

4-Gastric Secretion

Characteristics of the Gastric Secretions

- **Oxyntic glands** (also called *Gastric glands*) and **Pyloric glands**.
four types of cells فيها Oxyntic glands ال -
- **The Oxyntic** (acid-forming) glands
- Secrete *hydrochloric acid*. (HCL)
- *Pepsinogen*. protein الي يساعد في هضم ال
- *Intrinsic factor*. terminal ileum من ال absorption of B12 الي يساعد على ال
- *Mucus*
- located at the body and fundus.
- Constituting the proximal **80 %** of stomach.
يعني 4/5 ال proximal side

Pyloric glands

يعني موجودة في ال pylorus

- Secrete mainly **mucus** for protection of the pyloric mucosa from the stomach acid.
- They also secrete the hormone **Gastrin**,
بمساعدة في إفراز ال HCL
- located in the Antral portion of the stomach, the distal 20 % of the stomach.

Types of Cells

اللي موجودين في ال 80% proximal

❖ Parietal(oxyntic) cells

- Most distinctive cells in stomach (HCl & intrinsic factor).

❖ Chief(peptic) cells

- pepsinogen على طول بتحول بال HCL في ال stomach لل pepsin ،
اللي هي هضم ال proteins ل Tri&Di peptides

❖ Mucus neck cells:

- HCO_3^-
- Mucus

Types of Cells

موجودين في ال pylorus

❖ **G Cells:** Gastrin (hormone) ---> ↑ HCl secretion

❖ **D Cells:** Somatostatin (antrum).
Inhibit HCL secretion

هدول المسؤولين عن مرض اسمه carcinoid tumor الي يكون في ال stomach وفي ال appendix و ممكن يجي في ال terminal ileum

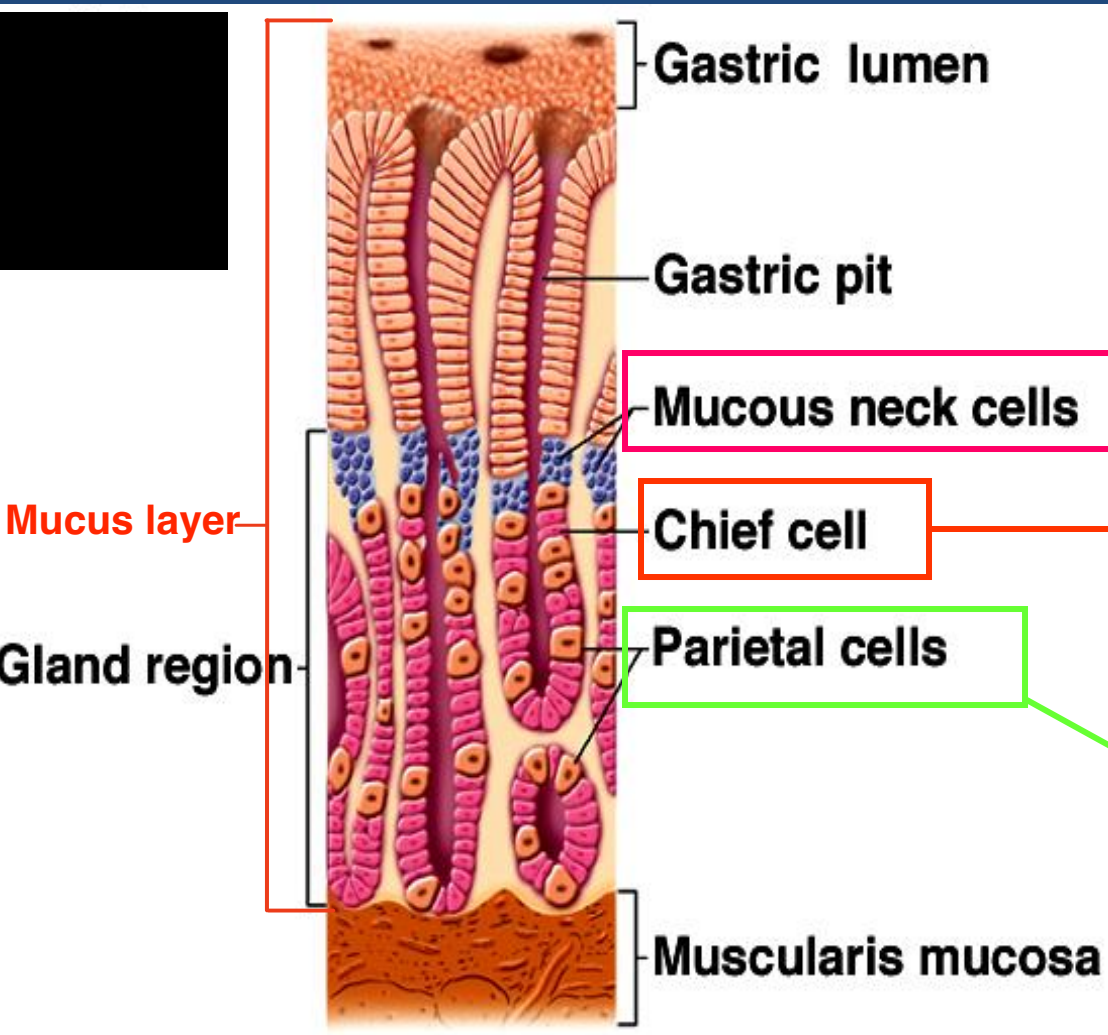
❖ **Enterochromaffin-like cell:** Histamine

❖ Present in a recess in deep part of gastric pits

Gastric juice

- HCL
- Pepsinogen
- Electrolytes
- Intrinsic factor من غيرہ مش ھیصیر لل absorption
B12 فی ال terminal ileum
- Mucus (mucus gel layer)

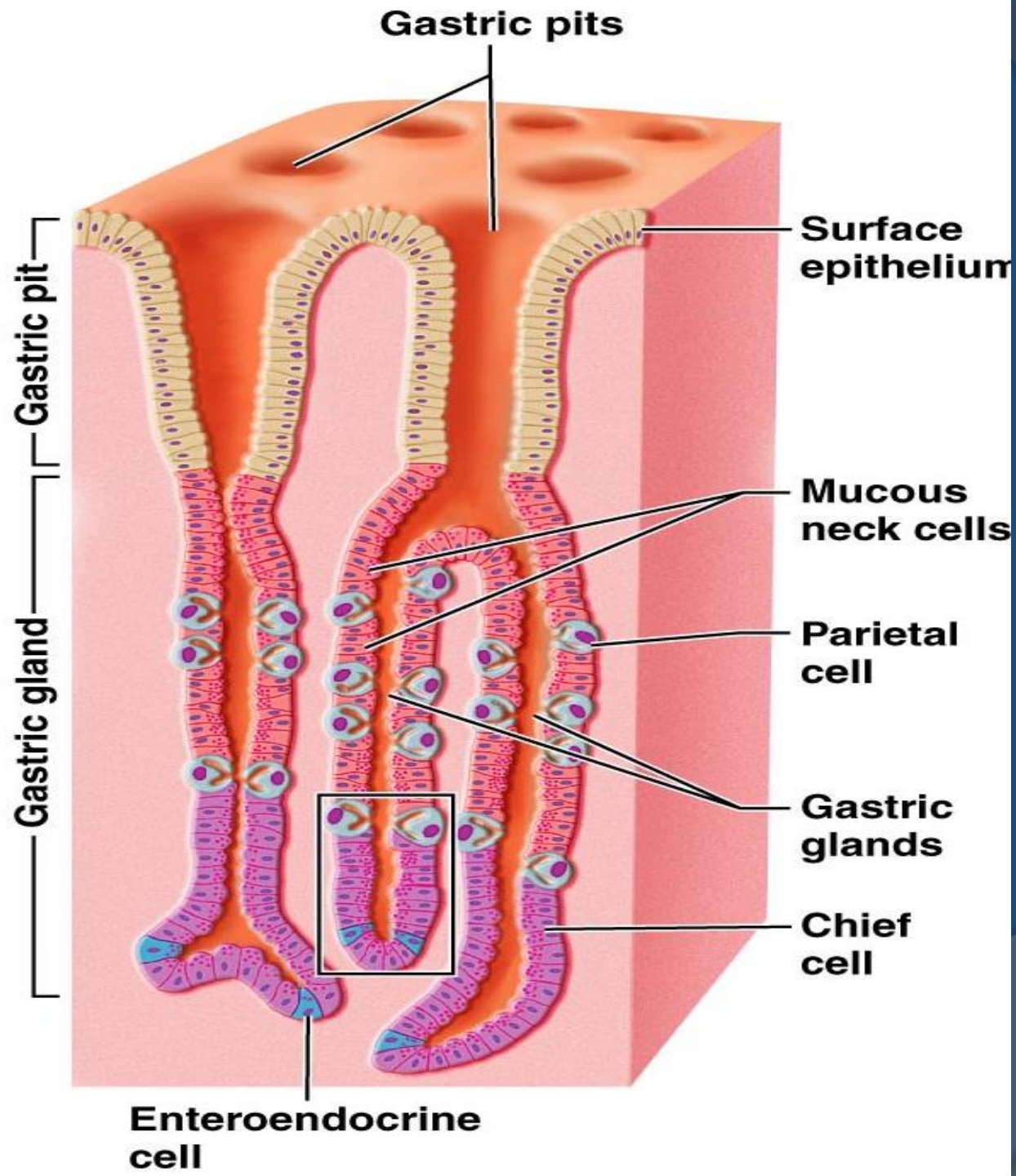
Exocrine gland cells of gastric pits

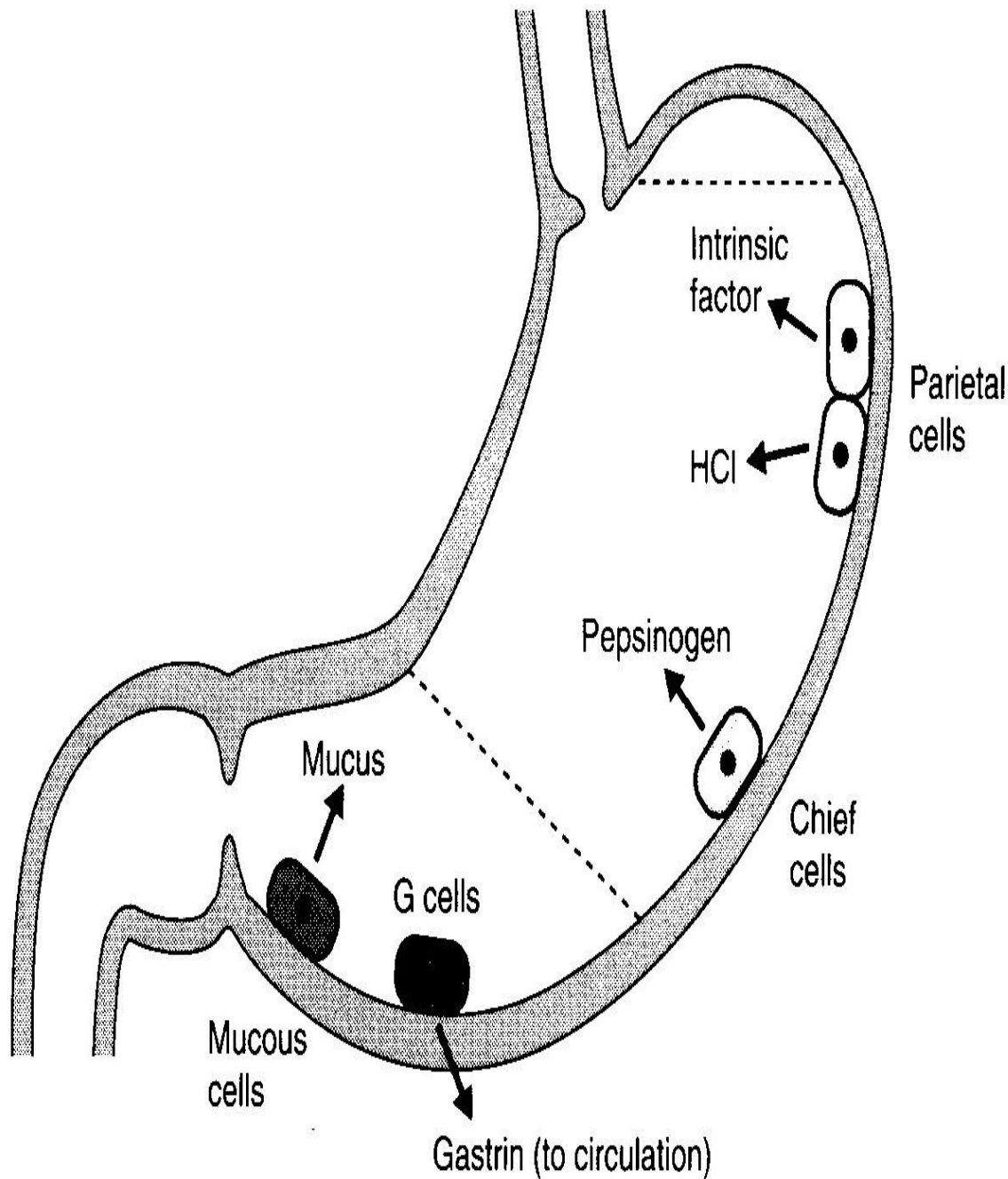


Produce alkaline mucus that covers mucosa layer

Synthesize and secrete the protease precursor known as pepsinogen.

Synthesize and secrete the HCl acid responsible for the acidic pH in the gastric lumen.





Cell Type	Location	Secretion
Parietal cells	Body	HCL Intrinsic factor
Chief cells	Body	Pepsinogen
G cells	Antrum	Gastrin
Mucous cells	Antrum	Mucus Pepsinogen

Secretion of hydrochloric acid

- Parietal cells secrete an isotonic acid solution that contains about **160 mmol/L** of hydrochloric acid.
- This has pH about **0.8**, which is extreme acidic. At this pH, the hydrogen ion concentration is about 3 million times that of the arterial blood. At the same time that hydrogen ions are secreted, bicarbonate ions diffuse into the blood so that gastric venous blood has a higher pH than arterial blood when the stomach is secreting acid

(alkaline tide.)

يعني، ال stomach بتفرز acid، وال acid هيروح على ال lumen of stomach، يبقى الدم الي راجع من ال stomach يكون alkaline

- ال pancreas بفرز alkaline secretions، يبقى الدم الي راجع منه يكون acidic tide

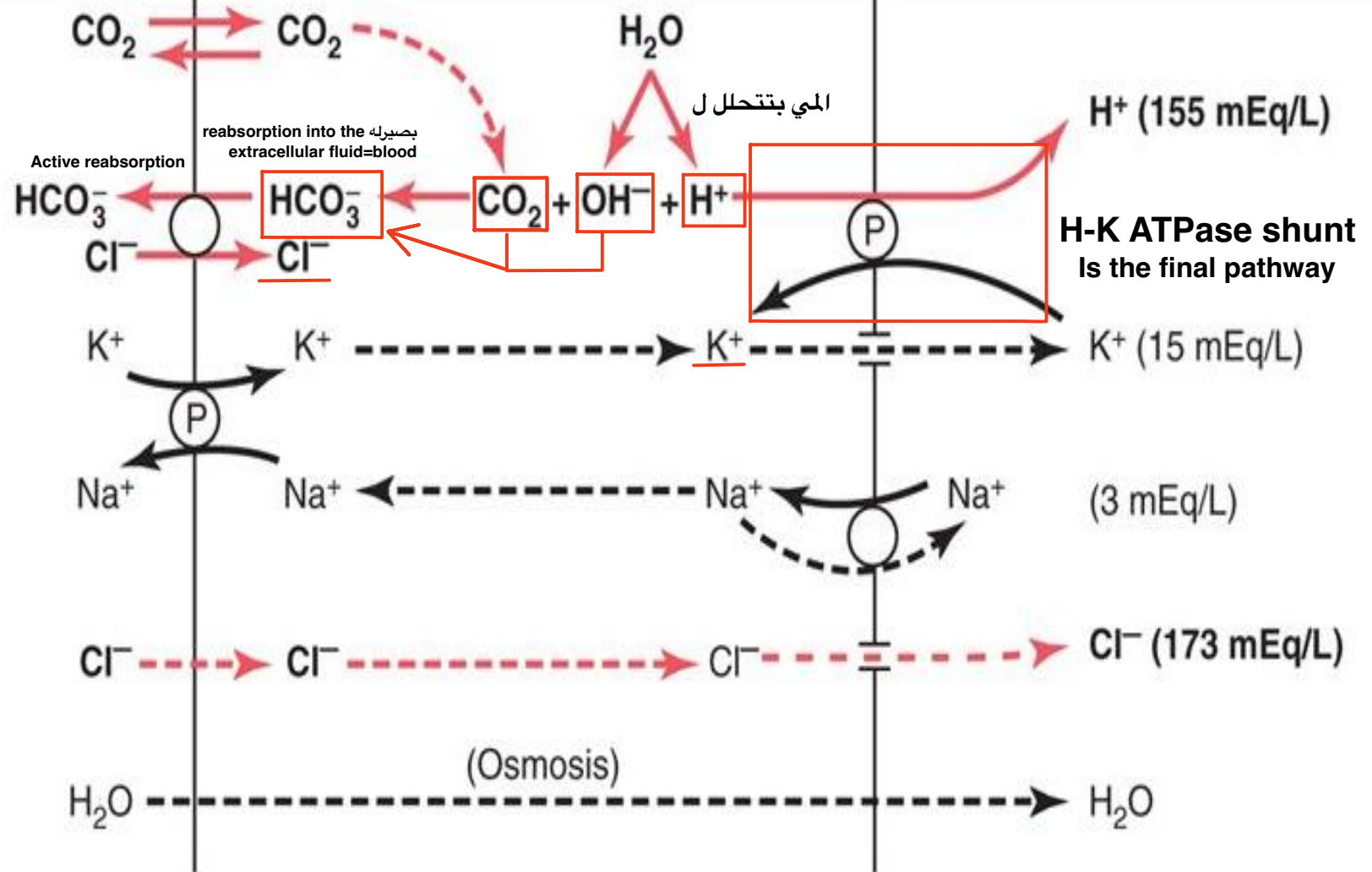
Basic mechanism of HCL secretion

- Water is dissociated in cytoplasm into H^+ , OH^- , H^+ is actively secreted into (Can), in exchange of K^+ by H-K ATPase shunt.
- Cl^- is actively transported from cytoplasm of cell into lumen of canaliculus (Can)
- Na^+ is actively transported in other direction
- K^+ , and few Na^+ ions passively diffuse as a result to lumen of (Can)
- Na^+ is actively reabsorbed by separate shunt
- Water pass to (Can) by osmosis
- CO_2 in cytoplasm combine with OH^- by carbonic anhydrase in to HCO_3^- which diffuse to plasma in exchange of Cl^-

Extracellular fluid

Parietal cell

Lumen of canaliculus
lumen of the stomach
يعني ال

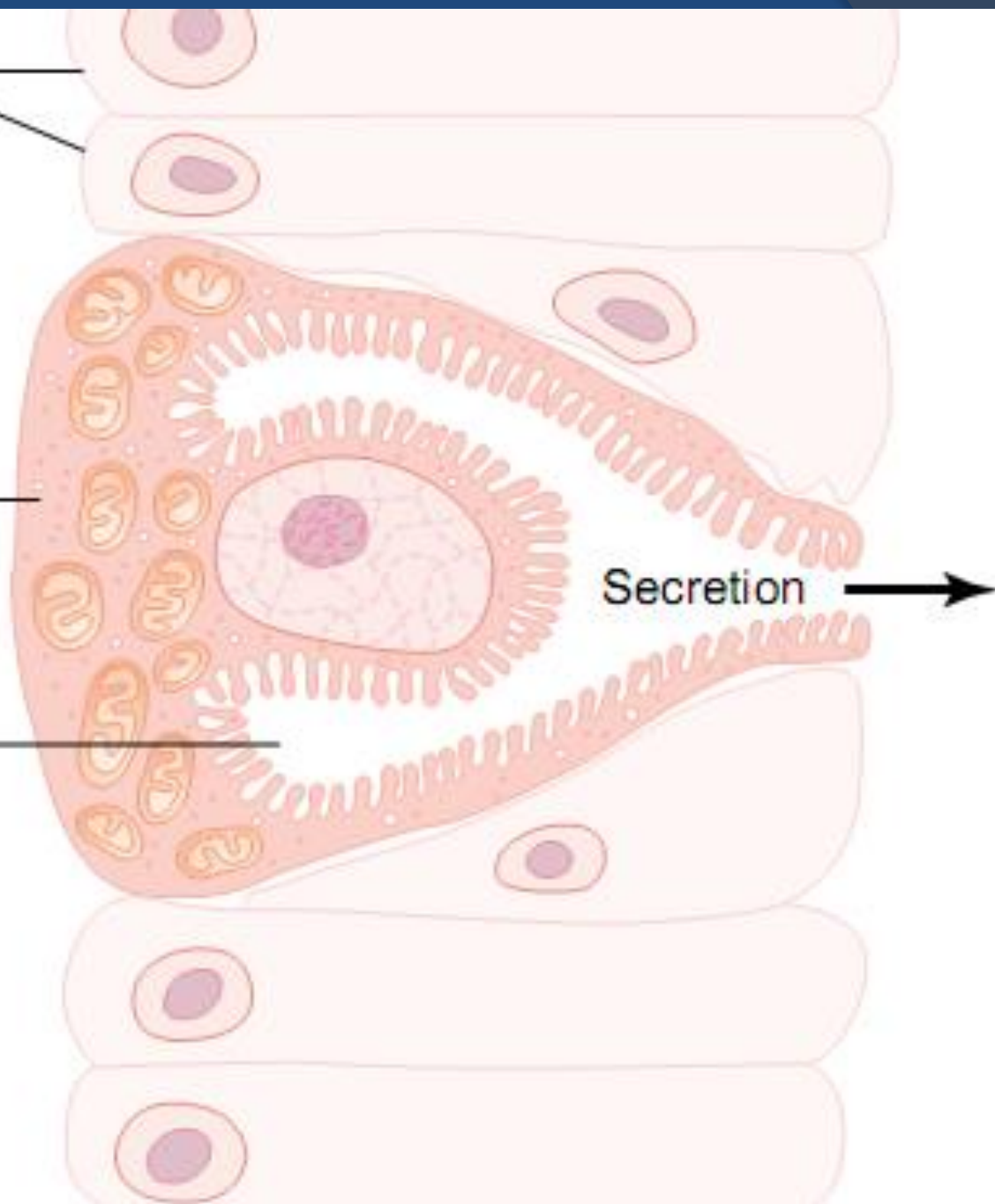


Mucous
neck cells

Oxyntic
(parietal)
cell

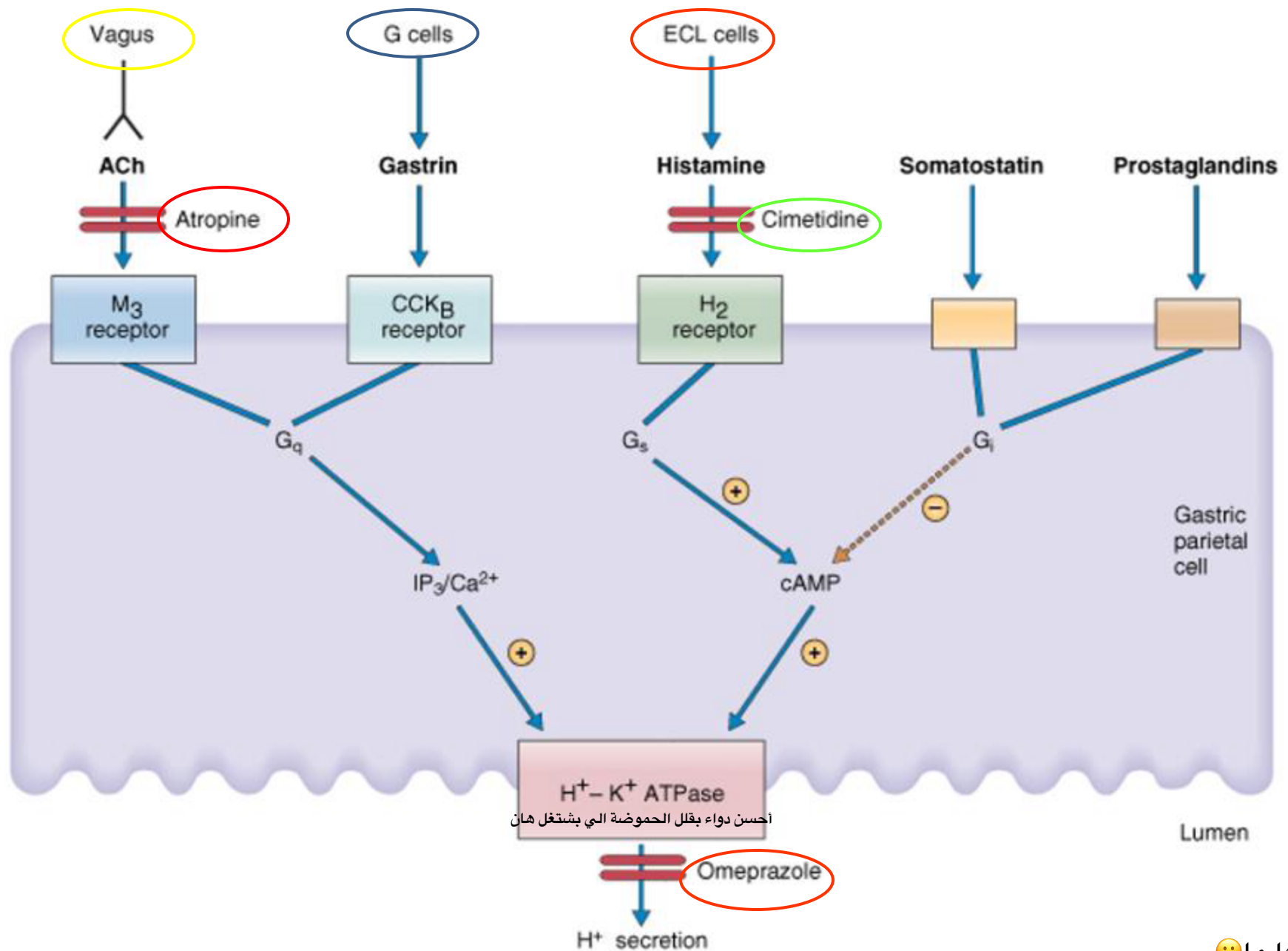
Canaliculi

Secretion

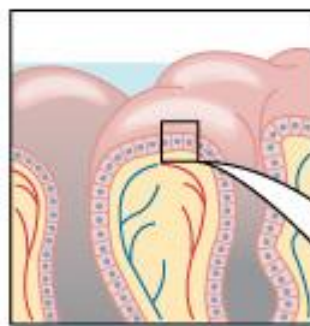


■ Basic Factors That Stimulate Gastric Secretion Are Acetylcholine, Gastrin, and Histamine and the mini brain of the gut

- Secretion and Activation of Pepsinogen.
- Secretion of Intrinsic Factor by Parietal Cells .
- Pyloric Glands-Secretion of Mucus and Gastrin .
- **Surface Mucous Cells** :They secrete large quantities of *viscid mucus(it is alkaline)* that coats the stomach mucosa with a gel layer of mucus often more than ^{1-2mm} **1 millimeter thick**, thus providing a major shell of protection for the stomach wall, as well as contributing to lubrication of food transport



- The stomach's ability to prevent back leak of acid can be attributed to the Gastric barrier due to the formation of **alkaline mucus** and to **tight junctions** between epithelia cells .
- If this barrier is damaged by toxic substances, such as occurs with excessive use of Aspirin or NSAIDS, Steroids, Alcohol, Vinegar, Bile salts the secreted acid does leak down an electrochemical gradient into the mucosa, causing stomach mucosal damage.



Stomach lumen with
gastric juice (pH ~ 2)

The mucus layer is a physical barrier

HCO_3^-

Bicarbonate is a chemical
barrier that neutralizes acid

HCO_3^-

pH ~ 7 at cell surface

Mucus
layer

Mucus
droplets

Gastric
mucus
cell

Capillary

Neural & Hormonal Control of Gastric Secretion

- Vagus nerve (neural effector).
- Gastrin (hormonal effector).
- Enterochromaffin-like cells
Histamine ---→ H_2 receptor (parietal cells) → acid secretion.

Stomach: Regulation of Secretion and Motility

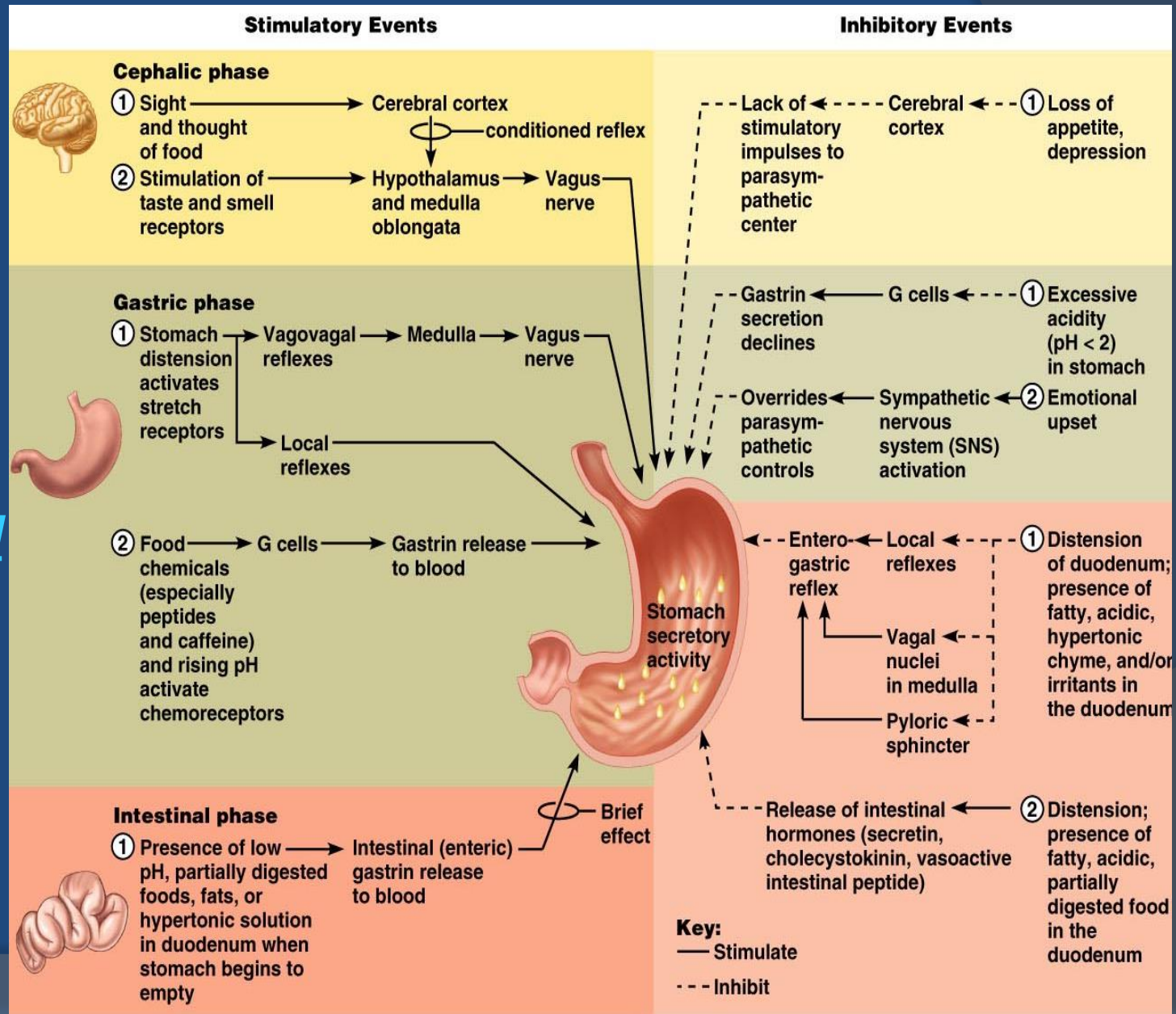
- phases of gastric acid secretion:

3 phases

■ Cephalic

■ Gastric

■ Intestinal



Stomach: Regulation of Secretion and Motility

مسؤولة عن 30% من إفراز ال HCL

1. Cephalic phase

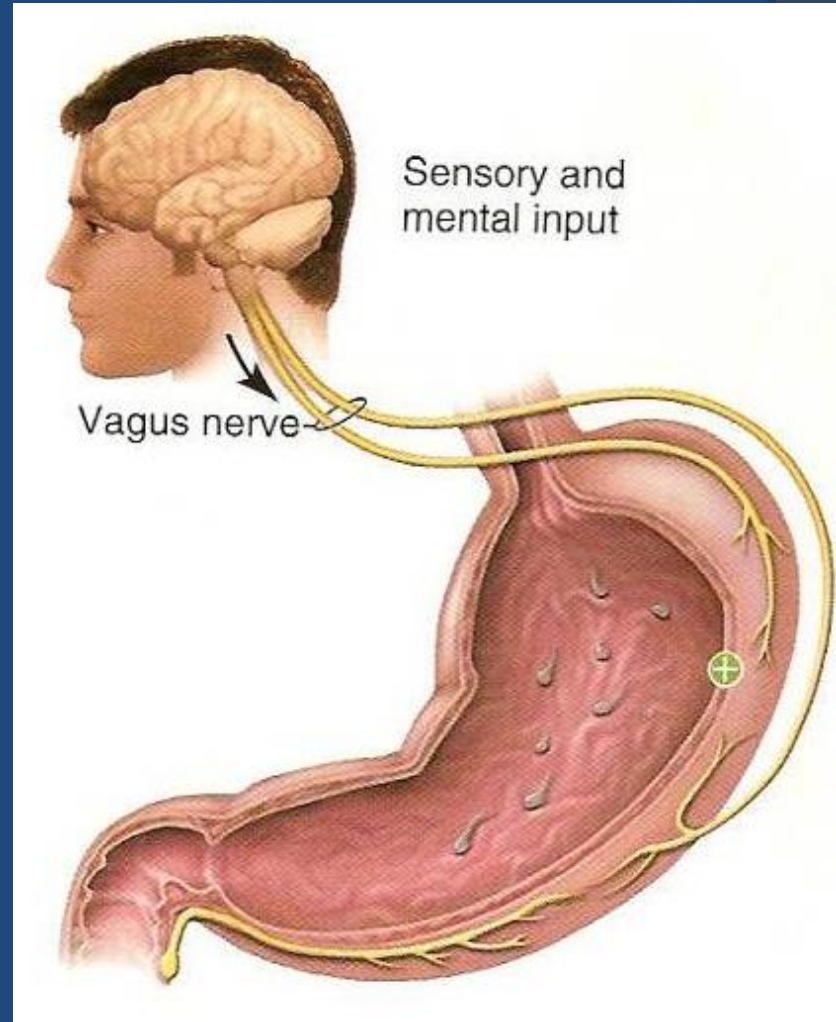
هي عبارة عن condition
و uncondition reflexes

- Stimuli

- Sight
- Smell
- Taste
- Thoughts/Memories

- Effect

- Parasympathetic impulses increase gastric secretion

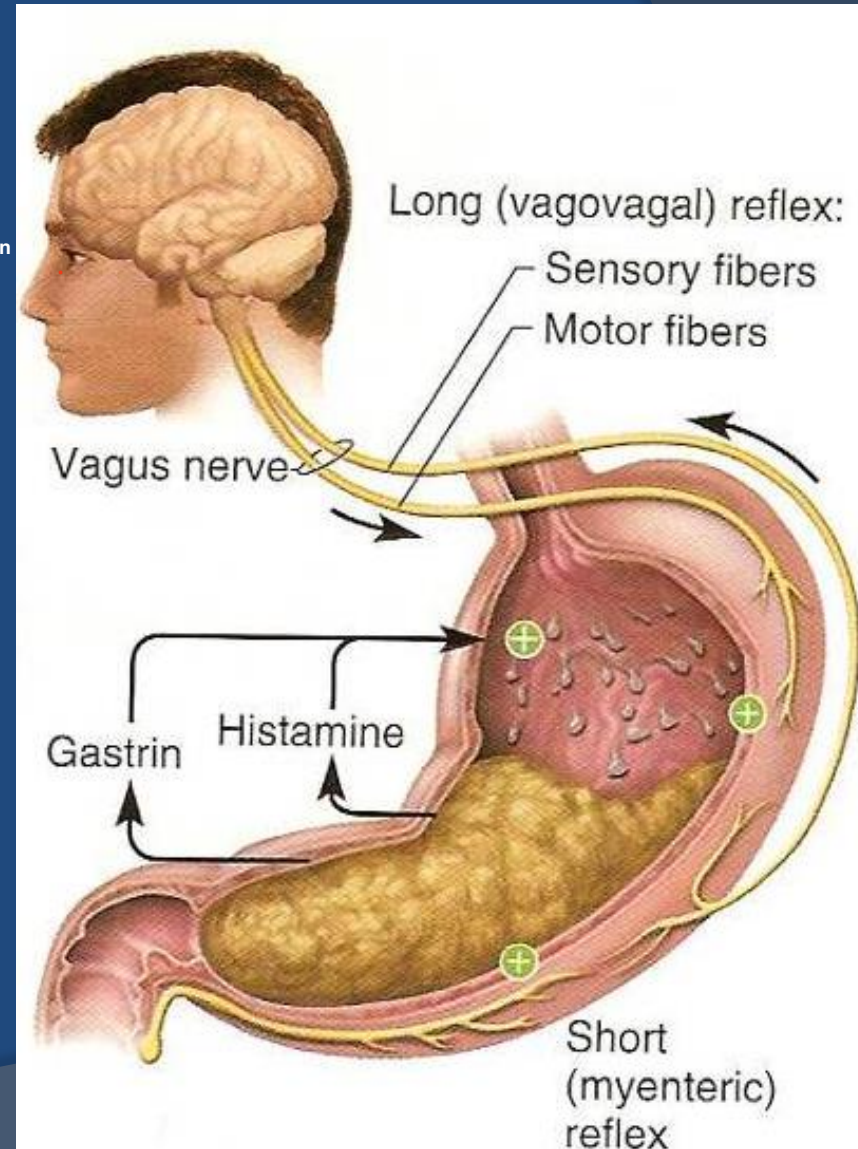


Stomach: Regulation of Secretion and Motility

2. Gastric phase stomach نفسها ومسؤول عن 60% من إفراز ال HCL

- Neural negative feedback mechanisms
- Distension activates stretch receptors causing Myenteric and Vaso-vagal reflexes to release **Ach**
Local reflex Minibrain Central reflexes بتروح لل meulla وبترجع
- Ach stimulates gastric juice secretion
- Chemoreceptor's respond to partially digested proteins, caffeine and rising pH
- Stimulate gastrin secretion from G cells

برضو ال composition of the food، ال food الموجود في ال peptides
(نتيجة هضم البروتين، وموجود ال caffeine) بحفزها تفرز HCL

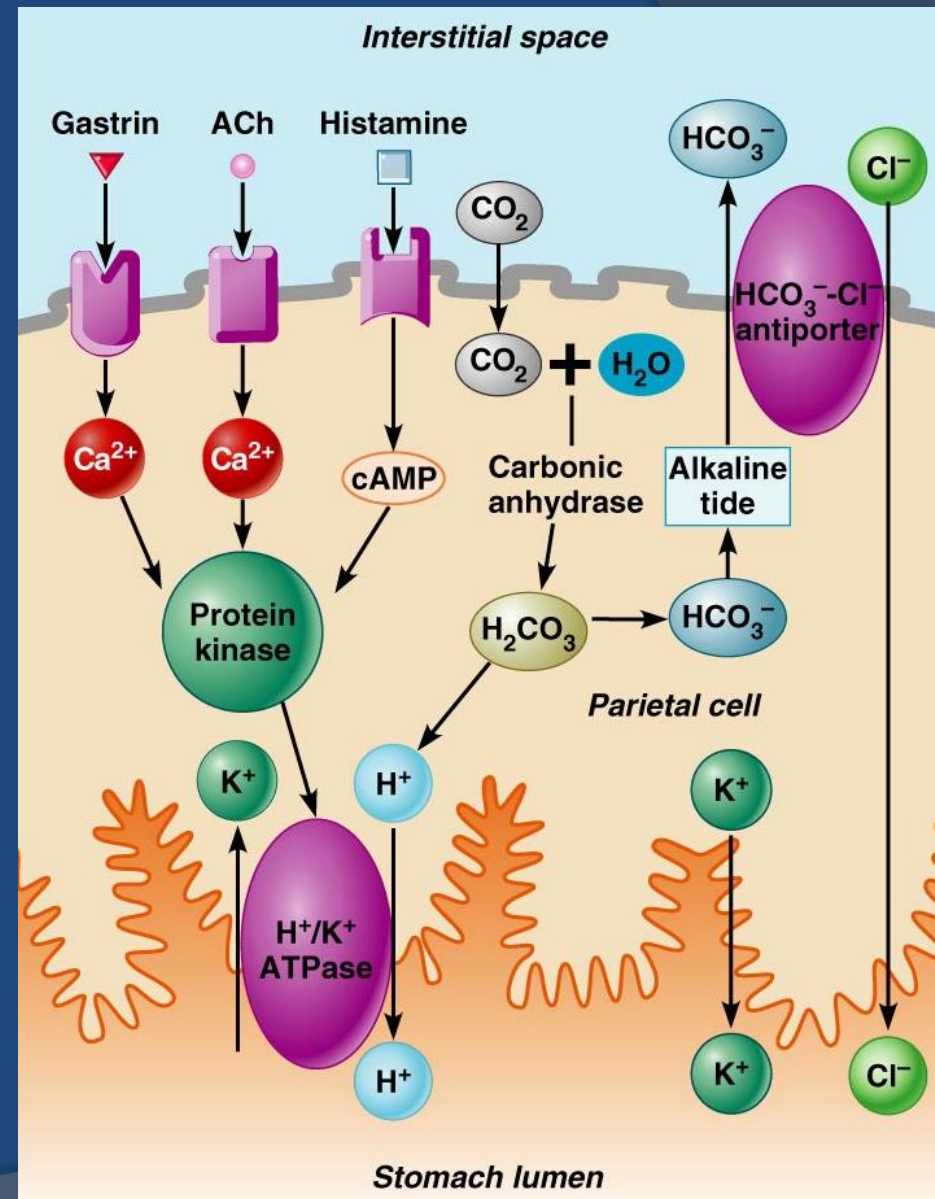


Stomach Regulation of Secretion and Motility

2. Gastric phase (cont.)

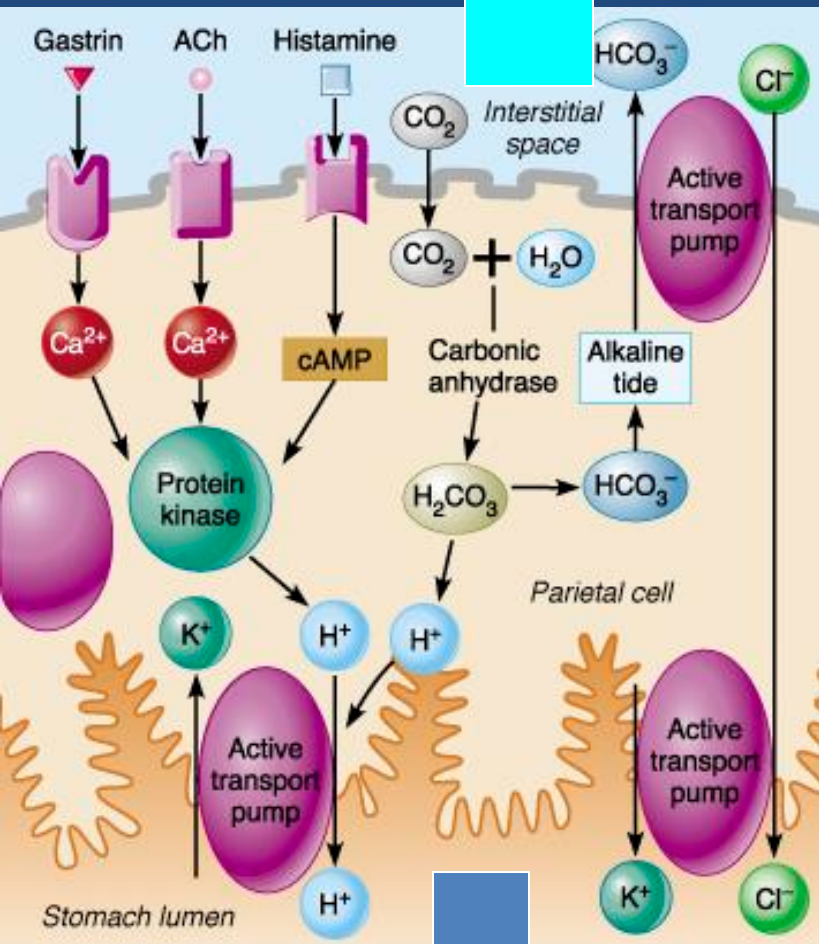
• Gastrin

- Inhibited at pH less than 2
- Gastrin transported in the blood to the gastric glands
- Greatly stimulates HCl secretion
- Stimulates histamine secretion
- Slightly stimulates pepsinogen secretion
- Contracts lower esophageal sphincter
- Relaxes pyloric sphincter
- Increases gastric motility



Stomach

KHCO_3 2. Gastric phase (continued)



Control of HCl secreting parietal cells

- stimulation by three signal chemicals
 - gastrin
 - acetylcholine
 - histamine

All three needed for strong H^+ secretion

H^+ pumps work in conjunction with carbonic anhydrase

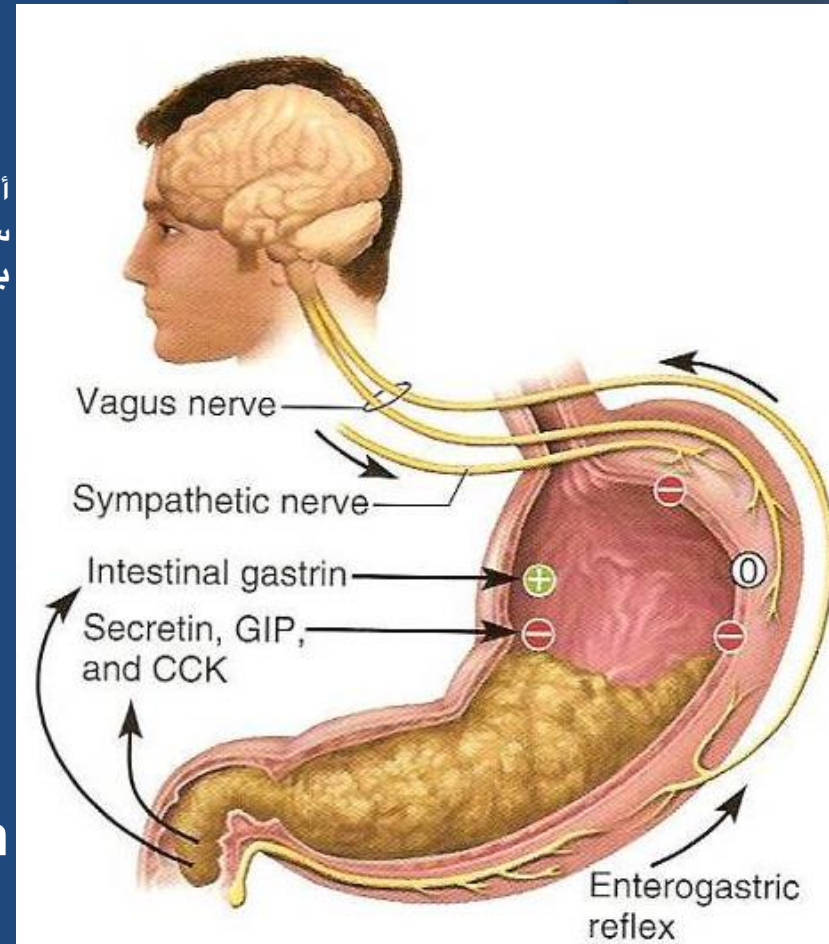
blockage of the histamine H_2 receptor decreases HCl secretion

- Tagamet
- Zantac

Stomach: Regulation of Secretion and Motility

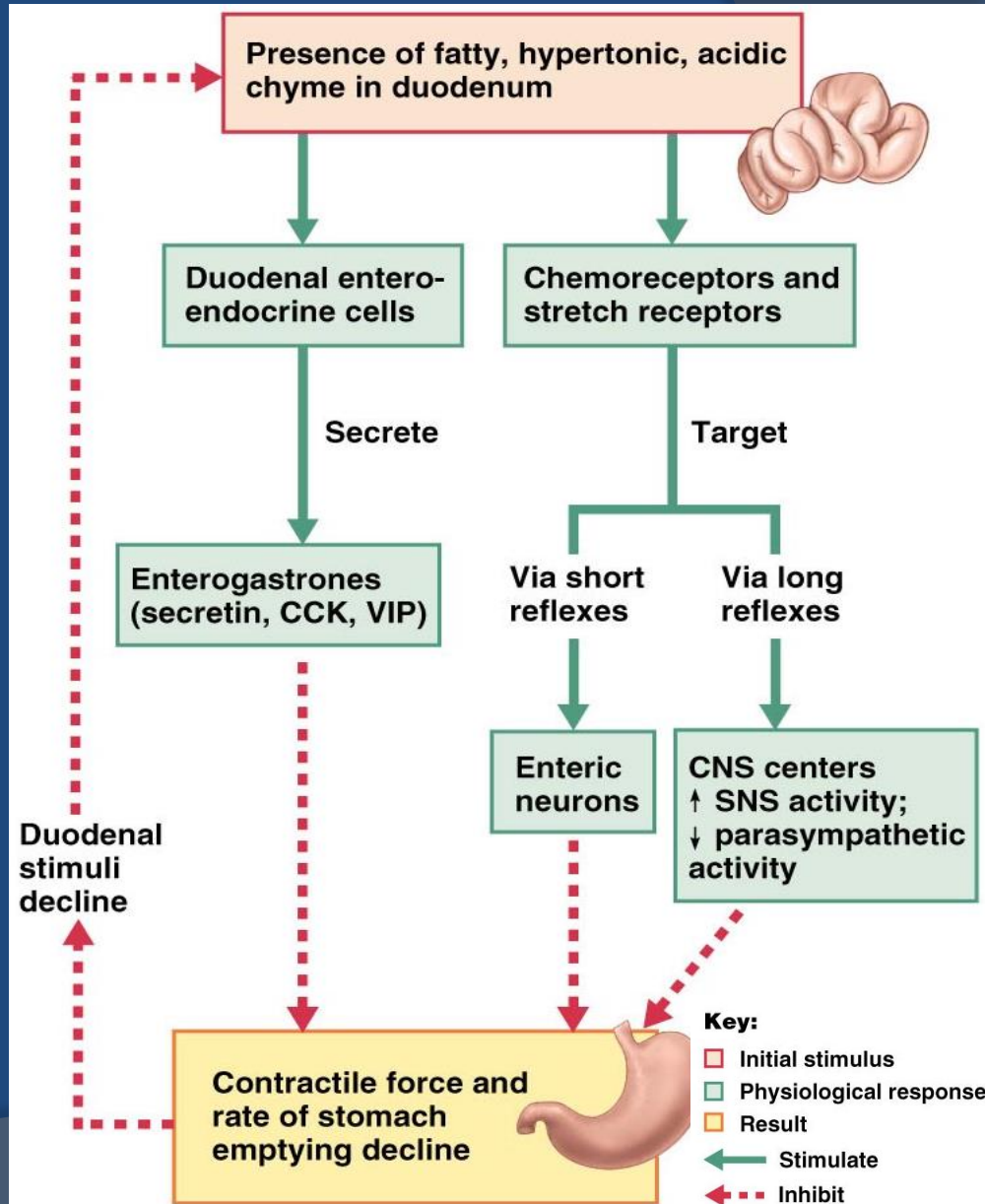
3. Intestinal phase has مسئولة عن 10% من إفراز ال HCL excitatory and inhibitory components:

- Excitatory أول ما يصل الأكل على ال duodenum لنص ساعة أو أقل، بزيد ال HCL secretion ،بعدين بصير كله inhibitory reflexes
- Very short phase
- Initiated by chyme entry into duodenum
- Stretch receptors stimulate release of intestinal (enteric) gastrin
- Chemoreceptor's detect fatty acids, & glucose in the duodenum
- Stimulate enteric gastrin release



Stomach: Regulation of Gastric Emptying

- Food normally passes through stomach in **4 hours**
عشان هيك بنخلي المريض قبل العملية يصوم 6 ساعات، في بحكوا 4 بتكفي بس كزيادة حرص بنخليه يصوم 6
- Hormonal/neuronal reflexes regulate gastric emptying
- Large meals and large amounts of liquid increase stomach distension → increasing rate of emptying
- Stomach emptying inhibited by the Enterogastric reflex, enterogastrones, and fat in the duodenum.

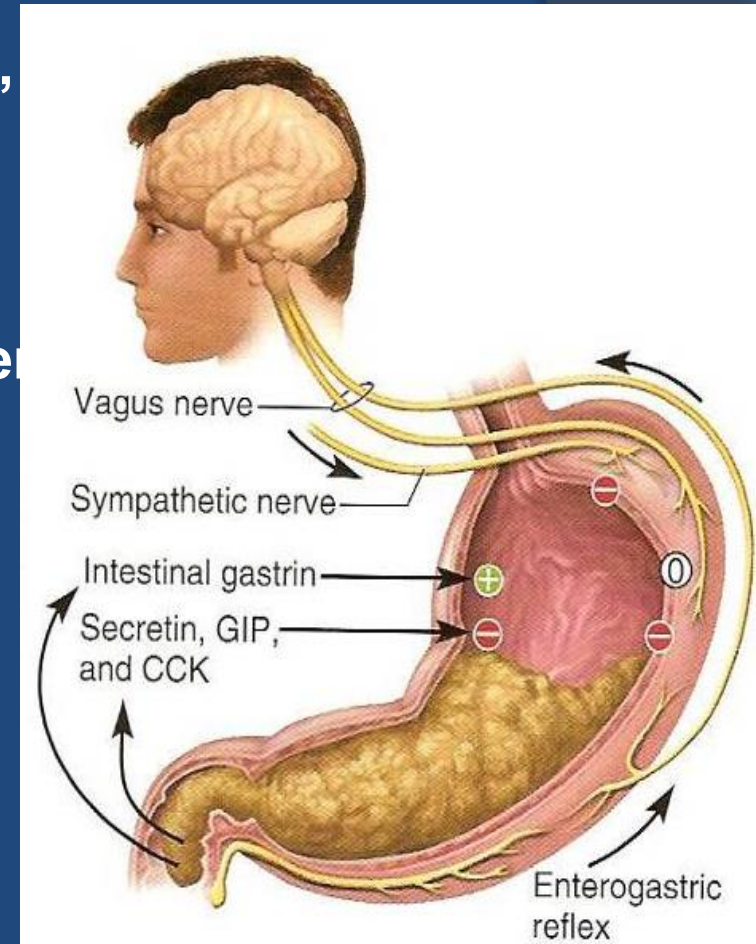


Stomach: Regulation of Secretion and Motility

3. Intestinal phase (cont.)

- Inhibitory

- Enterogastric reflex: stretch receptors, chemoreceptors trigger 3 reflexes that
 1. Inhibit vagovagal reflex
 2. Inhibit myenteric reflex
 3. Activate sympathetic nervous system to close pyloric sphincter
- Inhibit gastric secretion
 - Enterogastrone secretion
- Enteroendocrine cells in the small intestine release:
 - Cholecystikin (CCK)
 - Gastric inhibitory peptide (GIP)
 - Secretin
 - Vasoactive intestinal peptide (VIP)
 - Hormones inhibit gastric secretion



Stimulatory Events

Inhibitory Events

Cephalic phase

- ① Sight and thought of food → Cerebral cortex → conditioned reflex
- ② Stimulation of taste and smell receptors → Hypothalamus and medulla oblongata → Vagus nerve

Gastric phase

- ① Stomach distension activates stretch receptors → Vagovagal reflexes → Medulla → Vagus nerve
Local reflexes
- ② Food chemicals (especially peptides and caffeine) and rising pH activate chemoreceptors → G cells → Gastrin release to blood → Stomach secretory activity

Intestinal phase

- ① Presence of low pH and partially digested foods in duodenum when stomach begins to empty → Intestinal (enteric) gastrin release to blood

- ① Loss of appetite, depression
مش زيك بتكتئب بتاكل التالاجة

- ① Excessive acidity ($< \text{pH } 2$) in stomach
لما تكون أقل من 2 هتمنع ال HCL secretion
- ② Emotional upset

- ① Distension of duodenum; presence of fatty, acidic, hypertonic chyme, and/or irritants in the duodenum
Local reflexes → Vagal nuclei in medulla → Pyloric sphincter → Enterogastric reflex

- ② Distension; presence of fatty, acidic, partially digested food in the duodenum
Release of intestinal hormones (secretin, gastric inhibitory peptide, cholecystokinin, vasoactive intestinal peptide)

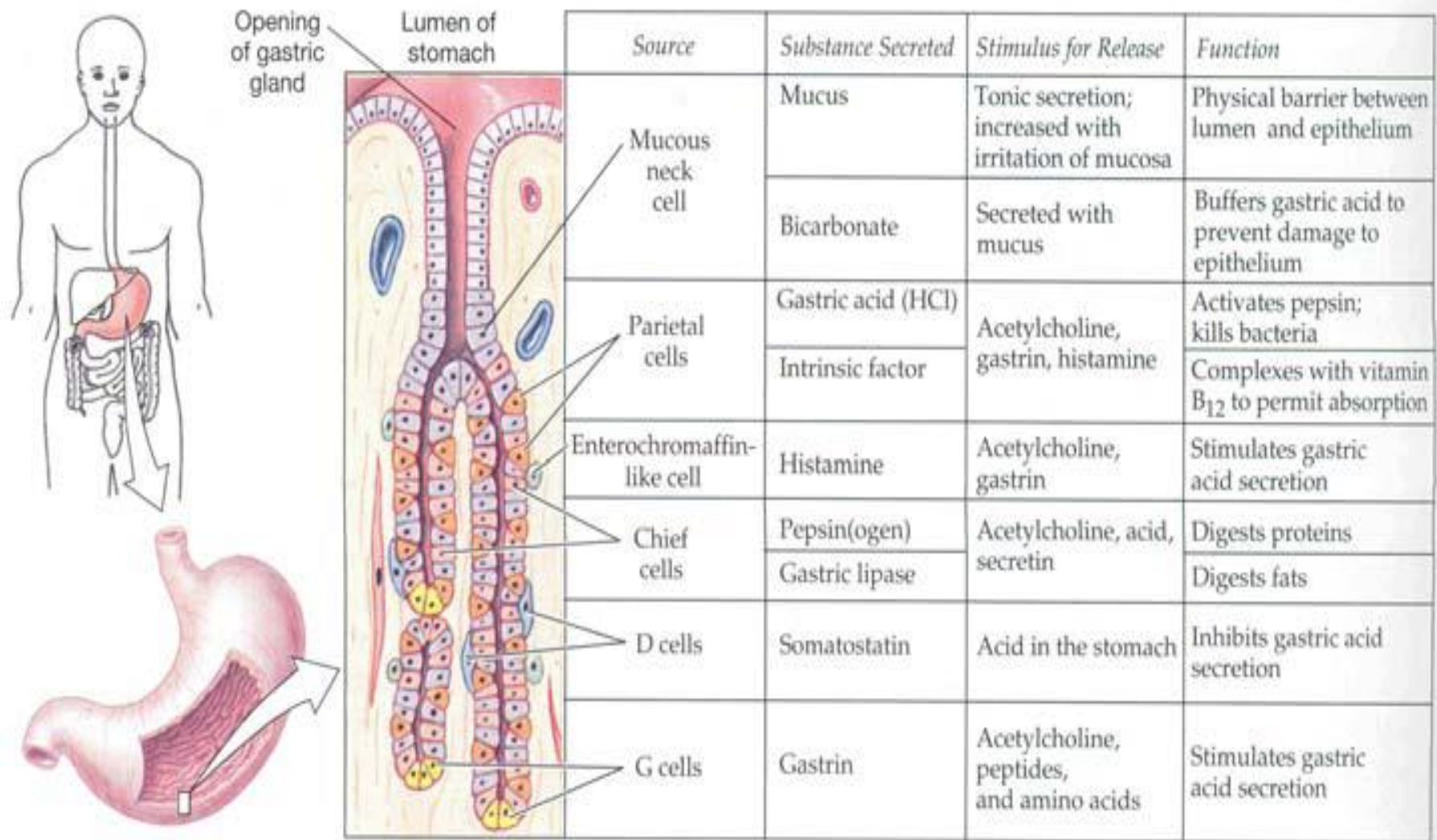
Key:

— Stimulate

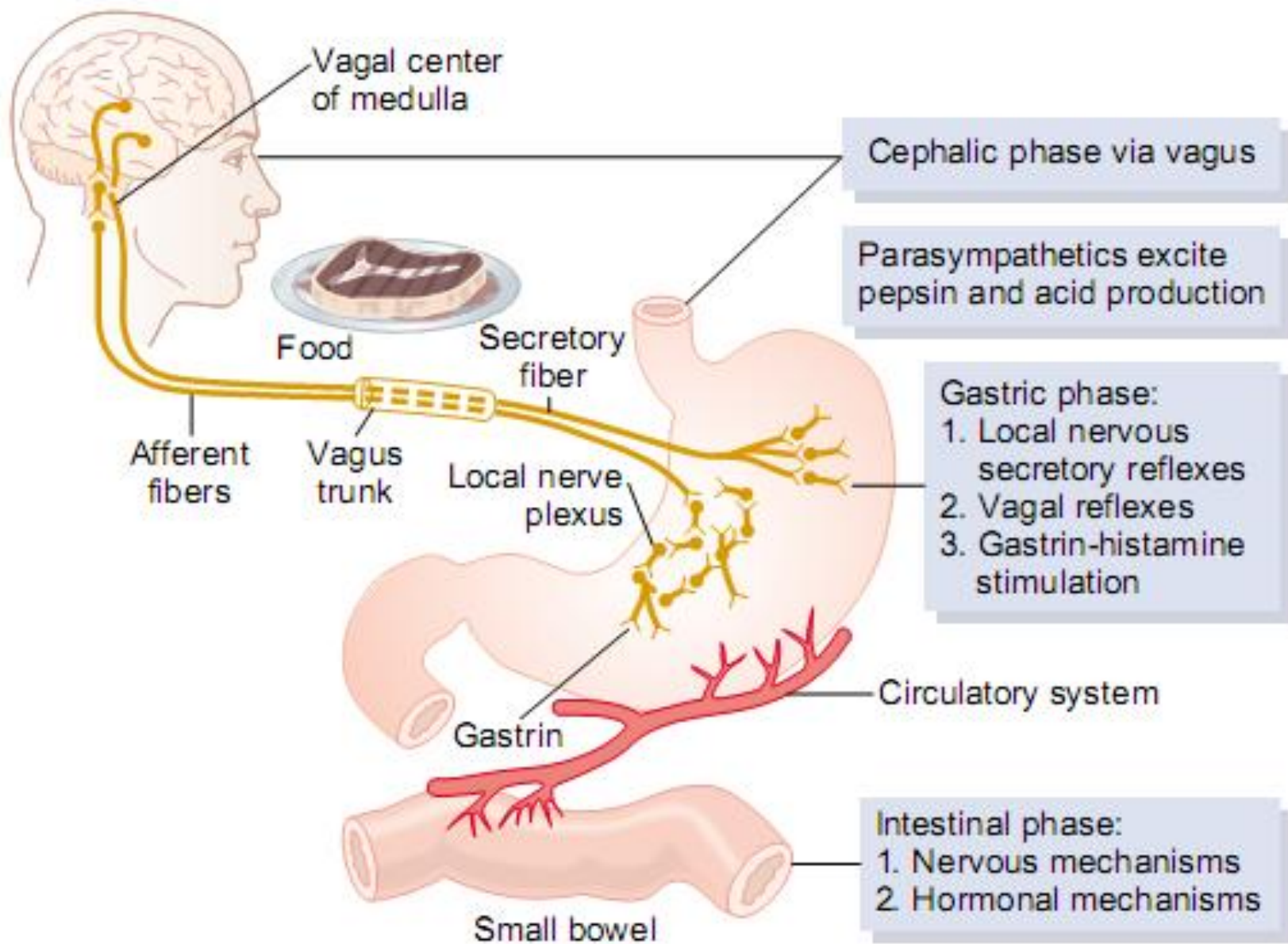
---- Inhibit

في الغالب inhibition of secretion, لما يصير عنا
حامض في ال duodenum او عنا
feedback inhibition of HCL secretion

Gastric Glands and secretions



■ Figure 20-16 Cell types of the gastric mucosa



Figure

Phases

Final suggestion of a proteins is a amino acids
From carbohydrates is glucose
From Fat are fatty acid and glycerol

- يبدأ بهضم ال proteins بس ما
بخلصها ل amino acids، بحولهم ل
Tripeptides و Dipeptides

Secretion and Activation of Pepsinogen

- ال Fat هضمها mainly بكون عن طريق ال pancreas وال carbohydrates برضو mainly عن طريق

ال pancreas، ال proteins صح ال pancreas مهم، لكن يبدأ هضمهم عن طريق ال Pepsinogen

- **Secreted by the peptic and mucous cells of the gastric glands**
- **When pepsinogen is first secreted, it has no digestive activity. However, as soon as it comes in contact with hydrochloric acid, it is activated to form active pepsin.** (Active form of Pepsinogen)

- ال pepsinogen بصيرله activation عن طريق ال HCL، وهو لما يصيرله activation بصير يعمل لخواته activation
- **Pepsin functions as an active Proteolytic enzyme in a highly acid medium (optimum pH 1.8 to 3.5), but above a pH of about 5 it has almost no Proteolytic activity and becomes completely inactivated in a short time.**

- ال pepsin بحتاج very low PH to work، اذا كانت عالية لن يعمل

Regulation of Pepsinogen Secretion

- ⦿ (1) stimulation of the *peptic cells* by acetylcholine released from the Vagus nerves or from the *gastric enteric nervous plexus*.
- ⦿ (2) stimulation of peptic cell secretion in response to acid in the stomach. The acid probably does not stimulate the peptic cells directly but instead elicits additional enteric nervous reflexes that support the original nervous signals to the peptic cells.