Transport in Mammals

A. The Circulatory System

The Mammalian Circulatory

The mammalian circulatory system is a closed double circulation.

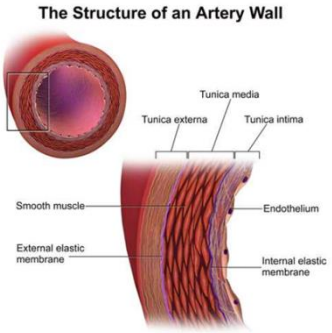
• The circulatory system also includes a heart and blood vessels (arteries, capillaries and veins).

• Arteries and veins contain three layers of tissues known as the tunica intima, tunica media, and tunica externa:

- Tunica interna: endothelium, containing squamous epithelial cells

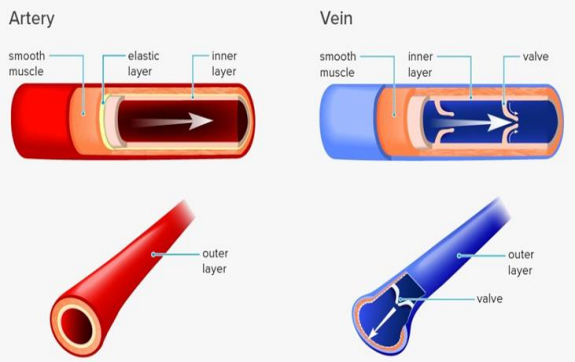
- Tunica media: containing smooth muscle, elastic fibres, and collagen fibres

- Tunica externa: containing elastic and collagen fibres



• Arteries: These blood vessels transport oxygenated blood swiftly to the tissues at high pressures. They have thick walls to withstand this high pressure. The exception to this is the pulmonary artery, carrying deoxygenated blood to the lungs.

• Veins: Many capillaries join to form venules which then join to form veins. These blood vessels carry deoxygenated blood back to the heart. The exception is pulmonary vein, carrying oxygenated blood from the lungs to the heart.



B. Comparison Of Blood Vessels

Components Of Blood

Blood is composed of 4 components:

- Plasma: This is the liquid part of the blood. It is a dilute solution of salts, glucose, amino acids, vitamins, urea, protein and fats.
- Leukocytes (white blood cells): Involved in the immune system.
- Platelets: Involved in blood clotting.
- Erythrocytes (red blood cells): Involved in carrying oxygen.
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Tissue Fluid

This fluid surrounds all the cells. Substances move from the blood to the tissue fluid and from the tissue fluid they diffuse into the cells.

Lymph

Fluid inside the lymphatic vessels is called lymph. Lymph is very similar to tissue fluid but has a different name as it is in a different place and contains more large proteins and white blood cells than tissue fluid.

Haemoglobin (Hb)

Haemoglobin (Hb) transports oxygen and carbon dioxide:

- In respiring tissues: The pCO_2 is high and the pO_2 is low.
- In the lungs: The pO_2 is high and the pCO_2 low.

• The presence of a high pCO_2 causes Hb to release oxygen. This is called the Bohr Effect. High pCO_2 are found in actively respiring tissues which need oxygen. This causes Hb to release oxygen even more readily than it would otherwise.

• In high altitudes: the pO_2 is low, causing altitude sickness. In order to increase oxygen intake, populations that live in high altitude areas have adapted by developing higher haemoglobin count, larger lung capacity, increased red blood cell count and greater number of mitochondria to increase the efficiency of oxygen transport from lung to tissue

C. Heart

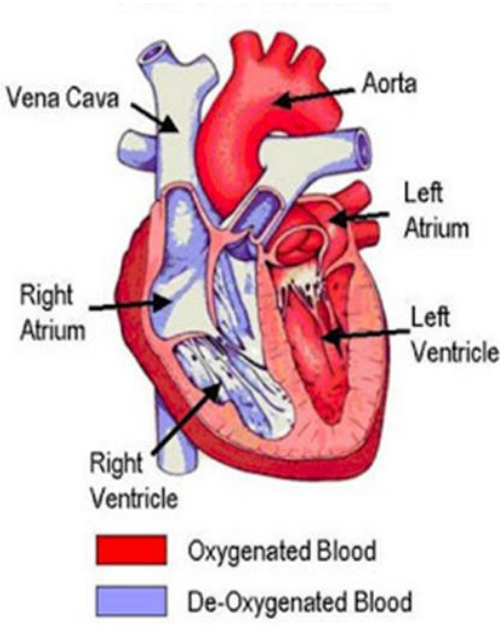
Heart

Heart, organ that serves as a pump to circulate the blood. It may be a straight tube, as in spiders and annelid worms, or a somewhat more elaborate structure with one or more receiving chambers (atria) and a main pumping chamber (ventricle), as in mollusks.

The heart cavity is divided down the middle into a right and a left heart, which in turn are subdivided into two chambers :

- The upper chamber is called an atrium (or auricle)
- The lower chamber is called a ventricle.

The two atria act as receiving chambers for blood entering the heart; the more muscular ventricles pump the blood out of the heart.



How the Hearts Pumps Blood

The heart, although a single organ, can be considered as two pumps that propel blood through two different circuits:

1. The right atrium receives venous blood from the head, chest, and arms via the large vein called the superior vena cava and receives blood from the abdomen, pelvic region, and legs via the inferior vena cava.

2. Blood then passes through the tricuspid valve to the right ventricle, which propels it through the pulmonary artery to the lungs.

3. In the lungs venous blood comes in contact with inhaled air, picks up oxygen, and loses carbon dioxide. Oxygenated blood is returned to the left atrium through the pulmonary veins.

4. The low-pressure circuit from the heart (right atrium and right ventricle), through the lungs, and back to the heart (left atrium) constitutes **the pulmonary circulation.** Passage of blood through the left atrium, bicuspid valve, left ventricle, aorta, tissues of the body, and back to the right atrium constitutes **the systemic circulation.**

5. Blood pressure is greatest in the left ventricle and in the aorta and its arterial branches. Pressure is reduced in the capillaries (vessels of minute diameter) and is reduced further in the veins returning blood to the right atrium.