

The Human Body Systems

Chapter 19, 20 & 21

I. Chapter 19 - Circulatory System

A. A **closed system** consisting of the 4 chambered heart, a network of arteries, veins, capillaries, blood and the lymph system

B. Path of the blood: vena cava → rt atrium → rt ventricle → pulmonary artery → lungs → pulmonary vein → left atrium → left ventricle → aorta → body → back to the vena cava

C. Blood flow goes from the

heart → arteries → arterioles → capillaries → venules → veins → back to the heart

D. Arteries

1. Vessels that carry blood **AWAY** from the heart
2. Thick walled vessel w/ layer of connective tissue and smooth muscle
3. Elastic: able to flex w/ each beat of the heart (pulse)
4. Branches into smaller and smaller vessels called **arterioles**

E. Capillaries

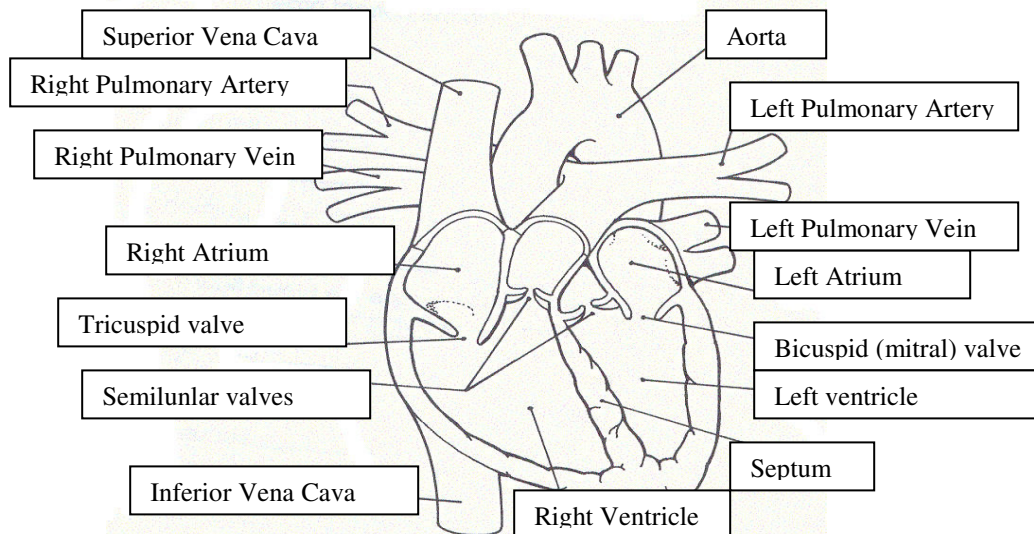
1. Arterioles and venules are connected by these microscopic vessels which are only one cell thick
2. Vessels are small enough that blood cells travel through in single file
3. Vessel walls not perfect seal and **leak** plasma into intercellular spaces (lymph)
4. Point where gas exchange (O₂ and CO₂), nutrients and wastes are exchanged

F. Veins

1. Vessels that carry blood **back toward** the heart
2. Thin walled w/ less connective and muscle tissue surrounding them
3. Not very flexible
4. Has “**one-way**” **valves** to help prevent blood from pooling in the extremities
5. Smaller branches from capillaries get larger and larger forming **venules** which then form veins

G. Heart

1. Acts as a **duel pump** (right and left)
 - a) right pump: collects blood from the body and pumps to the lungs
 - b) Left pump: collects blood from the lungs and pumps to the body
2. Regular **contractions** force blood through the various pathways
 - a) The pacemaker of the heart is the **SA node** (sinoatrial node) located in the upper back wall of the right atrium. This triggers an impulse that travels down to the AV node (atrioventricular node) located at the bottom of the right atrium. The AV node causes both ventricles to contract.
3. **Pericardium** is a tough sac membrane around the heart covers and protects the heart in the thoracic cavity.
4. **Atrium: AKA- Auricles**: thin walled upper chambers receive blood and pump it to the ventricles
5. **Ventricles**: Thick layered lower chambers pump blood out of the heart. The Rt & lft chambers are separated by a thick wall called the **septum** that divides the heart in half.
6. Four “Flap-like” valves control the direction of blood flow through the heart
 - a) **AV Valves** separate atrium from ventricle
 - (1) Right side is the **tricuspid**
 - (2) Left side is bicuspid or **mitral valve**
 - b) **Semilunar Valves**: keep blood from falling back into ventricles



H. Pathways of the Blood: **Pulmonary, Systemic and Lymphatic**

1. **Pulmonary Circulation**

- a) carries deoxygenated blood from the right side of the heart to and through the lungs where it is oxygenated. It then goes back to the left side of the heart.
- b) **Pulmonary artery** is the only artery that carries unoxygenated blood which is also rich in carbon dioxide.
- c) **Pulmonary Vein** is the only vein which carries rich oxygenated blood.

2. **Systemic Circulation:**

- a) Takes oxygenated blood from the pulmonary veins and pumps it to the rest of the body
- b) **Coronary Circulation:** blood supplied to the heart itself
 - (1) By-pass surgery, heart attack, blood vessel blockage, etc.
- c) **Hepatic-Portal Circulation:** Blood flow from digestive tract to the liver
- d) **Renal Circulation:** Circulation to and through the kidneys
- e) **Body Circulation**

3. **Lymphatic Circulation**

- a) Body cells bathed by intercellular fluid and aids in the transportation of gases, nutrients and wastes.
- b) Excess fluid called **Lymph** and is collected in vessels that make up the lymphatic system.
- c) like veins, **lymphatic vessels** have valves which help move lymph thru the system – moves by muscle contractions and indirect squeezing, there is no pump that moves the lymph
- d) **Lymph nodes** are collecting points usually found in the **armpit, groin, throat** and **Chest** regions that are filled w/ lymphocytes and are used to filter out, trap and then destroy bacteria and microorganisms that were collected.
- e) **Lymph** fluid is eventually dumped into a vein in the neck (Superior Vena Cava) where it reenters the circulatory system

4. **Blood**

- a) The blood is made up of **Plasma** and three main types of cells: **RBC** (red blood cells), **WBC** (white blood cells) and **platelets**.
 - (1) **RBC:** nonnucleated cells that contain an iron containing molecule (**hemoglobin**) that carries the oxygen to the cells of the body. Anemia results

when there is not enough hemoglobin and the blood can not carry enough oxygen to the body.

(2) **WBC**: Several cell types that are involved in the immune system

(a) **Leukemia** is a cancer of the bone marrow that causes an uncontrolled growth of white blood cells

(3) **Platelets** are the RBC cell fragments involved in blood clotting. Also involved in clotting are long strands of protein called **fibrin**.

(4) **Plasma** is the yellowish fluid of the blood that carries all of the cells and materials which actually make up the substance we call “blood”

(a) **Yellow color from dissolved proteins – 3 types**

(i) **Albumins** – transport hormones and fatty acids

(ii) **Globulins** – transport vitamins & help fight viral infections

(iii) **Fibrinogens** – cause blood to clot

5. **Spleen** – Helps cleanse the blood by destroying & removing damaged RBC’s cell fragments and platelets

6. **Thymus Gland** – located beneath the sternum and above the heart, main function is to “raise” T-cells until they are mature enough to work properly

II. Chapter 21 – The Immune System

A. Infectious Disease are caused by a **pathogen** – an organism or virus that causes a disease.

1. Disease occurs when a pathogen has invaded the body and causes harm to individual cells

2. Examples include: **measles, mumps, pneumonia, chicken pox, HIV & AIDS**, etc.

3. Pathogens include various types of **Bacteria, Viruses, Fungi & Protists**

a) **Bacteria** – cause food poisoning, botulism, ear infections, tuberculosis, strep throat, etc.

(1) Cause damage, hence disease, by invading and kills/damaging cells themselves or

(2) Produce waste products called toxins that poison – botulism

b) **Viruses** – cause disease by killing/damaging invaded cells – colds (over 200 types) and flu, chicken pox and AIDS

c) **Fungi** – molds, yeast, etc cause athlete’s foot, ringworm, yeast infections

d) **Protists** – cause gastronomic distress – Giardia sp. and malaria

B. The Body’s Defenses

1. 1st Line of Defense: Barriers keep pathogens out.

a) **Skin** – waterproof barrier w/ destructive oils and sweat to help killoff pathogen

b) **Breathing Passages** – nasal passages, trachea, bronchi and lungs lined w/ ciliated epithelial cells that secrete mucus and moved “captured” pathogens up & out of the respiratory tract to be expelled or swallowed!

c) **Mouth & Stomach** – Saliva and stomach acids aid in killing off pathogens

2. 2nd Line of Defense: Once infected.... Then what? The **inflammatory response**

a) Damaged cells trigger the body’s **inflammatory response**

(1) Blood vessels dilate (widen & enlarge) causing increased blood flow and leak plasma and white blood cells into the area – causes swelling, redness, tenderness and fever.

3. 3rd Line of Defense: The Immune Response

a) **White Blood Cells – WBC** – Several Types

(1) **Phagocytes** – Attack, engulf pathogens and destroys them

(a) **phils – latin suffix meaning “love”**

(i) **Basophils** – least abundant WBC “loves” base type stains –

(ii) Eosinophils – “loves” eosin type stains

(iii) Neutrophil – Most abundant WBC – loves neutral stains

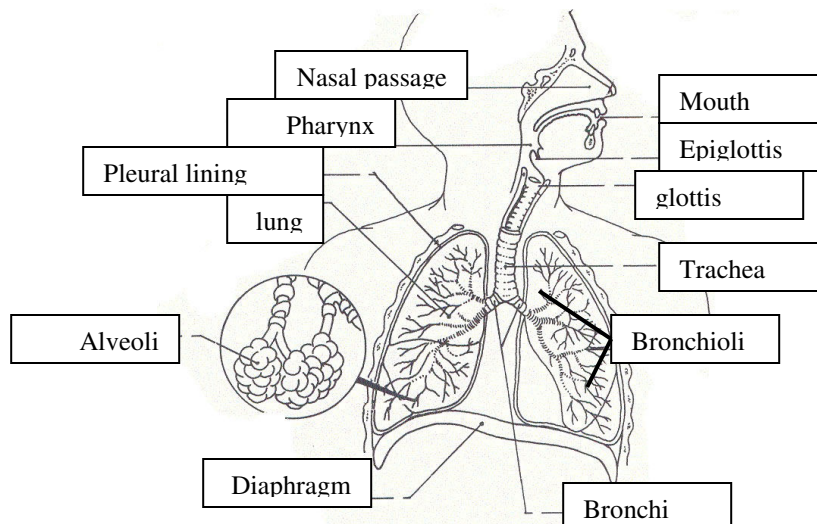
- (2) **Lymphocytes (T cells and B cells)** produce antibodies
- b) **Antibodies** are proteins that react with antigens (foreign molecules that have attacked the body) to deactivate them.
- (1) **T Cells** – Identify one kind of pathogen from another –
- (a) Over 10 million T Cells in your body, each able to recognize different types of proteins (**Antigens**) found on the cell membrane of the pathogen. T Cells are able to identify the antigens as from your own body or are foreign
- (i) Some T Cells attack and kill our own infected cells and invading viruses
- (ii) Other T Cells stimulate B Cells to kick into action
- (2) **B Cells** – Once activated, they produce **antibodies** that are specific to the infected type of antigen (about 2,000 antibodies per second!!!)
- (3) **Antibodies** – attach to the proteins (antigens) of the pathogens and they form clumps of pathogens that mark them for destruction by the phagocytes

III. Chapter 20 - Respiratory System

A. Body system designed to carry air to and from the lungs

B. Inspired air rich in **Oxygen** enters the body thru the **nostrils or mouth**. It travels through the **nasal passages** where it is **Cleaned, Warmed and Humidified**.

C. It then passes through the **pharynx** (back of the throat where nasal passages meet the back of the mouth), past the flap of tissue (**epiglottis**) that protects the **glottis** (the opening to the wind pipe) and then the Larynx or voice box. The air next enters the **Trachea**.



D. **Trachea**: Tube about 12 cm long by 2.5 cm in diameter

1. Held open by cartilaginous rings
2. Inside of tube is lined w/ **cilia**
 - a) cilia beat and move mucous and debris out of the lungs
3. The trachea branches into the right and left **Bronchi**

E. The two **Bronchi** branch into smaller and smaller **Bronchioles**: tubes inside the lungs

1. Inflammation of the bronchi is called **bronchitis**.
2. Bronchial spasms can result in the bronchi to close up and cause a decreased amount of air movement (**Asthma**) and air to be trapped in the alveoli. This air can be quickly reduced in oxygen causing loss of consciousness or even death.

F. Lungs: Located in the thoracic cavity bound on the bottom by the **diaphragm** (a flat sheet of muscle). Each lung and chest cavity wall is surrounded by a thin moist **Pleural** membrane.

1. **Pneumonia** is a lung infection cause by bacteria, viruses or fungi.

G. Alveoli: Air sac at end of tubes that resemble a cluster of grapes

1. lungs contain about 300 million alveoli
2. gas exchange takes place between the air and the blood: carbon dioxide is exchanged for oxygen
3. alveoli are surrounded by blood vessels called **capillaries**
4. Surface area of the lungs is about 70 square meters

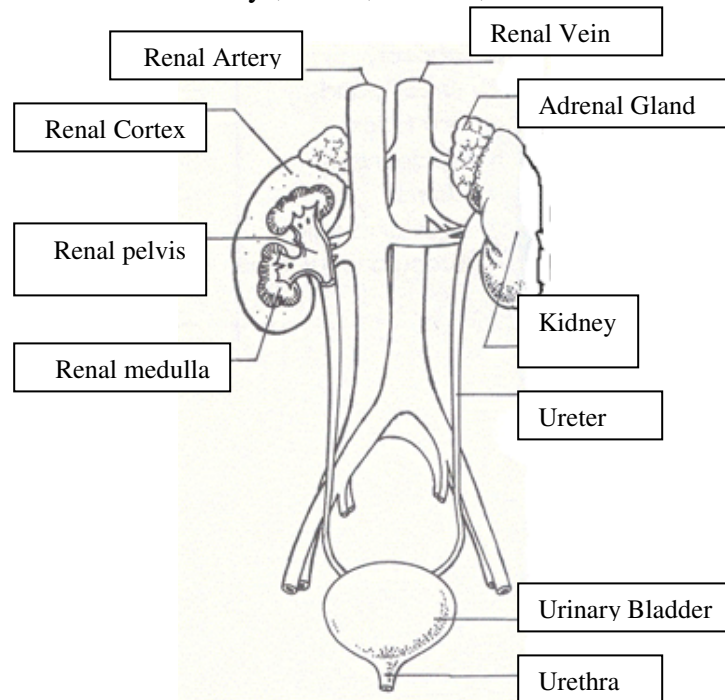
H. Breathing: The exchange of air into and out of the lungs

1. **Inhale: Active Phase:** Intercostal (chest) muscles contract & expand the chest and the diaphragm contracts (lowers) causing lower pressure than atmospheric pressure and air rushes into the lungs
2. Oxygen is absorbed and carbon dioxide is removed from blood
3. **Exhale: Passive Phase:** both chest and diaphragm relaxes causing air in the lungs to be pushed out.

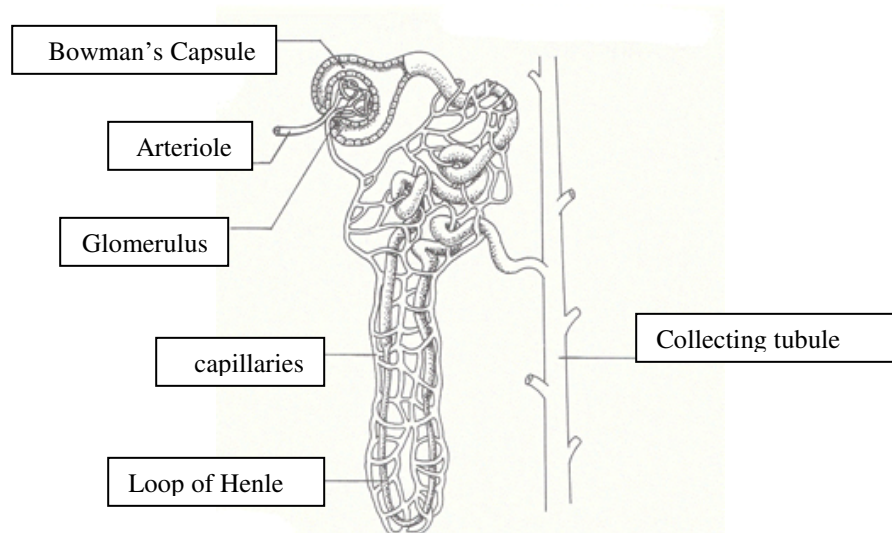
IV. Chapter 20 - Excretory System

A. Body system that collects and removes the waste products (urea, salts, amino acids etc.) produced by the cells of the body

B. Organs involved include: the kidneys, ureter, bladder, urethra



1. **Kidney** – the major organ of the excretory system. Both are located in the lower back region of the body and is enclosed by connective tissue called a capsule. The kidneys are the filters of the excretory system. They control the balance between the quantity of salts and water in the blood.



a) **Cortex:** the outer portion of the kidney that contain the basic functional unit (nephrons). Nephrons are small independently filtering units of the kidney. About 1 million nephrons in each kidney

(1) **Nephrons** are complex units consisting of arterioles, venules, capillaries, **Bowman's Capsule** & the **glomerulus** (function mainly to filter the blood), **Loop of Henle** (functions mainly to reabsorb water)and the collecting tubule (collects **urine** as it forms from the filtration process).

b) **Medulla:** The inner portion of the kidney

c) **Renal Pelvis:** The central area of the kidney. Site where the collecting tubules combine to form the ureter

d) **Adrenal Gland:** The Endocrine gland located on top of the outside top of each kidney

2. **Ureter** (one from each kidney): the tube that connects the kidney to the urinary bladder

3. **Bladder:** Strong muscular organ that stores the urine until released from the body through the urethra.

4. **Urethra:** connects and passes stored urine out of the body.

C. The body removes wastes in other ways also:

1. The **lungs** remove carbon dioxide and excess water each time we exhale

2. **Sweat Glands** also excrete water, salts and even small amounts of urea

3. **Liver:** Breaks down toxic substances, excess amino acids and other large molecules into smaller pieces that the kidney can then filter out of the blood.