Chapter 24

Circulatory System

1. Read and memorize Chapter summary. Unifying concepts of animal circulation – facilitates exchange of materials and energy by transporting them from one part of body to another part. For example heat produce inside the body is lost at skin level and gases are transported between lungs and tissues.

2. **Open blood vascular system** uses open-ended vessels and blood bathes body organs. It means blood runs in open cavities and there is no separate interstitial fluid. For example, snails and insects.

3. **Closed blood vascular system** has arteries and veins joined by a network of capillaries. So blood remains in vessels and does not bathe the organs. The organs are bathed by interstitial fluid. For example, earthworm, fish, bird and human. Blood in this system runs under pressure and delivers materials faster than open type.

4. **3 Main Components**: 1) a pumping organ – Heart 2) Vascular channels – Blood vessels 3) Blood. Arteries have more muscular walls and transport blood at high pressure. Veins have less muscular walls and transport blood at low pressure. Arteries transport blood from heart to organs. Veins transport blood from organs to heart. Capillaries have walls made only of endothelium.

5. **Blood**: is a connective tissue with liquid matrix called Plasma. Plasma is mainly water with dissolved salts and molecules. It has **Red Blood Cells** = RBC in it. In mature condition RBC’s do not have nuclei or organelles. It helps to pack more Hemoglobin protein. One hemoglobin molecule can transport 4 molecules of Oxygen. **White Blood Cells** = WBC are amoeboid cells and defend the body against invaders like bacteria, viruses and allergens. **Platelets** are cell fragments and release factors that initiate **blood clotting** on injury to tissue.

6. Blood pressure in arteries is high. Capillaries have moderate blood pressure. Veins have the lowest blood pressure. All veins have valves in them to allow blood to return to heart by squeezing veins.

7. **The Path of Blood**: **Pulmonary Circuit**: Oxygen poor blood from Right ventricle → Pulmonary Artery → Lung Alveoli O₂ enters blood → O₂ rich blood Pulmonary Vein → O₂ rich blood in Left Atrium. **Systemic Circuit**: O₂ rich blood from Left Ventricle → Aorta → Arteries → Body organs/tissues → O₂ poor blood in Veins → Main Veins → O₂ poor blood in Right Atrium.

8. **How the heart works**: Atria always receive blood from veins and pass it to Ventricles. Ventricles pump blood to lungs or body through arteries. Main veins → Atria → Ventricles → Arteries. The right side of heart has O₂ poor blood and is shown Blue. The left side of the heart has O₂ rich blood and is shown red. Consult Fig 25.15. 2 phases of cardiac cycle are **Systole** = contraction and **Diastole** = relaxation. In young humans Blood pressure is measured and written as 120/80.
It means 120 is the systolic pressure and 80 is the diastolic pressure in arteries. **SA Node = Pacemaker** is a special group of cells in right atrium and establishes the basic rhythm of contraction of heart. Hormones and brain can regulate the heartbeat but origin is in pacemaker.

9. **Hypertension:** is abnormally high blood pressure. The walls of arteries lose elasticity with age = Arteriosclerosis. Low Density Lipoproteins = LDL’s deposit inside arteries as Plaque (Atherosclerosis) and can partially or completely block it. Fig 25.17. This deposition also increases the inelasticity of arteries and an increase in blood pressure. Mostly obese persons have higher level of Cholesterol and higher deposition of LDL’s.

10. **Heart attack:** is the main cause of death in America. When one of the coronary arteries get blocked a part of heart muscles die. It is called heart attack. Obese persons are more prone to heart attacks.

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**Chapter 25**

**Respiratory System**

1. Respiration is the liberation of chemical energy by the oxidation of food. The released chemical energy is stored as ATP molecules. Most organisms need O₂ for respiration and release CO₂ as waste product. Respiration takes place inside cells.

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\text{Glucose +6 O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{ATP (energy)}
\]

2. Simple animals like sponges and cnidarians can exchange materials with environment because almost all cells are in direct contact or lie nearby the surface of body. Many other animals like earthworms use body surface as respiratory organ. Most animals (lizards, birds, mammals) living on land respire with Lungs but insects use a system of branched tubes called Tracheae. Most animals living in water respire with Gills (fishes).

3. Any respiratory surface must be a) Thin b) moist. Only moist and thin permeable surfaces can exchange materials. A rich blood supply inside the surface delivers the O₂ to tissues and collects CO₂ from them.

4. **Human Respiratory System:** It has 3 main Phases. A) Breathing B) transport of gases in blood C) exchange of gases between blood and tissues.

5. **Breathing:** 2 Phases of Breathing are Inhalation and Exhalation. When air enters the lungs it is inhalation and when it leaves the body it is exhalation. **During inhalation** rib cage moves up and out and diaphragm, a muscular sheet, moves down. It reduces pressure around lungs. As a consequence Lungs expand. **During exhalation** rib cage moves down and in and the diaphragm moves up. The respiratory route air passes through is:

Nostrils → nasal cavity → Pharynx → Larynx → Trachea → Bronchi (with cartilaginous rings) → Bronchioles (without rings) → Alveoli (air sacs).

Nasal cavity is lined with hair and mucus which help to clean air. Alveoli are the seat of exchange of O₂ / CO₂ between lungs and blood. O₂ from its higher concentration in alveoli moves to blood
and CO₂ from its higher concentration in blood moves to alveoli. Both gases move by diffusion. Breathing is regulated by respiratory centers present in Brain Stem. The center is more sensitive to changes in CO₂ concentration than O₂ concentration.

6. **Gas transport in blood:** O₂ binds with hemoglobin and forms **Oxyhemoglobin** inside RBC’s and transported to tissues of body through heart. Most CO₂ enters RBC’s and join with water enters plasma as **HCO³⁻** = bicarbonate ion. Some CO₂ molecules combine with hemoglobin and travels as Carbaminohemoglobin.

7. **Blood-tissue gas exchange:** Pulmonary veins carry O₂ to heart and arteries carry O₂ to blood capillaries with thin walls. O₂ enters interstitial fluid and finally into cells. Mitochondria use O₂ and produce CO₂ which leaves cells and enters into blood capillaries through interstitial fluid. Capillaries join to form veins which carry CO₂ to heart which sends the blood to lungs for gas exchange.

8. **Lung disease:** SO₂ sulfur dioxide, CO carbon monoxide and O₃ like pollutants damage lungs but the worst is tobacco smoke which carries more than 4000 chemicals attached to smoke particles. Many of these molecules are toxic and others are carcinogenic = cause cancer. So lung cancer is more common in smokers than non-smokers. In addition tobacco smoke inactivates cilia lining the lung passages so that harmful particles remain in lungs and make alveoli inelastic. The condition is called Emphysema and is the cause of smoker’s cough.