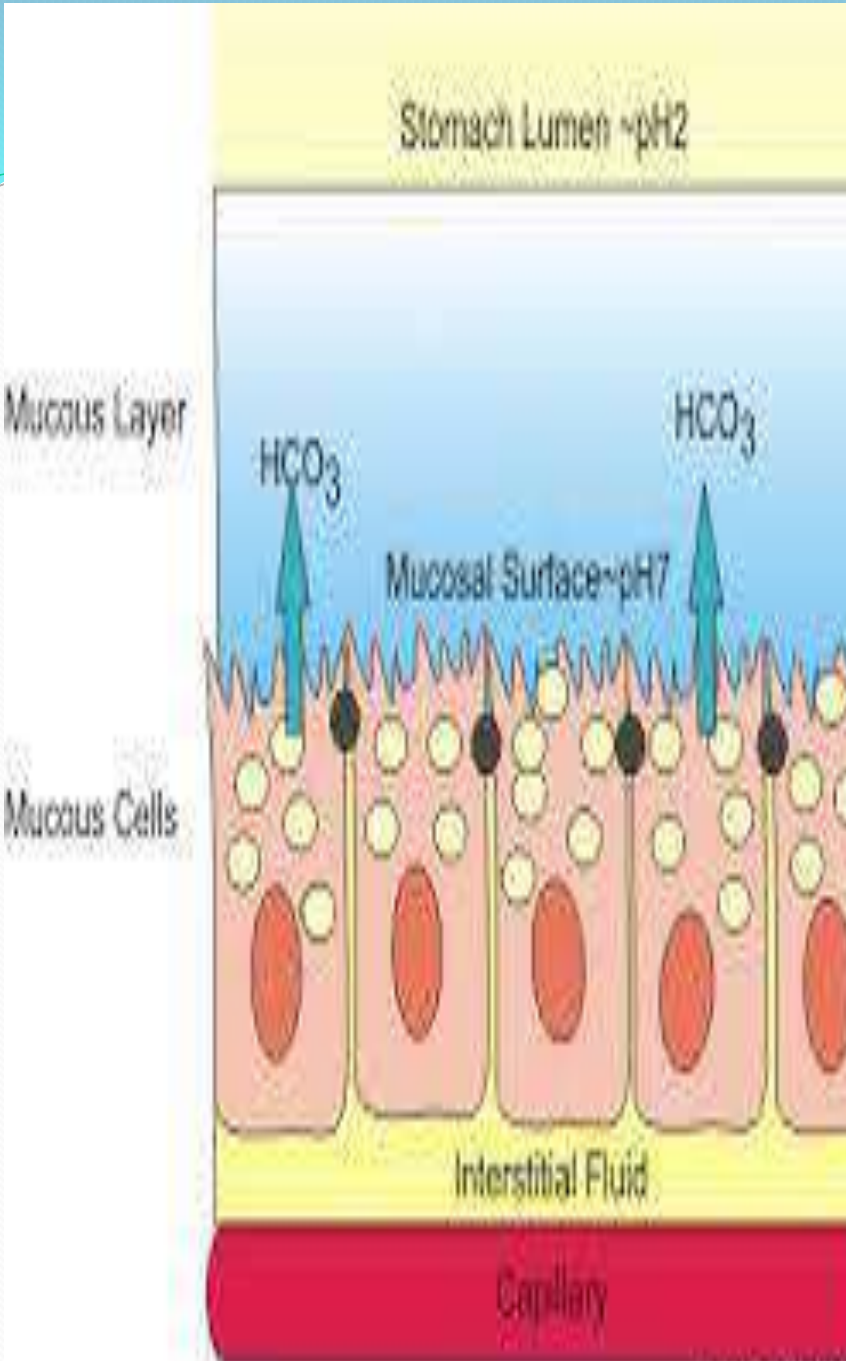
↓
 العصارة الصفراء
 يتم إفرازها من البنكرياس
 وتخزن في المرارة، تحتوي على HCO_3^-

↓
 تحتوي على HCO_3^- وتصب
 في الاثنا عشر.

لما الـ acidity تزيد ، يطلع هرمونات اسمها
 Cholecystinin و secretin و يتم
 افرازهم من dudenuom هاي الهرمونات
 تحفز خروج bile & pancreatic juice
 عشان موجود فيها hco_3^- لحتى تعادل
 acidity و هيك ما بيحصل قرحة

Gastric Mucosal Barrier

هاي عبارة عن غلاف محيط ب mucosa وهو مكون من mucus layer surface mucosal clee و معه HCO_3^- و مش بس هو يلي بيحافظ، الخلايا هاي بتكون ملزقة ببعض لدرجة ما بتسمح لل HCl يمر من خلالها و حتى ال H^+ ما بقدر يمر من الجدار،



COMPONENTS OF GASTRIC MUCOSAL BARRIER

- ⊕ A compact epithelial cell lining → يعني الخلايا ملاصقة ببعضها
ما يسمح لأي شيء يمر من خلاله
- ⊕ A special mucous covering → مخاط مائل بحدار
المعدة
- ⊕ Impermeability of luminal membrane of the gastric mucosal cells to hydrogen ions H^+
لا يسمح بمرور H^+
- ⊕ Rapid replacement of entire stomach lining → طول الوقت في
عملية تجديد الخلايا

Digestive Systems

- Functions of digestive system:

- Accessory organs

- Pancreas

- Exocrine gland between stomach and small intestine
- Produces several digestive enzymes:

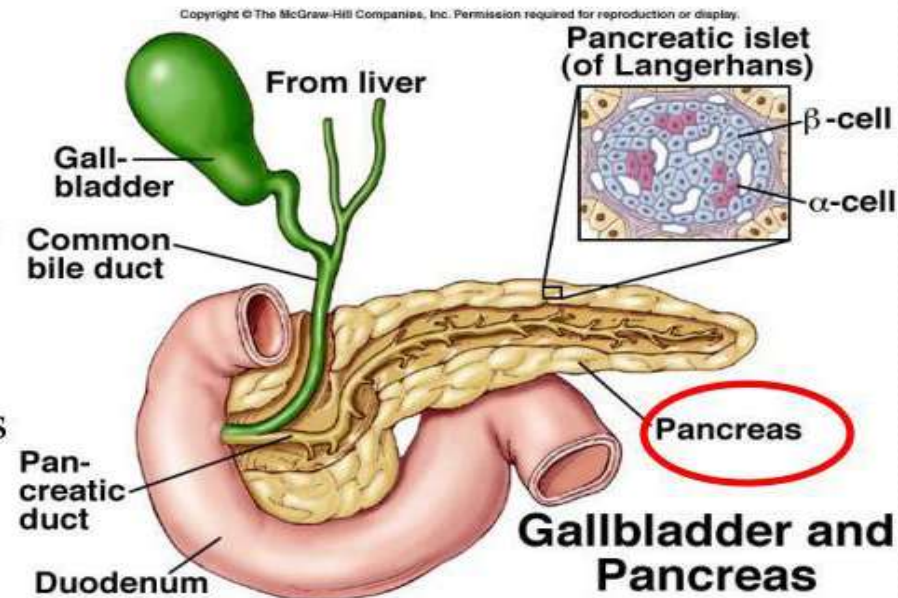
- » **trypsin**: digests proteins

- » **pancreatic amylase**: digests starches → الشويين

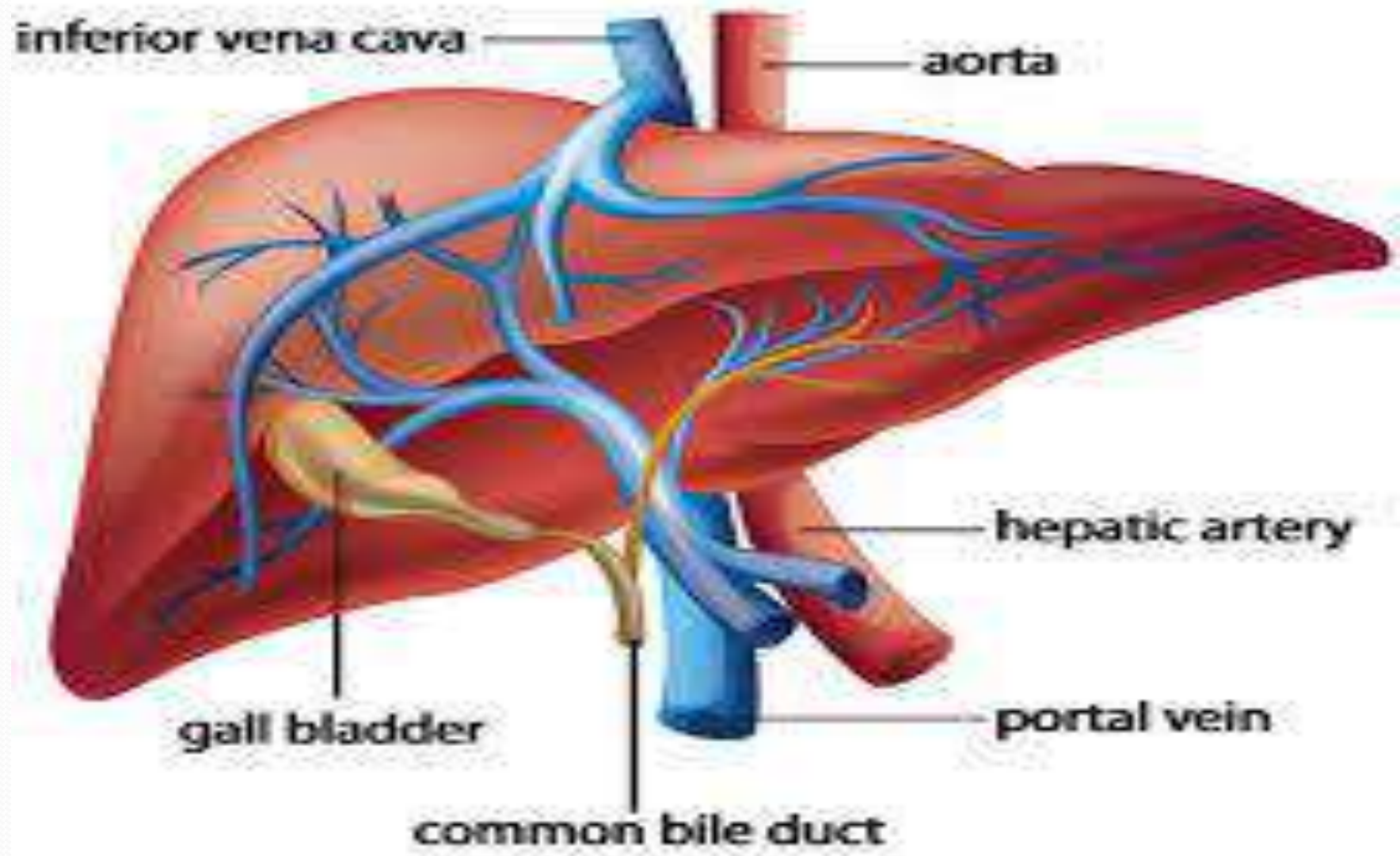
- » **lipase**: digests fats

- Also acts as endocrine gland

- » produces hormones to regulate glucose levels in blood (insulin and glucagon)



Human Liver Anatomy



Functions of the Liver

- Metabolic مصنع الأيض في الجسم © MD, Sun Bunlorn Page
- Storage- Glycogen, vitamins (all Fat soluble and few water soluble), iron
- Excretory/Secretory – bile excretion → تخزن في Gallbladder
- Protective (eg. kuffer cells) → خلايا أكولة
- Coagulation – production of clotting factors (13 factor)
- Detoxification of drugs via cytochromes.

Bile Juice →

بصفت تفسر الهيموغلوبين
بصفتي ع bile pigment

- Bile is a bitter-tasting, dark green to yellowish brown fluid, produced by the liver, it is stored in the gallbladder and upon eating is discharged into the duodenum. .
- The principal function of the gallbladder is to serve as a storage reservoir for bile.
- The main components of bile are water, bile salts, bile pigments, and cholesterol.
- Bile salts act as emulsifying agents in the digestion and absorption of fats. Cholesterol and bile pigments from the breakdown of hemoglobin are excreted from the body in the bile.

1

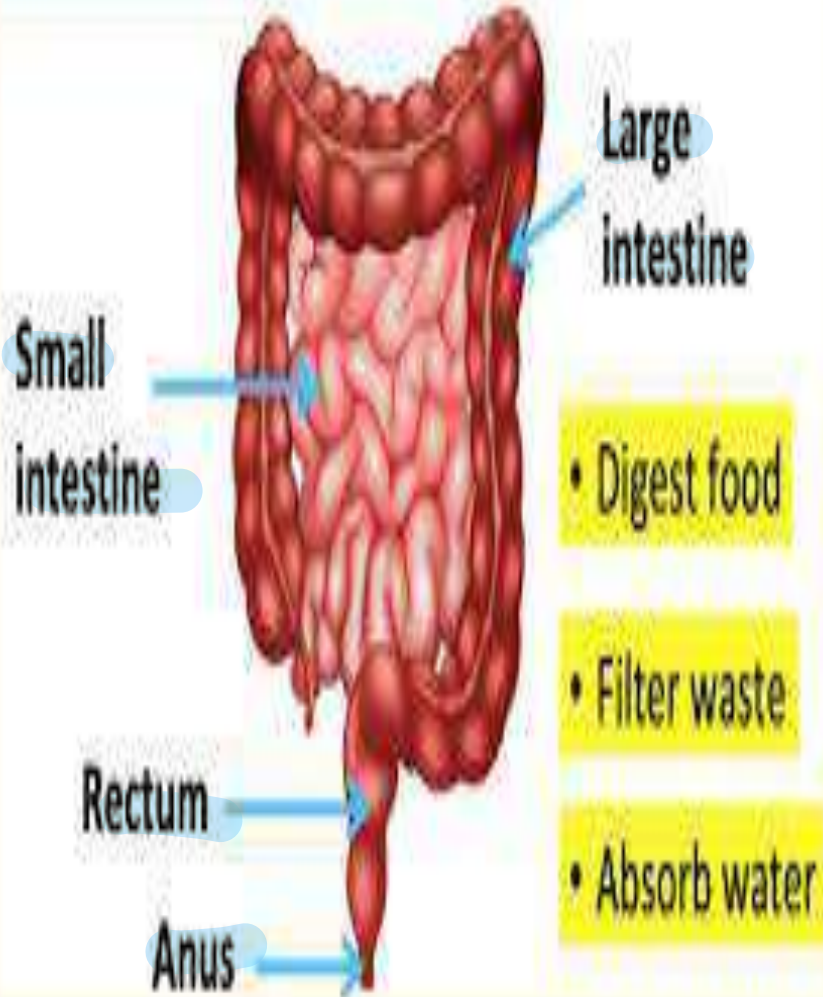
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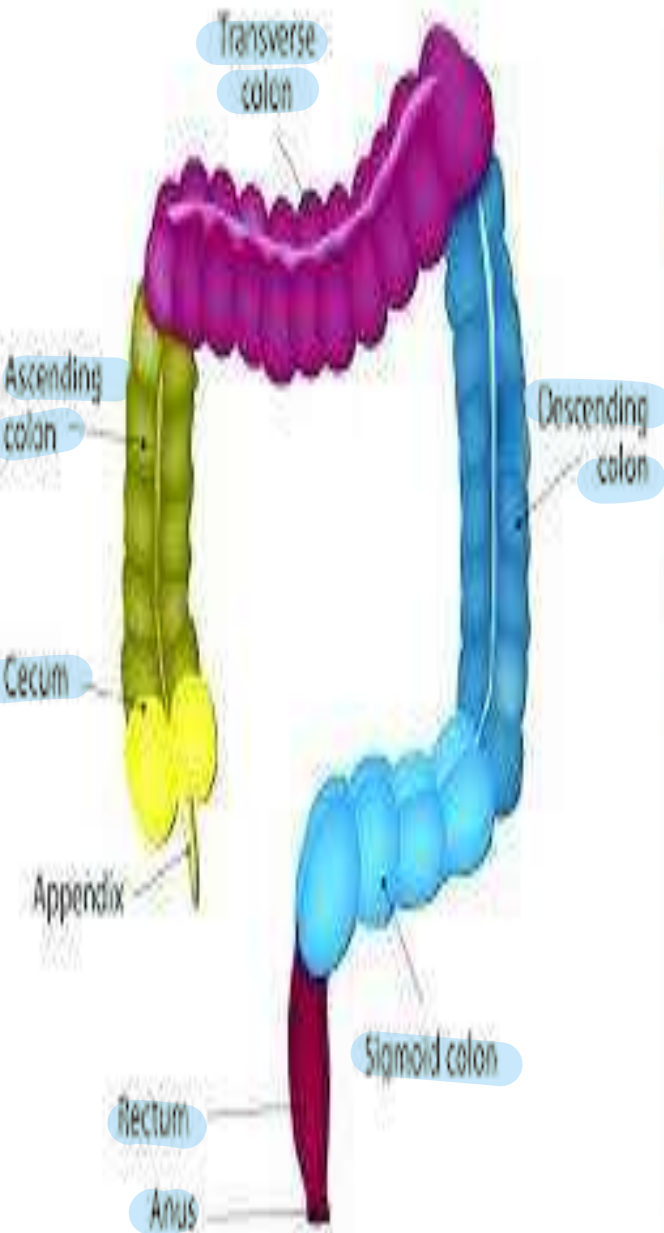
3

water soluble fat كولي

Intestines Anatomy & functions



Functions of large intestine



• 3 primary functions:

1. absorbing water and electrolytes,
 2. producing and absorbing vitamins,
 3. forming and propelling feces toward the rectum for elimination.
- Convert the liquid contents of the ileum into semisolid feces by absorbing water, salts, and electrolytes. It also stores and lubricates feces with mucus.

تبدأ في الكبد لأن
تنتهي صون

Which of these ions is present in saliva and is bactericidal?

Na (a)

K (b)

Cl (c)

Hco₃ (d)

Thiocyanate (e)

Which of these cells of gastric glands secretes HCL and intrinsic factor?

Peptic cell (a)

Parietal cell (b)

Mucus neck cell (c)

Enteroendocrine cell (d)

Surface mucus cell (e)

Which of these pancreatic enzymes acts to digest starch?

Trypsin (a)

Amylase (b)

Lipase (c)

Chymotrypsin (d)

Phospholipase (e)

The liver acts as an excretory organ for which of these substances?

Glycogen (a)

Fat soluble vitamins (b)

Water soluble vitamins (c)

Bile (d)

Iron (e)

Water is absorbed primarily by
which of these digestive organs?

Stomach (a)

Pancreas (b)

Liver (c)

Small and large intestine (d)

Esophagus (e)



Thank

You●