

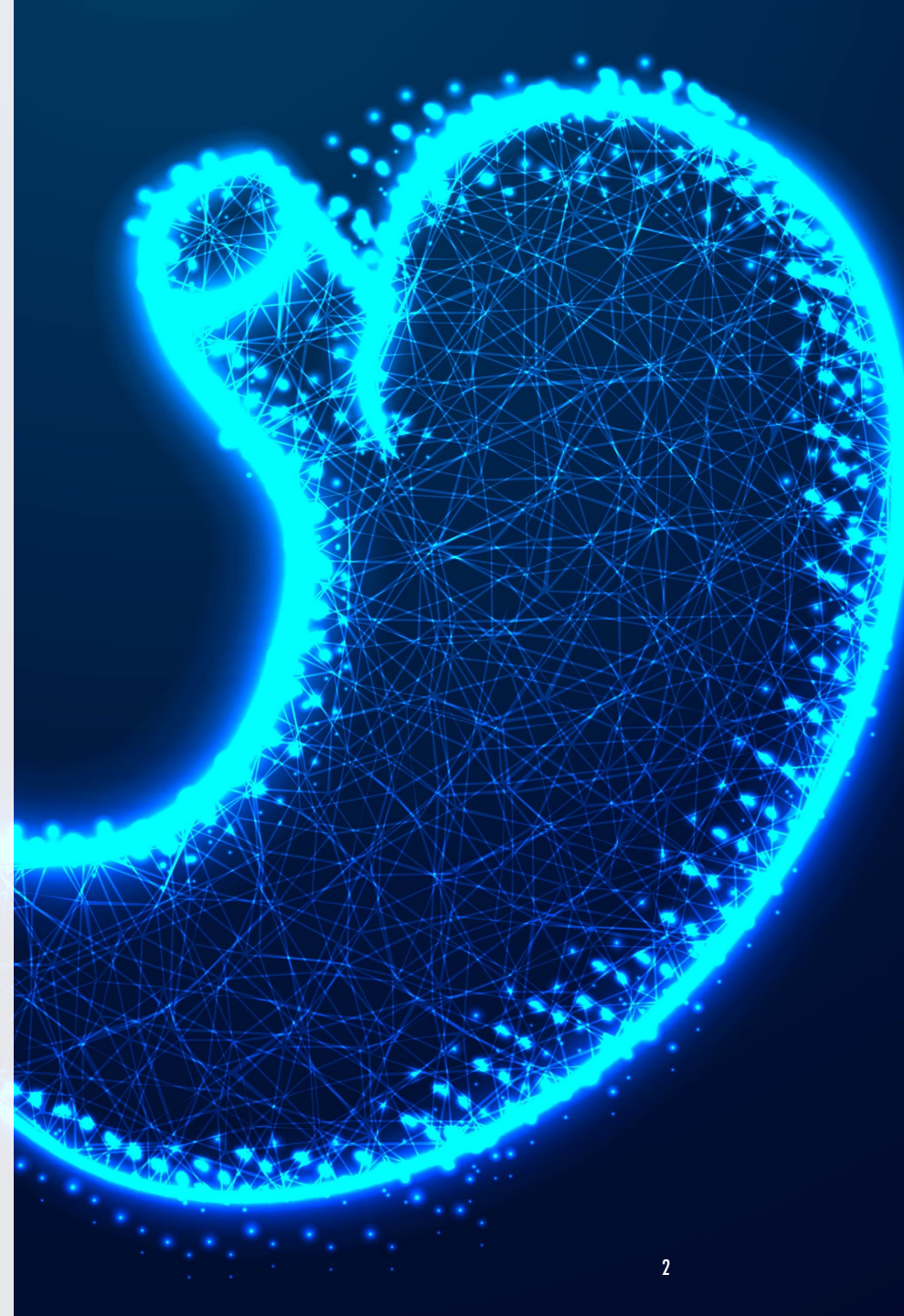
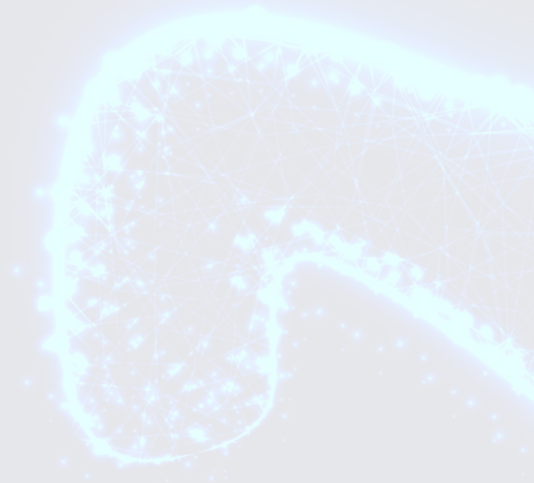


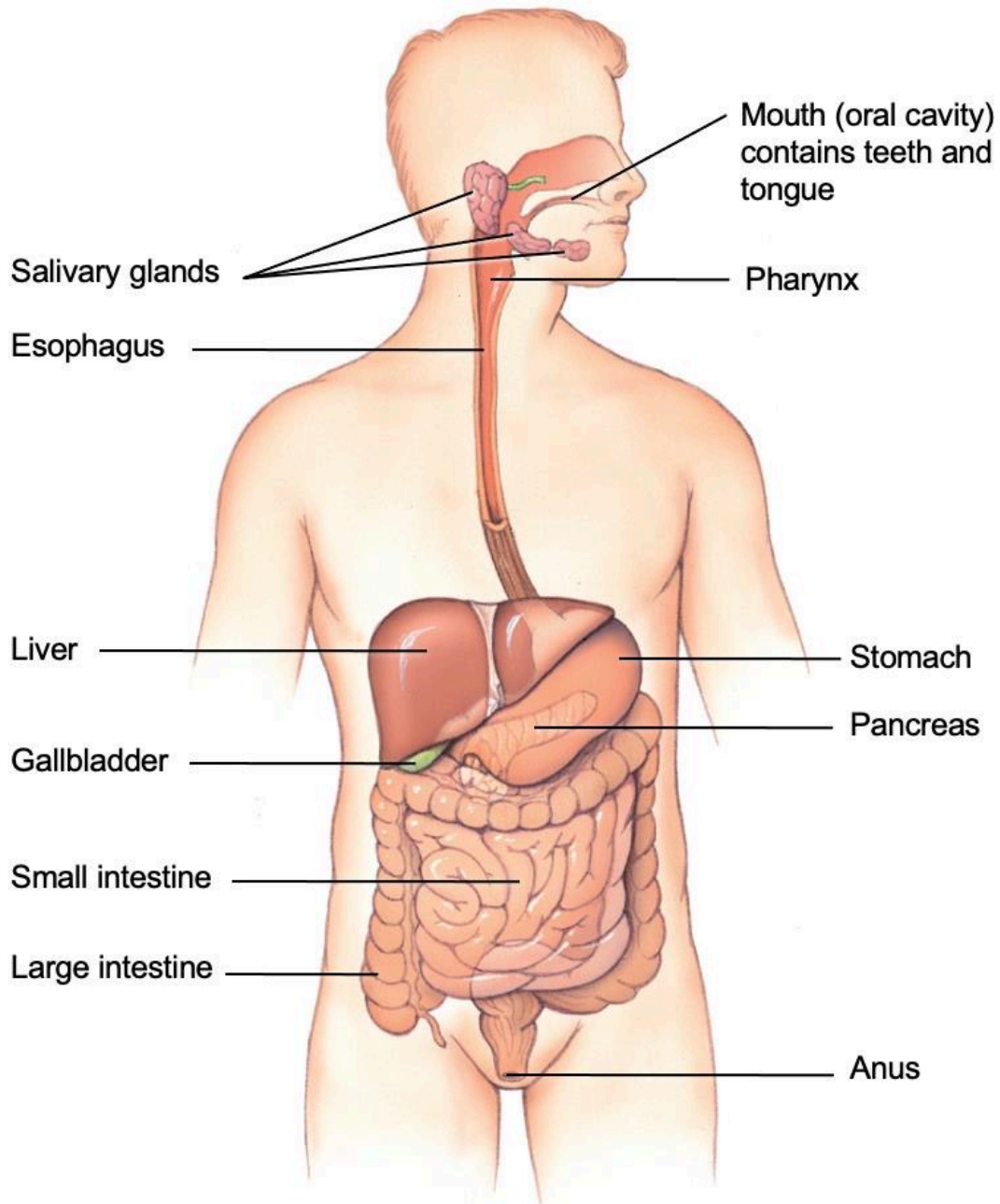
LAB 4: THE GASTROINTESTINAL SYSTEM

Protocol slides
PCB 3702L
FIU

LAB 4 PROTOCOL OBJECTIVES

1. Identify digestive system structures while performing the dissection of a fetal pig.

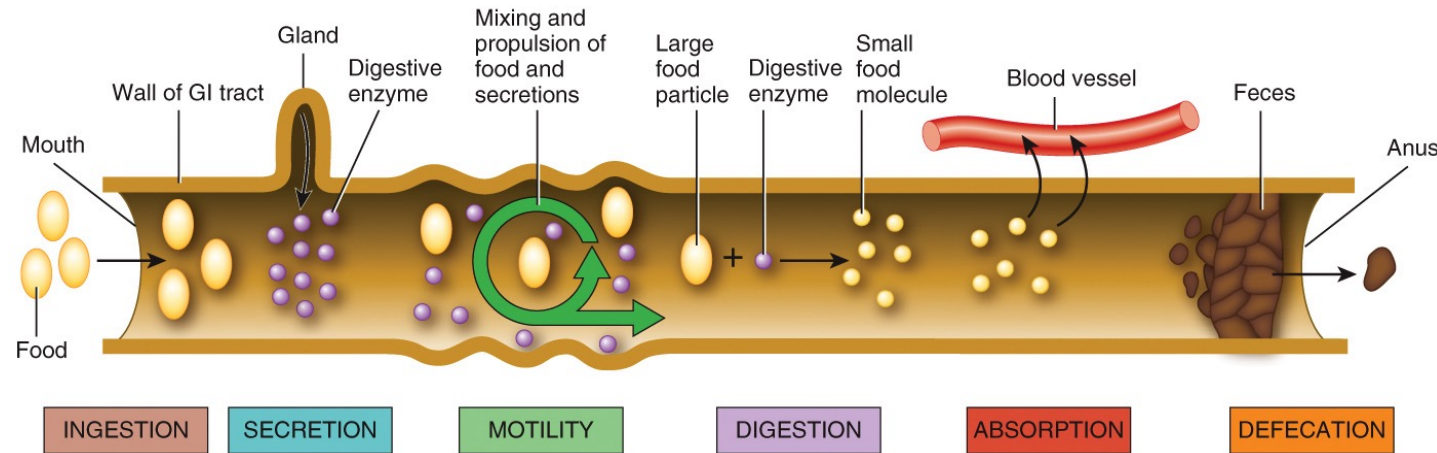




ANATOMY OF THE DIGESTIVE SYSTEM

- **GI tract = Alimentary Canal**
- **What organs are part of the GI tract?**
 - Oral cavity, pharynx, esophagus, stomach, small intestine, large intestine
- **What organs are considered accessory digestive organs?**
 - The teeth, tongue, salivary glands, pancreas, liver, and gallbladder

DIGESTIVE PROCESSES



<i>Term</i>	<i>Definition</i>	<i>Primary Location(s)</i>
Ingestion	Taking food into the mouth	Oral cavity
Secretion	The release of enzymes & digestive substances into the lumen of the GI tract that help with the breakdown of food	Mouth (salivary glands), esophagus, stomach, small intestine, large intestine, liver, gallbladder, pancreas
Motility	Rhythmic contractions of smooth muscle that propel food along the GI tract e.g., peristalsis	Esophagus, stomach, intestines
Digestion	The mechanical and chemical breakdown of food into usable nutrients	Oral cavity, stomach, intestines (chemical digestion occurs mainly in the duodenum)
Absorption	Water & nutrients being reabsorbed into the bloodstream or lymph from the lumen of the GI tract	Mouth, stomach, intestines (mainly in the jejunum and Ileum)
Defecation	Accumulation and elimination of waste products and indigestible material from the body as feces	Large intestine (rectum and anus)

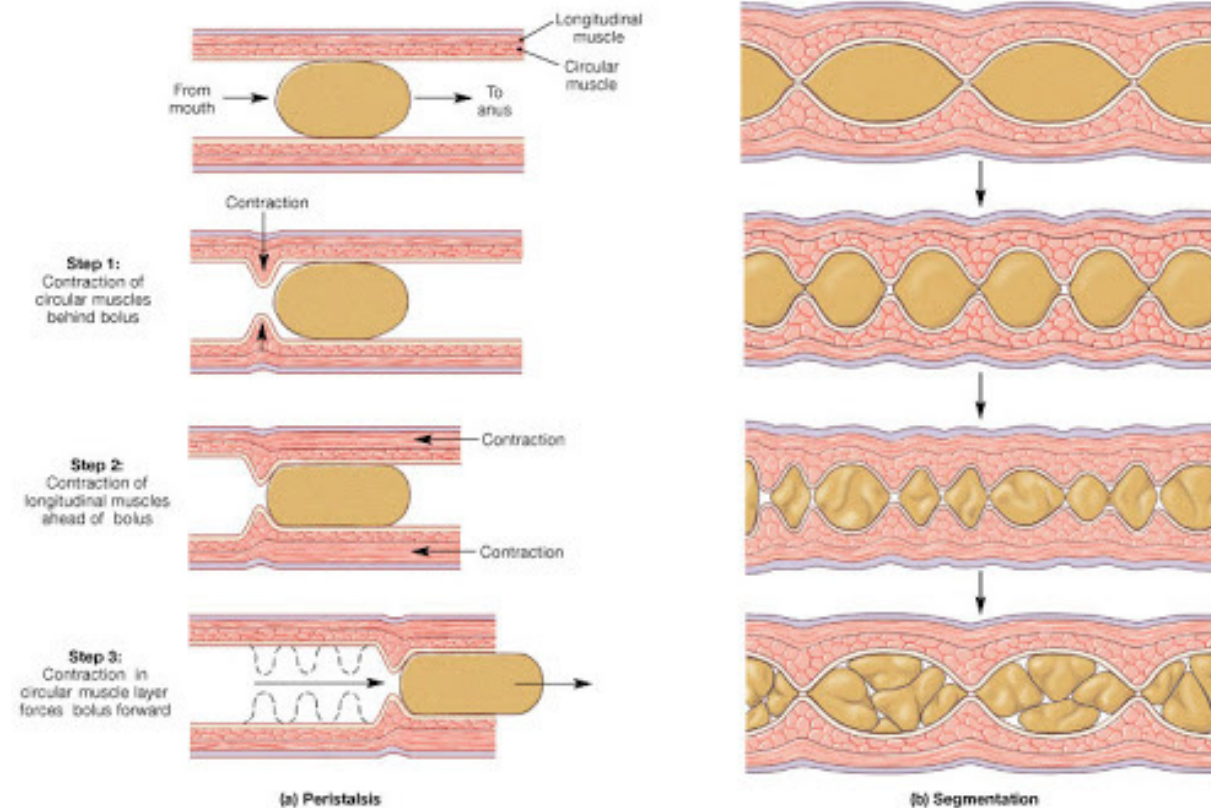
PATTERNS OF GI MOTILITY: PERISTALSIS & SEGMENTATION

What is peristalsis? Successive muscular contractions along the wall of a hollow muscular tube propel the luminal contents in a **forward** direction. It involves the contraction of both circular and longitudinal muscles within the muscularis externa.

Where does peristalsis occur in the body? Occurs throughout the GI tract, from the esophagus to the anus. *Primarily in the esophagus and stomach.*

What is segmentation? Alternating muscular contractions that mix luminal contents. Involves the contraction of circular muscle at various intervals.

Where does segmentation occur? *Mostly in the small intestine*



THE MOUTH, PHARYNX, AND ESOPHAGUS

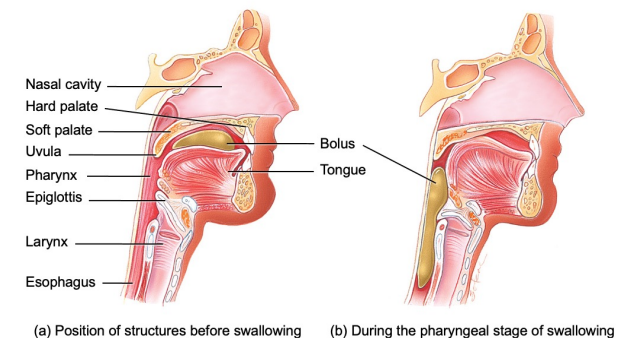
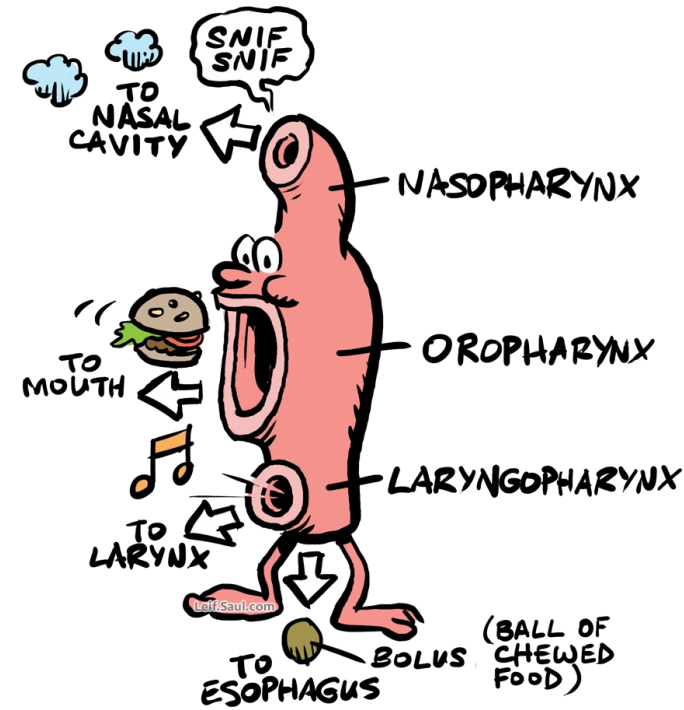
The **tongue** forms the floor of the oral cavity and is an accessory digestive organ mainly composed of skeletal muscle. The tongue moves food towards the pharynx

The **salivary glands**, another accessory organ, produce saliva, which aids in the formation of a **bolus**. These glands are responsible for releasing **salivary amylase**, which initiates the chemical digestion of starch within the mouth

The **pharynx** receives the bolus from the oral cavity and passes it to the esophagus. The pharynx is considered part of both the digestive and respiratory systems

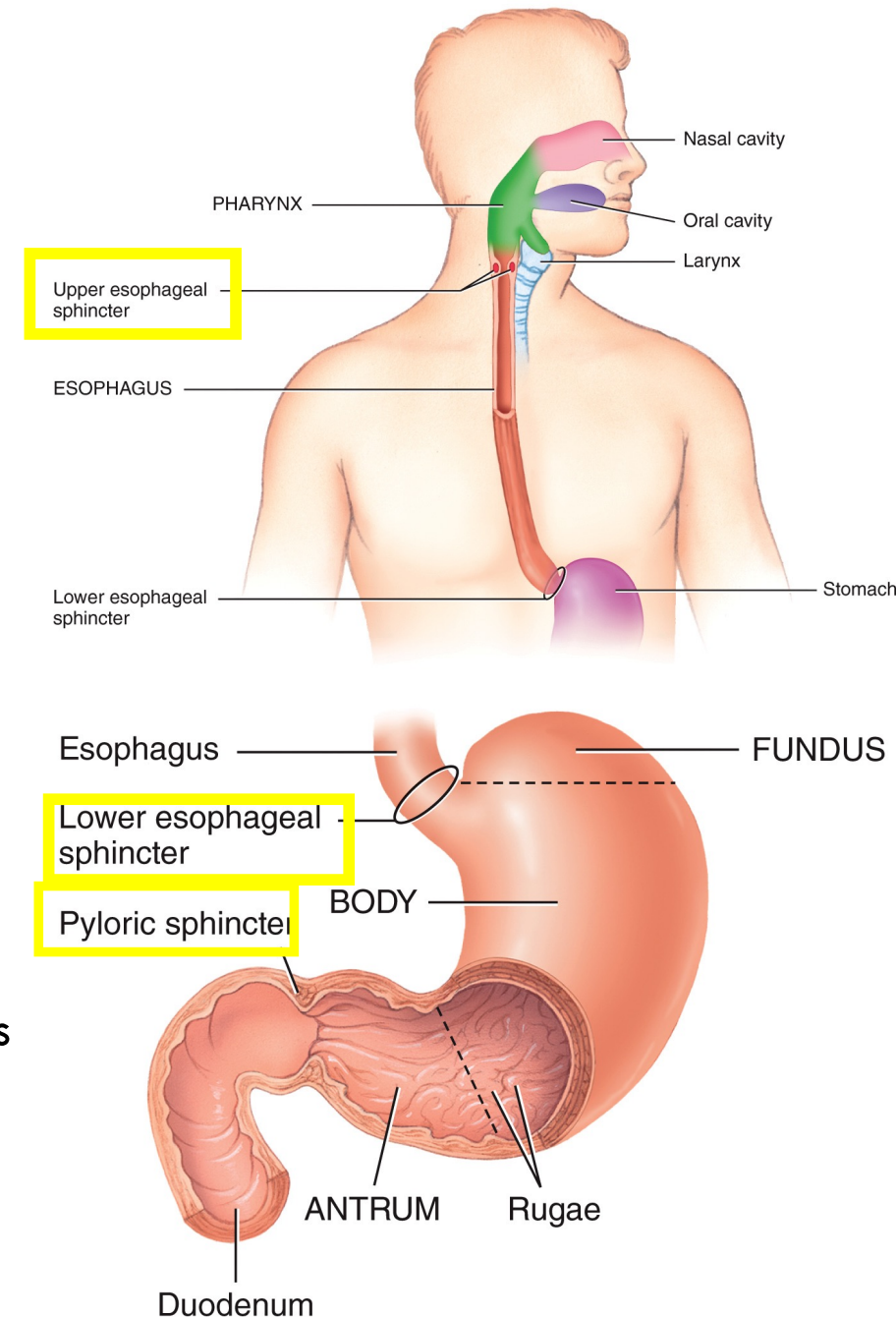
The **esophagus** is a collapsible muscular tube that receives the bolus from the pharynx and moves it into the stomach.

The **larynx** is **NOT** part of the digestive system. It is part of the respiratory system!!!



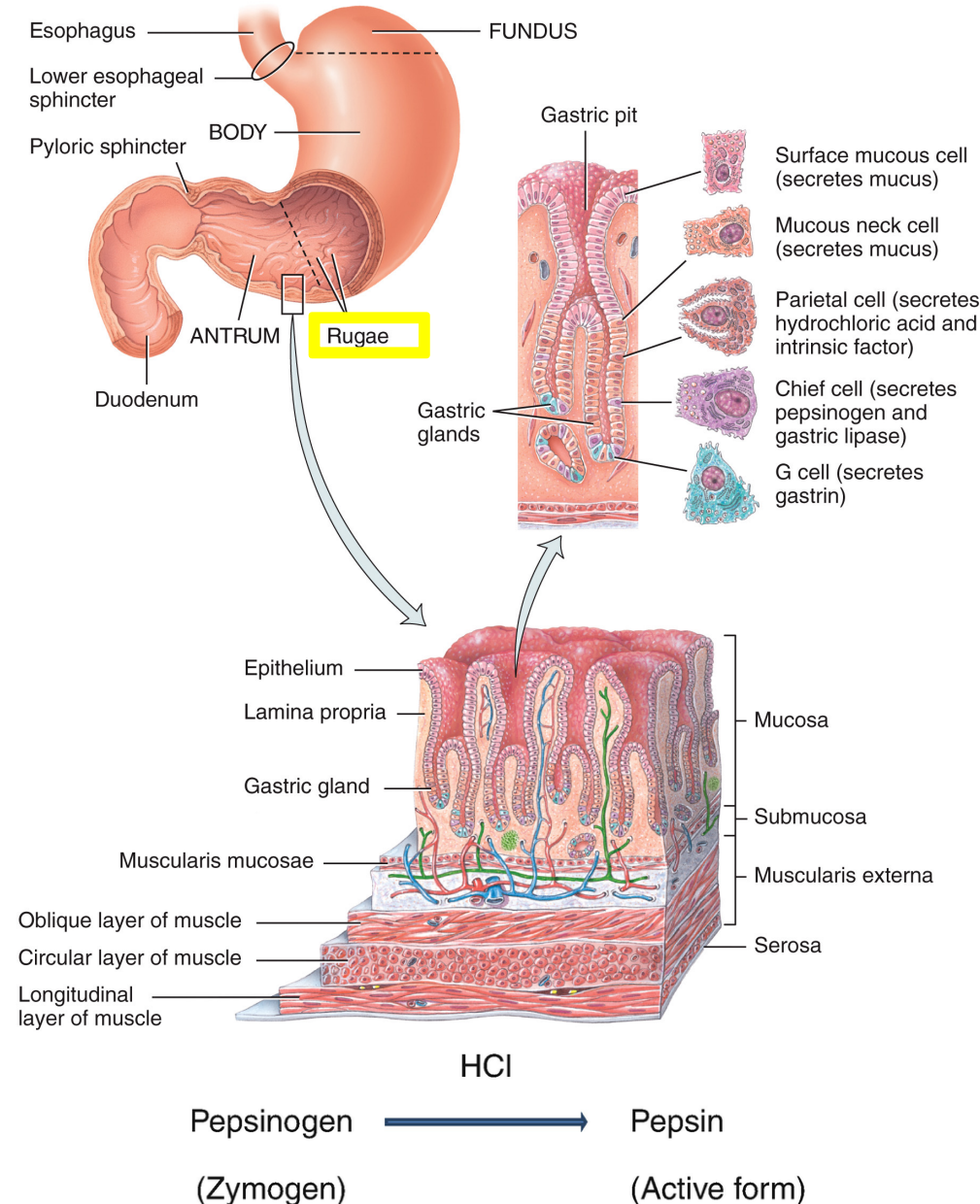
THE STOMACH CONTINUED

- **Mechanical Digestion** – (1) Cycles of propulsion and retropulsion mix food (the bolus) with gastric juice, reducing it to chyme; (2) The presence of a third muscle layer, the oblique layer, enhances gastric motility. Helps churn the chyme in the stomach, aiding in further mechanical breakdown
- **Minimal Absorption** – Alcohol and NSAIDs (e.g., aspirin) absorption. Excessive NSAID use may lead to peptic ulcers (disrupts the mucosal lining of the stomach)
- **Structural features:**
 - Gastric mucosa contains large folds, called *rugae* when the stomach is empty (non-distended). When the stomach becomes distended, these folds flatten out
 - Rugae allow the stomach to expand
 - Thick *mucus layer* to protect against autodigestion from HCl



THE STOMACH

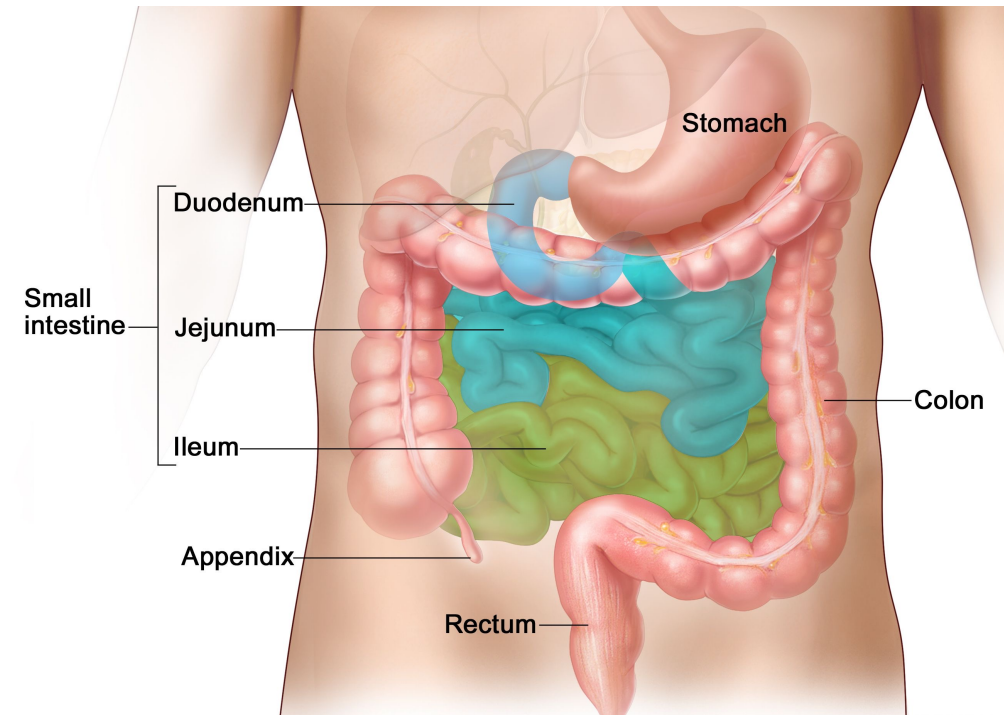
- **Location:** Upper left quadrant, under the diaphragm
- **Functions:** Chemical & mechanical digestion, minimal absorption
 - **Chemical Digestion** – Gastric glands release hydrochloric acid (HCl) and digestive enzymes, primarily pepsinogen, for protein breakdown. These glands have three types of exocrine cells: **mucous cells, parietal cells, and chief cells**.
 - Surface mucous cells and mucous neck cells produce mucus to prevent autodigestion
 - Parietal cells secrete HCl (kills microbes and denatures proteins) and intrinsic factor (for vitamin B12 absorption)
 - Chief cells produce pepsinogen (activated to pepsin by HCl) and gastric lipase (for lipid digestion)
 - Another cell found within the gastric pits are G cells (endocrine cells) that release gastrin hormone into the bloodstream, stimulating gastric juice production and stomach motility



THE SMALL INTESTINE - DJ ILEUM

• Functions:

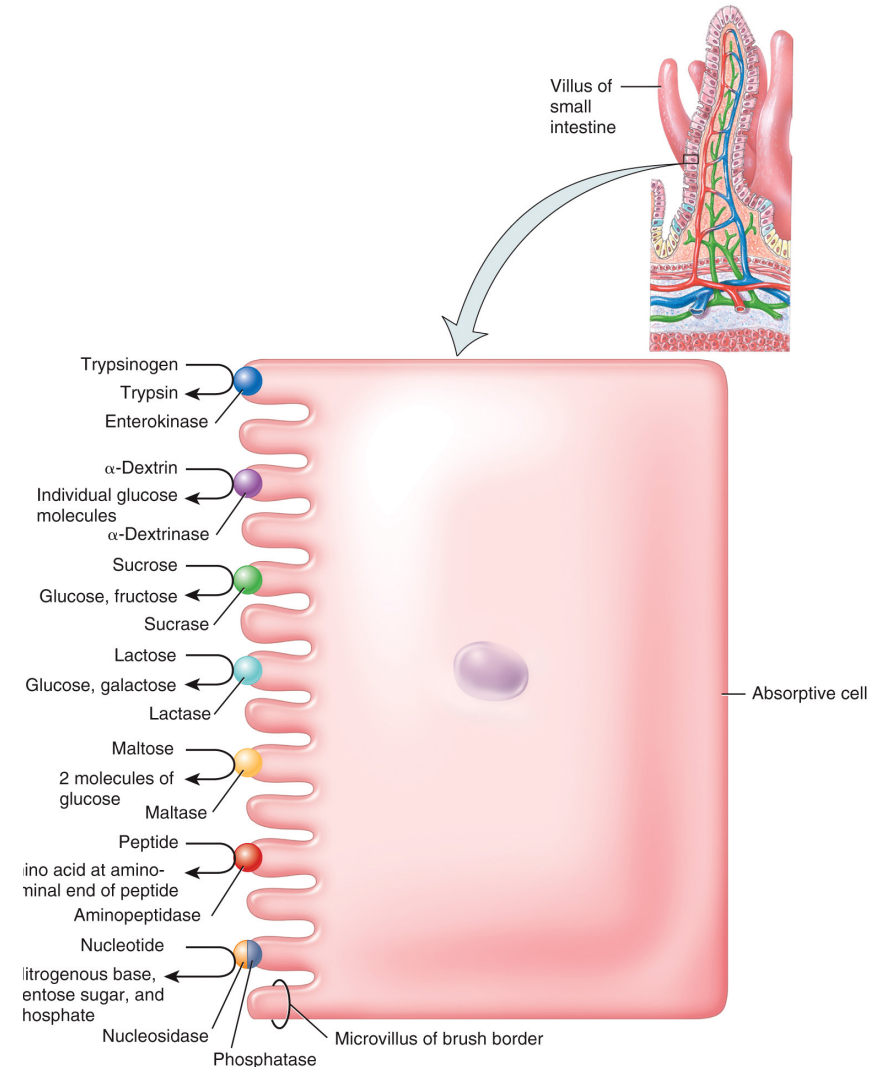
- **Duodenum:** Primary involved in chemical digestion, containing disaccharidases and peptidases that break down disaccharides and peptides
- **Jejunum, Ileum:** Specialized for the absorption of nutrients
- **Duodenum's Response to Chyme:**
 - **Secretin** (a hormone that stimulates the release of pancreatic juices and increases bile production in the liver)
 - **CCK** (a hormone that stimulates the release of pancreatic juices and bile from the gallbladder; induces satiety)
 - Both hormones are produced by small intestine cells
 - Pancreatic juices and bile drain into the duodenum



THE SMALL INTESTINE CONTINUED

•Structural Features:

- The Ileum has Peyer's Patches (aggregated lymphoid nodules)
- Villi, finger-like protrusions of the mucosa, cover the entire small intestine
- Duodenum: Shorter villi assist in mixing
- Jejunum: Longer, densely packed villi optimize nutrient absorption
- Ileum: Like the jejunum, features villi for nutrient absorption
- Microvilli on absorptive cell apical membranes increase surface area for nutrient absorption and enzyme secretion
- Brush border enzymes in microvilli participate in the final digestion of carbohydrates, proteins, and nucleic acids



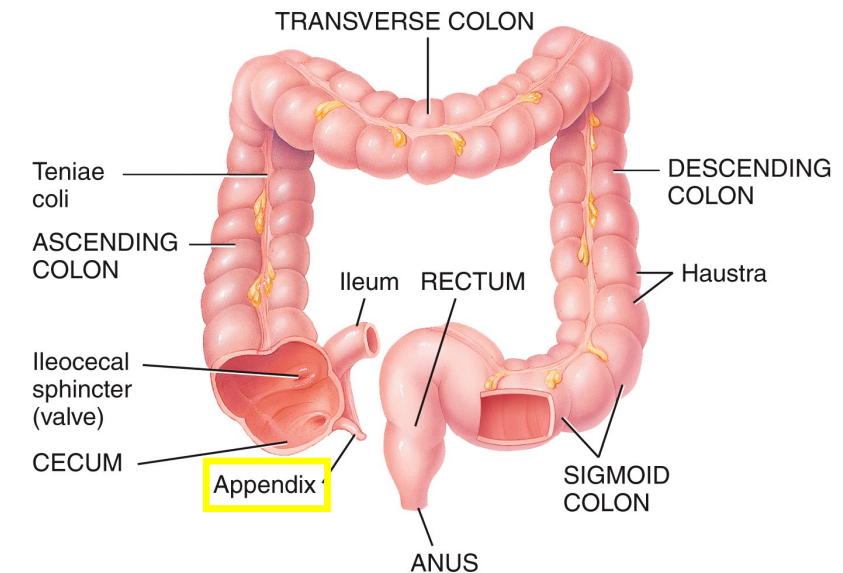
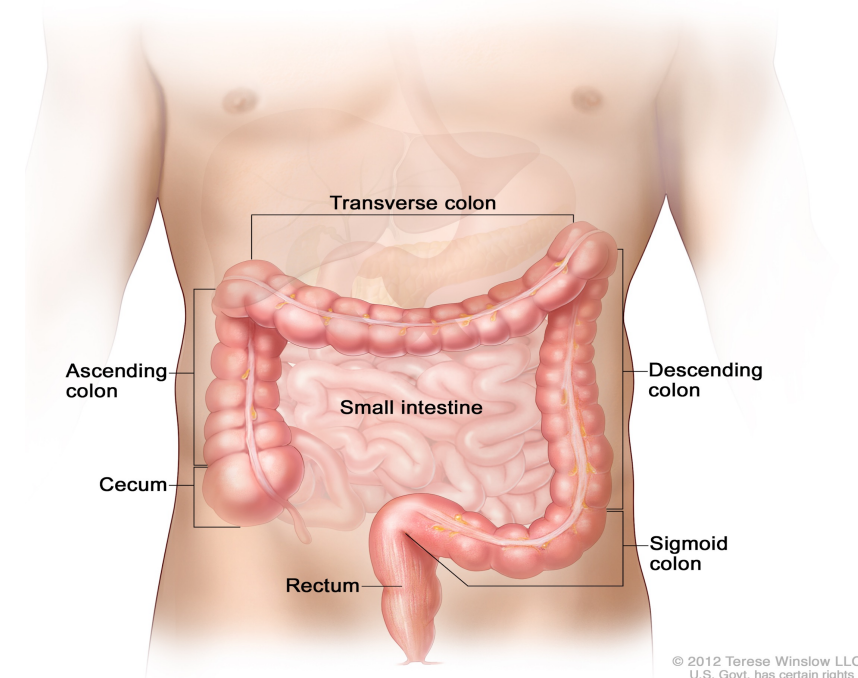
THE LARGE INTESTINE

Functions: Absorption of some water & ions, production of certain vitamins, the formation of feces, and the expulsion of feces from the body

1. **Cecum:** Absorption of excess fluids (water & salts)
 - The appendix extends from the cecum and contains lymphoid nodules that participate in immune responses
2. **Colon:** Subdivided into ascending colon, transverse colon, descending colon, and sigmoid colon; absorbs fluids and forms feces
 - Feces are stored in the sigmoid colon
3. **Rectum:** Absorbs remaining fluids.
4. **Anus:** Feces excreted from the body

What causes constipation or diarrhea?

- If too much water absorbed = Dry feces (**constipation**)
- If too little water absorbed = Liquid feces (**diarrhea**)



ACCESSORY ORGANS: THE PANCREAS

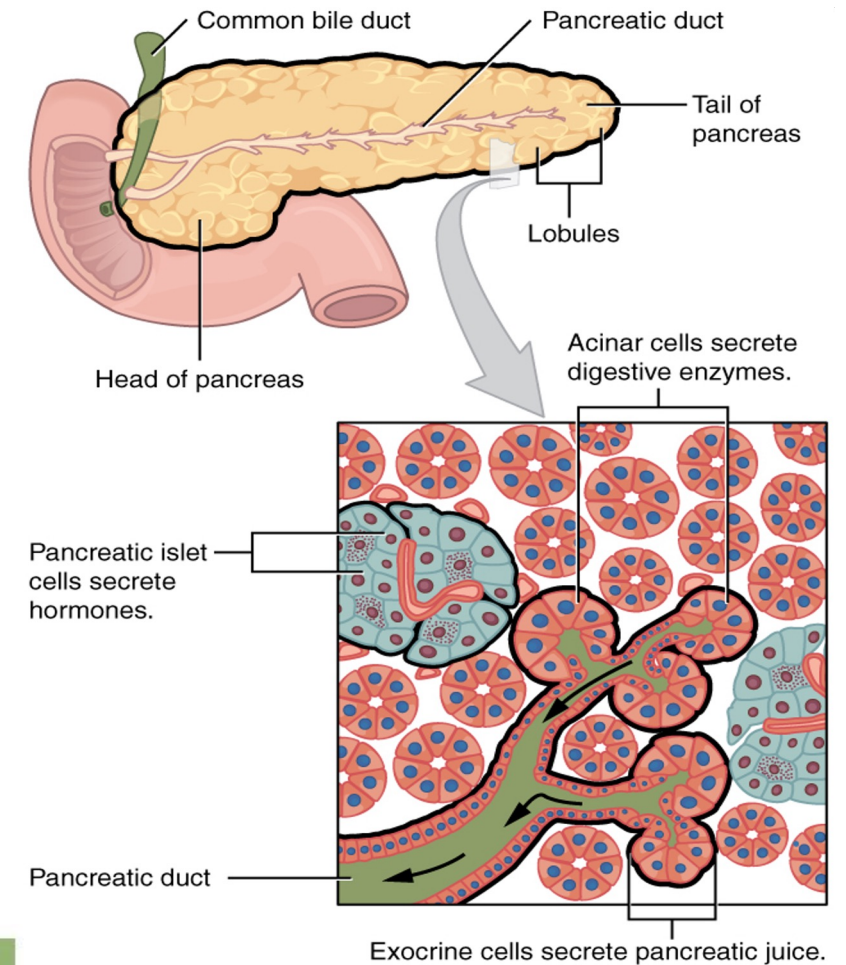
Functions: Produces both exocrine and endocrine secretions

Endocrine Function: The pancreas produces and releases hormones, including insulin and glucagon, into the bloodstream. These hormones are responsible for maintaining blood glucose levels

Exocrine: The pancreas produces and releases pancreatic juices that contain bicarbonate-rich fluid and digestive enzymes. These enzymes include amylases, proteases, lipases, and nucleases (digest carbohydrates, proteins, fats, and nucleic acids respectively)

- Proteases are initially released as **zymogens** (inactive forms of enzymes) and are later activated in the **duodenum**.
- Examples of proteases include **trypsinogen** and **chymotrypsinogen**, which are activated into trypsin and chymotrypsin, respectively. These activated enzymes play a role in cleaving large polypeptides into smaller peptides. Trypsinogen is activated by **enterokinase**, an enzyme produced in the small intestine

Pancreatic Juice (from pancreas)				Bile (from liver)
Proteases / Endopeptidases (digest proteins / polypeptides)	Amylase (digest sugars)	Nuclease (digest DNA / RNA)	Lipase (digest fats)	Bile Salts (emulsify fats)
Proteins → Peptides → Amino acids	Starch → Maltose	Nucleic acid → Nucleosides	Dietary fat Triglycerides	Monoglycerides Fatty acids

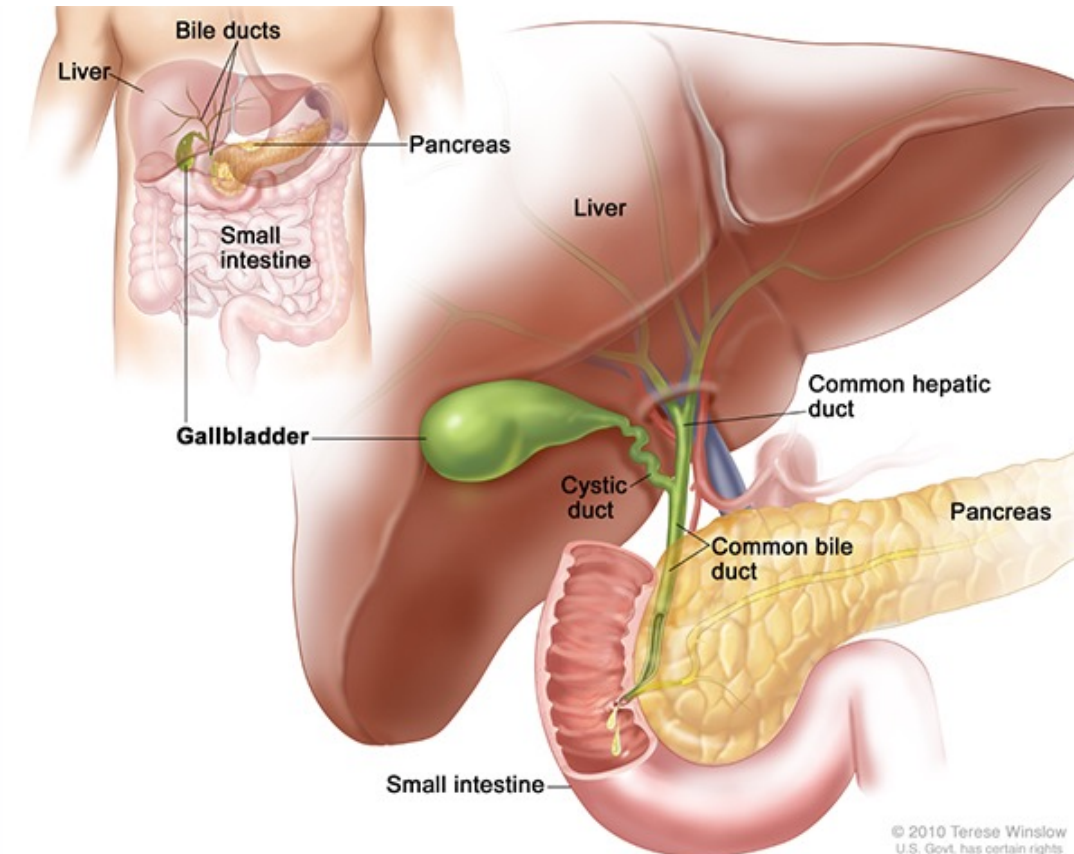


ACCESSORY ORGANS: THE LIVER AND GALLBLADDER

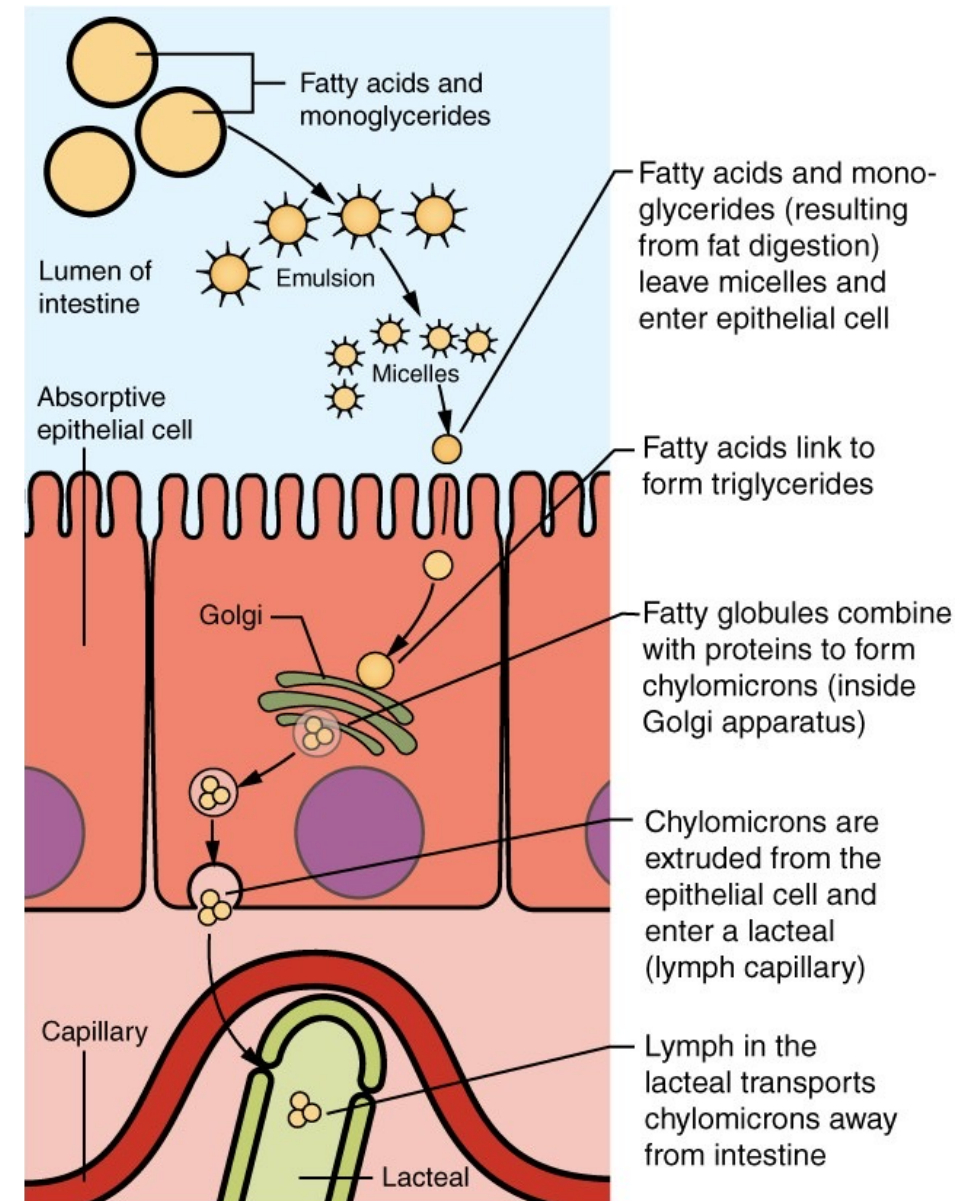
Some Functions of the Liver Include: 1) Bile production, 2) processing of nutrients, and 3) detoxification and drug metabolism

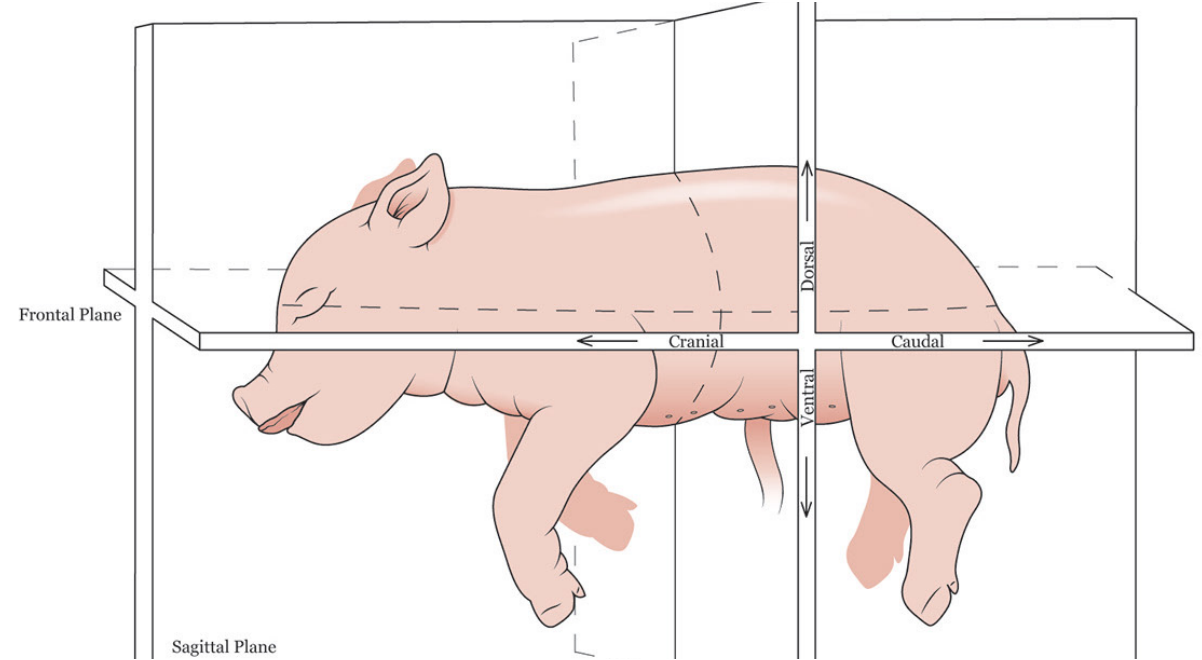
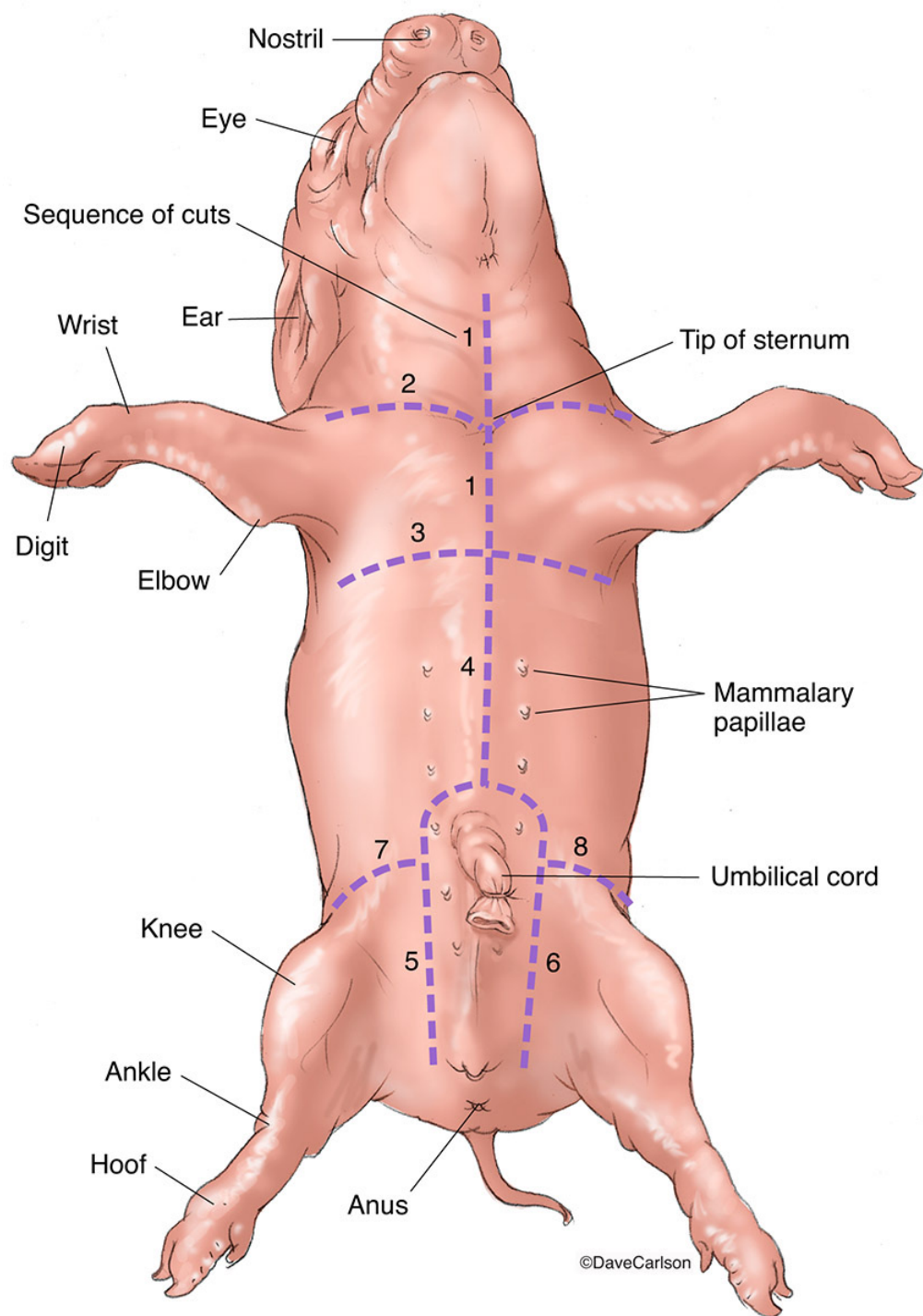
- **Bile:** A non-enzyme substance that emulsifies fats
 - composed of water, amphipathic bile salts, bilirubin (pigment), fats, etc.
 - participates in **mechanical digestion**, increasing the surface area of lipids for pancreatic lipase to act on
 - bile salts remain associated with digested fats to form small spheres of lipids called micelles

Gallbladder Primary Function: Stores and concentrates bile



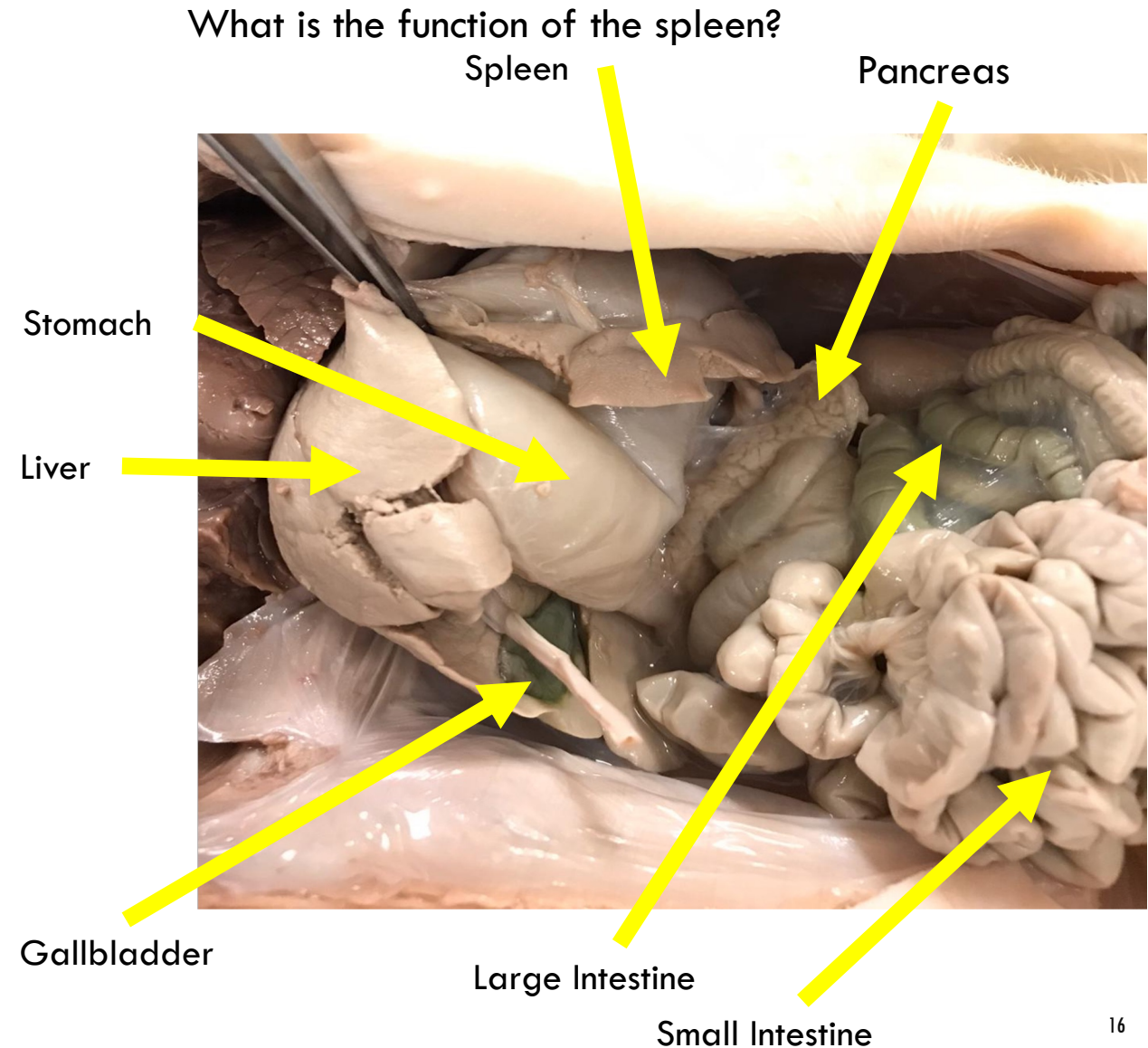
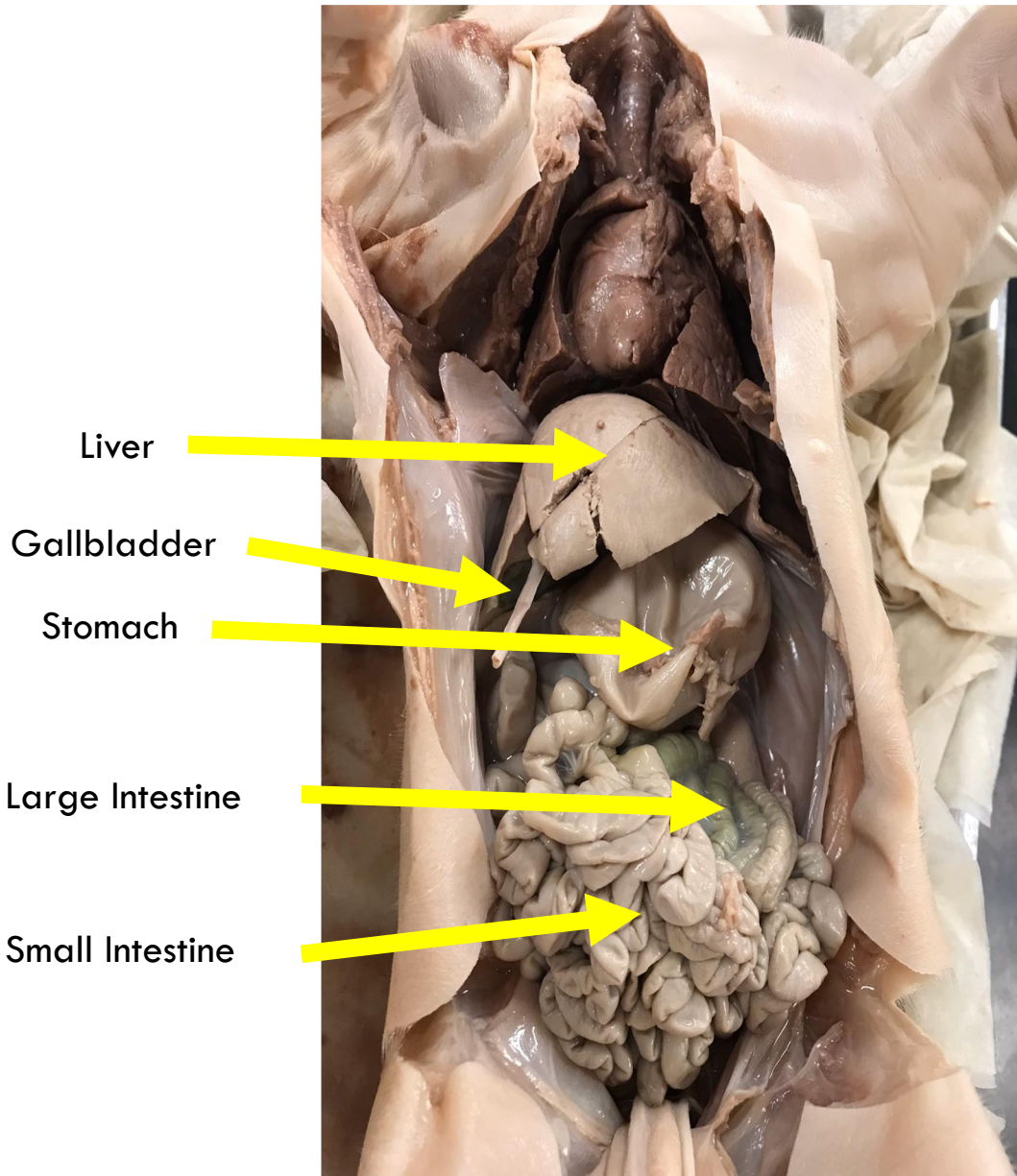
LIPID DIGESTION



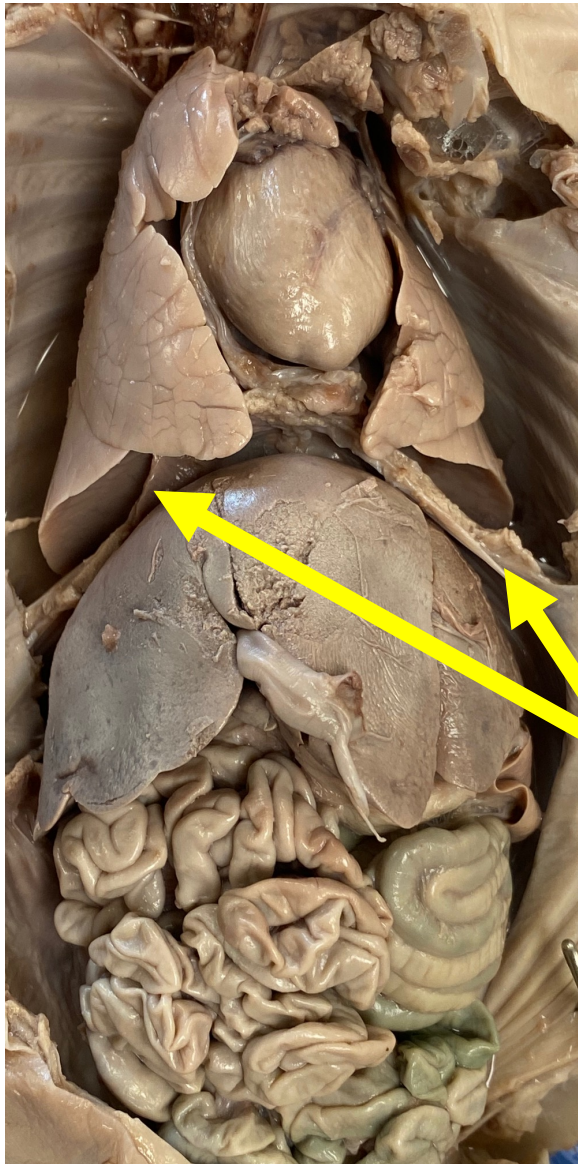


FETAL PIG DISSECTION

FETAL PIG DISSECTION — THE DIGESTIVE SYSTEM



FETAL PIG DISSECTION – THE DIGESTIVE SYSTEM



The diaphragm separates the thoracic from the abdominopelvic cavities. It is the most important muscle for respiration.

Diaphragm

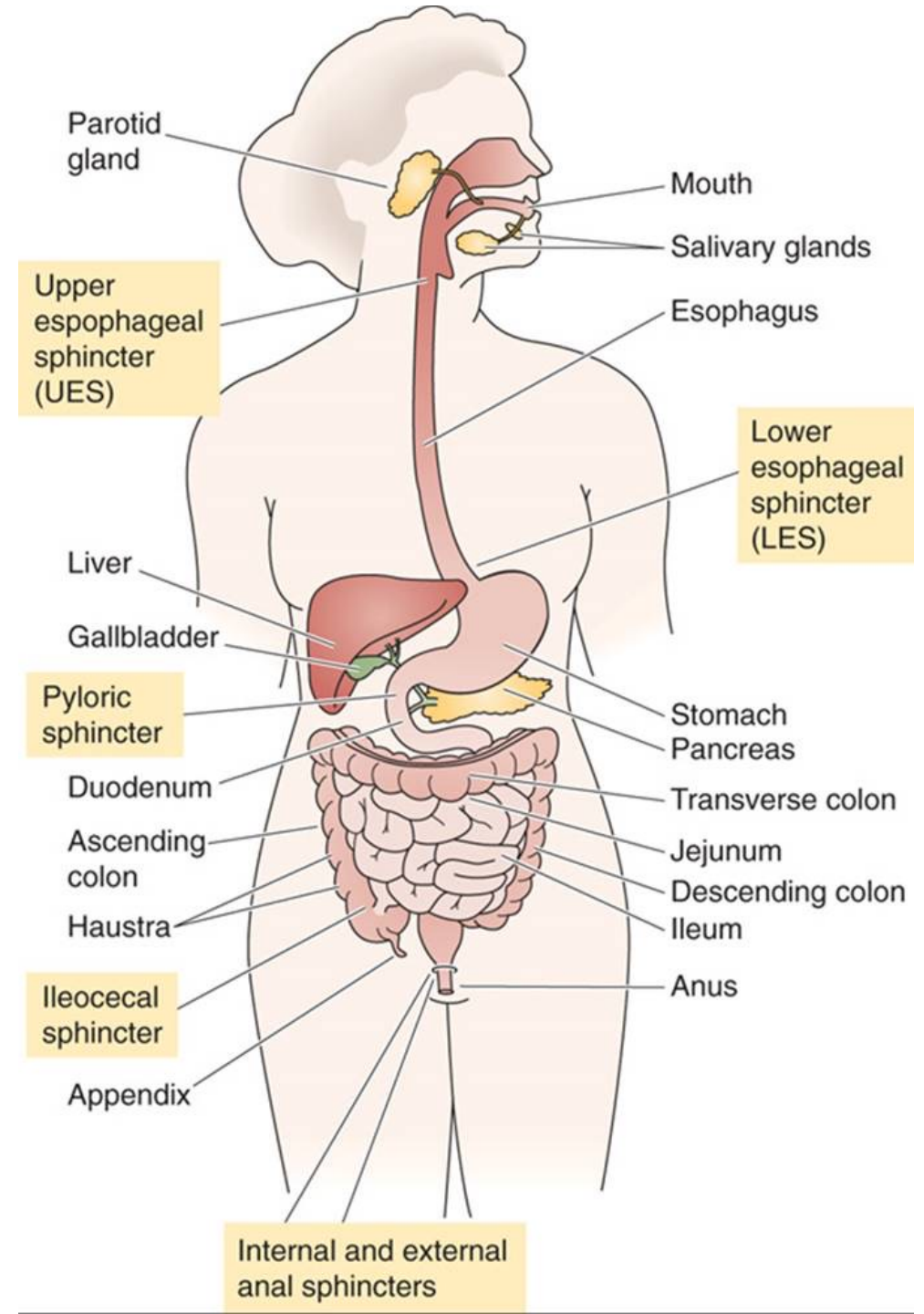
Liver



Stomach

SPHINCTERS

Sphincters in the GI system are muscular valves that control the flow of food, digestive juices, and waste materials, ensuring their regulated movement and preventing backflow to maintain digestive efficiency and prevent issues like reflux and incontinence.





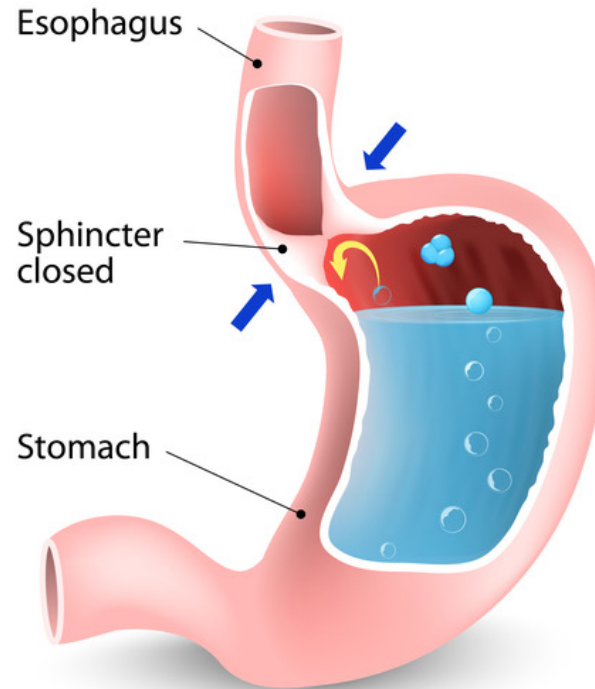
PRACTICE QUESTION

A constriction of the _____ will prevent food from passing from the stomach into the duodenum of the small intestine.

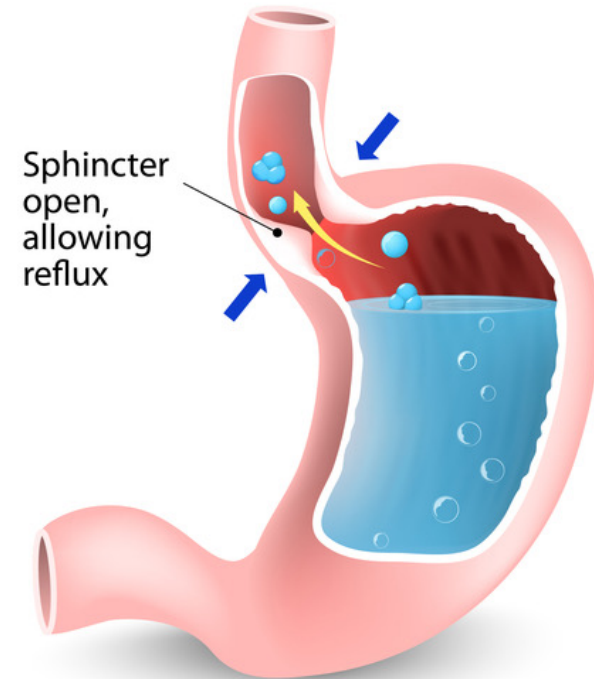
- A. cardiac sphincter
- B. pyloric sphincter
- C. ileocecal valve
- D. rugae

CLINICAL APPLICATION: GASTROESOPHAGEAL REFLUX DISEASE (GERD)

- If the lower esophageal sphincter fails to close adequately after food has entered the stomach, the stomach contents can reflux (back up) into the esophagus
- Hydrochloric acid (HCl) from the stomach contents can irritate the esophageal wall
- The symptoms of GERD can often be controlled by avoiding foods that strongly stimulate stomach acid secretion (coffee, chocolate, tomatoes, fatty foods, orange juice, peppermint, spearmint, and onions)



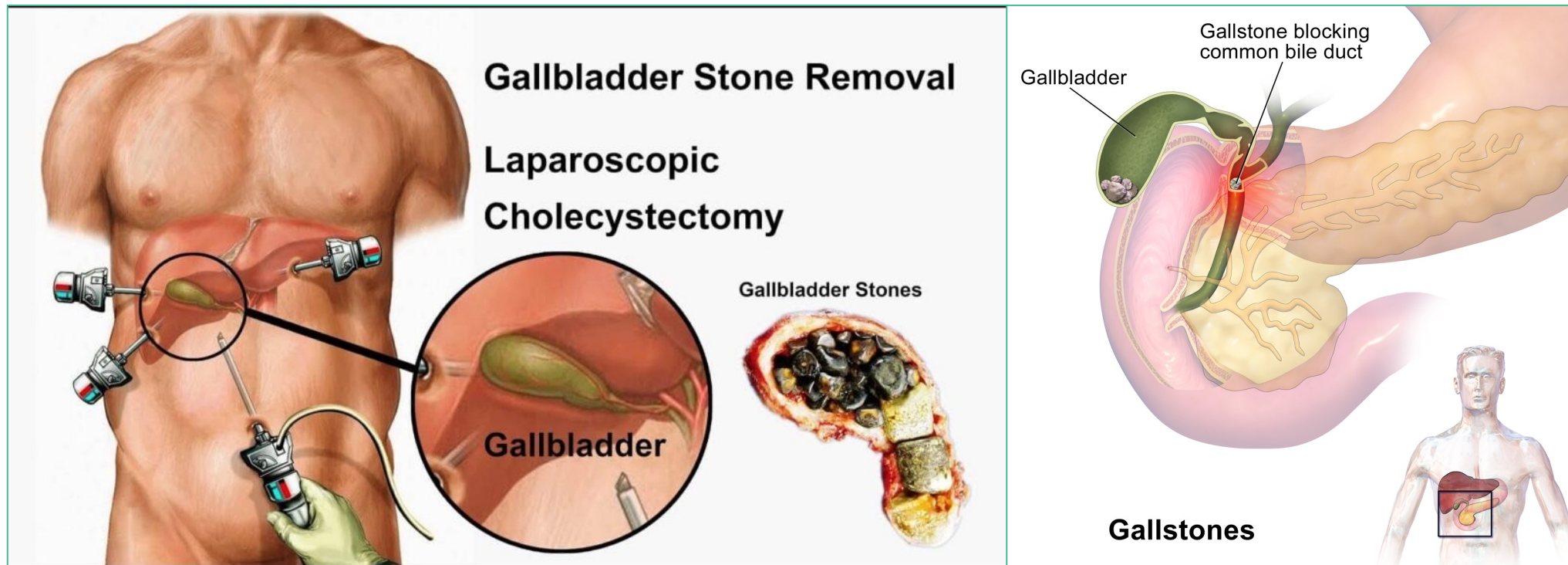
Healthy

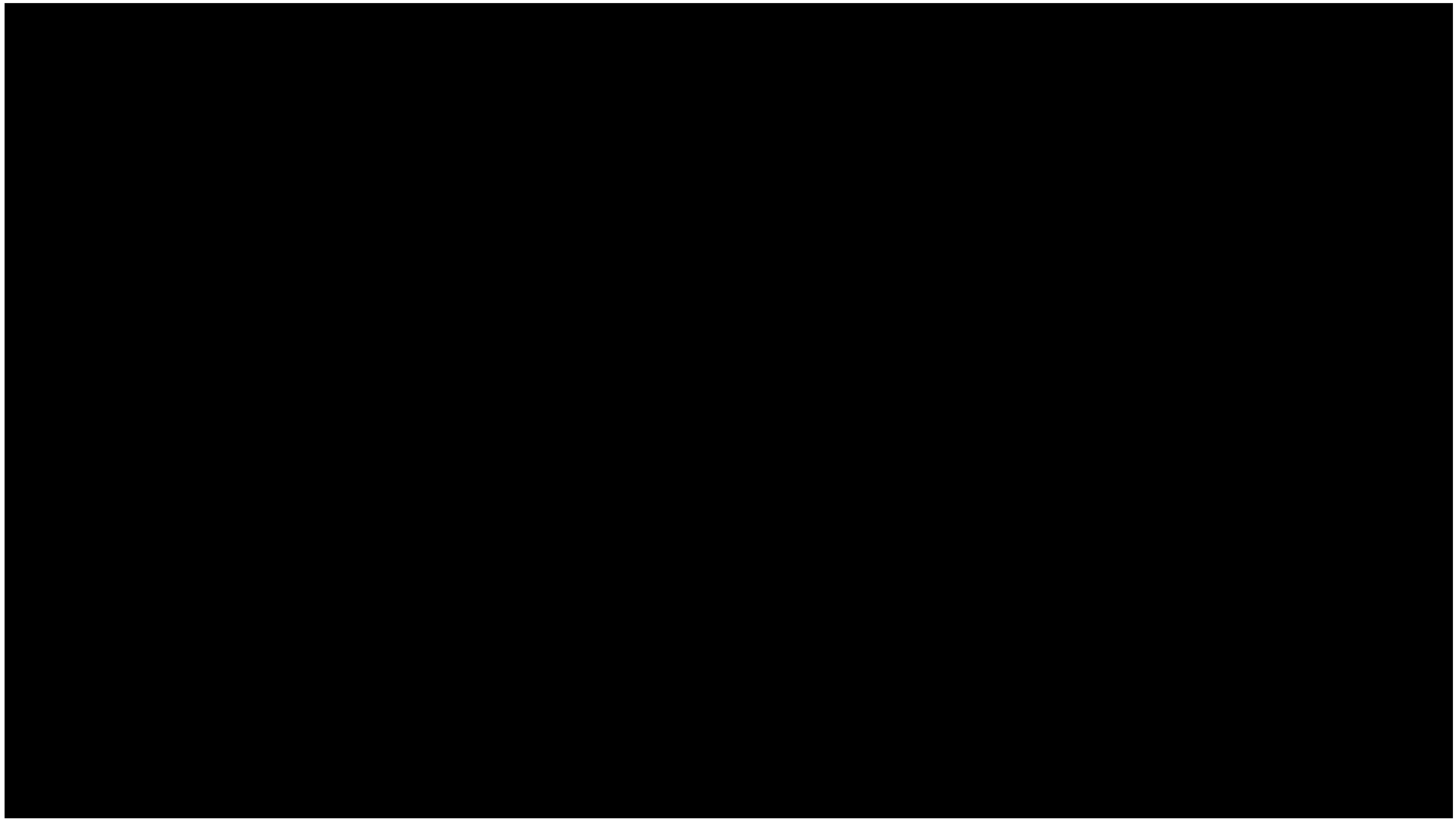


GERD

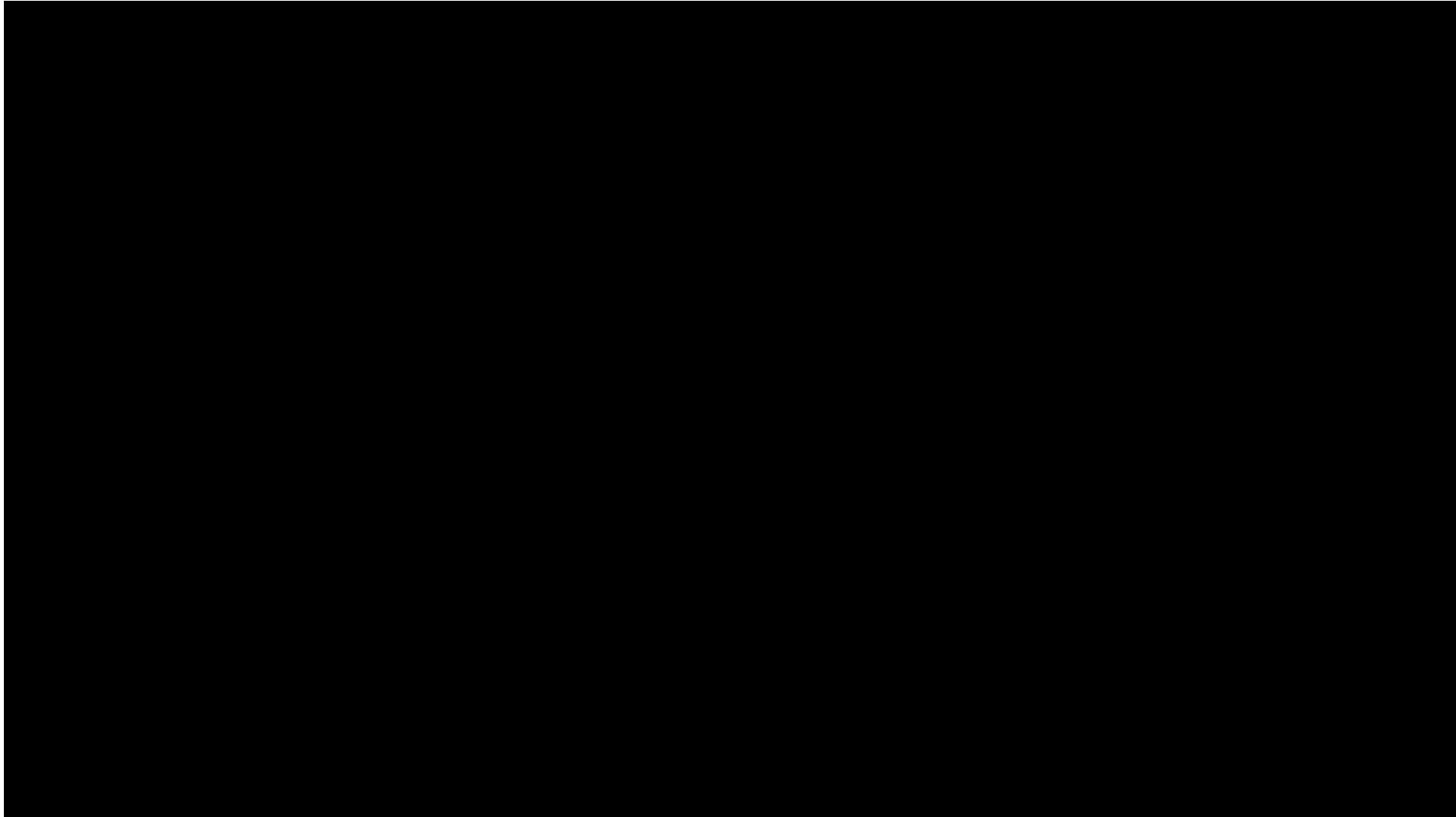
CLINICAL APPLICATION: CHOLECYSTECTOMY

- “Lap Chole”
- Surgical procedure to remove gallbladder, often performed laparoscopically
- **What kind of lifestyle and dietary changes would you expect in these patients?**





CLINICAL APPLICATION: UPPER GI ENDOSCOPY



CLINICAL APPLICATION: COLONOSCOPY

CLINICAL APPLICATION:

