

# Chapter 5: The Cardiovascular System

## Overview

- **Closed system** of heart and blood vessels.
- **Heart** pumps blood.
- **Blood vessels** circulate blood throughout the body.
- **Main function:** Deliver oxygen and nutrients, remove carbon dioxide and waste products.

## The Heart

- **Size, Location & Orientation:**
  - Located in the **thoracic cavity** between the lungs (inferior mediastinum).
  - Between the **2nd rib and 5th intercostal space**.
  - Turned on its longitudinal axis to the left; rests on the diaphragm.
  - **Cone-shaped:** narrow mobile lower part (**apex**), wide fixed upper part (**base**).

## Heart Coverings (Pericardium)

- Double-walled sac of connective tissue for protection and anchoring.
- 1. **Fibrous pericardium:** Outer superficial layer.
- 2. **Serous pericardium:** Inner layer, composed of two sub-layers:
  - **Parietal layer:** Lines interior of fibrous pericardium.
  - **Visceral layer (Epicardium):** Lines outer surface of the heart (part of heart wall).
- **Serous pericardial fluid:** Fills space between layers, provides frictionless environment.

## The Heart Wall

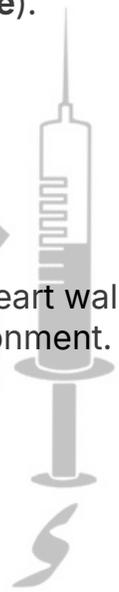
- Three layers:
- 1. **Epicardium:**
  - Outer layer of thin connective tissue.
  - Same as the visceral pericardium.
- 2. **Myocardium:**
  - Middle layer, thick bundles of cardiac muscles.
  - Reinforced by dense fibrous connective tissue (**skeleton of the heart**).
  - Generates and conducts nerve impulses, regulated by **ANS**.
- 3. **Endocardium:**
  - Inner layer of simple squamous epithelium (**Endothelium**).
  - Continuous with the lining of blood vessels entering/leaving the heart.

## External Heart Anatomy

- **Auricle:** Flap-like appendage at the top of each atrium; function unknown.

## The Heart Chambers

- Right and left sides act as separate parts.
- Four chambers:
  - **Atria (Receiving chambers):**
    - Right atrium.
    - Left atrium.
  - **Ventricles (Discharging chambers):**
    - Right ventricle.
    - Left ventricle.



## Blood Circulation

- **Circulatory system:** Blood vessels carry blood away from and towards the heart.
- **Arteries:** Carry blood *away* from the heart.
- **Veins:** Carry blood *back* to the heart.
- **Function:** Carries oxygen, nutrients, hormones to cells; removes waste products (e.g., CO<sub>2</sub>).

## Associated Great Vessels of the Heart

1. **Aorta:** Leaves left ventricle.
2. **Pulmonary trunk:** Leaves right ventricle; splits into right and left pulmonary arteries.
3. **Superior vena cava & Inferior vena cava:** Enter right atrium.
4. **Pulmonary veins (four):** Enter left atrium.

- **Left ventricle:** Systemic pump, thicker walls than right ventricle, more powerful.

## The Heart Valves

- Allow blood to flow in only one direction, preventing backflow.
- Four valves:

### 1. **Atrioventricular (AV) valves:** Between atria and ventricles.

- **Bicuspid valve (mitral valve):** Left side, 2 flaps/cusps.
- **Tricuspid valve:** Right side, 3 flaps/cusps.

### 2. **Semilunar valves:** Between ventricles and arteries.

- **Pulmonary semilunar valve.**
- **Aortic semilunar valve.**

- Valves open when blood is pumped, close to prevent backflow.
- **AV valves** held by **chordae tendineae** ("heart strings"), connected to **papillary muscles**.

## Coronary Circulation

- Circulation of blood supplying the heart muscle (**myocardium**).
- **Coronary arteries:** Supply oxygenated blood (arise from ascending aorta).
- **Cardiac veins:** Drain deoxygenated blood, empty into **coronary sinus** on posterior heart.
- Blood from coronary sinus empties into the **right atrium**.
- Blood in heart chambers *does not* nourish the myocardium; heart has its own circulatory system.

## Blood Vessels: The Vascular System

- Transports blood to tissues and back.
- Hierarchy:
  - **Large Arteries (Elastic arteries)**
  - **Medium Arteries (Muscular arteries)**
  - **Arterioles (small arteries)**
  - **Capillaries**
  - **Venules (small veins)**
  - **Medium-sized Veins**
  - **Veins**



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## Blood Vessels: Anatomy (Tunics)

- Walls have three layers, except for capillaries:

### 1. **Tunica interna (Tunica intima):**

- Endothelium (simple squamous epithelium on basement membrane) and elastic fibers.

### 2. **Tunica media:**

- Smooth muscle and elastic fibers.

### 3. **Tunica externa (Tunica adventitia):**

- Mostly connective tissue.

## Arteries

- Carry blood away from the heart. Walls are generally thicker than veins.

### 1. **Large Arteries (Elastic arteries):**

- E.g., aorta; closer to heart.
- Allow stretch and recoil.
- Tunica media: mainly elastic fibers with few muscle fibers.

### 2. **Medium-sized Arteries (Muscular arteries):**

- Most common type, farther from heart.
- Tunica media: more smooth muscle, few elastic fibers.

### 3. **Small Arteries (Arterioles):**

- Smaller diameter, provide greatest resistance.
- Control blood flow through capillaries.

## Capillaries

- Smallest blood vessels, form **capillary beds**.
- Single layer of simple squamous epithelium tissue.
- Site of **gas and nutrient exchange** between blood and tissues.

## Capillary Beds

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- Consist of two types of vessels:

### 1. **Vascular shunt:** Directly connects arteriole to venule.

### 2. **True capillaries:** Exchange vessels.

- O<sub>2</sub> and nutrients cross to cells.
- CO<sub>2</sub> and waste products cross into blood.

## Types of Capillaries

### 1. **Continuous capillaries:**

- Endothelial cells joined by tight junctions.
- Found in muscles, adipose tissue, CNS (blood-brain barrier).

### 2. **Fenestrated capillaries:**

- Pores (fenestrae) in vessel wall.
- Found in kidney, intestine, endocrine glands.

3

### . **Sinusoids (Discontinuous capillary):**

- Almost no basal lamina, wide gaps/pores between endothelial cells.
- Found in liver, spleen, bone marrow; allow passage of proteins.



# Veins

- Relatively large vessels with large lumen.
- Carry deoxygenated blood from the body to the heart.
- **EXCEPTION:** Four pulmonary veins carry oxygenated blood from lungs to left atrium.
- Walls contain same three layers as arteries, but:

1. **Tunica media is much thinner.**

2. Less elastic, collagenous, and smooth muscle tissue.

3. **Thickest layer is tunica adventitia (externa).**

4. Larger veins contain **valves** to prevent backflow.

## Movement of Blood Through Veins (Assisted)

1. **Skeletal muscle pumps:** Action of surrounding muscles.

2. **Venous valves:** Ensure one-directional flow.

3. **Breathing:** Diaphragm flattening increases abdominal pressure, moving blood towards heart.



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# Chapter 6: The Respiratory System

## Overview

- Provides oxygen to all body tissues.
- Functions:
  1. **Gas exchange** (O<sub>2</sub> and CO<sub>2</sub>) between blood and external environment.
  2. **Smell.**
  3. **Sound production.**

## Function of the Respiratory System (Respiration Types)

- **External Respiration:**
  - Gas exchange between **alveoli and capillaries** within the lungs.
  - Alveoli are the *only* site of gas exchange; other structures are passageways.
  - Passageways purify, warm, and humidify incoming air.
  - Shared responsibility with cardiovascular system.
- **Internal Respiration:**
  - Gas exchange between **capillaries and cells.**
  - Primarily responsibility of the cardiovascular system.

## Organs of the Respiratory System

- Nose and nasal cavity
- Pharynx
- Larynx
- Trachea
- Bronchi
- Lungs (bronchioles and alveoli)

## Anatomy of the Nose and Nasal Cavity

- Only external part of respiratory system; contains nostrils (nares).
- Supported by nasal bone.
- **Nasal cavity:** Divided by **nasal septum** (vomer bone inferiorly, perpendicular plate of ethmoid bone superiorly).
- **Olfactory receptors:** Located in mucosa on superior surface.
- **Respiratory mucosa:** Lines rest of cavity.
  - Moistens and warms air.
  - Traps foreign particles.
  - Contains cilia that move contaminated mucus posteriorly to pharynx (swallowed and digested).
- **Lateral walls:** Have projections called **conchae** (increase surface area and air turbulence).
- **Nasal cavity:** Separated from oral cavity by **palate** (anterior hard palate - bone, posterior soft palate - muscle).

# Pharynx (Throat)

- Passage from nasal cavity to larynx.
- Three regions:

1. **Nasopharynx:** Superior, behind nasal cavity.
2. **Oropharynx:** Middle, behind mouth.
3. **Laryngopharynx:** Inferior, attached to larynx.

- Oropharynx and laryngopharynx are common passageways for air and food.

## Structures of the Pharynx

- **Auditory tubes:** From middle ear, enter nasopharynx.
- **Tonsils:**
  - **Pharyngeal tonsil (adenoids):** In nasopharynx.
  - **Palatine tonsils:** In oropharynx.
  - **Lingual tonsils:** At base of tongue.

## Larynx (Voice Box)

- Routes air and food into proper channels.
- Plays a role in speech.
- Made of eight rigid hyaline cartilages and a spoon-shaped flap of elastic cartilage (**epiglottis**).

## Structures of the Larynx

- **Thyroid cartilage:** Largest hyaline cartilage, protrudes anteriorly (**Adam's apple**).
- **Vocal cords (vocal folds):** Vibrate with expelled air to create sound/speech.
- **Epiglottis:** Superior opening of the larynx; routes food to esophagus, air to larynx.

## Trachea (Windpipe)

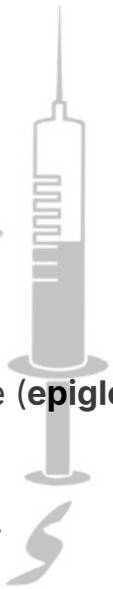
- Connects larynx with bronchi.
- Lined by **pseudostratified ciliated columnar epithelium** (nasal mucosa).
  - Cilia beat continuously against incoming air.
- Walls reinforced with **C-shaped hyaline cartilage**.

## Primary Bronchi

- Formed by division of the trachea.
- **Right primary bronchus:** Wider, shorter, straighter than left; divides into **3 secondary (lobar) bronchi**.
- **Left primary bronchus:** Divides into **2 secondary (lobar) bronchi**.

## Respiratory Tree Divisions

- Bronchi subdivide into smaller branches:
  - Primary bronchi
  - Secondary bronchi
  - Tertiary bronchi
  - Bronchioles



## Bronchioles

- All but the smallest branches (bronchioles) have reinforcing cartilage.

## Alveoli

- Terminal bronchioles end in **alveoli** (site of gas exchange).
- Functional unit of the respiratory system.
- Simple squamous epithelium.
- Contain **alveolar macrophages**.
- **Pulmonary capillaries** cover external surfaces.

## Respiratory Membrane (Air-Blood Barrier)

- Thin squamous epithelial layer lining alveolar walls.
- Pulmonary capillaries cover external surfaces of alveoli.

## Lungs

- Each lung divided into lobes by fissures:
  - **Left lung:** Two lobes (one fissure).
  - **Right lung:** Three lobes (two fissures).

## Coverings of the Lungs (Pleura)

- **Visceral pleura:** Covers lung surface.
- **Parietal pleura:** Lines walls of thoracic cavity.
- **Pleural fluid:** Fills space between layers, allows gliding.



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# Chapter 7: The Digestive System

## Functions

1. **Digestion:** Breaking down large food molecules into small, soluble molecules.
2. **Absorption:** Movement of nutrients (end products of digestion) into bloodstream or lymph.

## Parts of the Digestive System

- Two main groups:
  1. **Alimentary canal/tract (gastrointestinal or GI tract):** Continuous coiled hollow tube.
  2. **Accessory digestive organs/Associated digestive organs.**

### Organs of the Alimentary Canal

- Oral cavity (Mouth)
- Pharynx
- Esophagus
- Stomach
- Small intestine
- Large intestine
- Anus

### Associated Structures of Digestive System

- Teeth
- Salivary Glands
- Pancreas
- Liver
- Gallbladder

## Mouth (Oral Cavity) Anatomy

- **Lips (labia):** Protect anterior opening.
- **Cheeks:** Form lateral walls.
- **Tongue:** Muscular organ (skeletal muscle), contains **papillae** (taste buds).
- **Teeth:** Accessory organ, for chewing.
- **Hard palate:** Anterior roof of mouth (bony).
- **Soft palate:** Posterior roof of mouth (fleshy), ends in **uvula**.
- **Vestibule:** Space between lips/cheeks externally and teeth/gums internally.
- **Tonsils:** Lymphatic tissue at posterior end.
  - **Palatine tonsils.**
  - **Lingual tonsils.**

## Salivary Glands

- Accessory digestive organs, secrete **saliva** (mucous and serous fluid).
  - Serous part: Clear, alkaline, contains **salivary amylase**.
  - Saliva also contains bacteria-inhibiting substances.
- Glands:
  - **Parotid Glands:** Anterior to ear.
  - **Submandibular Glands:** Empty into floor of mouth.
  - **Sublingual Glands:** Empty into floor of mouth.
- Help form a **food bolus**.



# Pharynx Anatomy

- Lies behind nasal cavity, oral cavity, and larynx. Passageway for air and food.
- 3 parts (similar to respiratory system): Nasopharynx, Oropharynx, Laryngopharynx.

# Esophagus Anatomy

- Approx. **25 cm** long.
- Runs from pharynx to stomach through the diaphragm (**hiatus opening**).
- Lined by **stratified squamous epithelium**.

# Layers of Alimentary Canal Organs

- From esophagus to large intestine, walls have four basic tissue layers:

1. **Mucosa:** Innermost layer, lines lumen.

- **Surface epithelium:** Stratified squamous in esophagus, mostly simple columnar below.
- **Lamina propria:** Connective tissue.
- **Muscularis Mucosae:** Scanty smooth muscle.

2. **Submucosa:** Soft connective tissue with blood vessels, nerve endings, lymphatic tissue.

3. **Muscularis externa:** Smooth muscle layer (inner circular, outer longitudinal).

4. **Serosa (visceral peritoneum):** Outermost layer, produces serous fluid.

# Stomach Anatomy

- Located on left side of abdominal cavity (epigastric area).
- Two openings:
  - Upper: **Cardiac opening** with **cardioesophageal sphincter**.
  - Lower: **Pyloric sphincter** or valve.
- Four Regions:
  - **Cardiac region:** Near heart.
  - **Fundus:** Expanded portion, lateral to cardiac region.
  - **Body:** Midportion, largest part.
  - **Pylorus:** Funnel-shaped terminal end.
- **Greater curvature** (lateral), **Lesser curvature** (medial).
- **Rugae:** Internal folds of mucosa; disappear when stomach fills.
- **Lining epithelium:** Simple columnar epithelium with mucus cells (protective bicarbonate-rich mucus).
- **Gastric glands** in gastric pits secrete gastric juice:

1. **Parietal cells:** Secrete **HCl**.

2. **Neck cells:** Mucus neck cells.

3. **Enteroendocrine cells:** Produce hormones.

4. **Stem cells:** Regeneration.

5. **Chief cells:** Produce **pepsinogen** (inactive form of pepsin).

# Small Intestine Anatomy

- Major digestive organ.
- Three subdivisions:
  - **Duodenum:** C-shaped, **25 cm**, shortest, curves around pancreas head.
  - **Jejunum:** **40%** of length.
  - **Ileum:** Almost **60%** of length; joins **cecum** (first part of large intestine) via **ileocecal valve**.
- Wall contains four layers.
- **Submucosa** contains **Peyer's patches** (lymphatic tissue).
- Three structural modifications to increase surface area for digestion and absorption:

1. **Circular folds (plicae circulares):** Deep folds of mucosa and submucosa; do not disappear when full.

2. **Villi:** Fingerlike structures formed by mucosa.

3. **Microvilli:** Tiny projections of plasma membrane (create **brush border**).

## Chemical Digestion in the Small Intestine

- **Intestinal enzymes:** Embedded in plasma membrane of microvilli.
- **Pancreatic enzymes:** Produced by pancreas, carried to small intestine via main pancreatic duct.
- **Bile:** Formed by liver, leaves via common hepatic duct, enters small intestine via bile duct.
  - **Function:** Emulsify fats (physically break large fat globules). *Does not contain enzymes.*
- Main pancreatic duct and bile duct meet at the **hepatopancreatic ampulla**.

## Large Intestine Anatomy

- Larger in diameter, shorter in length than small intestine.
- Extends from ileocecal valve to anus.
- Parts:
  - **Cecum:** Saclike first part, includes **Appendix**.
  - **Colon:** Ascending, Transverse, Descending, Sigmoid.
  - **Rectum.**
  - **Anal canal.**
  - **Anus.**
- Wall has 4 layers, but no folds or villi.
- Lining of simple columnar epithelium contains mainly **goblet cells** (produce mucus to lubricate feces passage).
- Muscularis externa layer of cecum and colon has inner circular muscle and modified reduced outer layer of longitudinal muscles.
- **Anal canal:**
  - Upper half: longitudinal folds (**columns of Morgagni**), simple columnar epithelium.
  - Lower part: stratified squamous epithelium.
  - Lamina propria contains sebaceous glands, hair follicles, large veins (can dilate to **hemorrhoids**).
- **Anus:** Opening of large intestine.
  - **External anal sphincter:** Skeletal muscle, voluntary control.
  - **Internal involuntary sphincter:** Smooth muscle.



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# Pancreas

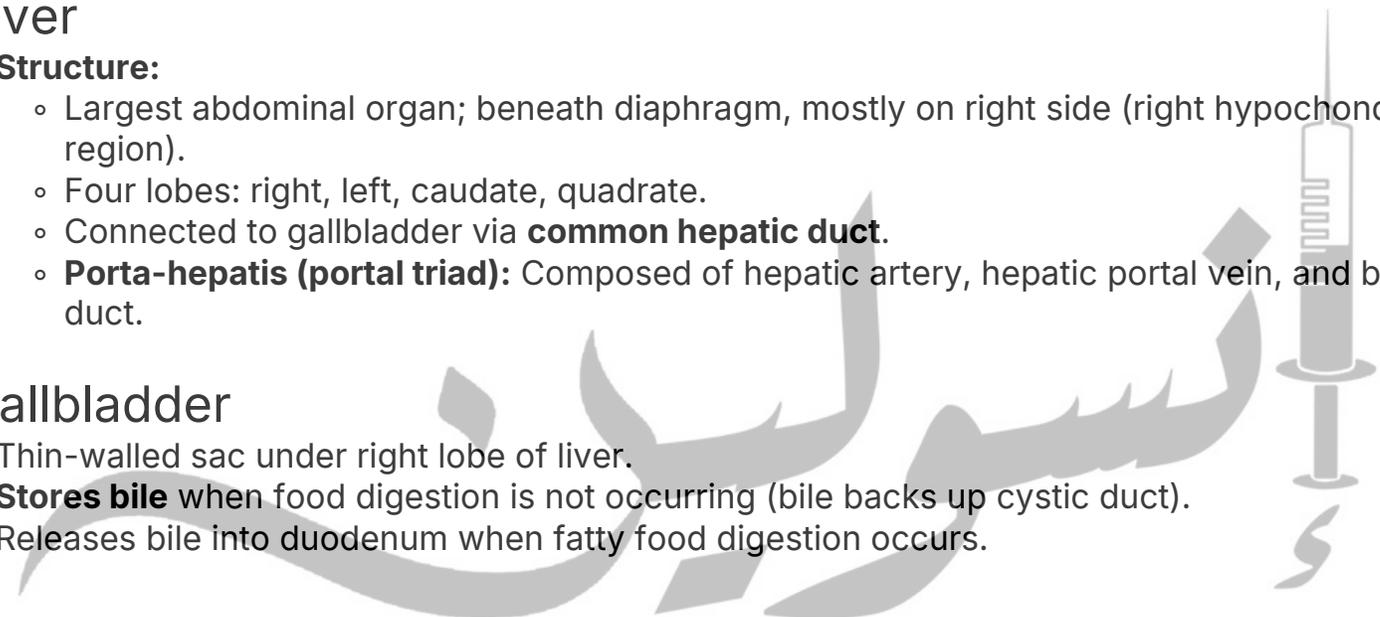
- Functions as both **endocrine and exocrine gland**.
- Extends across abdomen from spleen to duodenum.
- **Exocrine function:** Secretes a wide spectrum of digestive enzymes in alkaline fluid into duodenum from **acini secretory cells**.
- **Endocrine function:** Produces hormones (**Insulin** and **Glucagon**) from **Islets of Langerhans**.

# Liver

- **Structure:**
  - Largest abdominal organ; beneath diaphragm, mostly on right side (right hypochondriac region).
  - Four lobes: right, left, caudate, quadrate.
  - Connected to gallbladder via **common hepatic duct**.
  - **Porta-hepatis (portal triad):** Composed of hepatic artery, hepatic portal vein, and bile duct.

# Gallbladder

- Thin-walled sac under right lobe of liver.
- **Stores bile** when food digestion is not occurring (bile backs up cystic duct).
- Releases bile into duodenum when fatty food digestion occurs.



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# Chapter 8: The Urinary System

## Organs of the Urinary System

- Kidneys
- Ureters
- Urinary bladder
- Urethra

## Functions of the Urinary System

- Elimination of waste products.
- Removal of excess substances from blood.
- Produces hormones and enzymes.

## Location of the Kidneys

- Located in posterior wall of abdomen.
- **Adrenal gland** (suprarenal gland) on top of each.
- Extend from **T12 to L3 vertebra**.
- Right kidney is slightly lower than left (under liver); left kidney is under spleen.

## Regions of the Kidney

- **Renal hilus:** Concaved area on medial side, where nerves, ureter, renal artery, renal vein pass.
- Composed of **kidney flesh** and **renal pelvis**.
- **Kidney flesh** has two regions:
  1. **Renal Cortex:** Outer region, granular (many capillaries). Has outer layer and **renal columns** (penetrate between medullary pyramids).
  2. **Renal Medulla:** Deeper, reddish-brown, striped (tubules and blood vessels). Composed of triangular **renal/medullary pyramids**.
- **Renal Pelvis:** Inner collecting tube; collects urine and transports to ureters.
- **Calyces:** Cup-shaped structures funneling urine to renal pelvis.
  - Urine from nephrons collects into **minor calyces**.
  - Several minor calyces form a **major calyx**.
  - Major calyces join to form the **renal pelvis**.

## Nephrons

- **Structural and functional units of the kidneys.**
- Responsible for forming urine.
- **Vascular part:**
  - **Glomerulus** and **peritubular capillary bed**.
  - **Afferent arteriole** and **efferent arteriole**.
- **Tubular part (Renal tubule):**
  - Bowman's capsule/Glomerular capsule.
  - Proximal convoluted tubule.
  - Descending limb of the loop of Henle.
  - Ascending limb of the loop of Henle.
  - Distal convoluted tubule.
  - Collecting tube.



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## Glomerulus

- Specialized capillary bed.
- Attached to afferent and efferent arterioles on both sides.
- Sits within a **glomerular capsule (Bowman's capsule)**.
- Glomerulus and glomerular capsule form the **renal corpuscle**.

## Ureters

- Thin muscular tubes attaching kidney to bladder.
- Bind between renal pelvis and urinary bladder.
- Lined by **transitional epithelium**.

## Urinary Bladder

- Hollow muscular sac (three layers of smooth muscle = **detrusor muscle**).
- Temporarily stores urine.
- Mucosa made of **transitional epithelium**.
- Female bladder smaller than male.
- Interior has three openings: two **ureteral orifices** (ureters) and one **internal urethral orifice** (urethra).
- **Trigone**: Smooth triangular region outlined by these three openings.

## Urethra

- Thin-walled tube, carries urine from bladder to outside.
- **Internal urethral sphincter**: Thickening of smooth muscle at bladder-urethral junction (involuntary).
- **External urethral sphincter**: Skeletal muscle as urethra passes through pelvic floor (voluntary).

## Urethra Gender Differences

- **Length:**
  - Females: **4 cm**.
  - Males: **20 cm**.
- **Location:**
  - Females: Vertical, anterior to vaginal opening.
  - Males: S-shaped, through prostate and penis (prostatic, membranous, spongy parts).
- **Function:**
  - Females: Only carries urine.
  - Males: Carries urine and is a passageway for sperm cells.

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# Chapter 9: The Reproductive System

## The Reproductive System

- **Gonads:** Primary sex organs.
  - Males: **Testes.**
  - Females: **Ovaries.**
- Gonads produce **gametes** (sex cells, exocrine product) and secrete **hormones** (endocrine product).
- **Sperm:** Male gametes.
- **Ova (eggs):** Female gametes.

## Female Reproductive System

- Ovaries
- Duct System:
  - Oviducts (Uterine tubes, fallopian tubes)
  - Uterus
  - Vagina
- External genitalia
- Mammary Glands

### Uterine (Fallopian) Tubes/Oviducts

- Divided into 3 segments:
  1. **Infundibulum:** Funnel-shaped, has fingerlike projections called **Fimbriae** (receive ovulated oocyte).
  2. **Ampulla:** Thickest smooth muscle layer; site of **fertilization.**
  3. **Isthmus:** Opens into uterus.

### Regions of the Uterus

- Pear-shaped organ, increases in size during pregnancy.
- **Fundus:** Superior rounded region above uterine tube entrance.
- **Body:** Main portion.
- **Cervix:** Narrow outlet, projects into vagina.

### Walls of the Uterus

- **Endometrium:** Inner layer.
- **Myometrium:** Middle layer of smooth muscle.
- **Serous layer (Perimetrium):** Outermost layer.

### Vagina

- Fibromuscular tube; **8 to 10 cm** in length.
- Extends from cervix to exterior.
- Lined by **stratified squamous epithelium.**

## Male Reproductive System

- Testes
- Accessory glands
- Accessory duct system
- Penis



## Testes

- Oval in shape, paired.
- **Endocrine gland:** Produces **testosterone**.
- **Exocrine gland:** Produces **sperms**.
- **Tunica albuginea:** Fibrous sac surrounding each testis.
- **Seminiferous tubules:** Approx. **800** per testis, arranged in lobules; produce thousands of sperms per second, empty into **rete testis**.

## Sperm

- Produced in seminiferous tubules, stored in **epididymis** until maturation.
- 3 parts:
  - 1.**Head:** Contains DNA, covered by **acrosome** (enzymes for fertilization).
  - 2.**Midpiece/Middle piece:** Provides energy for mobility.
  - 3.**Tail:** Only flagellum in human body (movement).
- Mature sperms lack ER, Golgi apparatus, lysosomes.
- **Spermatogenesis** takes **64 to 72 days**.

## Accessory Duct System (Transport of Sperm)

- **Epididymis:** Stores sperm cells until maturation.
- **Ductus deferens:** Carries sperm from epididymis to ejaculatory duct.
- **Ejaculatory duct:** Penetrates prostate gland, delivers sperm to urethra.
- **Urethra.**

## Urethra (Male)

- Extends from base of urinary bladder to tip of penis.
- Carries both urine and sperm.
- Regions: Prostatic urethra, Membranous urethra, Spongy (penile) urethra.

## Male Accessory Glands

- **Semen:** Mixture of sperm and accessory gland secretions.
- Glands:
  - **Seminal vesicles (paired):** Base of bladder; produce thick, yellowish alkaline secretion (**60% of semen**).
  - **Prostate gland:** Inferior to urinary bladder; secretes whitish milky fluid (activates sperms).
  - **Bulbourethral glands (paired):** Pea-sized, inferior to prostate; secrete thick, clear secretion (cleanses urethra of acidic urine, lubricant).

## External Genitalia

- **Scrotum:** Divided sac of skin outside abdomen.
  - Maintains testes at **2-3°C lower** than normal body temperature for sperm viability.
- **Penis.**



# Chapter 10: The Endocrine System

## The Endocrine System

- Uses chemical messages (**Hormones**).
- Hormones released into capillaries, blood carries them to target cells.

## Location of Major Endocrine Organs

- Pituitary Gland
- Pineal Gland
- Thyroid Gland
- Parathyroid Gland
- Adrenal Gland
- Pancreas
- Gonads (Ovary and Testes)
- Thymus

### Pituitary Gland

- Two lobes: Anterior lobe/Anterior pituitary and Posterior lobe/Posterior pituitary.

### Thyroid Gland

- Two lobes and connecting **isthmus**.
- Located in anterior triangle of neck, below cricoid cartilage.

### Parathyroid Glands

- Generally **4 glands** embedded in the back of the thyroid gland.

### Adrenal Glands (Suprarenal glands)

- Located on top of the kidneys.
- Two areas:
  - **Medulla**: Inner region.
  - **Cortex**: Outer region.

### Pancreatic Islets (Islets of Langerhans)

- Pancreas is a mixed gland (endocrine and exocrine).
- Exocrine function: Digestive enzyme secretion (acini cells).
- **Islets of Langerhans**: Endocrine function (produce hormones like Insulin and Glucagon).

### Thymus

- Located posterior to the sternum.
- Largest in infants and children, then atrophies.

### Pineal Gland

- Small projection of the diencephalon.
- Part of Epithalamus.



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# Paranasal Sinuses

- Cavities within bones surrounding the nasal cavity.
- Bones: Frontal, Sphenoid, Ethmoid, Maxillary.
- Functions:
  1. Lighten the skull.
  2. Act as resonance chambers for speech.
  3. Produce mucus that drains into the nasal cavity.



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# Chapter 11: The Lymphatic System

## The Lymphatic System

- Three parts:
  - Fluid: **Lymph**.
  - **Lymphatic vessels**: Transport lymph.
  - **Lymphoid organs**: Contain lymphoid tissue.
- Functions:
  - Draining interstitial fluid (transport fluids back to blood).
  - Transport dietary lipids (absorb digested fat at intestinal villi).
  - Play essential roles in body defense and resistance to disease.

## Lymphatic Organs

- **Primary Organs**:
  - Red Bone Marrow
  - Thymus Gland
- **Secondary Organs**:
  - Lymph nodes
  - Lymph nodules
  - Spleen

## Lymphatic Vessels

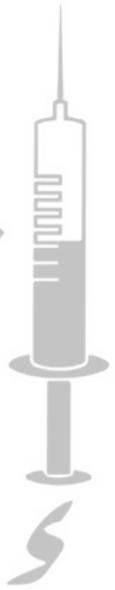
- Begin as **lymph capillaries** between cells.
- Not a circulating fluid system like blood.
- Interstitial fluid drains into lymphatic capillaries, forming lymph.
- Lymph capillaries merge to form lymphatic vessels.
- Lymphatic vessels carry lymph into and out of lymph nodes.
- Finally, back to the vascular system (circulatory veins near the heart).

## Lymph Nodes

- Lymph is filtered through lymph nodes before returning to blood.
- Found in clusters (cervical, axillary, inguinal regions).
- Vary in size.
- Provide biological filtration.

## Lymph Nodules

- Found singly or in groups throughout mucous membranes of respiratory, urinary, reproductive, and digestive tracts.
- **MALT (mucosa associated lymphoid tissue)**: Includes Peyer's Patches (in Ileum), Tonsils, some in the appendix.
- Acts as a guard to protect respiratory and digestive tracts.



## Other Lymphoid Organs

- **Tonsils:** Lymphoid tissue under mucous membranes of throat.
  - Palatine tonsils, Pharyngeal tonsils (adenoid), Lingual tonsils.
  - Considered the first line of defense.
- **Thymus gland:**
  - Located in mediastinum above the heart.
  - Largest at age **10-12**, then begins atrophy.
- **Spleen:**
  - Largest lymphoid organ.
  - In the upper left quadrant of abdomen.

## Sensory Organs

### Structure of the Eye

- Eyeball measures **2.5 cm** in diameter.
- Anterior **1/6** exposed, rest protected by bony orbit.
- Wall of eyeball composed of three layers (tunics):
  - 1. Outer layer: **Sclera & Cornea.**
  - 2. Middle layer: **Choroid.**
  - 3. Innermost layer: **Retina.**

### The Outer Layer (Tunic)

- **Sclera:**
  - White, dense connective tissue layer.
  - Covers entire eyeball except cornea.
- **Cornea:**
  - Transparent, central anterior portion of sclera.
  - Allows light to pass through.
  - Outer surface: nonkeratinized; Middle: collagen fibers and fibroblasts; Inner: simple squamous epithelium.

### The Middle Layer: Choroid Layer (Vascular Tunica)

- Densely pigmented, numerous blood vessels nourish photoreceptors in retina.
- Contains melanocytes (produce melanin, appears dark brown).
- Anteriorly forms two structures:
  - **Ciliary body** and **suspensory ligaments** (suspend the lens).
  - **Iris:** Pigmented layer (eye color), between cornea and lens, regulates light entering pupil.
  - **Pupil:** Rounded opening/hole in center of Iris.
- **Lens:** Contains proteins called **crystallins**; lacks blood vessels.

### Innermost Layer: Retina

- Lines posterior of the eye.
- Contains photosensitive receptor cells (**photoreceptors**):
  - **Rods**
  - **Cones**



## Neurons of the Retina

- Rods and cones sensitive to light.
- **Macula lutea:** Yellowish pigment spot in posterior eye.
- **Fovea centralis:** Depression in center of Macula lutea; devoid of rods and blood vessels, contains *only cones*; produces **sharpest vision**.
- **Optic disk (blind spot):** No photoreceptor cells; where optic nerve leaves.

## Chambers of the Eyeball

- **Anterior chamber:** Between cornea and Iris; contains **aqueous humor** (watery fluid).
- **Posterior chamber:** Between Iris and lens; contains **aqueous humor**.
- **Vitreous chamber:** Between lens and retina; contains gelatinous **vitreous body** (humor).

## Muscles That Move the Eyeball

- Superior

**NURSING TEAM**

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