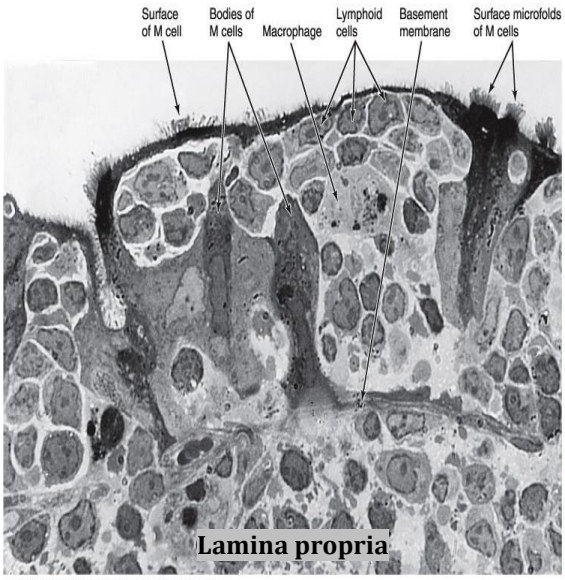
Histology 3

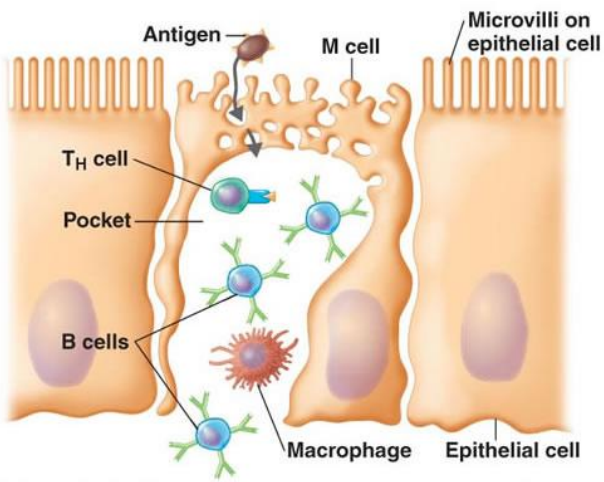
This is the last Histology lecture in the GI system. Enjoy! ☺
There are some extra notes listed as footnotes.

We will continue talking about a few things from last lecture, starting with M cells:

Microfold (M) Cells:

- Follow the gut-associated lymphoid tissue **(GALT)**[1]
- Found in the small intestine, especially the **ileum**, opposite to **Peyer's patches**.
- Have **discontinuities** or interruptions in their **basement membranes**, *and* a number of **lymphocytes and macrophages**, which aids in their function.
- They engulf viruses, bacteria, or foreign bodies, and deliver them to the lymphocytes or macrophages. Therefore, the lymphatic system receives the message, and forms antivirals and antibacterials.
  So, their **function** is: *engulfment*, and *sending messages to* the lymphatic system.





(b) M cells facilitate contact between antigens passing through the intestinal tract and cells of the body's immune system.

The lamina propria of the small intestine has villi, which helps in absorption, and the movement of these villi depends on the nervous system. *Remember:* plicae circularis, villi, and microvilli all help in absorption.

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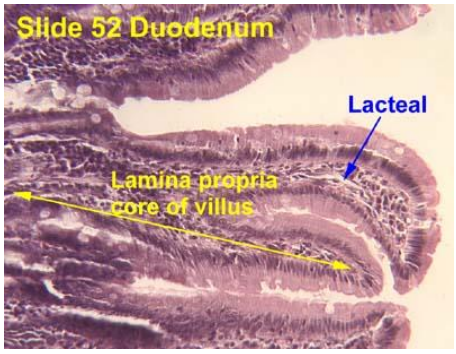
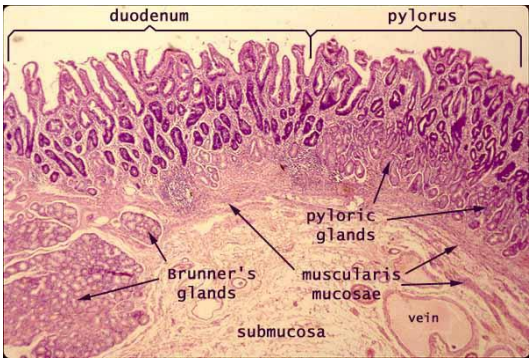
[1] GALT includes antibody-secreting plasma cells, macrophages, and a very large number of lymphocytes located in both the mucosa and the submucosa. M cells actually endocytose antigens and **transport them to the underlying GALT**.

All the absorptive material should go through the portal vein to the liver, but we have the **lacteals**, which are special lymphatic capillaries for the absorption of *fat*. So, part of the fat goes to the lymphatic system through lacteals.

In the small intestine, especially the **duodenum**, the **submucosa** contains tubular glands called **Brunner's glands**. Their function is secretion of an **alkaline** solution (pH 8.1-9.3), which **neutralizes** the acidic chyme of the pylorus. However, as we know, the first inch of duodenum remains a common site for *duodenal ulcer*.

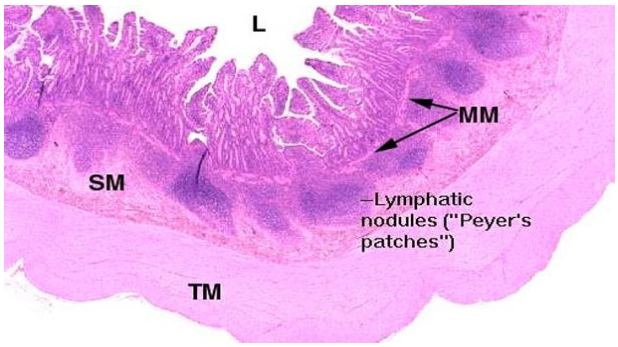


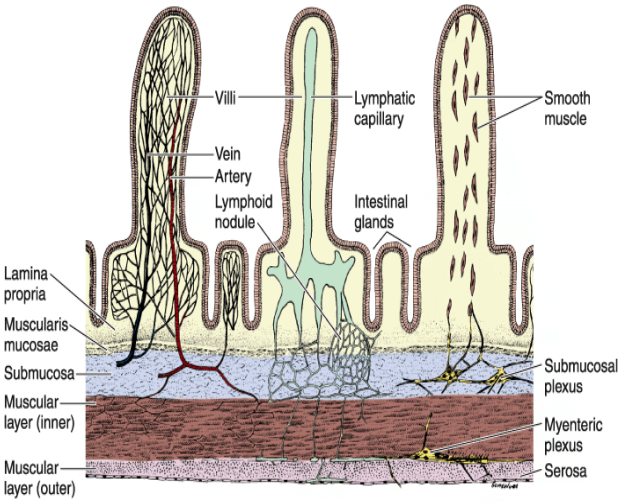


Peyer's Patches:

- Common feature and characteristic of **ileum**.
- A type of **GALT**.
- *Remember:* lymphocytes increase as we go distally in the GIT, and appear as **lymphatic nodules** in the lamina propria or submucosa. In the ileum, they're known as **Peyer's patches**.
- As we know, opposite to them are M cells(Microfold cells).

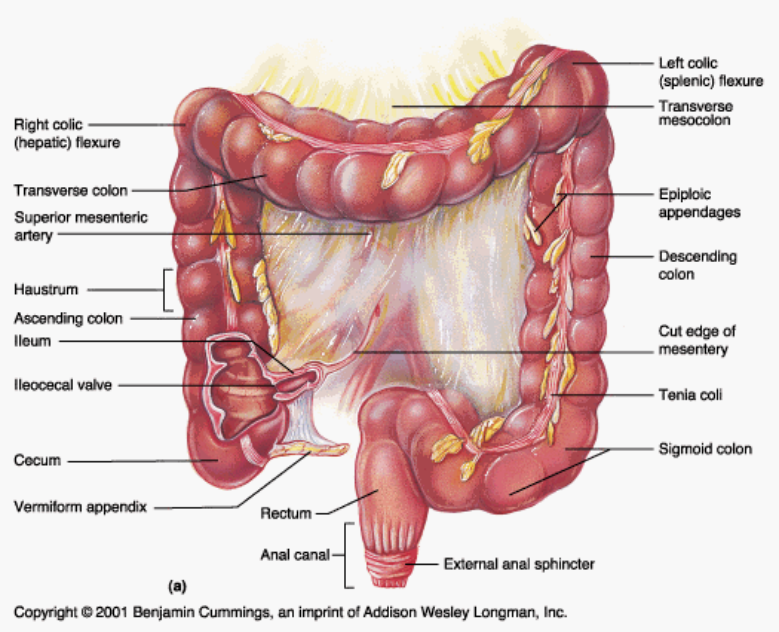
The muscularis externa, as usual, has a **myenteric plexus** of nerves between its outer longitudinal and inner circular layers, which is considered **parasympathetic**; responsible for the peristaltic movement of the small intestine, and is secretomotor to the gland. There's also **Meissner's plexus** in the submucosa; responsible for muscularis mucosa and the glands in the lamina propria.

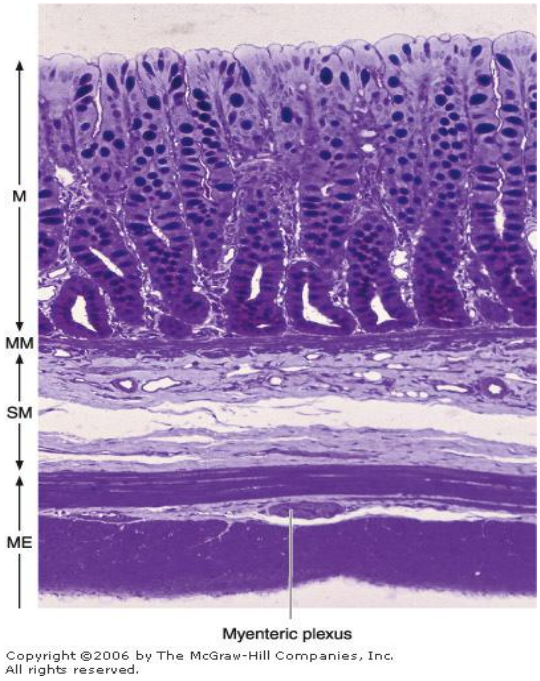




- Some **clinical points** about the **peristaltic movement:**
  After operations, the patient remains **NPO**[2], i.e. **nothing by mouth**. He/she is not allowed to eat nor drink. The Dr. keeps coming and putting the stethoscope on the patient's abdomen, to hear the motility of the small intestine. This indicates that, after **anesthesia**, the **parasympathetic fibers** of the **myenteric** plexus need time until they can be stimulated and active again. Thus, the small intestine remains without motility *for a period of time*; until the motility is heard again, then the patient is allowed to drink then eat.

LARGE INTESTINE (ascending colon, transverse colon, descending colon, sigmoid colon, rectum, and anal canal): Has the same layers of the GIT, but differences occur within each layer.



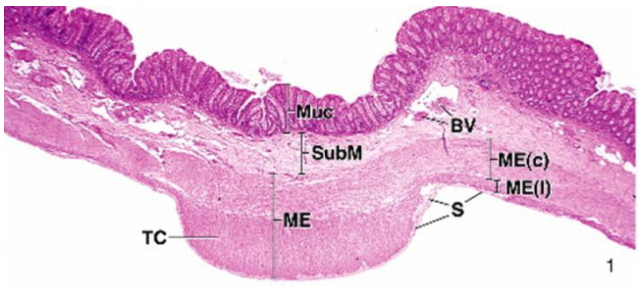


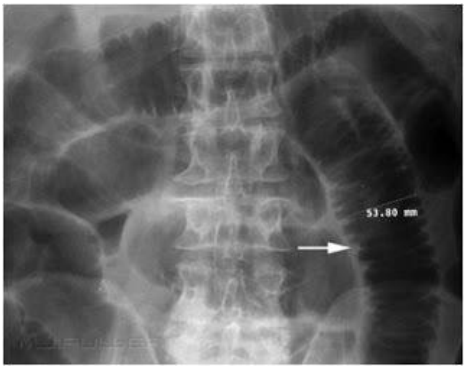
[2] NPO: Nil Per Os; Latin for "nothing by mouth."

Comparison between the small and large intestines:

	Small Intestine	Large Intestine
Function	Mainly **absorption**	Absorption of water **and** formation of feces (needs more *lubrication*)
1- Mucosa: Has finger-like projections/**Villi**	✓	✗ (Has a **smooth** surface)
Epithelial cells	Simple columnar	Simple columnar
Goblet cells (in the *epithelium*)	Numerous	More numerous (*lubrication*)
Microvilli	Very numerous[3]	Found on surface, but **few & short** (very small)
Glands	Crypts of Lieberkühn	Crypts of Lieberkühn, but as **straight tubular** glands. (Fill the lamina propria, and open on the surface)
Gland's cell types	Simple columnar, absorptive, enteroendocrine, stem, & Paneth's cells	All *except* **Paneth's cells**
Goblet cells (in the *gland*)	Numerous	More numerous
Muscularis mucosa	✓	Well-developed (more prominent)
2- Submucosa: Lymphoid tissue	GALT, found in the form of Payer's patches	**More** abundant/prominent GALT, found as lymphatic nodules*, and lymphocytes may reach the lamina propria.
3- Muscularis Externa:	**No** taeniae coli	Has **taeniae coli***
4- Serosa: Appendices epiploicae*	✗	✓

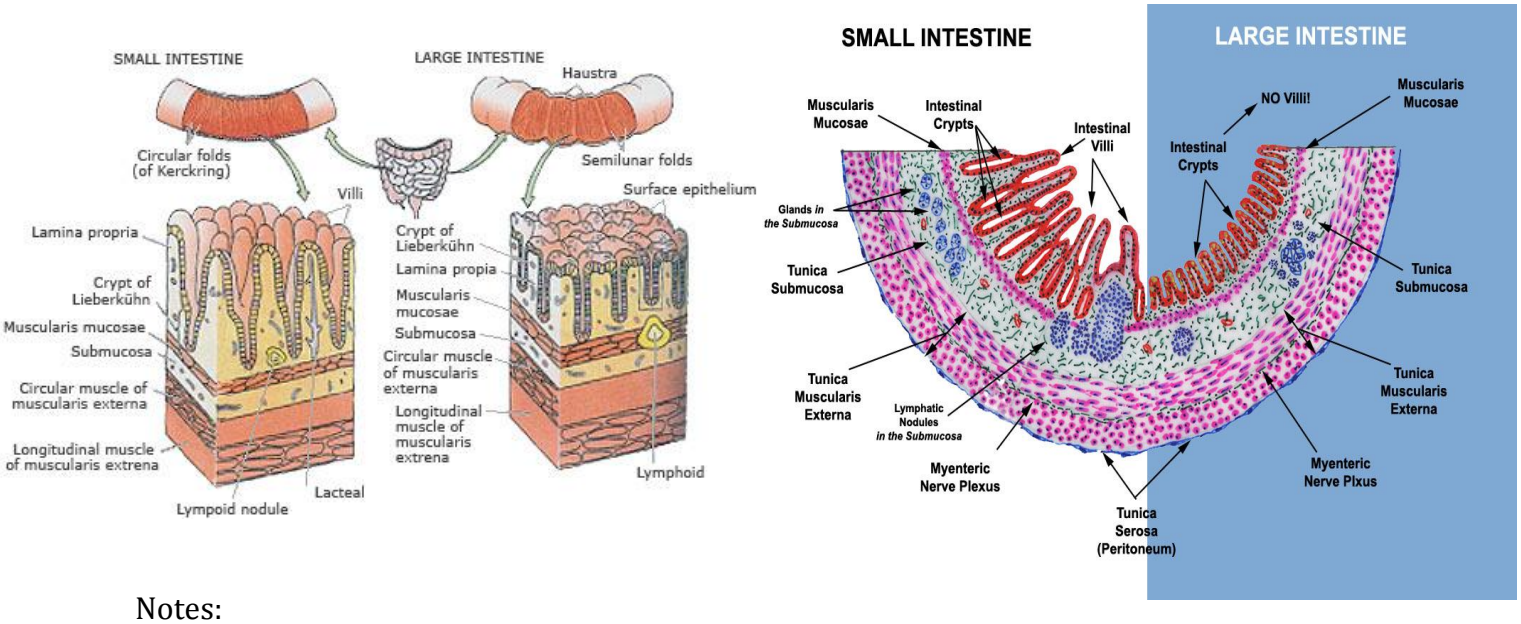
* Solitary lymphatic nodules can be found in the lamina propria or submucosa.
* Taeniae coli: **thickening** of **3 bands of** the outer longitudinal smooth muscles *on* one side of the large intestine's surface. It causes shrinkage on one side of the surface. This is why the large intestine has **sacculation** or **haustration,** which is unique, and helps distinguish it from the small intestine, even on X-ray.





[3] *Remember:* They form a "striated/brush border"

* **<u>Appendices epiploicae</u>**: **tags of fat** attached to the **serosa** (close to the abdomen or peritoneum). Also characteristic of the large intestine, and helps distinguish it from the small intestine.



Notes:

*The crypts of Lieberkühn in small intestines contain Paneth's cells, while in the large intestines they are straight and tubular glands, and they doesn't have Paneth's cells. They fill the lamina propria and open on the surface.

*We can find solitary lymphatic nodules in the lamina propria or the submucosa .

<u>The Anal Canal:</u>

- The only part of the large intestine which has *different* characteristics than the ones mentioned above.
- Its mucosa has a longitudinal folding called the **anal column**; unique to the anal canal, and it forms at its end the **anal valves and sinuses** (at the orifice).
- After the mucosal epithelium was simple columnar, it changes to become **stratified squamous epithelium** in the anal canal; due to exposure to friction and injury. And at the orifice it becomes **skin** with hair follicles.

(A section in the appendix will be covered during the lab.)

* <u>The stem (renewal) cells of the:</u>

- **Stomach** → found at the **neck** of the glands; may move *upwards or downwards*, and need **5-7 days** for renewal.(Note : it is 4-7 days in the slides, but the doctor said in the lecture : 5-7 days)
- **Small intestine** → found mainly at the **base**; their movement is usually *upwards*, and takes about **3-6 days**.

- **Large intestine** → at the **base** (like the small intestine), but take **5-7 days** to move to the maturation area.

The Liver:

- The **largest gland** in the GIT.
- One of the associated organs of the GIT.
- Located at the **right hypochondriac** region, and extends to the **epigastric** region, *especially* the left lobe.
- Has **5 surfaces**: anterior, right, superior, posterior, and visceral.
- Weighs 1.5-2 kg (large)
- **$^1/_8$ liver** is sufficient for the body function; if $^7/_8$ liver is diseased there wouldn't be a problem, but the problem is when a person wakes up to find the whole liver diseased, ex. *fibrosis of the whole liver*; the most common cause of which is alcoholism.
- Its cells are called *hepatocytes* (have a rounded nucleus, and are usually binuncleated; as they have a huge function), and its macrophages are called *Kupffer cells* (dark).
- **All** the absorbed material in the GIT, after **digestion** (into simple molecules), reaches the liver through **portal vein**.
- **Functions:**

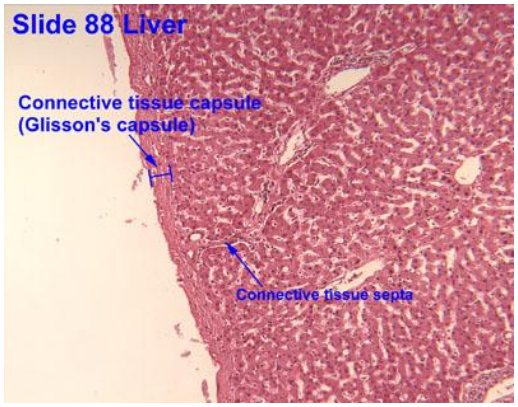
  1- Exocrine Gland: formation of **bile and bile salts**, used in the digestion of *fat*. The **common bile duct** collects from the liver and gallbladder, and sends *to the duodenum*.

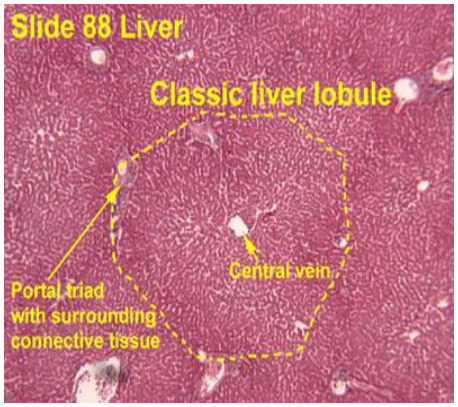
  2- Endocrine Gland: synthesis of hormones and proteins, like albumin, fibrinogen, prothrombin, and thrombin.

  3- Synthesis of **Heparin**, an **anticoagulant**,

  4- Synthesis of **coagulative material**. (Notice the opposite functions)

  5- Storage of Glycogen, important for energy.

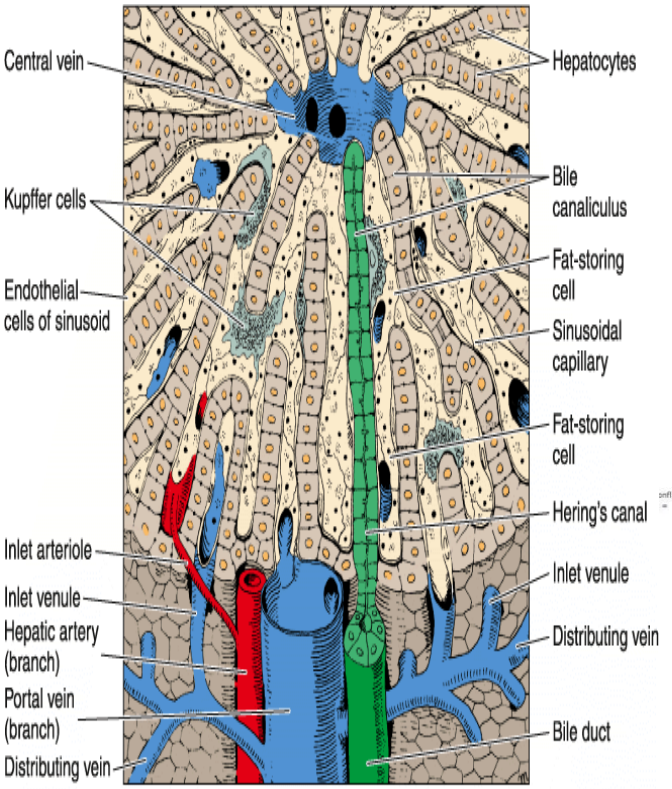


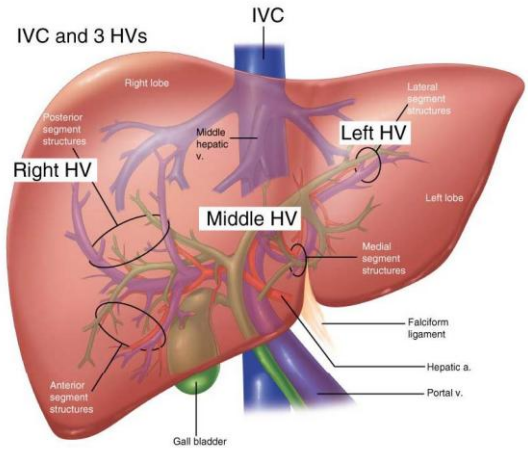


Since the liver is gland, it's surrounded by a **CT capsule** (**<u>Glisson's capsule</u>**), and divided by septa into lobes and lobules. The *hexagonal lobules* of the liver are called **"Classic lobules",** and the centre of each lobule is the **central vein**. The hepatocytes are arranged **radially towards** the **central vein**.

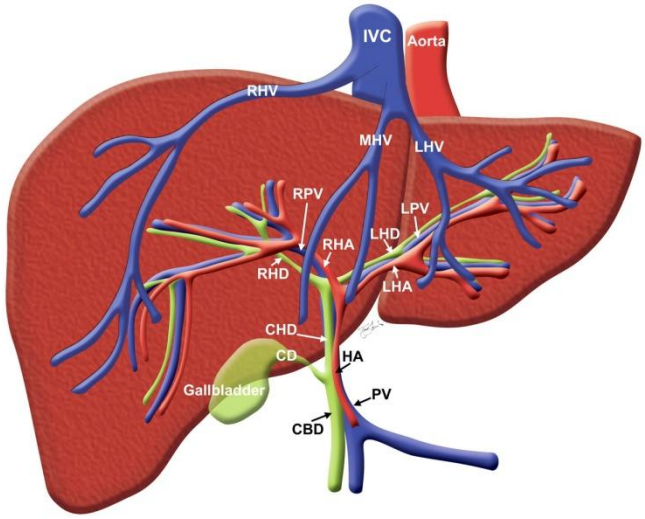
The blood supply of the liver is by: **hepatic artery**, a branch from the celiac trunk of the abdominal aorta, it carries *oxygenated blood* and enters through the <u>hilum</u> of the liver, or **porta hepatis.** There are *spaces* between the columns of hepatocytes called **blood sinusoids**, in which blood is collected from the artery *or* portal vein. The **portal vein** also **accompanies** the hepatic artery; it enters the porta hepatis and goes towards the central vein as well. However, the **portal vein's blood** contains **absorptive material,** unlike the hepatic artery containing oxygenated blood, and both go to the **hepatocytes**.

After the hepatocytes have performed their function, they secrete the **bile and bile salts**, which move in an **opposite direction to** the hepatic artery and portal vein; **towards** the porta heptis, and are collected into the **common bile duct**, which empties into the duodenum. The venous blood (containing CO_2 and waste products) after the activity of hepatocytes will drain into the **central vein** of the liver lobule, which is therefore considered the **venous drainage** of the hepatocytes. Central veins drain into **3 hepatic veins (right, left & central)**, which drain into the inferior vena cava (IVC).
* The **<u>hepatic</u> <u>veins</u>** are considered the **venous drainage** of the liver, and not portal vein.

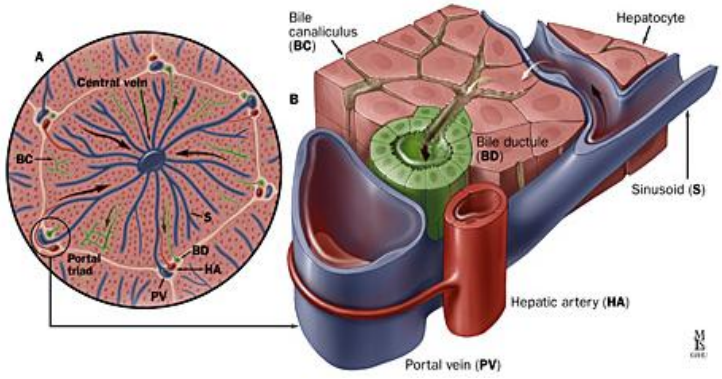




influence of the three hepatic veins (HVs) and the inferior vena cava (IVC). Note that the middle and left hepatic veins (HVs) drain into a common trunk before entering the IVC.

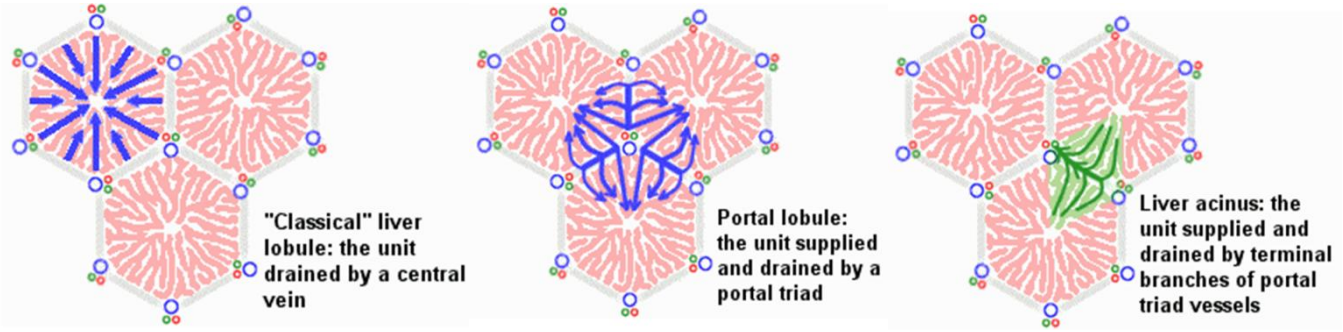


<u>Portal Triad:</u> at the *edges* of the hexagonal (classical) lobules, each triad contains: **hepatic artery, portal vein,** and the **bile duct** (which are all important to the hepatocyte).



There are **3 types of liver lobules:**
1- Classical lobule: *central vein* at the centre. (The unit is drained by central vein).
2- Portal lobule: its centre is the **portal triad**, ("or porta hepatis", which receives all bile)
3- *Liver acinus:* diamond in shape; between 2 central lobules **and** 2 portal triads.

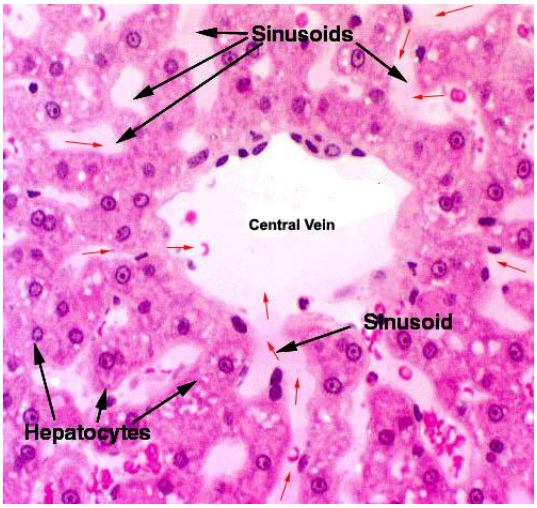
Q)Which area has the **most amounts of oxygen**; the line between 2 portal triads, or that between 2 central veins?
Between **2 portal triads**. Thus, the hepatocytes **around** this line would be **more active** than those around central vein.

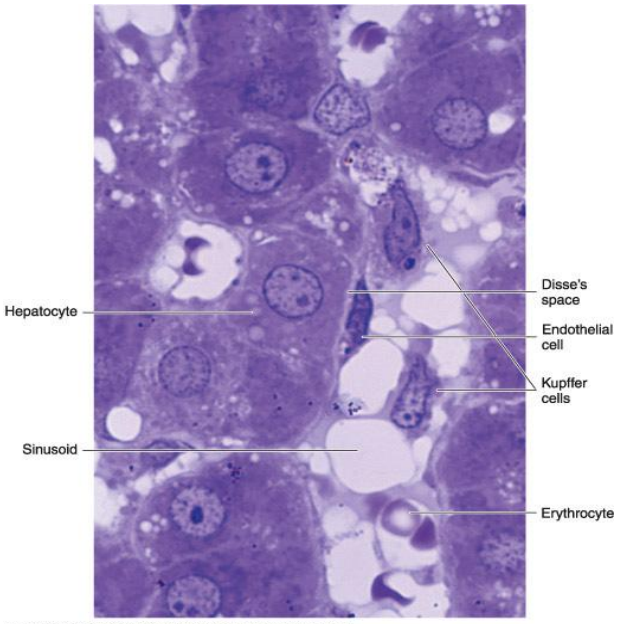


Note: the classical lobule has portal triads on it's edges.

The *type* of blood collected in the blood **sinusoids** between the hepatocytes is **mixed blood**; containing oxygen **and** absorptive material, and it goes to the hepatocytes for their function, while the venous blood is collected at the central vein, so the sinusoid are directed towards the central vein.

Sinusoidal capillaries: are irregularly dilated vessels composed of a discontinuous layer of **fenestrated endothelial cells** lining the wall of the sinusoids. In addition. *Kupffer cells* (macrophages) are also found lining the blood sinusoids.





Disse's space: between the hepatocytes and blood sinusoids, **prevents** direct contact between them. It has a type of cells called ***Ito's cells*** or ***fat-storing cells***, and reticular fibers.

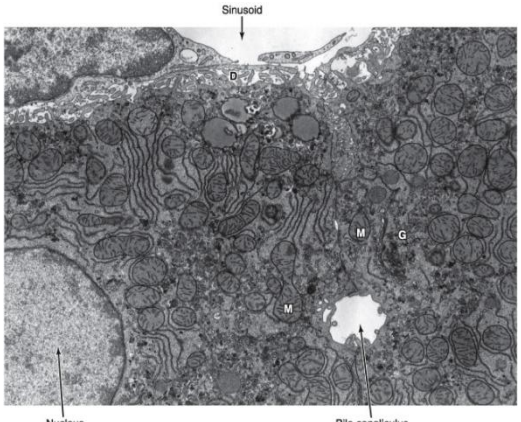
Recall: the endothelial cells + Kupffer cells also form a *barrier*.

Hepatocyte does all the functions we mentioned; exocrine and endocrine..

Ito's cells *or* fat-storing cells: in addition to storage of fat, they release *retinoids*, and have a role in *immunity*; may secrete **IgA**.

Hepatocytes are usually found as **2 sets of cells**, forming a column of cells.

Sinusoids are always found on one side of the hepatocytes, i.e. *between* columns of hepatoctyes, while the **bile canaliculi** are found **between 2 adjacent hepatocytes**. Bile is collected into these bile canaliculi, and then into **Herring's canals**, which are larger, and at the end into the **bile duct** at the porta hepatis.



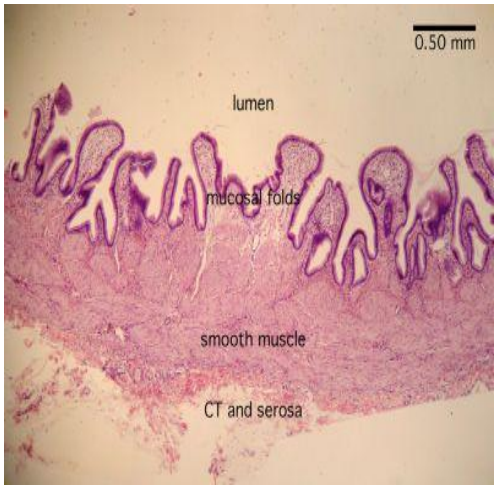
Hepatocytes: in addition to being binulceate, they have **basophilic bodies** at their bases; aggregates of RER. They also have large number of mitochondria & RNA.

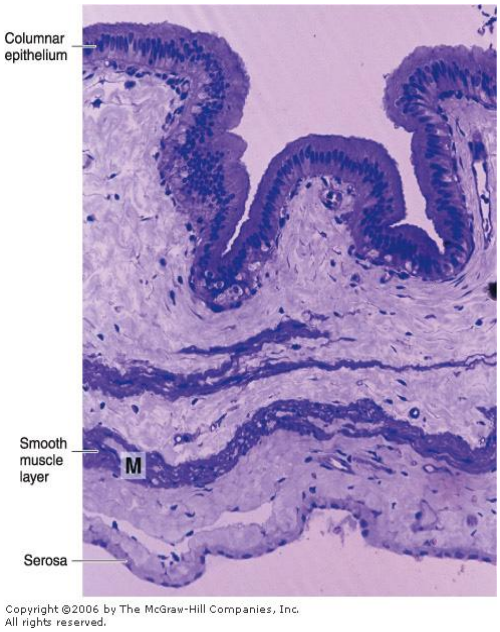
The Gallbladder

- Follows the GIT; its lining epithelium is formed of **simple columnar** cells; however, it does **not** have goblet cells.
- Function: **concentration of bile** (about 20 times!)
- **Stores** about 30-50 mL of bile.
- Gross anatomy: it has a fundus, body, neck, and a cystic duct.

The liver produces diluted bile, which goes through the *right & left hepatic ducts* → *common hepatic duct*
Common hepatic duct + **cystic duct** (of the gallbladder) = **common bile duct** which empties into the *2nd part of duodenum*, and has a sphincter called the **sphincter of Oddi,** which is always **closed**, so, when the diluted bile reaches the sphincter, it *returns* to the **gallbladder,** *where* the absorption of water and concentration of bile occurs.
When someone eats a **large meal**, which needs 20 L of diluted bile, the gallbladder receives stimulation leading to its contraction, and **opening of the sphincter** occurs; emptying about *1 mL of concentrated bile*, which is enough for *fat digestion*. That is why **cholecystectomy** (removal of the gallbladder) leads initially to suffering due to *many problems*, including continuous diarrhea, intolerance to fatty food, and the patient should eat many meals.

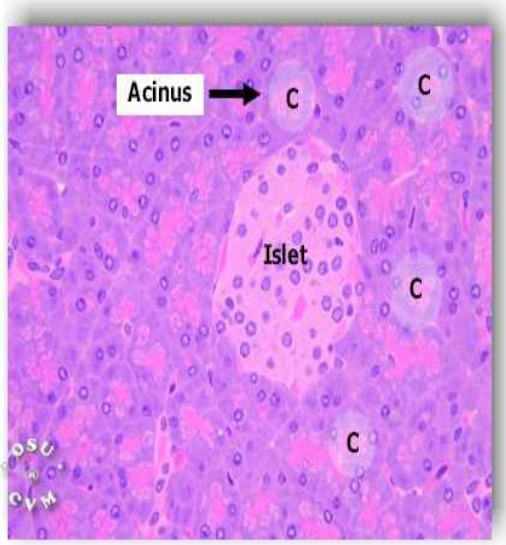
A section in the **gallbladder** shows:
1- *Abundant folding* of the **mucosa**; larger surface area for the absorption of water. The mucosa also has a *honeycomb* appearance
2- **No** goblet cells (as they're not needed here)
3- Ill-defined or absent muscularis mucosa
4- Ill-defined or absent submucosa
5- Irregular muscularis externa

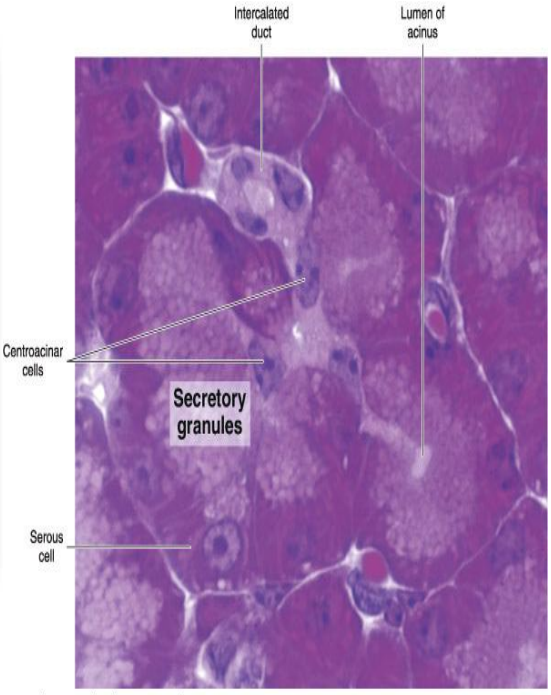




The Pancreas:

- **Mixed:** exocrine *and* endocrine.
- Compared to the parotid gland.
  Under the microscope:
  Parotid gland: serous acini.
  Pancreas has:
  - ✓ Pale patches which are **islets of Langerhans** (which have α-cells, and insulin-producing β-cells); these are the endocrine.
  - ✓ **Pancreatic acini** (exocrine), similar to the parotid gland, but are unique in having **centroacinar cells** (pale cells at the center), which produce secretion and are the beginning of the **intercalated duct** (found in the parotid). However, there are **NO striated ducts in the pancreatic duct system**; they are replaced by *stratified cuboidal and columnar interlobular ducts.*
    The cells of the serous acini have **polarity**:
    A. Their **apex** is acidophilic; has zymogenic protein granules.
    B. Their **base** is basophilic (having RNA & mitochondria)





Thank You!

Done by: Majd Abu Shaar