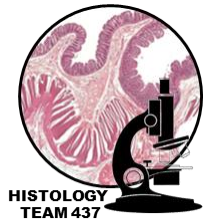
Alimentary Canal (2)
Small intestine



Red: important.
Black: in male|female slides.
Gray: notes|extra.

Editing file

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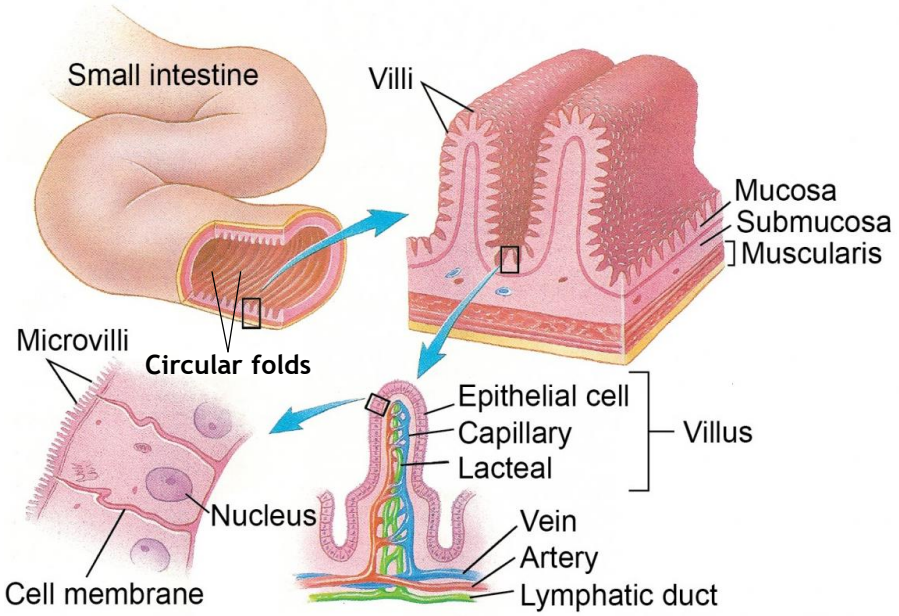
➢ OBJECTIVES

- **Describe the microscopic structure of the three regions of the small intestine:**
  - **Duodenum**
  - **Jejunum**
  - **Ileum**

➢ Small Intestine

- Small intestine (small bowel) is about 20 feet long & about an inch in diameter.
- Its job is to absorb most of the nutrients
- It has 3 regions:
  - **Duodenum** (Shortest| Most important)
  - **Jejunum**
  - **Ileum**
- To increase surface area (400-600 folds) the mucosa has:
  - **Plicae circulares (circular folds)** (2-3 folds): **Permanent folds mucosa & submucosa**
  - **Intestinal crypts (crypts of Lieberkühn)**
  - **Microvilli (Brush border)** (20 folds)
  - **Villi** (10 folds) *All regions of small intestine has villi
- Circular fold & villi make mucosa of small intestine



➢ Mucosa of Duodenum

- **Epithelium:**
  <u>Simple columnar epithelium with goblet cells</u>
- **Lamina propria:** Loose areolar C.T.
- **Muscularis mucosae:** 2 layers of smooth muscle cells

➢ Duodenum

Mucosa	Intestinal villi	is a **finger-like projection** of small intestinal mucosa & it is formed of: ○ **Central core of loose areolar C.T. containing:** • **Lymphocytes** (Macrophage) **| Plasma cells | Fibroblasts |Capillary loops** • **Smooth muscle cells** (few) **| Lacteal** (blindly ending lymphatic channels) ○ **Villus-covering epithelium**
	Cells Covering Villi	**Cells Covering the Villi:** ○ **Surface columnar absorptive cells**: • have brush border (**microvilli**) as proximal convoluted tubule in kidney • covered with **thick glycocalx** that has **digestive enzymes** • have **Junction complex** (**tight**, **adhering** & **desmosome** junctions) ○ **Goblet cells:** Increase toward the ileum (it start to appear in duodenum) ○ **Enteroendocrine** (EE) cells (DNES cells)
	Intestinal Glands (Crypts)*	○ **Simple tubular glands** that open **between villi** ○ Composed of **5 cell types**: • **Columnar absorptive cells**. • **Goblet cells**: secrete **mucus** • **Enteroendocrine** (EE) (DNES) cells: secrete **hormones** • **Paneth cells**: secrete **Lysozyme** (**antibacterial**) found in the **base of the crypts** • **Stem cells**: are **regenerative cells**, are found in the **base of the crypts**
Submucosa		○ Connective tissue containing blood vessels & nerves ○ Contains **Brunner's glands** (**secrete mucus**)
Muscularis Externa		○ **2** smooth muscle layers: • Inner circular layer • Outer longitudinal layer
Serosa / Adventitia		○ Duodenum is invested by a serosa or adventitia

Mechanism of neutralization:
1- Goblet cell secret mucus
2- Brunner's gland secret mucus & alkaline fluids
3- Pancreatic secretion
4- Cells are covered with glycocalyx

*Intestinal gland located in small and large intestine

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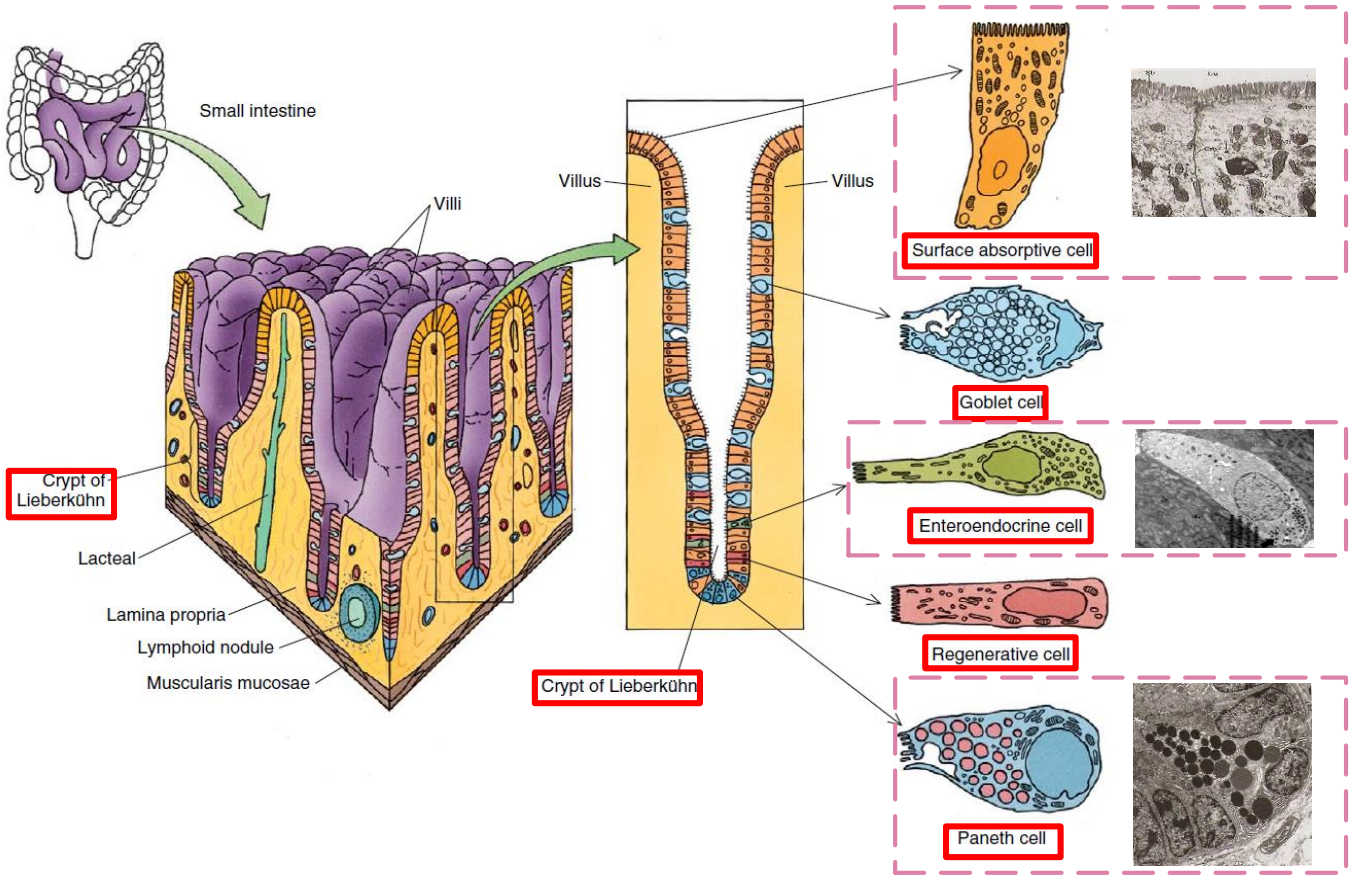
Duodenum

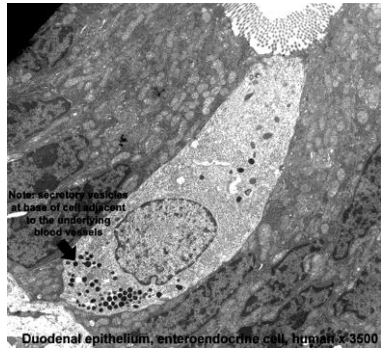

Small intestine
Villi
Villus
Villus
Crypt of Lieberkühn
Lacteal
Lamina propria
Lymphoid nodule
Muscularis mucosae
Crypt of Lieberkühn
Surface absorptive cell
Goblet cell
Enteroendocrine cell
Regenerative cell
Paneth cell


MUCOSA
Villus
Absorptive columnar cell
Goblet cell
Intestinal gland (Crypt of Lieberkuhn)
Paneth cells
Muscularis mucosa
SUBMUCOSA
Brunner's glands
MUSCULOSA Inner circ. layer
Outer long. layer
SEROSA
Mesothelium


Goblet cells
A
Absorptive columnar epithelium

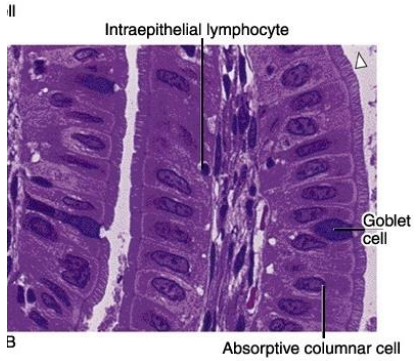
➢ Enteroendocrine EE (DNES) cells

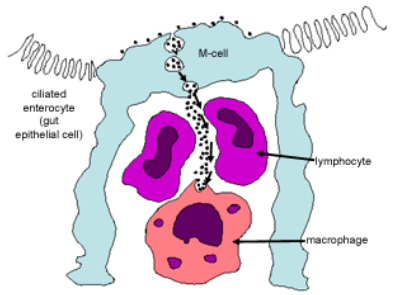
- **EC cells:** Secrete **endorphin** & **serotonin**
- **S cells:** Secrete **secretin**
- **D cells:** Secrete **somatostatin**
- **A cells:** Secrete **glucagon**
- **Mo cells:** Secrete **motilin**
- **CCK-PZ cells:** Secrete **cholecystokinin** (pancreozymin)



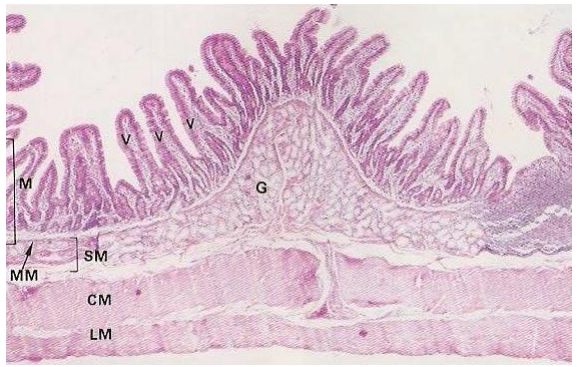
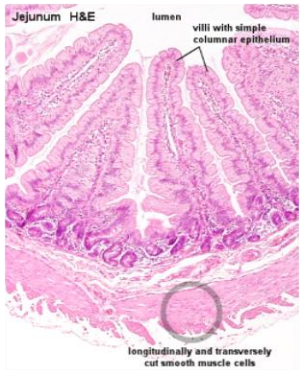
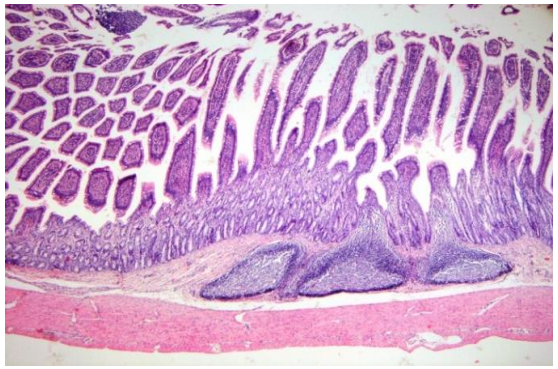
➢ M Cells (Microfold cells)

- They are mainly found within the **intestinal epithelium** overlying **lymphatic nodules** of **lamina propria**
- Each is a **dome-shaped cell** (or **specialized squamous cell**) with a **basal concavity** that contains **intraepithelial lympocytes** and **macrophages**
- They **phagocytose** and **transport antigens** present in the intestinal lumen to the underlying lymphoid tissue cells to initiate the **immune response** to these **antigens** leading to the **secretion of IgA**





➢ Regional differences of small intestine

Duodenum	Jejunum	Ileum
• Its **submucosa** has **Brunner's glands** • It is invested by **serosa or adventitia**	• has neither Brunner's glands nor Peyer's patches (Not has) • Jejunum is invested by **serosa**	• Its lamina propria, opposite the **attachment of the mesentery** • has **lymphoid nodules** (Peyer's patches) that extend to the submucosa • Ilium is invested by **serosa**
		

*All small intestine have **serosa** except 2nd & 3rd part of duodenum

➢ QUESTIONS:

Q1: Which type of **esophageal mucosa (epithelial lining)?**

a) Stratified squamous epithelium
b) Simple squamous epithelium
c) keratinized stratified squamous epithelium
d) Non keratinized stratified squamous epithelium

Q2: To **increase surface area** the mucosa has?

a) Permanent folds of the mucosa & submucosa
c) Villi & Microvilli (Brush border)
b) Intestinal crypts (crypts of Lieberkühn)
d) All of them

Q3: Which of the following cells can **secrete hormones**?

a) Goblet cells
b) Enteroendocrine
c) Paneth cells
d) Stem cells

Q4: Which of the following cells found in **base** of the **crypts** ?

a) Columnar absorptive cells
b) Stem cells
c) Paneth cells
d) B & C

Q5: Which of the following **layers** have **Brunner's glands**?

a) Mucosa
b) submucosa
c) Muscularis Externa
d) serosa

1- D
2- D
3- B
4- D
5- B

Q6: How many **Muscularis externa layers** in **duodenum**?

a) Three b) Four c) Two d) One

Q7: Which of the following cells **secrete somatostatin**?

a) EC cells b) S cells c) D cells d) Mo cells

Q8: **M cells** ultimately lead to the **secretion of**?

a) IgA b) IgG c) IgM d) IgE

Q9: Which of the following is **secreted by A cells**?

a) Endorphin b) Glucagon c) Motilin d) Cholecystokinin

Q10: Which region of small intestine neither has Brunner's glands nor Peyer's patches?

a) Ilium b) Colon c) Duodenum d) Jejunum

10- D
9- B
8- A
7- C
6- C

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