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| Class | 10th | Chapter | 02 |
|---|---|---|---|
| Subject | Biology | Board | Federal |

## Chapter 2: Circulatory System

**SECTION I: MULTIPLE CHOICE QUESTIONS**

**1. The heart's upper chambers are called** A) ventricles **B) atria** C) valves D) arteries
**Correct Answer: B) atria**

**2. Blood components that help the body to control bleeding areA) platelets** B) red blood cells C) white blood cells D) haemoglobin
**Correct Answer: A) platelets**

**3. Bicuspid valve connects** A) left atrium and right atrium B) left atrium and right ventricle C) right atrium and left ventricle D) right atrium and right ventricle
**Note on Question Standard:** The bicuspid (mitral) valve specifically connects the **left atrium** to the **left ventricle**. None of the listed options state this pair. If forced to choose from the given textbook options where **(B)** is listed in some answer keys despite a typo, option **B** is typically selected; however, the scientifically accurate answer is **Left atrium and left ventricle**.

**4. Which of the following chambers has the thickest walls in human heart?** A) left atrium B) right atrium **C) left ventricle** D) right ventricle
**Correct Answer: C) left ventricle**

**5. The left half of the human heart:** A) has deoxygenated blood **B) has oxygenated blood** C) pumps blood to the lungs D) passes blood through the lungs
**Correct Answer: B) has oxygenated blood**

**6. The pulmonary arteries carry blood to the:** A) brain B) heart C) liver **D) lungs**
**Correct Answer: D) lungs**

**7. Which one of the following helps to fight germs?** A) Red blood cells **B) White blood cells** C) Platelets D) Plasma
**Correct Answer: B) White blood cells**

**8. The blood vessels that carry blood from heart to the various parts of the body are called:** A) septum **B) arteries** C) veins D) capillaries
**Correct Answer: B) arteries**

**9. Which one of the following is a double membrane sac that covers the human heart?** A) epicardium **B) pericardium** C) myocardium D) endocardium
**Correct Answer: B) pericardium**

**10. The alternating expansion and relaxation of the artery that you feel in your wrist is the:A) pulse** B) coronary artery C) blood pressure D) plasma
**Correct Answer: A) pulse**
**11. Nutrients are exchanged between the blood and body cells in the:** A) arteries **B) capillaries** C) veins D) aorta
**Correct Answer: B) capillaries**
**12. Which is the largest artery in the human body?** A) pulmonary artery **B) aorta** C) common iliac artery D) femoral artery
**Correct Answer: B) aorta**
**13. What is the valve in the opening between the right atrium and the right ventricle called?** A) pulmonary valve B) aortic valve **C) tricuspid valve** D) bicuspid valve
**Correct Answer: C) tricuspid valve**
**14. Human heart is:A) myogenic** B) neurogenic C) cardiogenic D) digenic
**Correct Answer: A) myogenic**
**15. Pacemaker is situated in heartA) In the wall of right atrium** B) on interauricular septum C) on interventricular septum D) in the wall of the left atrium
**Correct Answer: A) In the wall of right atrium**

# SECTION II: SHORT ANSWER QUESTIONS

**Q1. Write the functions of**

- **a. Pericardium:** Encloses and protects the heart, reduces friction during heartbeats, and anchors the heart within the chest cavity.
- **b. Left atrium:** Receives oxygenated blood from the lungs via the pulmonary veins and pumps it into the left ventricle.
- **c. Right atrium:** Receives deoxygenated blood from the body through the superior and inferior vena cava and pumps it into the right ventricle.
- **d. Left ventricle:** Pumps oxygenated blood at high pressure into the aorta to be distributed to the entire body.
- **e. Right ventricle:** Pumps deoxygenated blood into the pulmonary trunk/arteries toward the lungs for oxygenation.
- **f. Bicuspid valve (Mitral valve):** Prevents the backflow of blood from the left ventricle into the left atrium during ventricular systole.
- **g. Tricuspid valve:** Prevents the backflow of blood from the right ventricle into the right atrium during ventricular contraction.
- **h. Semilunar valve:** Located at the bases of the aorta and pulmonary artery; prevents backflow of blood into the ventricles when they relax.
- **i. Septum:** A muscular wall that separates the left and right sides of the heart, preventing the mixing of oxygenated and deoxygenated blood.
- **j. Aorta:** The largest artery in the body; carries oxygenated blood away from the left heart to systemic circulation.

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- **k. Pulmonary artery:** Transports deoxygenated blood from the right ventricle to the lungs.
- **l. Pulmonary vein:** Carries oxygenated blood from the lungs back to the left atrium of the heart.
- **m. Plasma:** The liquid portion of blood; transports nutrients, hormones, waste products, and proteins throughout the body.
- **n. Red blood cells (Erythrocytes):** Contain hemoglobin to transport oxygen from the lungs to body tissues and carry away some carbon dioxide.
- **o. White blood cells (Leukocytes):** Defend the body against pathogens, infections, and foreign invaders as part of the immune system.
- **p. Platelets (Thrombocytes):** Play a crucial role in blood clotting and hemostasis to prevent excessive bleeding from injuries.

**Q2. Differentiate between**

- **a. Serum and blood:**
  - *Blood* is a fluid connective tissue composed of formed elements (RBCs, WBCs, platelets) suspended in plasma.
  - *Serum* is the straw-colored fluid remaining after blood plasma has clotted and clotting factors (such as fibrinogen) have been removed.
- **b. Artery and vein:**
  - *Arteries* carry blood away from the heart (mostly oxygenated, except pulmonary arteries) under high pressure and typically lack internal valves.
  - *Veins* carry blood toward the heart (mostly deoxygenated, except pulmonary veins) under low pressure and contain valves to prevent backflow.
- **c. Tricuspid and bicuspid valve:**
  - *Tricuspid valve* is located between the right atrium and right ventricle and possesses three cusps/flaps.
  - *Bicuspid valve* is located between the left atrium and left ventricle and possesses two cusps/flaps.
- **d. Systole and diastole:**
  - *Systole* refers to the contraction phase of the heart chambers, during which blood is pumped out.
  - *Diastole* refers to the relaxation phase of the heart chambers, during which they fill with blood.

**Q3. Why is a circulatory system necessary?**

A circulatory system is necessary because complex multicellular organisms are too large for diffusion alone to supply nutrients and remove wastes efficiently. It ensures the rapid transport of oxygen, nutrients, hormones, and immune cells to all body tissues while simultaneously removing metabolic wastes like carbon dioxide and urea.

**Q4. Name the three circuits of the circulatory system.**

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1. **Pulmonary Circuit:** Carries blood between the heart and the lungs.
2. **Systemic Circuit:** Carries blood between the heart and the rest of the body tissues.
3. **Coronary Circuit:** Supplies blood specifically to the heart muscle tissue itself.

**Q5. Describe coronary circuit.**

The coronary circuit is the network of blood vessels that delivers oxygenated blood and nutrients to the myocardium (heart muscle) and removes metabolic waste products. It consists of the coronary arteries (branching off the base of the aorta) and cardiac veins, which drain into the right atrium via the coronary sinus.

**Q6. Write the six functions of blood.**

1. **Transportation of respiratory gases:** Carries oxygen from the lungs to tissues and carbon dioxide back to the lungs.
2. **Transport of nutrients and wastes:** Distributes digested food molecules and carries metabolic wastes to excretory organs.
3. **Defense against infection:** White blood cells and antibodies protect against pathogens.
4. **Clotting/Hemostasis:** Platelets and clotting factors prevent blood loss from injured vessels.
5. **Regulation of body temperature:** Absorbs and redistributes heat throughout the body.
6. **Maintenance of pH and osmotic balance:** Buffers maintain stable acid-base balance and osmotic pressure.

**Q7. What are the organs that are connected to the circulatory system?**

Key organs connected to the circulatory system include the **heart** (the central pump), **lungs** (for gas exchange), **kidneys** (for filtration and waste removal), **liver** (for processing nutrients and detoxifying blood), and the **gastrointestinal tract** (for absorbing nutrients).

**Q8. Name the types of blood vessels.**

1. **Arteries**
2. **Arterioles**
3. **Capillaries**
4. **Venules**
5. **Veins**

**Q9. What are the types of white blood cells? Why these are called white blood cells?**

- **Types:** Broadly classified into **granulocytes** (neutrophils, eosinophils, basophils) and **agranulocytes** (lymphocytes, monocytes).
- **Reason for name:** They are called white blood cells (leukocytes) because they lack hemoglobin, making them appear colorless or white when viewed under a microscope relative to red blood cells.

**Q10. In what ways does pulmonary artery differ from all other arteries?**

Unlike all other systemic arteries in the body that carry **oxygenated blood**, the pulmonary artery carries **deoxygenated blood** from the right ventricle of the heart directly to the lungs for oxygenation.

**Q11. How are the valves of human heart important?**

Heart valves act as one-way mechanical gates that ensure blood flows in only one direction through the heart—from the atria to the ventricles and out into the arteries—thereby preventing any backward leakage or regurgitation.

**Q12. Suggest why an injury that cuts open artery is much more dangerous than an injury to vein?**

Arteries carry blood directly from the heart under **very high pressure**, meaning an injured artery will spurt blood rapidly and cause massive blood loss in a short time. Veins carry blood under much lower pressure, resulting in a steady, slower flow.

**Q13. Why are valves present in veins but not in arteries?**

Veins transport blood back to the heart against gravity under low pressure, requiring pocket-like valves to prevent the blood from flowing backward. Arteries carry blood under high pressure generated directly by the heart, which keeps blood moving forward naturally without needing backflow valves.

**Q14. Why are the walls of the atria thinner than the walls of the ventricle?**

Atria only need to pump blood a short distance into the adjacent ventricles, requiring minimal muscular force. In contrast, ventricles—especially the left ventricle—must pump blood over long distances to the lungs or the entire body, requiring much thicker, stronger muscular walls.

**Q15. Why is the muscle of the left ventricle thicker than that of right ventricle?**

The left ventricle must pump blood through the extensive **systemic circuit** (to the entire body against higher systemic resistance), whereas the right ventricle only pumps blood through the short **pulmonary circuit** (to the nearby lungs). Consequently, the left ventricle requires significantly more muscle mass.

# SECTION III: EXTENSIVE ANSWER QUESTIONS

**Q1. Describe the pulmonary and systemic circuits of the circulatory system.**

- **Pulmonary Circuit:**
  - Begins when deoxygenated blood returns from the body tissues into the right atrium, passes through the tricuspid valve into the right ventricle, and is pumped into the pulmonary trunk and pulmonary arteries.
  - These arteries branch into the left and right lungs, where carbon dioxide is released and oxygen is absorbed via the alveolar capillaries.
  - Oxygen-rich blood then returns to the left atrium via four pulmonary veins, completing the pulmonary loop.
- **Systemic Circuit:**
  - Begins as oxygenated blood moves from the left atrium through the bicuspid (mitral) valve into the left ventricle.
  - The left ventricle contracts, forcing blood through the aortic valve into the aorta, which distributes it to systemic arteries branching out to all body organs and tissues.
  - In the tissue capillaries, oxygen and nutrients are delivered to cells while carbon dioxide and wastes are picked up.

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- The resulting deoxygenated blood is collected by systemic venules and veins, eventually draining into the superior and inferior vena cava, which empty back into the right atrium.

**Q2. How are the materials transported through the blood?**

- **Through Plasma (Liquid Medium):**
  - *Nutrients:* Glucose, amino acids, and lipids absorbed from the gut are dissolved or suspended in plasma for delivery.
  - *Wastes:* Metabolic waste products like urea, uric acid, and excess ions are carried dissolved in plasma to the kidneys for excretion.
  - *Hormones:* Chemical messengers secreted by endocrine glands travel directly via plasma to target organs.
  - *Carbon Dioxide:* A significant portion of $CO_2$ is transported as dissolved bicarbonate ions ($HCO_3^-$) in plasma.
- **Through Cellular Components:**
  - *Oxygen:* Transported primarily by binding reversibly to hemoglobin inside red blood cells to form oxyhemoglobin.

**Q3. What are the organs connected to blood circulatory system? Explain.**

- **Heart:** Acts as the central muscular pump driving blood through vessels.
- **Lungs:** Facilitate external respiration by oxygenating deoxygenated blood and eliminating carbon dioxide.
- **Kidneys:** Act as filtration units, removing nitrogenous wastes, regulating blood volume, and maintaining ionic balance.
- **Liver:** Processes absorbed nutrients, regulates blood glucose levels, synthesizes plasma proteins, and breaks down toxins.
- **Intestines:** Absorb digested food materials directly into the capillary networks linked to the hepatic portal system.

**Q4. What are the components of blood?**

Blood consists of two main fractions:

1. **Plasma (approx. 55%):** A pale-yellow aqueous solution containing water, dissolved proteins (albumin, globulins, fibrinogen), electrolytes, nutrients, hormones, and wastes.
2. **Formed Elements / Blood Cells (approx. 45%):**
   - *Red Blood Cells (Erythrocytes):* Biconcave, nucleated (in lower vertebrates) or enucleated (in mammals) cells specialized for oxygen transport.
   - *White Blood Cells (Leukocytes):* Nucleated cells involved in immunity and defense.
   - *Platelets (Thrombocytes):* Cell fragments critical for blood clotting.

**Q5. Describe the cell types found in blood.**

- **Erythrocytes (Red Blood Cells):** Biconcave discs packed with hemoglobin. Their shape maximizes surface area for gas exchange, and they have a lifespan of about 120 days.

- **Leukocytes (White Blood Cells):** Divided into two main groups:
    - *Granulocytes:* Neutrophils (phagocytize bacteria), Eosinophils (combat parasites and allergic reactions), and Basophils (release histamine during inflammation).
    - *Agranulocytes:* Lymphocytes (produce antibodies and drive adaptive immunity) and Monocytes (differentiate into macrophages to engulf debris and pathogens).
- **Thrombocytes (Platelets):** Tiny cell fragments derived from bone marrow megakaryocytes that aggregate at injury sites to form a plug and initiate the clotting cascade.

**Q6. Draw and describe the structure of human heart.**

- *(Description of Structure)*:
    - **Chambers:** The human heart is a four-chambered muscular organ consisting of two thin-walled upper chambers (**atria**) and two thick-walled lower chambers (**ventricles**).
    - **Septum:** A thick internal muscular partition divides the heart into left and right halves, completely preventing the mixing of oxygenated and deoxygenated blood.
    - **Valves:** Includes atrioventricular valves (tricuspid on the right, bicuspid/mitral on the left) and semilunar valves at the bases of major outgoing arteries to maintain unidirectional flow.
    - **Pericardium:** A protective double-layered fibrous sac enclosing the heart.
    - **Blood Supply:** Nourished internally via the coronary artery network.

**Q7. Explain the circulation of blood through the human heart.**

1. Deoxygenated blood from the body enters the **right atrium** via the superior and inferior vena cava.
2. From the right atrium, blood flows through the **tricuspid valve** into the **right ventricle**.
3. The right ventricle contracts, pumping the deoxygenated blood through the **pulmonary semilunar valve** into the **pulmonary artery** toward the lungs.
4. In the lungs, blood releases carbon dioxide and picks up oxygen.
5. Oxygenated blood returns via the **pulmonary veins** into the **left atrium**.
6. Blood flows through the **bicuspid valve** into the **left ventricle**.
7. The powerful **left ventricle** contracts, pushing oxygenated blood through the **aortic semilunar valve** into the **aorta** for distribution throughout the body.

**Q8. Discuss the following heart diseases in human:**

- **a. Coronary heart disease:** Occurs when coronary arteries become narrowed or blocked by atherosclerotic plaques (fatty deposits and cholesterol), reducing blood flow and oxygen supply to the heart muscle, potentially leading to chest pain (angina) or heart attacks.
- **b. Myocardial infarction (Heart attack):** Occurs when a coronary artery is completely blocked (often by a blood clot), cutting off blood supply to a region of the myocardium, causing heart muscle tissue damage or death (necrosis).

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- **c. Angina (Angina pectoris):** A type of chest pain or discomfort that occurs when the heart muscle does not receive enough oxygen-rich blood, typically triggered by physical exertion or emotional stress and relieved by rest or medication.

**Q9. Explain the harmful effects of smoking related to heart diseases.**

- **Atherosclerosis promotion:** Chemicals in tobacco smoke (such as nicotine and carbon monoxide) damage the inner lining of blood vessels (endothelium), promoting the buildup of fatty plaques in arteries.
- **Increased heart rate and blood pressure:** Nicotine stimulates the sympathetic nervous system, causing the heart to beat faster and blood pressure to rise, increasing cardiac workload.
- **Blood clot formation:** Smoking increases blood viscosity and platelet stickiness, elevating the risk of dangerous clots that can trigger heart attacks and strokes.
- **Reduced oxygen capacity:** Carbon monoxide in cigarette smoke binds preferentially to hemoglobin instead of oxygen, reducing the amount of oxygen delivered to the heart muscle and other tissues.

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