chapter 5

1. Introduction to Physiological Structures and Life Processes

Life processes are essential functions that maintain living organisms, including nutrition, respiration, circulation, excretion, and regulation. This chapter focuses on blood circulation, heart function, and common health conditions like diabetes and hypertension.

2. Blood Circulatory System in Humans

2.1 Blood

A fluid tissue composed of **plasma**, **RBCs**, **WBCs**, and **platelets**, circulating nutrients, gases, wastes, and immune cells.

🧪 Structure of Blood

- **Plasma**: Liquid (55%)
- **Erythrocytes** (RBCs): ~45%
- **Leucocytes** (WBCs) + **Thrombocytes** (Platelets): <1%

2.2 Plasma

Functions:

- Transports nutrients, hormones, waste products
- Maintains blood volume & pH
- Transports antibodies and clotting factors

2.3 Erythrocytes (Red Blood Cells)

- Biconcave, no nucleus, contain **hemoglobin**
- Lifespan ~120 days

Major Functions:

- Transport **oxygen** from lungs to tissues
- Carry **CO_2** back to lungs

2.4 Leucocytes (White Blood Cells)

Types:

1. **Granulocytes**: Neutrophils, Eosinophils, Basophils
2. **Agranulocytes**: Lymphocytes, Monocytes

Major Functions:

- Fight infections by **phagocytosis**
- Produce **antibodies**
- Inflammation and allergy responses

2.5 Thrombocytes (Platelets)

Cell fragments that aid in **blood clotting** and repair of damaged vessels.

2.6 Major Functions of Blood

1. **Transport** – Nutrients, gases, hormones, waste
2. **Regulation** – Temperature, pH, water content
3. **Protection** – Immune defense, clotting

3. Blood Groups in Humans

3.1 ABO Blood Group System

- Types: **A**, **B**, **AB**, **O**
- Based on presence/absence of **antigens** (A/B) and antibodies (anti-A, anti-B)

3.2 Rh Blood Group

- Based on presence (+) or absence (–) of **Rh antigen (D)**

3.3 Methods to Test Blood Groups

- **Forward typing**: Add known antibodies to blood sample → observe clumping
- **Reverse typing**: Add known RBCs to the patient's serum

4. Human Heart

4.1 Structure of Human Heart

- Four chambers: 2 **atria**, 2 **ventricles**
- Valves ensure **unidirectional blood flow**
- Encased by **pericardium**, wall contains **myocardium**

4.2 Heart Attack (Myocardial Infarction)

- Occurs when a part of the heart muscle is blocked from blood flow

Risk Factors

- High blood pressure, smoking, high cholesterol, obesity, stress

Major Symptoms

- Chest pain, shortness of breath, sweating, nausea

Preventive Measures

- Healthy diet, exercise, no smoking, manage stress and BP

🧪 **Tests**

- ECG, blood enzyme (e.g., troponin), angiography

💊 **Treatments**

- Medications (aspirin, thrombolytics), stents, bypass surgery

4.3 Heartbeat and Pulse Rate

- **Heartbeat**: Rhythmic contraction/relaxation
- **Pulse rate**: Felt where arteries close to skin
  - **Bradycardia**: <60 bpm
  - **Tachycardia**: >100 bpm

4.4 Blood Vessels

- **Arteries**: Carry oxygen-rich blood *away* from heart (thick walls)
- **Veins**: Carry blood *to* the heart; have valves
- **Capillaries**: Microscopic vessels; allow exchange of materials between blood & tissues

5. Blood Circulation Process

Systemic Circulation

- Left ventricle → aorta → body tissues → vena cava → right atrium
- **Function**: Deliver oxygen and nutrients; collect CO_2 & waste

Pulmonary Circulation

- Right ventricle → pulmonary artery → lungs → pulmonary vein → left atrium
- **Function**: Oxygenate blood; remove CO_2

6. Blood Pressure (BP)

- **Systolic**: Pressure during heart contraction
- **Diastolic**: Pressure during heart relaxation

Category	Systolic (mmHg)	Diastolic (mmHg)
Normal	<120	<80
Prehypertension	120–139	80–89
Stage 1 Hypertension	140–159	90–99
Stage 2 Hypertension	≥160	≥100
Hypotension	<90	<60

Preventive Measures for Hypertension

- Low salt intake, exercise, proper sleep, limit alcohol, stress management

7. Diabetes

Major Symptoms

- Frequent urination, excessive thirst, fatigue, blurred vision

Major Causes

- Type I (genetic, insulin deficiency),
- Type II (lifestyle, insulin resistance)

Prevention & Control

- Balanced diet, exercise, weight management, monitor blood glucose

8. Uric Acid

Major Causes of High Uric Acid Levels

- High-purine foods, obesity, kidney issues, certain medications

Major Symptoms

- Joint pain (especially in big toe), swelling, redness

Preventive Measures

- Hydration, low-purine diet, weight control, avoid alcohol

Interesting Facts

- **One drop of blood** contains about **5 million RBCs**, **7,000 WBCs**, and **250,000 platelets**
- Normal blood pressure ensures **healthy kidney and brain function**
- Early detection and lifestyle changes can **reverse hypertension**

Quick Revision Summary

- **Blood**: plasma + RBC + WBC + platelets
- **Blood circulation**: systemic and pulmonary loops
- **Vitals**: pulse, BP, and their categories
- Lifestyle diseases: diabetes, hypertension, gout
- Preventive steps: diet, exercise, stress control

Common Mistakes Students Make

- Swapping systolic and diastolic meanings
- Thinking veins always carry deoxygenated blood (pulmonary exception)
- Confusing bradycardia with tachycardia
- Missing the full stages of pulmonary/systemic routes
- Overlooking asymptomatic and preventive aspects of lifestyle diseases