How do we stomach our food?

Part 1 - Stomach function

Prof. Barry Campbell

Infection Biology & Microbiomes, IVES

bjcampbl@liv.ac.uk
http://pcwww.liv.ac.uk/~bjcampbl/Indigestion%201.htm

Learning Outcomes:

- **LO1 - Define receptive relaxation (reservoir function, gastric accommodation of a meal)**

- **LO2 - Define and describe the composition and function of gastric secretions (acid, pepsinogens/pepsin, intrinsic factor, mucus, gastric lipase)**

- **LO3 - Define the cellular mechanisms of gastric acid secretion (i.e. gastric parietal cells and the proton pump)**

- **LO4 - Differentiate between the three phases in gastric secretion in response to ingestion of a meal**

- **LO5 - Explain what is hyper-acid secretion, introduce the role/importance of the *Helicobacter pylori* as a cause of gastric disease and mechanisms of gastric acid blockade.**

Part 1 -
Stomach function

LO1

Gastric motility

Controls entry to intestines

Lower oesophageal sphincter (LOS)

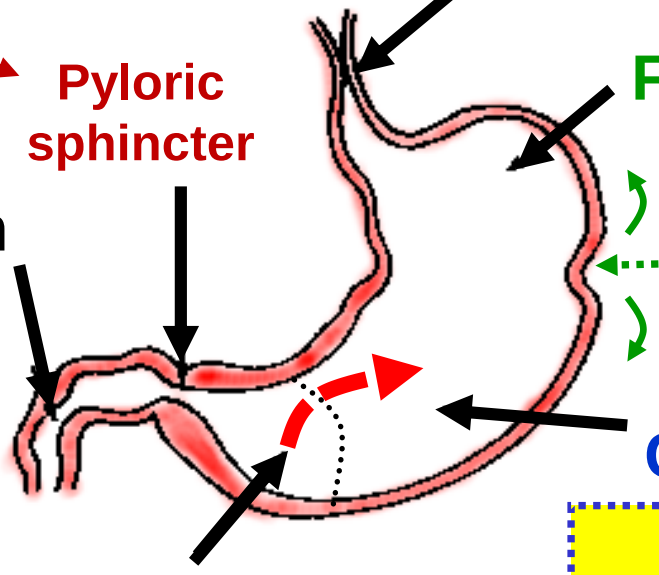
Controls entry to stomach Cardia

Pyloric sphincter

Fundus

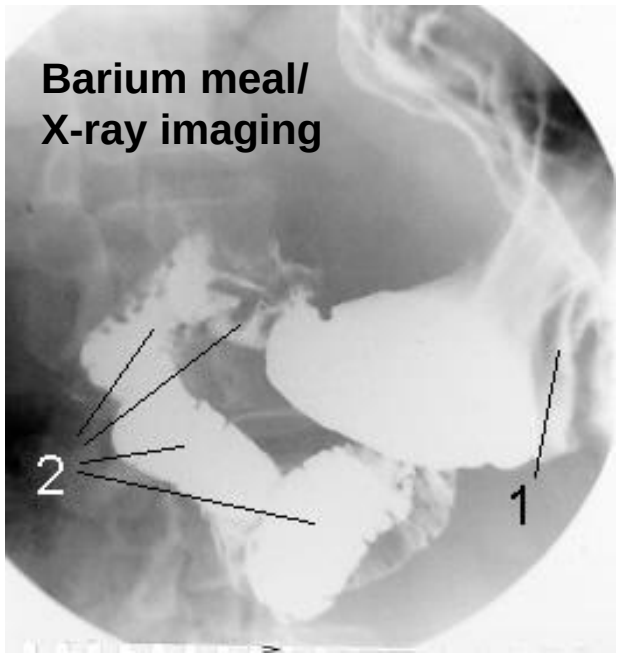
Duodenum

"Pacemaker zone" - initiates peristaltic contractions



Corpus

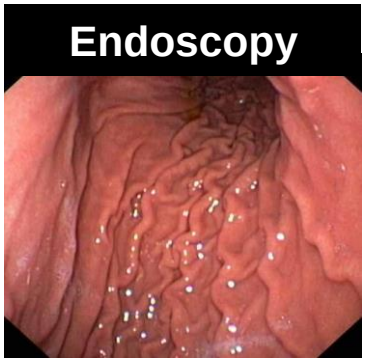
Relaxes to accommodate a meal



Antrum

Powerful muscular pump of the stomach

= retropulsion



Internal rugae to channel liquids fast

LO1

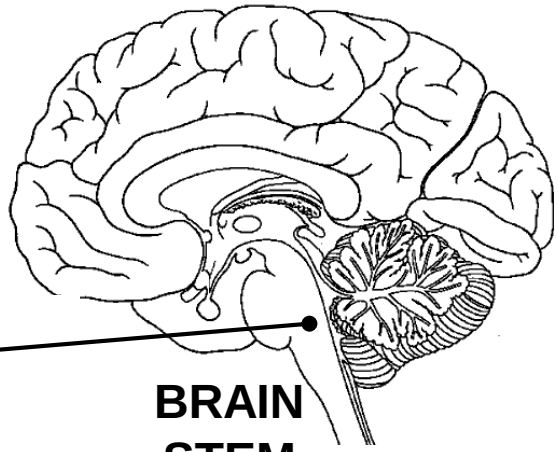
How do we accommodate a large meal?

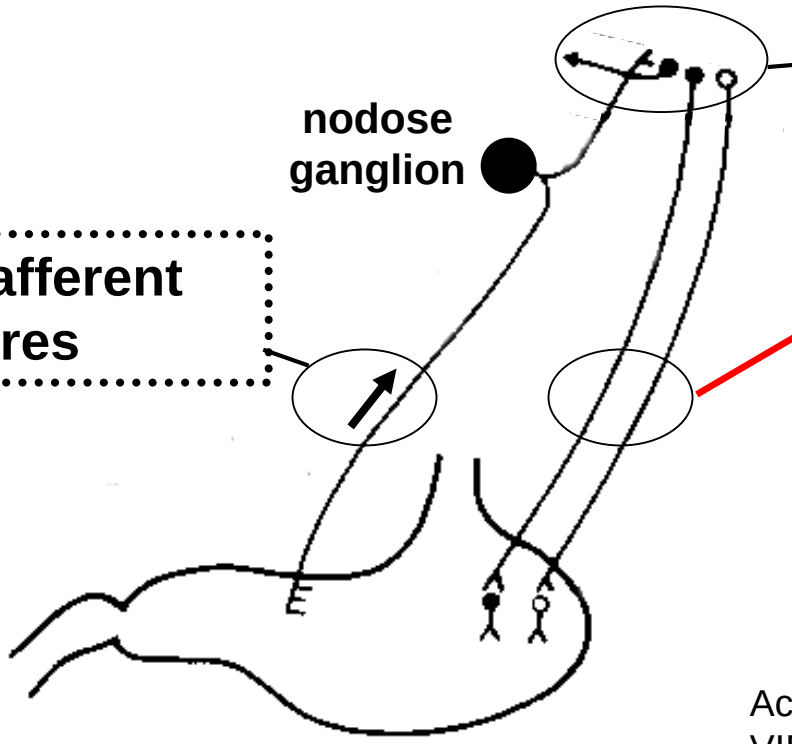
Receptive relaxation of the corpus

Example of vago-vagal reflex

Involuntary - involving the vagus (X cranial) nerve)

"Gut to brain, brain to gut talk"





Ach = acetylcholine
VIP = vasoactive intestinal polypeptide
NO = nitric oxide

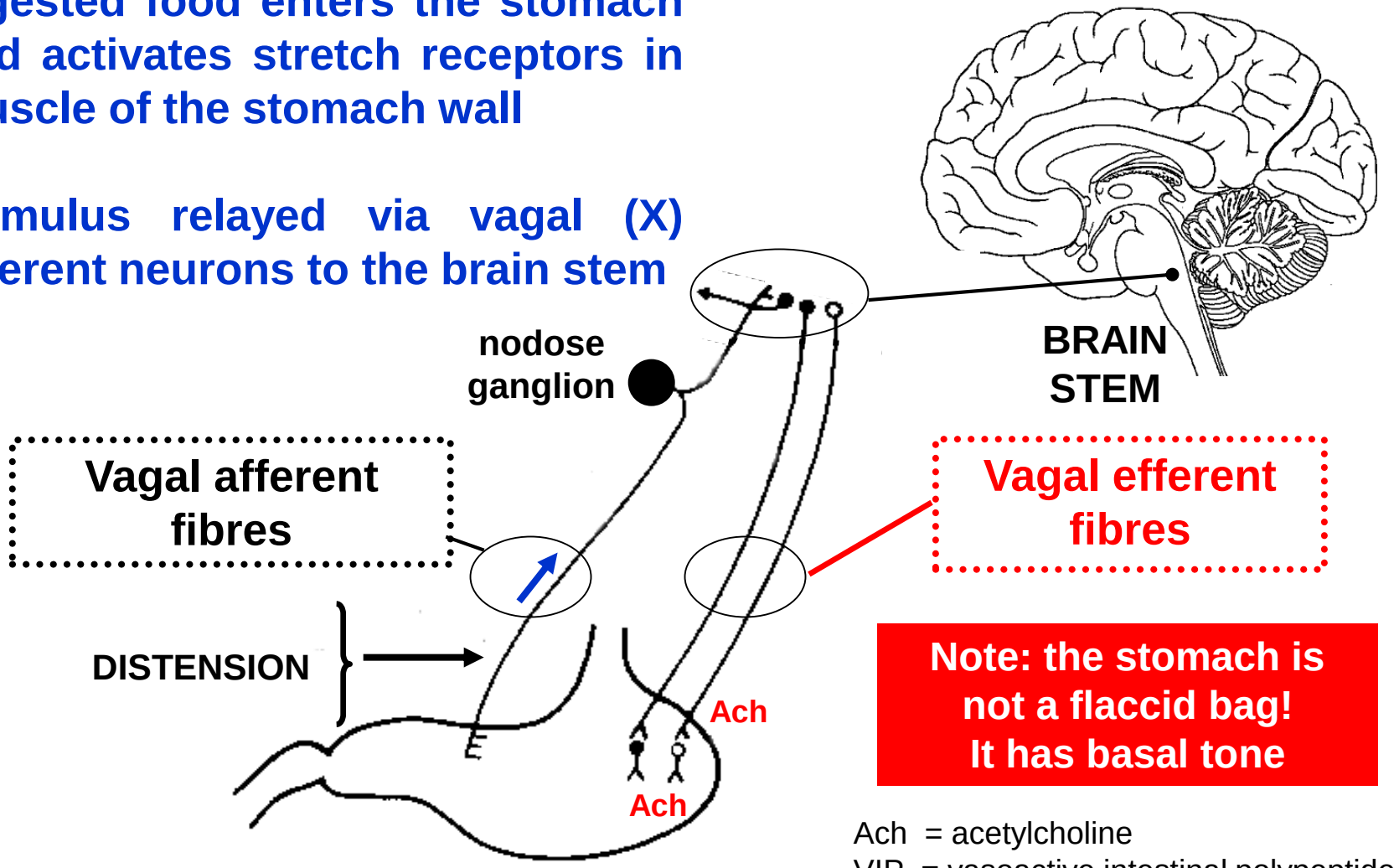
LO1

How do we accommodate a large meal?

Receptive relaxation of the corpus

1. Ingested food enters the stomach and activates stretch receptors in muscle of the stomach wall

2. Stimulus relayed via vagal (X) afferent neurons to the brain stem



Note: the stomach is not a flaccid bag! It has basal tone

Ach = acetylcholine
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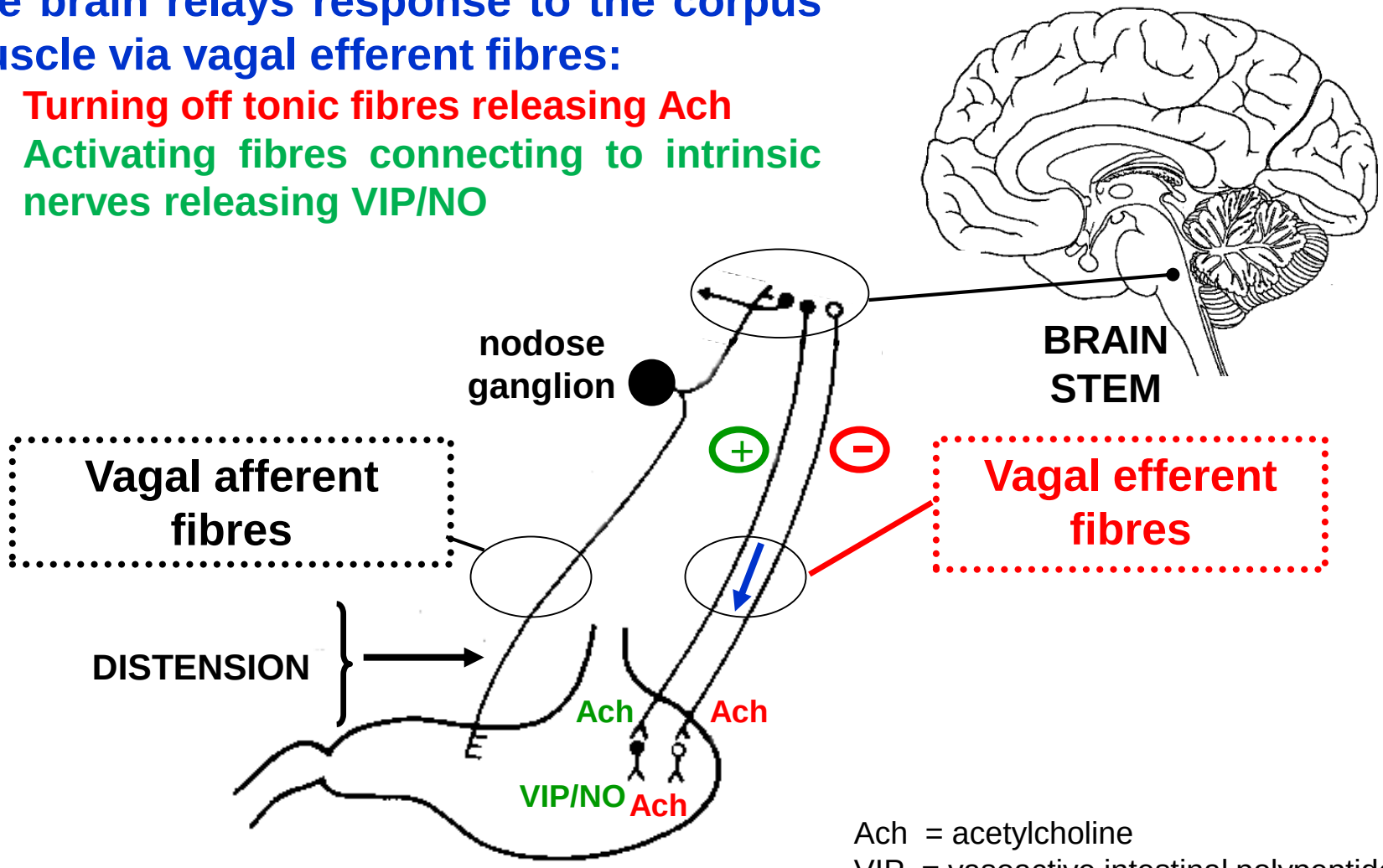
LO1

How do we accommodate a large meal?

Receptive relaxation of the corpus

3. **The brain relays response to the corpus muscle via vagal efferent fibres:**
   - a) **Turning off tonic fibres releasing Ach**
   - b) **Activating fibres connecting to intrinsic nerves releasing VIP/NO**



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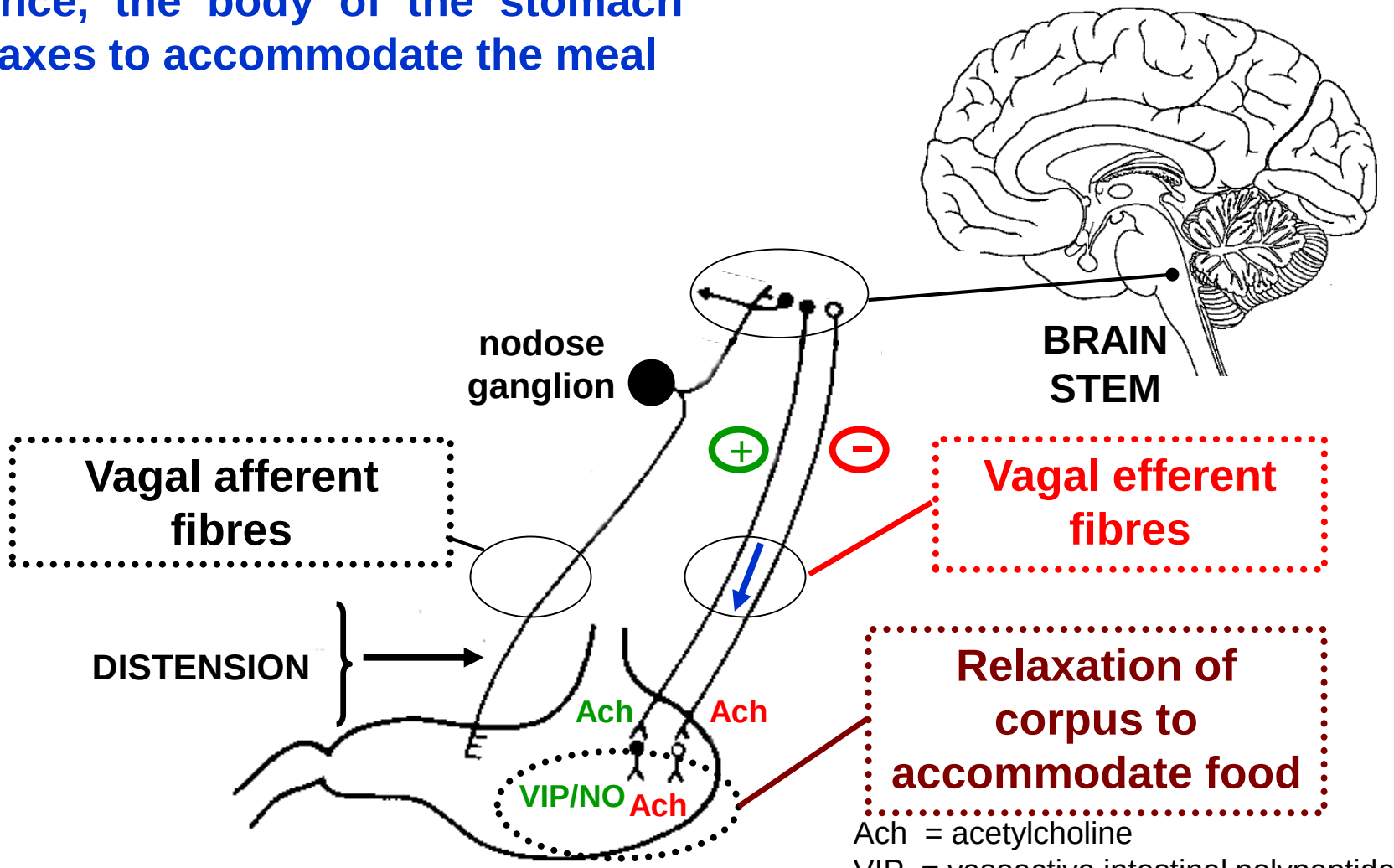
LO1

How do we accommodate a large meal?

Receptive relaxation of the corpus

4. Hence, the body of the stomach relaxes to accommodate the meal



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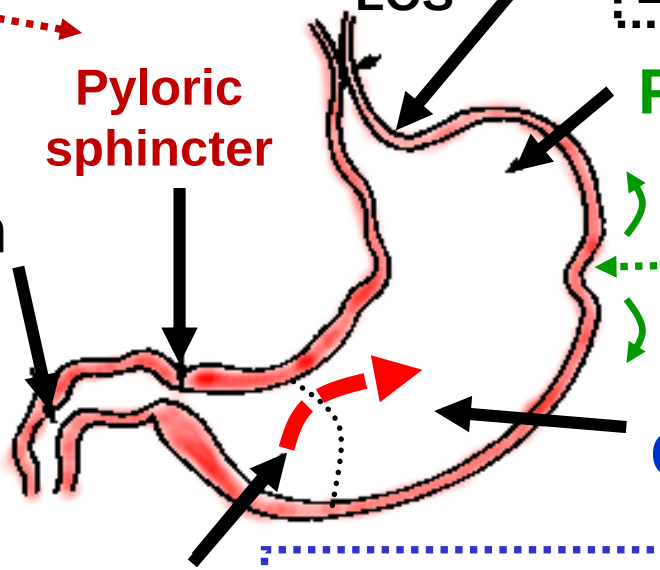
LO2

Function of the stomach regions

1. Senses contents
2. Regulated control of entry of chyme to sites of absorption



Cardia

1. Protective mucus
2. Lubrication of food

Fundus

1. Senses food
2. Fat digestion
3. Some protein breakdown

Corpus

1. Senses food
2. Accommodates the meal.
3. Acid-secreting, sterilising contents.
4. Proteolytic breakdown (pepsin & acid).
5. Protective mucus barrier
6. Supports Vitamin B12 absorption in ileum (release of intrinsic factor).

Duodenum

1. Senses contents to regulate pyloric canal closure
2. Fine digestion & absorption

Antrum

1. Mixing and churning of contents
   = retropulsion
2. Facilitating further proteolytic breakdown

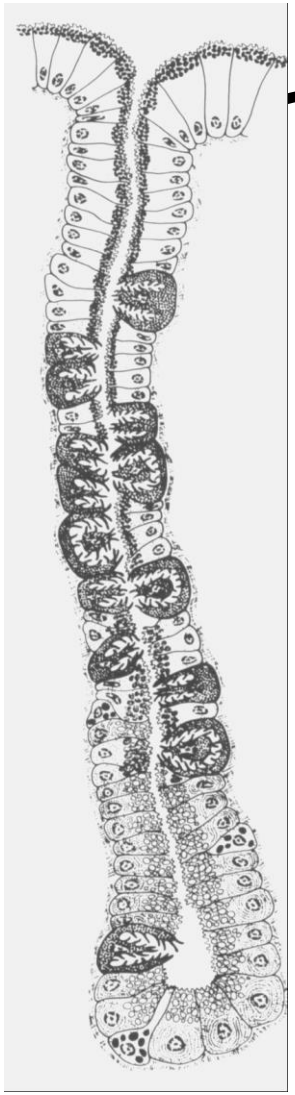
LO2

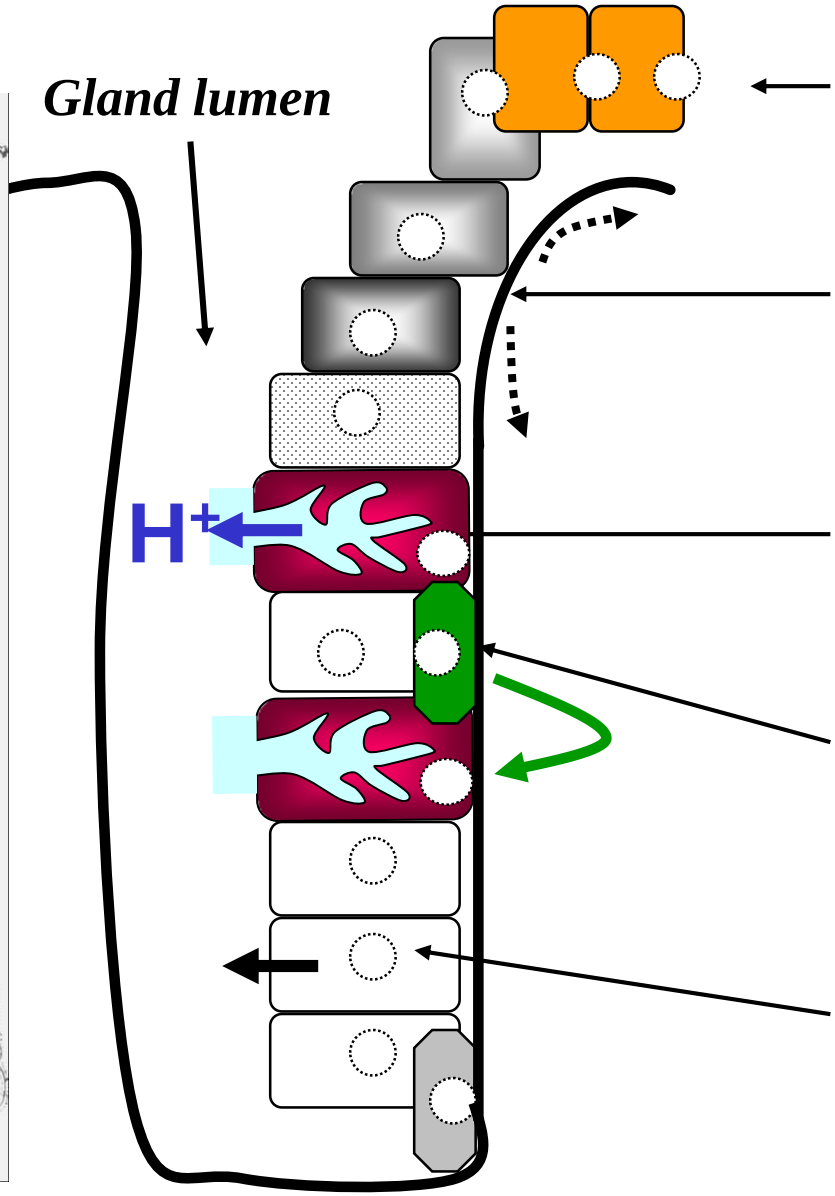
THE GASTRIC MUCOSA

	Major cell types	*Functions*
FUNDUS	• surface epithelial	- mucus, HCO_3^-
	• chief (zymogen)	- lipase/pepsinogen
CORPUS	• surface epithelial	- mucus, HCO_3^-
	• chief (zymogen)	- pepsinogen
	• parietal	- HCl, intrinsic factor
	• enterochromaffin-like (ECL)	- histamine
ANTRUM	• surface epithelial	- mucus, HCO_3^-
	• chief (zymogen)	- pepsinogen
	• G-cells	- gastrin
	• D-cells	- somatostatin

LO2

Cells of the gastric (corpus) gland





Surface epithelial cells - *protective role*

Proliferating cells

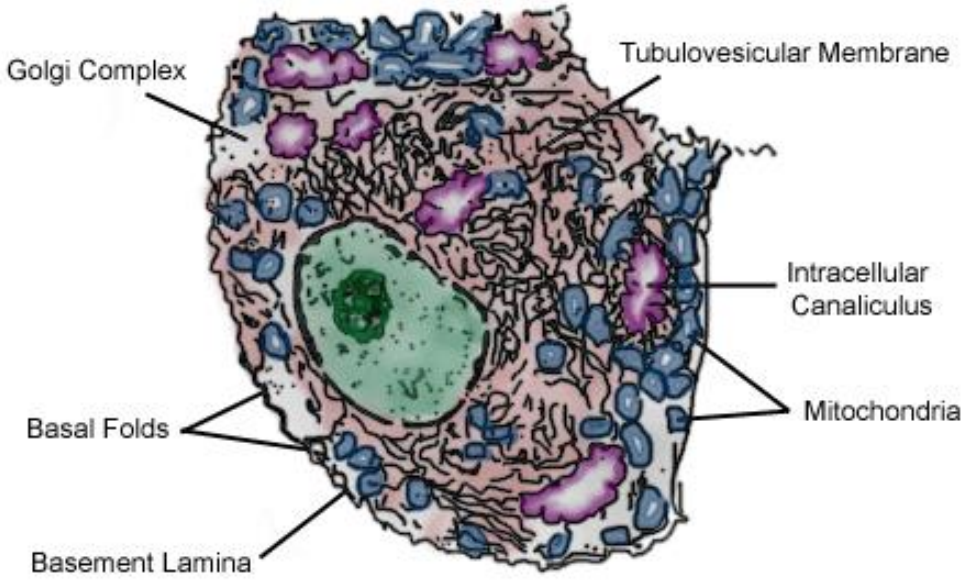
Parietal cells - *secrete acid to lumen*

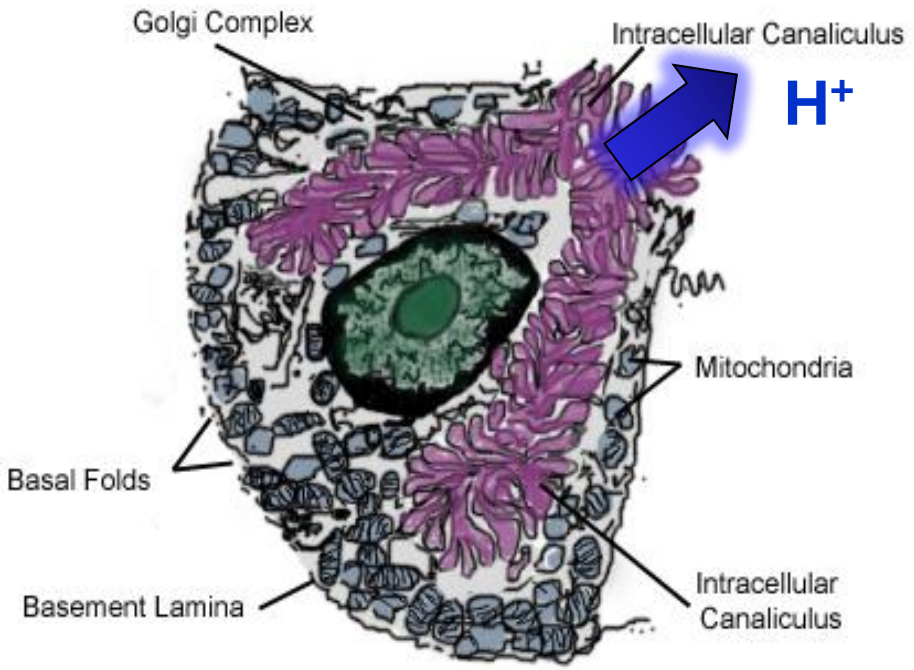
Enterochromaffin-like cell (ECL) - *secrete histamine*

Chief cells - *secrete pepsinogen to lumen*

LO3

The acid(HCl)-secreting parietal cell





resting

stimulated

The cell is packed with mitochondria

- supports high levels of cell respiration and <u>energy</u> required for pumping acid to the stomach lumen already high in acid.

Intracellular canaliculi and the tubulovesicles (where the proton pumps reside)fuse

- increases surface area exposed to the gland for increased acid secretion

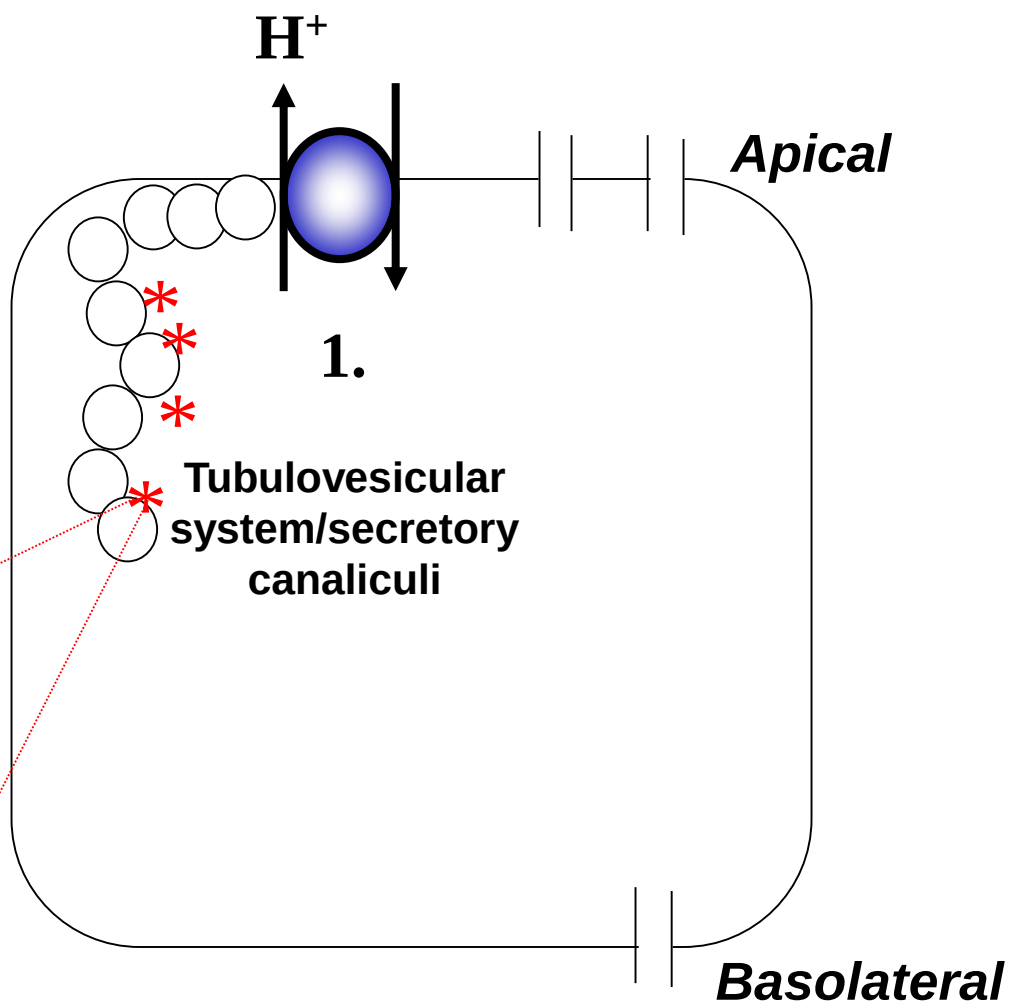
LO3

Parietal cell transport processes for HCl secretion

1. **The proton pump is a H+/K+ ATPase**

Energy needed to transport H+ to the lumen

- **Protons to be transported to the gland and stomach lumen are generated from cellular respiration**
- **A enzyme close to the secretory canaliculi generates carbonic acid (H_2CO_3).**



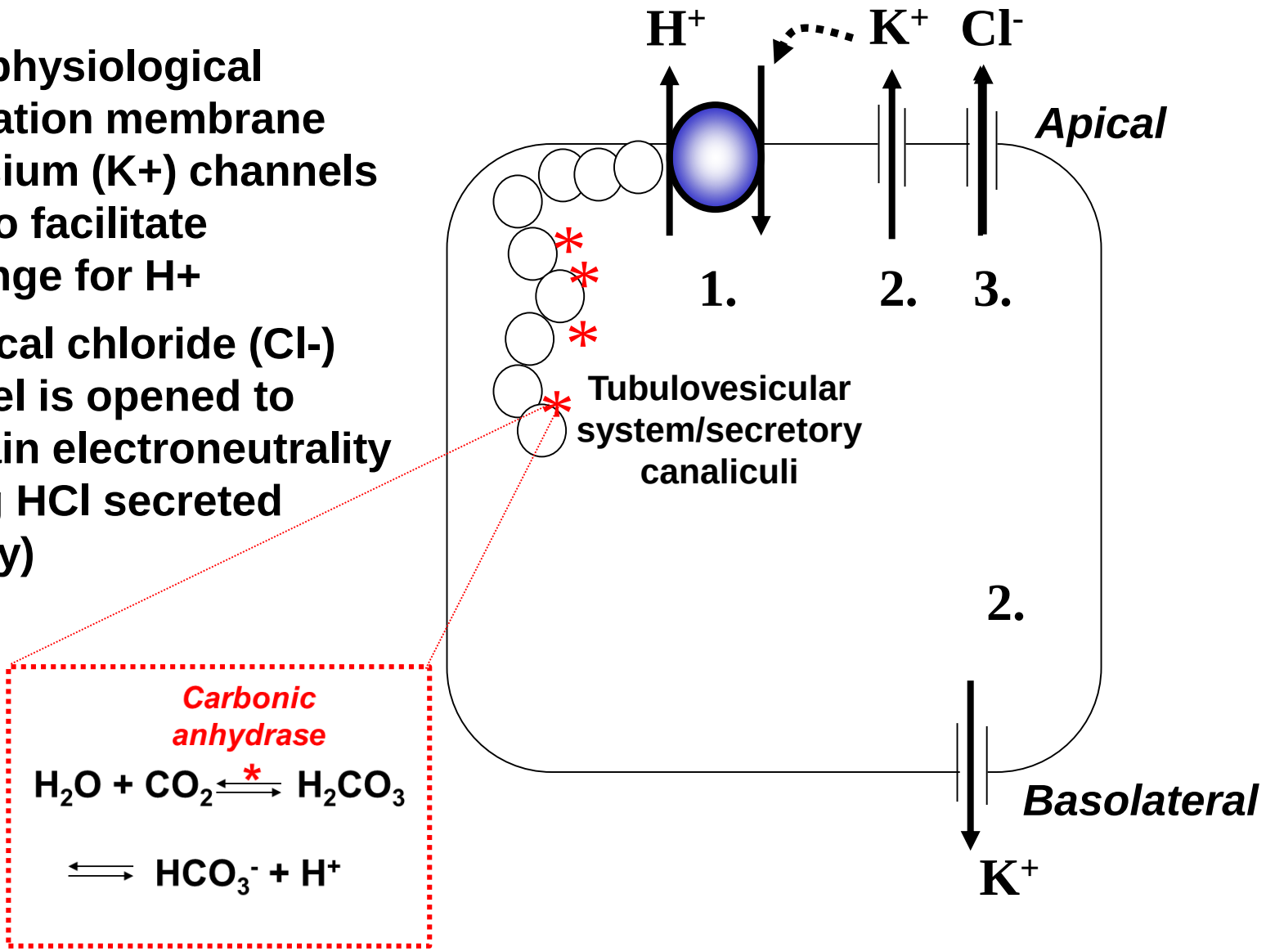
Carbonic anhydrase

$$H_2O + CO_2 \xrightleftharpoons{*} H_2CO_3 \rightleftharpoons HCO_3^- + H^+$$

LO3

Parietal cell transport processes for HCl secretion

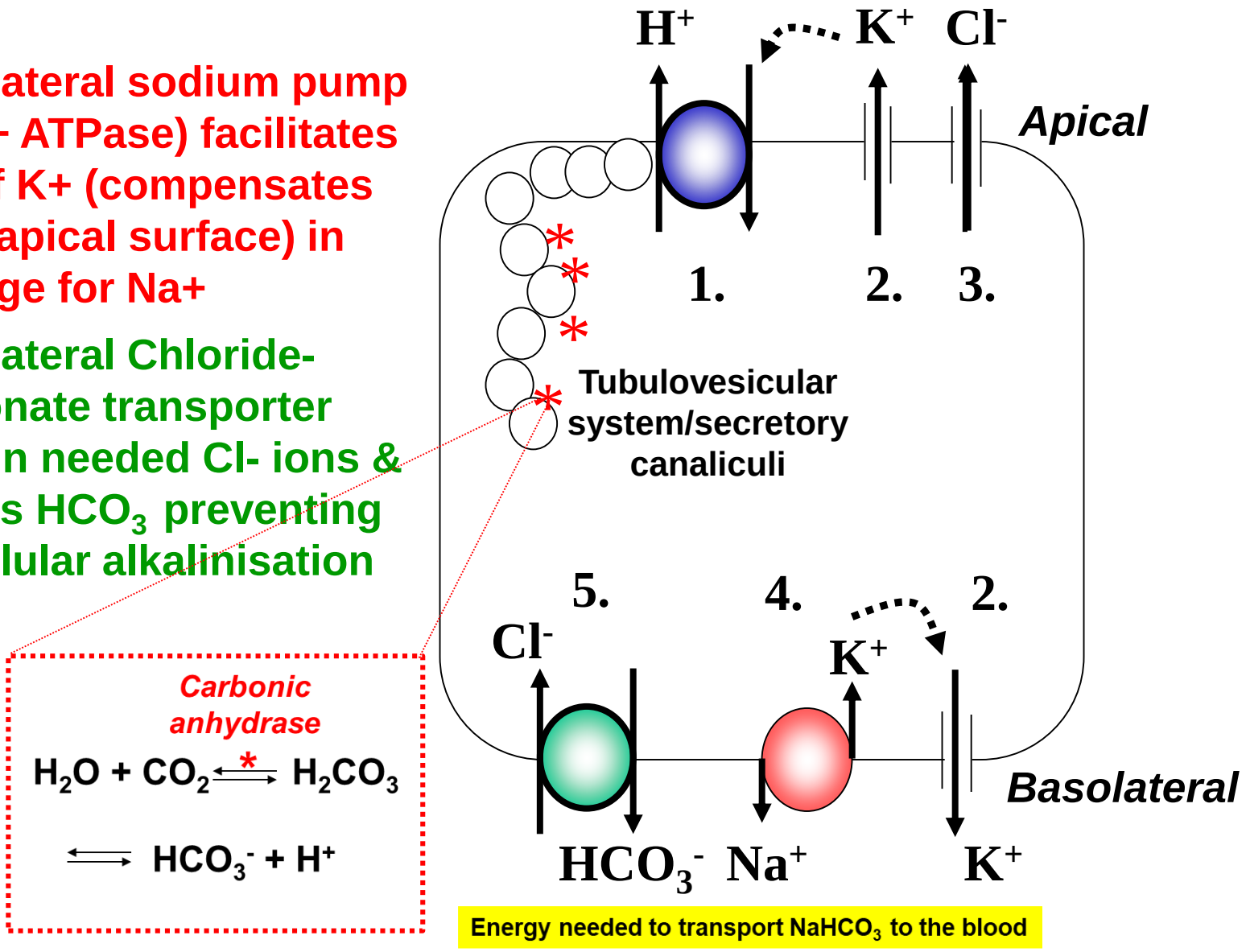
2. Upon physiological stimulation membrane potassium (K+) channels open to facilitate exchange for H+
3. An apical chloride (Cl-) channel is opened to maintain electroneutrality (giving HCl secreted apically)



LO3

Parietal cell transport processes for HCl secretion

4. A basolateral sodium pump (Na+/K+ ATPase) facilitates entry of K+ (compensates loss at apical surface) in exchange for Na+
5. A basolateral Chloride-bicarbonate transporter brings in needed Cl- ions & removes HCO_3 preventing intracellular alkalinisation



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Thank you for your attention.

bjcampbl@liv.ac.uk

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