



# Circulatory System 6



- Hands-on Learning
- Analysing
- Remembering
- Collaboration
- Curiosity
- Problem Solving
- Understanding
- Critical Thinking

## Learning Outcomes

Children will be able to:

- understand and describe the structure and function of different parts of heart
- draw diagrams of the heart and circulatory system
- list the functions of the heart, blood vessels, lymph, RBC and WBC
- discuss the blood vessels associated with the heart
- define circulation of blood in the heart and the body
- explain ABO blood groups and their importance in blood transfusion
- define abnormal conditions of the heart

Having learnt about structure and functions of blood and external structure of heart in class VI, here, we will study more details about structure and function of heart, circulation of blood in heart and body and the lymphatic system.

Circulatory system in humans consists of two systems:

- » Blood vascular system
- » Lymphatic system

## BLOOD VASCULAR SYSTEM

There are three main parts of blood vascular system: Heart, blood vessels and blood.

**Table 6.1** Parts of Blood Vascular System and their Functions

Parts	Function
1. Heart	Pumps blood into blood vessels.
2. Blood vessels	Arteries, veins and capillaries, through these vessels blood flows from heart throughout the body and returns to heart
3. Blood	Fluid that transports substances to various part of body.

## HEART – THE PUMPING ORGAN

The heart is a **muscular pumping organ**. It is of the size of a fist and is shaped like a cone. It lies between the two lungs in our chest cavity, slightly towards left-side.

## KEY CONCEPTS

- ❖ Blood vascular system
- ❖ Heart – The pumping organ
  - Structure of heart
    - Pericardium
    - Heart chambers
    - Septum
  - Blood vessels associated with heart
  - Working of heart and circulation of blood
    - Double circulation
  - Heartbeat and heart sounds
    - Heartbeat
    - Heart sounds
  - Cardiac cycle
  - Blood vessels
    - Arteries
    - Veins
    - Capillaries
- ❖ Blood groups and blood transfusion
  - ABO blood groups
  - Antigen and antibody interaction
    - Clumping reaction
  - Blood transfusion
  - Conditions related to the functioning of heart
- ❖ Lymphatic system
  - Lymph
    - Functions of lymph
  - Lymph vessels or lymphatics
  - Lymph nodes
    - Significance of lymphatic system

Its walls are formed of **cardiac muscles**. These muscles contract and relax tirelessly throughout life. Because of cardiac muscles, heart beats continuously and pumps blood into the arteries.

## Structure of Heart

### Pericardium

Heart is enclosed in a sac called **pericardium**. It is formed of two **pericardial membranes**. The space between these two membranes is occupied by **pericardial fluid**. It prevents friction between these membranes. Pericardium protects heart from injury.

### Heart Chambers

Human heart has four chambers:

- 1 Upper two chambers – right and left **auricles**
- 2 Lower two chambers – right and left **ventricles**

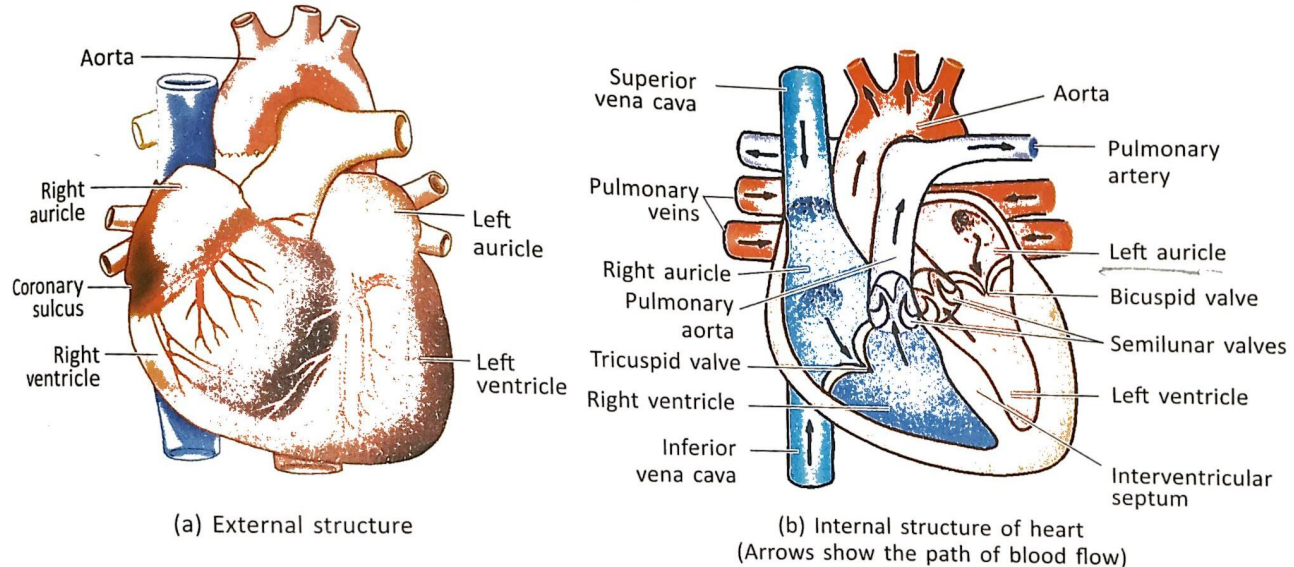


Fig. 6.1 The human heart

### Auricles or Atria (Receiving chambers of the heart)

Auricles are the **receiving chambers** of the heart. They have comparatively thin walls. The right auricle receives deoxygenated (impure) blood from the whole body by two large vessels, the **superior and inferior vena cavae** (sing. cava). The left auricle receives oxygenated (pure) blood from lungs by **four pulmonary veins**.

### Ventricles (Distributing chambers of the heart)

Ventricles are the **distributing chambers** of the heart. They pump blood into blood vessels. Their walls are thicker than those of auricles. The right ventricle receives deoxygenated blood from right auricle and pumps it to the lungs for oxygenation. The left ventricle is the **largest heart chamber** and has the **thickest walls**. It receives oxygenated blood from the left auricle and pumps it to the whole body.

**imp**

Why are ventricular walls thicker than atrial walls?

Ventricles pump blood to the whole body. So, they need thick and muscular wall to pump blood into two aortas under pressure. Auricles push blood to ventricles alone and need not to apply much pressure.



## Septum

A muscular wall between left and right auricles called **interauricular septum** and between left and right ventricles called **interventricular septum**, separates the left-side of the heart from its right-side. So the blood cannot go from one auricle to other auricle and from one ventricle to other ventricle.

## Significance of Separation of Right and Left Sides of Heart

Complete separation of right and left sides of heart prevents the mixing of oxygenated and deoxygenated blood. It has resulted in two independent circulations, pulmonary circulation and systemic circulation.

## Cardiac Valves

There are four valves in the heart which control the direction of blood flow in the heart and into the blood vessels. They open and close about 100,000 times a day.

- ▶ A **tricuspid valve** guards the opening of right atrium into right ventricle.
- ▶ A **bicuspid valve** guards the opening of left atrium into left ventricle.
- ▶ **Semilunar valves** are three half-moon-shaped valves present at the base of **pulmonary aorta** (pulmonary semilunar valve) and **aorta** (aortic semilunar valve). They control flow of blood from right ventricle into pulmonary aorta, and from left ventricle into aorta.

When atria contract, the cuspid valves open. When ventricles contract, the pulmonary and aortic semilunar valves open and cuspid valves are slam shut.

**Function of valves:** Valves prevent backflow of blood.

## Blood Vessels Associated with Heart

### 1. Blood Vessels Supplying Heart

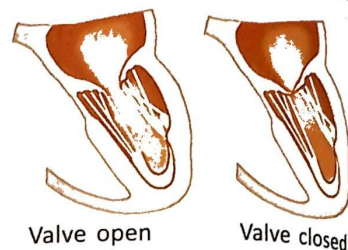
- ▶ A pair of **coronary arteries** arising from aorta supply oxygenated blood to heart muscles.
- ▶ A series of **coronary veins** collect blood from cardiac muscles. These join to form **coronary sinus** which opens into the right atrium.

### 2. Blood Vessels Arising from Heart

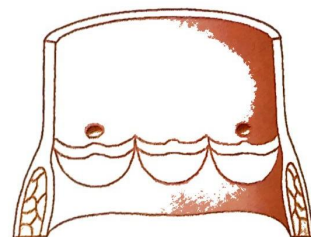
- ▶ **Pulmonary aorta** carries deoxygenated blood from right ventricle to lungs for oxygenation.
- ▶ **Aorta** arises from left ventricle and carries oxygenated blood to various parts of whole body.

### 3. Blood Vessels Bringing Blood to Heart

- ▶ **Pulmonary veins** (two pairs) bring oxygenated blood from lungs to the left auricle or left atrium.



**Fig 6.2** Structure of bicuspid valve



**Fig 6.3** Structure of semilunar valves

## TRICUSPID AND BICUSPID VALVES

Valves are flaps of connective tissue, attached to the papillary muscles of the ventricles by several cords of connective tissue. The cords prevent the valves from being forced into the auricles when ventricles contract. The valves permit the blood to flow from auricles into ventricles but not in reverse direction.

- Anterior or **superior vena cava** also called **precaval** brings deoxygenated blood to the right auricle from head and upper part of the body.
- Posterior or **inferior vena cava** also called **postcaval** brings deoxygenated blood to the right auricle from remaining part, i.e., lower part of the body.

### Working of Heart and Circulation of Blood

- The right atrium receives deoxygenated blood from various parts of the body by two larger veins, i.e., vena cavae (anterior vena cava and posterior vena cava). The left atrium receives oxygenated blood from lungs by two pairs of pulmonary veins.
- Both the atria contract at the same time and their cuspid valves open up. The blood from left atrium comes in the left ventricle and from right atrium into the right ventricle.
- Both the atria relax and ventricles contract. The cuspid valves are slam shut and semilunar valves open up.
  - The oxygenated blood from the left ventricle is pumped into aorta and is distributed to all the body parts by arteries.
  - The deoxygenated blood from right ventricle is pumped into pulmonary aorta and is transported to lungs by the pulmonary arteries for oxygenation.

#### Something More

- Pulmonary veins are the only veins that carry oxygenated blood.
- Aorta is the largest and the longest artery in the body.
- Posterior vena cava is the largest vein.

#### Something More

Blood circulation was discovered by William Harvey. He demonstrated that the heart acts as a pump, and that the blood flows in the body in a closed system of arteries and veins.

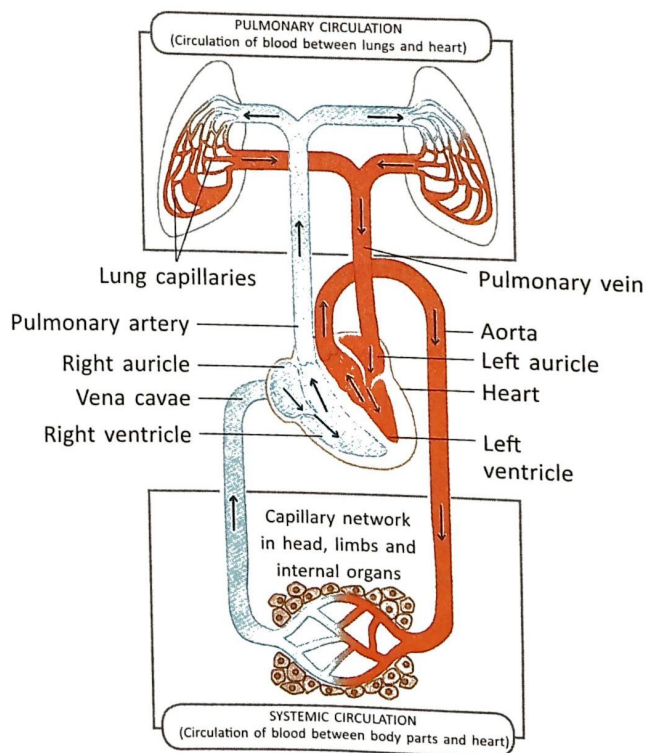
### Double Circulation

Blood in our body flows through two independent circulations: **Pulmonary circulation** and **systemic circulation**.

**Pulmonary Circulation:** The deoxygenated blood from the right ventricle is pumped to lungs through pulmonary arteries. Inside the lungs blood is oxygenated. The oxygenated blood from lungs is returned to heart into the left auricle by pulmonary veins.

**Systemic Circulation:** In systemic circulation, the oxygenated blood from left ventricle goes to all the body parts through aorta and is returned to heart to its right auricle.

As the blood travels twice through the heart in one complete cardiac cycle, it is called **double circulation**. In double circulation, the oxygenated and deoxygenated blood remain completely isolated.



**Fig. 6.4** Circulation of blood (Double circulation) in humans



## Heartbeat and Heart Sounds

### Heartbeat

The rhythmic contraction and relaxation of auricles and ventricles is known as **heartbeat**. A normal human heart beats about 72 times per minute. One heartbeat includes:

- » a phase of contraction of heart muscles – **Systole**
- » a phase of relaxation of heart muscles – **Diastole** or **General pause**
  - During systole, first the atria contract to push the blood into ventricles and then the ventricles contract to pump blood into blood vessels.
  - During diastole, the heart receives blood.

### Heart Sounds

Contraction of atrial chambers and then of ventricular chambers are the two phases of a systole. These two phases of systole can be heard as **lub** and **dub** sounds which are caused by the contraction of muscles and shutting down of valves.

- » In the **lub phase**, the ventricles contract and cuspid valves close.
- » In the **dub phase**, the pulmonary and aortic valves close.

A normal heart repeats these lub-dub sounds about 72 times per minute.

Doctors use **stethoscope** to hear this lub-dub sound.

### Cardiac Cycle

The events that occur during one heartbeat form one cardiac cycle. It is completed in 0.8 second. It includes the following three events:

- » Simultaneous contraction of both the auricles to pump blood into ventricles for 0.1 second – **Atrial systole**
- » Simultaneous contraction of both the ventricles to pump blood into arteries for 0.3 second – **Ventricular systole**
- » Relaxation of both auricles and ventricles for 0.4 second – **Diastole** or **Joint relaxation** or **General pause**

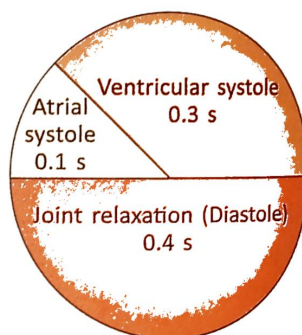
### Pulse Rate (Rate of Heartbeat)

The rhythmic contraction of heart can be felt in the arteries as regular jerks, called **pulse**. Each jerk marks the beginning of a new ventricular contraction or a new pulse. The pulse can be felt with the fingertips pressed over the radial artery in the wrist. The **pulse rate** is the number of pulses in one minute. It is equal to the heartbeat rate and is 72 times per minute for a normal healthy person. By checking the pulse rate of a person, doctors get important information on the condition of the heart and blood vessels.

#### Something More

**Blood pressure** is the pressure exerted by blood on the wall of arteries. It is measured by **sphygmomanometer**. Blood pressure is highest when ventricles contract and pump blood into arteries. This is called **systolic pressure**. Blood pressure is lowest when ventricles relax. This is called **diastolic pressure**.

The normal systolic pressure is about 120 mm of mercury and the normal diastolic pressure is 80 mm of mercury.



**Fig. 6.5** Events during a cardiac cycle

## Activity 1

**Aim:** To hear Lub-Dub sound of heart

**Procedure:** Place your ear on the left side of the chest of your friend. What do you hear?

**Observation:** The lub-dub sounds are heard with the rate of 72 times per minute.

Hands-on Learning

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## Activity 2

SEL Self-Awareness

**Aim:** To feel and determine the pulse rate

**Procedure:** Place the index and middle fingers of the right hand on the inner side of the wrist of your left hand. Press lightly and feel the throbbing movements or pulse. Count the number of pulses in one minute. This gives the pulse rate.

**Observation:** The number of pulses or throbs produced per minute (the pulse rate) is 72.

**Conclusion:** The throbbing movements correspond to the blood being pumped by the heart into the arteries.

Analysing

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### Pacemaker (Sino-Atrial Node — SAN)

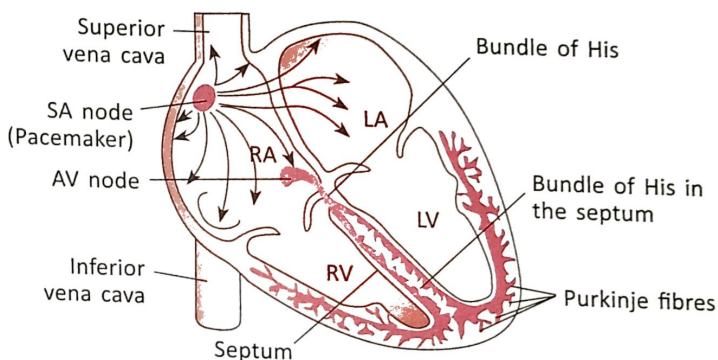
Pumping action of heart is generated and regulated by an electrical **conducting system** of heart which coordinates the contraction of various chambers of heart. This conducting system consists of:

- 1) **Sino-atrial or sino-auricular node (SAN)** or SA-node or Pacemaker.
- 2) **Atrio-ventricular node (AVN)** or AV-node, located at the base of right auricle.
- 3) **Bundle of His** or atrio-ventricular or AV bundle located at the septum of heart.
- 4) **Purkinje fibres** which are branchings of bundle of His.

**Sino-atrial node** is a small crescentic mass of specialised cardiac muscles. It is located in the upper wall of right atrium. The electric impulses are generated by the sino-atrial node spontaneously and continuously at regular intervals. In an adult, SA-node sends out impulses 60–100 times per minute. Impulse initiates heartbeat and sets the heart's rhythm. Therefore, SAN is described as **pacemaker**.

### Conduction of Heartbeat

- 1) Electrical impulses generated by sino-atrial node cause atria to contract. These electrical impulses are picked up by atrio-ventricular node (AVN).
- 2) Impulses from AV node are transmitted to the walls of ventricles through the bundle of His and its branches, Purkinje fibres which cause ventricles to contract.



**Fig. 6.6** Conducting system of heart showing pacemaker (Arrows indicate the spread of electrical impulses generated by SA-node)



## Check Point 1

Name the following.

1. The instrument used by doctors to hear heart sounds
2. The blood vessels from heart that have valves
3. The events during one heartbeat
4. The valve that guards the opening of right atrium into ventricle
5. The scientist who discovered circulation of blood
6. The circulation between lungs and heart

## Blood Vessels

Blood flows through a system of tubes called **blood vessels**. There are three kinds of blood vessels: Arteries, veins and capillaries.

### Arteries

Arteries are **distributing vessels**. They carry blood away from the heart to other parts of the body. They have thick, elastic and muscular wall.

Arteries carry oxygenated (containing oxygen) blood except pulmonary arteries that carry deoxygenated blood to lung. Oxygenated blood is bright red because of oxyhaemoglobin which is bright red in colour. In arteries, blood flows with jerks and under pressure due to the pumping action of heart.

Arteries branch into **small arteries** and **arterioles** and into **capillaries** inside organs.

### Veins

Veins are **collecting vessels**. They collect blood from body organs and carry it **to the heart**. They have **thin walls**. The pocket-shaped **valves** present inside veins make the blood flow only towards the heart. In veins the blood flows smoothly and is deoxygenated (without oxygen). The veins are darker in colour.

You can see some of your veins because they are just under the skin (i.e., superficial). They are more prominent in old persons.

Veins begin as capillaries. They join and rejoin to form larger veins (vena cavae) that open into the right auricle of heart.

### Capillaries

Capillaries are the finest blood vessels. They are the terminal branches of an artery which rejoin to form a vein. The capillaries have very thin walls (only one-cell thick) formed of squamous epithelium.

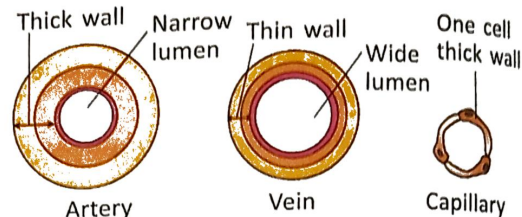
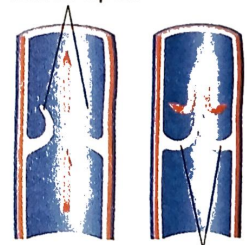


Fig. 6.7 Blood vessels

Valves in veins allow flow of blood towards the heart  
Valves open



Valves closed

Fig. 6.8 Valves in veins

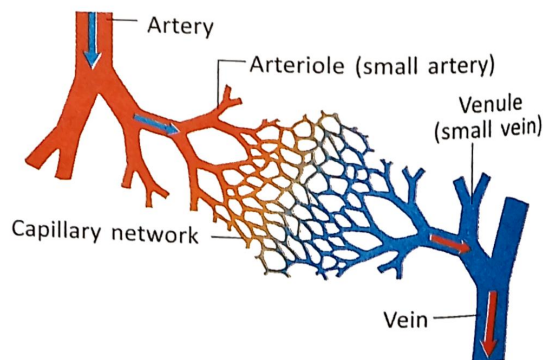


Fig. 6.9 Capillaries connect arteries and veins

## Unique role of capillaries

As the blood flows through capillaries, food nutrients and oxygen pass from blood to the cells while carbon dioxide and waste products pass from cells to the blood.

**Table 6.2** Differences between Artery, Vein and Capillary

Artery	Vein	Capillary
1. Situated deeper under the skin.	Situated just under the skin.	Situated very deep within the organs.
2. Thick-walled with narrow lumen (cavity).	Thin-walled with wide lumen.	One-cell thick tubes with narrow lumen.
3. Through artery, blood flows from heart to other body parts.	Through vein, blood flows from body organs to the heart.	Capillaries join artery with the vein and form a network in the body organs.
4. Supplies blood from heart to body organs.	Collects blood from body organs and brings it back to heart.	Helps in the exchange of food, nutrients, oxygen, wastes and carbon dioxide between blood and tissues.
5. Carries oxygenated blood (except pulmonary arteries).	Carries deoxygenated blood (except pulmonary veins).	Carries both types of blood.
6. Does not have valves.	Has valves to prevent backflow of blood.	Does not have valves.

### Something More

1. If all the blood vessels (arteries, veins and capillaries) in the human body are placed end to end, their total length would be more than 1,00,000 kilometres. They could form about 2.5 circles around the Earth.
2. A fish has two-chambered heart and it receives deoxygenated blood only.
3. The heart is four-chambered only in birds and mammals.
4. Generally, emotions are considered to be heart-related. Scientifically, the human heart has nothing to do with the emotions. The heart is just a pumping machine which pumps blood throughout the body via arteries and receives it back via veins.

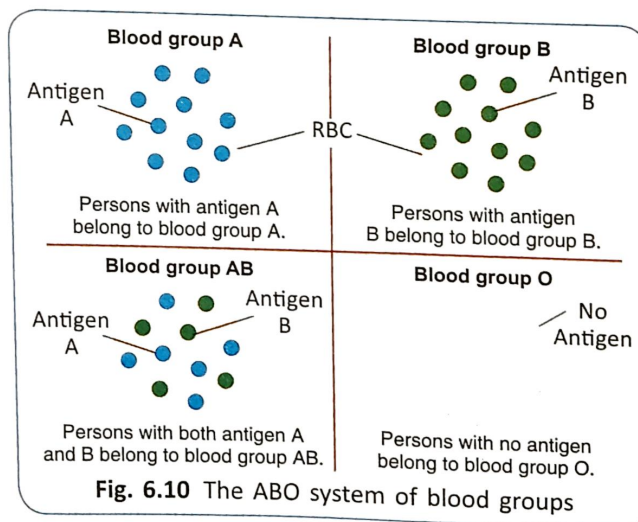
## BLOOD GROUPS AND BLOOD TRANSFUSION

### ABO Blood Groups

Karl Landsteiner (1900) discovered that human beings have glycoproteins on the surface of RBCs, called **antigens**, and another type of protein, gamma globulin in the blood plasma, called **antibodies**.

Two types of antigens, **antigen A** and **antigen B**, are found on human RBCs. Based on the presence or absence of these antigens, human blood falls into four blood groups. They are **A, B, AB and O**.

This forms **ABO system of blood groups**.



**Fig. 6.10** The ABO system of blood groups



## Antigen and Antibody Interaction

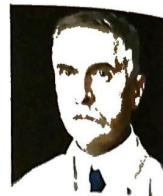
Two types of antibodies, **Anti-A antibody** and **Anti-B antibody** are found in human blood plasma. Persons with one antigen have natural antibodies in their plasma against other antigen, as shown in Table 6.3.

**Table 6.3** Different Human Blood Groups, their Antigens and Antibodies

Blood group	Antigen (on RBC)	Antibody (in plasma)
A	A	Anti-B
B	B	Anti-A
AB	A and B	None
O	None	Anti-A and Anti-B

### Know Your Scientist

Dr. Karl Landsteiner (1868–1943) was born in Vienna. He received medical degree in 1891 from the University of Vienna. He identified A, B, AB and O blood groups based on the presence of antigens. He established the reason for the failure of blood transfusion when the blood of a person is injected (transferred) into the blood of another person. For this, he was awarded the Nobel Prize in Physiology and Medicine in the year 1930.



## Clumping Reaction

Antigen A of blood group A and anti-A antibody from blood group B are not matching. They are incompatible. Similarly, antigen B and anti-B antibody are also incompatible. It means when blood from blood groups A and B is mixed, clumping (or lump formation) occurs due to antigen-antibody interaction.

## Blood Transfusion

In the case of severe injury or operation, there is considerable loss of blood and the patient needs blood from outside. This transfer of blood from one person to other is called **blood transfusion**.

- Person who gives blood is called **donor** and who receives blood is called **recipient**.
- For blood transfusion, the blood of the donor and that of the recipient need to belong to the same blood group or be compatible.
- In incompatible blood transfusion, the antigens of donor's blood are attacked by the antibodies of recipient blood. This causes **clumping of the donor's RBCs**.
- The blood transfusion is most successful, where the blood group of the donor and that of the recipient is the same (because they have similar antigens and antibodies).
- Persons with blood group AB have no antibody in their blood, because their RBCs have both types of antigens. Therefore, person with AB blood group can receive blood from all the four blood groups – A, B, AB and O. So persons with AB blood group are called **universal recipients** or **universal acceptor**.
- The blood from group O can be given to persons of any blood group because it has no antigens to react with the recipient's antibodies. Therefore, persons with blood group O are called **universal donors**. But they can receive blood only from blood group O persons, because of the presence of both types of antibodies in their plasma.

Doctors usually prescribe certain blood tests for the correct diagnosis of a disease. Let us know about some tests by performing an activity.

### Activity 3 **SEL** Self-Awareness

Analysing 21st CENTURY SKILL

**Aim:** To know the names of blood tests and their detectable diseases

**Material required:** Paper, pen

**Procedure:** Visit a nearby pathology lab and prepare a list of blood tests and the diseases for which they are carried out as given below:

Name of the Blood Test	Disease for which the Test is Carried Out
1. Blood glucose level	Diabetes
2. Haemoglobin estimation	Anaemia
3. RBC count	Polycythaemia, anaemia
4. WBC count, TLC (Total leucocyte count), DLC (Differential leucocyte count)	To know about infection (WBC count increases if a person has any infection)
5. Packed cell volume (PCV) or Haematocrit value of blood	To identify anaemia or polycythaemia (PCV increases in polycythaemia)
6. ESR (Erythrocyte sedimentation rate)	ESR increases in rheumatic fever, tuberculosis and malignancy.
7. ELISA Test (Enzyme-linked immunosorbent Assay)	Detection of virus infection, encephalitis, yellow fever, dengue, cancer and HIV

### Activity 4 **SEL** Self-Awareness

Collaboration 21st CENTURY SKILL

**Aim:** To know about the blood group of people

**Procedure:** Collect information about the blood groups of your family members and your friend's family members.

Make a chart for recording blood groups of different persons, on a sheet of paper as given alongside.

Family	Members of a Family	Blood Group					
		A	B	AB	O	Rh <sup>+</sup>	Rh <sup>-</sup>
Family I	Father				✓	✓	
	Mother				✓	✓	
	Son				✓	✓	
	Daughter				✓	✓	
Family II	Father						
	Mother						
	Son						
	Daughter						

### Activity 5 **SEL** Self-Awareness

Curiosity 21st CENTURY SKILL

**Aim:** To know the process of collecting blood sample for detecting disease by blood test

**Material required:** Paper, pen

**Procedure:** Visit a pathology laboratory and request the doctor to show you the process for collection of blood sample. Note down the instruments required and observe the blood being collected in a syringe and transferred into small bottles. Find out what already has been added to the bottle to prevent clotting of blood. Ask the doctor / nurse why it is necessary to shake the bottle nicely.

**Hint:** ● The anticoagulant, sodium citrate, is added to prevent clotting of blood.

● Shaking of bottle properly mixes anticoagulant with the blood.



## Check Point 2



Write True or False.

1. Arteries have valves in their lumen.
2. Capillaries help in exchange of materials.
3. The glycoprotein on the surface of RBCs is called antigen.
4. Persons of AB blood group are called universal donors.
5. No antibody is found in the plasma of people having blood group O.

## Conditions Related to the Functioning of Heart

### 1. Palpitations

Palpitations are the feelings that the heartbeats are unusually strong or very rapid. Usually, palpitations are not harmful but can be a sign of some serious heart condition.

Causes of palpitations

- › Usually felt after strenuous physical activity or in tense situations.
- › May be due to imagination, as the heart appears to skip a beat, jump or race.
- › Stress and anxiety.
- › Abnormal heartbeats which may be due to smoking, heavy drinking or intake of caffeine.
- › Increased heartbeat rate with above 100 beats per minute.
- › Abnormal functioning of auricles.

### 2. Cardiac Arrest

Cardiac arrest is sudden failure of heart to pump blood. Its symptoms are sudden collapse, no pulse, no breathing and loss of consciousness. This may be preceded by chest pain, dizziness, shortness of breath and blackout.

Heart conditions that lead to cardiac arrest

- Coronary artery disease
- Major blood loss
- Heart failure
- Low potassium in blood
- Enlargement of heart muscles
- Valvular heart disease (leaking or narrowing of heart valves)
- Abnormal activity of ventricles

Risk factors for cardiac arrest

- Family history
- High blood pressure
- Smoking
- High blood cholesterol
- Use of drugs
- Diabetes
- Overweight

### 3. Hypertension (HTN or HT)

Hypertension is also known as high blood pressure (HBP). It is a condition in which blood pressure in arteries remains persistently higher than normal 120/80 mm Hg. Blood pressure above 140/90 regularly is regarded as hypertension. In a hypertensive heart, the walls of ventricles get thickened. This causes the cardiac muscles to work harder, increasing the risk of heart attack. Very high blood pressure may cause dizziness.

**Causes of Hypertension:** It may be due to

- Hereditary factor
- Obesity
- Lack of physical activity
- Use of oral contraceptives
- Cigarette smoking
- Processed food
- Stress (physical or emotional)
- Pregnancy
- Diet with high salt
- Caffeine

#### 4. Heart Attack

It is the decrease in the blood supply to the heart muscles due to clotting or blockage in the coronary artery which supplies blood to the heart muscles. It may lead to heart failure or cardiac arrest.

### LYMPHATIC SYSTEM

The lymphatic system consists of Lymph (the fluid), Lymph vessels, and Lymph nodes.

#### Lymph

Lymph is filtered blood. It is a clear watery fluid without proteins and RBCs. It flows through lymphatic vessels. It is a link between blood and tissue fluid.

When blood flows through capillaries from the arterial end to its venous end, its fluid plasma filters out of the thin-walled capillaries at the arterial end. It is similar to plasma. It bathes all the body cells and facilitates exchange between blood and body cells by diffusion. This fluid is called **interstitial fluid or tissue fluid**. Most of the tissue fluid (about 90 per cent) gets back (reabsorbed) into the capillaries at the venous end to complete the blood volume. Rest 10 per cent fluid flows through a system of fine thin-walled channels called lymphatic capillaries of lymphatic system. The tissue fluid on entering lymphatic capillaries is called **lymph**. The lymph collected in the lymph vessels is poured back into the blood in the vena cava near heart.

#### Functions of Lymph

Lymph acts as a middle man between blood and tissue fluid. It carries out following functions:

- 1) Lymph helps in the distribution of nutrients and oxygen to tissue cells.
- 2) It helps in the removal of nitrogenous wastes and carbon dioxide from the tissue cells and pass them to the blood.
- 3) Lymph absorbs fatty acids and glycerol (digested fat) in the villi of small intestine through lacteals.
- 4) Its lymphocytes destroy harmful pathogens.
- 5) It controls concentration of proteins in the tissue fluid.
- 6) It carries lymphocytes and antibodies from lymph nodes to the blood.

#### Lymph Vessels or Lymphatics

Lymph vessels are called **lymphatics**. They start as blind **lymphatic capillaries** in the tissue spaces. They join to form larger ducts. **Lymph vessels have valves** to maintain flow of lymph towards vena cava. Lymphatics form network in the body. In the villi of small intestine, they are called **lacteals**.

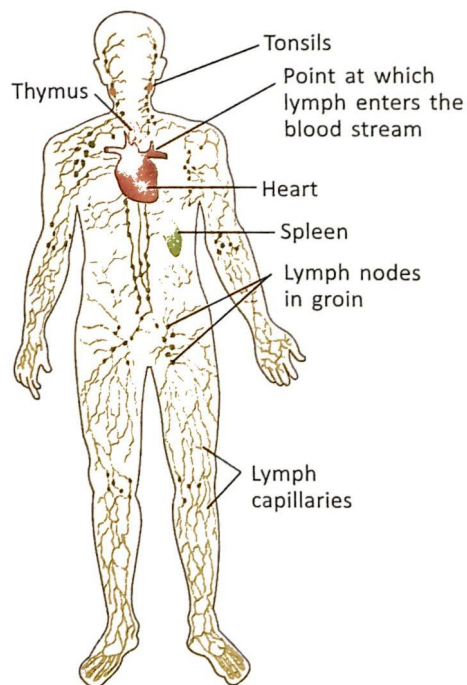


Fig. 6.11 Human lymphatic system



## Lymph Nodes

Lymph nodes are formed of **lymphatic tissue**. These are sites of lymphocyte maturation. **Thymus** and **spleen** are lymphatic organs. **Tonsils** and **adenoids** are masses of lymphatic tissue.

## Significance of Lymphatic System

- 1) Lymphatic system primarily serves for the return of tissue fluid to blood. If there is no lymphatic return, blood volume would continue to reduce and tissue fluid would increase because of leakage at the capillary level.
- 2) It returns proteins to blood and helps in maintaining osmotic concentration of blood to facilitate exchange of materials between blood and tissue cells.

## Check Point 3

Fill in the blanks.

1. \_\_\_\_\_ is feelings of rapid heartbeat.
2. The regular high blood pressure is called \_\_\_\_\_.
3. Lymph vessels are called \_\_\_\_\_.
4. \_\_\_\_\_ is the lymph vessel in villi.

Remembering/Understanding

21st  
CENTURY SKILLS



## Wrapping it Up

- Circulatory system distributes oxygen, food nutrients and other substances to various cells of the body. It removes CO<sub>2</sub>, nitrogenous wastes and excess of water and salts from the cells.
- Circulatory system comprises blood vascular system and lymphatic system.
- Blood, lymph and tissue fluids are the circulatory medium.
- Human heart is four-chambered and exhibits double circulation.
- Cuspid valves are present on atrio-ventricular apertures, whereas semilunar valves are present on the origin of aorta from left ventricle and of pulmonary aorta from right ventricle.
- Blood in arteries flows with jerk and under pressure from heart to organs because heart pumps blood into them. The flow of blood in them need not be regulated by valves.
- Blood in veins flows smoothly at one pace and from body organs towards heart. Veins have valves to control blood flow in one direction.
- Veins start as capillaries and by joining together form larger veins. They carry deoxygenated blood.
- Arteries begin as large vessels (aorta), branch and rebranch into capillaries.
- Palpitations, cardiac arrest and hypertension are caused due to abnormal functioning of heart.
- Lymph is a filtered blood and a connecting link between tissue fluid and blood.

## KNOW THESE TERMS

<b>Antibodies</b>	: A gamma globulin in the blood plasma
<b>Antigens</b>	: A glycoprotein on the surface of RBCs
<b>Cardiac arrest</b>	: Failure of heart to pump blood
<b>Cuspid valves</b>	: Valves present between auricles and ventricles
<b>Semilunar valve</b>	: The valves present at the opening of pulmonary trunk and aorta
<b>Systolic pressure</b>	: Blood pressure in the arteries at the time of contraction of ventricles
<b>Diastolic pressure</b>	: Blood pressure in the arteries at the time of joint diastole or relaxation of heart chambers
<b>Double circulation</b>	: The circulation of blood twice through the heart in one cardiac cycle
<b>Pacemaker</b>	: Specialised cardiac muscles in the wall of right auricle which generate heartbeat impulse