Digestive system and Body Cavities

Objectives
Know the boundaries and contents of each of the divisions of the body cavities and the mediastinum
Be able to define the serosa of each of the divisions of the body cavities
Know the tissue layers of the digestive tract
Know the parts and functions of digestive organs and glands
Know where digestive organs and glands are located relative to one another and to surface landmarks or abdominal regions
Be able to identify the intraperitoneal organs and their mesenteries
Know influence of autonomic nervous system
Coelomic Body Cavities

coelem forms within mesoderm during embryogeny
right and left sides separated by dorsal and ventral mesenteries
right and left sides join as most ventral mesenteries disappear

Thoracic Cavity – costal cage to respiratory diaphragm

Divisions

2 Pleural cavities for lungs

Mediastinum

Superior mediastinum

contains trachea, esophagus, great vessels of heart, thymus

Inferior mediastinum

separated from superior mediastinum at level of
sternal angle to 4th thoracic intervertebral disc

Anterior mediastinum

Middle mediastinum – pericardial cavity for heart

Posterior mediastinum

contains esophagus, descending aorta, inferior vena
cava, thoracic duct
Abdominopelvic or Peritoneal Cavity
Abdominal Cavity – separated from thoracic cavity by respiratory diaphragm
  **Greater sac** – formed by walls of abdominal cavity
  **Lesser sac** – formed by organs and mesenteries
Pelvic Cavity – boundary with abdominal cavity at pelvic brim or inlet
Serosa

**Parietal** – lines cavity wall
**Visceral** – covers surface of organ

**Pleura** – serosa of lungs and pleural cavities
**Pericardium** – serosa of heart and pericardial cavity
**Peritoneum** – serosa of organs of the abdominopelvic or peritoneal cavity

**Mesentery** – bilayer of serosa extending from body wall to organ or from organ to organ
  - serves as a conduit for blood vessels and nerves and site of fat deposition
  - sometimes referred to as ligaments
  - dorsal mesenteries vs ventral mesenteries

**Intraperitoneal** – an organ covered with visceral peritoneum, freely suspended by mesentery or simply united to other organs

**Retroperitoneal** – an organ embedded in body wall
Tissue layers of the Digestive System
Listed from luminal to superficial:

1) Mucosa
   A) Epithelium
typically stratified squamous (e.g., oral cavity), simple columnar (e.g., intestines), or cuboidal (e.g., glands and ducts)
   B) Lamina propria
   connective tissue supporting blood vessels and lymphatics
   C) Muscularis mucosa
   smooth muscle

2) Submucosa
   connective tissue supporting glands, ganglia, blood vessels and lymphatics

3) Muscularis Externa
   A) Inner circular band of smooth muscle
   B) Outer longitudinal band of smooth muscle

4) Serosa or Adventia (loose areolar connective tissue)
Divisions or Organs of the Digestive System

Oral cavity
Pharynx
Esophagus
Stomach or gaster
Small intestine
  Duodenum
  Jejunum
  Ileum
Large intestine
  Cecum
  Vermiform appendix
Colon
  Ascending
  Transverse
  Descending
  Sigmoid
Rectum
Anus
Digestive glands
  Salivary
  Liver
  Pancreas
Oral Cavity

**Vestibule** – superficial to dental arcade (tooth row)
**Oral cavity proper** – internal to and including dental arcade

Margins and boundaries of Oral Cavity

- Anterior – **labia** (superior labium and inferior labium)
- Lateral – **buccae**
- Floor – muscular
- Roof
  - **hard palate** inferior to nasal cavity
  - **soft palate** inferior to nasopharynx

Posterior – **uvula, palatoglossal folds** or **arches, sulcus terminalis**
  - anterior to **oropharynx**

Anatomical Directions specific to oral cavity

- **Labial** (included in “facial” of dentistry)
- **Buccal** (included in “facial” of dentistry)
- **Lingual**

Additional terms for teeth only:

- **occlusal**
- **apical**
- **mesial**
- **distal**
Contents of Oral Cavity

Vestibule
  Superior labial frenulum
  Inferior labial frenulum
  Opening of parotid duct – midbuccal

Oral cavity proper
  Gingiva
  Dentes or teeth
  Anterior $\frac{2}{3}$’s of tongue

Salivary glands (associated with, not really contained within oral cavity)
  Parotid – superficial to masseter muscle, anterior to auricular region
  Sublingual – medial floor of oral cavity
  Submandibular or submaxillary – lateral floor of oral cavity
Dentes
Parts
- **Crown** – above gingiva
- **Root** – in alveolus
- **Cervix** – neck
- **Pulp cavity**
  - **Apical foramen** – entrance to pulp cavity for alveolar arteries and nerves
Layers
- **Enamel** – covers crown only
- **Dentine** – forms root and crown deep to enamel, appositional growth within pulp cavity
- **Cementum** – cellular
- **Periodontal ligament**
Dentes
Directions

mesial, distal, buccal or labial, lingual, occlusal

Heterodont dentition

Incisors – one cusp and root, blade-like, uppers in premaxilla
Canines – one cusp and root, conical, uppers at pre-/maxillary suture
Premolars – two cusps and roots
Molars – four cusps and roots

Adult dental formula 2.1.2.3
Deciduous dental formula 2.1.0.2 (morphologically, not developmentally)
Tongue

Anterior 2/3’s – located in Oral cavity
  Taste buds
    Filiform papillae
    Fungiform papillae
      Gustatory sensory modalities: salt, sweet, sour, umami

Innervation
  1) Lingual nerve
     A) somatosensory – branch of nV₃ mandibular branch of trigeminal
     B) special sensory gustation – chorda tympani branch of nVII facial
  2) nXII hypoglossal – somatomotor
Tongue
Posterior $1/3$ – *located in Oropharynx*
Separated from anterior $2/3$ by *sulcus terminalis*
Taste buds

**Circumvallate papillae**
Gustatory sensory modality: bitter

Innervation
nIX glossopharyngeal – SS gustation, somatosensory, somatomotor
to stylopharyngeus muscle – gag reflex
Boundaries of Divisions of the Pharynx

Nasopharynx
- separated anteriorly from nasal cavity at internal nares
- separated inferiorly from oral cavity by soft palate
- roof formed by sphenoid bone

Oropharynx
- separated superiorly from nasopharynx at level of uvula
- separated anteriorly from oral cavity by the uvula, palatoglossal arches, and sulcus terminalis

Laryngeopharynx
- separated superior from oropharynx at superior margin of epiglottis
- separated anteriorly from larynx by glottis
- separated inferiorly from esophagus at inferior level of glottis
Features of Divisions of the Pharynx

Nasopharynx
openings of the pharyngotympanic or auditory tubes or Eustachian canals
Pharyngeal tonsils or adenoids

Oropharynx
posterior \( \frac{1}{3} \) tongue
Lingual tonsils
Palatopharyngeal arch or fold
Tonsilar fossa
formed between palatoglossal and palatopharyngeal arches, contains:
Palatine tonsils
Vallecula – depression between posterior \( \frac{1}{3} \) tongue and epiglottis

Laryngeopharynx
Esophagus

Muscular tube to transport food from pharynx to stomach, cervical to abdominal
Diameter ~ 10 mm, collapses when empty

Location
- Inferior to laryngeopharynx
- Posterior to trachea in cervical region and superior mediastinum
- Right of aorta, applied to right lung in superior and posterior mediastina
- Passes through respiratory diaphragm via esophageal hiatus

Superior 2/3 skeletal striated muscle – voluntary
Inferior 1/3 smooth muscle – involuntary
Inferior few inches intraperitoneal

Gastroesophageal sphinctor
Stomach or Gaster

acidic, enzymatic, and mechanical degradation of food

**Chyme** – product of gastric digestion

**Gastric Pits** of mucosa

  - Secretory
    - **Gastrin**
      - Proton pump (H$^+$ ion or HCl pH 2.0)

Chemoreceptor

Muscular – three well defined layers of muscularis externa

Intraperitoneal
Stomach or Gaster

Parts
  Fundus
  Body
  Pyloris
  Cardia
  Cardiac notch
  Greater curvature
  Lesser curvature
  Pyloric sphinctor
Stomach or Gaster

Location
- left superior epigastric abdominal region
- inferior to respiratory diaphragm on left side (fundus)
- inferior to liver on right side (pyloris)
- anterior to pancreas and left kidney
- right of spleen
- left of duodenum
- superior to transverse colon
Small intestine

located in abdominal cavity
22 feet in length on average, but highly variable
nutrient absorption
Simple columnar epithelium
**Intestinal villi** of mucosa
  - **Lacteals**
Circumscribed by colon right, superiorly, left, and in part inferiorly
Divisions
  - **Duodenum**
  - **Jejunum**
  - **Ileum**
Duodenum

5% of length of small intestine
retroperitoneal on posterior abdominal wall
left of right kidney
G-shaped, circumscribes head and neck of pancreas
Divisions
  Part 1 horizontal, begins at pyloric sphinctor
  Part 2 vertical – site of hepatopancreatic papilla
  Part 3 – horizontal
  Part 4 – oblique, ends at jejunum
Jejunum
35% of length of small intestine
Intraperitoneal, mostly in upper left abdominal quadrant
wider diameter, thicker walled than ileum

Ileum
60% of length of small intestine
Intraperitoneal, mostly in lower right abdominal quadrant
narrower diameter, thinner walled than jejunum
~60 Peyer’s patches – lymph organs in submucosa
Large intestine
Large diameter
Thin walled
Divisions

**Cecum or Caecum**
Intraperitoneal
blind thin walled sac for bacterial fermentation
Ileocecal orifice on left side superiorly
opening to vermiform appendix on left side inferiorly

**Vermiform Appendix**
Lymph organ
Intraperitoneal
McBurney’s point - located $\frac{2}{3}$ distance from umbilicus to right anterior superior iliac spine
Colon

Divisions

- **Ascending colon** – retroperitoneal on right abdominal wall
- **Right colic or hepatic flexure**
- **Transverse colon** – inferior epigastric to superior umbilical regions inferior to liver and stomach
- **Left colic or splenic flexure**
- **Descending colon** – retroperitoneal on left abdominal wall
- **Sigmoid colon** – intraperitoneal

Left half – separate blood supply and innervation

Features

- **Hastrum** (pl. haustra)
- **Epiploic appendages**
- **Taenia coli**

Diverticula and diverticulitis

- **Fistula** – a connection (i.e., tube, canal, or hole) uniting two epithelial structures
Rectum

Location – pelvic cavity
  superior – intraperitoneal
  inferior – non-peritoneal
  anterior to sacrum
in males posterior to urinary bladder superiorly and prostate gland inferiorly
in females posterior to uterus superiorly and vagina inferiorly
surrounded by adipose and pararectal lymph nodes

Functions
  storage organ – puborectal sling and anal sphinctors responsible for continence
  water resorption

highly vascularized – Superior, Middle, and Inferior Rectal or Hemorrhoidal Arteries and Veins
Anus

most distal division of digestive system
crosses pelvic diaphragm

**Internal anal sphincter** – smooth muscle, involuntary

**External anal sphincter** – skeletal striated muscle, voluntary
Pancreas
Retroperitoneal on posterior abdominal wall
Divisions – head, neck, body, tail
Relationships
  Retroperitoneal on posterior abdominal wall
  Head and neck circumscribed by duodenum on right
  Body and tail posterior to stomach
  Tail crosses hilum of left kidney and ends at spleen

Exocrine functions
digestive enzymes, neutralization of stomach pH

Endocrine functions
blood sugar balance
Islands of Langerhans or Islets
  Glucagon – elevates blood sugar
  Insulin – lowers blood sugar
  Diabetes melitus
  Diabetes insipidis – not related
Liver or Hepar

“the most versatile organ in the body”
- stores – minerals, metal ions, sugars, fats
- metabolizes – amino acids, cholesterol
- detoxifies – dietary poisons
- synthesizes – glycogen, blood proteins, glyco- and lipo-proteins

Endocrine functions
- Secretory – all that it synthesizes above
- Excretory – urea, some bilirubin

Exocrine functions
- **Bile**
  - Secretory – bile salts, i.e., digestive enzymes
  - Excretory – bile pigments, i.e., bilirubin, degraded cholesterol
Liver or Hepar
an essential integration of digestive and circulatory systems

Two pathways into the liver
Hepatic Artery – delivers oxygenated blood from systemic circulation
Hepatic Portal Vein – drains blood from spleen and intestines

digression on Spleen
located in Left Hypochondriac abdominal region, left of Gaster
intraperitoneal
Lymph organ
filters blood – traps and removes dead blood cells from circulation
degrades hemoglobin → bilirubin
parts
  Capsule
  Hilum
  Cords of Billroth - reticular fibers
  populated by leucocytes

Two pathways out of the liver
Hepatic Vein – returns blood to systemic circulation
Bile Duct – exocrine duct to digestive system
Location of Liver
right hypochondriac and upper right epigastric region
inferior to respiratory diaphragm
superior to transverse colon, gall bladder, and right side of gaster
anterior and superior to right kidney and duodenum
Lobes of the Liver
- Right
- Left
- Quadrate
- Caudate

Surfaces of the Liver
- **Diaphragmatic surface** – superior, anterior, right, smooth intraperitoneal surface in contact with respiratory diaphragm
- **Visceral surface** – inferior, intraperitoneal surface in contact with peritoneal organs
- **Bare area** – posterior, retroperitoneal
Relationships of the Liver to other organs

Visceral surface
- Gastric region
- Colic region
- Renal region
- Duodenal region
- Gall Bladder
- Hepatic artery, hepatic portal vein, common bile duct
- Inferior Vena Cava

Falciform Ligament – a rare ventral mesentery
Ligamentum Teres (vestige of umbilical vein)
Histology of the Liver

Lobule
Hepatocytes
Muralium
Sinusoids
Bile canaliculi

Gall bladder
“cystic” refers to gall bladder
located in right hypochondriac region, superior to pyloric sphincter
a storage organ – stores and releases bile produced by liver
Ducts of Liver and Pancreas
from Liver
  Right and Left Hepatic Ducts
  Common Hepatic Duct
  Cystic Duct – bidirectional to and from gall bladder
    the gall bladder stores bile for controlled release
Bile Duct or Common Bile Duct
from Pancreas
  Main Pancreatic Duct
  Accessory Pancreatic Duct (variable)
combined
  Hepatopancreatic Duct
  Hepatopancreatic Ampulla
  Hepatopancreatic Papilla
Lesser abdominal sac
formed by
   Liver
   **Lesser Omentum**
   Stomach
   Spleen to left
   **Greater Omentum**
   Transverse Colon
   **Transverse Mesocolon**
   Pancreas

**Epiploic foramen**
perforates Lesser Omentum – communicates greater and lesser sacs
located left of gall bladder
left margin – location of hepatic artery, hepatic portal vein, and bile duct
Respiratory System

Objectives
Know the parts and functions of respiratory organs
Know where respiratory organs are located relative to other organs
Recall muscles of respiratory ventilation and their innervation
Divisions or Organs of the Respiratory system

Nasal Cavity
Paranasal Sinuses
Pharynx
Larynx
Trachea
Primary Bronchi
Lungs
Muscles of respiratory ventilation
Nasal cavity
   Nostrils
   Vestibule
   Antrum
   Olfactory Epithelium

Sphenoethmoid Recess – communicates sphenoid sinus

Nasal Conchae

Nasal Meatuses
   Superior – communicates ethmoid air cells
   Middle – semilunar hiatus, communicates ethmoid air cells, maxillary and frontal sinuses
   Inferior – communicates nasolacrimal duct
Pharynx

begins at Internal Nares

Divisions

Nasopharynx
  opening of Pharyngotympanic Tube
  Pharyngeal Tonsils

Oropharynx
  Lingual Tonsils
  Palatine Tonsils

Laryngeopharynx
Larynx
located in thyroid region of anterior cervical triangle
begins at Aditis Laryngis or Glottis
anterior to Laryngeopharynx
superior and medial to Thyroid and Parathyroid Glands
posterior and medial to sternohyoid muscle
superior to Trachea
Consists of cartilagenous skeleton, muscles, membranes and mucosa
Innervated by Right and Left Recurrent Laryngeal Nerves – branches of nX vagus
Parts of the Larynx

- (suspended from or affixed to Hyoid bone)
- Epiglottis cartilage – elastic cartilage (all others hyaline)
- Thyrohyoid membrane
- Thyroid cartilage
  - Laryngeal Eminence
  - Superior and Inferior Cornua
- Cricoid cartilage
  - paired Corniculate cartilages
  - paired Arytenoid cartilages
- Arytenoideus muscle
- Aryepiglottic fold
- Vestibule
- Aditis laryngis
- Glottis
- Infraglottic cavity
- Vestibular or false vocal fold
- Ventricle
- Vocal fold
Trachea
location
Cervical region
  anterior to esophagus
  posterior to sternothyroid muscle
Superior mediastinum
  anterior to esophagus
  posterior to thymus (a lymph organ)
  branches at sternal angle to form paired primary bronchi

Tracheal rings or cartilages
Trachealis muscle
Mucosa lined with ciliated pseudostratified epithelium
Lungs
located in **pleural cavities**
suspended medially by **root of lung**, which includes:
- Primary Bronchus
- Pulmonary Arteries
- Pulmonary Veins
enters lungs via **Hilum**

Divisions of lungs
- **Lobes**
  served by **Secondary Bronchi**
- **Bronchopulmonary Segments**
  served by **Tertiary Bronchi**
- **Bronchioles**
- **Alveoli**
- **Surfactant**
General Features of lungs

Cupola or Apex
Costal Surface
Diaphragmatic Surface
Mediastinal Surface
Hilum
Features of right lung

Upper Right Lobe
Middle Right Lobe
Lower Right Lobe
Horizontal Fissure
Right Oblique Fissure

Mediastinal relationships

Esophagus
Azygos vein – drains Intercostal Veins
Right Brachiocephalic Vein – drains upper right ¼ of body
Superior Vena Cava – drains upper ½ of body
Cardiac Impression
Right Phrenic Nerve
Thoracic Vertebrae
Features of left lung

Upper Left Lobe
Lower Left Lobe
Left Oblique Fissure
Cardiac Notch
Lingula

Mediastinal relationships

Aorta – ascending, arch, descending
Left Subclavian Artery – serves left head, neck, and upper limb
Cardiac Impression
Left Phrenic Nerve
Thoracic Vertebrae
Extent of the pleura

Superiorly – first rib

Inferiorly

  Crosses 8\textsuperscript{th} rib anteriorly
  Crosses 10\textsuperscript{th} rib laterally
  Crosses 12\textsuperscript{th} rib posteriorly

Pleural recesses
Pathologies
  Collapsed lung
  Pneumothorax
  Hemothorax
  Adhesions