- it is customary to name the fascia according to the structure it overlies

**Diaphragmatic fascia**
- covers the under surface of the diaphragm

**Transversalis fascia**
- lines the transverses abdominis

**Psoas fascia**
- covers the psoas muscle

**Quadratus lumborum fascia**
- covers the quadratus lumborum

**Iliaca fascia**
- covers the iliacus muscle

> Abdominal blood and lymph vessels lie within the fascial lining, whereas the principal nerve lie outside the fascia; this is important in the understanding of the femoral sheath

**Femoral sheath**
- a downward prolongation of the fascial lining around the femoral vessels and lymphatics, for about ½ inches (4cm) into the thigh, behind the inguinal ligament

**Femoral nerve**
- it lies outside the fascial envelope, it has no sheath

**Peritoneal lining of the abdominal wall**
- a thin serous membrane consisting of a layer of mesothelium resting on connective tissue
- continuous below with the parietal peritoneum lining the pelvis

---

**The surface landmarks of the abdominal wall**

- **Xiphoid process**
  Thin cartilaginous part of the sternum
  Easily palpated in the depression where the costal margins meet in the upper part of the anterior abdominal wall

- **Xiphesternal junction**
  Identified by feeling the lower edge of the body of sternum
  Lies opposite the body of the 9th thoracic vertebra

- **Costal margin**
  The curved lower edge of the thoracic wall
  Formed in front by the cartilaginous attachments of the 7th, 8th, 9th and 10th ribs.
  Formed behind by the cartilages 11th and 12th ribs, 12th rib may be short and difficult to palpate
  Reaches its lowest level at the 10th costal cartilages which lies opposite the body of the 3rd lumbar vertebrae

- **Iliac crest**
  Can be felt along its entire length and ends in front at the anterior superior iliac spine and behind at posterior superior iliac spine
  Highest point lies opposite the body of the 4th lumbar vertebra
  About 2 inches posterior to the anterior superior iliac spine, the outer margin projects to form the tubercle of the crest which lies at level of the body of the 5th lumbar vertebra

- **Pubic tubercle**
  Maybe identified as small protuberance along superior surface of the pubis

- **Symphysis pubis**
  The cartilaginous joint that lies in the midline between the bodies of the pubic bones
  Felt as a solid structure beneath the skin in the midline at the lower extremity of the anterior abdominal wall

- **Pubic crest**
  Name given to the ridge on the superior surface of the pubic bones medial to the pubic tubercle

- **Inguinal ligament**
  Lies beneath a skin crease in groin
  The rolled under inferior margin of the aponeurosis of the external oblique muscle
  Is attached laterally to the anterior superior iliac spine and curves downward and medially, to be attached to the pubic tubercle
- 4 incisors
- 2 canines
- 4 molars

- Begins to erupt at about 6th month after birth and have all erupted by the end of the 2nd year.
- Approximate times of eruption:
  - Central incisors: 6-8 months
  - Lateral incisors: 8-10 months
  - First molars: 1 year
  - Canines: 18 months
  - Second molars: 2 years

- Teeth of the molar jaw usually appear before those of the upper jaw.
  - Permanent teeth
    - 32 in number: (in each jaw)
      - 4 incisors
      - 2 canines
      - 4 premolars
      - 6 molars
    - Begin to erupt during the 6th year
    - Last tooth to erupt is the third molar (during 17th and 30th years)
  - Approximate times of eruption:
    - First molars: 6 years
    - Central incisors: 7 years
    - Lateral incisors: 8 years
    - First premolars: 9 years
    - Second premolars: 10 years
    - Canines: 11 years
    - Second molars: 12 years
    - Third molars (wisdom teeth): 17-30 years

- Teeth of the lower jaw usually appear before those of the upper jaw.

**Tongue**
- Mass of striated muscle covered with mucous membrane
- Anterior: two-thirds lies in the mouth
- Posterior: third lies in the pharynx
- Muscles attach the tongue to the styloid process and the soft palate above and to the mandible and hyoid bone below.
- Divided into right and left halves by the **median fibrous septum**.
- 3 types of papillae present on the upper surface of the anterior two-thirds of the tongue:
  - Filiform papillae
  - Fungiform papillae
  - Vallate papillae
- Mucous membrane of the upper surface of the tongue is divided by the **sulcus terminalis** into two parts:
  - Anterior part or oral part
  - Posterior part or pharyngeal part
    - Devoid of papillae but has a nodular irregular surface cause by the presence of the underlying lymph nodules: lingual tonsil.
- Muscles of the tongue:
  - Intrinsic
    - Confined to the tongue and not attached to the bone
    - Consist of:
      - Longitudinal fibers
      - Transverse fibers
      - Vertical fibers
      - Same origin: **median septum and submucosa**
      - Same insertion: **mucous membrane**
      - Same nerve supply: **hypoglossal nerve**
      - Same action: alters shape of tongue
  - Extrinsic
    - Attached to bones and the soft palate (associated with submandibular region):
**Posterior wall**: second cervical vertebra and body of third cervical vertebra

**Lateral walls**: palatoglossal and palatopharyngeal arches and the palatine tonsils between them
- **Palatoglossal arch** – fold of mucous membrane covering the underlying palatoglossus muscle
- **Palatopharyngeal arch** – fold of mucous membrane on the lateral wall of the oral part of the pharynx behind the palatoglossal arch.
- **Tonsillar sinus** – triangular recess on the lateral wall of the oral pharynx behind the palatopharyngeal arch behind. It is occupied by the palatine tonsil.
- **Palatine tonsils** – 2 masses of lymphoid tissue located in the lateral walls of the oral part of the pharynx in the tonsillar sinuses.
  - **Anteriorly**: palatoglossal arch
  - **Posteriorly**: palatopharyngeal arch
  - **Superiorly**: soft palate
  - **Inferiorly**: posterior third of the tongue
  - **Medially**: cavity of the oral part of the pharynx
  - **Laterally**: separated by the superior constrictor muscle

- **Laryngeal part**
  - Lies behind the opening into the larynx and the posterior surface of the larynx
- **Anterior wall**: inlet of the larynx and the mucous membrane
- **Posterior wall**: bodies of the 4th, 5th, 6th cervical vertebrae
- **Lateral wall**: thyroid cartilage and thyrohyoid membrane

### Hard Palate
- Formed by the palatine processes of the maxillae and the horizontal plates of the palatine bones.
- **Boundaries**:
  - Alveolar arches
  - Nasal cavities (floor)
- **Undersurface** covered with mucoperiosteum and possesses a median ridge

### Soft Palate
- Mobile fold attached to the posterior border of the hard palate
- Has a midline conical projection: **uvula**
- Composed of mucous membrane, palatine alveolar, mucous, and muscles
- Muscles of the soft palate (refer to tabulated data – table 11-10, Clinical anatomy page 857)

### Microscopic Anatomy

**Pharynx**
- **Lining**:
  - Stratified squamous non-keratinized epithelium (region continues to the esophagus)
  - Pseudostratified columnar ciliated epithelium with goblet cell (region close to the nasal cavity)
- **Lamina propria**:
  - Small mucous salivary glands at region of the mucosa
  - Dense connective tissue
  - Constrictor and longitudinal muscles (layer outside)

#### 1.2 Esophagus

**Gross Anatomy**

**Esophagus**
- Tubular structure about 10 inches long that is continuous above with the laryngeal part of the pharynx opposite the sixth cervical vertebra
- In the neck: lies in front of the vertebral column
  - Laterally: lobes of the thyroid gland
  - Anteriorly: contact with the trachea and recurrent laryngeal nerves
- In the thorax:
  - Anteriorly:
    - Trachea
    - Left recurrent laryngeal nerve
- Produce gastric lipase that digests triglycerides with the help of lingual lipase
- 4 regions:
  - Cardia
  - Fundus
  - Body
  - Pylorus
- Fundus and body are identical in microscopic structure; only 3 histologic regions are recognized
  - Mucosa and Submucosa of the undistented stomach lie in longitudinally directed folds known as RUGAE which flatten out when stomach is filled

❖ Stomach Layers
- **Mucosa:**
  - Consists of a surface epithelium that invaginates to various extents into the Lamina Propria forming *Gastric Pits*
  - Emptying into the gastric pits are branched, tubular glands characteristic of each region of the stomach namely:
    - Cardiac Glands
    - Gastric Glands
    - Pyloric Glands
  - Lamina Propria
    - Composed of Loose CT interspersed with smooth muscle and Lymphoid cells
  - Muscularis Mucosae
    - Separates mucosa from underlying submucosa
    - A layer of smooth muscle
  - When the luminal surface of stomach is viewed under low magnification, numerous small circular or ovoid invaginations of the epithelial lining are observed. These are the opening of the gastric pits
  - Gastric Pits are lined and covered by Simple Columnar Epithelium; all cells secrete alkaline mucus
  - When released, the mucus forms a thick gel layer that protects them from the effects of the strong acid secreted by the stomach
  - Mucus → effective protection
  - Superficial luminal mucous layer
    - → more soluble, partially digested by pepsin & mixed with luminal contents
  - endogenous aggressors to the epithelial lining:
    - HCl
    - Pepsin
    - Lipases (lingual and gastric)
- **Submucosa:**
  - Composed of dense CT with blood and lymph vessels
  - Infiltrated by lymphoid cells
  - Macrophages
  - Mast cells
- **Muscularis:**
  - Composed of Smooth muscle fibers oriented in 3 main directions:
    - External Longitudinal
    - Middle Circular – greatly thicked in pylorus to form Pyloric Sphincter
    - Internal Oblique
- **Serosa:**
  - Thin covering

❖ 3 Histologic Regions of the Stomach
- **Cardia**
  - Narrow circular band
  - 1.5-3 cm in width
  - At the transition between esophagus and stomach
  - Mucosa contains simple/branched tubular cardiac glands; terminal portions are frequently coiled, often with large lumen
  - Most secretory cells produce mucus and lysozyme enzyme that attacks bacterial walls
  - few hydrochloride-producing parietal cells
  - glands similar in structure to cardiac glands of terminal portion of esophagus
- **Fundus & Body**
  - Lamina Propria is filled with branched, tubular gastric(fundic) glands
joins the stomach to the jejunum
important in receiving the openings of the bile and pancreatic ducts
curves around the head of the pancreas
1st in. (2.5 cm) resembles the stomach—>
  • covered with peritoneum on its anterior and posterior surfaces
  • has the lesser omentum attached to its upper border
  • greateromentum attached to its lower border
  • lesser sac lies behind this short segment
remainder of the duodenum is retroperitoneal

❖ Parts of the Duodenum
(1) First Part
  ✓ 2 in. (5 cm) long
  ✓ begins at the pylorus
  ✓ runs upward and backward on the right side of the first lumbar vertebra
  ✓ lies on the transpyloric plane
  ✓ Relations:
    • Anteriorly
      • Quadrate lobe of the liver
      • gallbladder
    • Posteriorly
      • Lesser sac (1st inch only)
      • Gastroduodenal artery
      • Bile duct
      • Portal vein
      • Inferior vena cava
    • Superiorly
      • Entrance into the lesser sac (epiploic foramen)
    • Inferiorly
      • Head of the pancreas
(2) Second Part
  ✓ 3 in. (8 cm) long
  ➔ vertically downward in front of the hilum of the right kidney on the right side of L2 and L3.
  Duodenal wall is pierced by the bile duct and main pancreatic duct about halfway down its medial border
  • Bile duct and main pancreatic duct unite to form the ampulla that opens on the summit of the
  major duodenal papilla
  ✓ Accessory pancreatic duct (if present) opens into the duodenum a little higher up on the minor
  duodenal papilla
  ✓ Relations:
    • Anteriorly
      • Fundus of the gallbladder
      • Right lobe of the liver
      • Transverse colon
      • Coils of the small intestine
    • Posteriorly
      • Hilum of the right kidney
      • Right ureter
    • Laterally
      • Ascending colon
      • Right colic flexure
      • Right lobe of the liver
    • Medially
      • Head of the pancreas
      • Bile duct
      • Main pancreatic duct
(3) Third Part
  ✓ 3 in. (8 cm) long
Describe the arterial supply, venous drainage, lymphatic supply, and nerve supply of the following:

Oral cavity
Esophagus
Stomach
Liver
Gallbladder
Pancreas
Small Intestine
Large Intestine

<table>
<thead>
<tr>
<th>Organ</th>
<th>Arterial supply</th>
<th>Venous drainage</th>
<th>Lymphatic supply</th>
<th>Nerve supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral cavity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tongue</td>
<td>1. Lingual artery</td>
<td>Internal jugular vein</td>
<td>1. submental lymph nodes (tip of the tongue)</td>
<td>All intrinsic &amp; extrinsic muscles are supplied by the hypoglossal except palatoglossus</td>
</tr>
<tr>
<td></td>
<td>2. Tonsillar branch of the facial artery</td>
<td></td>
<td>2. submandibular &amp; deep cervical lymph nodes (remainder of the anterior 2/3 of the tongue)</td>
<td>SENSORY NERVE SUPPLY: Lingual = mucous membrane covering the anterior 2/3 of the tongue, excluding the vallate papillae. Glossopharyngeal = general sensation &amp; taste appreciation from the posterior 2/3 of the tongue including the vallate papillae vagus</td>
</tr>
<tr>
<td></td>
<td>3. ascending pharyngeal artery</td>
<td></td>
<td>3. deep cervical lymph nodes (lymph from the posterior 3rd of the tongue)</td>
<td></td>
</tr>
<tr>
<td>Teeth</td>
<td></td>
<td></td>
<td></td>
<td>Maxillary teeth = branch off the maxillary nerve,division of the mandibular nerve</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mandibular teeth = branches of the inferior alveolar nerve,branch of the mandibular nerve</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Molar teeth = posterior superior alveolar nerve</td>
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<td></td>
<td></td>
<td></td>
<td>Premolar = middle posterior alveolar nerve</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Canine &amp; incisor teeth = anterior superior alveolar nerve</td>
</tr>
<tr>
<td>Oral lining</td>
<td></td>
<td></td>
<td>Roof = greater palatine &amp; nasopharyngeal nerves (nerve fibers travel in the maxillary nerve)</td>
<td></td>
</tr>
<tr>
<td>Glands</td>
<td></td>
<td></td>
<td>Sublingual salivary glands = lymph drains into the</td>
<td>Sublingual salivary gland = parasympathetic secretomotor supply</td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>
State the tributaries of the portal system and caval system of the GIT.

**Portal vein**
- drains blood from the abdominal part of the gastrointestinal tract from the lower 3rd of the esophagus to halfway down the anal canal
- also drains blood from spleen, pancreas, and gall bladder
- enters the liver and break into sinusoids, from w/c the blood passes into the hepatic veins that join the inferior vena cava
- about 2 in. (5cm.) long and is formed behind the neck of the pancreas by the union of the superior mesenteric and splenic veins
- ascends to the right, behind the first part of the duodenum, and enters the lesser omentum
- runs upward in front of the opening into the lesser sac to the porta hepatic, where it divides into right and terminal branches
- portal circulation begins as a capillary plexus in the organs it drains and ends by emptying blood into the sinusoids within the liver

Tributaries:

- **Splenic vein**
  - Leaves the hilum of the spleen and passes to the right in the splenico renal ligament lying below the splenic artery
  - Unites with the superior mesenteric vein behind the pancreas to form the portal vein
  - Receives the short gastric, left gastroepiploic, inferior mesenteric, and pancreatic veins

- **Inferior mesenteric vein**
  - Ascends on the posterior abdominal wall and joins the splenic vein behind the body of the pancreas
  - Receives the superior rectal veins, the sigmoid veins, and the left colic vein

- **Superior mesenteric vein**
  - Ascends in the root of the mesentery of the small intestine on the right side of the artery
  - Passes front of the third part of the duodenum and joins the splenic vein behind the neck of the pancreas
  - Receives the jejunal, ileal, ileocolic, right colic, middle colic, inferior pancreaticoduodenal, and right gastroepiploic veins

- **Left gastric vein**
  - Drains the left portion of the left curvature of the stomach and the distal part of the esophagus
  - Opens directly into the portal vein

- **Right gastric vein**
  - Drains the right portion of the lesser curvature of the stomach and drains directly into the portal vein

- **Cystic veins**
  - either drain the gall bladder directly into the liver or join the portal vein
**Tributaries of the caval system of the GIT:**

**Inferior vena cava**
- Conveys most of the blood from the body below the diaphragm to the right atrium of the heart
- Formed by the union of the common iliac veins behind the right common iliac artery at the level of the 8th thoracic vertebra, and drains into the right atrium of the heart.
- The right sympathetic trunk lies behind its right margin and the right ureter lies ½ inch (1.3cm) from its right border
- The entrance into the lesser sac separates the inferior vena cava from the portal vein.

Tributaries:
- 2 anterior visceral tributaries-hepatic veins
- 3 lateral visceral tributaries
  - Right suprarenal vein (the left drains into the left renal vein)
  - Renal veins
  - Right testicular or ovarian vein (the left drains into the left renal vein)
- Five lateral abdominal wall tributaries
  - Inferior phrenic vein
  - 4 lumbar veins
- 3 tributaries of origin
  - 2 common iliac veins
    - External iliac vein
    - Internal iliac vein
  - Median sacral vein

**Describe the characteristics of the following motor activities of the GIT:**

**Mastication (Chewing)**
- Is partly reflex and partly voluntary in control
- Mastication reflex is coordinated by reflex centers in the brain stem which facilitate the opening and closing of the jaw
- Chewing is controlled by the somatic nerves to the skeletal muscle of the mouth and jaw
- In addition to voluntary control of these muscles, rhythmical chewing motions are reflexly activated by the pressure of food against the gums, hard palate at the roof of the mouth and tongue
- Activation of these mechanoreceptors leads to reflexive inhibition of the muscles holding the jaw closed
**Composition**
- Daily secretion of saliva is 800-1500 ml
- Compared to plasma saliva is hypertonic contains higher concentration of K and bicarbonate and lower concentration of sodium and chloride
- Proteins include
  - Alpha amylase-enhance digestion process of starch and carbohydrate
  - Lingual lipase-enhance digestion process of fat
  - Lysozyme
  - Mucin

**Control of Salivary Secretions**
Salivary glands are controlled solely or mainly by the nervous mechanism
- Parasympathetic stimulation
  - Results in a secretion of a large volume of watery fluid that is high in electrolytes but low in proteins
- Sympathetic stimulation
  - Results in the secretion of a small volume of fluid containing a high concentration mucus

**Functions of Saliva**
- Help maintain healthy oral tissue
- Aid in digestion
- Exert buffer action against acids in food
- Lubricates the food making swallowing easier
- Moistens the mouth facilitating speech
- Antimicrobial in function
- Prevents bad breath

**Esophageal Secretion**
- Esophageal secretion is entirely mucoid in character
- Mucus is secreted by mucus cells or goblet cells in the epithelial lining of the esophagus
- Functions
  - Primarily provides lubrication for swallowing
  - The upper esophagus secretes mucus which prevents mucosal excoriation by the newly entering food
  - Mucus secreted in the esophagi-gastric junctions protect the esophageal wall from digestion by gastric juices that may flow back into the lower esophagus thus preventing peptic ulcer formation at the gastric end of the esophagus

**Gastric Secretion**
**Composition of gastric juice**
Daily secretion of gastric juice is about 3 liters. It is composed of water and different solutes including HCL, sodium, Potassium, bicarbonate, intrinsic factor, mucus, blood group substance, pepsinogen and gastric hormones, which can diffuse into the gastric lumen

**Structural basis for gastric secretion**
The secretory cells are located on the surface of the stomach and in glands that is buried with in the mucosa
The stomach mucosa has 2 types of tubular glands the oxyntic and pyloric glands.

**Oxyntic of fundic glands**
- Located in the fundus and corpus of the stomach
- Contains 3 types of secretory cells
  - **parietal cells**
    - secrete HCK- and the intrinsic factor
  - **chief cells**
    - secrete pepsinogen but not acid
    - precursur for the proteolytic enzyme pepsin
• There is also a 2 way synergism between gastrin and histamine
• However there is no synergism between gastrin and acetylcholine
• There is a 3 way synergism among histamine acetylcholine and gastrin
• Somatostatin released from the interneurons within the enteric nervous system inhibits HCL secretion by parietal cells

Gastric secretion
Function of Gastrin
a.) stimulate HCL secretion
b.) increases gastric and intestinal motility
c.) increases pancreatic secretion
d.) necessary for proper growth of G1 mucosa

Pepsinogen Secretion

- Pepsinogen is converted to the active form, pepsin by the action of HCL and pepsin
- Pepsin is a proteolytic enzyme that begins the process of protein digestion
- Pepsinogen is released from the chief cells of the oxyntic glands during the 3 phases
  - cephalic phase- vagally stimulated cholinergic neurons within the enteric nervous system directly stimulate the chief cells to release pepsinogen
  - gastric phase-the low pH enhance pepsinogen secretion via local reflexes via local reflexes acetylcholine is the transmitter that stimulate the chief cells
  - Intestinal phase- the presence of hydrogen within the duodenum contribute to the pepsinogen secretion low pH stimulates the release of secretin from endocrine cells in duodenum and jejunum, secretin enhances pepsinogen release.

Intrinsic factor
• It is the glycoproteins secreted by the parietal cells in the fundus
• It is required for thereabsorption of Vitamin B12
• The vitamin B12 complex carried to the terminal ileum, where the vitamin is absorbed

Pancreatic Secretion

- Physiologic anatomy
  - Pancreas has
    - An endocrine portion-secretes insulin (islets of Langerhans)
    - An exocrine portion- secrete digestive enzyme and NAHCO3
      - Exocrine cells are organized into acini that produces 4 types of digestive enzymes
        - Peptidase
        - Lipase
        - Amylase
        - Nucleases
      - The digestive enzymes and HCO3 flow through the long pancreatic duct that usually joins the hepatic duct immediately before it empties into the duodenum through the sphincter of Oddi
  - Composition
    - Water
    - Electrolytes
      - Na and K same conc as in plasma
        - HCO3 much higher conc as in plasma
        - Ca, Mg, Zn, HPO4 and SO4 in small amount
      - Enzymes
        - 3 major types of enzymes are secreted
          - Pancreatic amylase- secreted in active form
          - Pancreatic lipases
          - Pancreatic proteases- secreted in their inactive forms (trypsinogen and chymotrypsinogen)
            - Trypsinogen- converted to trypsin by enterokinase or by trypsin itself
            - Chymotrypsinogen- are converted to their active form by trypsin
  - Control of Pancreatic Secretion
    - Occurs both in interdigestive and digestive states
    - Interdigestive pattern of secretion begins when the upper GIT is cleared of food