Lab Activity 29

Anatomy of the Digestive System

Portland Community College
BI 233
Digestive System

- **Alimentary Canal**: hollow tube extending from mouth to anus
  - Technically outside the body
  - Covered with mucous membrane
- **Accessory digestive organs** – teeth, tongue, gallbladder, salivary glands, liver, and pancreas
Teeth

- Incisor (cutting)
- Canine (tearing)
- Premolar (tearing and grinding)
- Molar (grinding)
Salivary Glands

- **Parotid**: Primarily serous with digestive enzymes and lysozymes

- **Sublingual**: Primarily mucous

- **Submandibular**: Mixed
Esophagus

- Extends from pharynx through the diaphragm at the esophageal hiatus to the lower esophageal sphincter into the stomach
Membranes

- **Parietal Peritoneum**: Covers the wall of the abdominal cavity
- **Visceral Peritoneum**: Covers the outside of all the abdominal organs
- **Mesentery**: A fold of peritoneum attaching the small intestine to the posterior abdominal wall
- **Greater Omentum**: A thick sheet of tissue (lots of fat) that hangs off the greater curvature of the stomach
- **Lesser Omentum**: Anchors the liver to the lesser curvature of the stomach
- **Mesocolon**: A fold of peritoneum attaching the colon to the posterior abdominal wall
Membranes

- Greater omentum
- Transverse colon
- Transverse mesocolon
- Descending colon
- Jejunum
- Mesentery
- Sigmoid mesocolon
- Sigmoid colon
- Ileum
Greater Omentum

Liver
Stomach
Gallbladder
Transverse colon underneath
Greater omentum
Membranes

Liver
Lesser omentum
Pancreas
Falciform ligament
Stomach
Duodenum
Transverse mesocolon
Transverse colon
Mesentery
Greater omentum
Jejunum
Ileum
Visceral peritoneum
Parietal peritoneum
Urinary bladder
Rectum
Mesentery
Stomach Rugae

- Cardia
- Fundus
- Serosa
- Body
- Rugae of mucosa
- Greater curvature
- Lesser curvature
- Pyloric canal
- Pyloric sphincter (valve)
- Pyloric antrum
- Duodenum
- Muscularis externa
  - Longitudinal layer
  - Circular layer
  - Oblique layer
- Esophagus
Position of Stomach
Small Intestine: Gross Anatomy

- Runs from pyloric sphincter to the ileocecal valve
- Has three subdivisions: duodenum, jejunum, and ileum
- The bile duct and main pancreatic duct:
  - Join the duodenum at the hepatopancreatic ampulla
  - Are controlled by the sphincter of Oddi
- The jejunum extends from the duodenum to the ileum
- The ileum joins the large intestine at the ileocecal valve
Duodenum

- Portal Vein
- Pyloris of stomach
- Bulb
- Minor papilla
- Major papilla
- Pancreas
Pancreas

- Head
- Body
- Tail

- Common Bile Duct
- Accessory Duct
- Pancreatic Duct
Small Intestine: Ileum

Ileocecal valve

Ileum empties into cecum (large intestine)
Large Intestine

- Is subdivided into the
  - Cecum
  - Appendix
  - Colon
  - Rectum
  - Anal canal
- The saclike cecum:
  - Lies below the ileocecal valve in the right iliac fossa
  - Contains a wormlike vermiform appendix
Large Intestine

- Ileocecal valve is in here
- Cecum
- Appendix
- Ileum
- Hepatic Portal Vein
- Aorta
- Superior Mesenteric Artery
- Inferior Mesenteric Artery
Colon

- Has distinct regions: ascending colon, hepatic flexure, transverse colon, splenic flexure, descending colon, and sigmoid colon
- The sigmoid colon joins the rectum
- The anal canal, the last segment of the large intestine, opens to the exterior at the anus
Valves and Sphincters of the Rectum and Anus

- Three valves of the rectum stop feces from being passed with gas
- The anus has two sphincters:
  - Internal anal sphincter composed of smooth muscle
  - External anal sphincter composed of skeletal muscle
- These sphincters are closed except during defecation
Structure of the Anal Canal

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

- Gallbladder
- Right and left hepatic ducts of liver
- Common hepatic duct
- Bile duct and sphincter
- Cystic duct
- Duodenum
- Hepatopancreatic ampulla and sphincter
- Accessory pancreatic duct
- Pancreas
- Jejunum
- Main pancreatic duct and sphincter
- Major duodenal papilla

- Mucosa with folds
Liver

- The largest gland in the body
- Superficially has four lobes – right, left, caudate, and quadrate
- The falciform ligament:
  - Separates the right and left lobes anteriorly
  - Suspends the liver from the diaphragm and anterior abdominal wall
Fetal Umbilical vessels become the ligamentum teres
Liver

- **Portal vein**
  - From the small intestines
  - Blood not yet filtered
- **Hepatic vein**
  - Drains the liver after the
  - Blood has been filtered
  - Goes to the inferior vena cava
- **Portal triad**
  - Bile duct, Portal Vein, and Hepatic artery
  - On histology slides, you can identify branches of these structures
Parotid salivary gland

- Serous acini
- Intercalated duct
- Striated duct
Submandibular salivary gland

- Mucus Acini
- Serous Acini
- Duct
- Serous Acini Demilune
GI Tract Histology

All of the hollow organs have the same basic 4 layers.

1. Mucosa (Lumen side)
   - Epithelial layer (remember from 231: stratified squamous, columnar ect…)
   - Lamina Propria: Base made of loose areolar connective tissue
   - Muscularis Mucosa: Base of smooth muscle fibers

2. Submucosa
   - Dense irregular connective tissue
   - This is where the blood vessels, nerves and the glands are.
GI Tract Histology

3. Muscularis Externa
   - The main smooth muscle layer used for peristalsis
   - Longitudinal and Circular layers with myenteric plexus (parasympathetic ganglion) in between

4. Serosa (Abdominal cavity side)
   - Epithelial layer (usually simple squamous)
   - Also known as the visceral peritoneum
GI Tract Histology

- Mucosa epithelium
- Lamina propria
- Mucosal glands
- Submucosal gland
- Muscularis mucosae
- Submucosal plexus
- Myenteric plexus
- Mucosa
- Submucosa
- Muscularis externa
- Serosa (visceral peritoneum)
Myenteric Plexus in Muscularis Externa

- Longitudinal Muscle Layer
- Myenteric Plexus
- Circular Muscle Layer
- Satellite Cell
- Neuron Cell Body
Esophagus Histology

1. Mucosa
   • Epithelium
   • Non-keratinized stratified squamous
Esophagus Histology

2. Submucosa (#2)
   - Esophageal glands
   - Vessels
   - Submucosal Plexus
Esophagus Histology

- 3. Muscularis Externa
  - Upper 1/3 = Skeletal
  - Middle 1/3 = Blend
  - Lower 1/3 = Smooth

- 4. Adventitia (Rest of GI tract: Serosa)
  - Coarse Fibrous CT: binds/anchors
Esophagus Histology
Muscularis Externa
Stomach Histology

- 4 layers:
  - Mucosa (inside layer)
    - Simple columnar epithelium
  - Submucosa
  - Muscularis Externa smooth muscle in 3 layers
  - Serosa (visceral peritoneum)
Stomach Histology: Mucosa (Inside layer)

- Mucosa: Simple columnar epithelium

(b) Enteroendocrine cell

- Gastric pits
- Surface epithelium
- Mucous neck cells
- Parietal cell
- Gastric glands
- Chief cell

Pepsinogen → HCl → Pepsin

Mitochondria in parietal cell

Parietal cell

Chief cell

Enteroendocrine cell
Stomach Mucosa

- Mucous neck cells
  - Alkaline mucus
- Parietal cells
  - HCL
  - Intrinsic factor
- Chief cells
  - Pepsinogen
  - Gastric lipase
- G cells (in antrum)
  - Gastrin
Stomach Mucosa

Mucus Neck Cells

Gastric Pits
Stomach

- Parietal Cell
- Chief Cells
- Muscularis Mucosae
- Capillary

Gastric Glands in Fundic Stomach
Small Intestine: Histology

- Structural modifications of the small intestine wall increase surface area
  - Plica circularis: Transverse folds on the mucosa
  - Villi: Fingerlike extensions of the mucosa
  - Microvilli (Brush border): Tiny projections of absorptive mucosal cells’ plasma membranes
Small Intestine: Plica Circularis
Small Intestine Histology: Mucosa

- **Plicae circulares:** Large deep, permanent folds of the mucosa and submucosa.

- Slow the movement of chyme (more time for digestion/absorption) and increase the surface area.
Small Intestine Histology

- Villi
- Crypt
- Mucosa
- Submucosa
- Circular muscle
- Longitudinal muscle
- Serosa
- Submucosal artery and vein
- Submucosal plexus
- Peyer's patch
- Myenteric plexus
- Lymph vessel
Small Intestine Histology: Villi

- **Villi**: Fingerlike projections of the mucosa.
- Made of simple columnar epithelium
- Increase the surface area.
- Within the core of each villus is a capillary bed and a lacteal for transport of the absorbed nutrients.
Small Intestine: Villi

Villus

Lacteal

Simple Columnar Epithelium
Small Intestine Histology: Mucosa

- Microvilli: Tiny projections of the plasma membrane of the simple columnar absorptive cells.
- Often called the "brush border" due to their appearance.
- They further increase the available surface area and contain membrane-bound enzymes involved in digestion.
Small Intestine
Small Intestine

Paneth Cells in Crypt of Lieberkuhn

Submucosa in PlicaCircularis

Neurons of Meissner's Plexus

MM

Crypt

Mucosa
Paneth cells in a Crypt of Lieberkühn secrete lysozymes
Small Intestine Histology: Submucosa with Brunner’s Glands

- Brunner’s glands in the proximal duodenum secrete alkaline mucus
Small Intestine Histology: Submucosa with Peyer’s Patches

• Peyer’s patches are found in the submucosa of ileum
  • Lymphoid tissue
Large Intestine: Histology

- Colon mucosa is simple columnar epithelium except in the anal canal
- Has numerous deep crypts lined with goblet cells
- Anal canal mucosa is stratified squamous epithelium
- Superficial venous plexuses are associated with the anal canal
Large Intestine Histology
Large Intestine Histology

- No Villi
- Many goblets (mucus)
- Many surface absorptive cells (absorb water)
- Crypts of Lieberkühn
Large Intestine Histology

- lumen
- crypts
- muscularis mucosae
- mucosa
- submucosa
- crypts
Anal Canal Histology

- At the junction of the rectum and anus, the histology of the mucosa changes to stratified squamous
Liver Histology

- Liver sinusoids – enlarged, leaky capillaries located between hepatic plates
- Kupffer cells – hepatic macrophages found in liver sinusoids
Liver Histology

- Hexagonal-shaped liver lobules are the structural and functional units of the liver
  - Composed of hepatocyte (liver cell) plates radiating outward from a central vein (flows toward hepatic vein)
  - Portal triads are found at each of the six corners of each liver lobule
- Portal triads
  - Bile duct
  - Hepatic artery – supplies oxygen-rich blood to the liver
  - Hepatic portal vein – carries venous blood with nutrients from digestive viscera
Liver Histology
Liver: Portal Triad
Liver

- Brach of Portal Vein
- Bile Duct
- Hepatocytes
- Branch of Hepatic Artery
Pancreas

- **Exocrine function: Acinar cells**
  - Secretes pancreatic juice which breaks down all categories of foodstuff
  - Acini (clusters of secretory cells) contain zymogen granules with digestive enzymes
- **Endocrine function: Islets of Langerhans**
  - Release of insulin and glucagon
Pancreas Histology

1. Connective tissue
2. Islet of Langerhans
3. Pancreatic acinus
Pancreatic ducts

- The ducts leading into the duodenum
  - Cuboidal or columnar
  - Secrete HCO$_3^-$
The End