HISTOLOGY LAB: FINAL

* small & large intestine, liver, gallbladder, pancreas

Disclaimer: most of these photos are taken from outside sources like Anatomy Hero (YT), diFiore's Atlas, digital histology, and others

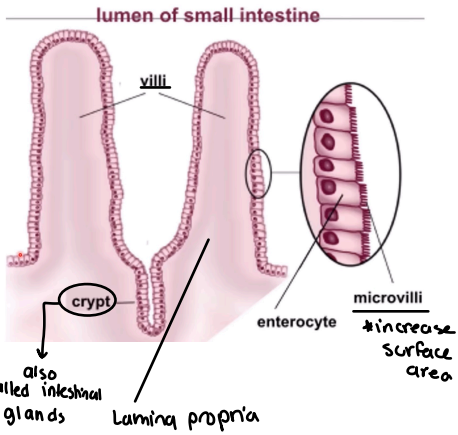
→ if you only wish to look at the lab pictures and their notes refer to slides:

6 → small intestine
13-14 → colon, rectum, anus
19 → liver
23 - pancreas
24 - gallbladder

GOOD LUCK =)

① small intestine

* finger like
* simple columnar



*recall: main function is to absorb nutrients → this will apply to the structure

*close up of a villi

* peyers patches

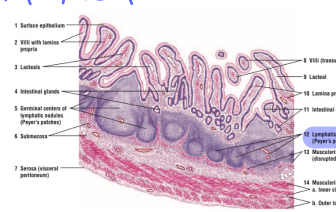
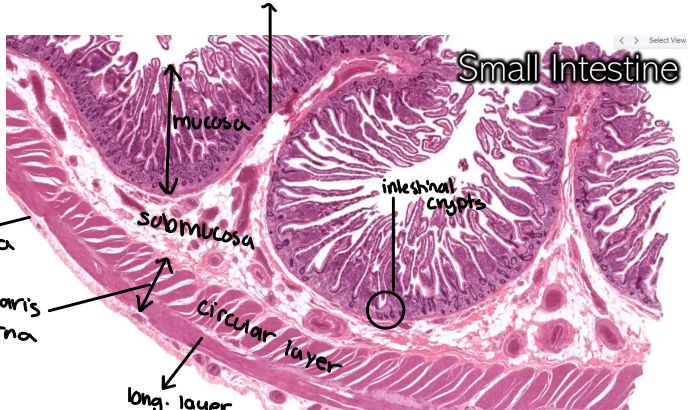


FIGURE 13.6 ■ Small intestine: Ileum with lymphatic nodules (Peyer's patches) (transverse section). Stain: hematoxylin and eosin. Low magnification.

A characteristic feature of the ileum is the aggregations of lymphatic nodules (5, 12) called Peyer's patches (5, 12). Each Peyer's patch is an aggregation of numerous lymphatic nodules that are located in the wall of the ileum opposite the mesenteric attachment.

*From difiore's

muscularis mucosae



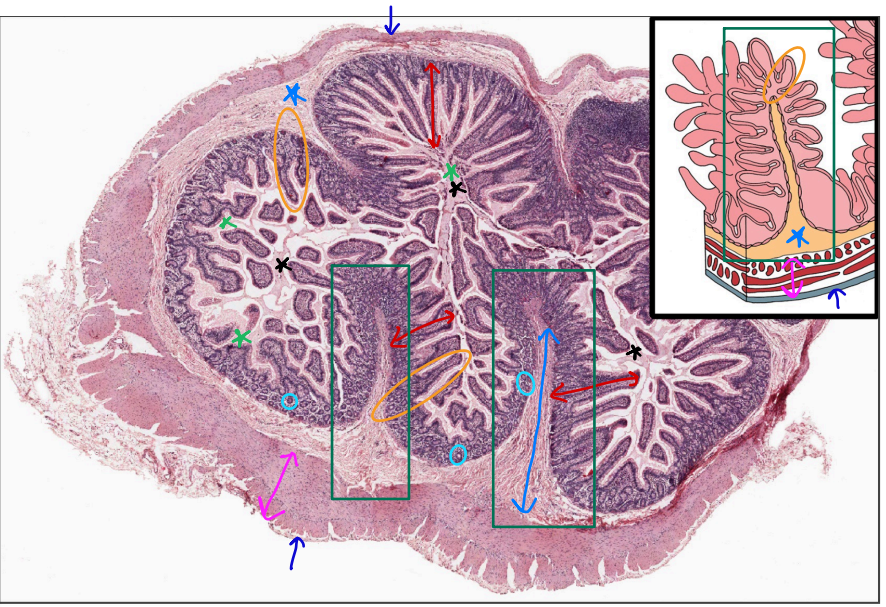
* lower magnification

this is a section from the ileum. WHY?

Well, it's NOT the duodenum b/c there are no brunner glands in the submucosa

* ileum should have peyers patches * in the mucosa

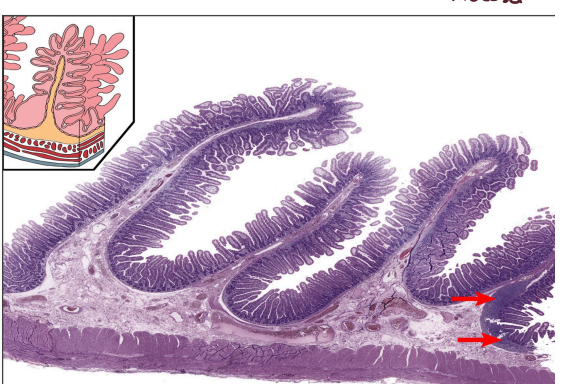
*note: I believe this is actually the jejunum, this info. is taken from Anatomy Hero on YT (No peyer's patches!)

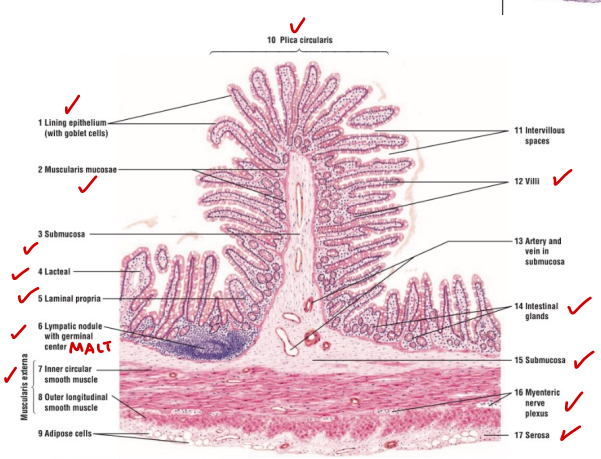


* lumen
* mucosa
* villi
* submucosa
* plica circularis
* muscularis externa
* serosa
* glycocalyx
* intestinal glands

This section is from the JEJUNUM!
Why?
1. Not duodenum → no brunner's glands in submucosa
2. Not ilium → no peyers patches in mucosa

* section from jejunum,
RED ARROWS
= MALT

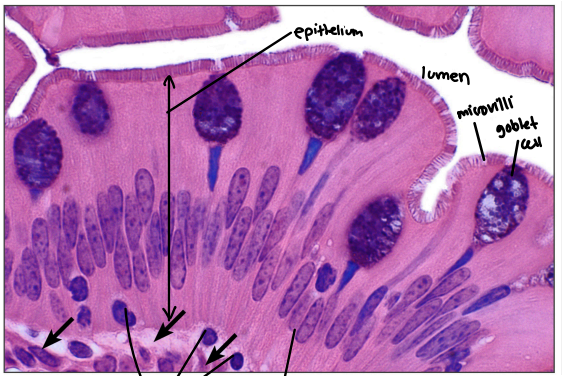


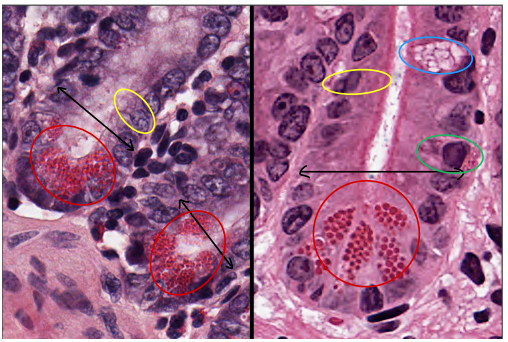


ALSO jejunum

FIGURE 13.3 ■ Small intestine: jejunum (transverse section). Stain: hematoxylin and eosin. Low magnification.

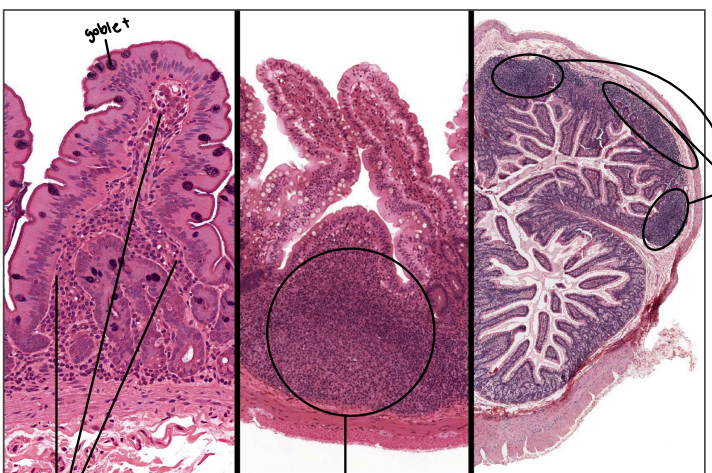
*PAS Stain

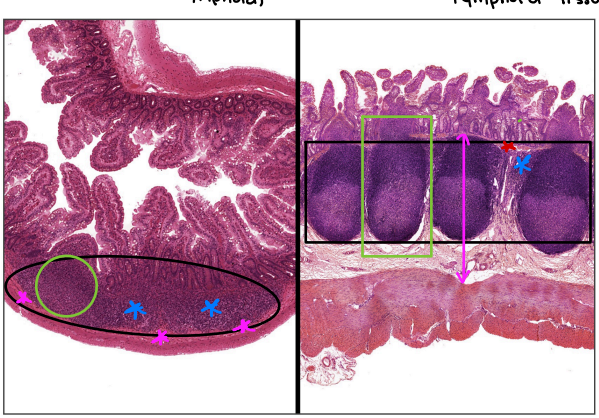




*intestinal glands
*enterocytes (yellow)
*paneth cells
→secrete lysozyme

*goblet cell
*enteroendocrine cell
→ DNES; hormone-secreting; secrete into lamina propria

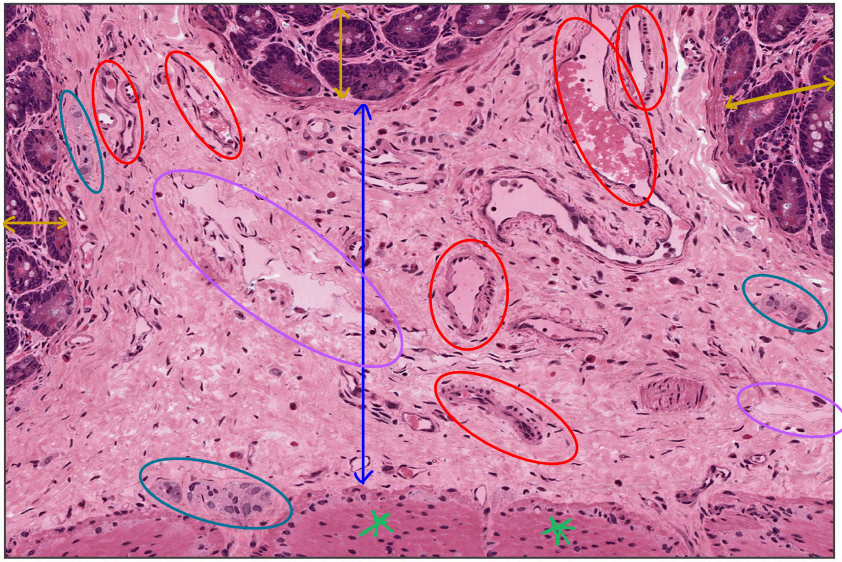




*Peyer's patches (ILEUM!)
*diffuse lymphoid tissues
*Lymphoid nodules
*Muscularis mucosa
*Submucosa

Mucosa-associated lymphoid tissue (MALT) is present all along the length of the tubular digestive tract and consists of both diffuse and nodular lymphoid tissue. Large accumulations of MALT, Peyer's patches, are particularly prominent in the lamina propria of the ileum as shown in these images. Larger lymphoid nodules often extend into the submucosa. MALT filters tissue fluid, detecting foreign antigens and initiating an immune response. 50x, 10x

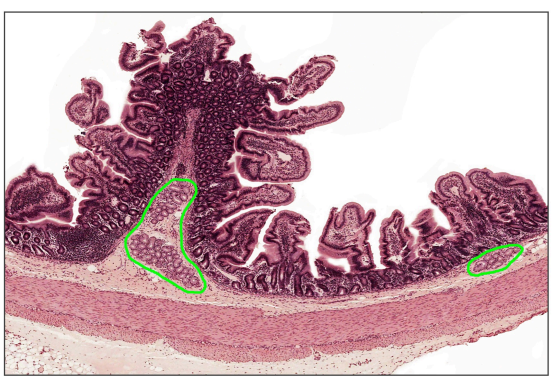
from digital histology



* mucosa
* submucosa
* blood vessels
  * endothelium, RBCs
* lymphatic vessels
  * endothelium, no RBCs
* submucosal (Meissner's) plexus
* muscularis externa

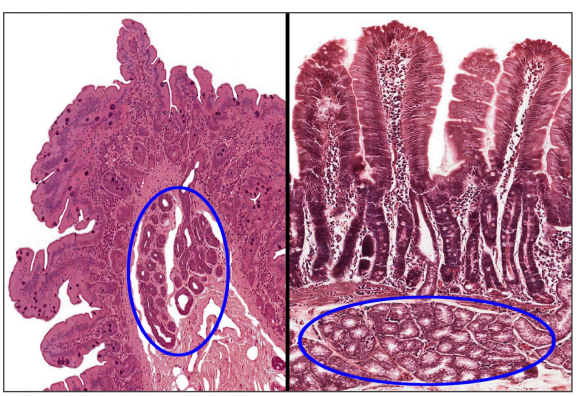
Submucosa

The submucosa consists of dense, irregular connective tissue containing larger blood vessels, nerves and lymphatics. In addition, the submucosa also contains the submucosal (Meissner's) plexus which innervates the smooth muscle of the muscularis mucosae and regulates glandular secretions. 200x



- Submucosal glands (Brunner's glands)

In the duodenum, seen here, the submucosa also contains a mucus-secreting gland, named Brunner's gland. This submucosal gland secretes an alkaline mucus that protects the intestinal mucosa from acidic gastric chyme. These glands are most numerous in the proximal regions of the duodenum. 40x



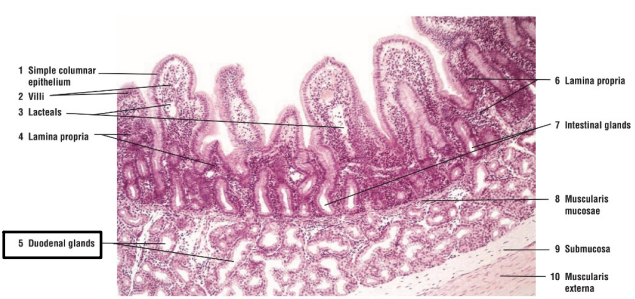
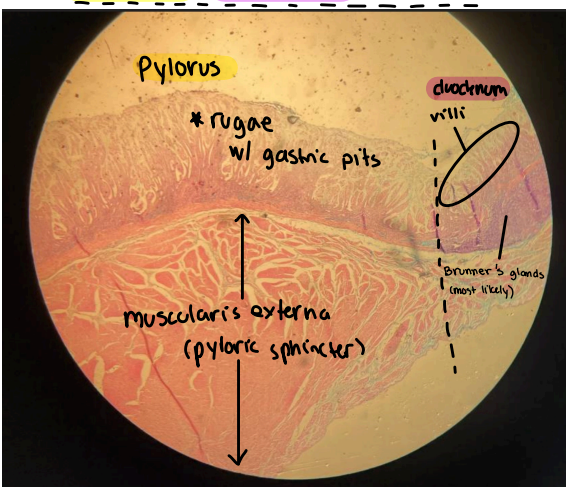


FIGURE 13.2 ■ Small intestine: duodenum (transverse section). Stain: hematoxylin and eosin. ×25.

Lastly, these are sections from the **DUODENUM** b/c of the **Brunner's glands** in the **submucosa**

NOW Let's look at some images from the lab (since these will come on the exam ☺)

Pyloric - Duodenal Junction



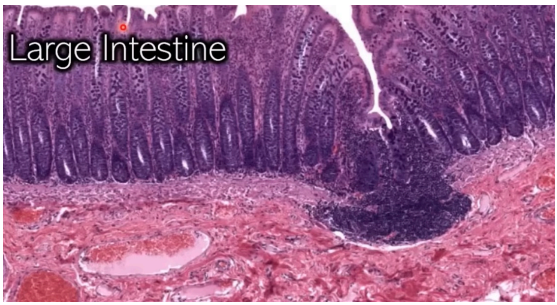
Ileum - Peyer's Patch

Duodenum

* a note I remember from the Histology lab doc: Duodenal villi are leaf-like, while jejunal & ileal villi are more finger-like

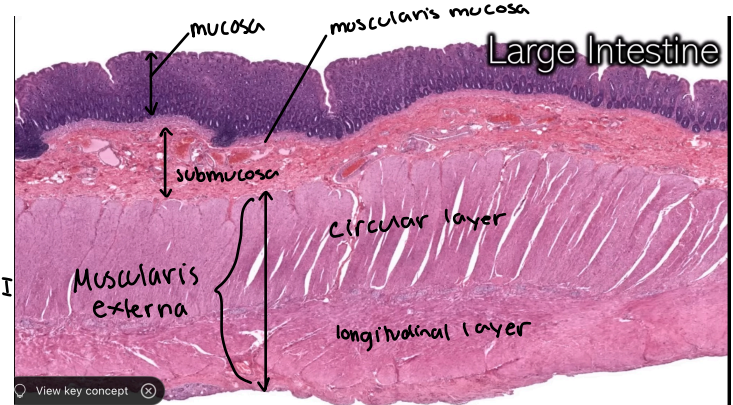
* Distinguishing feature of duodenum = Brunner's glands

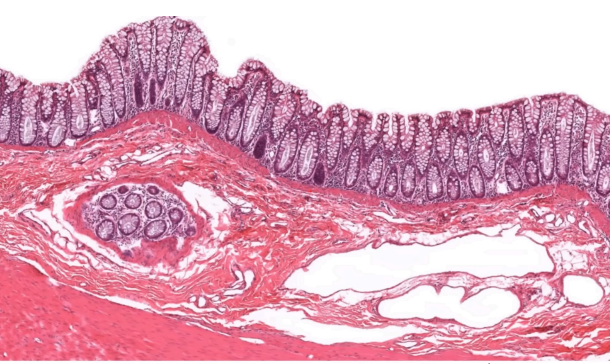
② Large intestine



*larger ridges
↑ looks more organized & regular when compared to the stomach
*simple columnar

*whether it's adventitia or serosa depends on where we are in the colon
*no villi here, but microvilli *are present
More numerous goblet cells than SI





*no finger-like projections so this is large intestine
& A TON of goblet cells!

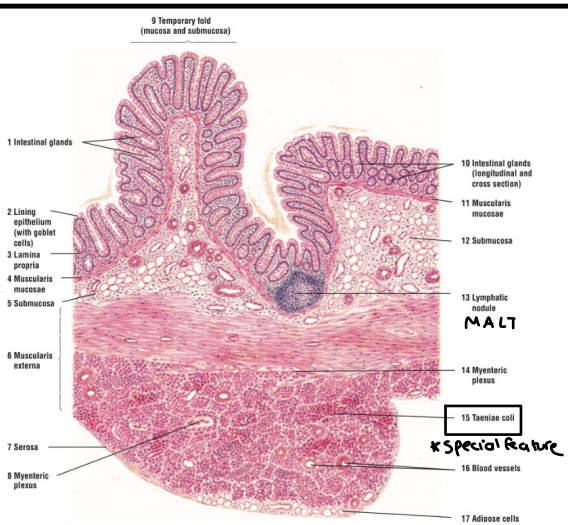
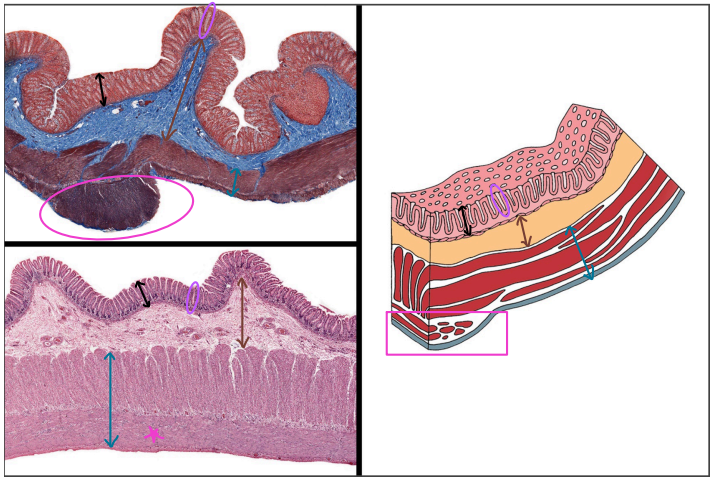
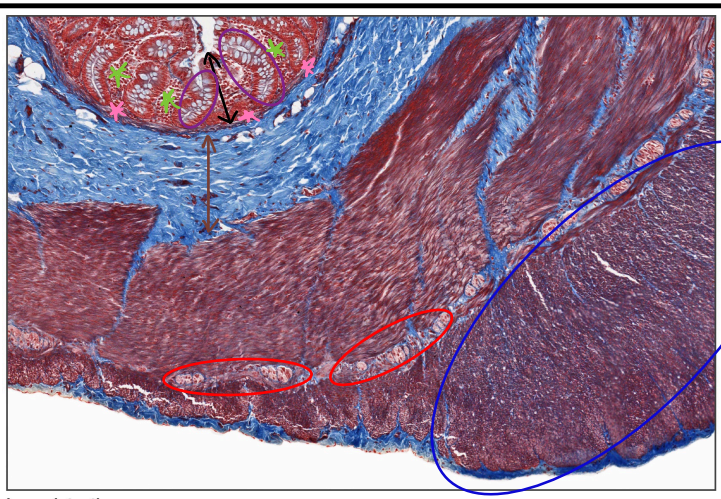


FIGURE 13.10 ■ Large intestine: colon wall (transverse section). Stain: hematoxylin and eosin. Medium magnification.



- mucosa
- submucosa
- taenia coli
- intestinal glands
- muscularis

- mucosa
  - intestinal glands w/ goblet cells
  - lamina propria
  - muscularis mucosae
- submucosa
  - taeniae coli
- Myenteric (Auerbach's) plexus (btwn muscular layers!)



Large intestine

This image shows the layers of the large intestine at higher magnification. 400x

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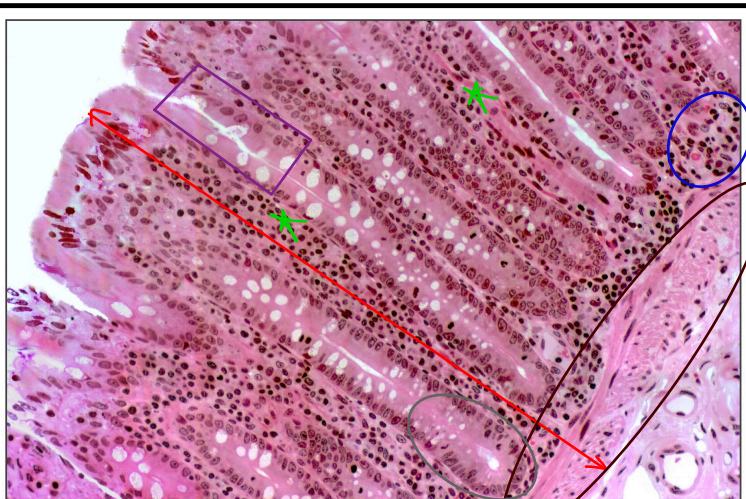
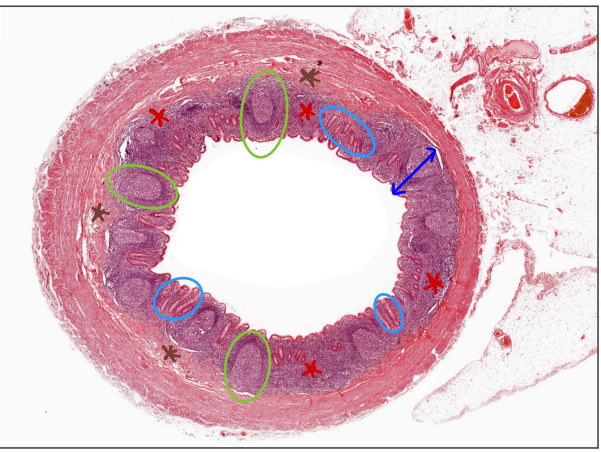


- mucosa
- muscularis mucosae
- lymphocytes
- lamina propria
- intestinal gland (crypts of Lieberkühn)
  - both in large & small intestine
- tubular gland

APPENDIX

* we can tell by the massive lymphoid follicles that occupy most of the submucosa & often extending to mucosa



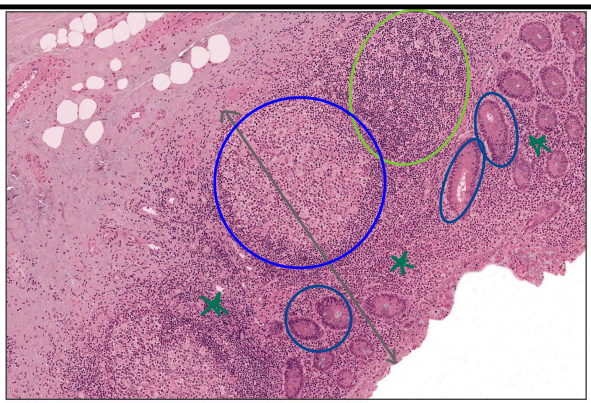
* mucosa
* intestinal glands
* diffuse lymphoid tissue
* MALT nodules - in submucosa

These are secondary lymphoid nodules, characterized by a pale germinal center surrounded by a darker outer zone.

* submucosa

→ NOTE: no taenrae coli here!

* mucosa
* intestinal glands
* diffuse lymphoid tissue
* PRIMARY lymphoid nodule (no pale germinal center)
* SECONDARY lymphoid nodule (pale germinal center!)



Appendix

The mucosa of the appendix resembles that of the colon; straight intestinal glands are located in the lamina propria; villi are not present. Abundant diffuse and nodular lymphoid tissue infiltrate the appendix. 400x

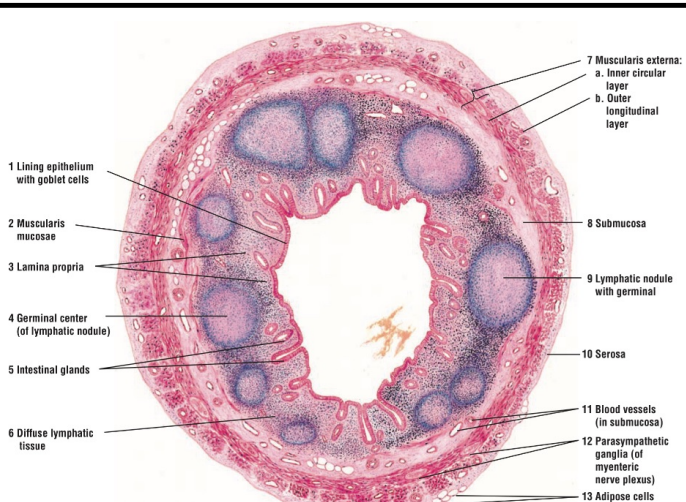


FIGURE 13.11 ■ Appendix (panoramic view, transverse section). Stain: hematoxylin and eosin. Low magnification.

RECTUM

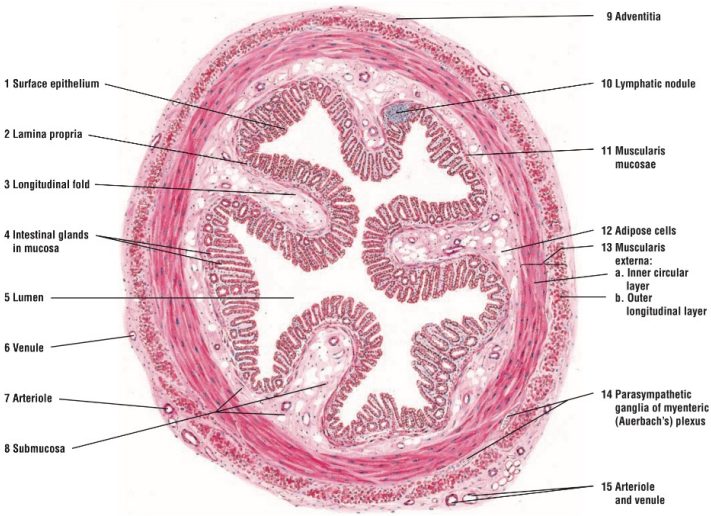
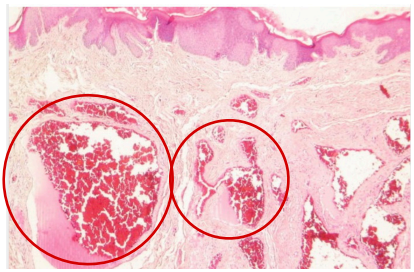


FIGURE 13.12 ■ Rectum (panoramic view, transverse section). Stain: hematoxylin and eosin. Low magnification.

* As I was having trouble distinguishing rectum from large intestine, the Histology Lab Dr. mentioned to me an unique feature of the rectum:- hemorrhoidal plexus in the submucosa



*looking like this

When we look at the ano-rectal junction, it becomes more obvious:-

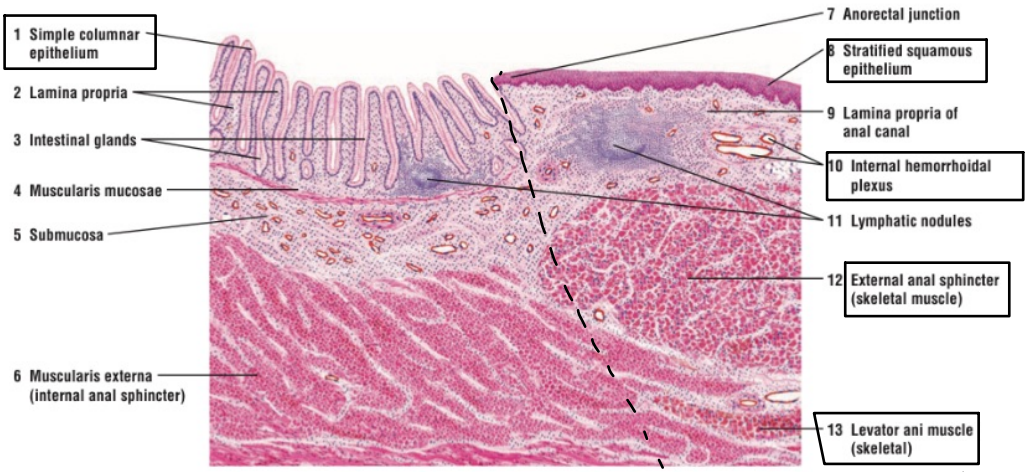
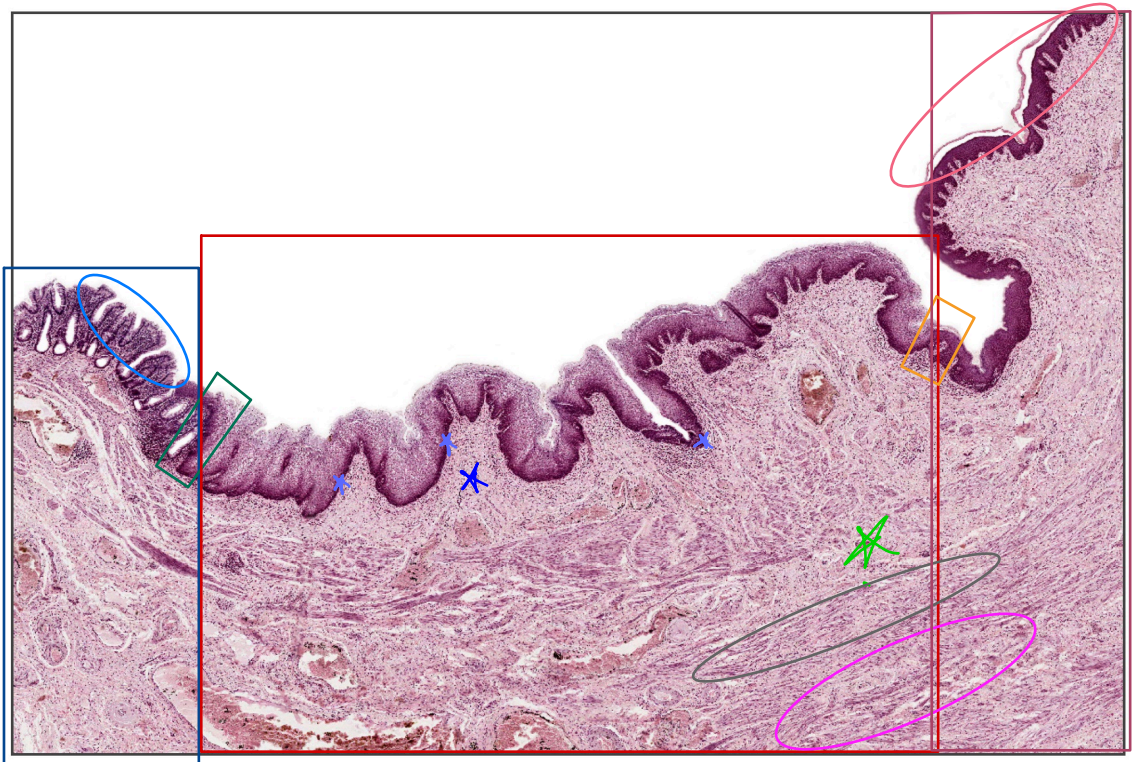


FIGURE 13.13 ■ Anorectal junction (longitudinal section). Stain: hematoxylin and eosin. Low magnification.

* Obviously anus

This image actually shows 2 junctions! see if you can spot them



Recto-anal junction

The epithelium changes abruptly at the junction of the rectum (simple columnar) with the anal canal (stratified squamous moist). The rectum resembles the rest of the large intestine, having straight intestinal glands with many goblet cells. A more gradual transition of the epithelium occurs between the anal canal and the anus, the latter being lined by a stratified squamous, keratinized epithelium.
100x

* Rectum * simple columnar epithelium

* Junction 1: anorectal junction → b/c of the abrupt transition from simple columnar to stratified squamous non-keratinized

* Anal canal → non-keratinized stratified squamous epithelium

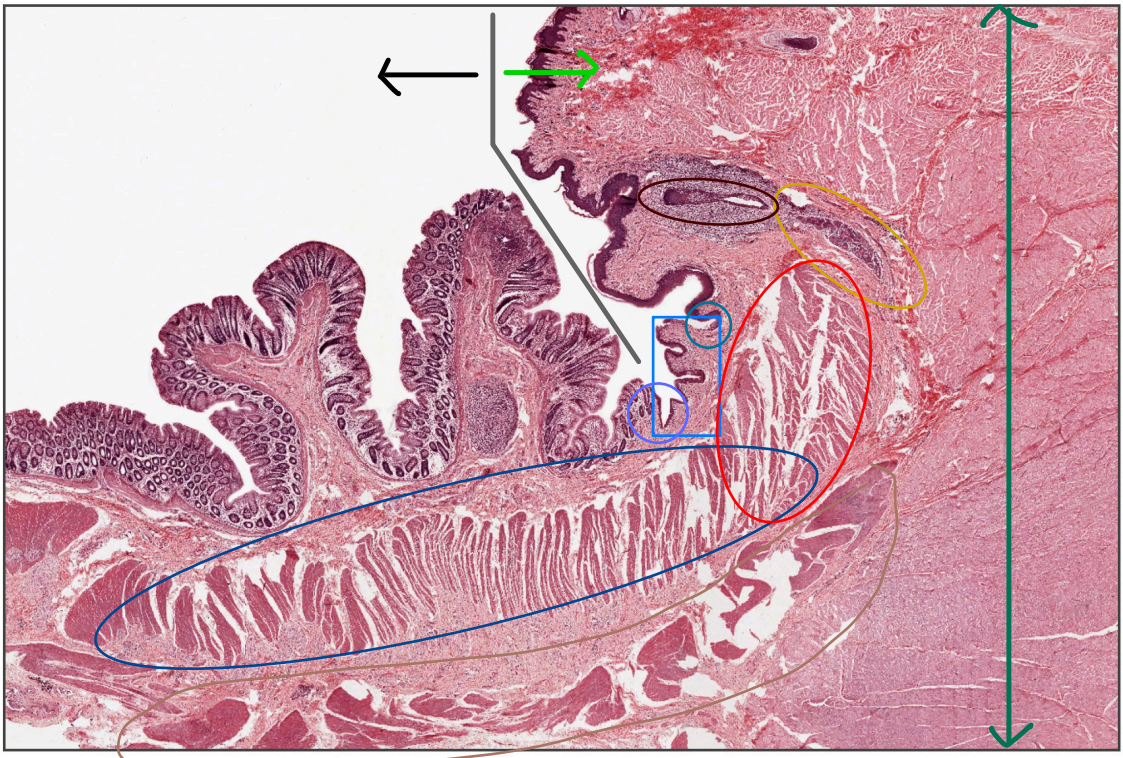
* basal (germinative) layer * lamina propria * submucosa * inner circular muscle layer (internal anal sphincter)

* outer longitudinal muscle layer

* Junction 2: anocutaneous junction (between anal canal and anus) → abrupt transition btwn stratified squamous non-keratinized -&- keratinized

* Anus → keratinized stratified squamous epithelium

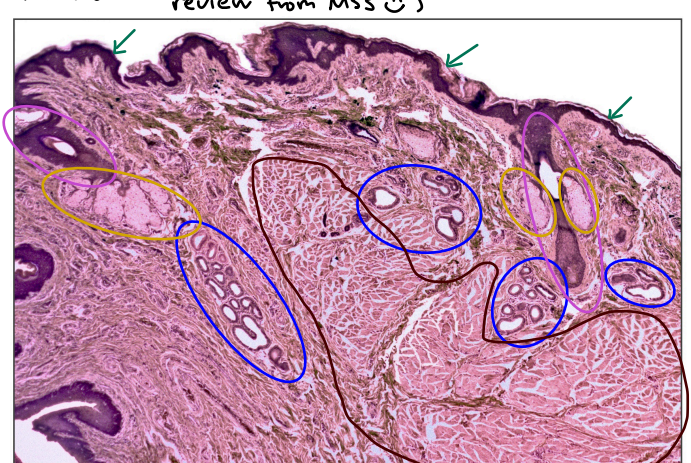
* Stratum corneum (layer of keratin)



*Rectum → simple columnar epithelium * anal canal (non-keratinized)
*recto anal junction *anocutaneous junction * anus * apocrine sweat gland
*hair follicle * muscularis externa (inner layer)
*internal anal sphincter (due to thickening of the layer)
* muscularis externa outer layer * external anal sphincter (skeletal muscle!)

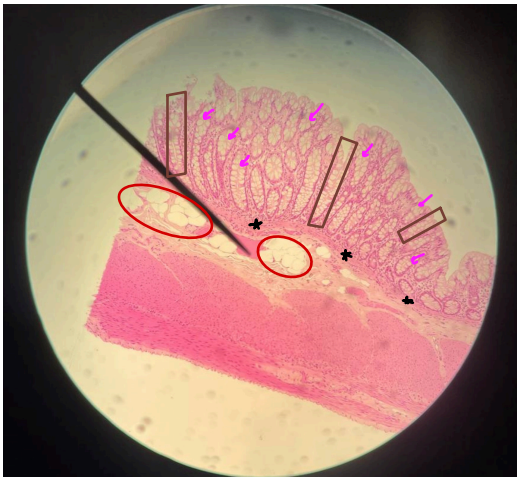
ANUS (specific details may not be included – a little review from MSS 😉)

Anus is cutaneous! Skin!



* apocrine sweat glands
*hair follicles
* sebaceous glands
* stratified squamous keratinized epithelium
*external anal sphincter

Time for some lab pics =)

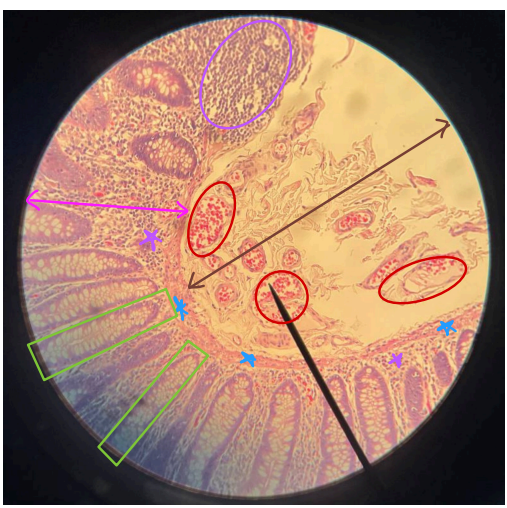


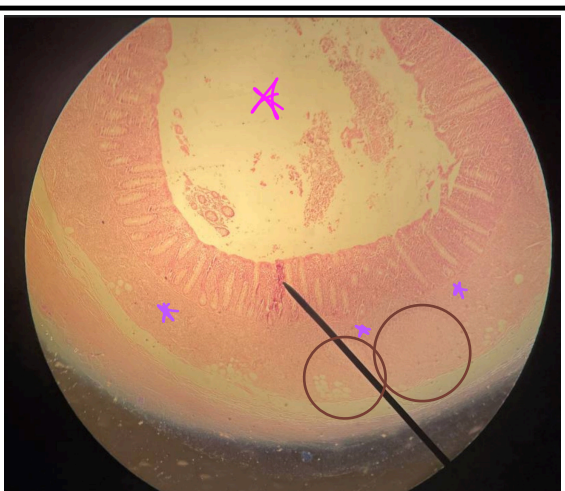
*we can immediately notice the large amount of goblet cells, and the straight crypts and no villi present → this is the colon!

* goblet cells
* crypts of Lieberkühn (straight, test tube shape)
* muscularis mucosae
* submucosal fat

*For the same reasoning as before, by looking at the structure & organization of the crypts, plus the large amount of goblet cells this is the colon

* Mucosa
* submucosa
* scattered lymphoid follicles
* blood vessels
* muscularis mucosae
* crypts





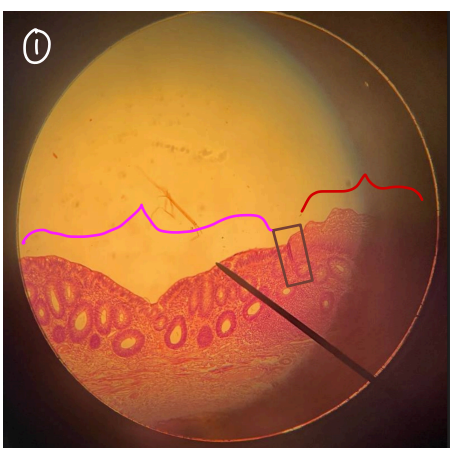
*Looking closely we see the massive amount of lymphoid tissue; therefore, this is an appendix

* lumen
* a little hard to see but these are 2ndry lymphoid nodules with a germinal center
* diffuse lymphoid

*This is also a colon because of the organization of the mucosa, but the special thing here is the haustration present here due to tenaie coli!

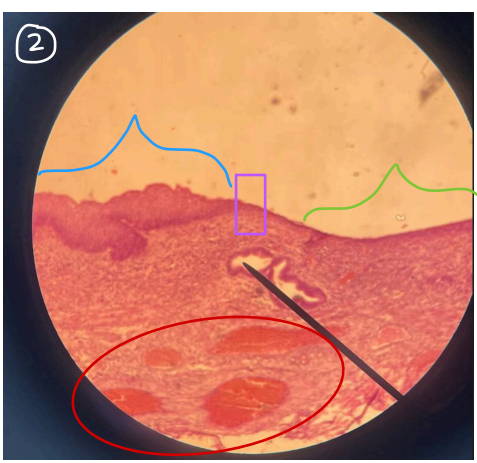
* haustration
* mucosa
* submucosa
* muscularis externa

The following images will show key features of the rectoanal junction:-



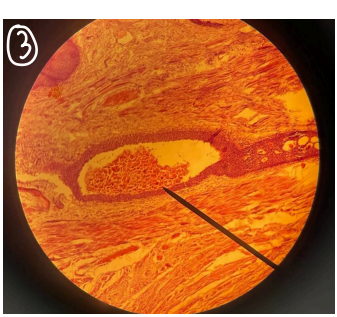
Rectoanal Junction: abrupt change from simple columnar, intestinal crypts to stratified squamous non-keratinized

* rectoanal junction * rectum
* anal canal



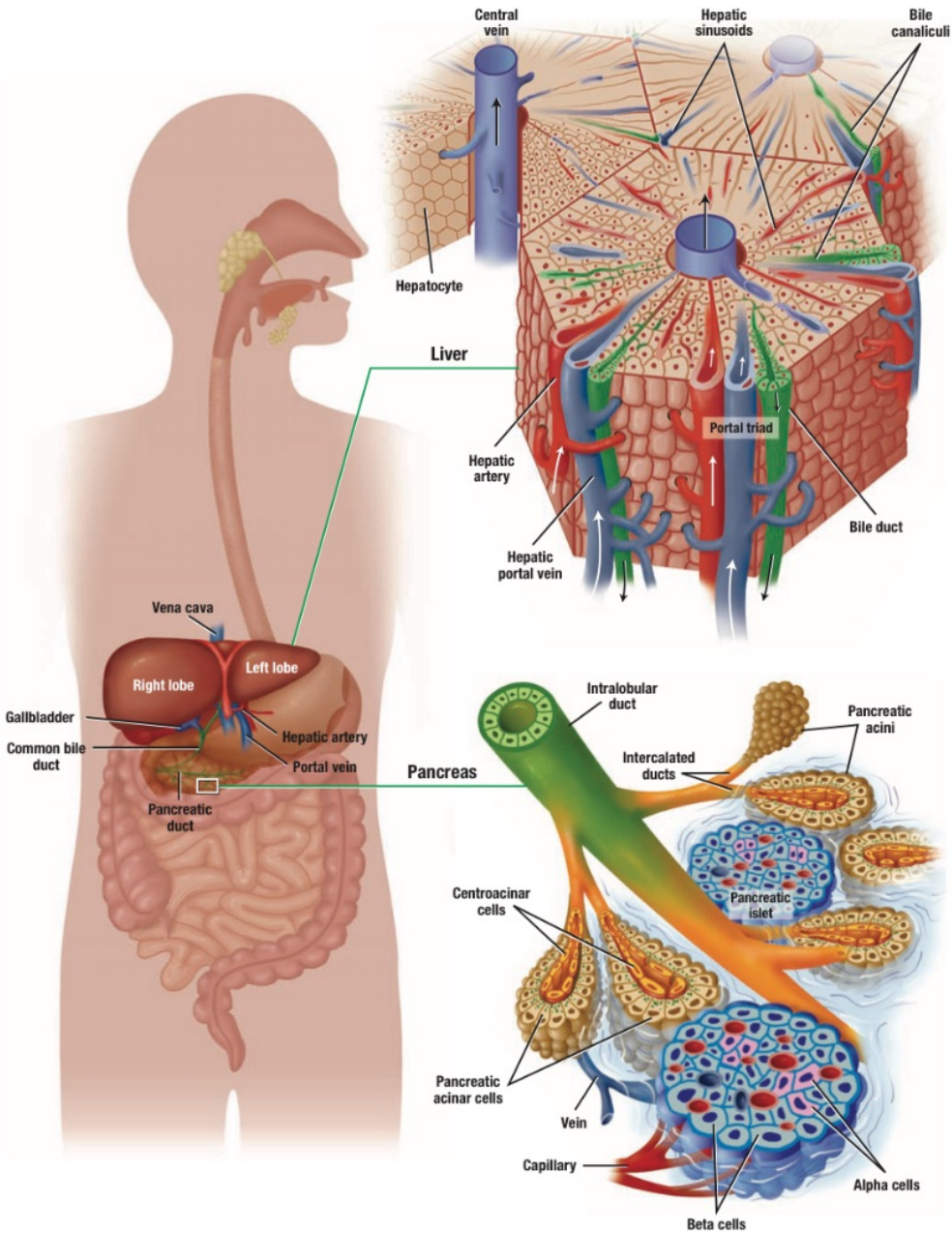
Anocutaneous junction: abrupt change from stratified squamous non-keratinized to keratinized

* anocutaneous junction * anal canal
* anus
* hemmorrhoidal plexus!
  → recall we said this is a distinguishing feature in rectum-ε-anus



this is a closeup of this plexus in the submucosa

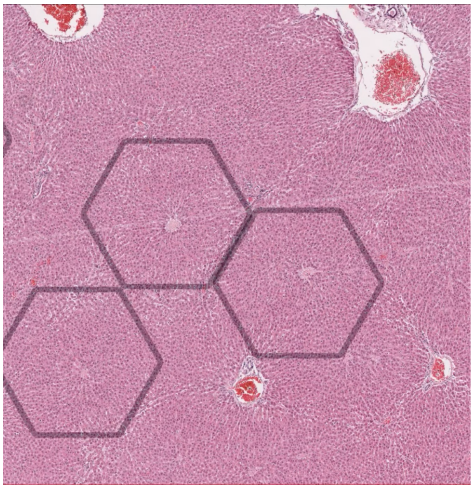
Before we move on, here's a nice figure summarizing gross & histological features of the liver -&- pancreas:



OVERVIEW FIGURE 14 ■ A section from the liver and the pancreas is illustrated, with emphasis on the details of the liver lobule and the duct system of the exocrine pancreas.

③ Liver

*some basics from Down The Scope Microscopy on YT



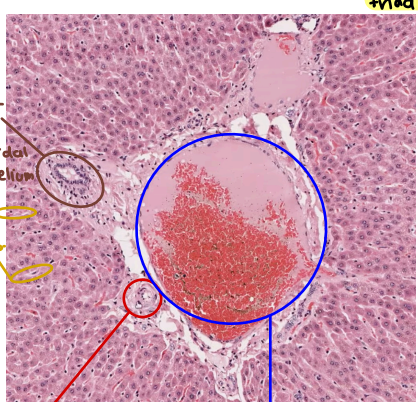
*low magnification under microscope → you can notice the geometric lobules

Liver has 2 sources of blood :-

1) hepatic artery from heart (20-30%)

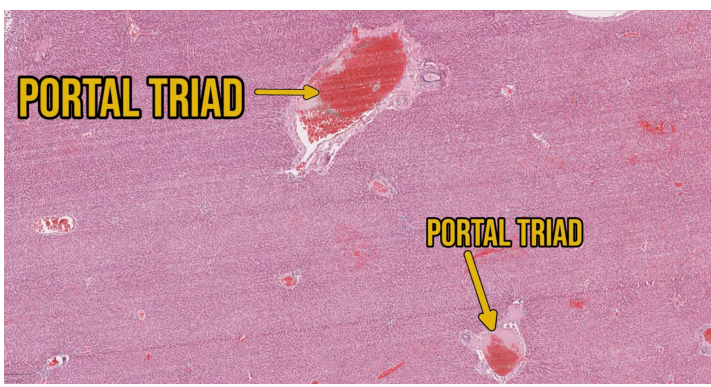
2) hepatic portal vein from intestines (70-80%)

→ Let's take a closer look at a portal triad :-

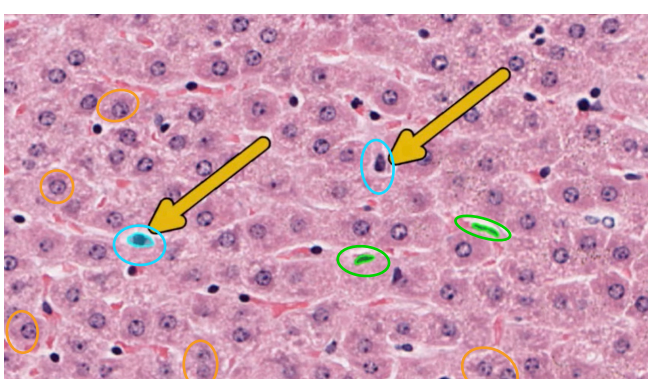


Both have simple squamous endothelial linings

*there should also be lymphatics in this triad =)



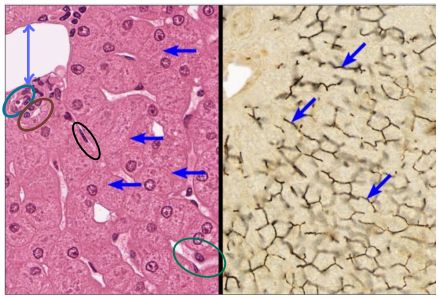
*this is the classic Portal triad, where branches of the HA -&- HPV are located



*endothelial cells lining sinusoids

*Kupffer cells (rounder nuclei & more cytoplasm)

hepatocytes, frequently binucleated



* endothelial (flat nuclei)
* bile canaliculi
* hepatic artery
* kupffer cell
* bile duct
* hepatic portal vein

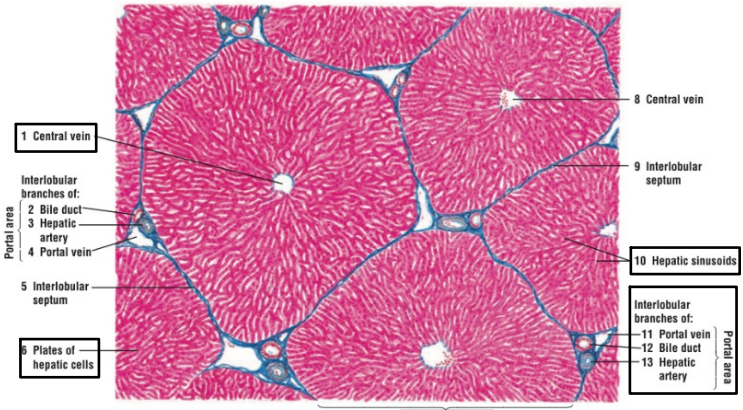
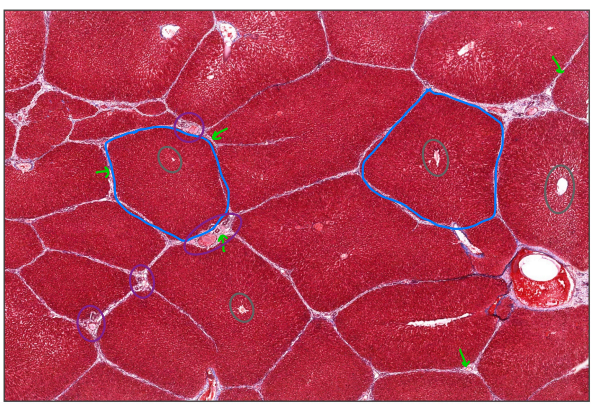
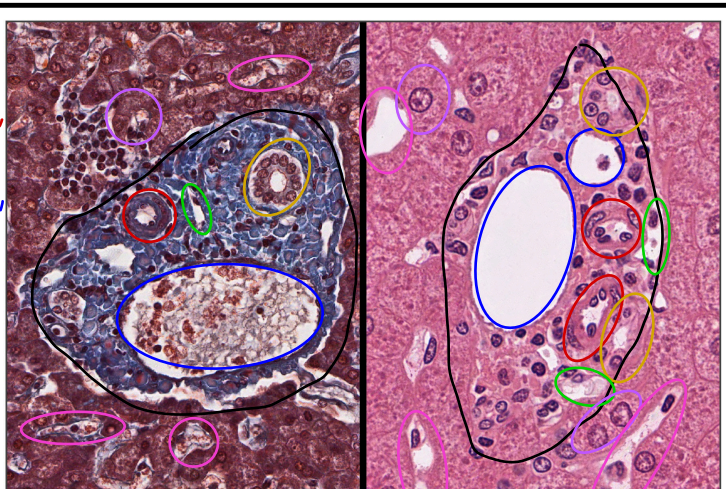


FIGURE 14.1 ■ Pig liver lobules (panoramic view, transverse section). Stain: Mallory-azan. Low magnification.



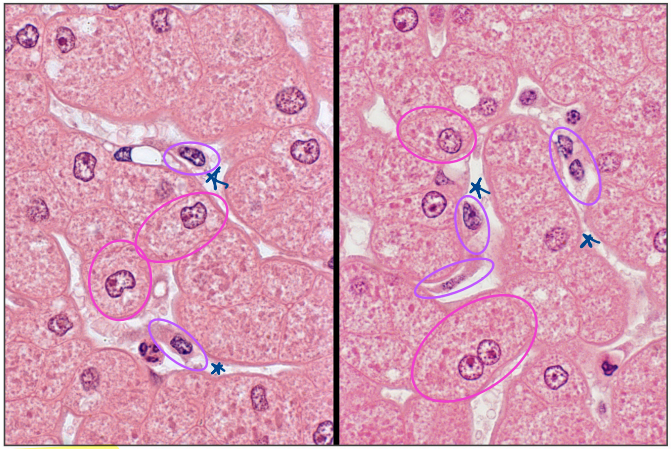
* liver lobules
* connective tissue
* portal triad
* central vein

* portal triads
* hepatic arteries (endothelium, small lumen, thick wall)
* hepatic portal veins (endothelium, large lumen, thin wall)
* bile ducts (simple cuboidal)
* lymphatic canals (clear contents, thin wall, irregular lumen - not round)
* hepatocytes
* sinusoids



Liver: portal canals

Portal canals, located in the interlobular connective tissue surrounding classic lobules, contain the portal triad (branches of the hepatic portal vein, hepatic artery and bile duct) and lymphatic vessels. The left image (pig liver) has been stained with a trichrome stain to differentiate connective tissue from liver parenchyma. 800x, 800x



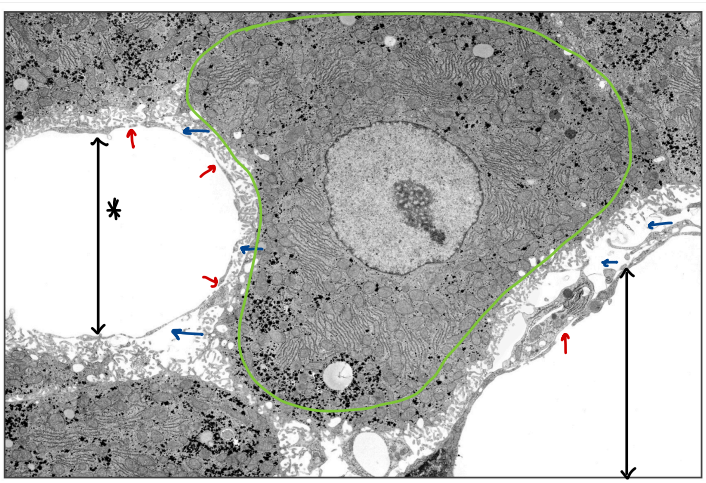
Liver: sinusoids

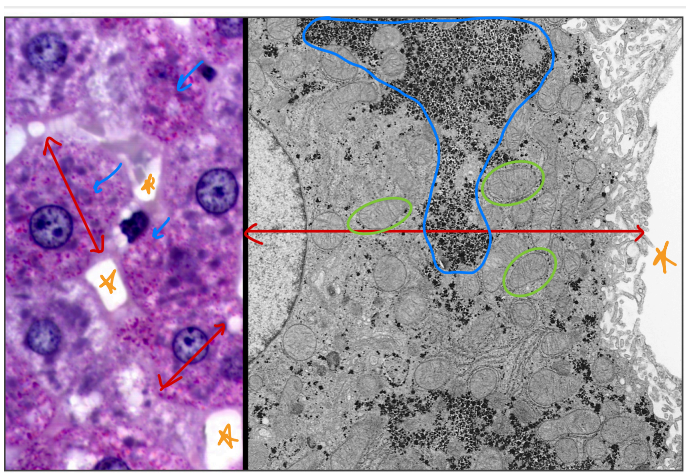
Sinusoids are discontinuous capillaries that separate plates of hepatocytes. Kupffer cells, spanning the lumen of these sinusoids, are a type of macrophage that phagocytose aging red blood cells and other debris in the sinusoidal lumen. Like other macrophages, their cytoplasm contains large numbers of lysosomes and often appears vacuolated and lacy. 1000x

* hepatocytes
* hepatic sinusoids
* kupffer cells

---

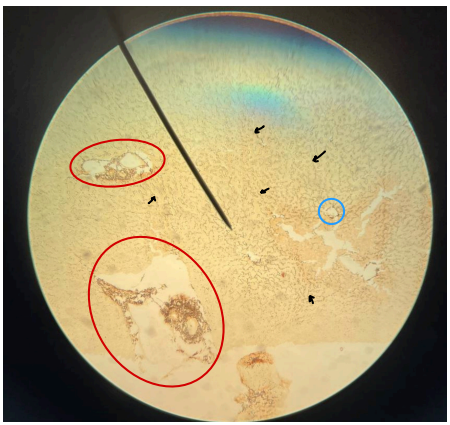
* Sinusoids
  * NOTE: Dr. Ghada mentioned this to be a central vein, but according to the source of the image (digital histology) & the fact that this structure has fenestrations, this should be classified as a sinusoid
* Fenestrations
* Space of Disse
* Hepatocyte





* hepatocytes
* glycogen
* mitochondria
* Sinusoids

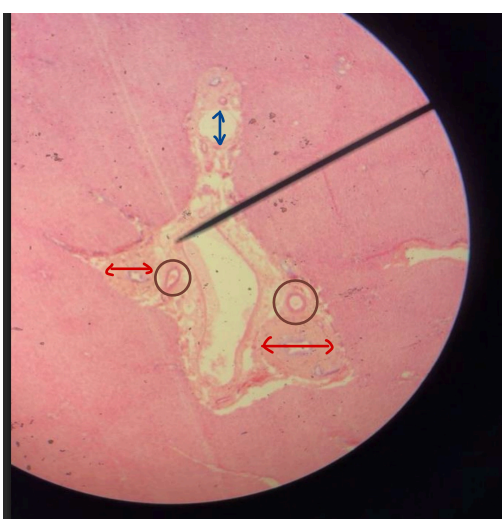
Lab time!



* special stain of the liver to point out the reticulin fibers
* central vein
* portal triads?

Portal Triads

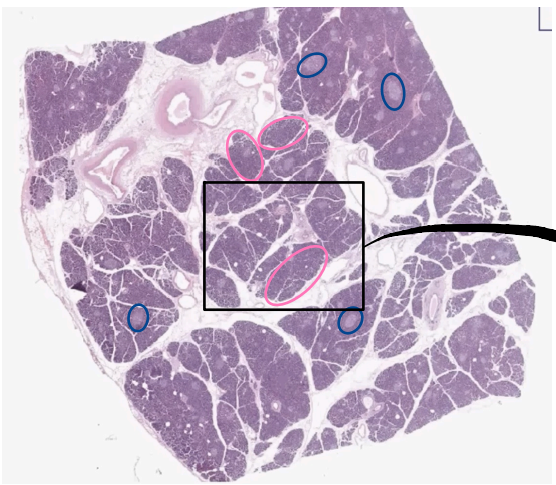
* hepatic artery branches
* portal vein branch
* NOT sure! But I think bile duct branches b/c it looks like simple cuboidal — magnification is too low to tell



④ Pancreas

Quick overview: The pancreas has two functional components. The ① exocrine component makes up most of the organ and consists of secretory acini and zymogenic cells organized into small lobules, separated by connective tissue that carries blood vessels, ducts, and nerves. Scattered within these acini are the ② pancreatic islets of Langerhans, which form the endocrine component and are the defining feature of the pancreas.

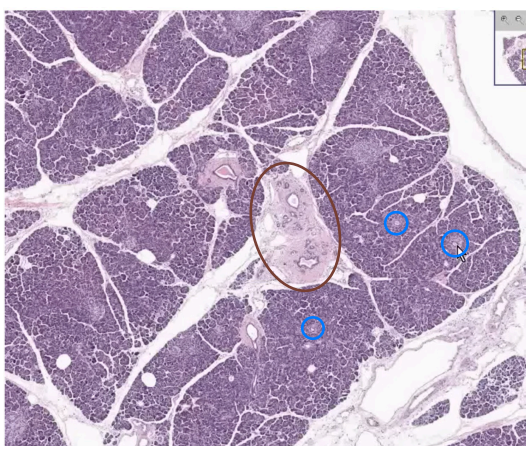
*this is important to distinguish it from a salivary gland!



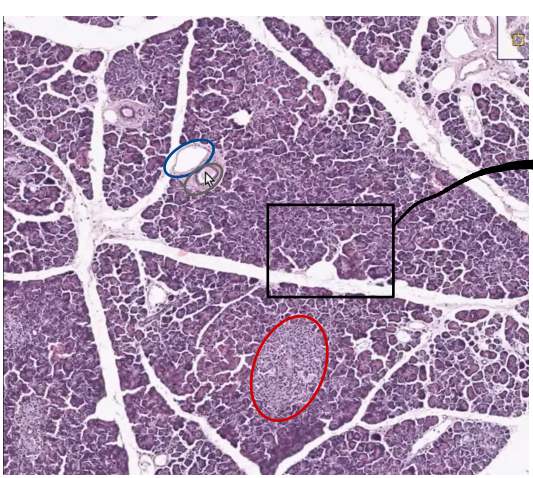
WashingtonDeceit on YT – Shotgun Histology Pancreas

* islets of Langerhans
  → distinguishing feature of pancreas (otherwise it looks like a parotid gland!)

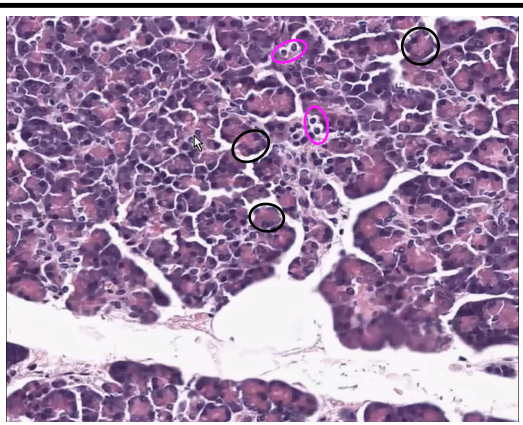
* exocrine lobules



* intralobular ducts * interlobular ducts



* vein * duct (cuboidal/columnar cells) * islet of Langerhans (no ducts)!

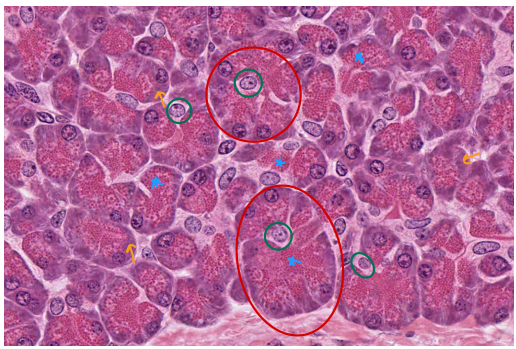


* acini (5-6 cells w/ nuclei @ periphery & zymogen granules in center)
* centroacinar cells (look like fried eggs w/ no granules)

Flow of pancreatic secretions:-

Both considered intralobular

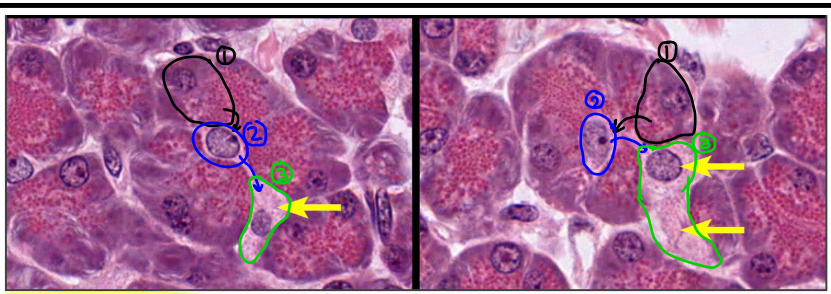
acinar cells → centroacinar cells: intercalated duct pushed into acinus → intercalated duct → intralobular ducts → interlobular duct: btwn lobules in CT septa → Main pancreatic duct of Wirsung



* acini
* basal rough endoplasmic reticulum
* secretory granules
* centroacinar cells (fried egg appearance)

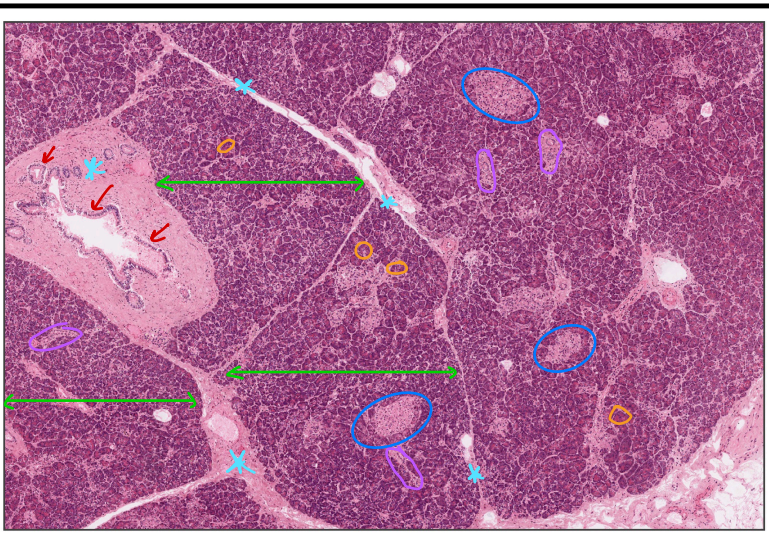
yellow arrows = intercalated duct cells ; note the flow of secretion

① acinar cells → ② centroacinar cells → ③ intercalated duct cells

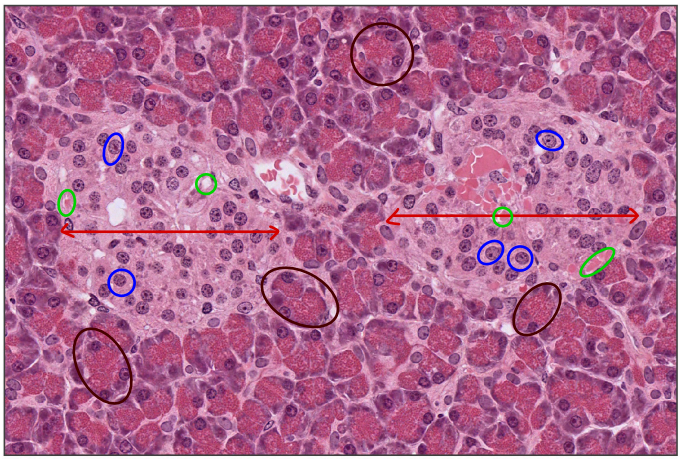


Intercalated duct cells

Images of acini show the beginning of the duct system starting with the centroacinar cells. In the top row, centroacinar cells are seen in the center of the acinus. In the bottom row, the first portion of the intercalated duct is visible as well as its continuity with the centroacinar cells. 1000x

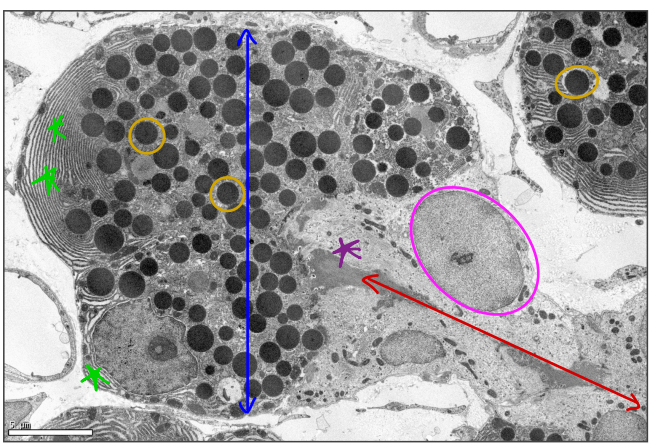


* lobules * acini
* islets of Langerhans (endocrine)
* intralobular duct
* interlobular duct
* interlobular CT



* Islets of Langerhans
* endocrine cells
* capillaries (to carry the cells' secretions)
* acini

* acinus
* rough endoplasmic reticulum
* zymogen granules w/ secretions
* intercalated duct
* nucleus of intercalated duct
* lumen



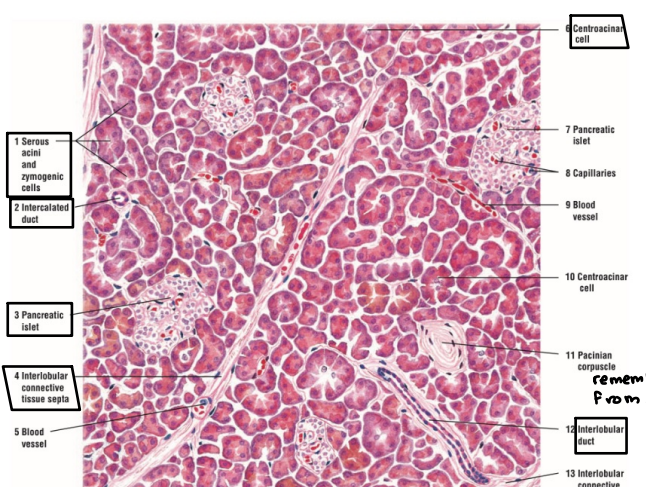


FIGURE 14.10 ■ Exocrine and endocrine pancreas (sectional view). Stain: hematoxylin and eosin. Low magnification.

remember from MSS =)

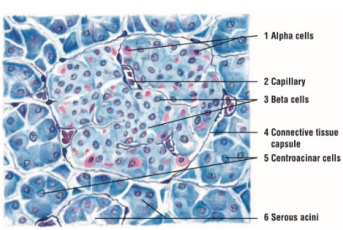
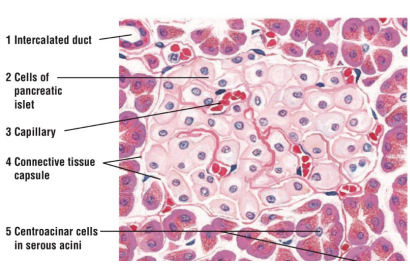
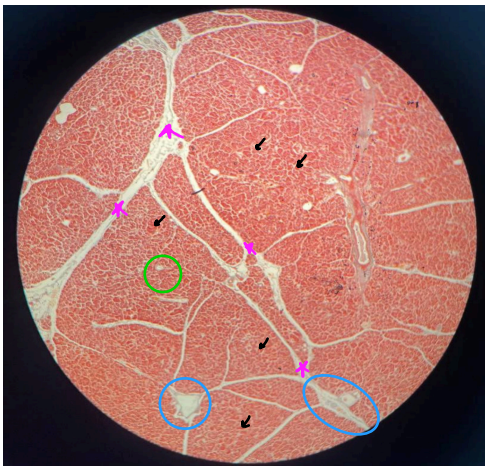


FIGURE 14.12 ■ Pancreatic islet (special preparation). Stain: Gomori's chrome alum hematoxylin and phloxine. High magnification.



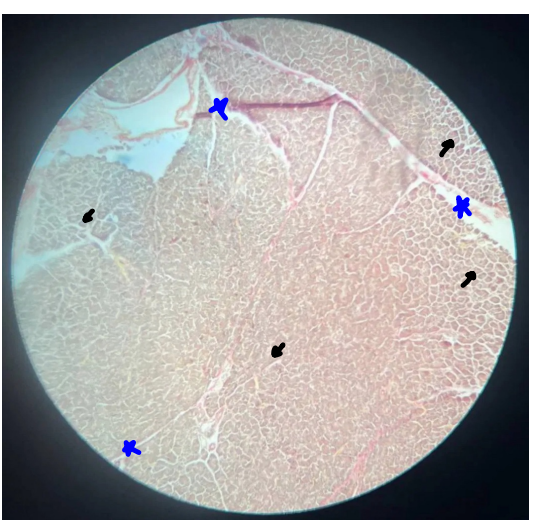
Lab!



* exocrine acini
* possibly intercalated ducts
* interlobular ducts
* CT septa

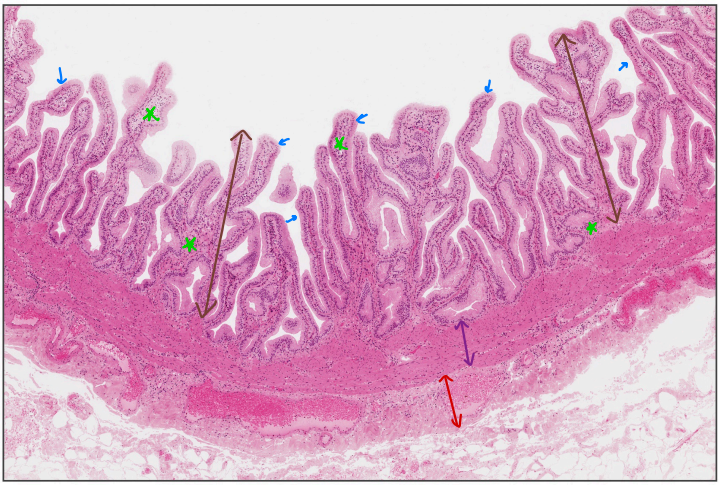
* exocrine acini
* septa

→ this image is too low magnification to notice any obvious ducts

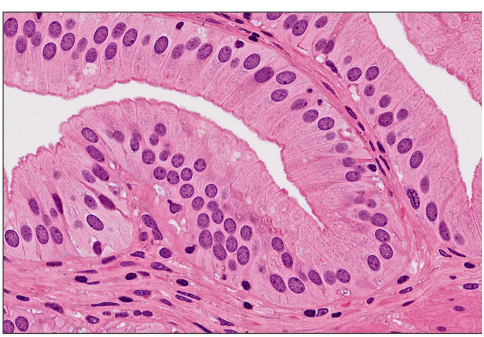


⑤ Gallbladder (last but not least ☺)

* Characteristic feature = **NO SUBMUCOSA**
  - ✓ simple columnar epithelium
  - ✓ rugae (according to slides)



* mucosa
* epithelium (simple columnar)
* lamina propria
* muscularis externa (notice how the submucosa was skipped!)
* serosa



Gall bladder: mucosa

Simple columnar epithelium lines the surface of the gall bladder. Cell nuclei tend to be basally located and the apical surface possesses numerous, short microvilli. The lamina propria, located beneath the epithelium, is quite cellular, including cells of the lymphoid series. 400x

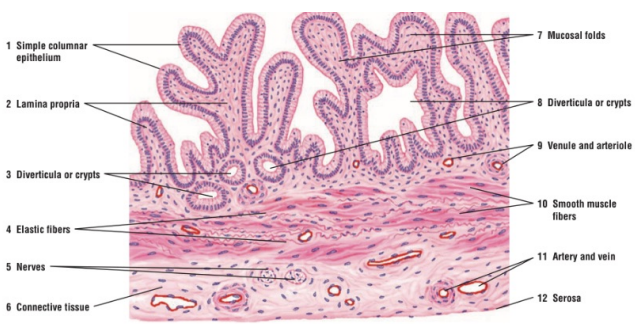
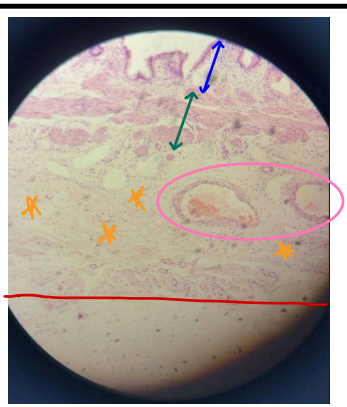


FIGURE 14.9 ■ Wall of gallbladder. Stain: hematoxylin and eosin. Low magnification.

Last Lab pic..

→ notice the immediate transition from mucosa to muscularis externa with NO submucosa!



* mucosa
* muscularis externa
* serosa
* blood vessels
* connective tissue

دعواتكم ❤️

اللّهم إني أستودعك ما قرأت وما حفظت وما تعلمت فرُدّه إليّ عند حاجتي إليه، إنّك على كلّ شيء قدير.

اللّهم أكرمني بسرعة الفهم وثبات العقل والذّهن والذّاكرة.

اللّهم ألهمني الصّواب في الجواب، اللّهم لا سهل إلاّ ما جعلته سهلا وأنت تجعل الحزن سهلا يا أرحم الرّاحمين.