10

Transportation of Substances

Prior Knowledge

In the previous classes, I have learnt that

- Blood transports oxygen and digested food to all parts of the body.
- Heart is also known as the pumping organ and pumps blood to the entire body.
- Excretion is the process of removal of the toxic wastes produced in the body.

Learning Objectives

In this chapter, I will learn about:

- Transportation of substances in animals and humans
- Circulatory system in humans
- Excretion in animals and humans
- Transportation of substances in plants
- Excretion in plants

Let's Get Going

Unscramble the words given below to find the answers.

1. The end product of carbohydrate digestion

   ☐☐☐☐☐☐☐ (SUEGCOL)

2. The oxidation of food in the body occurs in the presence of

   ☐☐☐☐☐☐ (NYGXOE)

3. The muscular organ that beats very fast after skipping or running

   ☐☐☐☐☐ (ETAHR)

4. The process of removal of wastes from animal body

   ☐☐☐☐☐☐☐☐☐

   (ETCREIONX)

5. The tissue seen in plants that carries water from roots to other parts of the plant

   ☐☐☐☐☐ (YLXME)

TRANSPORTATION OF SUBSTANCES IN ANIMALS

You have learnt that plants absorb water and dissolved minerals from their roots and transport them to the leaves. They also transport food prepared in the leaves to different parts of the plant. Similarly, transportation of various substances takes place within the bodies of unicellular organisms and animals.

In unicellular organisms such as *Amoeba* and *Paramoecium*, the transportation occurs within the single cell by the process of diffusion (Fig. 10.1).

Multicellular organisms with simple bodies such as sponges and jellyfish that live in water do not have a circulatory system. The water brings in food and oxygen as it enters their body and carries away carbon dioxide and waste materials as it goes out of the body.

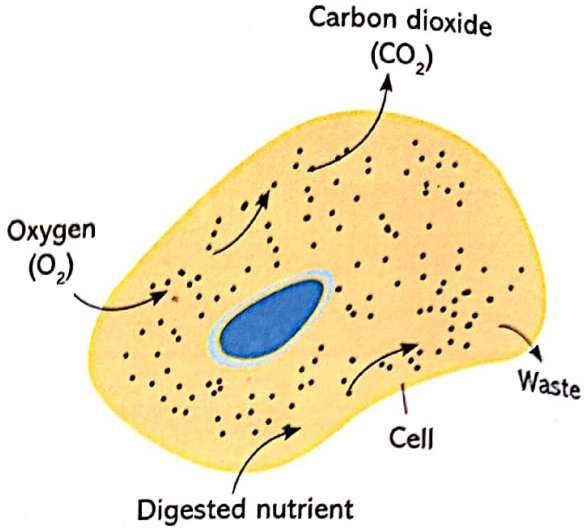


Fig. 10.1 Transportation in a unicellular organism

More complex organisms have well-developed transport systems to supply materials to their cells and remove waste products.

CIRCULATORY SYSTEM IN HUMANS

In human beings, various substances such as nutrients, oxygen and carbon dioxide have to be transported to and from the cells in different parts of the body. This system in human body is known as **circulatory system** (Fig. 10.2). This is very important for the efficient functioning of the body.

Human beings have a very well-developed circulatory system. It is composed of the following components.

- Blood
- Blood vessels
- Heart

Let us learn about these in detail.

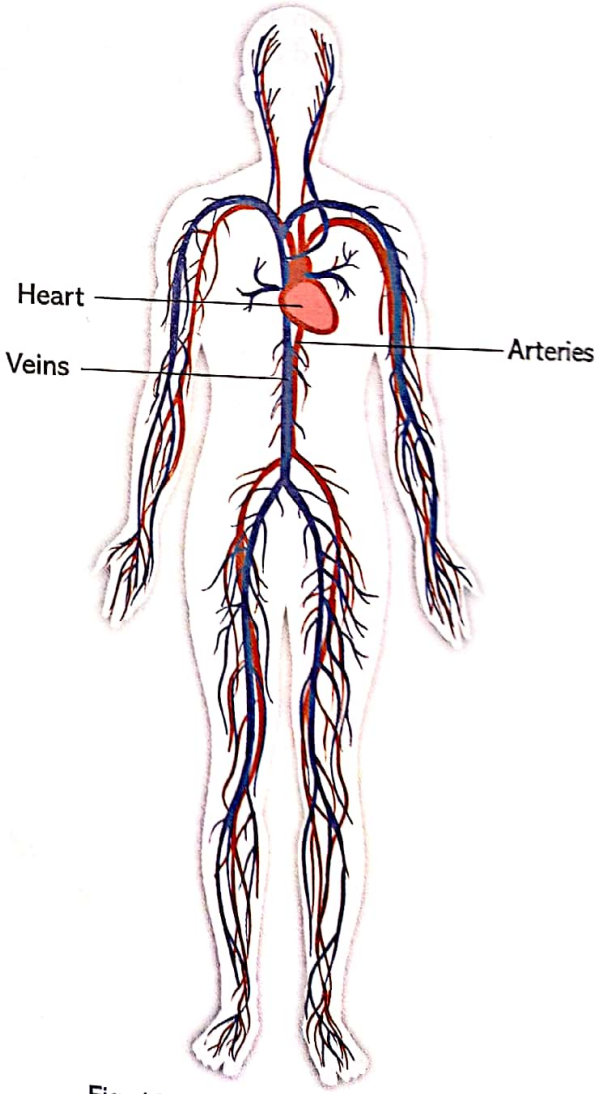


Fig. 10.2 Human circulatory system

Real World

There are four main types of blood groups: A, B, AB and O. These blood groups can be either positive (+ve) or negative (-ve). Every person has a specific blood type.

Blood

Blood is a fluid that flows in the blood vessels connecting different parts of our body. The average adult has about 4 to 5 litres of blood and it constitutes about 8% of our body weight. Without blood, the human body would stop working.

Following are main functions of blood.

1. It transports oxygen from lungs to all parts of the body and also carries carbon dioxide to the lungs which is later exhaled.
2. It carries the digested food from the small intestine to different parts of our body.
3. Waste materials produced in the body are transported to the kidneys for their removal.
4. It helps to maintain a constant body temperature.
5. It also carries hormones and various **antibodies** to the places where they act.

My Dictionary

Antibody: a protective protein produced by the body whenever a foreign body enters into human body

Composition of blood

If you were to see a drop of blood smear under the microscope, you would be amazed to find that blood is actually a mixture of liquid and cells (Fig. 10.3). It has two main components: the liquid component called **blood plasma** (55%) and the solid component which includes **blood cells** (45%) and cell fragments. Each one of these has an important role to play in our body.

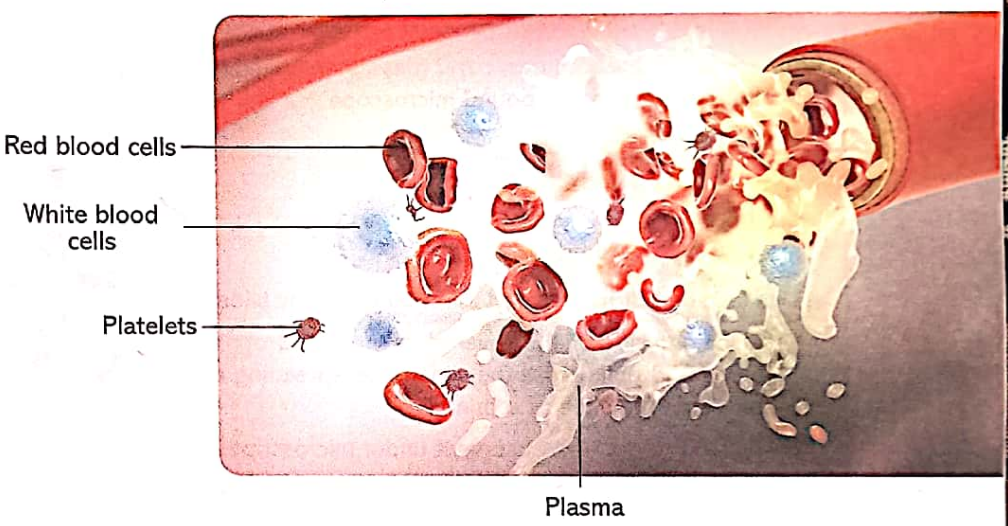


Fig. 10.3 Components of blood

Plasma: It is the fluid part of the blood. It is pale yellow in colour consisting of 90% water. The rest 10% consists of proteins, ions such as potassium, sodium and calcium, nutrients, dissolved gases and metabolic wastes such as urea and uric acid.

Real World

Blood of some molluscs and crustaceans (crabs) is blue in colour because they contain a pigment called haemocyanin instead of haemoglobin.

Blood cells: There are three types of blood cells—red blood cells, white blood cells and platelets.

- **Red blood cells (RBCs):** The red blood cells or **erythrocytes** are specialized cells that transport oxygen and carbon dioxide to different parts of the body. They contain a pigment called **haemoglobin** which gives the blood a red colour. You have learnt in the previous chapter that haemoglobin combines with oxygen and forms oxyhaemoglobin which is then carried to all the cells of the body. They have an average life span of 120 days.

- **White blood cells:** The white blood cells or **leucocytes** are fewer in number and larger in size compared to red blood cells. They are colourless, do not contain any pigment and make up less than 10% of the total cells in blood. They protect the body against diseases by destroying the germs that enter our body. There are five types of white blood cells.
- **Platelets:** They are also called as **thrombocytes.** They are smallest of all cells and are colourless. They help the blood to form **clots.** Whenever there is a wound, the platelets join together at the wound site forming a natural bandage preventing further blood loss.

My Dictionary

Clot: A sticky mass that is formed when the blood dries up and that prevents further bleeding

New blood cells are formed in the body by a process called ***haematopoiesis.*** It takes place in the bone marrow which is found in the long bones of our bodies such as thigh and arm bones.

Let's Try

Aim: To observe blood cells under microscope

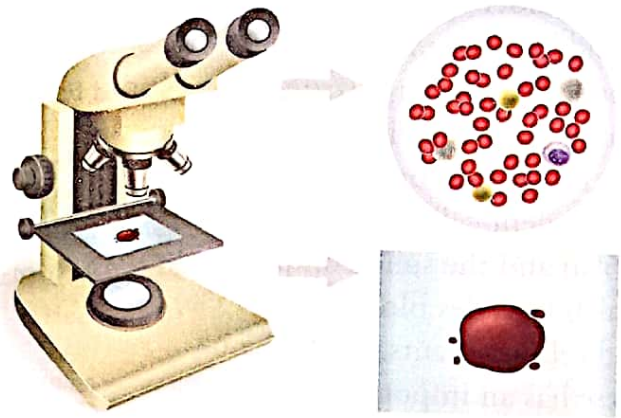
Note: *To be strictly performed under adult supervision.*

Materials required: Slides, cover glass, sterile lancet, alcohol, cotton and compound microscope

Procedure:

1. Wash your hands.
2. Wipe the end of the finger with alcohol and prick it using the sterile lancet.
3. Place one drop of blood on one end of the slide.
4. Place one side of the cover glass into the drop of blood and pull across the slide once, spreading the blood on the slide as a thin film.
5. Allow it to dry and observe it under microscope.

Observation: Large number of disc-like cells are seen. These are the various blood cells.



Real World

Anaemia is a condition that develops when blood lacks enough healthy RBCs and haemoglobin. This results in less oxygen being supplied to the cells which causes weakness and fatigue in the person.

According to WHO, there are 2 billion people with anaemia in the world and about half of them suffer due to deficiency of iron in diet. It is also a major health issue in India. Women, young children and people with chronic diseases are more likely to suffer anaemia. This can be treated by having a balanced diet that includes iron-rich foods such as eggs, meat, beans, green leafy vegetables and fruits.

Blood Vessels

Blood flows through a complex system of tubes or vessels called **blood vessels.** The blood vessels are of three types—arteries, veins and capillaries. Capillaries are the thinnest of the three and connect arteries to veins. Table 10.1 shows the differences between arteries and veins.

Table 10.1 Differences between arteries and veins

Arteries	Veins
They carry oxygenated blood (oxygen-rich) from heart to all parts of the body.	They carry deoxygenated blood (carbon dioxide-rich) from different parts of the body to the heart for purification.
The only exception is the pulmonary artery which carries deoxygenated blood from heart to the lungs.	The only exception is the pulmonary vein which carries oxygenated blood from lungs to the heart.
They are deep seated in the body.	They lie closer to the surface of the skin and can be easily seen as greenish-blue tubes on hands and legs.
They have thicker elastic walls which help to sustain the pressure with which the blood flows through them.	They have thinner walls.
They do not have any valves.	They have a series of valves which allows the blood to flow only in one direction.
Arteries further branch into even smaller vessels called arterioles which join the capillaries.	Venules are the fine blood vessels that arise from capillaries and join together to form a vein.

Capillaries are extremely thin blood vessels which connect the arteries and veins. The walls of the capillaries are so thin that the diffusion of gases and nutrients take place very easily.

My Dictionary

Valve: A flap of tissue that opens in only one direction to prevent the backward flow of blood

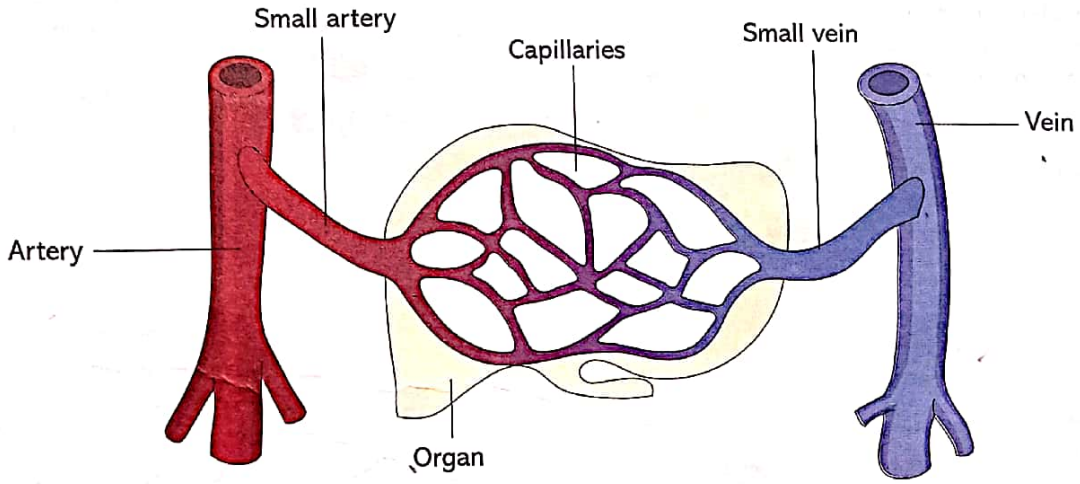


Fig. 10.4 Comparison of arteries, veins and capillaries

The Heart

It is one of the most important parts of the human body. It is located between the lungs, slightly tilted towards the left lung. It is well protected by the ribcage. It is about the size of your closed fist. It is muscular and has a powerful pump-like structure that pumps blood into the blood vessels over 1000 times in a day. It beats about 60-80 times in a minute.

Structure of the heart

- The human heart is made up of four chambers (Fig. 10.5). The upper right and left chambers are the **atria** (singular: atrium) and the lower right and left chambers are the **ventricles** (singular: ventricle).
- The atria are smaller than ventricles, have thinner walls and receive blood from the different parts of the body. So, they are connected to the veins that carry blood to the heart.
- The ventricles are larger, stronger pumping chambers that send blood out of the heart. So they are connected to the arteries that carry blood away from the heart.
- The atria and ventricles are separated from each other by walls or partitions which have valves in them. The valves allow the movement of blood only in one direction.
- The valve between right atrium and the right ventricle is called the **tricuspid valve** and the valve between the left atrium and left ventricle is called the **bicuspid valve.**
- The right atrium opens into the right ventricle and the left atrium opens into the left ventricle. Due to this kind of construction, the blood flowing in the right side of the heart is completely separated from the left side of the heart. The deoxygenated blood flows through the right side while oxygenated blood flows through the left side. A partition called the **septum** separates the right side of the heart from the left and prevents mixing of the oxygen-rich blood and carbon dioxide-rich blood.

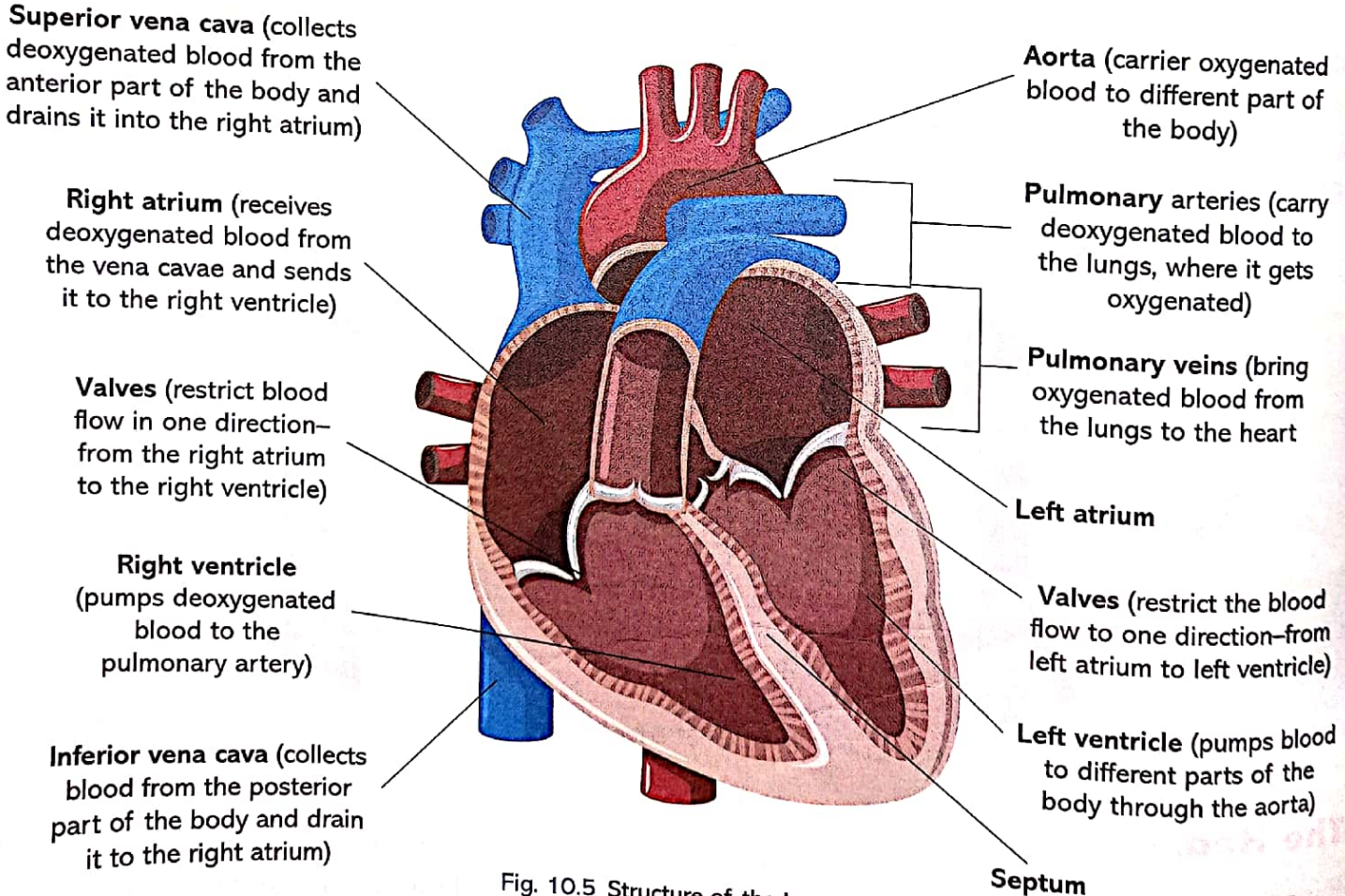


Fig. 10.5 Structure of the human heart

Circulation of Blood in the Body

Blood keeps circulating in the body by the contraction and relaxation of the heart as shown in Figure 10.6.

- The deoxygenated blood from the different parts of our body enters the right atrium which then move to the right ventricle through the tricuspid valve.
- After it is filled, the right ventricle pumps blood through the pulmonary artery to the lungs for re-oxygenation.
- In the lungs, the carbon dioxide in the blood diffuses out and absorbs the oxygen from the inhaled air.
- This oxygenated blood returns to the left atrium through the pulmonary veins.
- From the left atrium, the blood passes through the bicuspid valves to the left ventricle where it is pumped out through the aorta. Aorta is the largest artery of the body which carries oxygenated blood to all organs and muscles of the body.

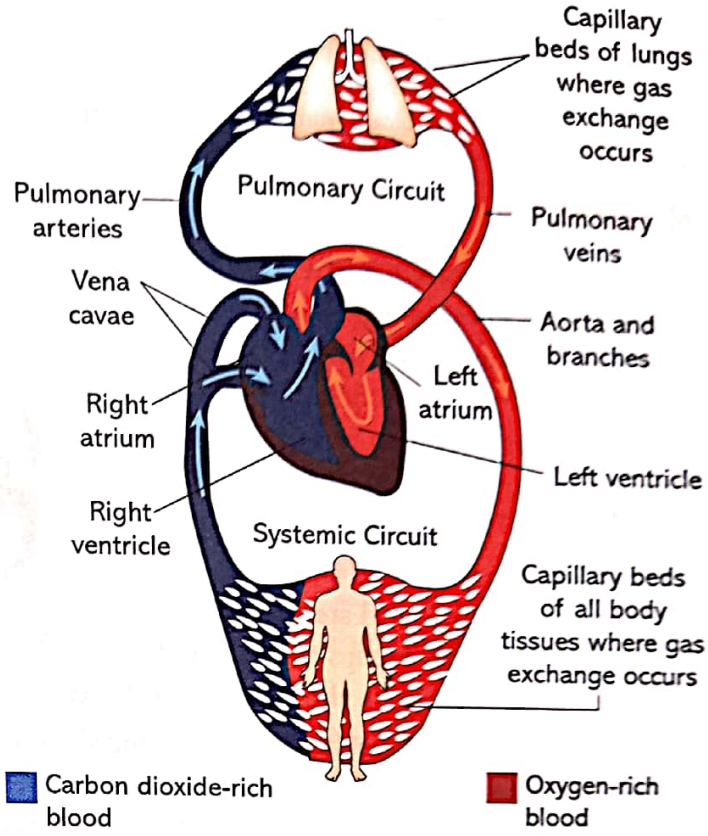


Fig. 10.6 Circulation of blood in the human body

Figure 10.7 shows the path travelled by the blood in human body.

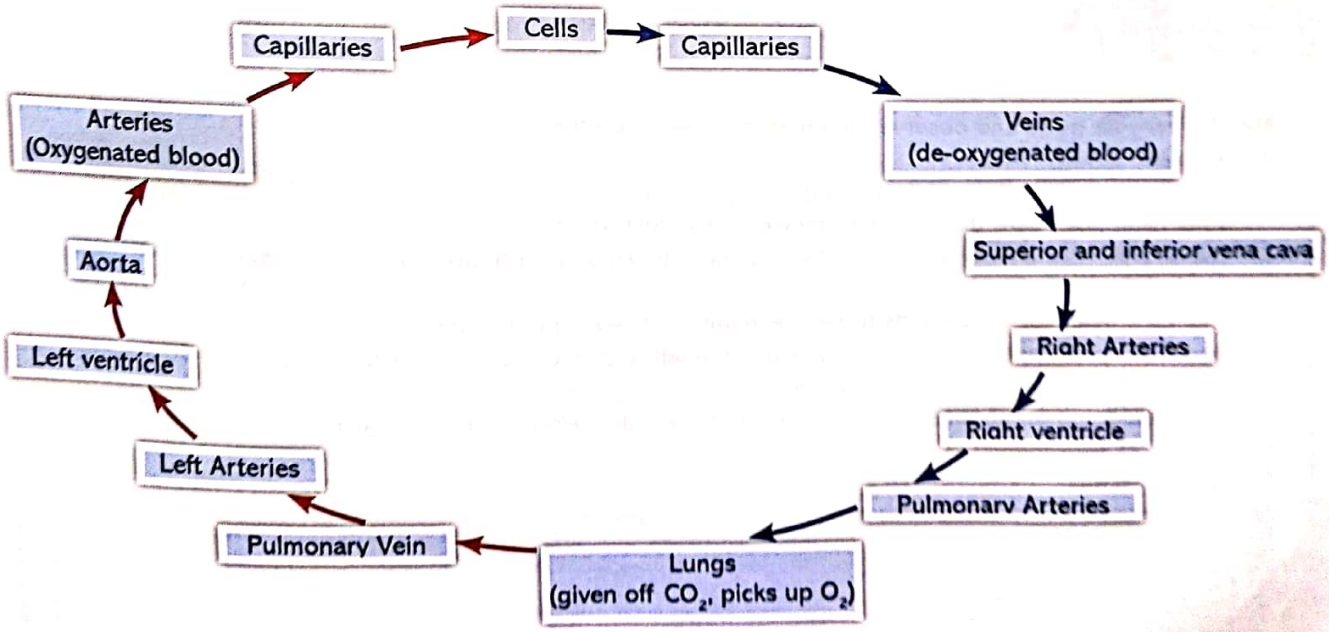


Fig. 10.7 Path of blood in the human body