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M1 - GI Sequence

Stomach

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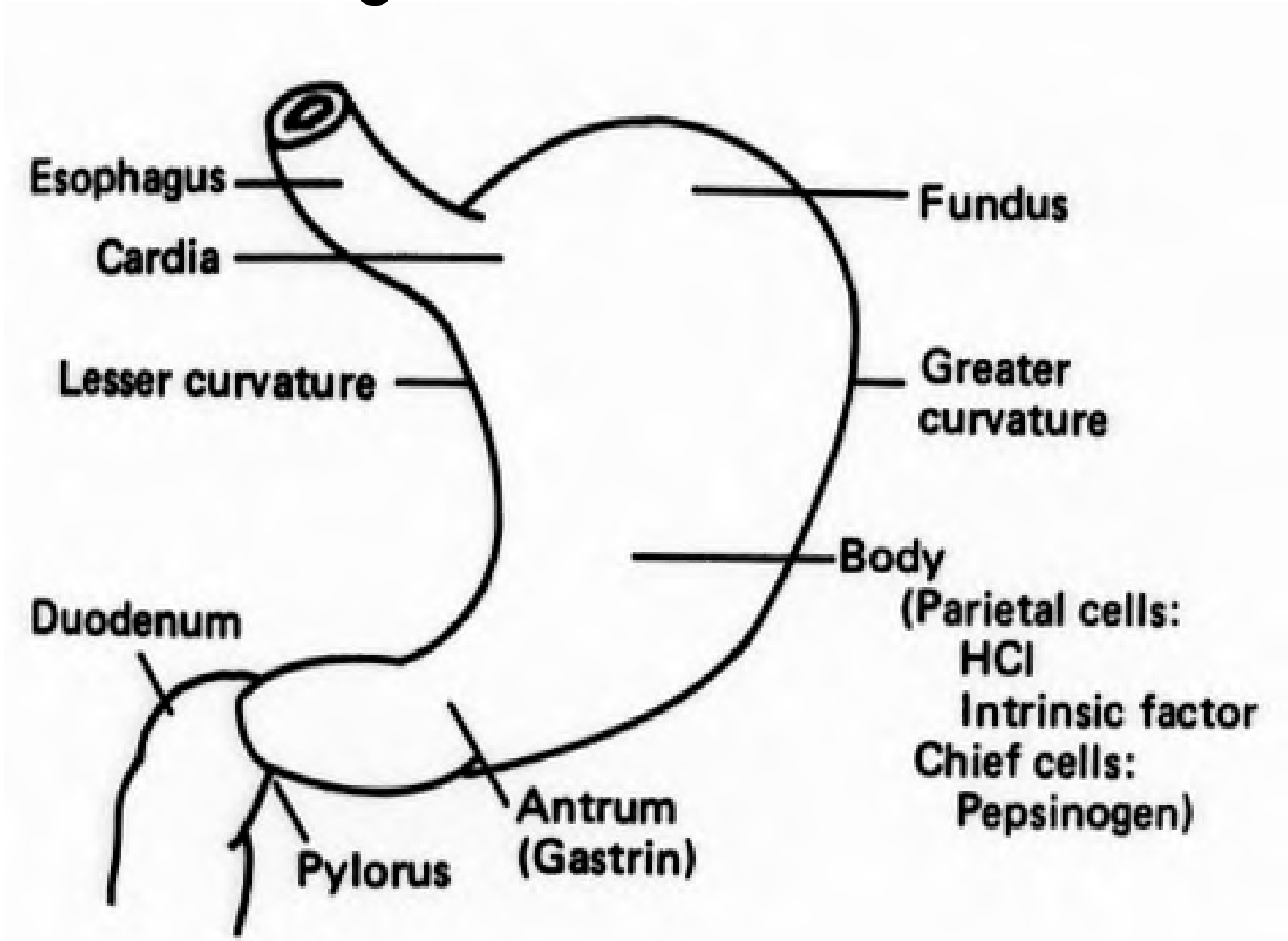
Winter, 2009

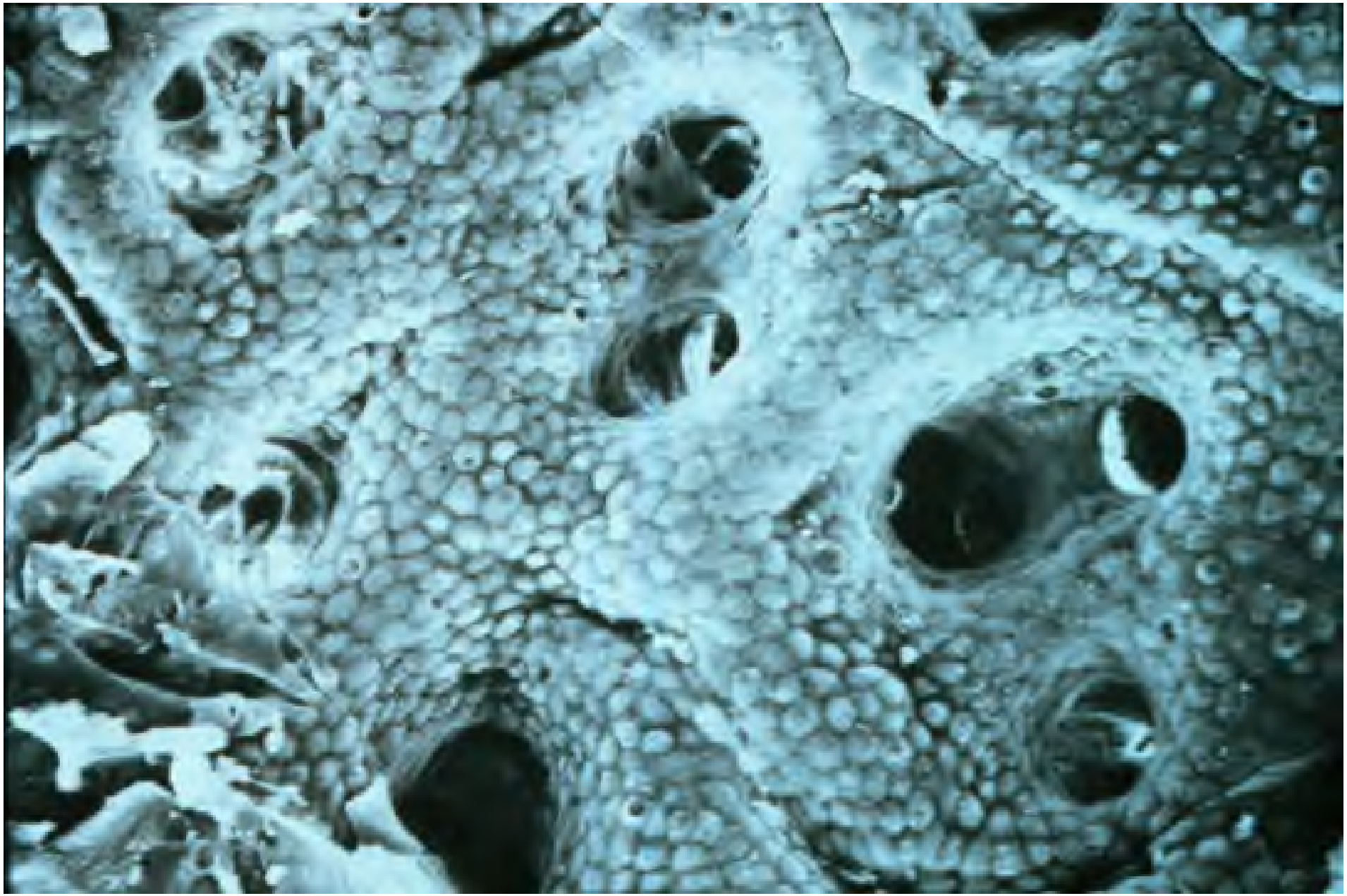
University of Michigan
Medical School

FUNCTIONS OF STOMACH

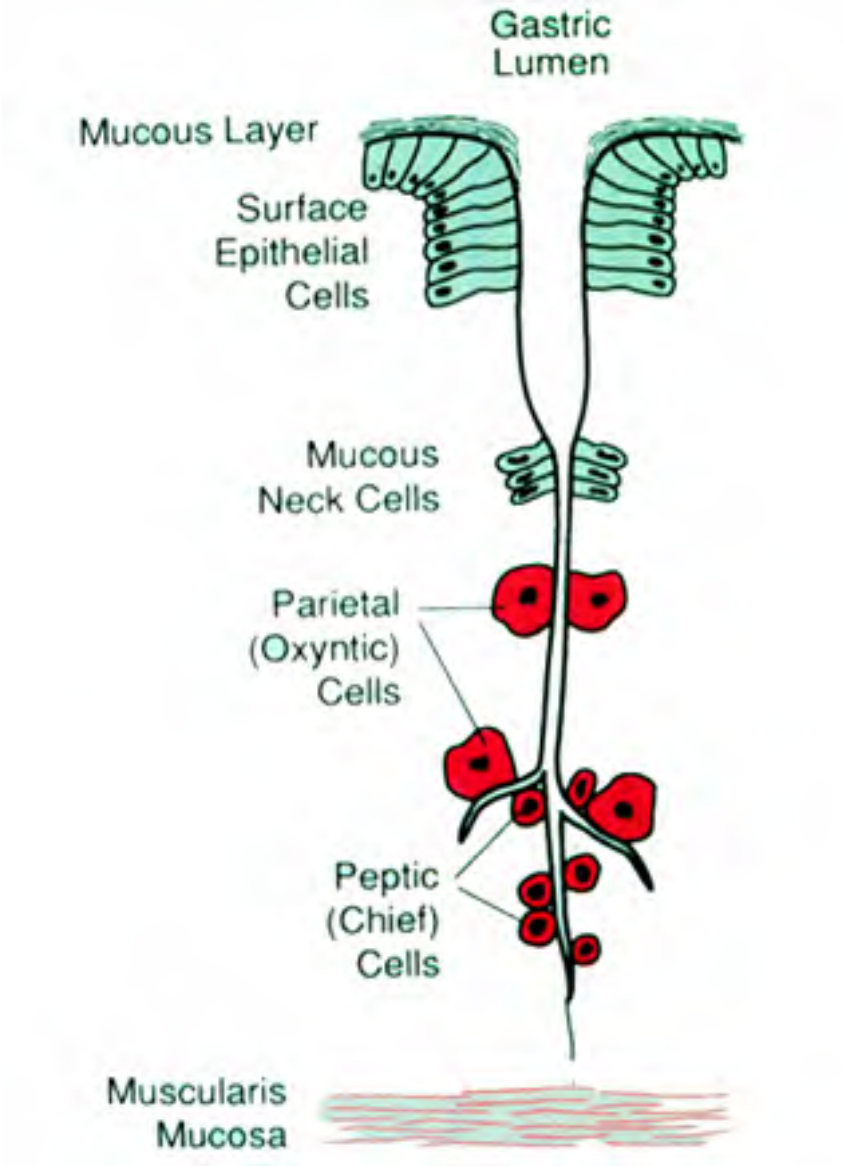
1. Storage of ingested meal
2. Regulate rate of emptying into small intestine
3. Mix contents of stomach
4. Mechanical and Chemical Breakdown of food
5. Inhibit bacterial growth
6. Provide intrinsic factor for vitamin B_{12} absorption

Regions of the Stomach

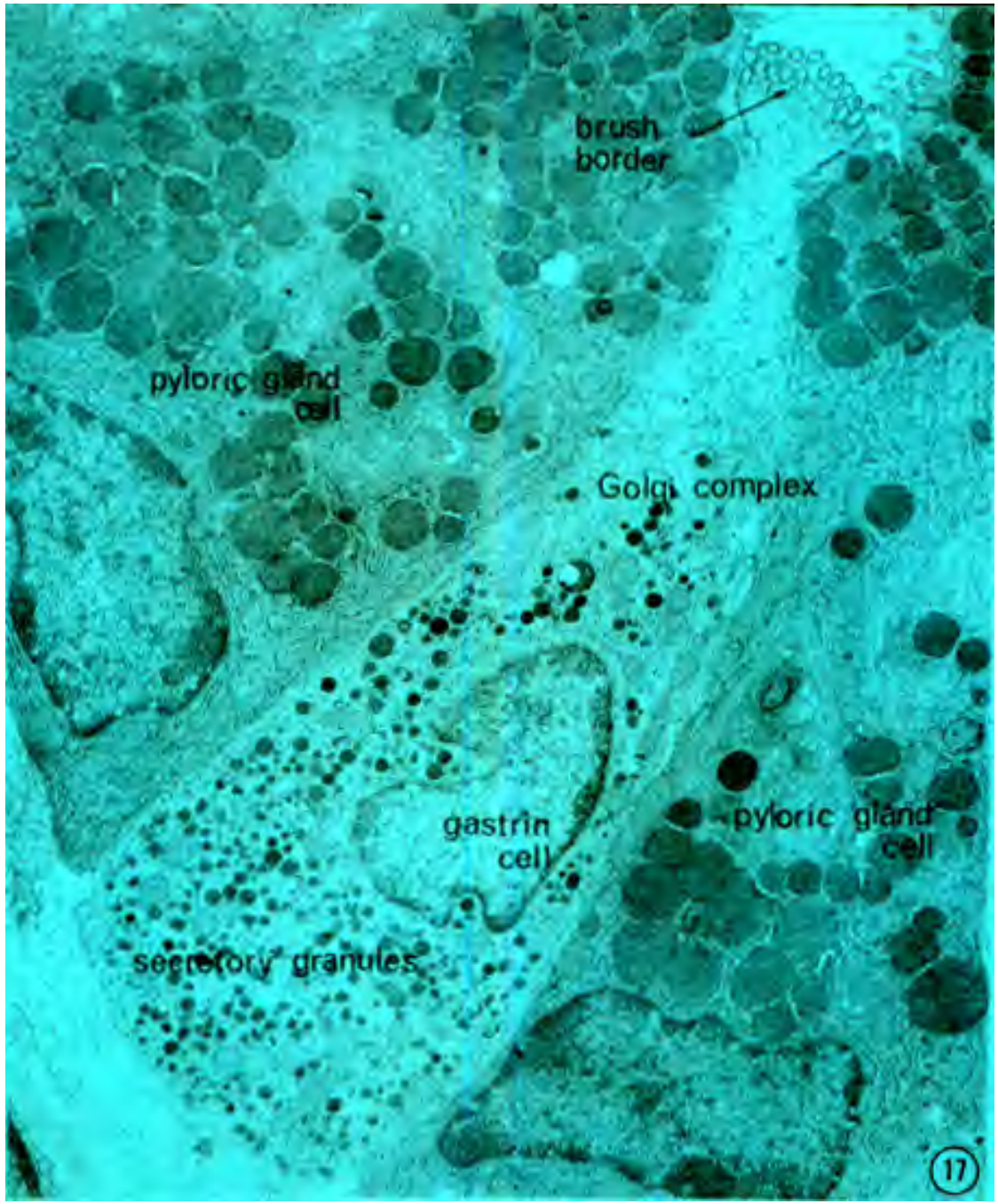




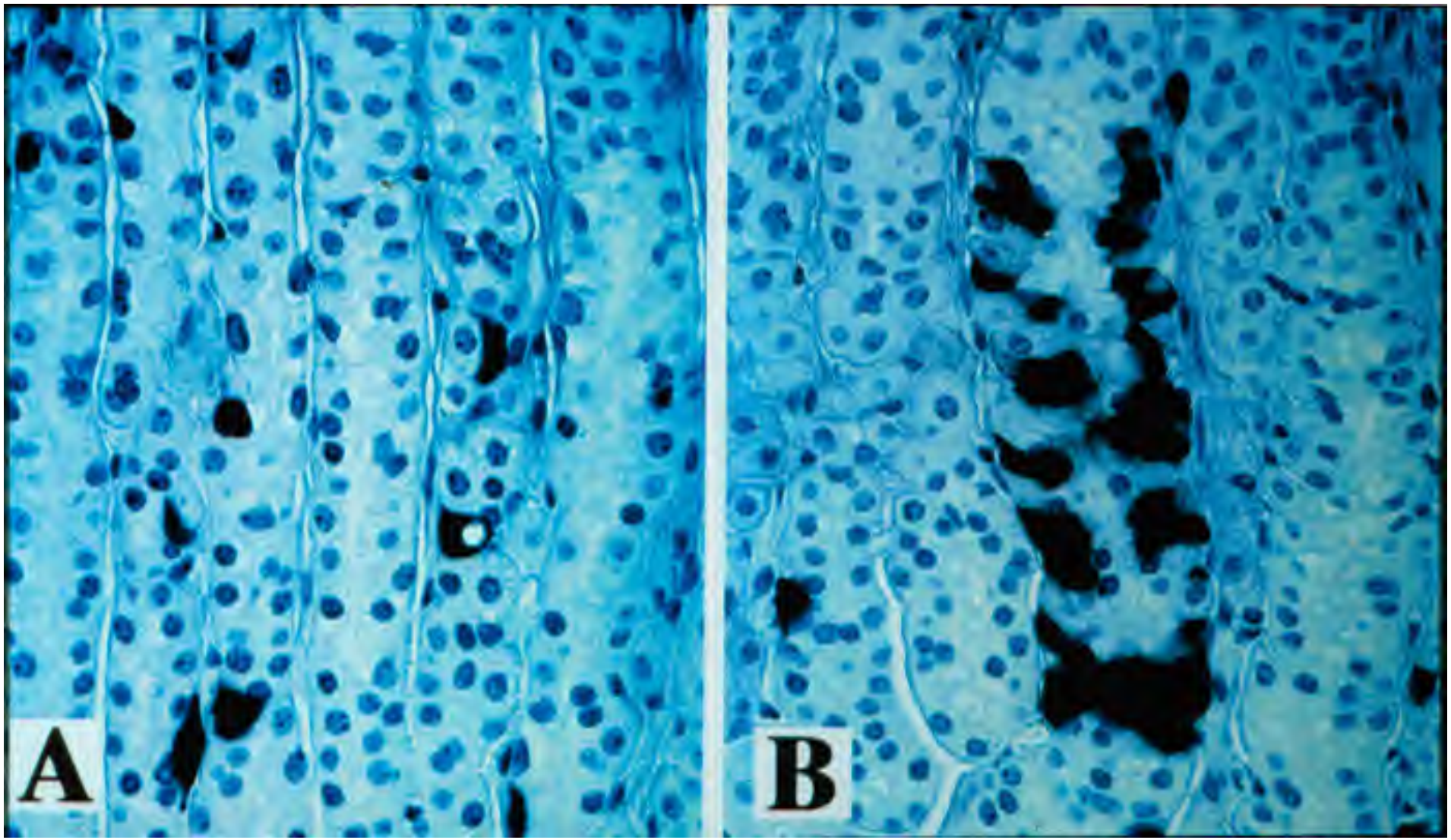
Gastric Gland and Surface Pit from Body of the Stomach



 Modified from Fig. 7 Johnson, L. *Essential Medical Physiology.* Raven Press, New York, NY; 1992: 482.



Location of Histamine in the Gastric Mucosa



Normal **Acid Inhibition**

GASTRIC SECRETIONS

Substance	Cell	Region
HCl	Parietal Cell (Oxyntic cell)	fundus-body
Intrinsic Factor	Parietal Cell	fundus-body
Pepsinogen	Chief Cell	fundus-body-antrum
Mucus	Mucus Cell	fundus-body-antrum

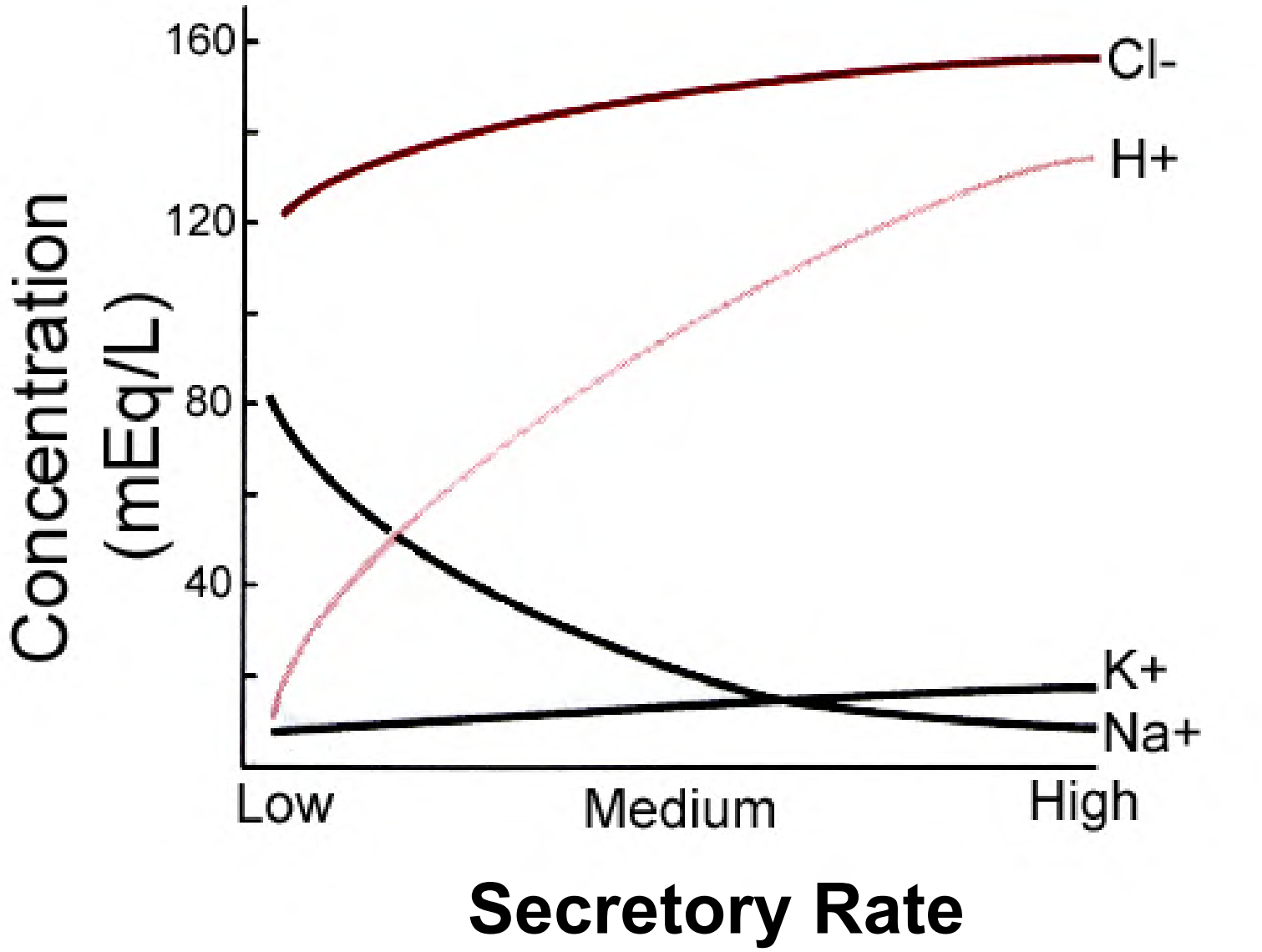
Volume: 1.5-2.0 liters/day, isotonic

basal rate: 1.5 mmoles H^+/hr

max rate: 6-40 mmoles H^+/hr

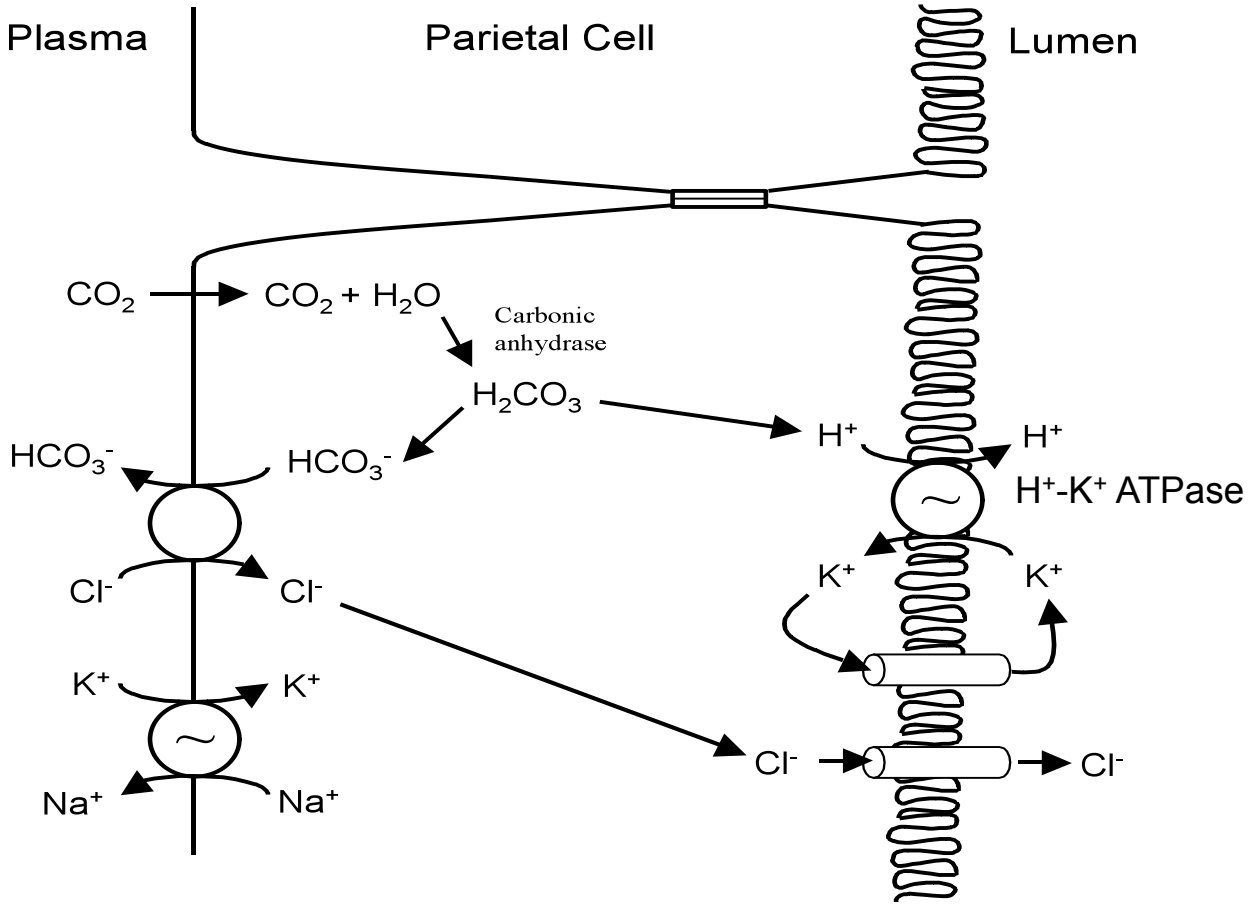
pH max: 1.0

Ion Concentrations in Gastric Juice Relative to Secretory Rate

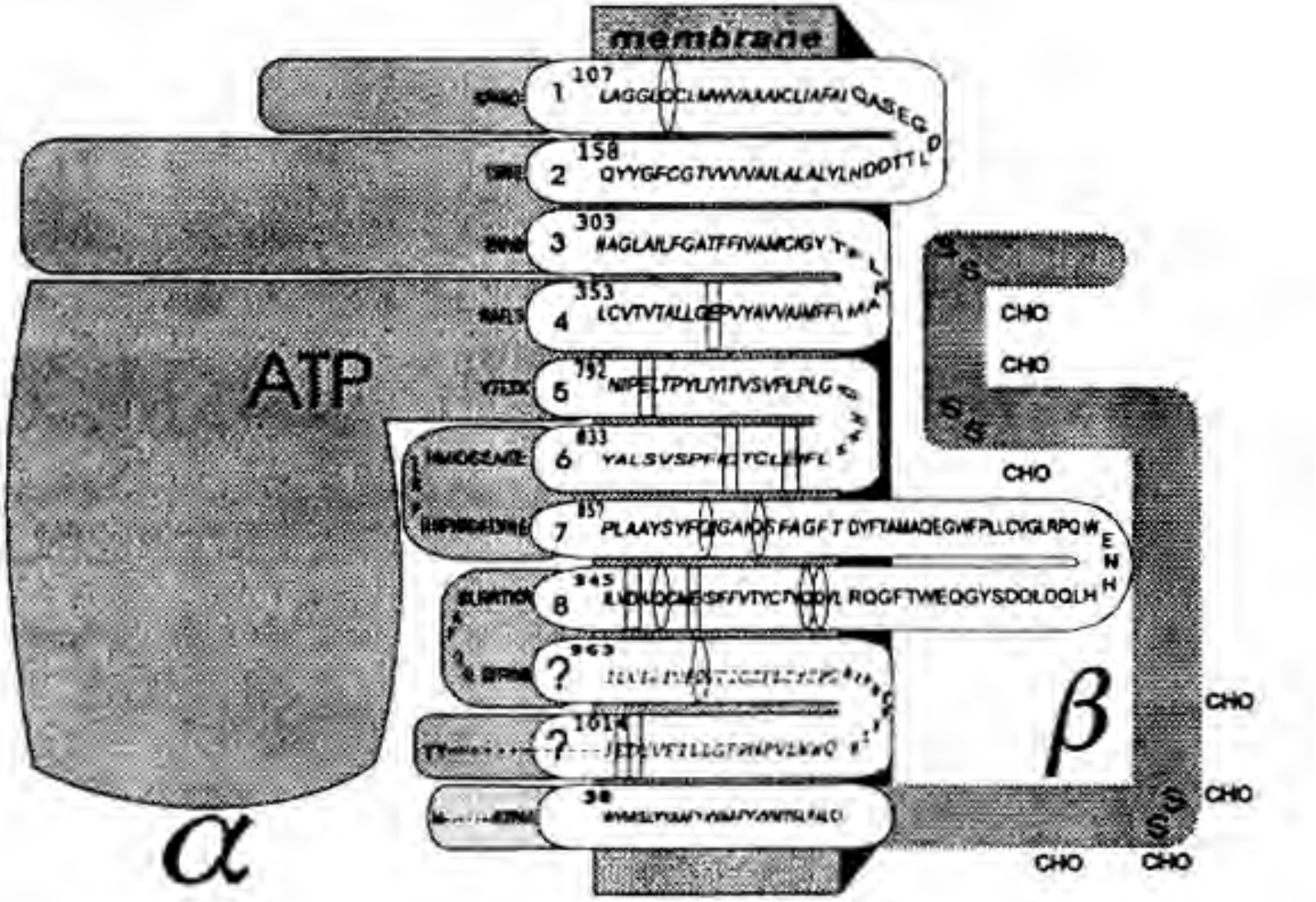


PD-INEL Fig. 9 Johnson, L. *Essential Medical Physiology.* Raven Press, New York, NY; 1992: 484.

Mechanism of HCL Secretion by Parietal Cells



Schematic representation of the H+,K+ -ATPase heterodimer in the apical membrane of the parietal cell



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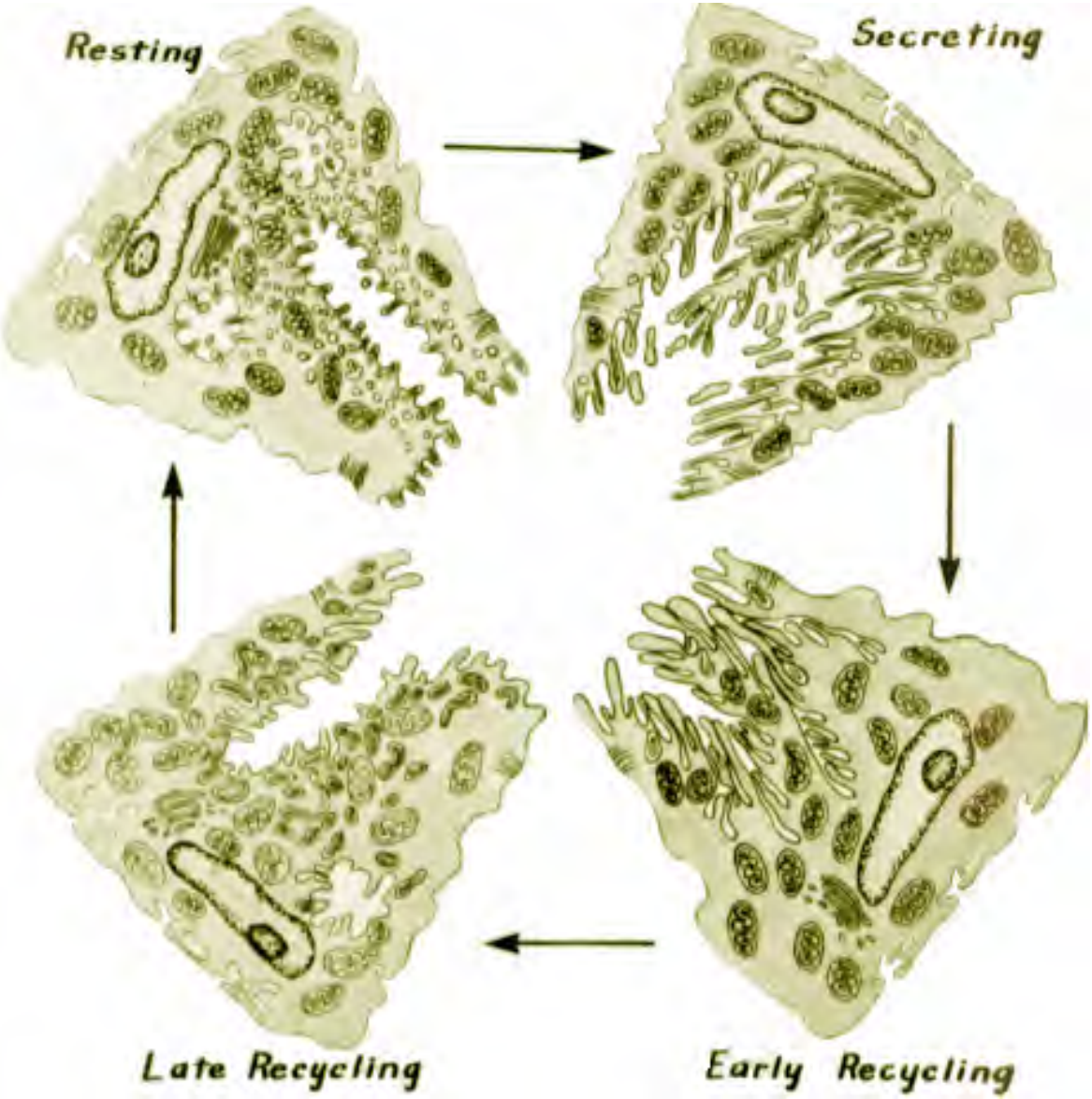
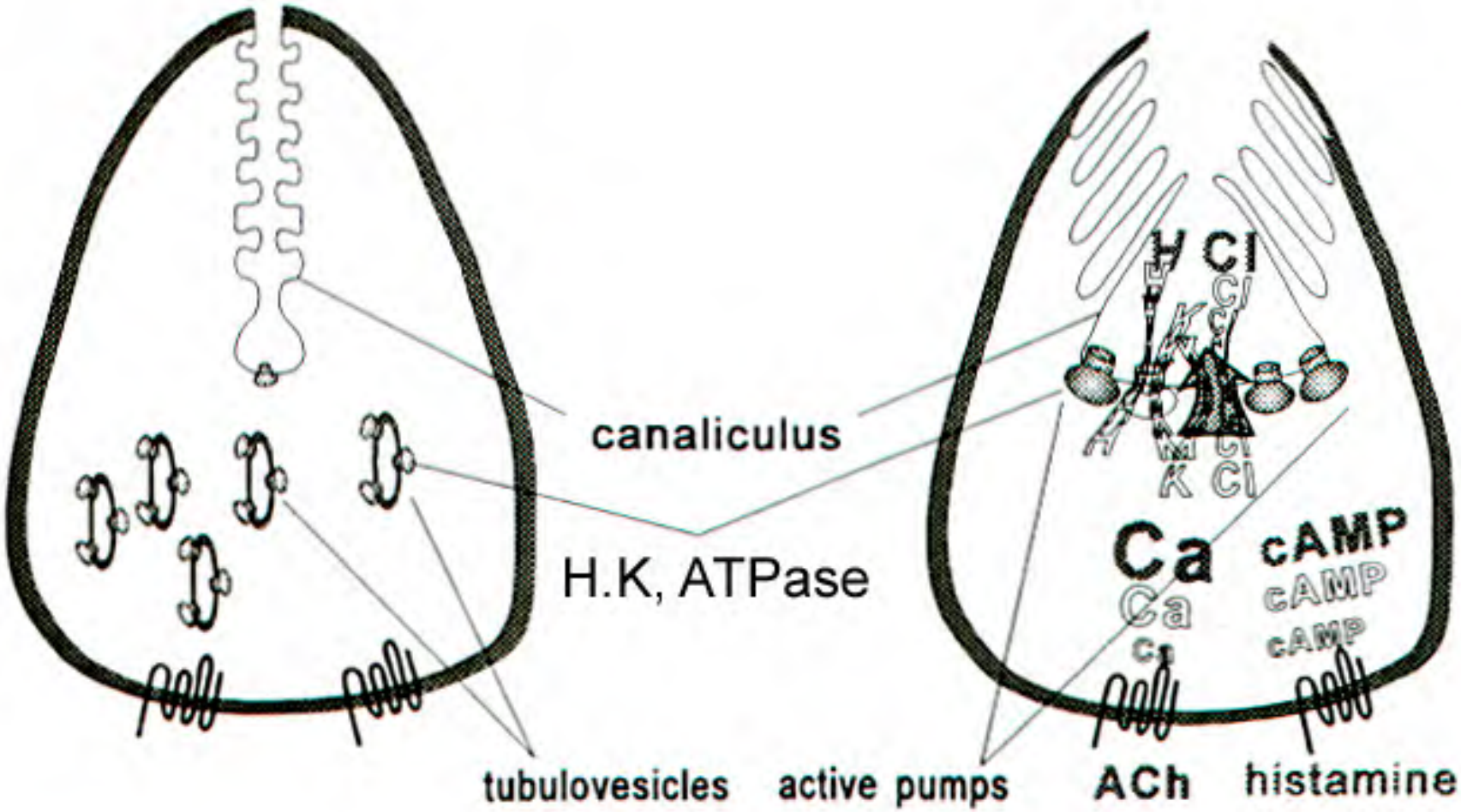
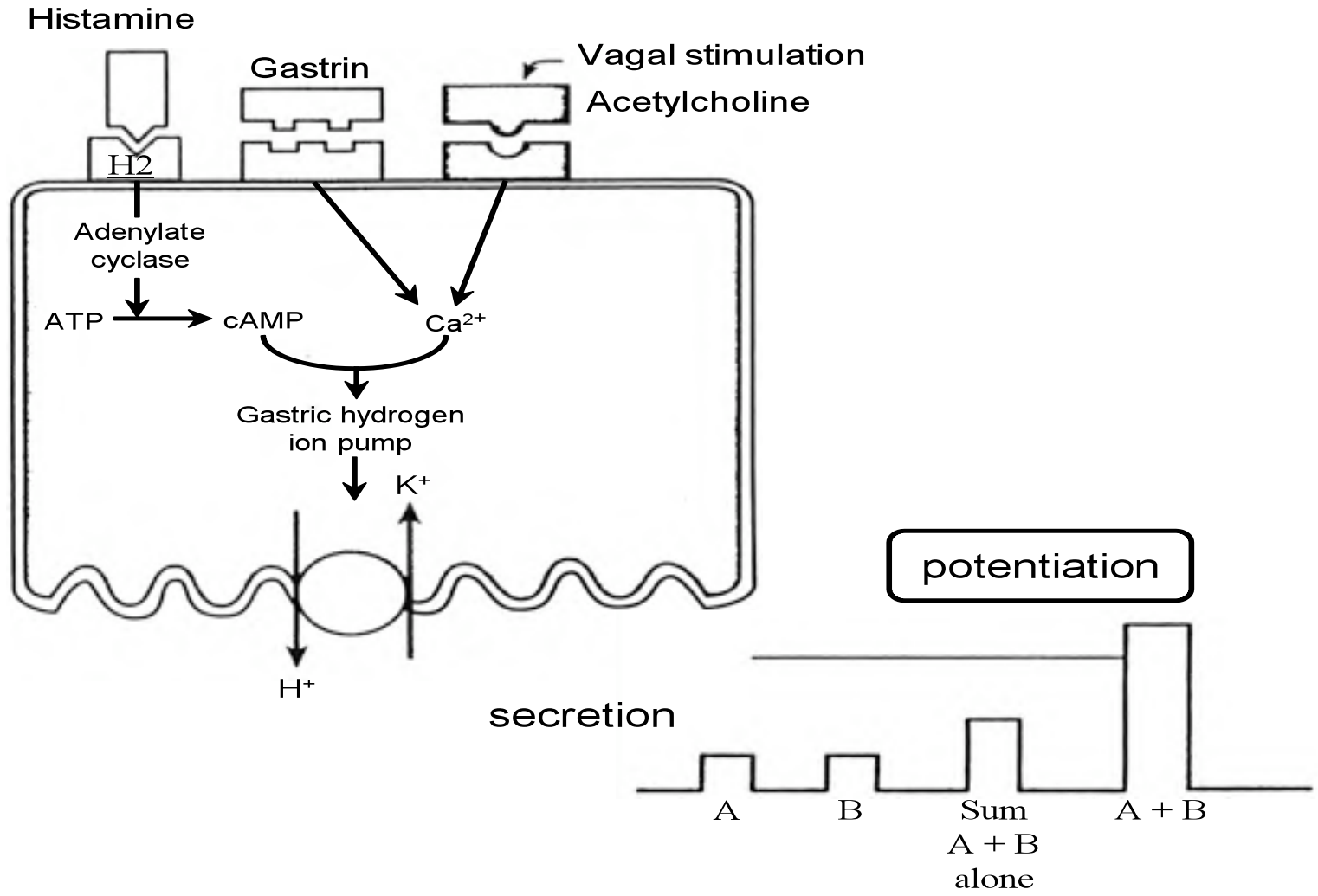
Parietal Cell Vesicles Cycle between Resting and Secreting State



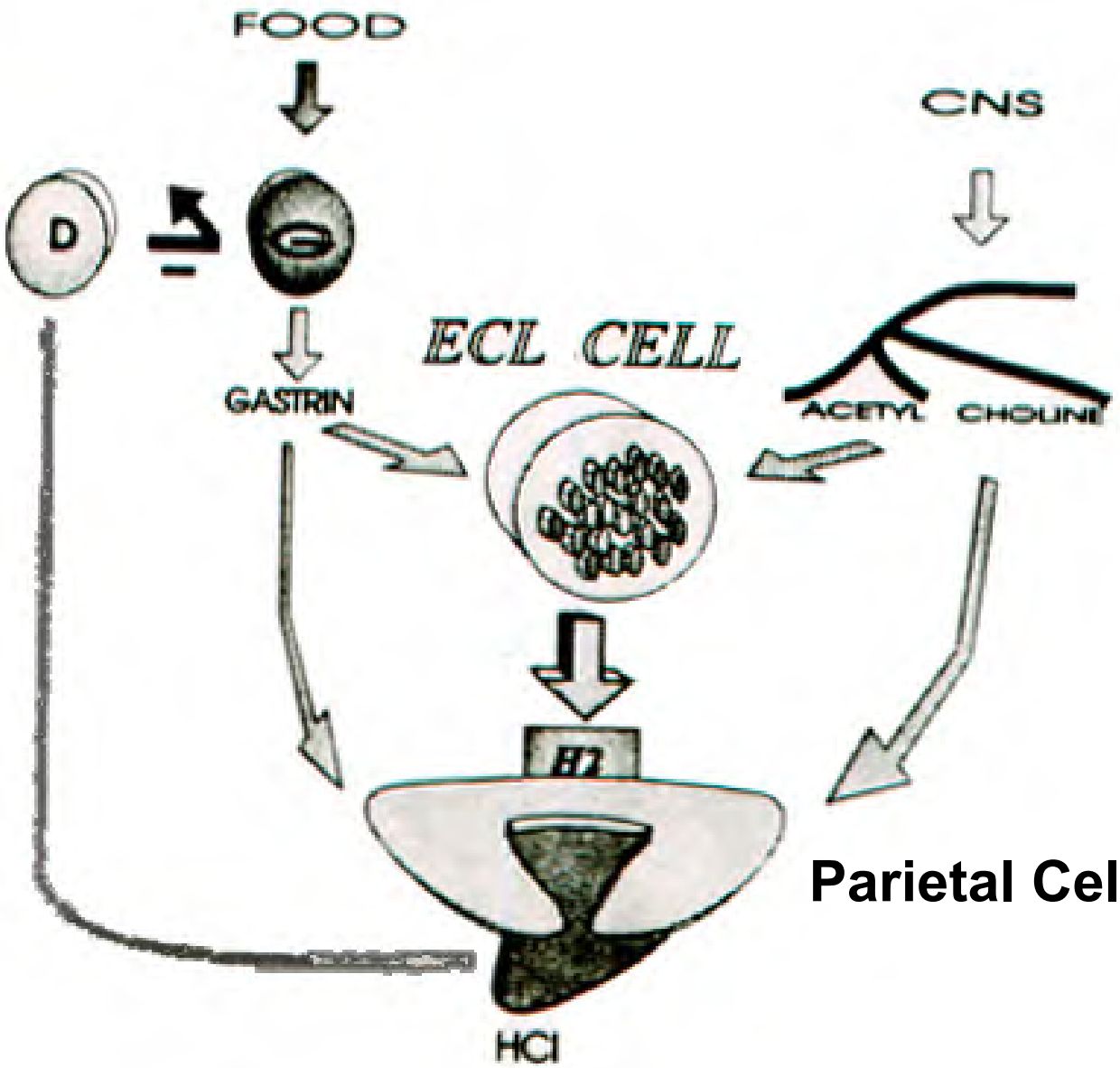
Secretory Transformation of Parietal Cells



Receptors and Intracellular Messengers Regulating Parietal Cell H^+ Secretion



Role of the ECL Cell in Peripheral Regulation of Gastric Acid Secretion



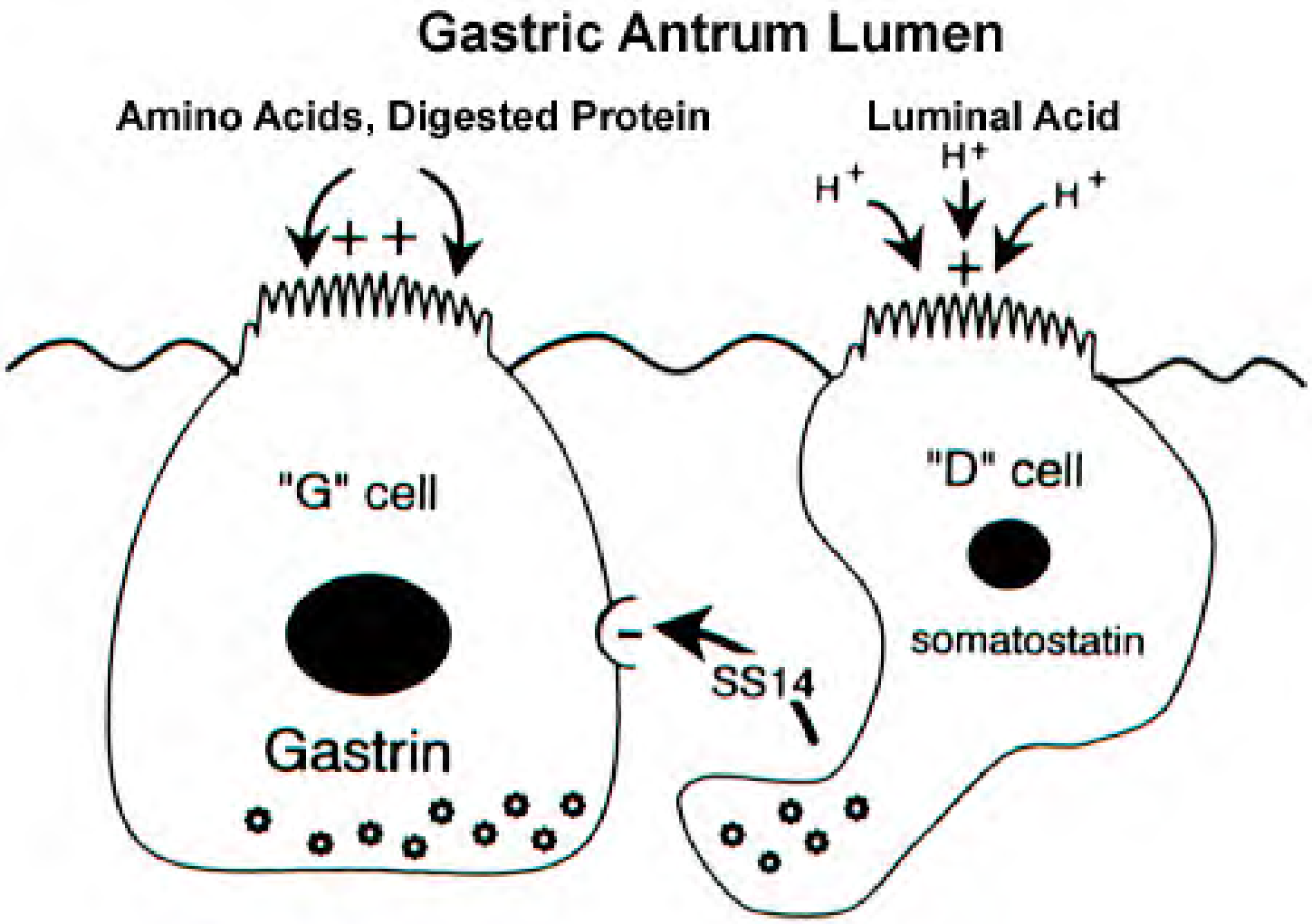
INTEGRATED CONTROL OF GASTRIC ACID SECRETION BY NEURAL AND HUMORAL PATHWAYS

1. Vagus acts directly on parietal cells and indirectly by effects on gastrin and histamine release.

2. Histamine released from enterochromaffin-like cells (ECL cells) reaches parietal cells by local diffusion.

3. Gastrin released from antral G cells reaches parietal cells by systemic circulation.

4. Inhibitory regulators include somatostatin released from D cells in antrum and body of stomach and intestinal hormones collectively termed “enterogastrone”, and prostaglandins from surface cells.

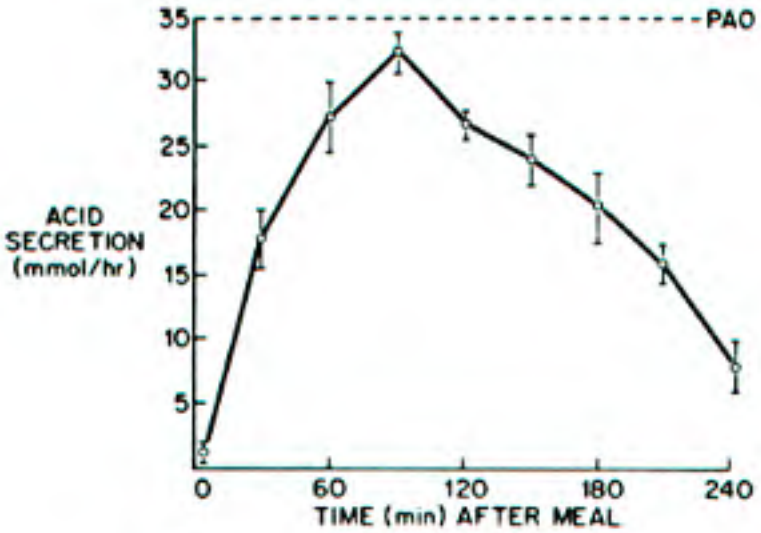


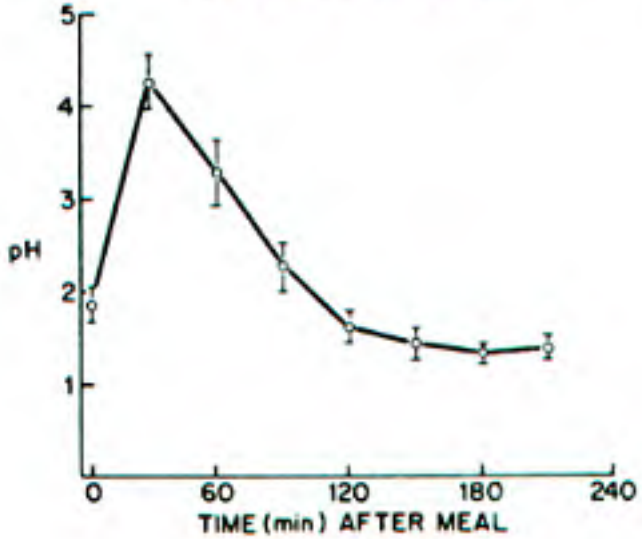
Gastrin release from G cells of the antrum is stimulated by luminal amino acids and digested proteins and is inhibited in a paracrine fashion by somatostatin in response to luminal acid. Somatostatin is released when pH is < 3.0

METHODS FOR MEASURING ACID SECRETION

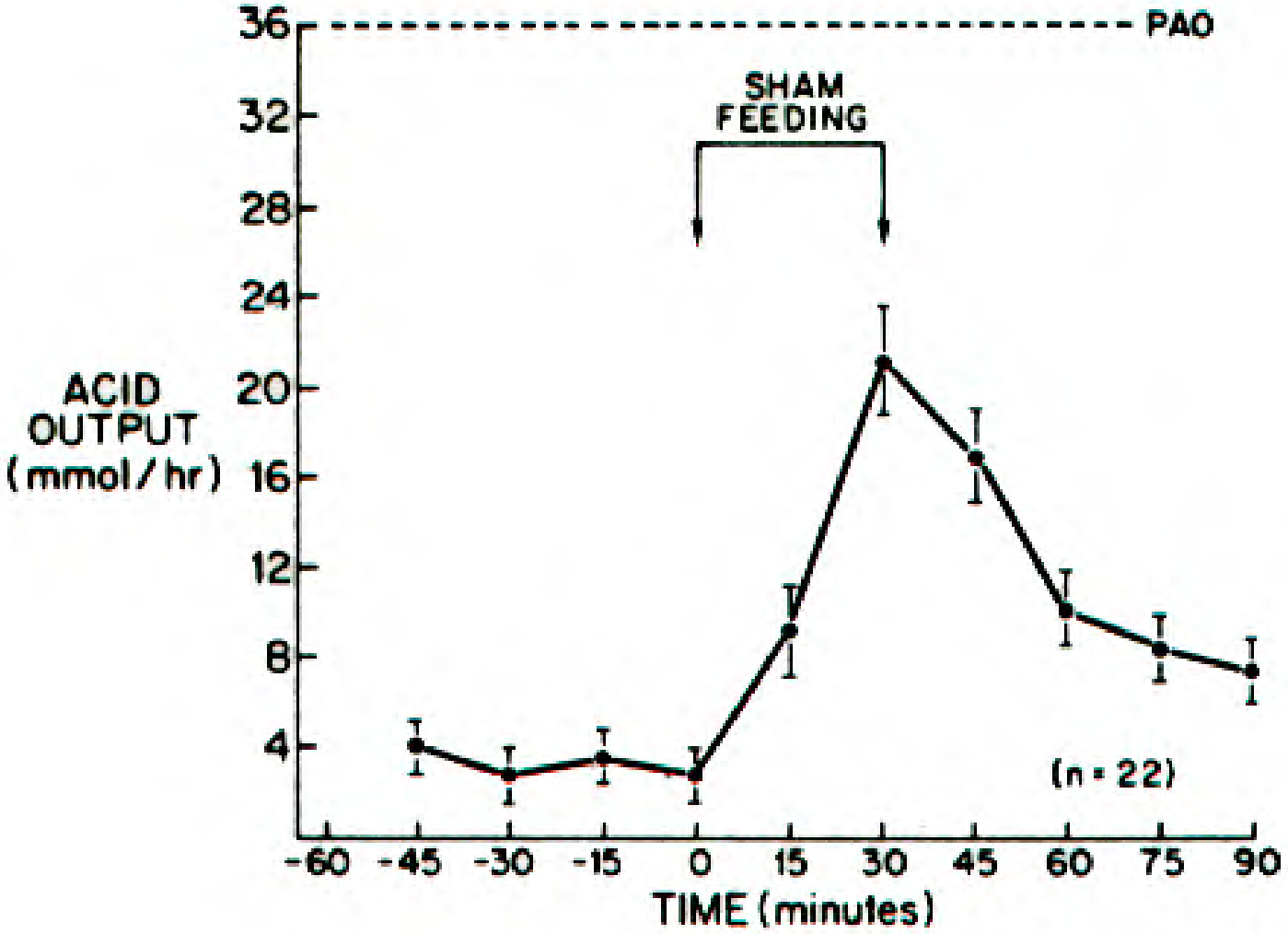
1. Gastric Aspiration
2. Intragastric Titration
3. Basal vs. Peak Acid Output

Acid Secretion and Intragastric pH Following a Sirloin Steak Meal

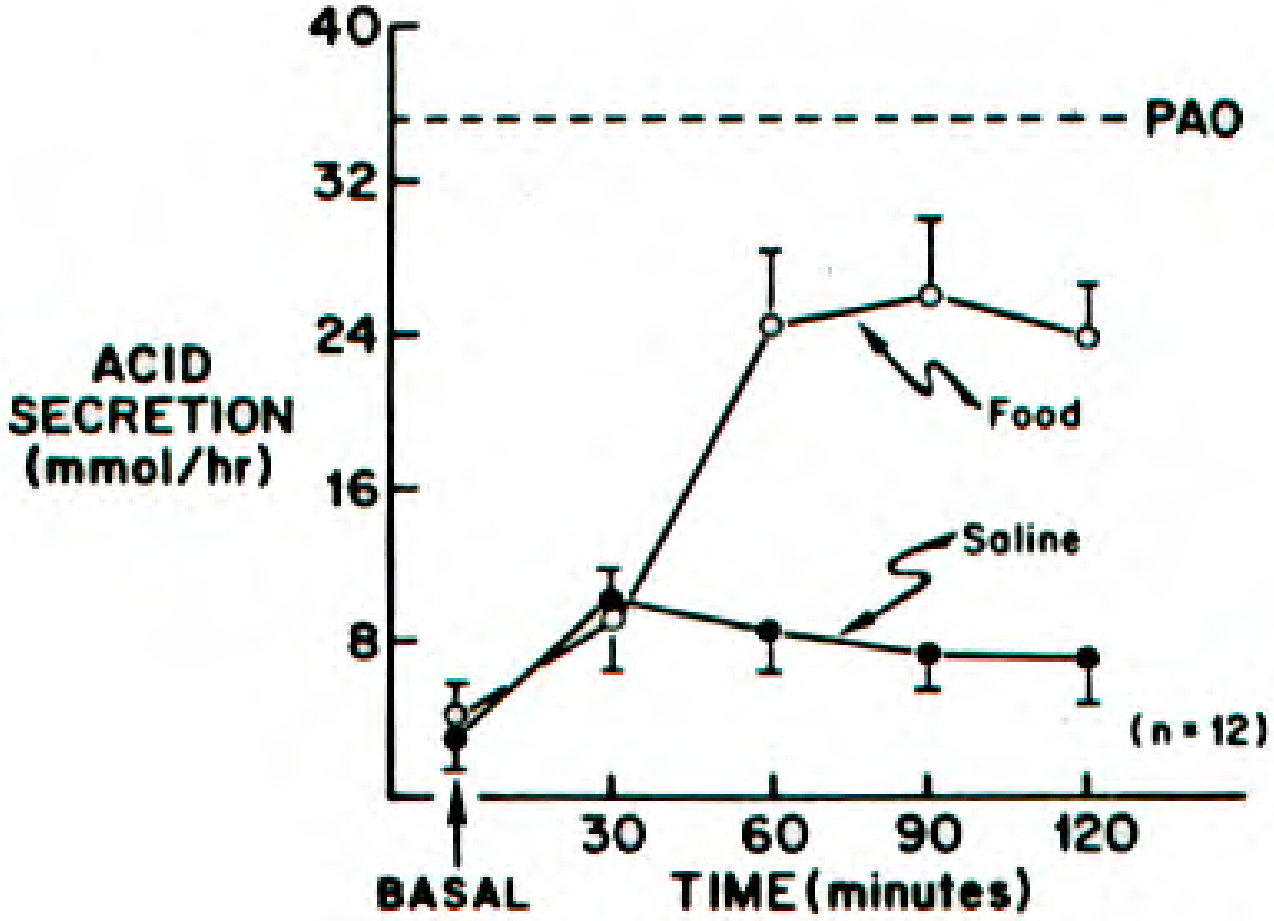




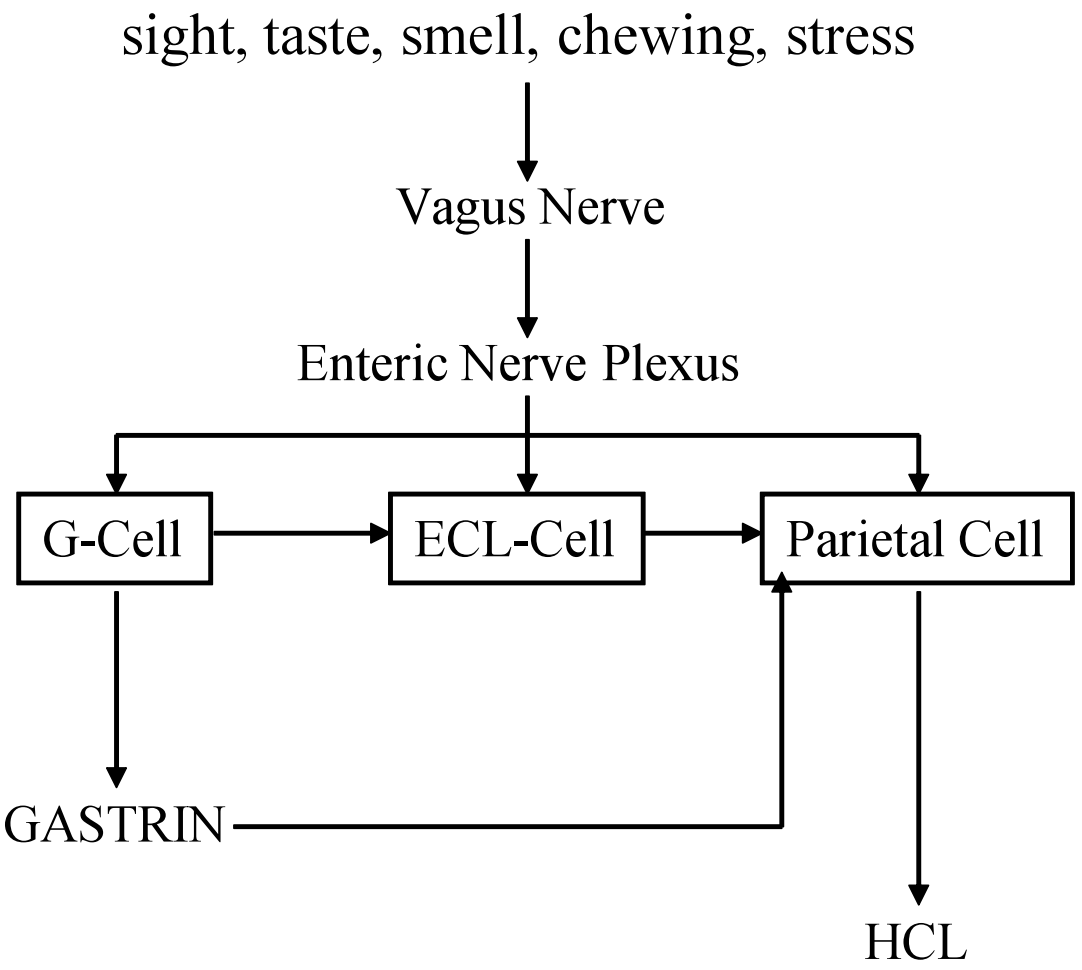
Acid Secretion During Sham Feeding



Acid Secretion In Response To Intra-Gastric Saline (Distension) And Food

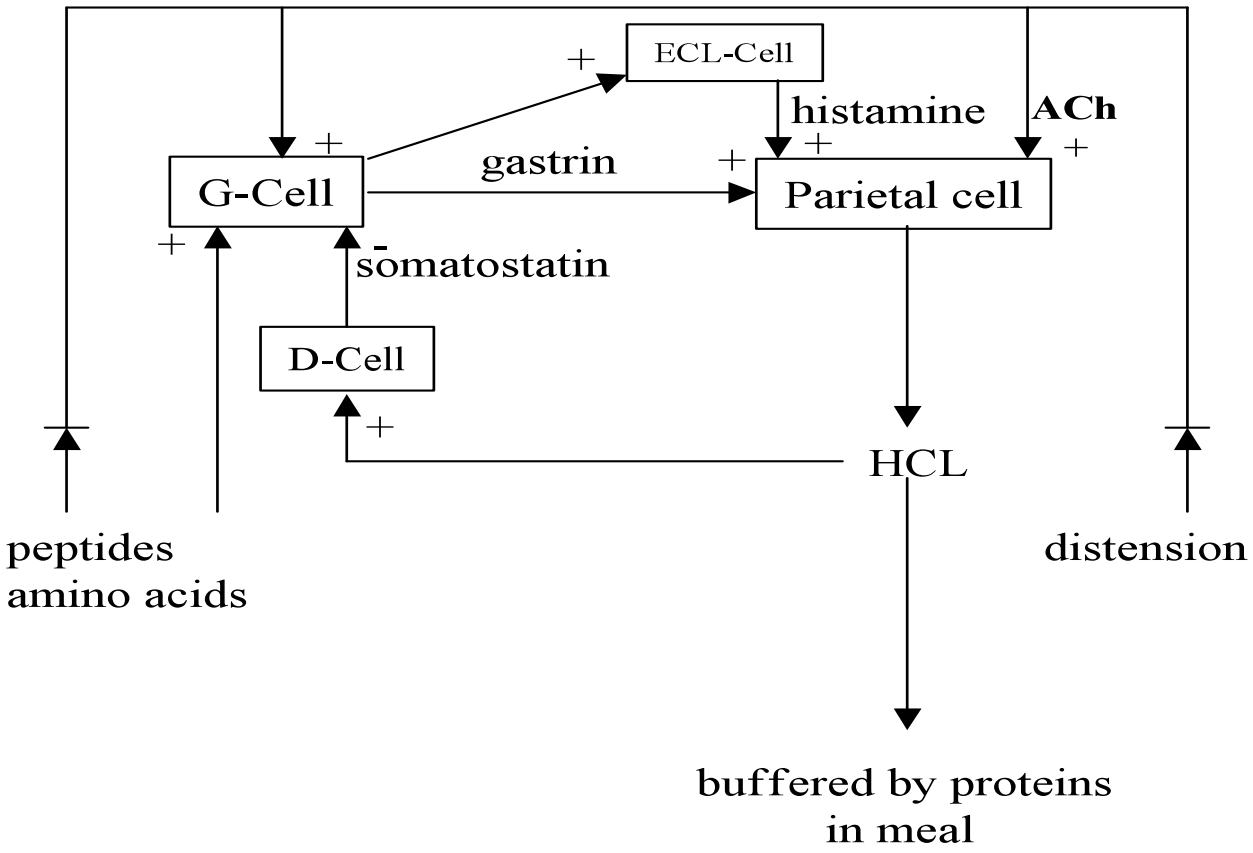


Cephalic Phase of Gastric Secretion

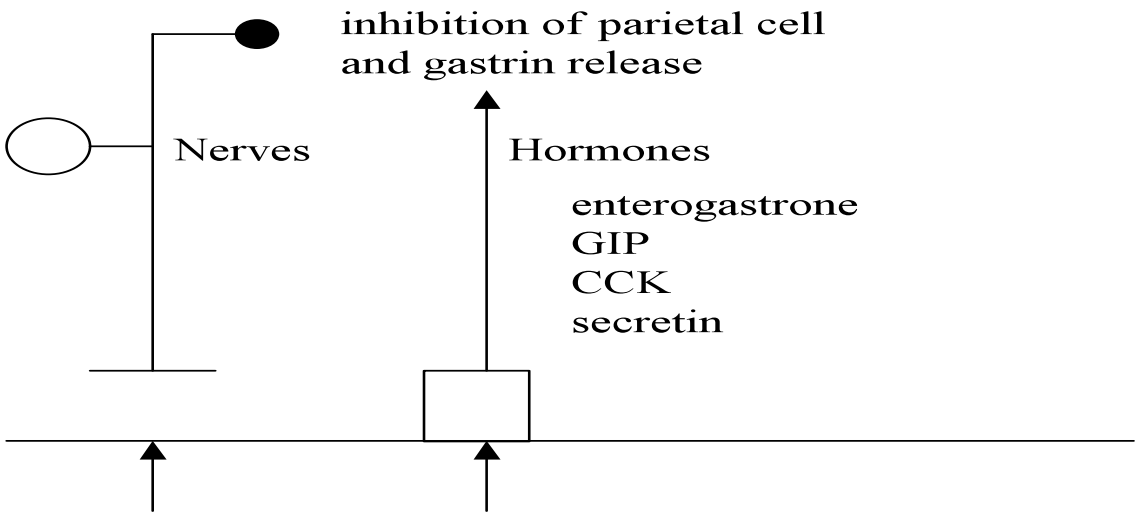


Gastric Phase Acid Secretion

long and short reflexes



Intestinal Phase Acid Secretion



luminal stimuli

- fatty acids
- acid
- amino acids
- hypertonic solutions
- distension

PEPSIN

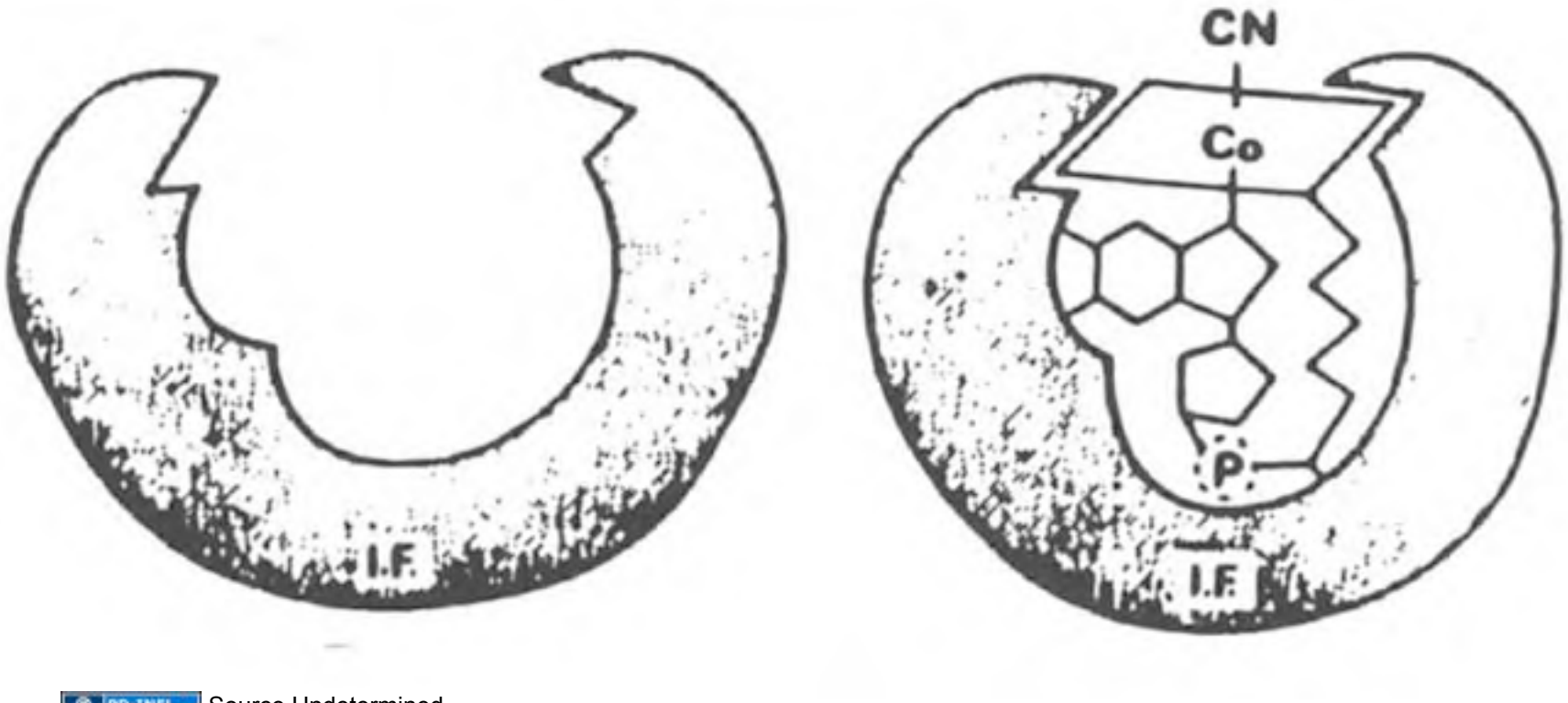
1. Proteolytic enzyme secreted by chief cells as an inactive precursor, pepsinogen.

2. Release stimulated by vagal nerve and by presence of acid in stomach.

3. Activated by peptide cleavage at acid pH.

4. Initiates digestion of protein. It is an endopeptidase and active at acid pH

THE MOLECULE OF INTRINSIC FACTOR AND ITS COBALAMIN COMPLEX



Intrinsic Factor

1. Glycoprotein of Mol. Wt. 55,000 which binds Vitamin B_{12} (cobalmin).

3. Produced by parietal cells.

4. After binding B_{12} it binds receptors on ileal absorptive cells and is internalized by endocytosis.

4. Absent in pernicious anemia.

Sequential Steps in the Absorption of Cobalamin (Vit B_{12})

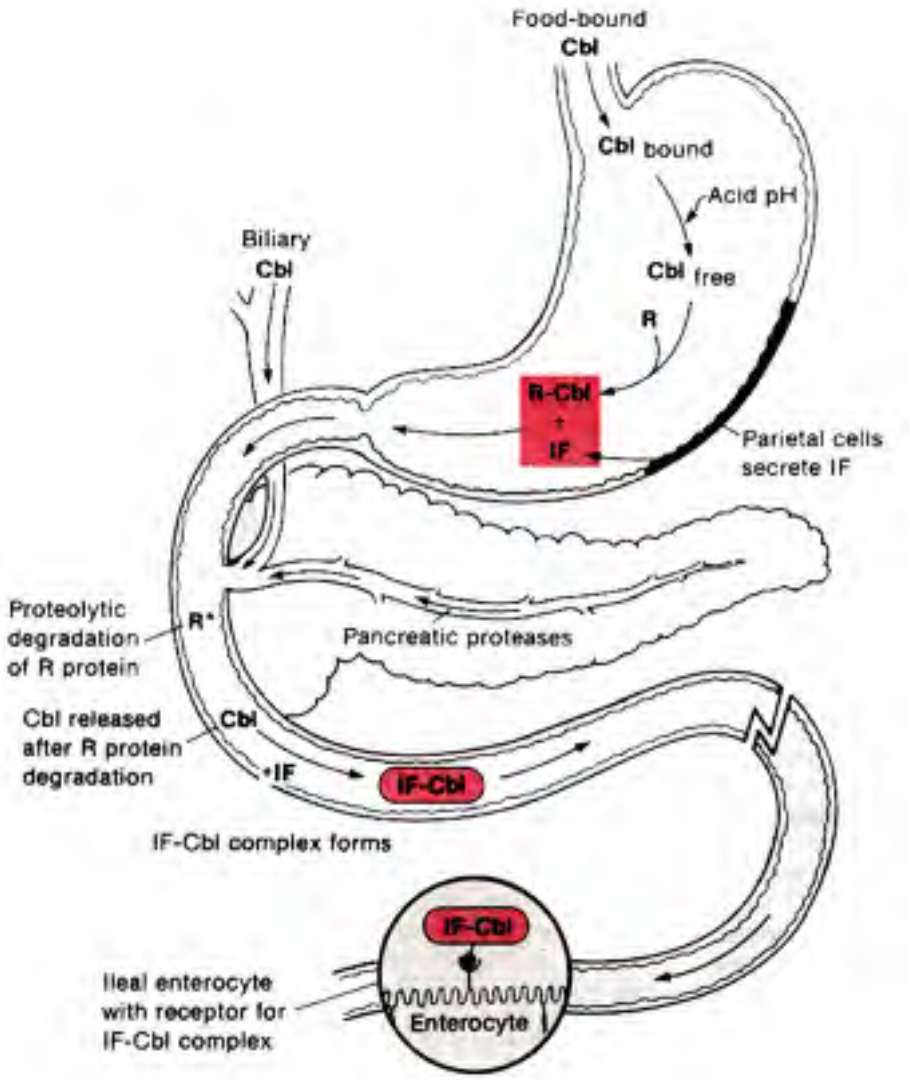
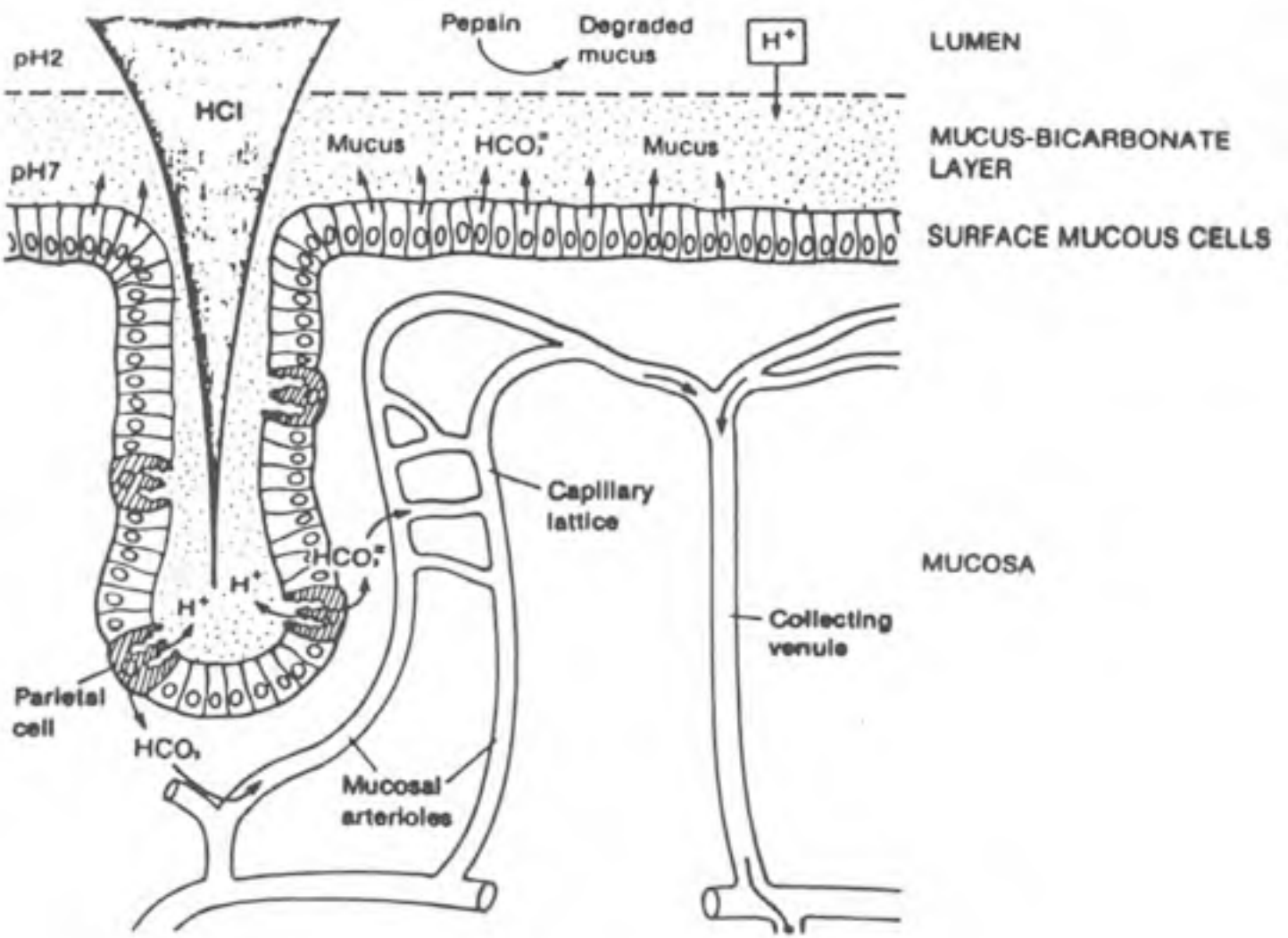


 Fig. 20.2 Yamada, T, *et al. Textbook of Gastroenterology*. 4th ed. Vol. 1 Lippincott, Williams, and Wilkins, Philadelphia, PA; 2003: 453.

MECHANISMS CONTRIBUTING TO GASTRIC CYTOPROTECTION



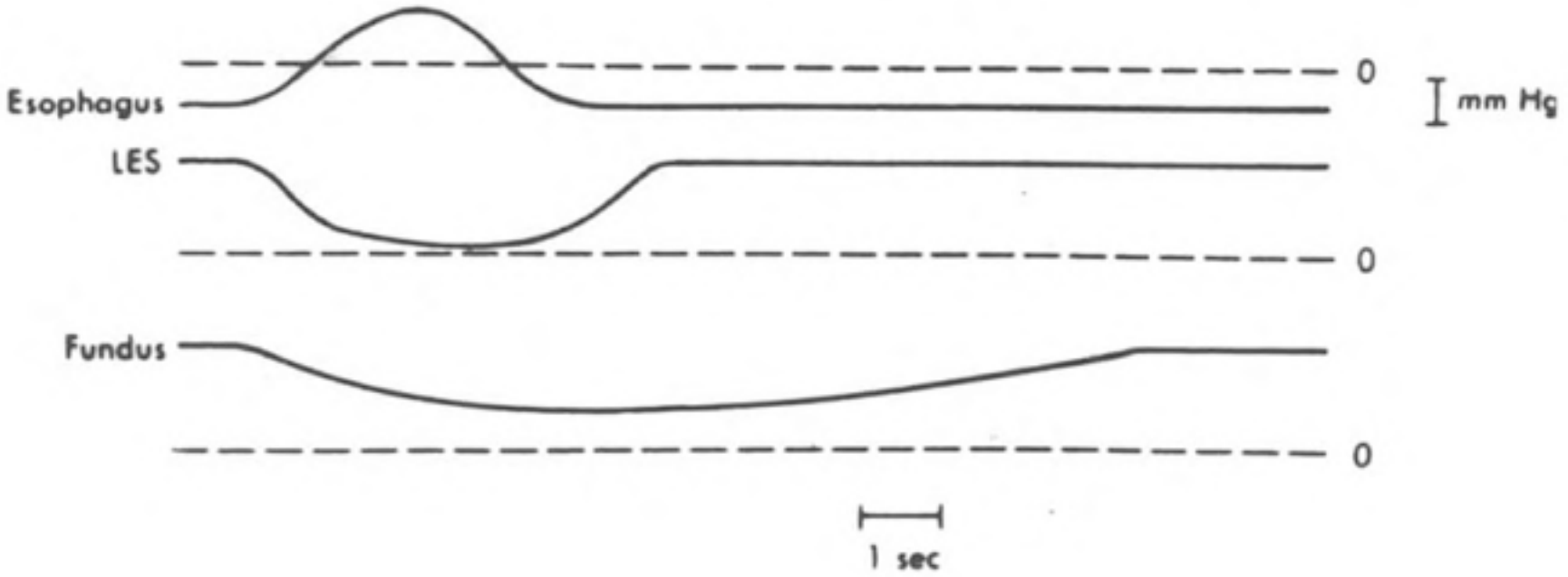
GASTRIC MOTILITY

1. **Proximal – Receptive relaxation as stomach fills (Fundus)**

2. **Distal – Propulsive mixing and grinding (Antrum)**

3. **Pylorus – Regulates outflow**

Entry of Food is Preceded by Gastric Relaxation



Antral Peristalis

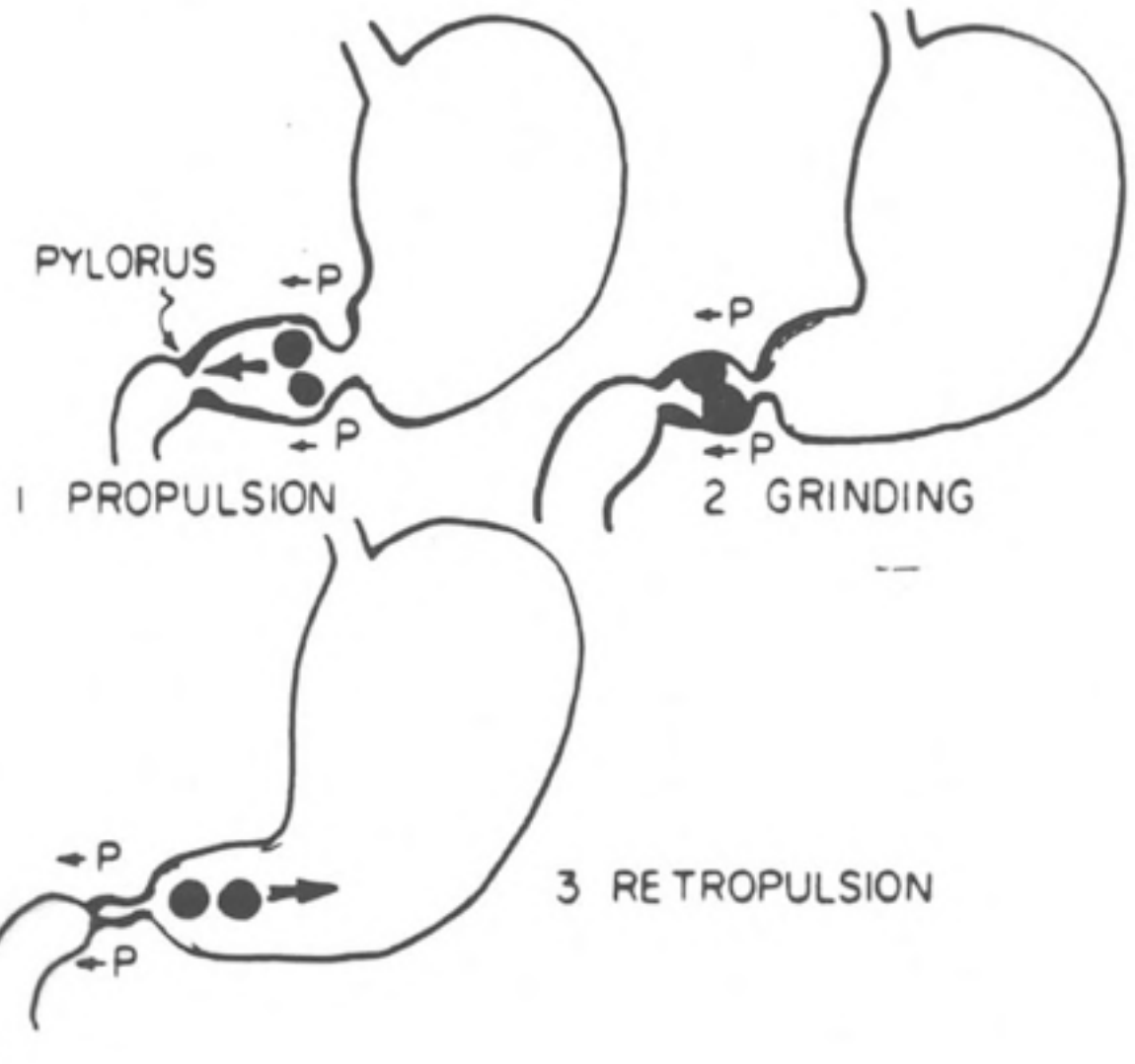
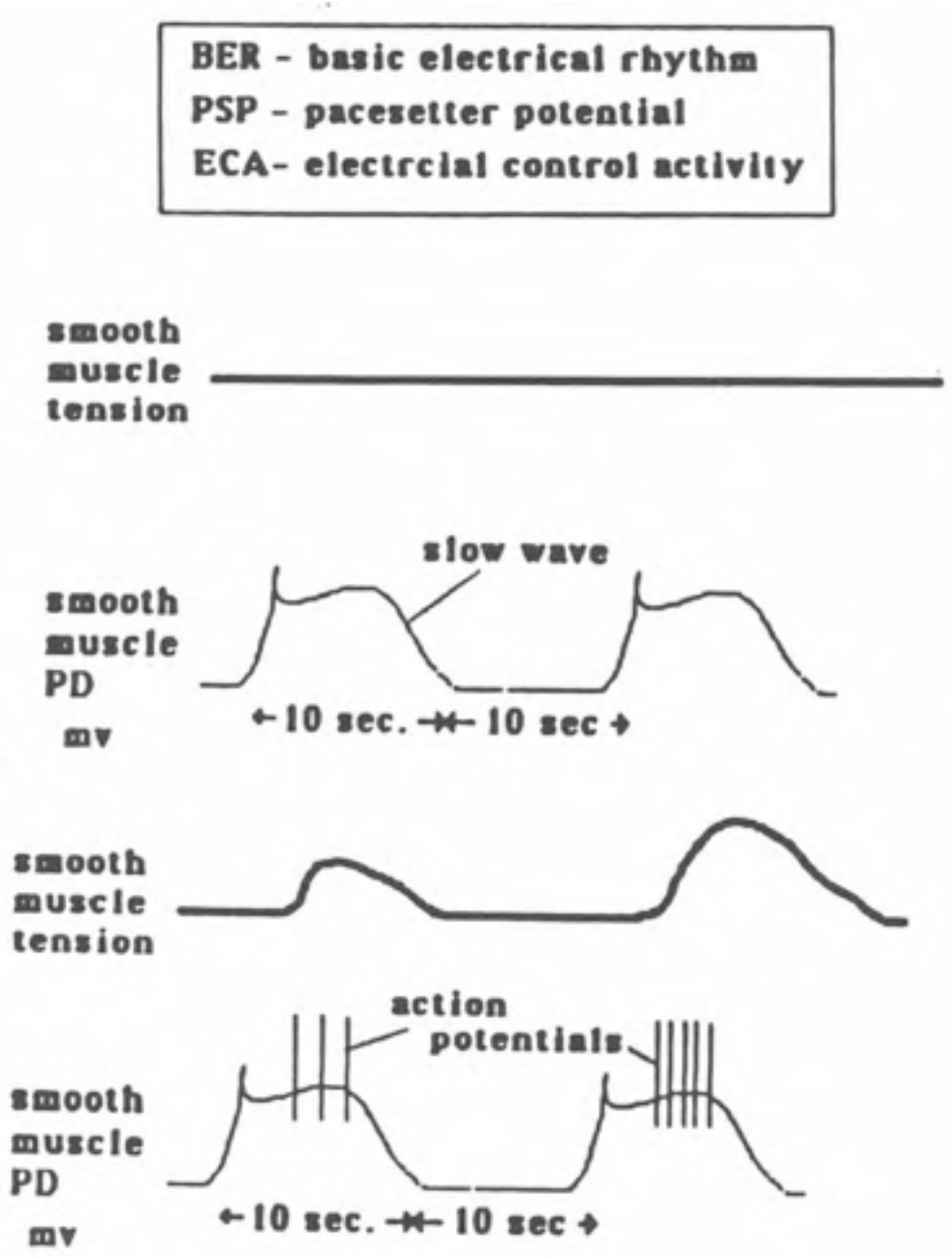
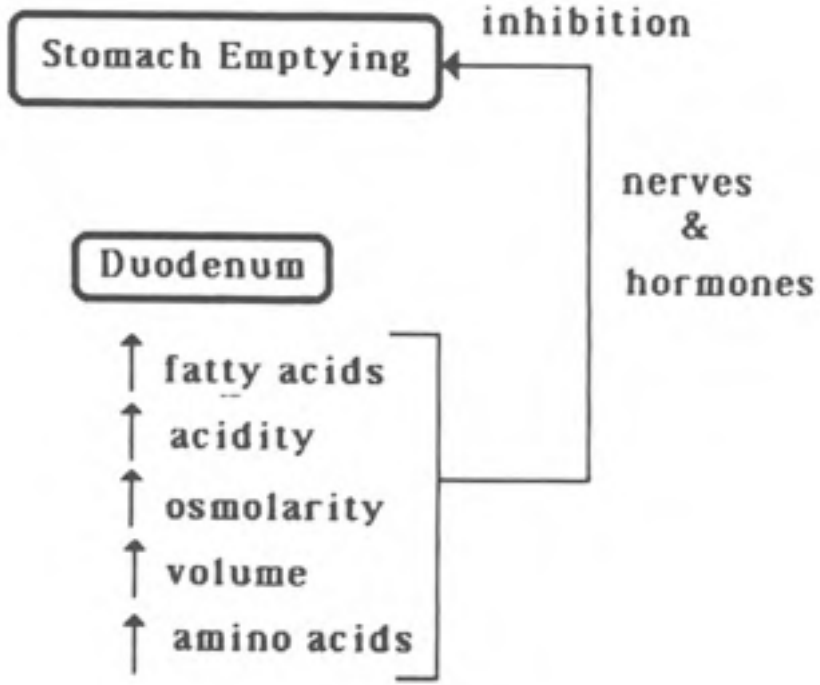


 Fig. 4-9 Granger, D, *et al. Clinical Gastrointestinal Physiology*. W.B. Saunders, Philadelphia, PA; 1985: 84.





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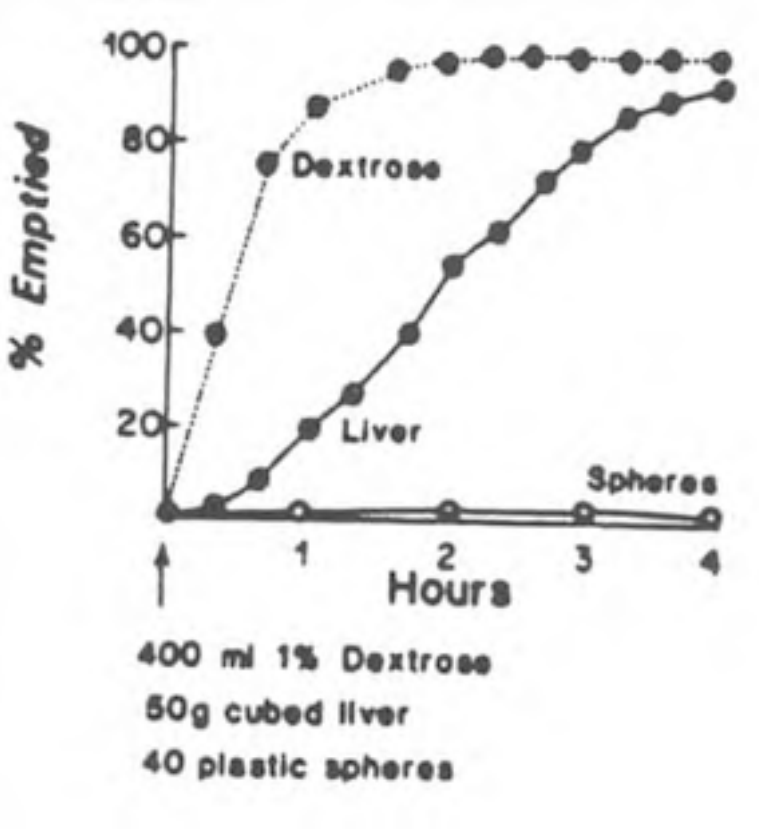

PD-INEL Hinder, RA, Kelly, KA. “Canine Gastric Emptying of solids and liquids”. *Am. J. Physiol*. 233: E335, 1977.

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Slide 9 – Source Undetermined

Slide 11 – Fig. 9 Johnson, L. *Essential Medical Physiology.* Raven Press, New York, NY; 1992: 484.

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Slide 30 – Fig. 20.2 Yamada, T, *et al. Textbook of Gastroenterology*. 4th ed. Vol. 1 Lippincott, Williams, and Wilkins, Philadelphia, PA; 2003: 453.

Slide 34 – Fig. 4-9 Granger, D, *et al. Clinical Gastrointestinal Physiology*. W.B. Saunders, Philadelphia, PA; 1985: 84.

Slide 35 – Jim Sherman

Slide 36 – (Left) John Williams

Slide 36 – (Right) Hinder, RA, Kelly, KA. “Canine Gastric Emptying of solids and liquids”. *Am. J. Physiol*. 233: E335, 1977.