Overview of Gastroenterology
Gastroenterology Made Really Simple!

Food → Nutrients → Waste

Nutrients
The Basic Structure

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The Propulsion System: Driven by the Muscles

- Periodic phasic contractions
- Local tonic contractions (sphincters)

Food → Nutrients → Waste
The Neural Control System: The Brain in the Gut

Muscularis Mucosae

Submucosal plexus

Myenteric plexus

Longitudinal muscle

Circular muscle

Mucosa

ACh

NE

NE

Parasympathetic nerves (Vagus/Pelvic)

Sympathetic ganglia

ACh

NE

ACh

ACh

ACh

NE

NE
# The Neurocrine Effectors

<table>
<thead>
<tr>
<th>Peptide</th>
<th>Actions</th>
</tr>
</thead>
</table>
| Acetylcholine (ACh)                          | • Smooth muscle contraction  
|                                              | • Sphincter relaxation  
|                                              | • Increased salivary, gastric, and pancreatic secretions                 |
| Norepinephrine (NE)                          | Smooth muscle relaxation  
|                                              | Sphincter contraction  
|                                              | Increased salivary secretion                                            |
| Vasoactive intestinal peptide (VIP)          | Smooth muscle relaxation  
|                                              | Increased intestinal and pancreatic secretions                          |
| Gastrin-releasing peptide (GRP, bombesin)    | Increased gastrin secretion                                             |
| Enkephalins                                  | Smooth muscle contraction  
|                                              | Decreased intestinal secretions                                         |
| Substance P                                  | Smooth muscle contraction  
|                                              | Increased salivary secretions                                           |
| Neuropeptide Y                               | Smooth muscle relaxation  
|                                              | Decreased intestinal secretions                                         |
# The hormonal control system

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Stimuli</th>
<th>Site of secretion</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrin</td>
<td>Vagal stimulation</td>
<td>G cells (stomach)</td>
<td>Stimulation of gastric acid secretion</td>
</tr>
<tr>
<td></td>
<td>Gastric distension</td>
<td></td>
<td>Growth of gastric mucosa</td>
</tr>
<tr>
<td></td>
<td>Peptide and amino acids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholecystokinin (CCK)</td>
<td>Fatty acids</td>
<td>I cells (duodenum and jejunum)</td>
<td>Pancreatic enzyme, HCO3 secretion</td>
</tr>
<tr>
<td></td>
<td>Peptide and amino acids</td>
<td></td>
<td>Gallbladder contraction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inhibition of gastric emptying</td>
</tr>
<tr>
<td>Secretin</td>
<td>Fatty acids</td>
<td>S cells (duodenum)</td>
<td>Pancreatic enzyme, HCO3 secretion</td>
</tr>
<tr>
<td></td>
<td>Duodenal motility</td>
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<td>Gallbladder contraction</td>
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<td></td>
<td></td>
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<td>Inhibition of gastrin, acid secretion</td>
</tr>
<tr>
<td>Ghrelin</td>
<td>Fasting</td>
<td>Stomach</td>
<td>Stimulates appetite (CNS)</td>
</tr>
<tr>
<td>Glucagon-like peptide (GLP-1)</td>
<td>Fatty acids, amino acids</td>
<td>L cells (duodenum and jejunum)</td>
<td>Satiety (CNS)</td>
</tr>
<tr>
<td></td>
<td>Oral glucose</td>
<td></td>
<td>Inhibition of acid secretion</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stimulation of insulin secretion</td>
</tr>
</tbody>
</table>
Gastrin
Glucagon (A cells)
Secretin
CCK
GIP
Motilin
Neurotensin
VIP
Substance P
Glicentin (L cells)
Somatostatin
GRP
Guanin
Peptide YY
Ghrelin
Gut-brain hormonal interactions

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Salivary Secretion

Acinus

Duct

Hypotonic saliva

Alpha-Amylase
Kallikrein
Mucus
Electrolytes

Na, Cl
K, HCO₃

Na
Cl
HCO₃
K
H
Cl
Gastric Secretions

- Pepsinogen
- Gastric Lipase
- Mucus
- Hormones
- Parietal cells
- Chief cells
- Mucous cells
- NE cells
- HCl
- IF

Hormones
Biliary Secretion

- Cholesterol & bile acids
- Water and electrolytes
- (CCK)
- Water and electrolytes
- (Secretin)
- Bile acids
Pancreatic Secretions

- Acinus
- Centroacinar Cells
- Duct

**Basic Pancreatic Secretions**

- **Alpha-Amylase**
- **Lipases**
- **Proteases**

**Centroacinar Cells**

- **Bicarbonate**

**Carbonic Anhydrase**

- \( \text{H}_2\text{CO}_3 \) → \( \text{H}_2\text{O} + \text{CO}_2 \)

**Paracellular**

- **Na**
- **K**
- **Cl**
- **H**
- **HCO_3^-**

**Basic Pancreatic Secretions**

- **Na**

**Paracellular**
Alpha-amylase breaks 1:4 linkages except at either end of starch molecules. This results in the production of three simple sugars as shown above.
Overview of Carbohydrate Digestion

- **Starch**
  - Maltose
  - Dextrin
  - Maltotriose
    - **Dextrinase**
    - Glucose

- **Lactose**
  - **Lactase**
  - Glucose
  - Galactose

- **Sucrose**
  - **Sucrase**
  - Glucose
  - Fructose
Overview of Protein Digestion

- **Pepsinogen**
  - **Low pH**
  - **Pepsin**

- **Trypsinogen**
  - **B. B. Enterokinase**
  - **Trypsin**

- **Trypsinogen**
  - **Trypsin**

- **Chymotryp.**
  - **Trypsin**
  - **Chymotrypsin**

- **Proelastase**
  - **Trypsin**
  - **Elastase**

- **Procarboxy.**
  - **Trypsin**
  - **Carboxypeptidase**
Overview of Protein Digestion

Stomach

Proteins

- Amino acids
- Oligopeptides

Small Intestine

Proteins

- Oligopeptides
- Amino acids

B. B. Peptidases

Pepsin

Trypsin, et al.
Overview of Lipid Digestion

Triglycerides
  - Lipases
    - Monoglyceride
    - Fatty Acids

Phospholipids
  - Phospholipase A2
    - Lysolecithin
    - Fatty Acids

Chol. Ester
  - Chol. ester hydrolase
    - Cholesterol
    - Fatty Acids