Key concepts in Digestion IV

The Brain-Gut axis
...gut to brain, brain to gut talk...

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The autonomic nervous system

**Sympathetic system:**
- **Noradrenaline**
  - **ACTION**
    - Gut secretions (+) e.g. acid, enzymes & electrolytes
    - Spinal cord
    - Pons/medulla
    - Midbrain
  - **EFFECTS**
    - Gut sphincters (-) reflex relaxation
    - Pancreas (+) exocrine & endocrine secretion
    - Rectum (+) defaecation

**Parasympathetic system:**
- **Acetylcholine (Ach)**
  - **ACTION**
    - Salivary glands
  - **EFFECTS**
    - (+) secretion of saliva
    - Gut wall
    - Gut sphincters
    - Gut secretions (+) e.g. acid, enzymes & electrolytes
    - Pancreas (+) exocrine & endocrine secretion
    - Rectum (+) defaecation

- **β** (+) secretion of saliva
- **α** (+) vasoconstriction
- **β2** (-) vasodilation
- **β1/2** (-) decrease motility
- **α** (+) contraction sphincters

**Adrenaline**
- (+) secretion
- Adrenal medulla
The enteric nervous system

- Myenteric plexus
- Circular muscle
- Deep muscular plexus
- Submucosal plexus
- Submucosal artery
- Muscularis mucosa
- MUCOSA
- Longitudinal muscle
CNS to gut connections

- Vagal afferent
- Vagal efferent
- Nodose ganglion
- Spinal afferent
- Dorsal root ganglion
- Spinal cord
- Brain stem
The brain-gut axis

**Gut-to-brain**
(afferent neurons)

- autonomic reflexes
- e.g. vago-vagal reflex
  control of gastric tone
- Pain
  - discomfort, bloating etc.
- cyto-protection
  - reflex control of blood flow

**Brain-to-gut**
(efferent neurons)

- “Cephalic phase”
  - thought, smell, taste
    stimulate H⁺
- autonomic reflexes
  - e.g. vago-vagal reflex
    control of gastric tone
Receptive relaxation of the body of the stomach (corpus) in response to a meal.

- CCK & DISTENSION
- Vagal afferent
- Vagal efferent fibres
- Relaxation of corpus to accommodate food
- Satiety effects
- CCK receptors
- Ach
- VIP
- BRAIN STEM
- nodose g.
Cholecystokinin (CCK) cell physiology

- **Fatty acid**
- **Protein**
- **? Other**

**Small intestine lumen**

- **Apical**
- **basolateral**

**I-cell**

**CCK**

**CNS**

- **food intake**
- **gastric emptying**

**pancreas**

**gallbladder**

**Vagus nerve**

**circulation**
CCK: integrator of brain and gut

*Cholecystokinin (CCK)*
*regulates digestion in the small intestine by:*

- stimulating secretion of pancreatic juice
- stimulating gallbladder contraction
- inhibiting gastric emptying and food intake

CCK acts directly on pancreas and gallbladder, and modifies CNS function via the vagus nerve.