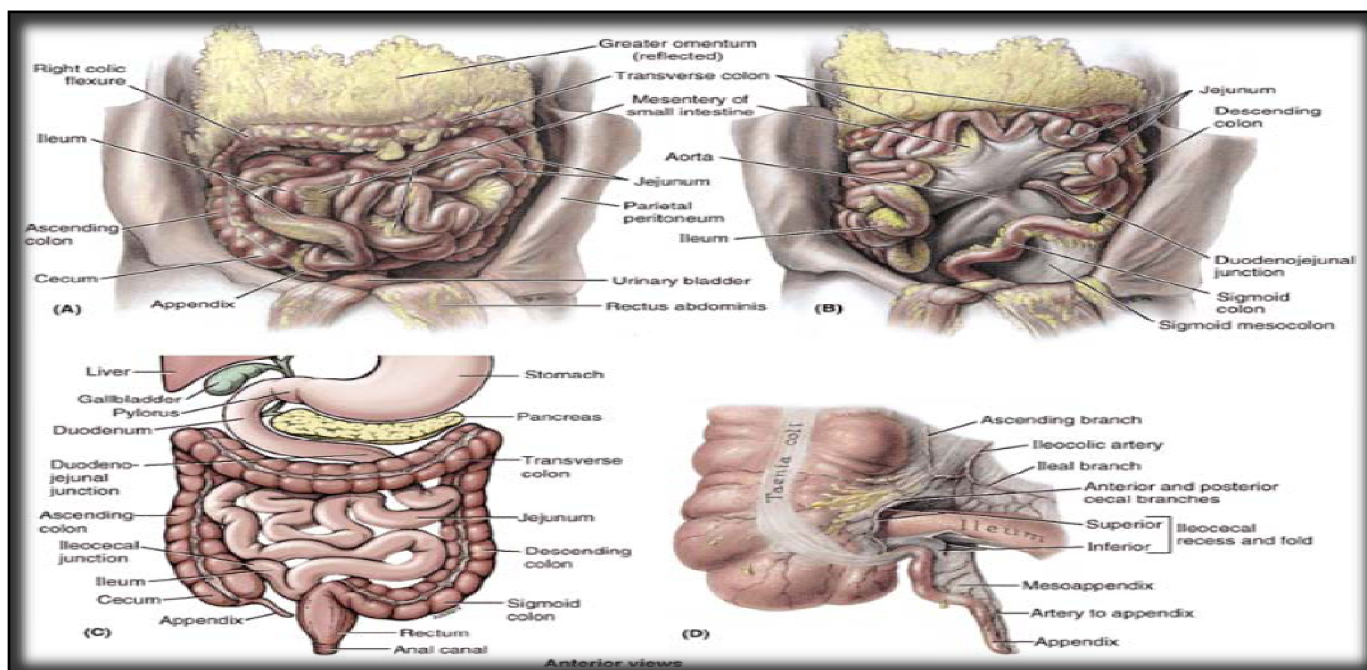




# GI ANATOMY PART 3 THE INTESTINAL SYSTEM

D.HAMMOUDI.MD



INTESTINE

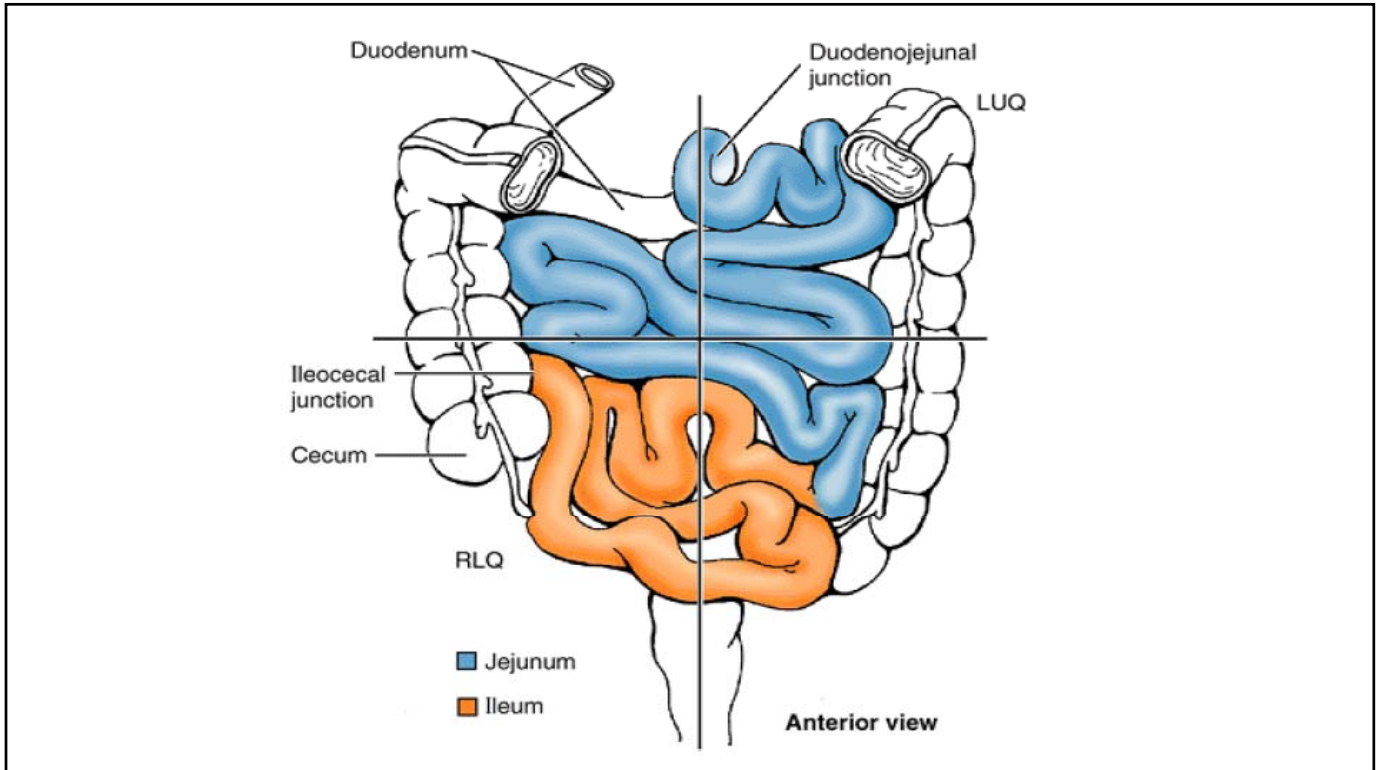
# Small Intestine

- 3 parts:
  1. **Duodenum** – 1<sup>st</sup> part- shortest part
  2. **Jejunum** – 2<sup>nd</sup> part – longest
  3. **Ileum** – 3<sup>rd</sup> part
- **Mesentery** – parietal membrane that covers the small and large intestine supplying nerves and blood to this region

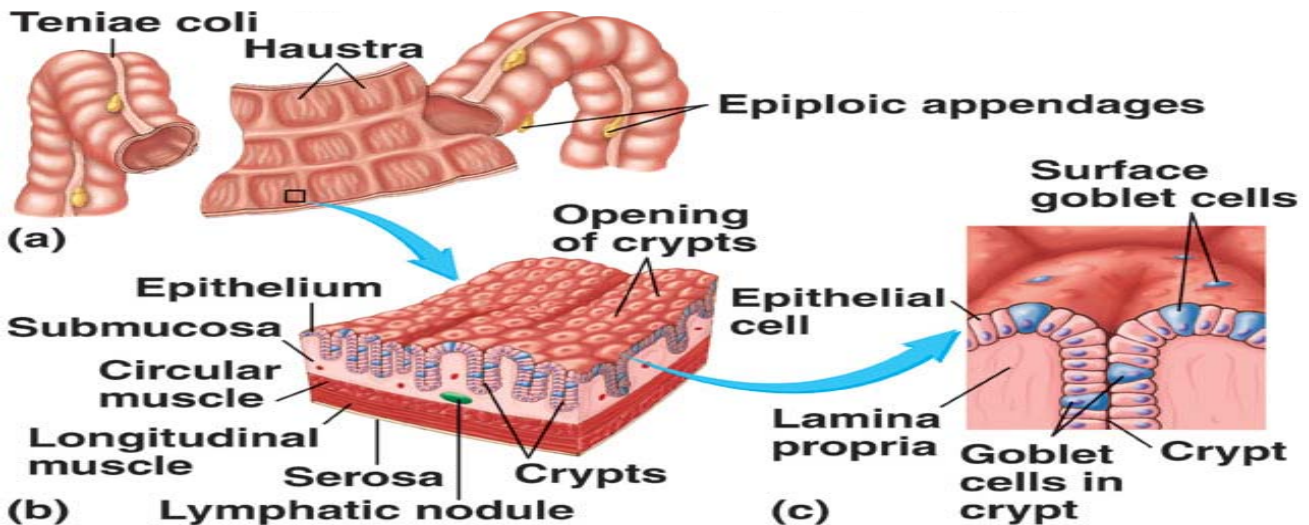


Distinguishing Characteristics of Jejunum and Ileum in Living Persons

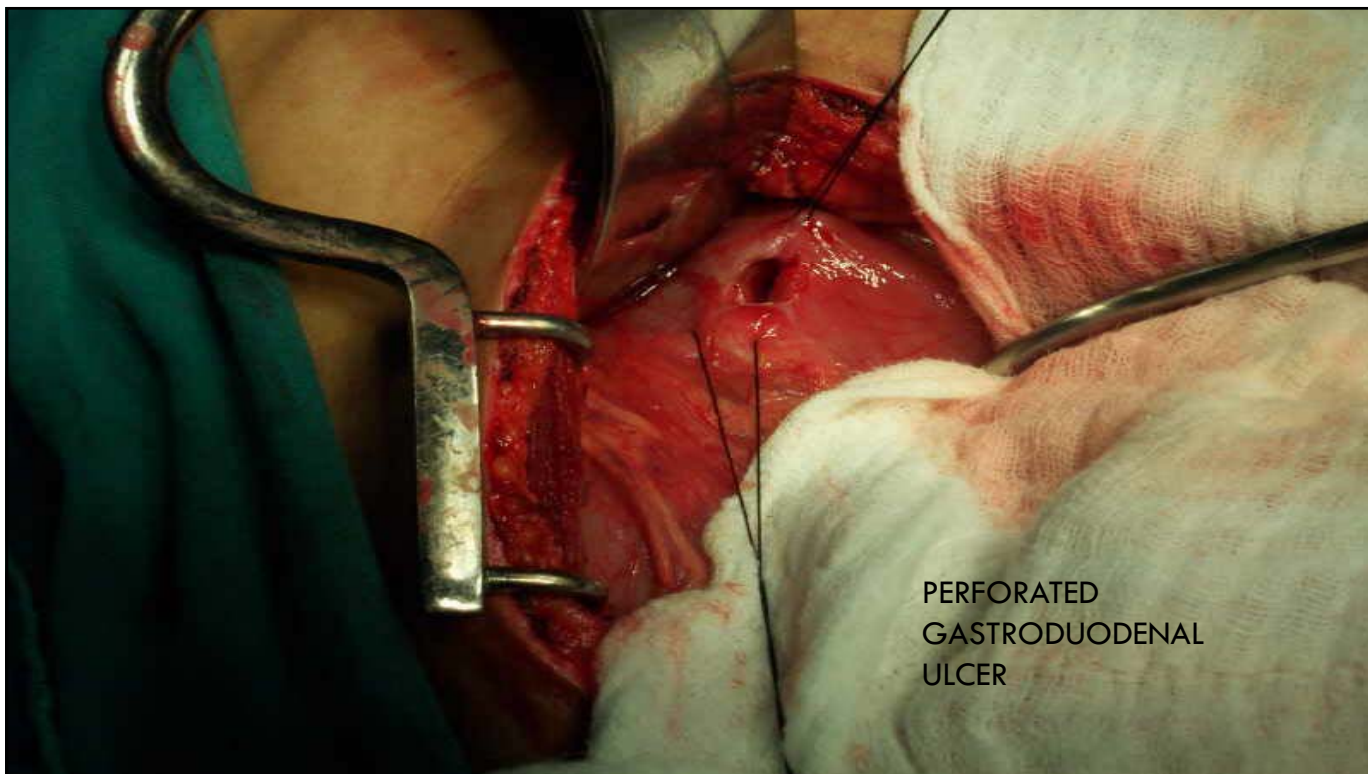
Characteristic	Jejunum	Ileum
Color	Deeper red	Paler pink
Caliber	2â€”4 cm	2â€”3 cm
Wall	Thick and heavy	Thin and light
Vascularity	Greater	Less
Vasa recta	Long	Short
Arcades	A few large loops	Many short loops
Fat in mesentery	Less	More
Circular folds ( <i>L. plicae circulares</i> )	Large, tall, and closely packed	Low and sparse; absent in distal part
Lymphoid nodules (Peyer patches)	Few	Many



- Teniae coli: three thickened bands of longitudinal muscle fibers.
- Haustra: sacculations or pouches of the colon between the teniae.
- Omental appendices: small, fatty appendices (projections) of colon.
- Caliber: the internal diameter is much larger.









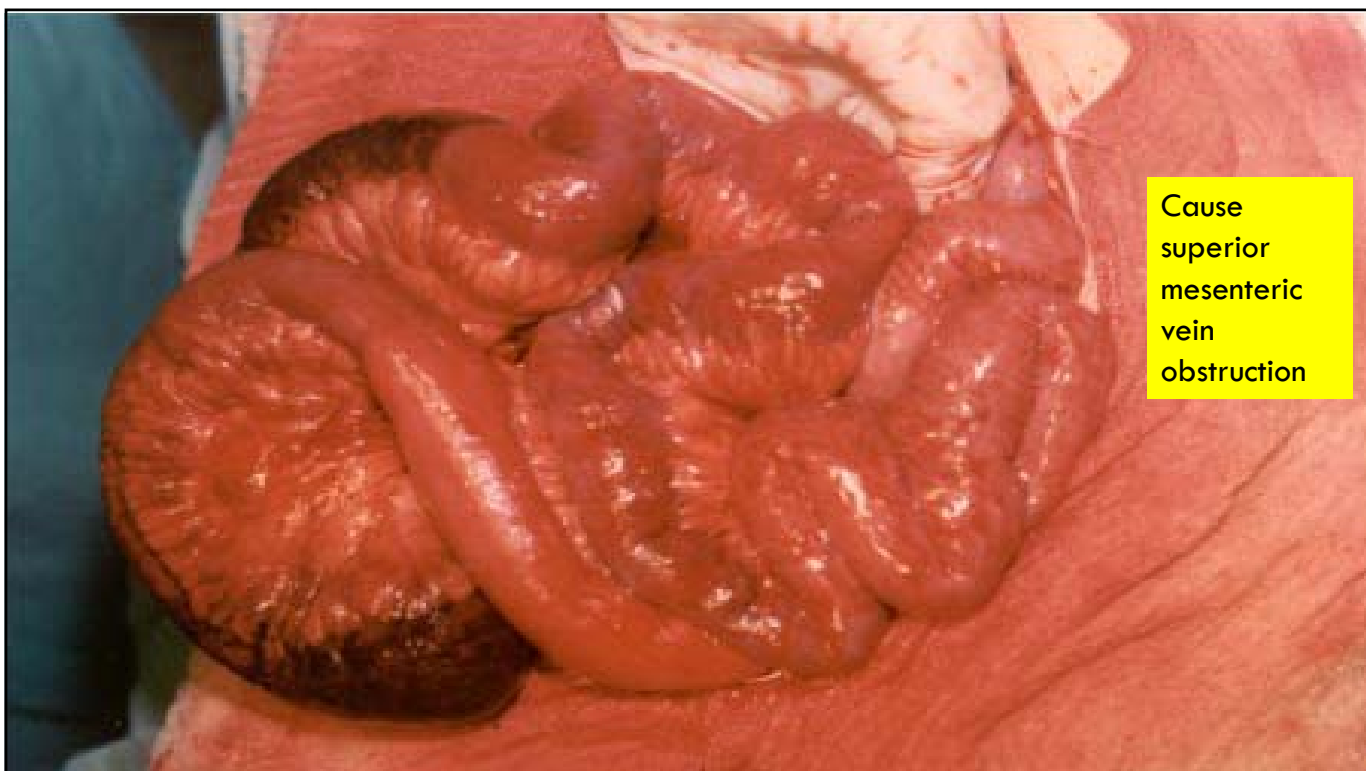
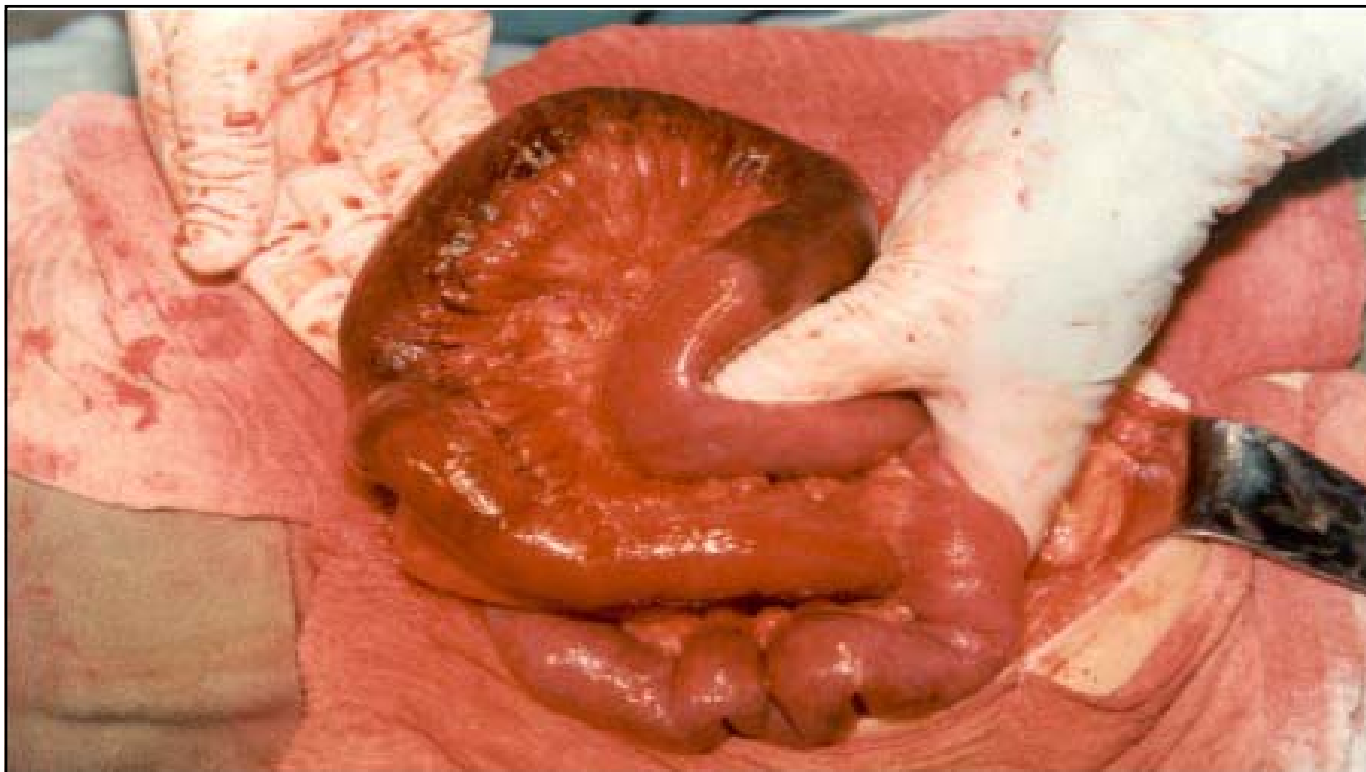


Perforated colon cancer

This was a cancer of the hepatic flexure which perforated, producing a bacterial peritonitis with abundant free bile as well.

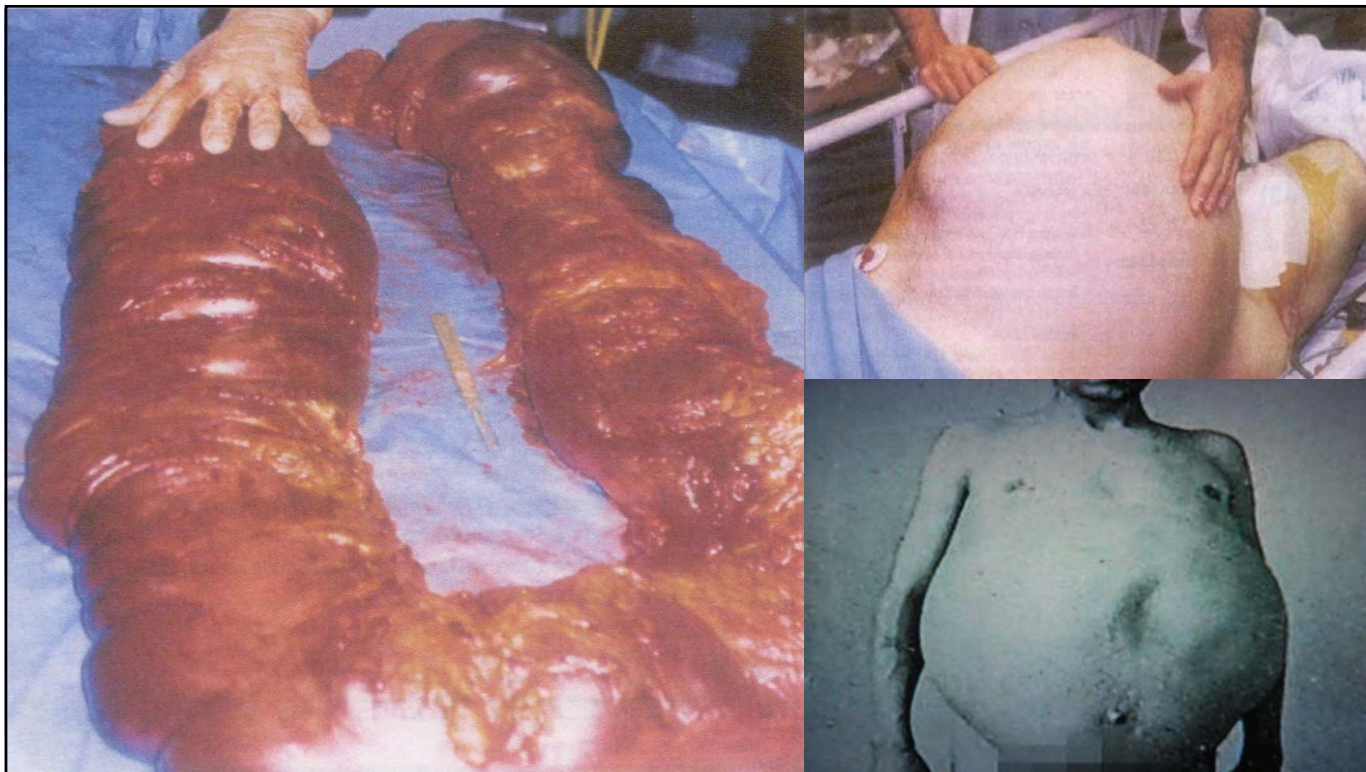


Intestinal ischemia



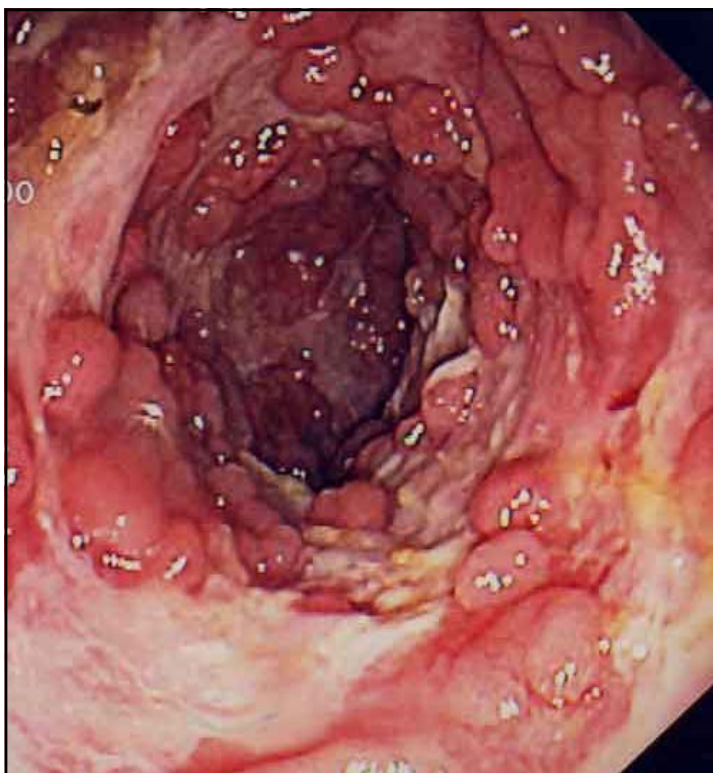
Cause  
superior  
mesenteric  
vein  
obstruction



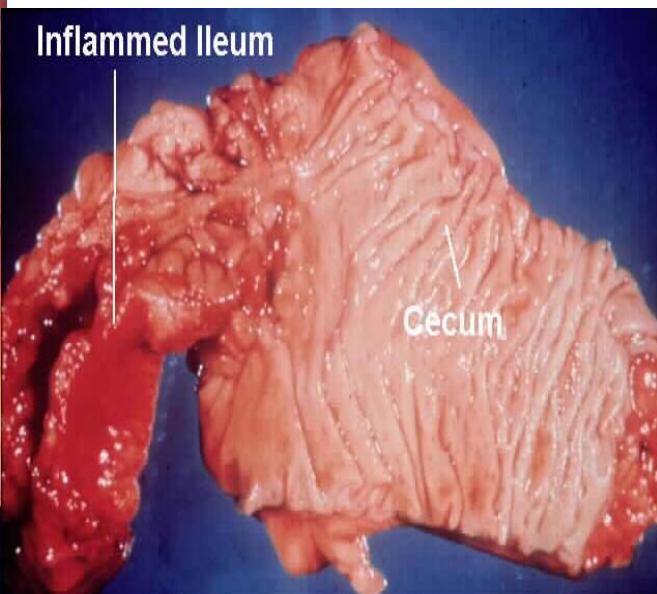


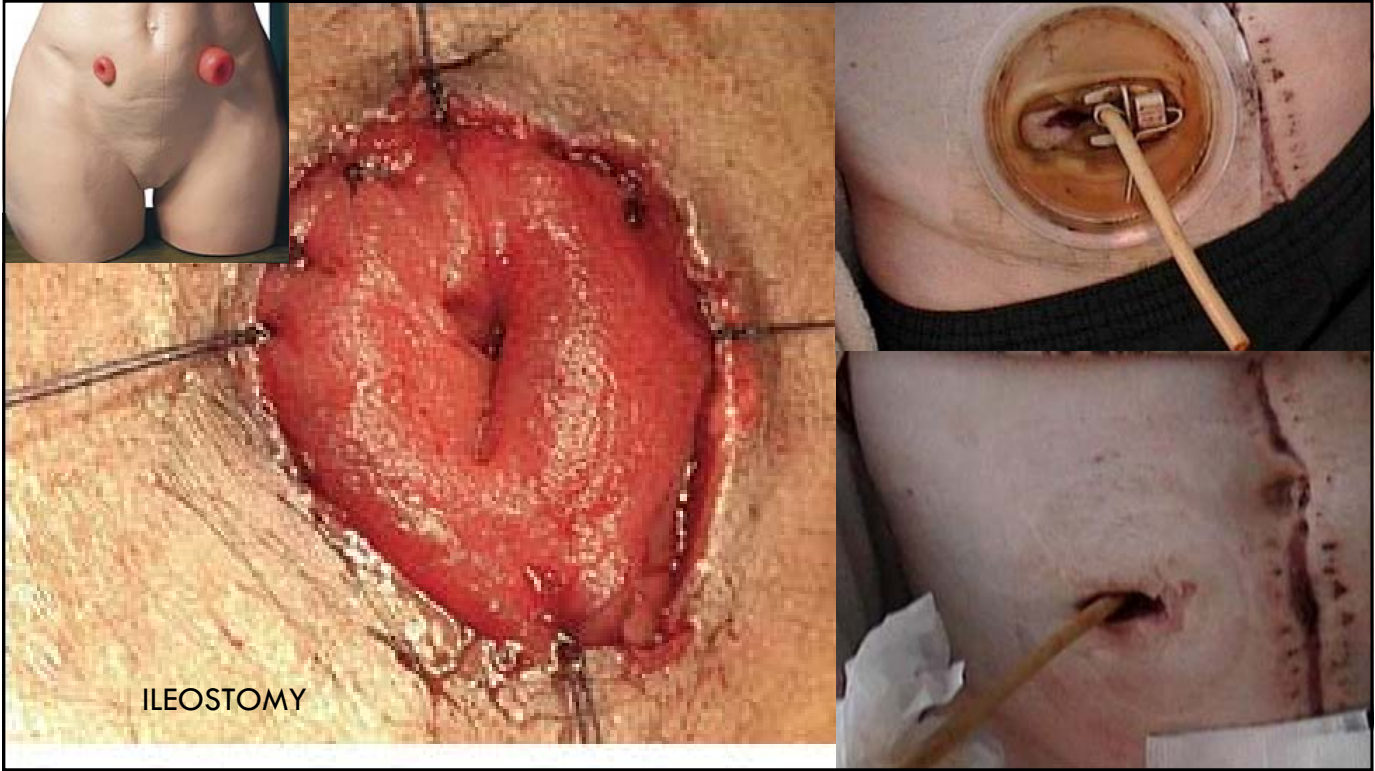
Megacolon at the Mutter museum philadelphia





CROHN DISEASE





## The Colon

**(a)**

- Right colic (hepatic) flexure
- Transverse colon
- Superior mesenteric artery
- Haustrum
- Ascending colon
- Ileum
- Ileocecal valve
- Cecum
- Vermiform appendix
- Rectum
- Anal canal

*The lips of the valve protrude into the cecum preventing backflow.*

- Left colic (splenic) flexure
- Transverse mesocolon
- Epiplioic appendages
- Descending colon
- Cut edge of mesentery
- Teniae coli - bands of longitudinal muscle
- Sigmoid colon
- External anal sphincter

This bend together with a thickening of the muscularis helps keep the rectum free of feces after defecation.

**Fecal pressure stimulates involuntary sphincter relaxation, and mitil contraction of rectal muscles.**

**Defecation reflex relaxes external sphincter and contracts rectal and abdominal muscles.**

**Mesocolon**

**(b)**

- Rectal valve
- Floctum
- Hemorrhoidal veins
- Levator ani muscle
- Anal canal
- External anal sphincter
- Internal anal sphincter
- Anal columns
- Anal sinuses
- Anus

From cerebral cortex (conscious) control

Voluntary motor nerve to external anal sphincter

Defecation reflex relaxes external sphincter and contracts rectal and abdominal muscles.

External anal sphincter (skeletal muscle)

**(c)**

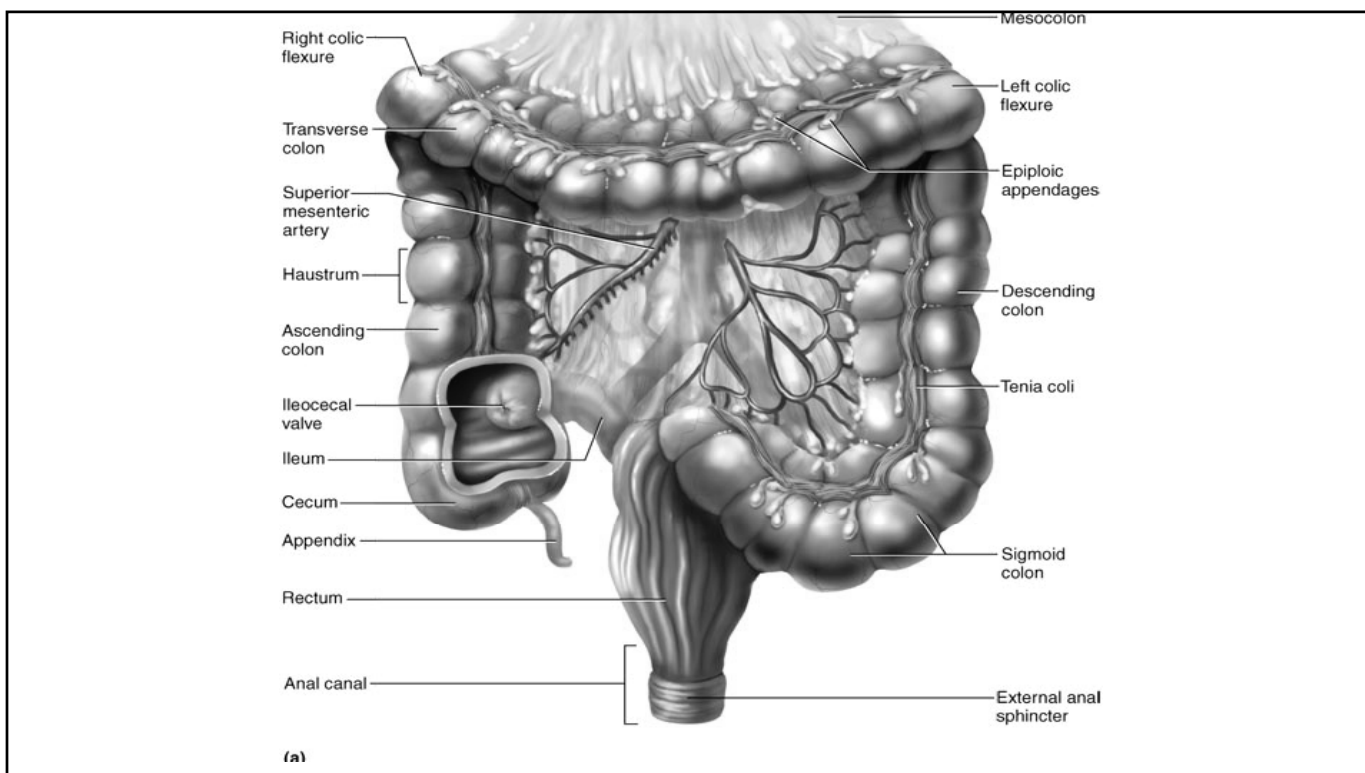
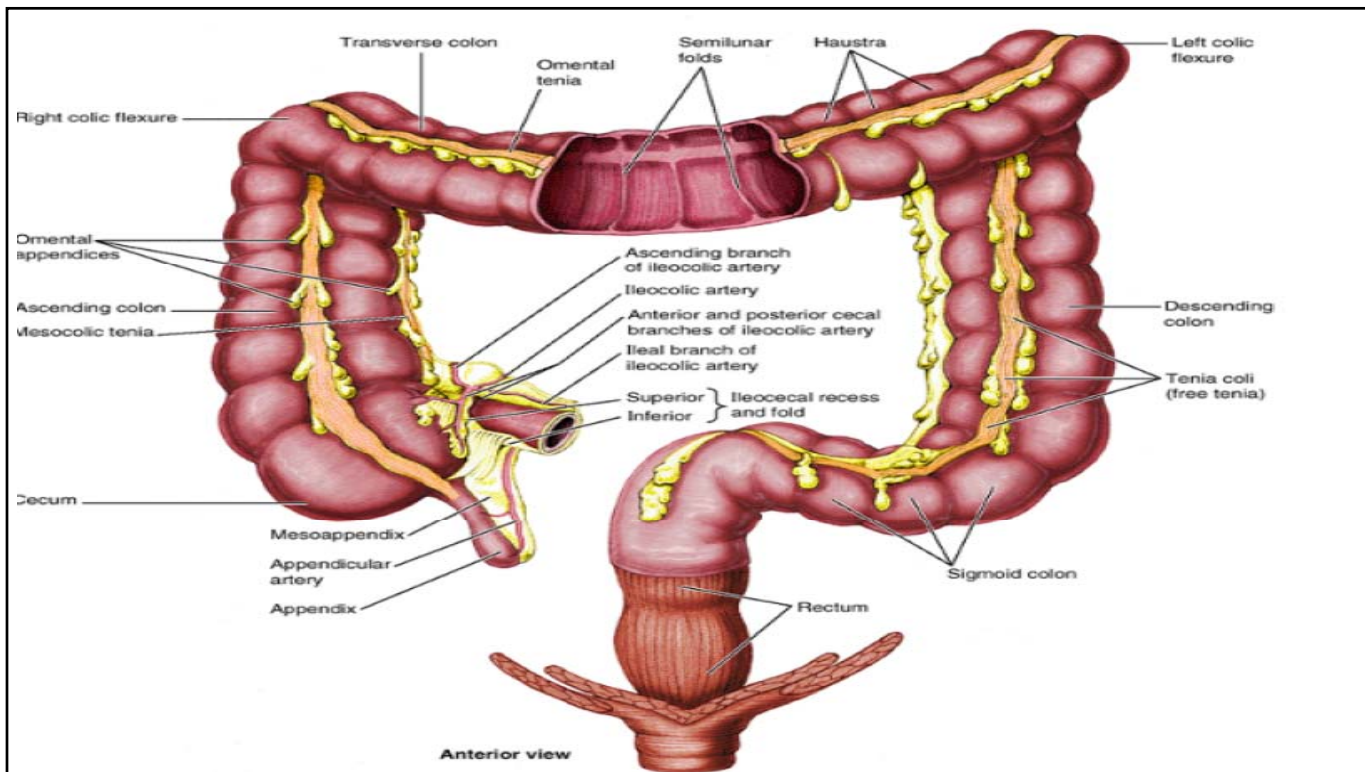
involuntary motor nerve parasympathetic division

Internal anal sphincter (smooth muscle)

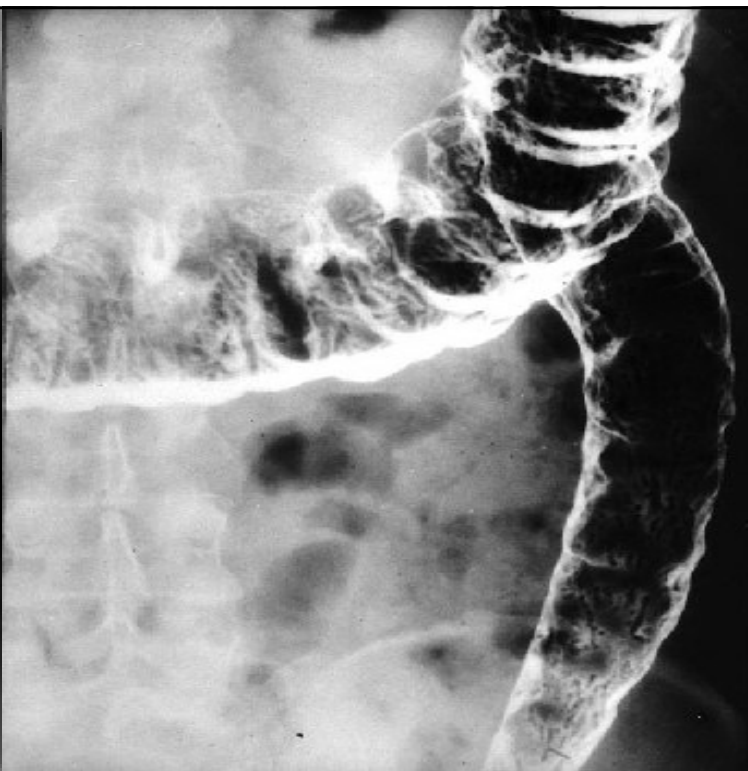
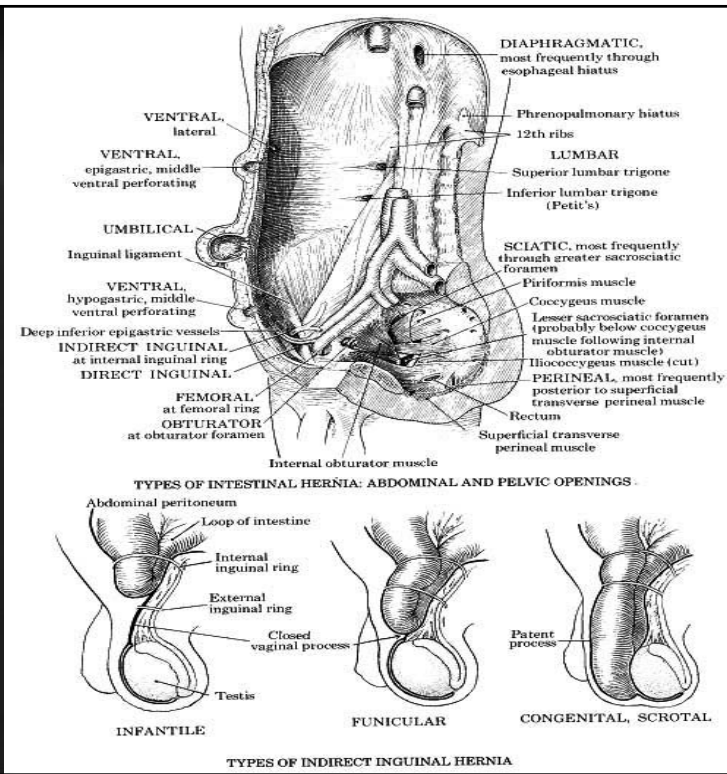
- ILEOCOEC ARTERY
- ILEAL BRANCH
- CECIC BRANCH
- SUPERIOR MESPENTERIC ARTERY
- POSTERIOR CECAL ARTERY
- APPENDICULAR ARTERY
- ANTERIOR CECAL ARTERY
- ILEOCOEC FOLD (SUPERIOR ILEOCOECAL FOLD)
- ILEOCOEC FOSSA (SUPERIOR ILEOCOECAL FOSSA)
- ILEOCAL FOLD (INFERIOR ILEOCOECAL FOLD; BLOODLESS FOLD OF PEREUS)
- ILEOCOEC FOSSA (INFERIOR ILEOCOECAL FOSSA)
- MESO-APPENDIX
- APPENDICULAR ARTERY
- RETROCECAL FOSSA
- RETROCECAL FOLDS
- RETROCECAL FOLD (CECIC FOLD)
- RIGHT PARACOEIC OUTFER
- ANTERIOR PRES. TAENIA (TAENIA TERRAL)
- APPENDICULAR ARTERY
- DORSOMEDIAL (MESOCOIC) TAENIA
- DORSOLATERAL (DORSAL) TAENIA
- POSTERIOR CECAL ARTERY
- RETROCECAL FOLDS
- RETROCECAL FOSSA

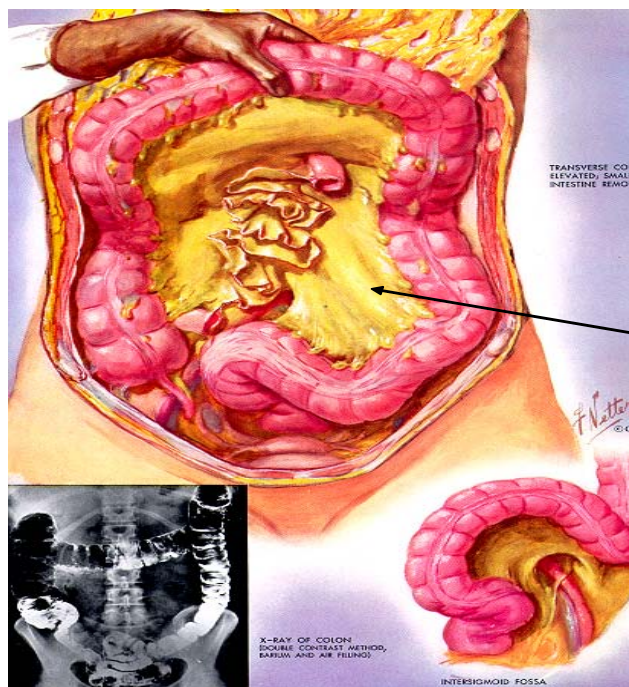
*F. Netter M.D. © CIBA*



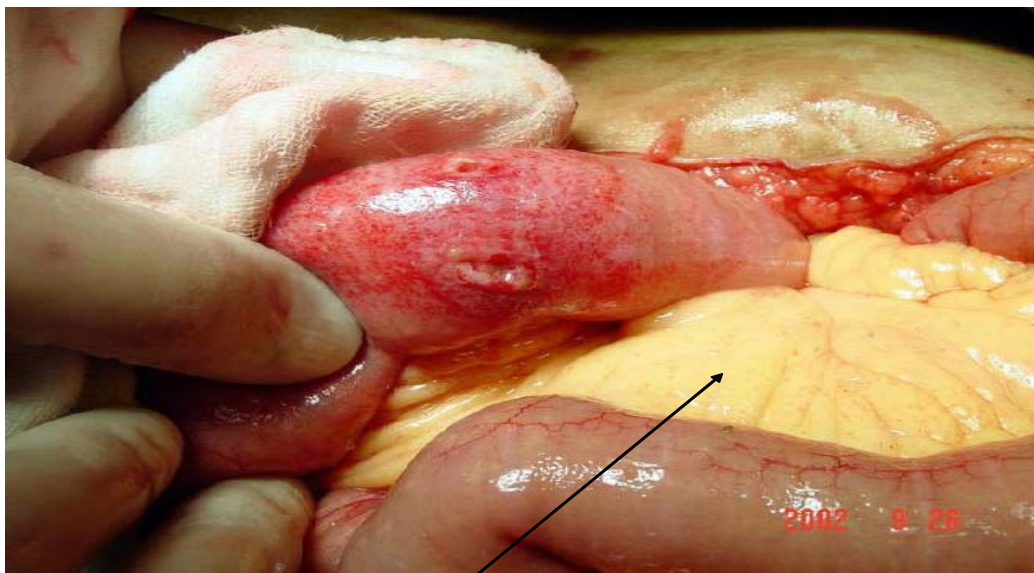




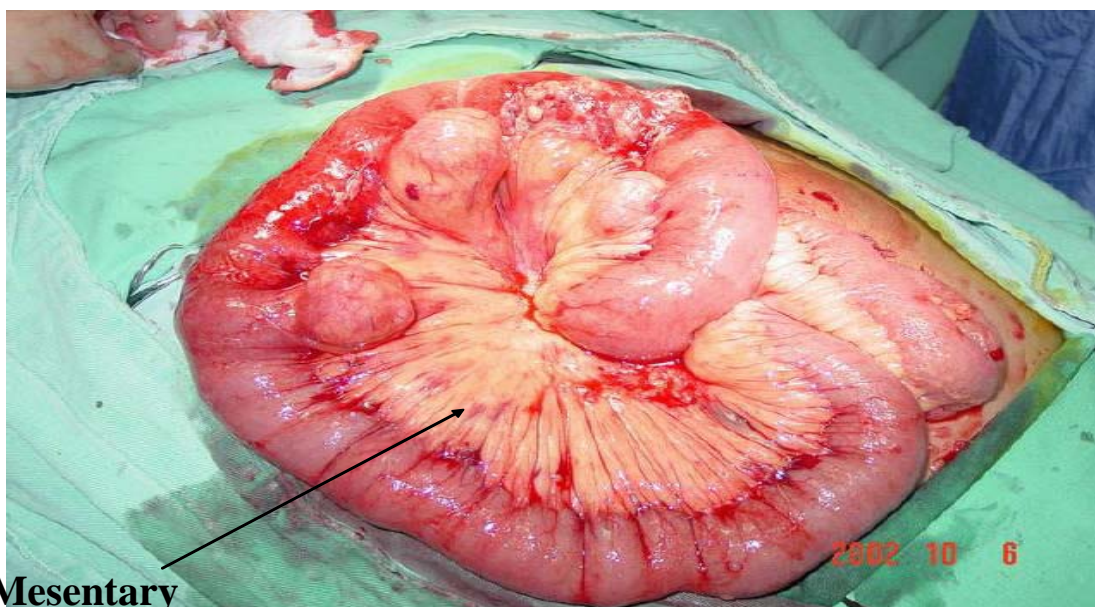




Mesocolon



**Mesentary**



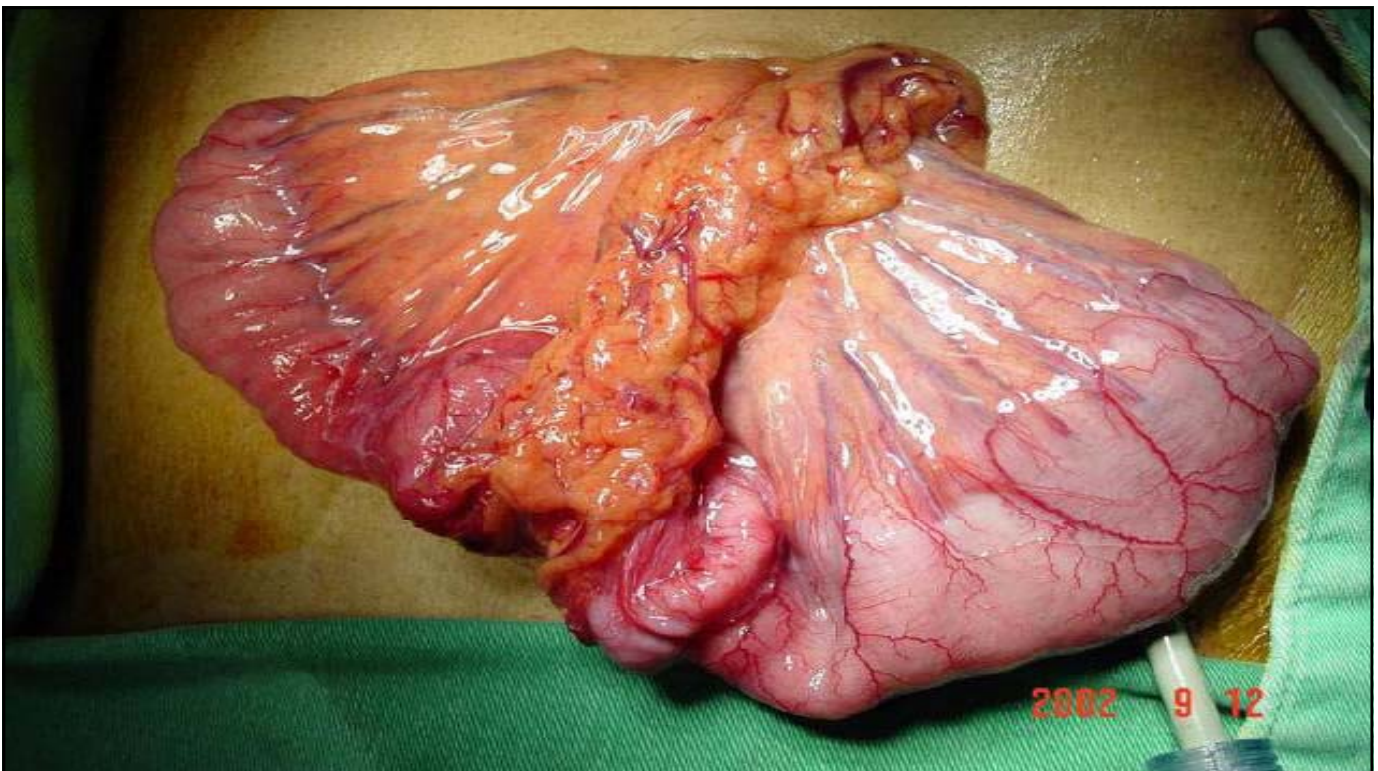
**Mesentary**

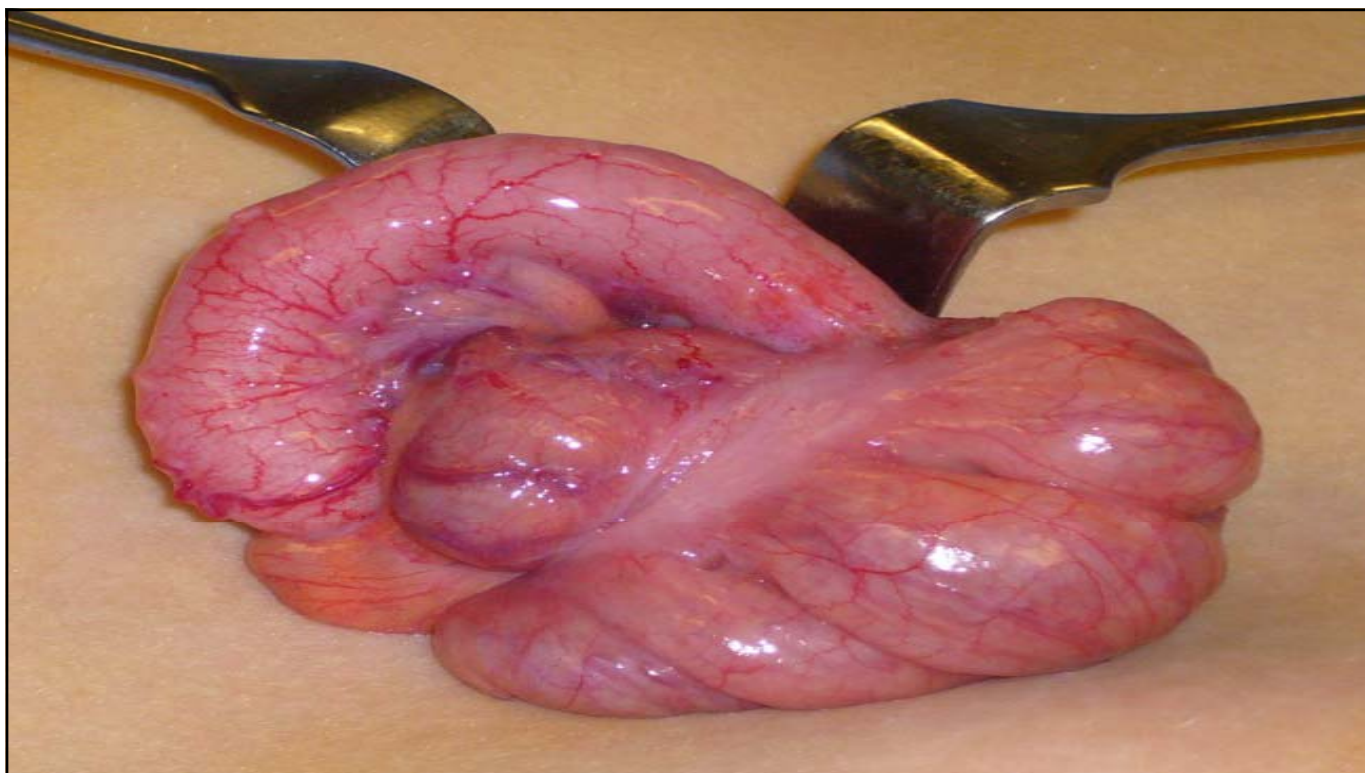
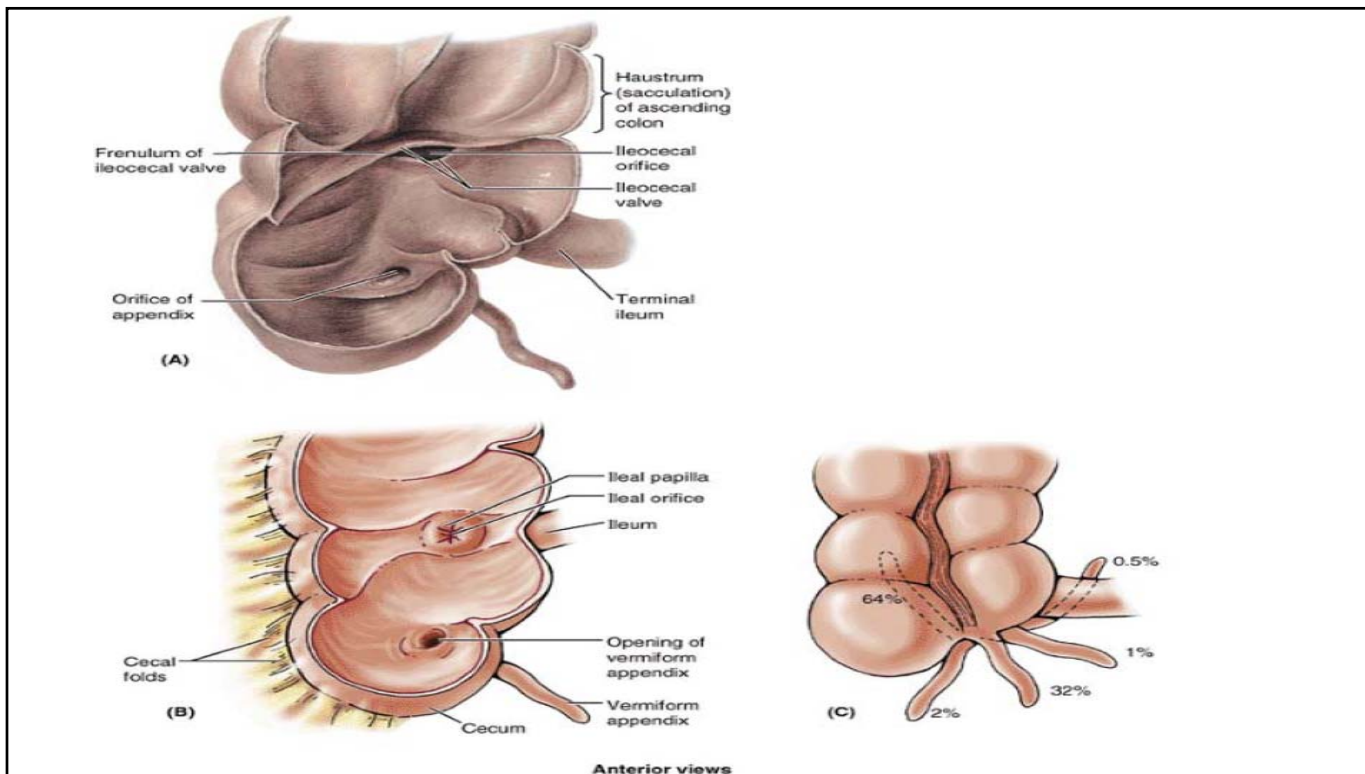


## Mesentery

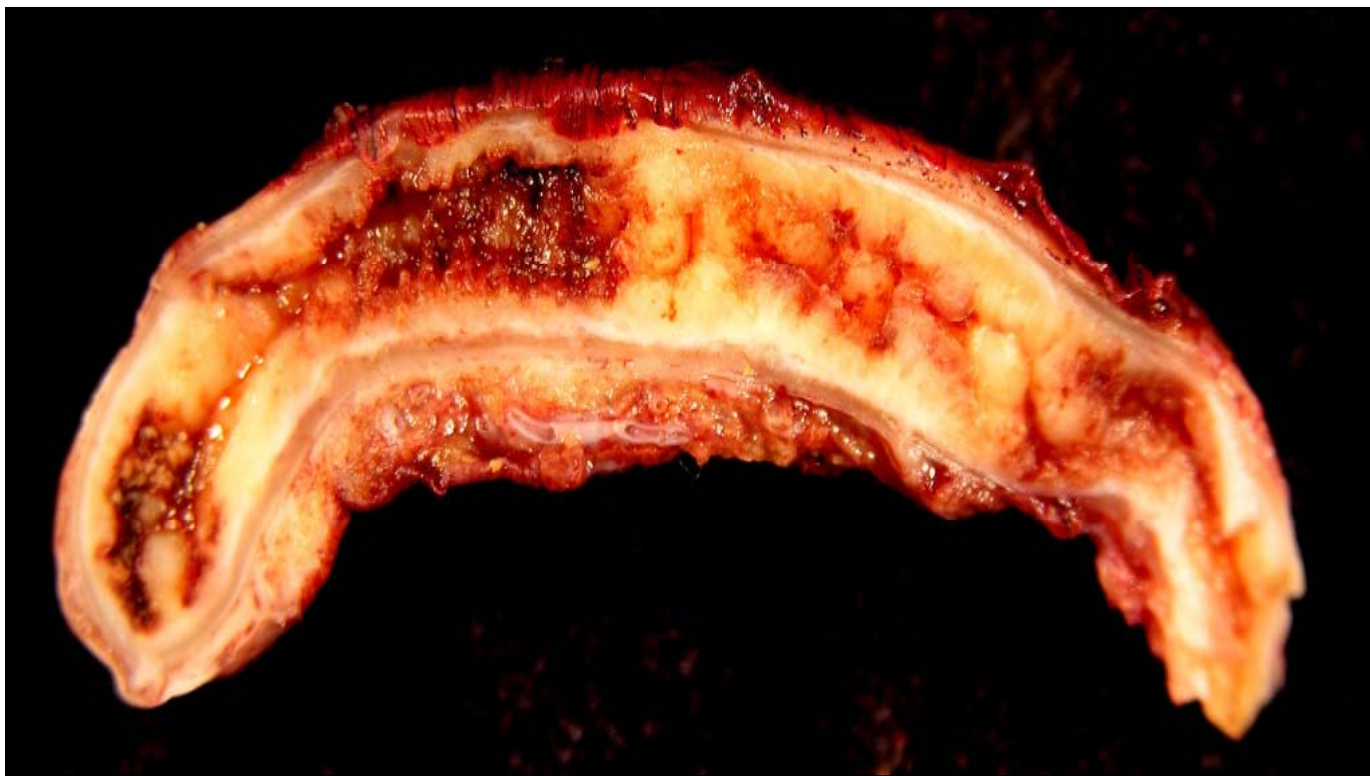


Seen here is a loop of bowel attached via the mesentery. Note the extent of the veins. Arteries run in the same location. Thus, there is an extensive anastomosing arterial blood supply to the bowel, making it more difficult to infarct. Also, the extensive venous drainage is incorporated into the portal venous system heading to the liver.

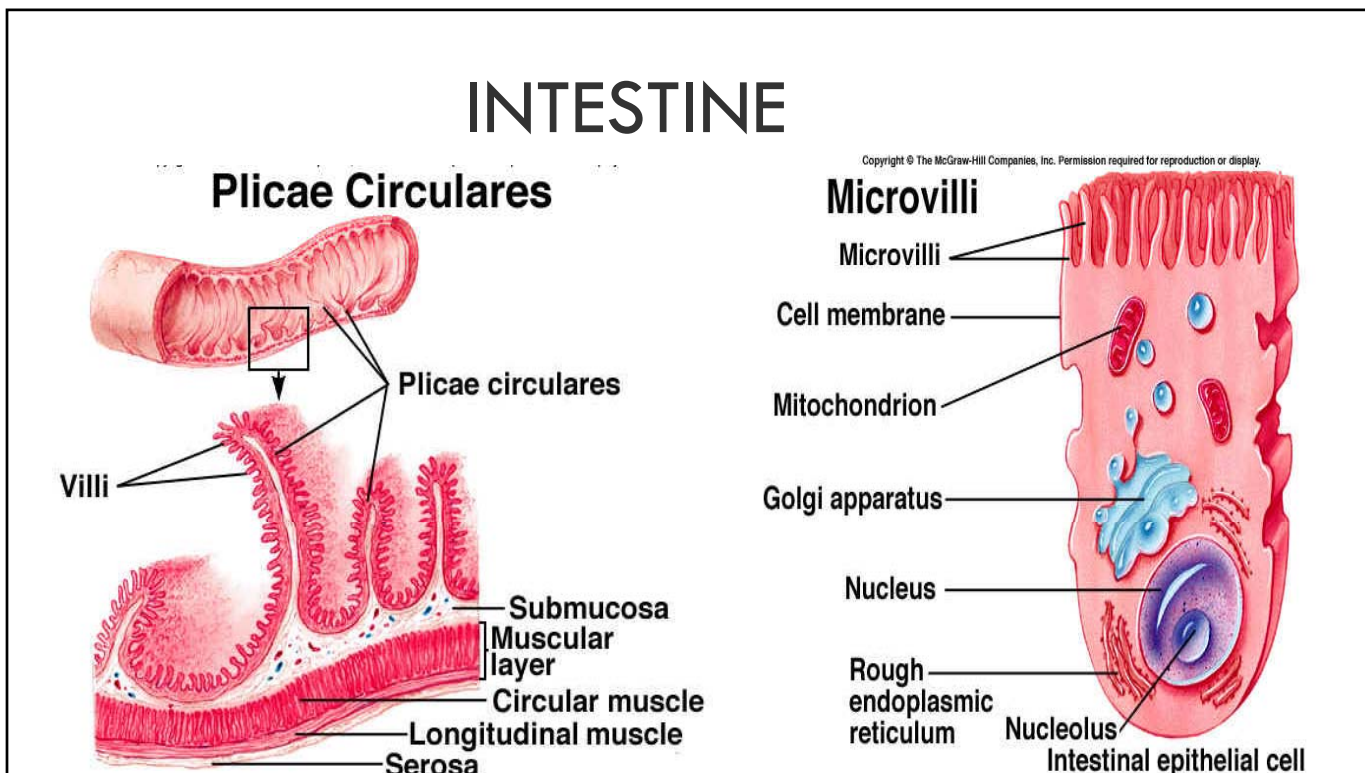
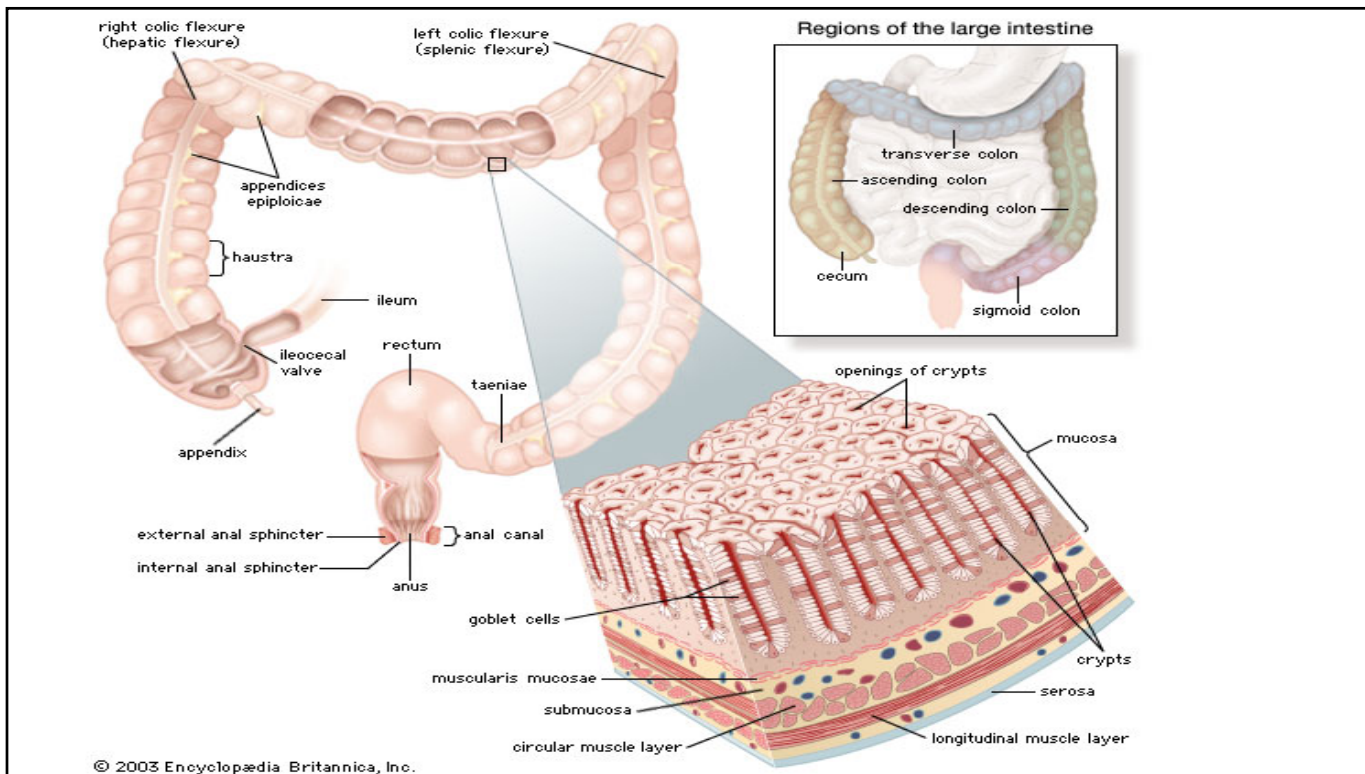






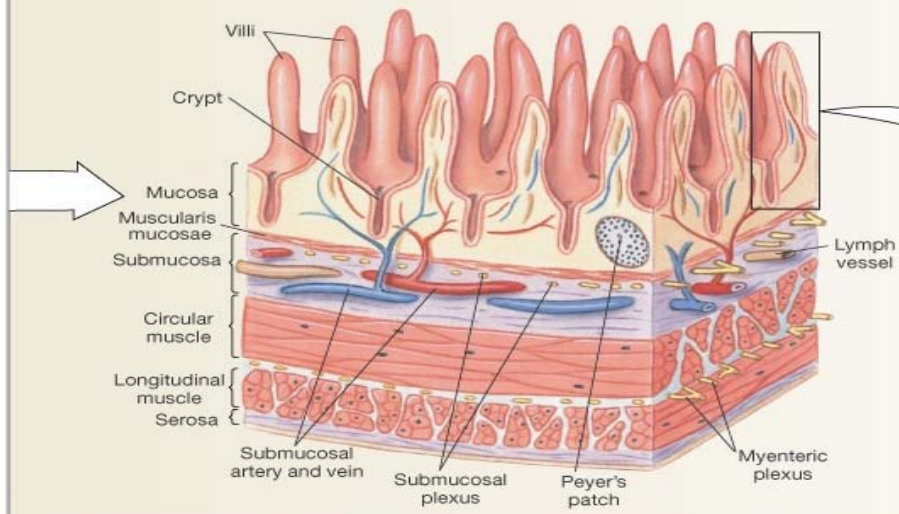




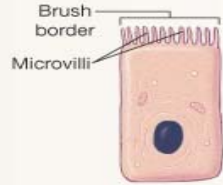


SECTIONAL VIEWS OF THE STOMACH AND INTESTINE

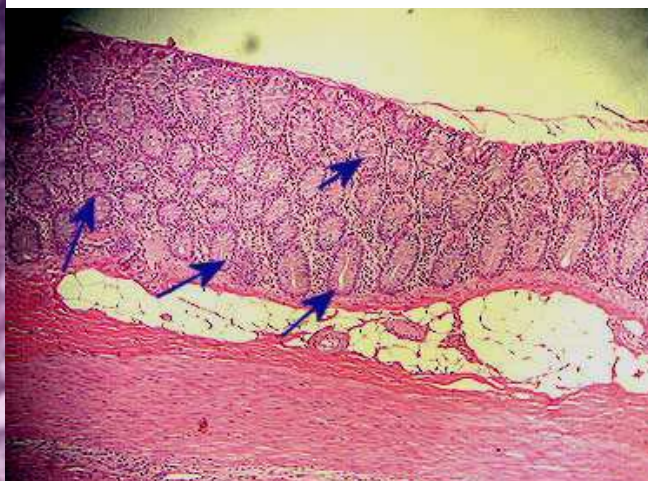
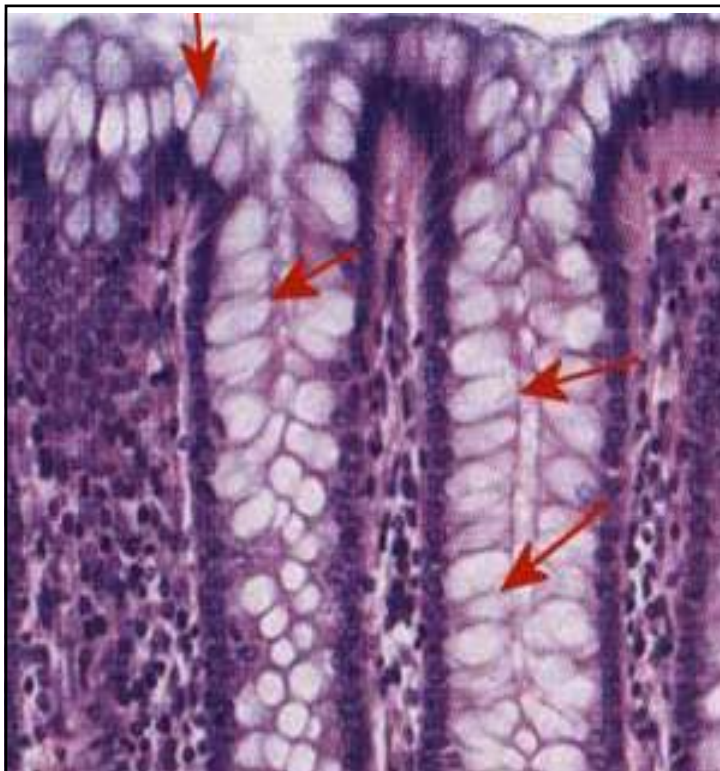
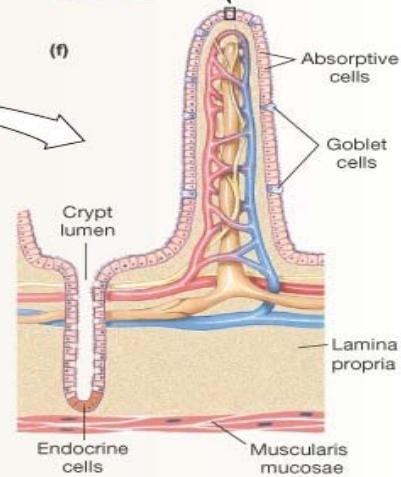
(e) Intestinal surface area is enhanced by finger-like villi.



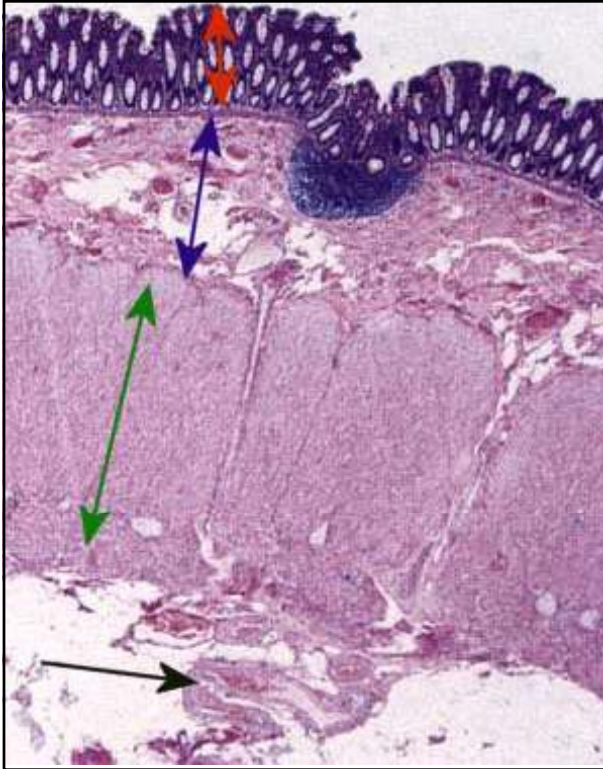
(g) Absorptive cell



(f)







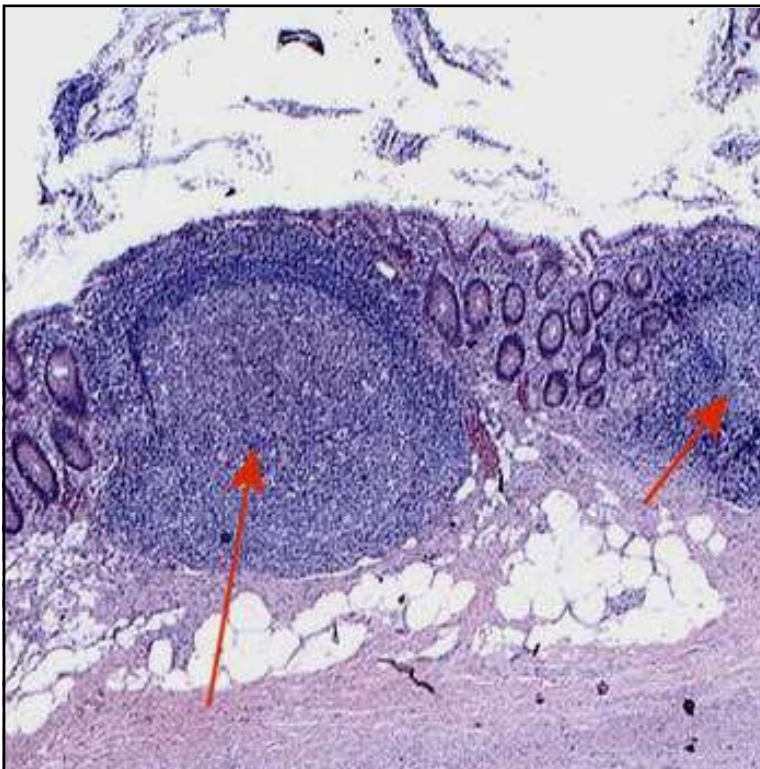
### Colon (taenia coli)

Red arrow - Mucosa

Blue arrow - Submucosa

Green arrow - Muscularis Externa

**Black arrow** - Taenia coli

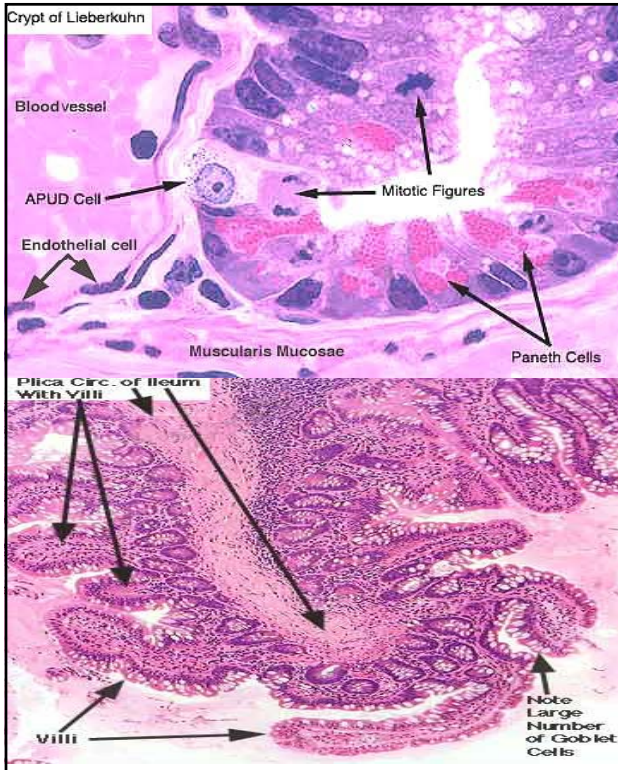


**Appendix.** There are three clues to identifying the Appendix.

- 1) Presence of Dense lymphoid tissue (red arrow)
- 2) Lack of villi, and very flat surface
- 3) fecal matter (stuff that looks like crud) in the lumen. If you see these three things, which are all see in this image, you know you are in the Appendix.

Red arrow - Lymphoid tissue





### **Mucosa**

**Plica Circularis** - Folds in mucosa and submucosa

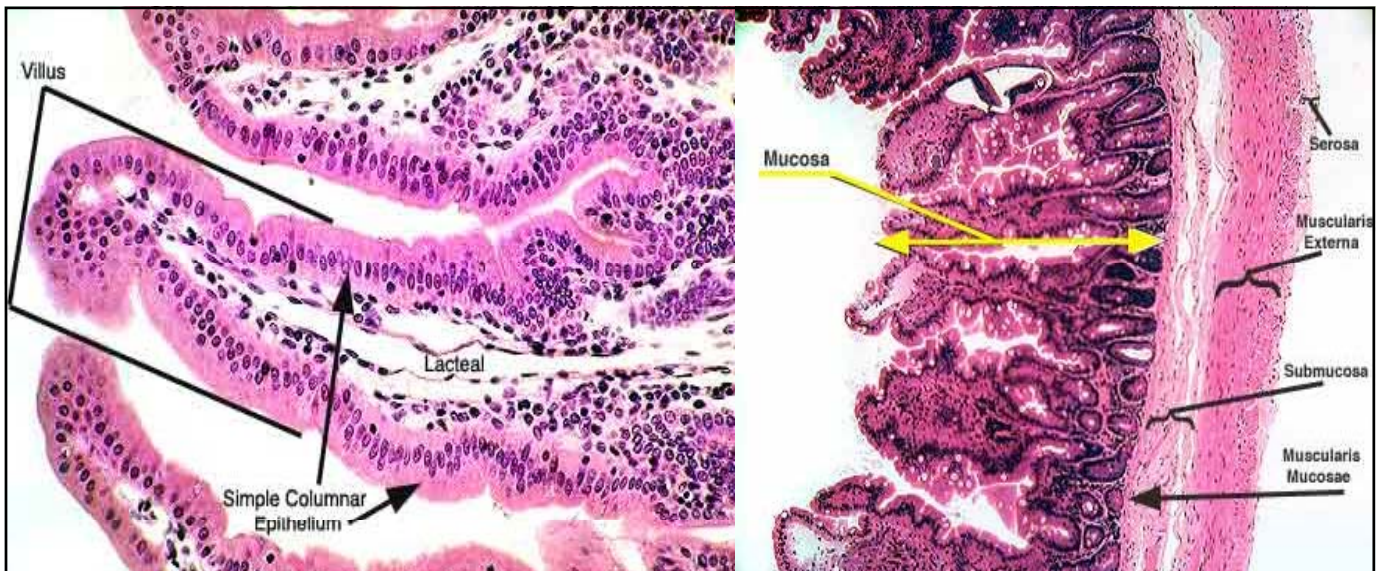
**Villi** - mucosal projections

**Columnar epithelium** - with increasing numbers of Goblet cells as it approaches the large intestine

**Crypts of Lieberkuhn** (intestinal glands)-

**Paneth cells** - eosinophilic, granular cells at base of intestinal glands of Lieberkuhn

**Enteroendocrine cells** (APUD cells)



**Villus** in the duodenum showing the **simple columnar epithelium** on the surface and the **lacteal** running down the center of the villus surrounded by **lamina propria**.

### **Submucosa**

**Submucosal (Meissner's) plexus** (found scattered in the submucosa)

•**Muscularis Externa**

inner circular smooth muscle layer  
outer longitudinal smooth muscle layer

•**Myenteric (Auerbach's) plexus** (found between the two layers of the muscularis externa)

**Serosa**

Connective tissue of mesentery or peritoneum is found on the outermost surface of the digestive tube within the peritoneal cavity. Mesothelium lines the outer surface of the parts that are not retroperitoneal.

As you look through the slides, be thinking of the four basic layers and how their components may differ from one part of the small intestine to the other.

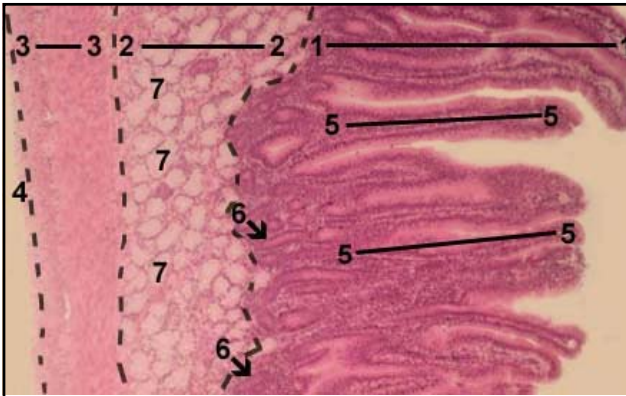
The nerves of the small intestines are derived from the plexuses of parasympathetic nerves around the superior mesenteric artery.

From this source they run to the **myenteric plexus (Auerbach's plexus)** of nerves and ganglia situated between the circular and longitudinal muscular fibers from which the nervous branches are distributed to the muscular coats of the intestine.

From this a secondary plexus, the **plexus of the submucosa (Meissner's plexus, Submucous plexus, submucosal plexus)** is derived, and is formed by branches which have perforated the circular muscular fibers. This plexus lies in the submucous coat of the intestine; it also contains ganglia from which nerve fibers pass to the muscularis mucosae and to the mucous membrane.

The nerve bundles of the submucous plexus are finer than those of the myenteric plexus. Its function is to innervate cells in the epithelial layer and the smooth muscle of the (muscularis externa).

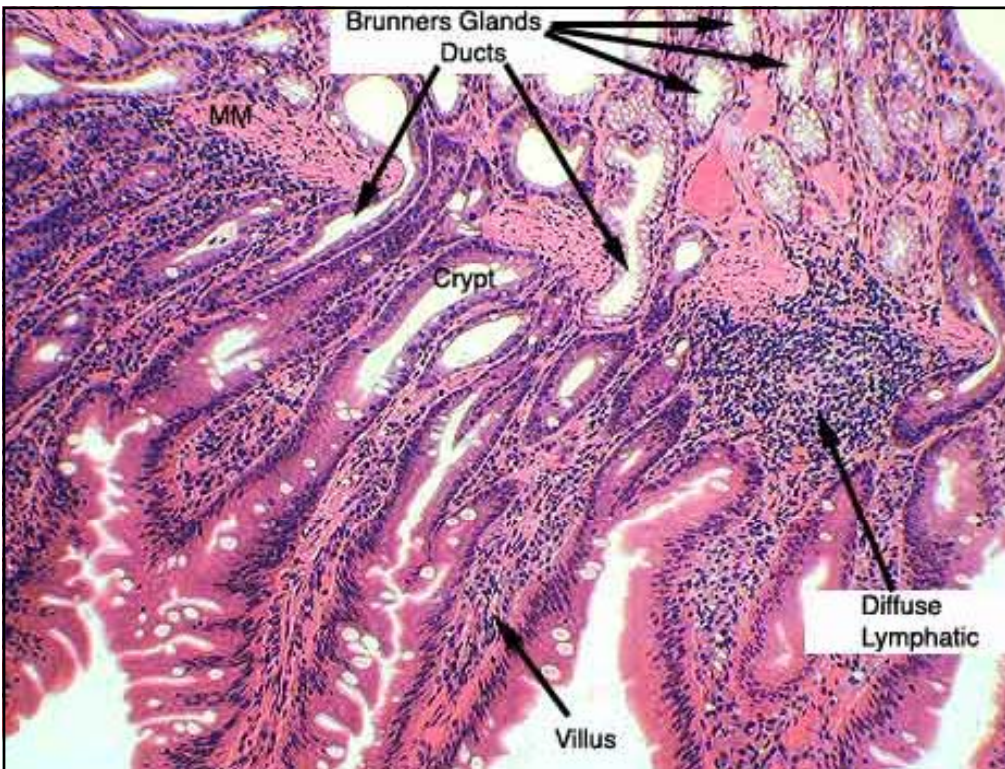
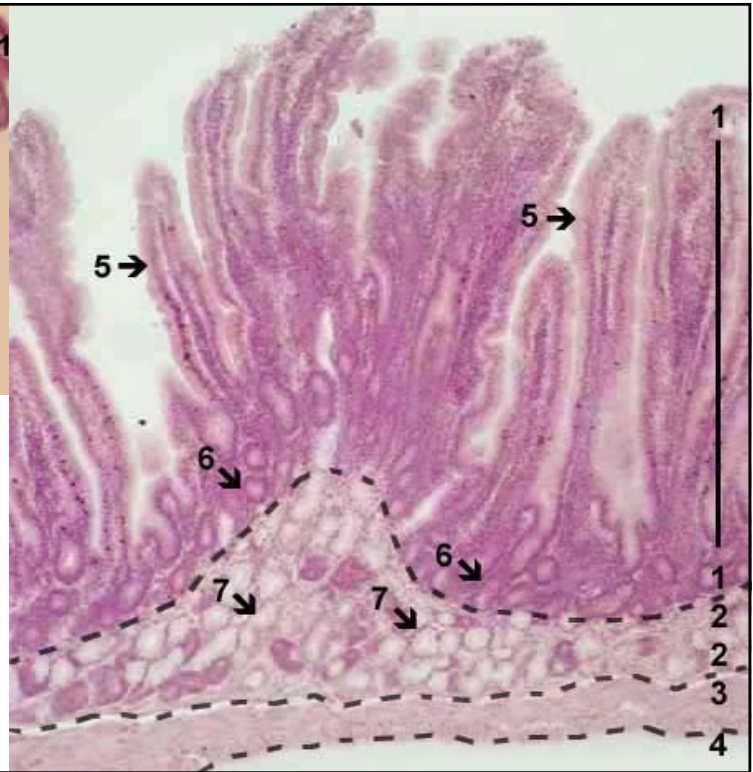




### DUODENUM

Stained with haematoxylin and eosin

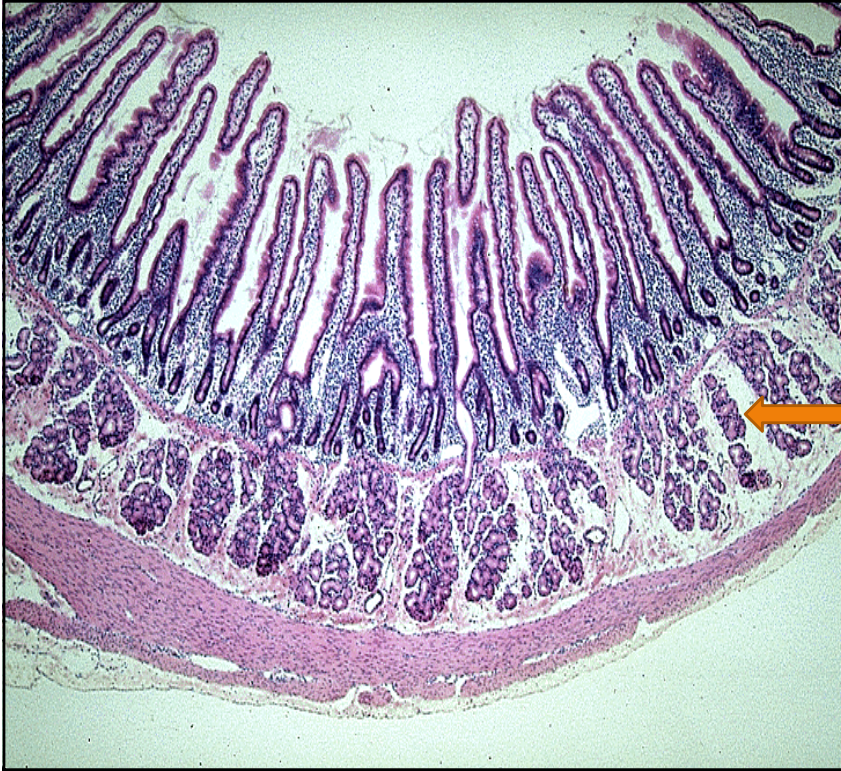
- 1 - tunica mucosa
- 2 - tunica submucosa
- 3 - tunica muscularis propria
- 4 - tunica serosa
- 5 - villi
- 6 - glands (crypts) in the lamina propria of the mucosa
- 7 - glands in the tunica submucosa (Brunner's glands)



the epithelial lining has been detached so all you see on each villus is the lamina propria bounded by a naked basement membrane.

Crypts of Lieberkuhn are intestinal glands, which contain **Paneth cells**, which in turn, contain eosinophilic granules. The submucosa is marked by pockets of **Brunner's glands (mucous-producing glands)**

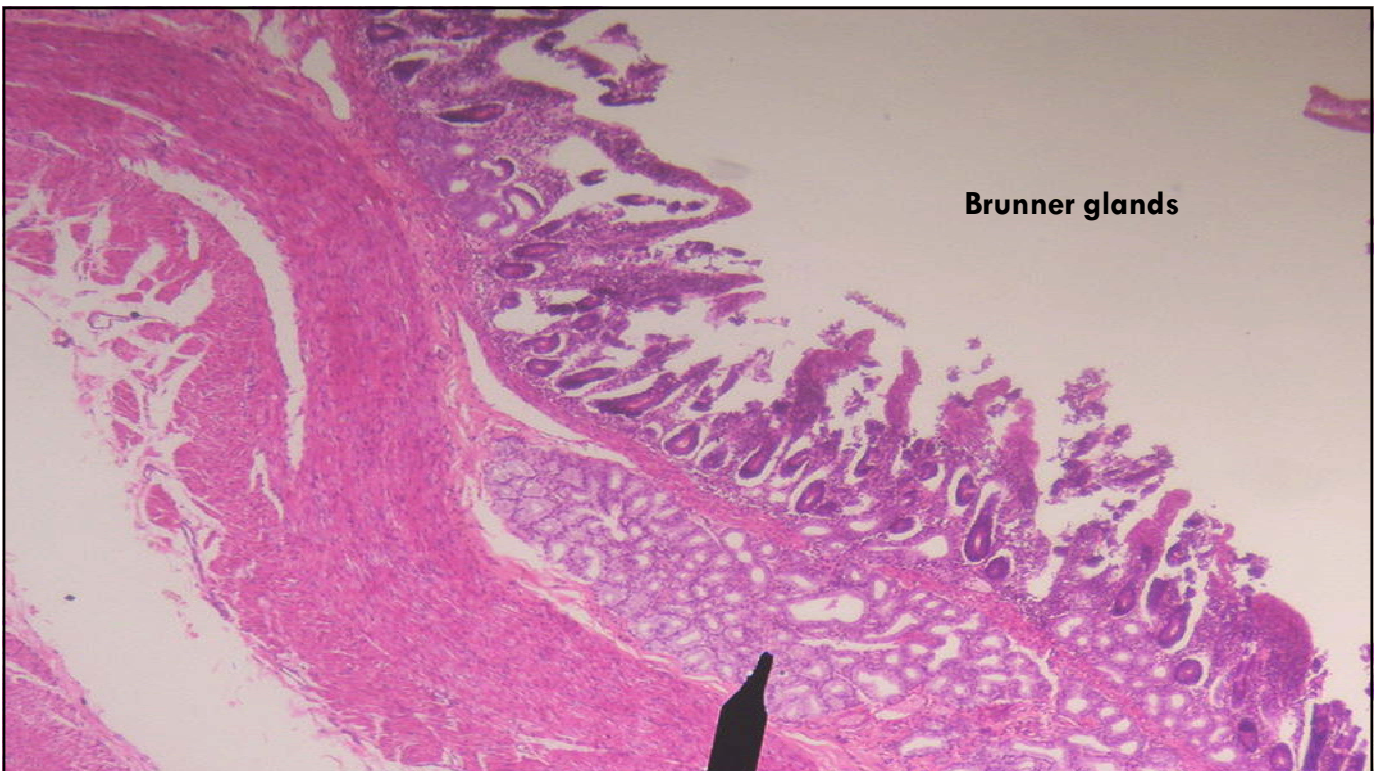




**Brunner glands (or Pancreal glands)**

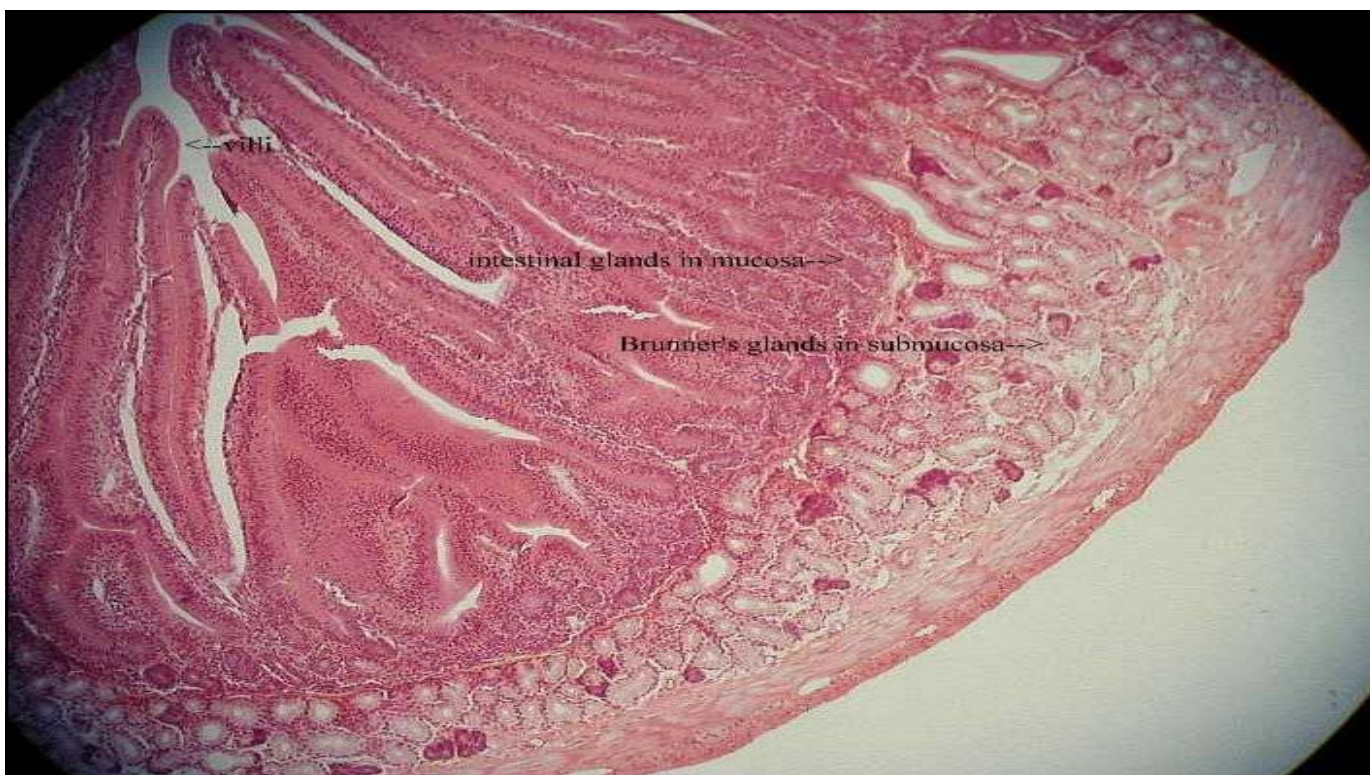
are compound tubular submucosal glands found in that portion of the duodenum which is above the sphincter of Oddi.

The main function of these glands is to produce an alkaline secretion (containing bicarbonate) in order to: protect the duodenum from the acidic content of chyme (which is introduced into the duodenum from the stomach); provide an alkaline condition for the intestinal enzymes to be active, thus enabling absorption to take place; lubricate the intestinal walls. They are the distinguishing feature of the duodenum

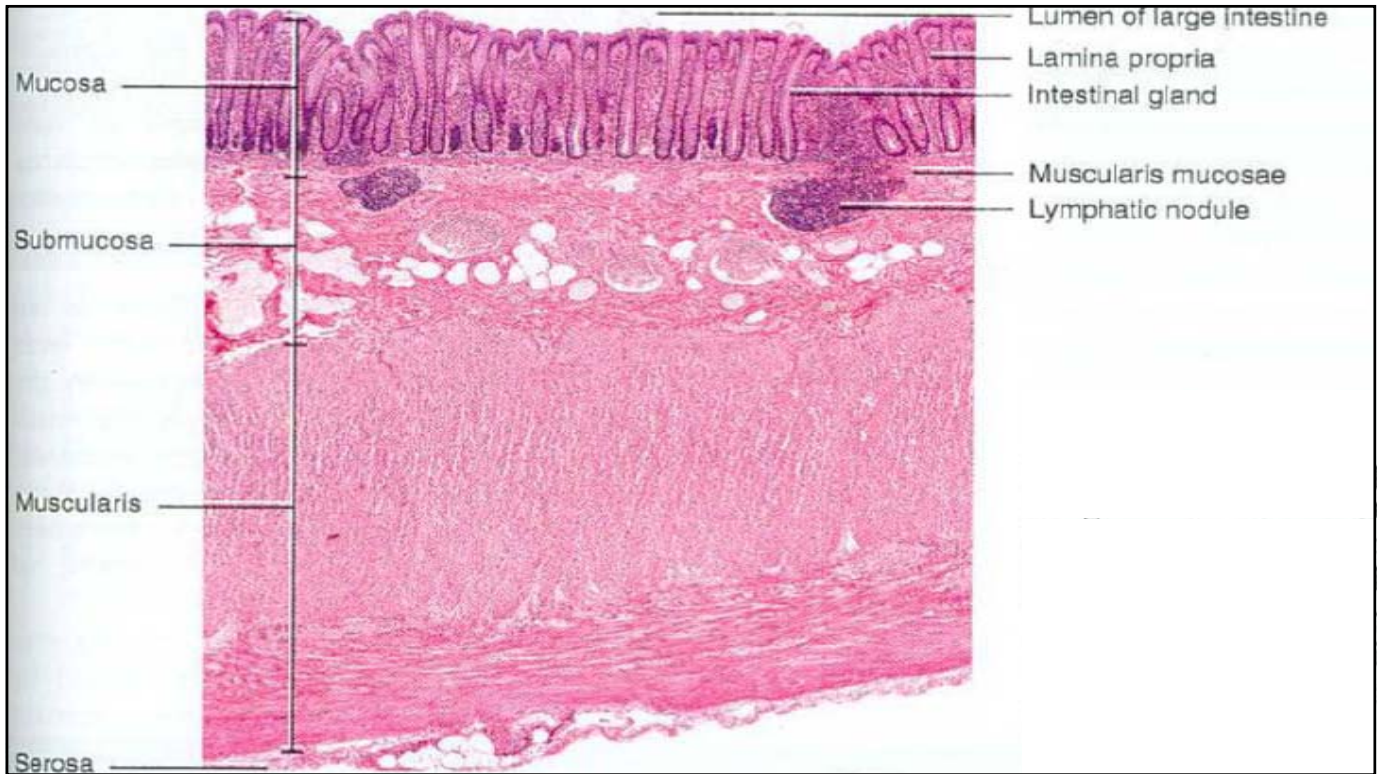


**Brunner glands**





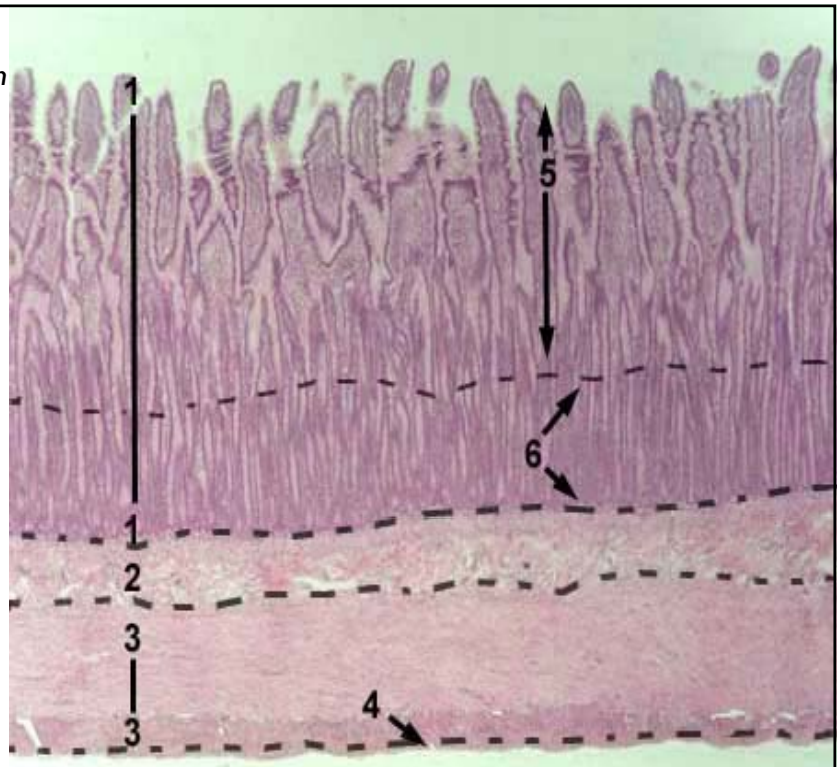


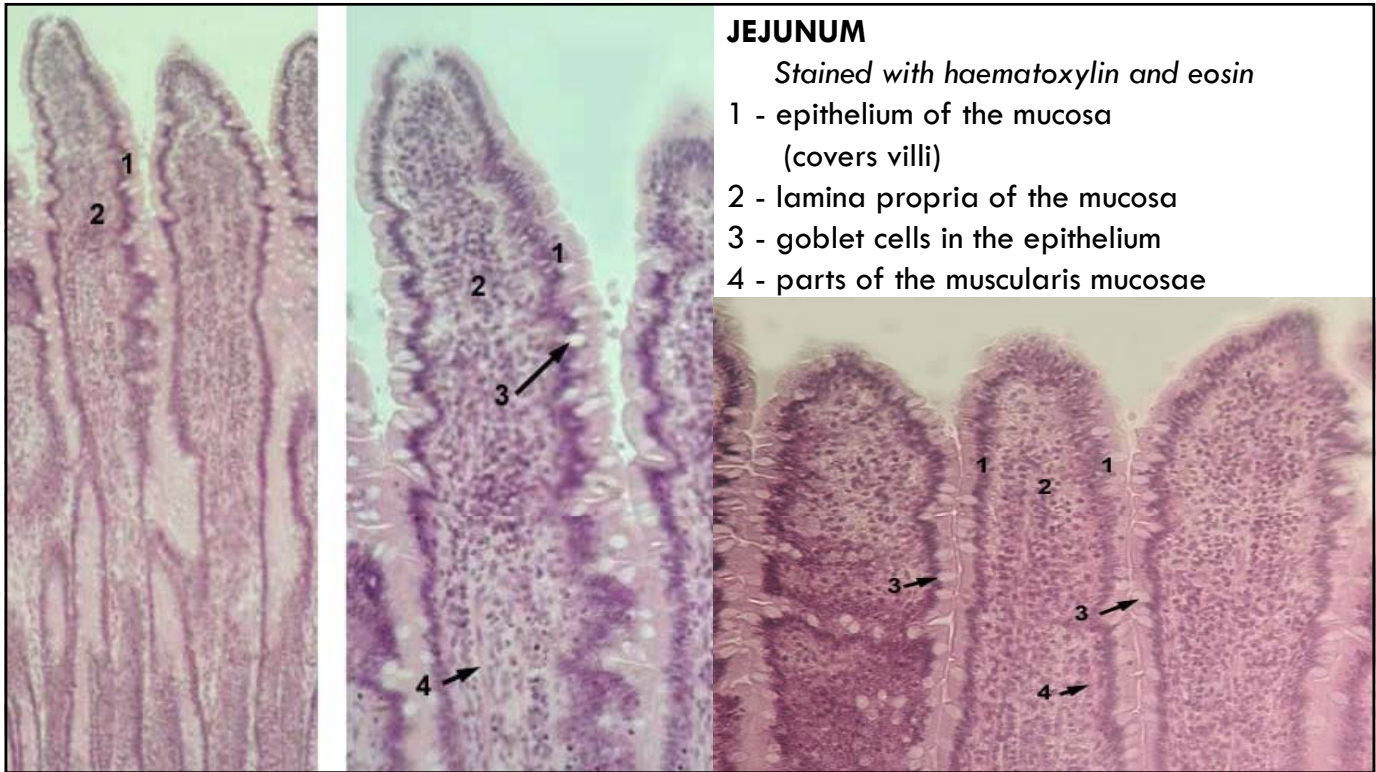


## JEJUNUM

*Stained with haematoxylin and eosin*

- 1 - tunica mucosa
- 2 - tunica submucosa
- 3 - tunica muscularis propria
- 4 - tunica serosa
- 5 - villi
- 6 - glands (crypts) in the lamina propria of the mucosa

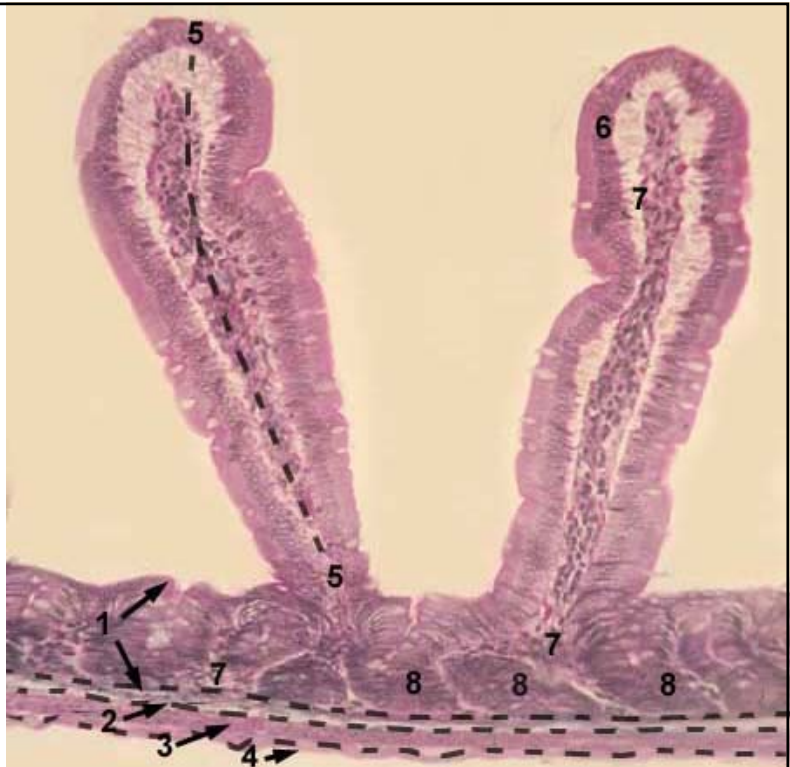




**ILEUM**

Stained with haematoxylin and eosin

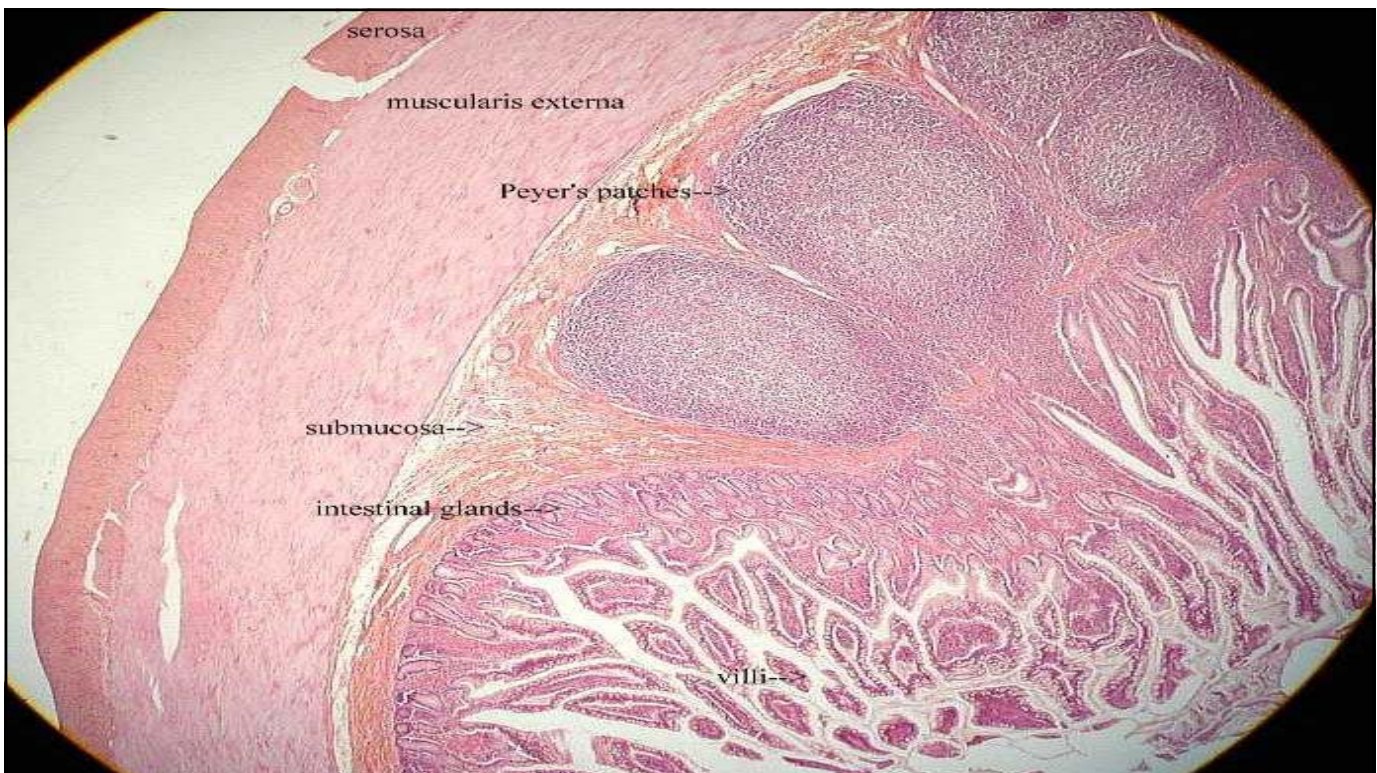
- 1 - tunica mucosa  
 2 - tunica submucosa  
 3 - tunica muscularis propria  
 4 - tunica serosa  
 5 - villi  
 6 - epithelium of the mucosa  
 (covers villi)  
 7 - connective tissue of the lamina  
 propria of the mucosa  
 8 - glands (crypts) in the lamina  
 propria of the mucosa



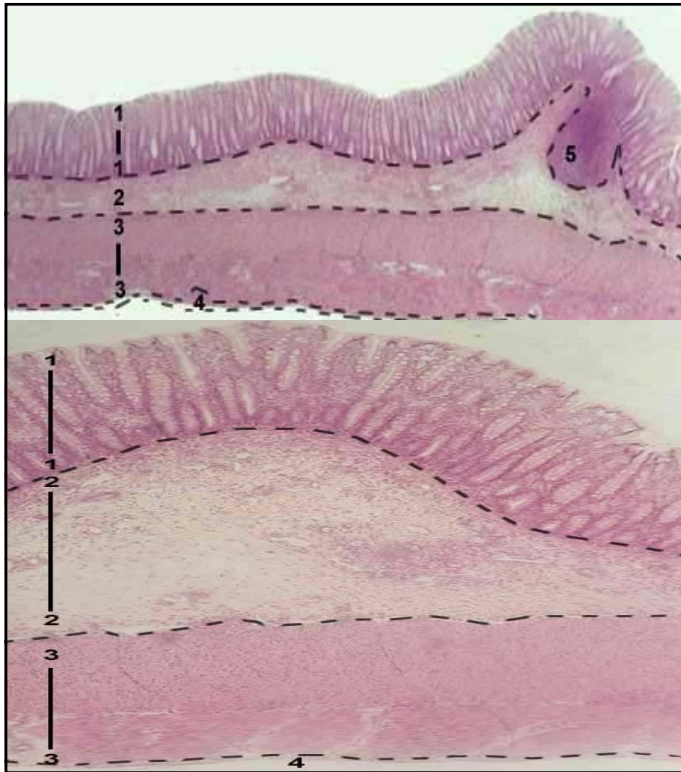




mucosa  
submucosa  
*Peyer's patches* (lymphatic tissue in submucosa)  
intestinal glands  
muscularis externa  
serosa







### COLON

*Stained with haematoxylin and eosin*

- 1 - tunica mucosa
- 2 - tunica submucosa
- 3 - tunica muscularis propria
- 4 - tunica serosa
- 5 - lymphoid follicle in the lamina propria of the mucosa

### COLON

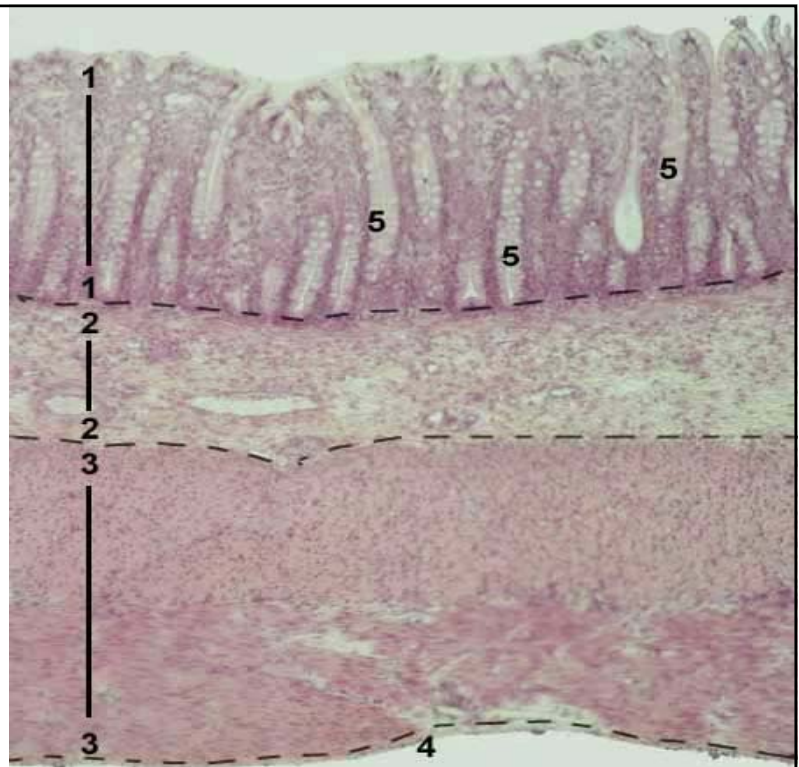
*Stained with haematoxylin and eosin*

- 1 - tunica mucosa
- 2 - tunica submucosa
- 3 - tunica muscularis propria
- 4 - tunica serosa

### COLON

*Stained with haematoxylin and eosin*

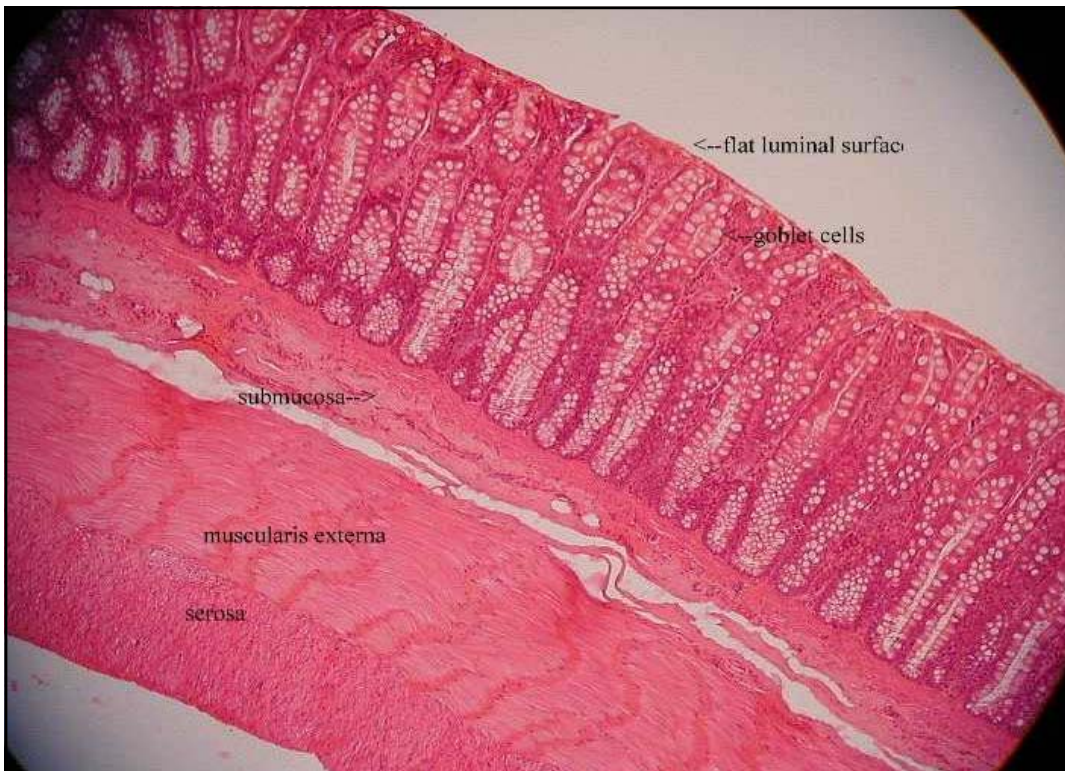
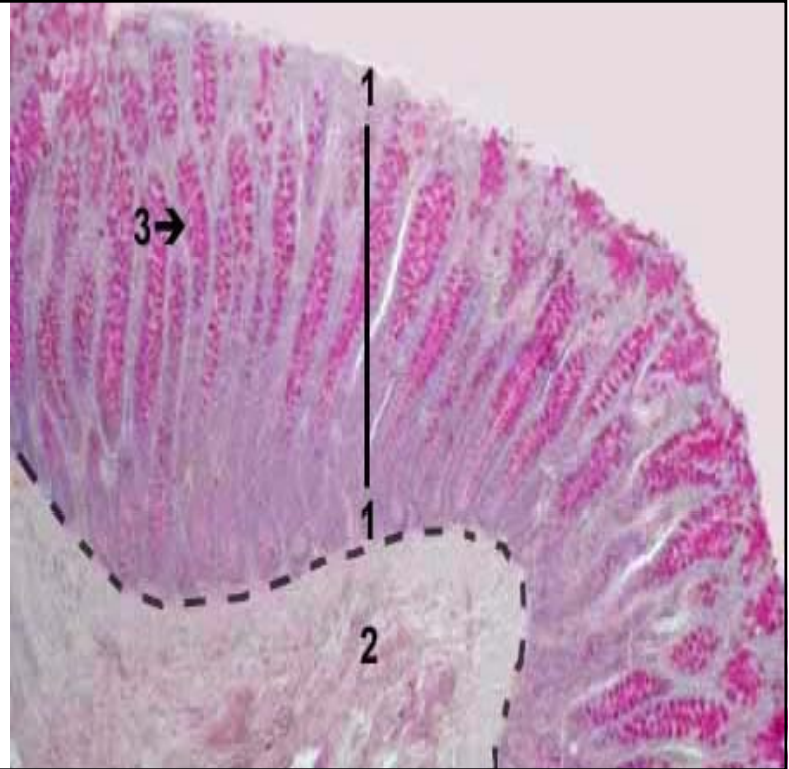
- 1 - tunica mucosa
- 2 - tunica submucosa
- 3 - tunica muscularis propria
- 4 - tunica serosa
- 5 - glands (crypts) in the lamina propria of the mucosa





**COLON***Stained with mucicarmin*

- 1 - tunica mucosa
- 2 - tunica submucosa
- 3 - goblet cells in the epithelium of crypts  
(stained with red-magenta color)



mucosa (flat luminal  
 surface)  
 goblet cells  
 submucosa  
 lymph nodes (if  
 present)  
 muscularis externa  
 serosa



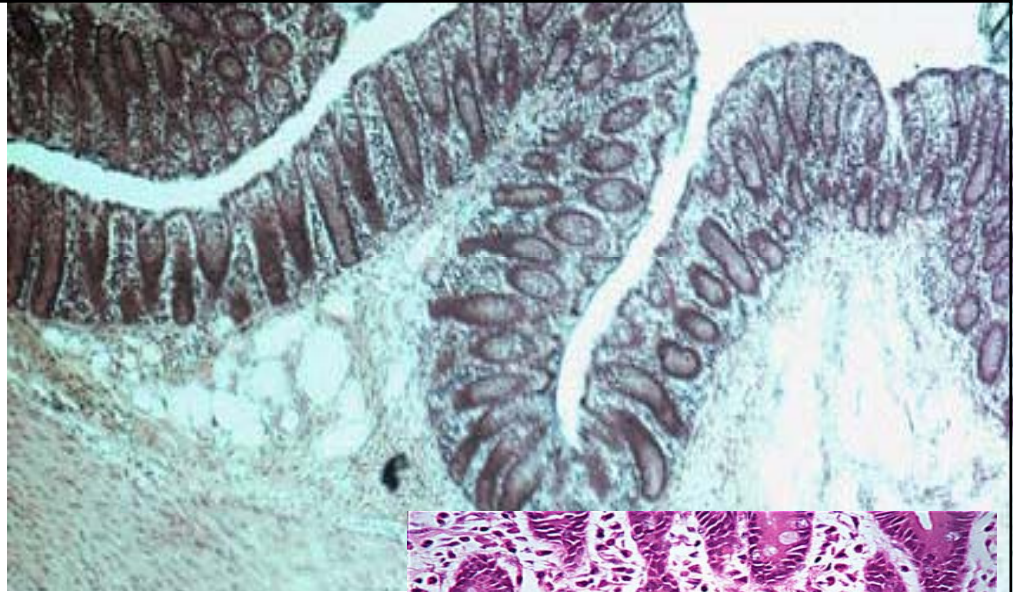
The **crypts of Lieberkühn** (or **intestinal glands**) are glands found in the epithelial lining of the small intestine and colon. the crypts secrete various enzymes, including **sucrase and maltase, along with endopeptidases and exopeptidases.**

Also new epithelium is formed here, keeping in mind that the epithelium at this site is frequently worn away by the passing food.

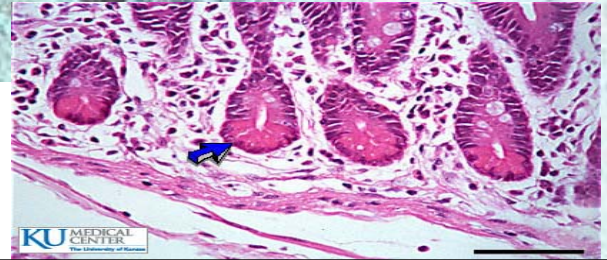
Loss of proliferation control in the crypts is thought to lead to colorectal cancer.

The basal portion of the Crypt contains **multipotent stem cells.** At each mitosis one daughter remains a stem cell while the other differentiates and migrates up the side of the crypt and eventually the villus.

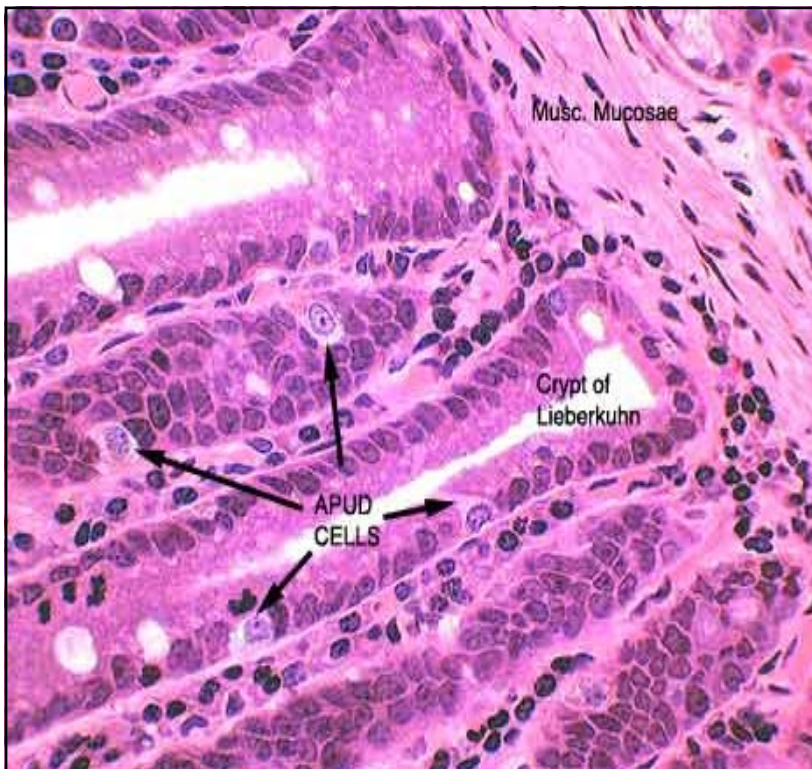
Goblet cells are among the cells produced in this fashion.



This particular section is of colon, with lots of intestinal glands (crypts of Lieberkuhn) but no villi.



KU MEDICAL CENTER  
The University of Kansas



### Helpful Hint

There are specific features to look for when attempting to identify a particular portion of the small intestine:

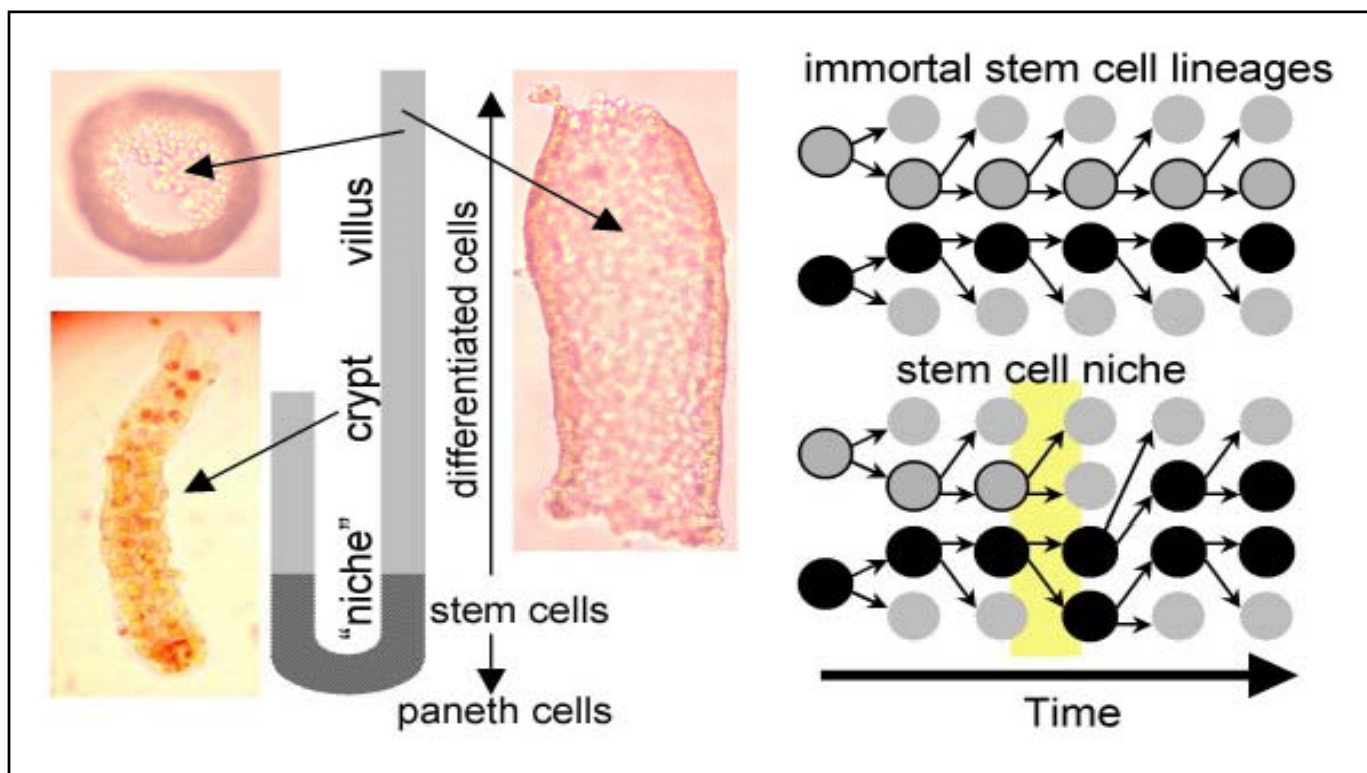
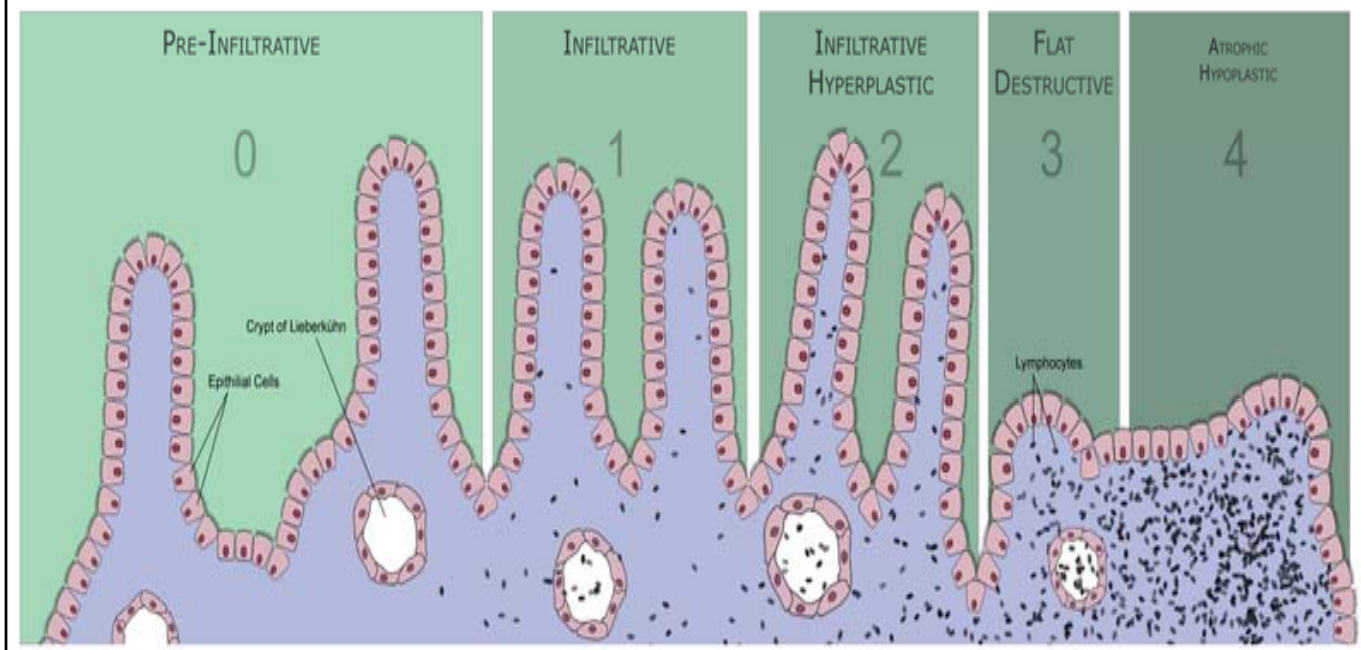
**Duodenum - Brunner's glands in submucosa, some Goblet Cells**

**Jejunum - large plicae with many villi, more Goblet Cells**

**Ileum - aggregates of Peyer's patches, even more Goblet Cells**



# UPPER JEJUNAL MUCOSAL IMMUNOPATHOLOGY

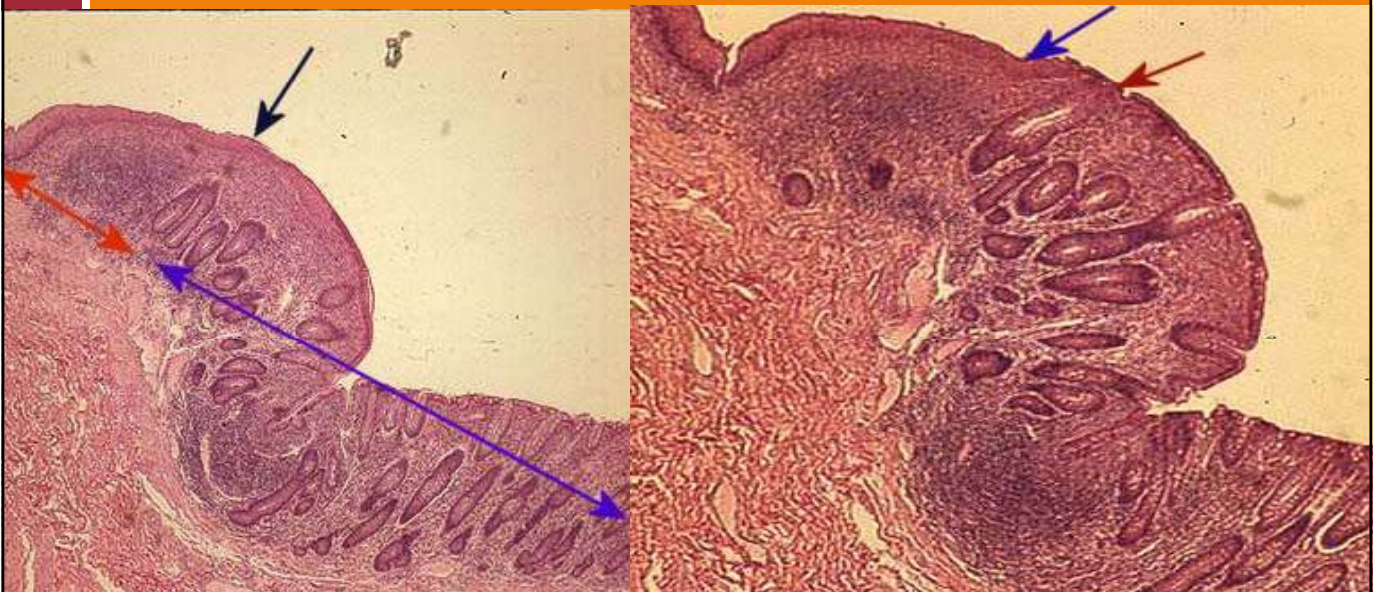


## Rectum

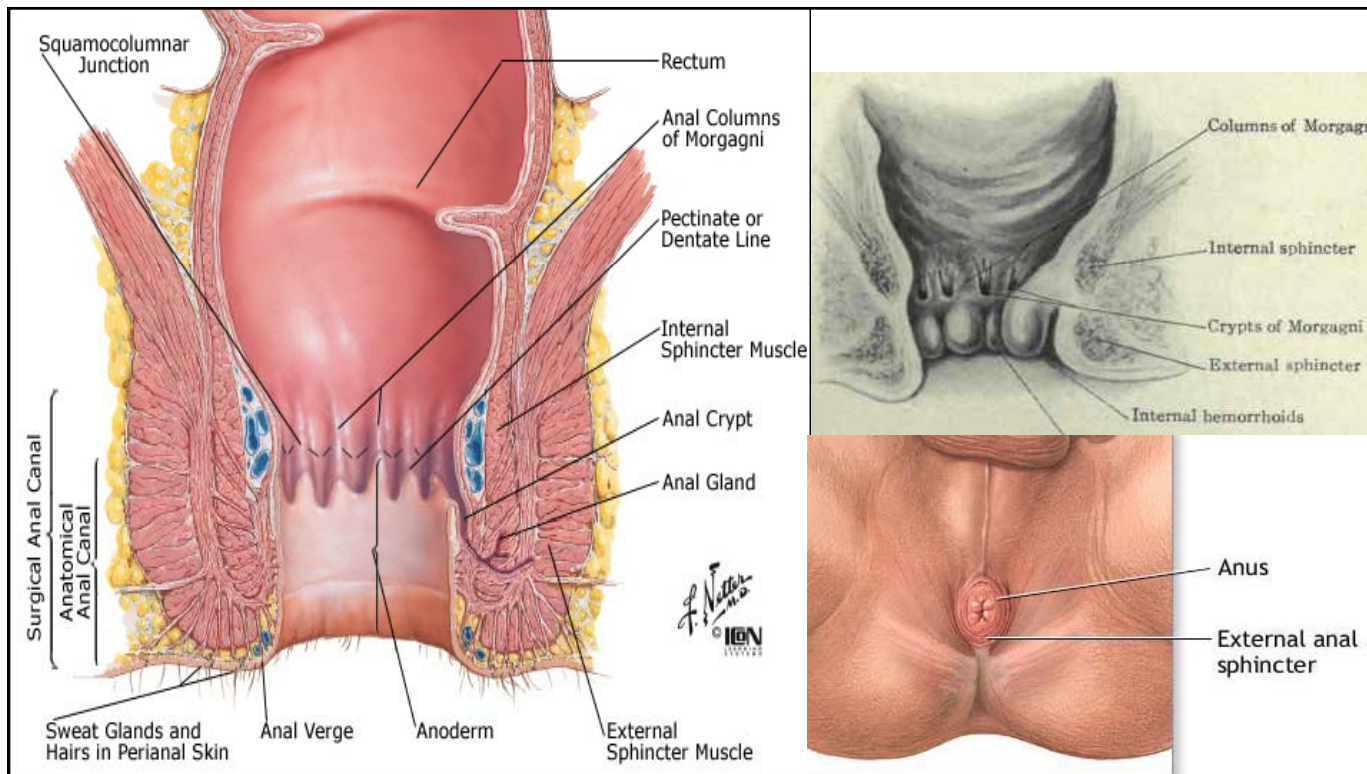


## Rectal-Anal Junction

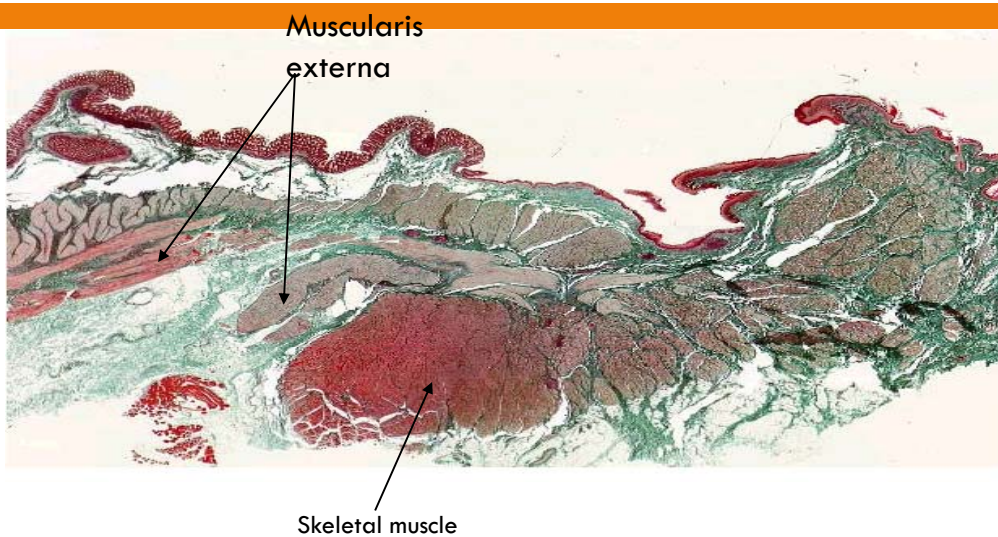
Blue arrow - end of Rectum  
 Red arrow - Beginning of Anus  
 Black arrow - Transition point





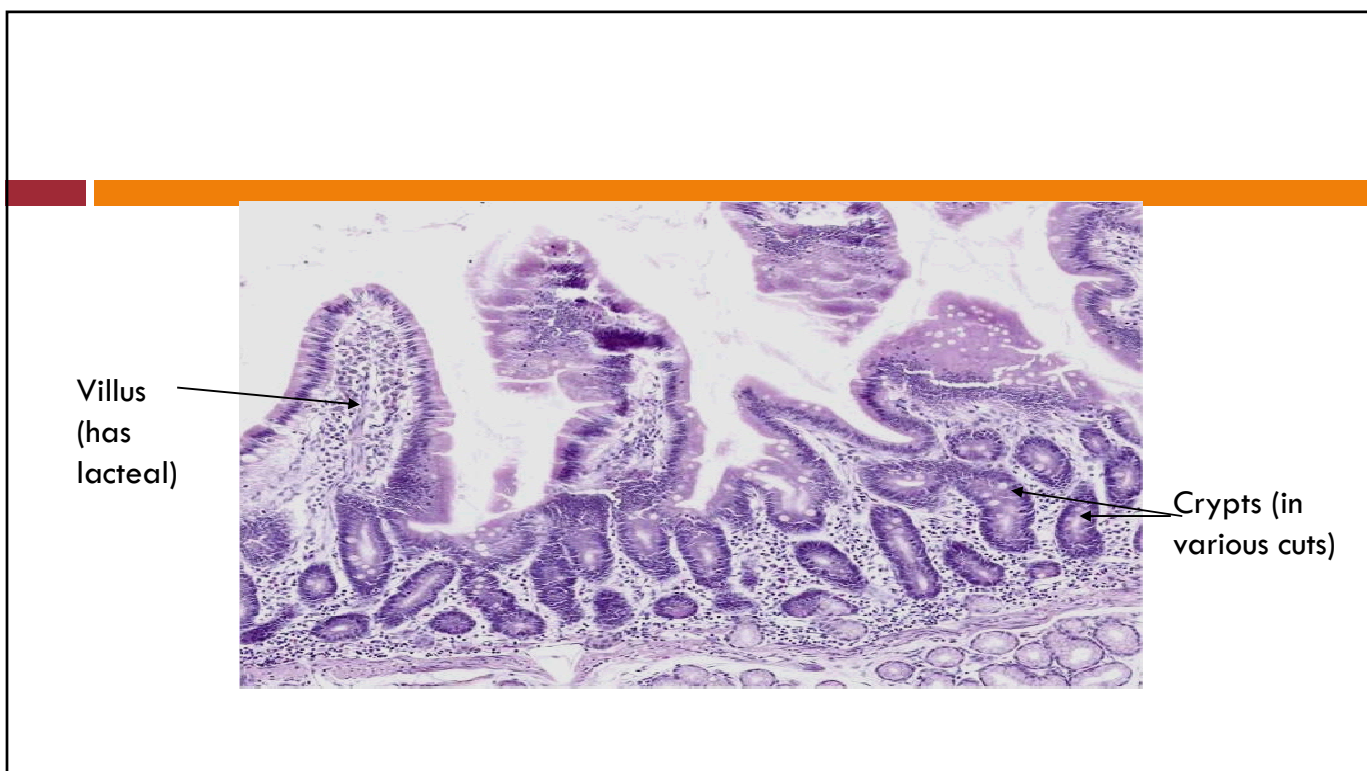
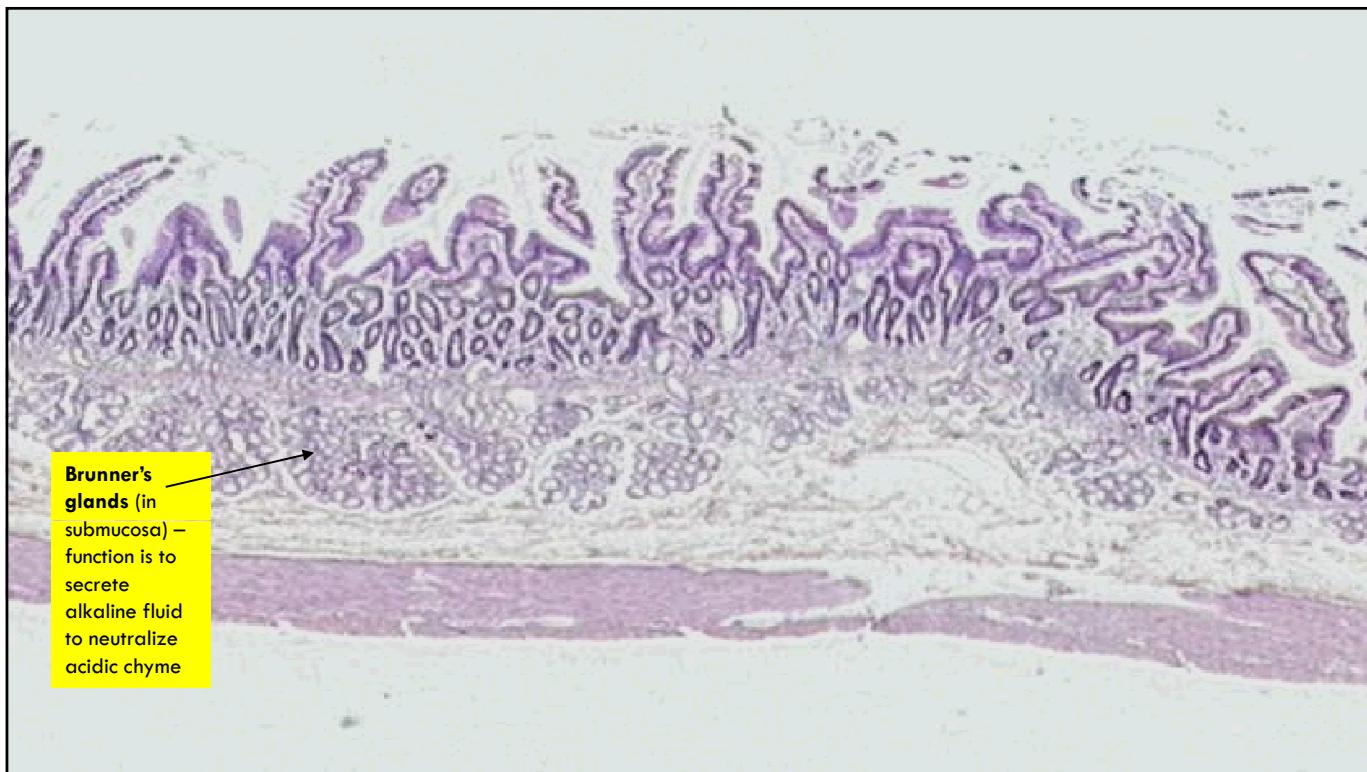


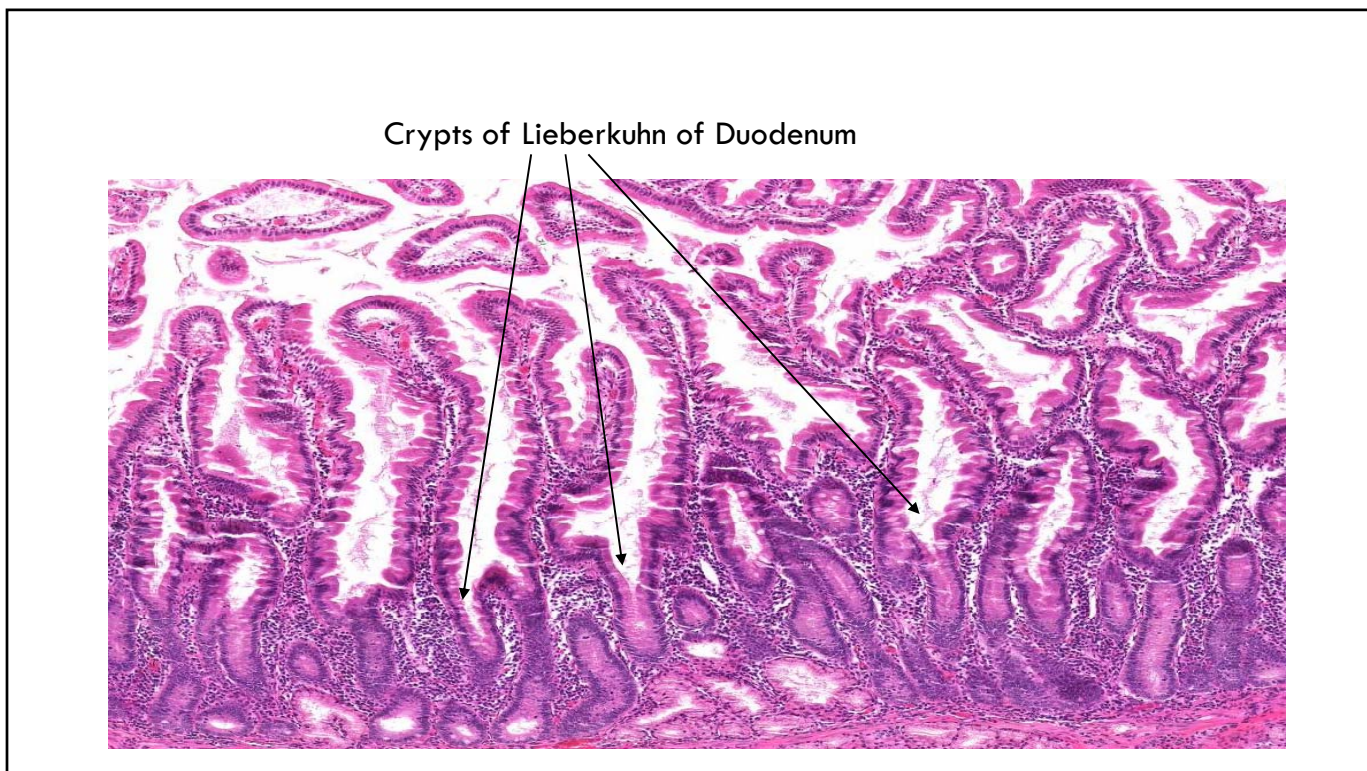
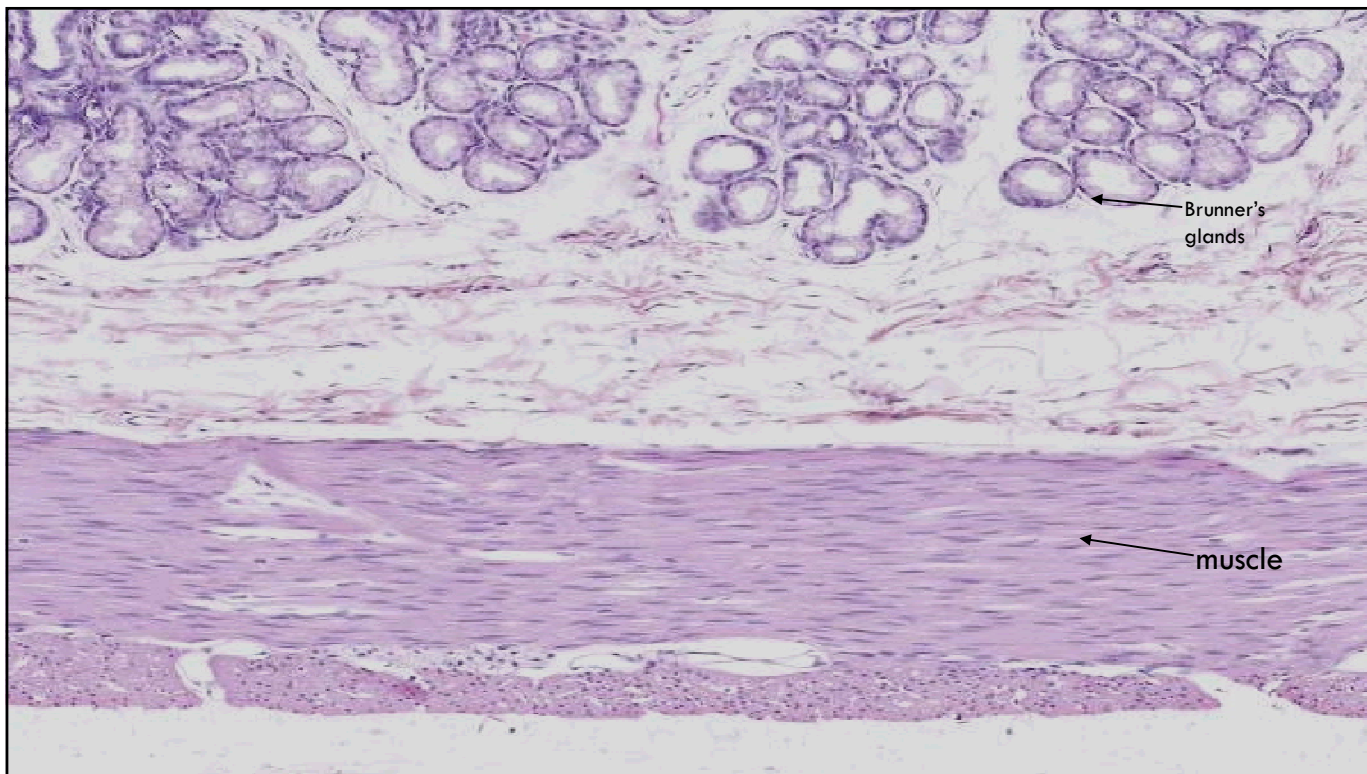
Anus and Rectum – monkey (low mag) UW2059





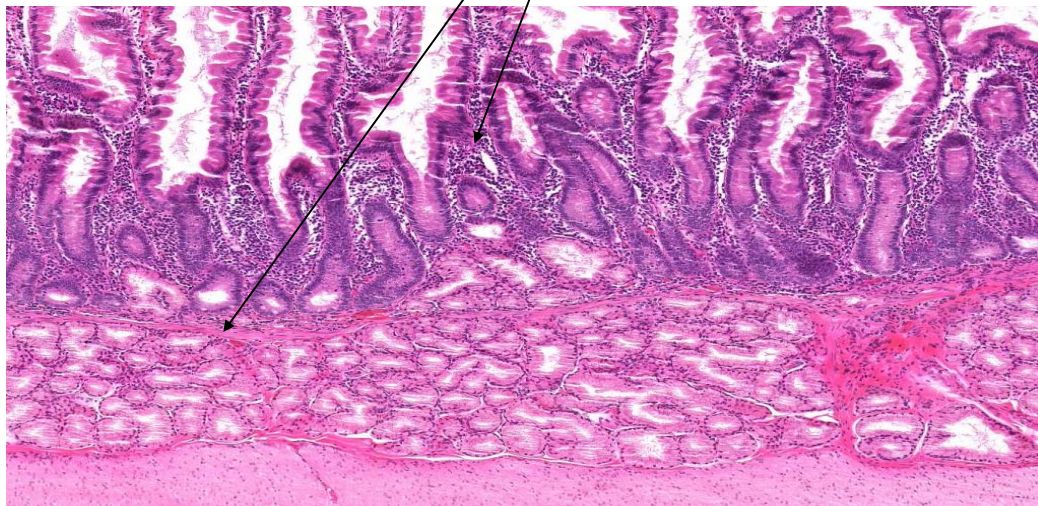








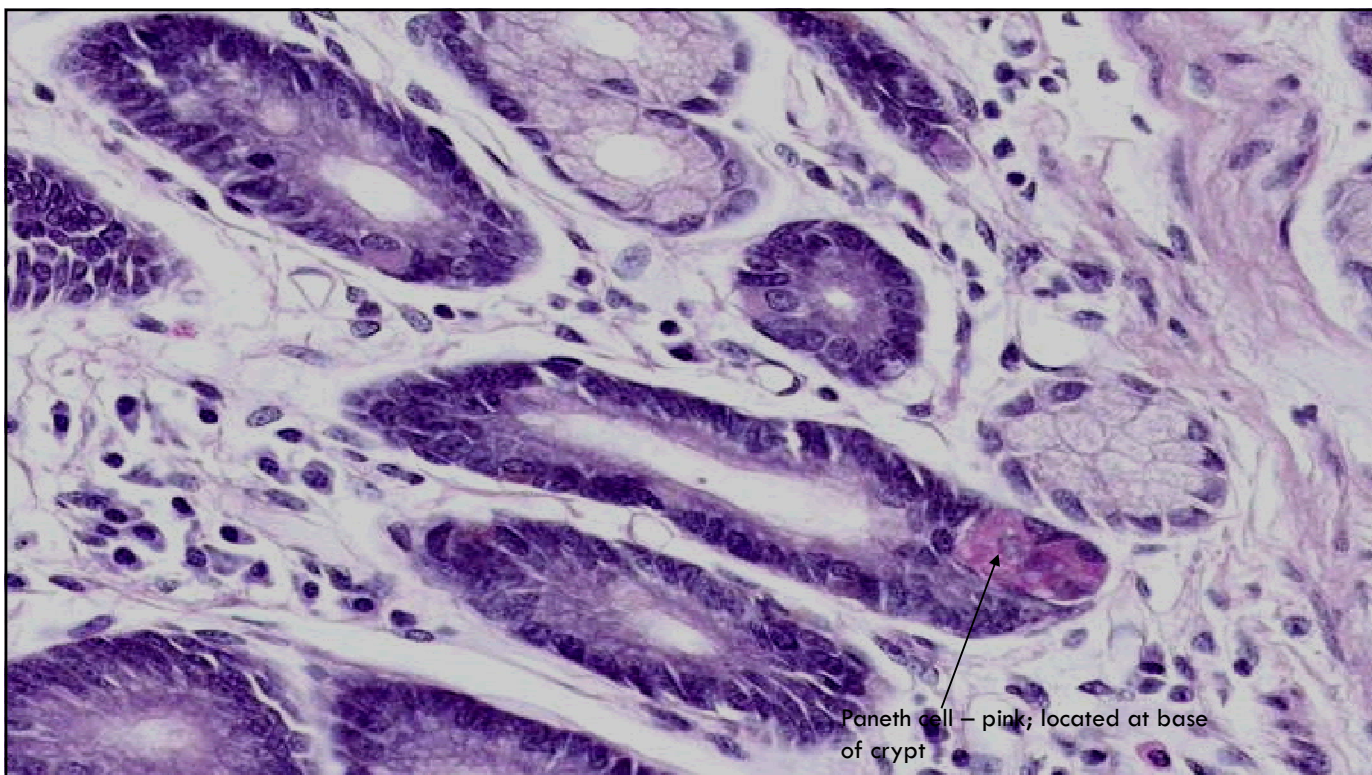
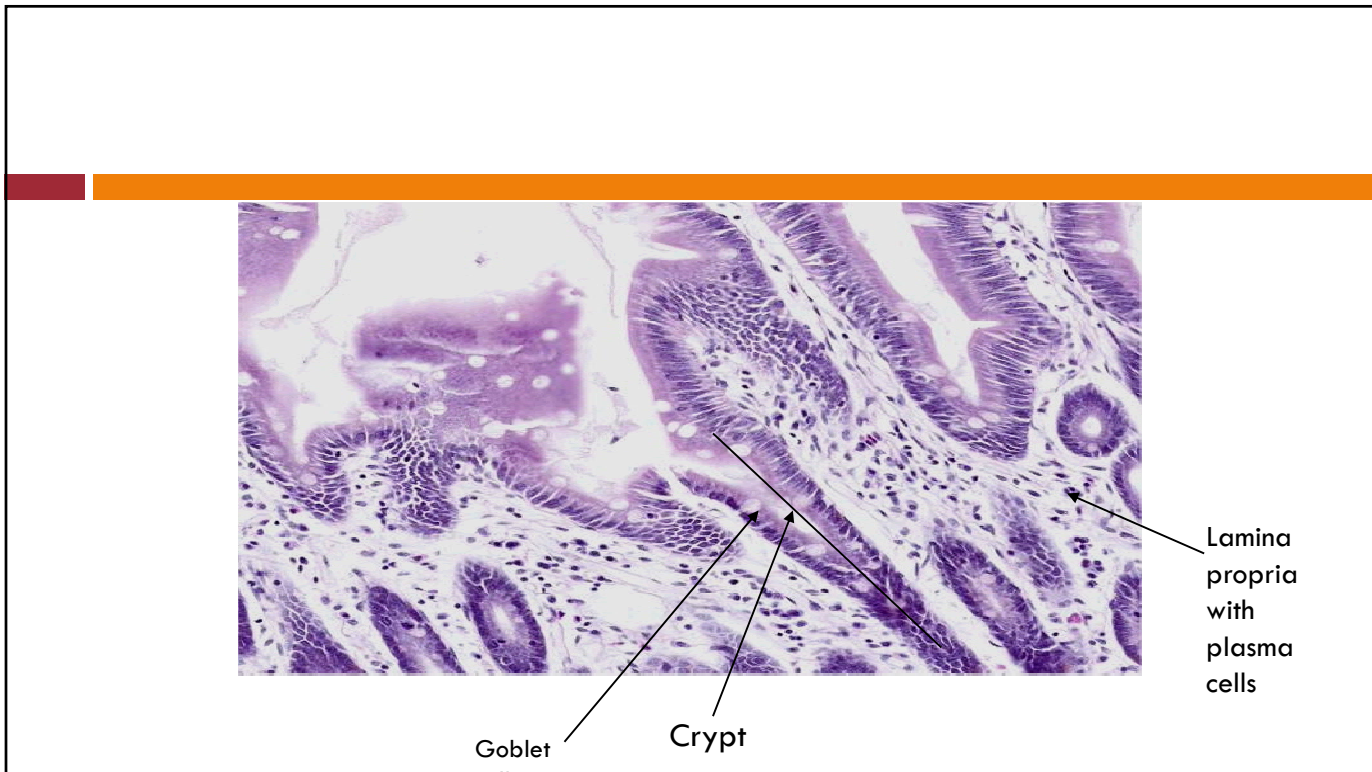
Muscularis mucosae extend into villi causing contraction



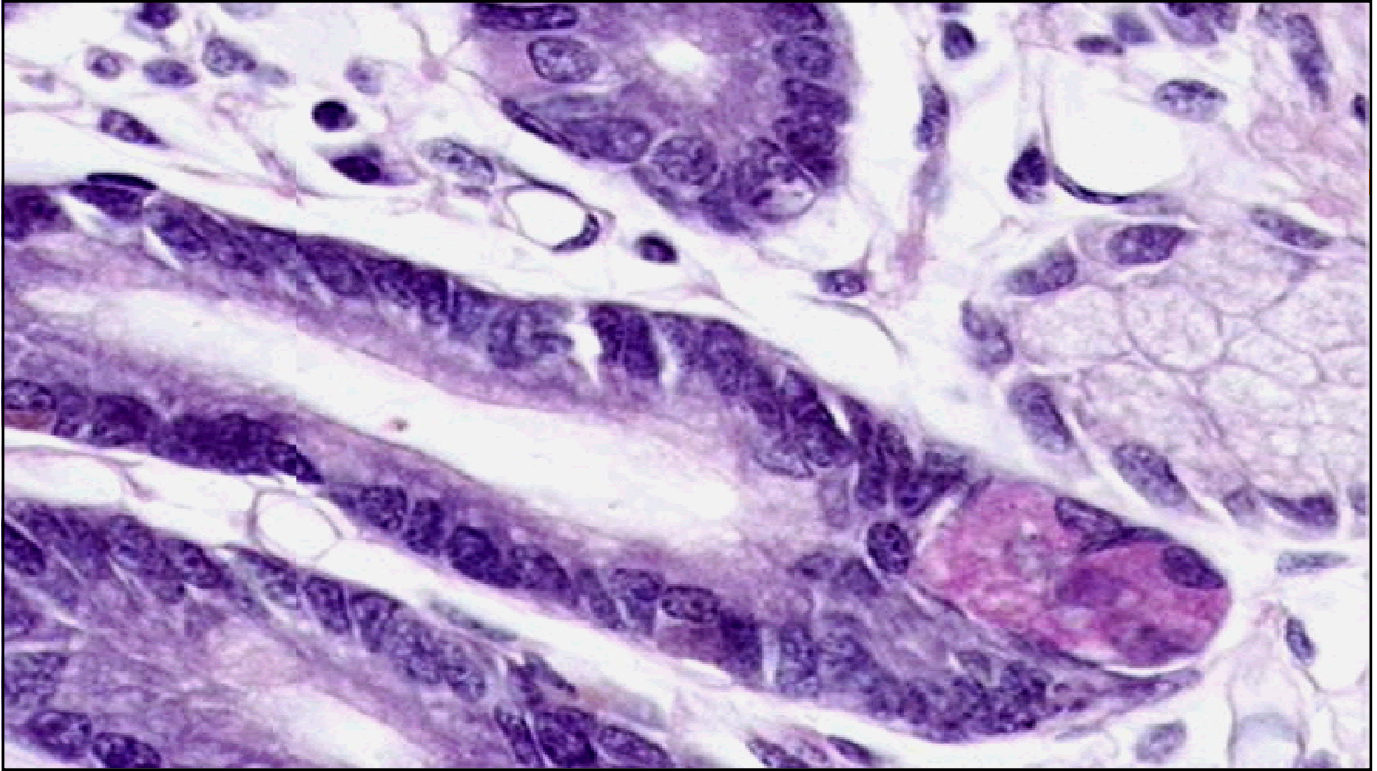
enterocytes



Goblet cells







## Jejunum – MCW070

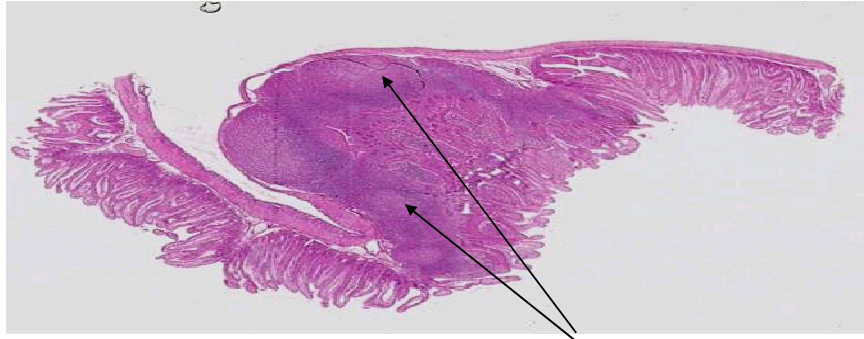
### Plica circulares

-a.k.a. valves of Keckring

-are "large infoldings of the mucosa and submucosa"



## Ileum (low mag)



Peyer's patches (will find M cells on luminal side)

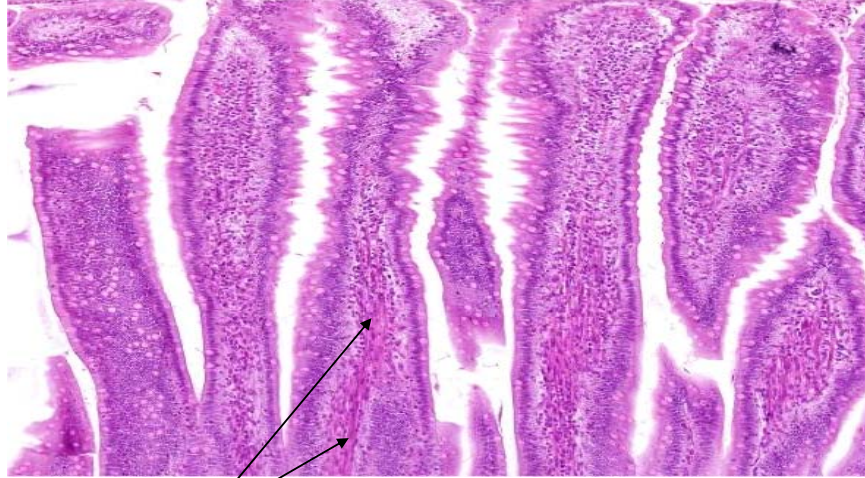
## Ileum – MCW072 (low mag)



Submucosa – has vasculature



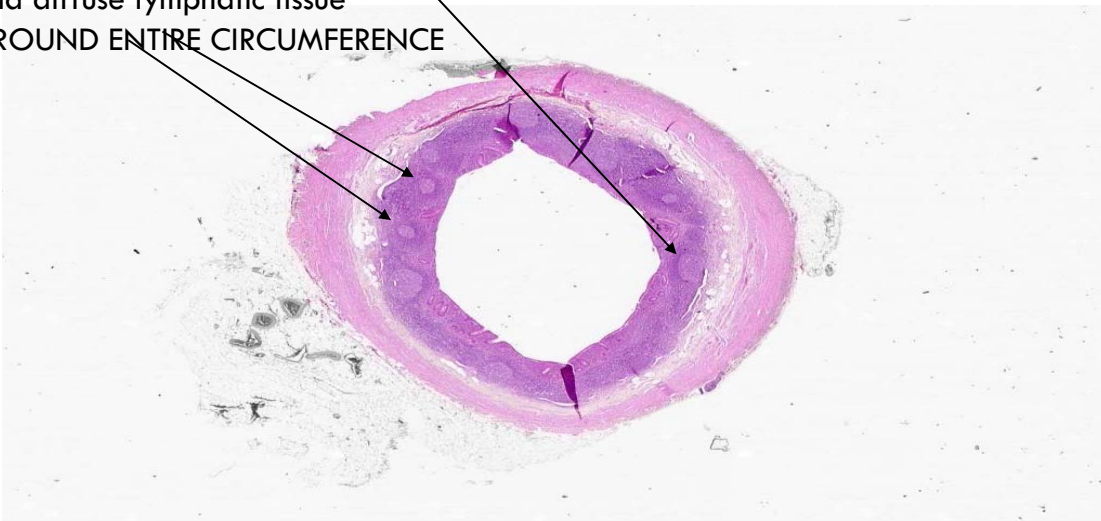
## Ileum - LH0131



Lacteal

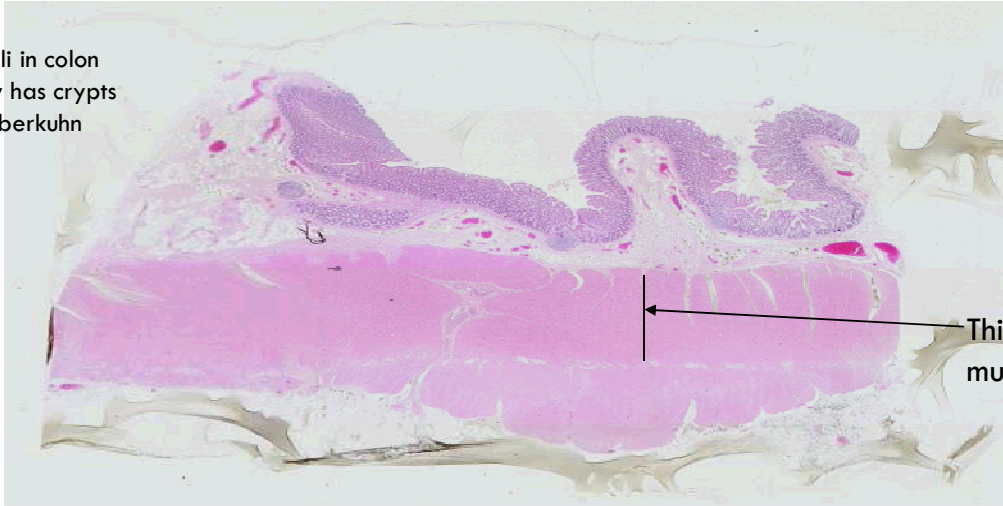
## Appendix

Numerous lymphatic nodules  
and diffuse lymphatic tissue  
AROUND ENTIRE CIRCUMFERENCE



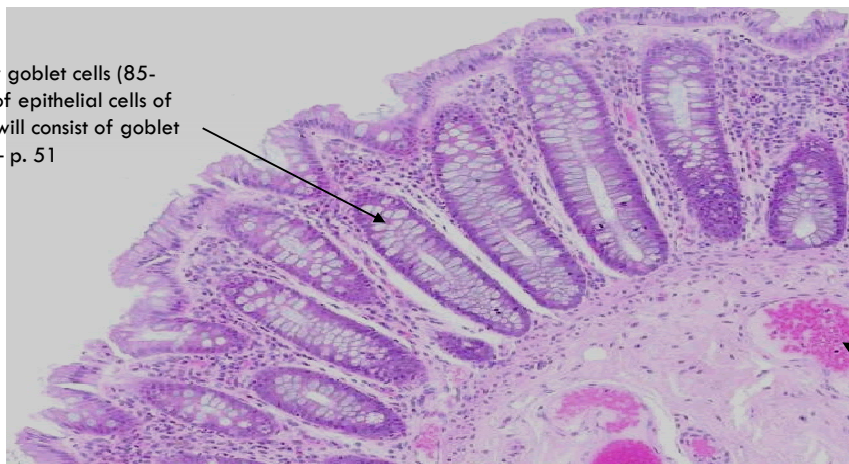
## Colon – LH0135 (low mag)

No villi in colon  
– only has crypts  
of Lieberkuhn



Thick internal  
muscle layer

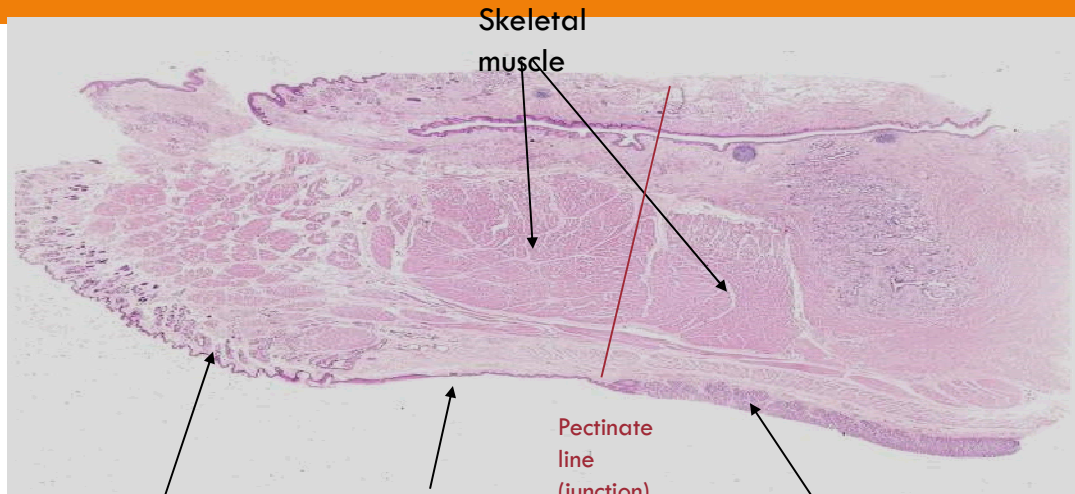
Mostly goblet cells (85-  
95% of epithelial cells of  
colon will consist of goblet  
cells) – p. 51



Vasculature  
with blood



## Recto-anal junction – MCO 0079 (low mag)



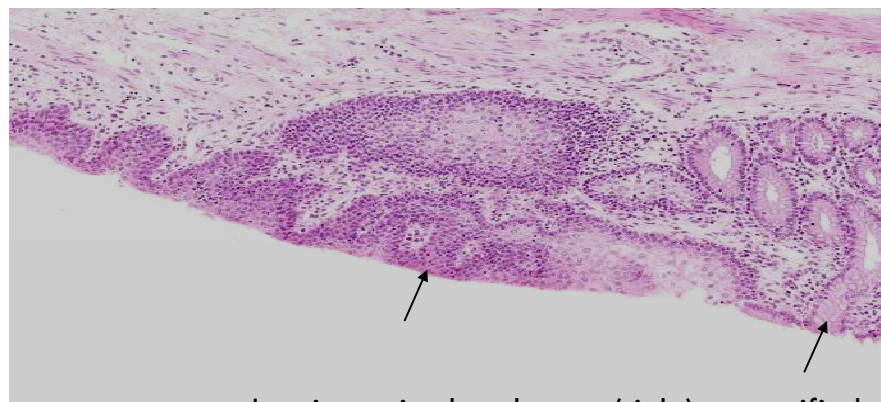
Epithelium - stratified squamous keratinizing (external skin)

Epithelium - stratified squamous non-keratinizing

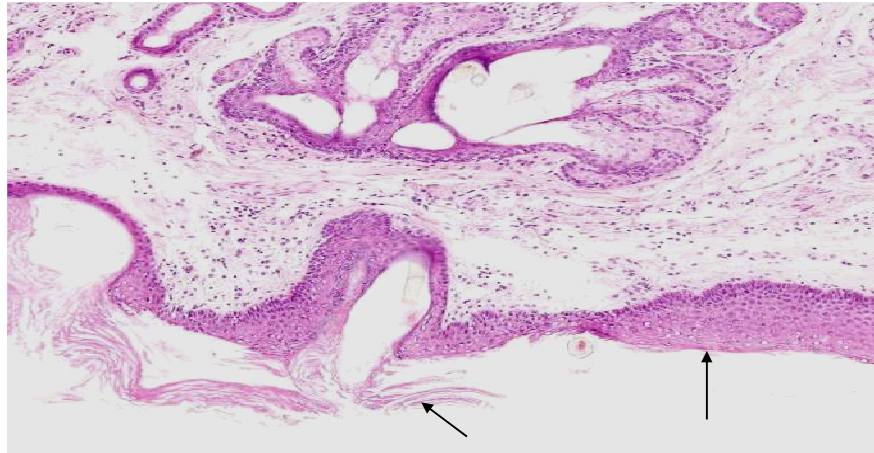
Epithelium - simple columnar w/ goblet cells

Skeletal muscle

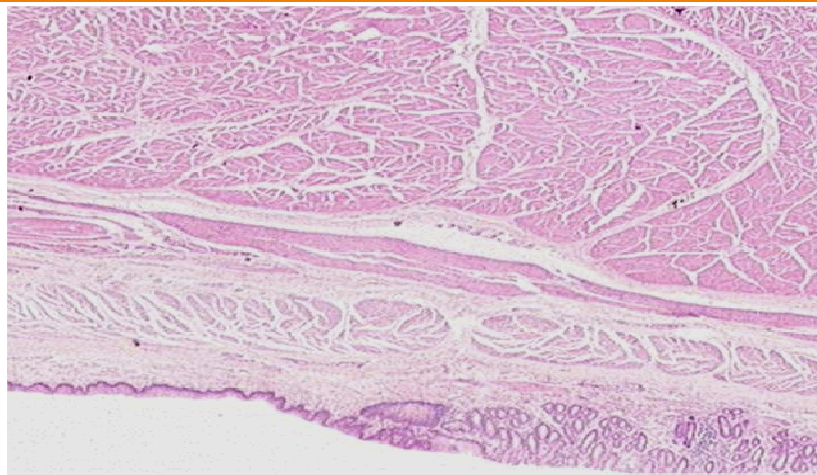
Pectinate line (junction)



Junction - simple columnar (right) to stratified squamous nonkeratinizing (left)



Junction - stratified squamous keratinizing (left) and stratified squamous nonkeratinizing (right)



**External anal sphincter** – skeletal muscle

**Internal anal sphincter** (muscularis externa – has inner and outer layer) – smooth muscle