# Anatomy and physiology

## The cardiovascular system

# The Cardiovascular system

## Learning outcome

Understand the key structure and functions of the cardiovascular system

## Topics

In this presentation we are going to look at:

Structure of the cardiovascular system

Functions of blood

Location of the primary blood vessels

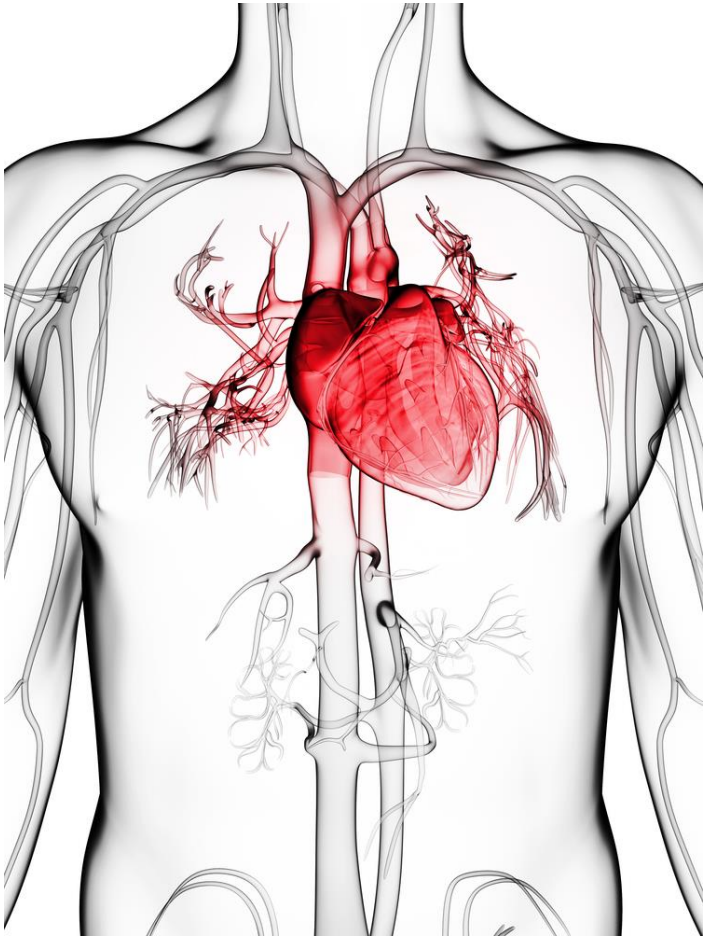
# Structure of the cardiovascular system

- **The heart** provides a constant supply of blood by maintaining the circulation.
- **Blood vessels** provide an extensive network of vessels through which blood flows to and from the heart.

# The structure of the heart

The heart lies in the thoracic cavity, between the lungs.

It is divided into a left and right side, with a two chambers on each side.



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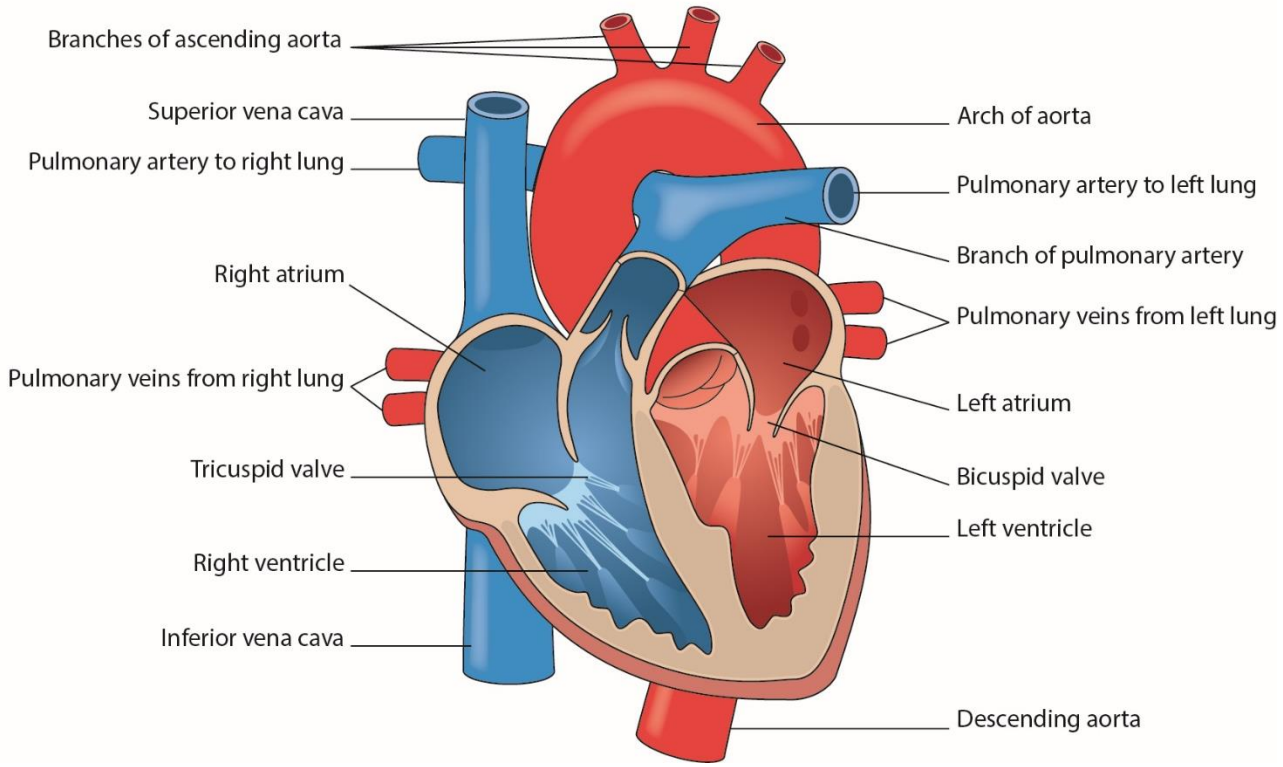
# The structure of the heart

The **superior vena cava** and the **inferior vena cava** are the two largest veins of the body. They empty blood from the head and body into the right atrium.

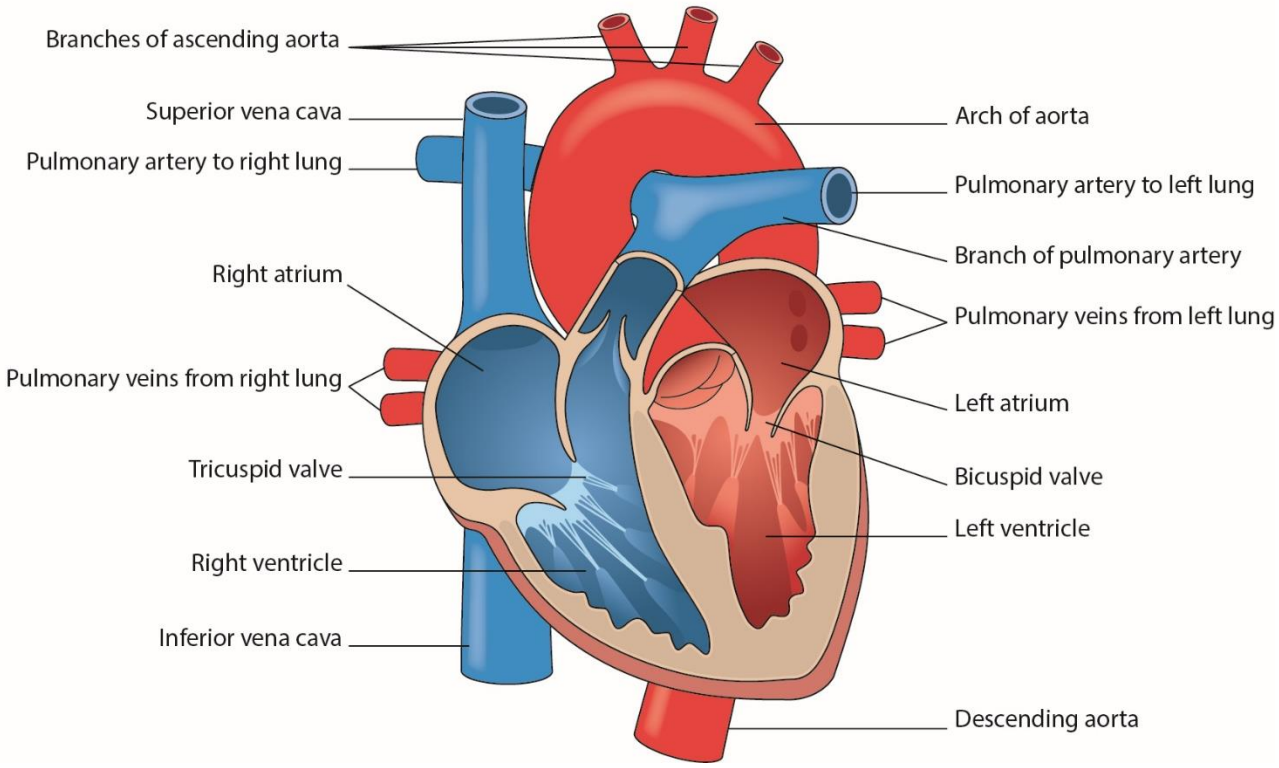
The right atrioventricular valve separates the **right atrium** from the **right ventricle.**



# The structure of the heart

The blood passes into the **right ventricle** from the atrium and into the pulmonary artery.

The beginning of the pulmonary artery is guarded by the three semilunar pulmonary valves. These prevent the back flow of blood.



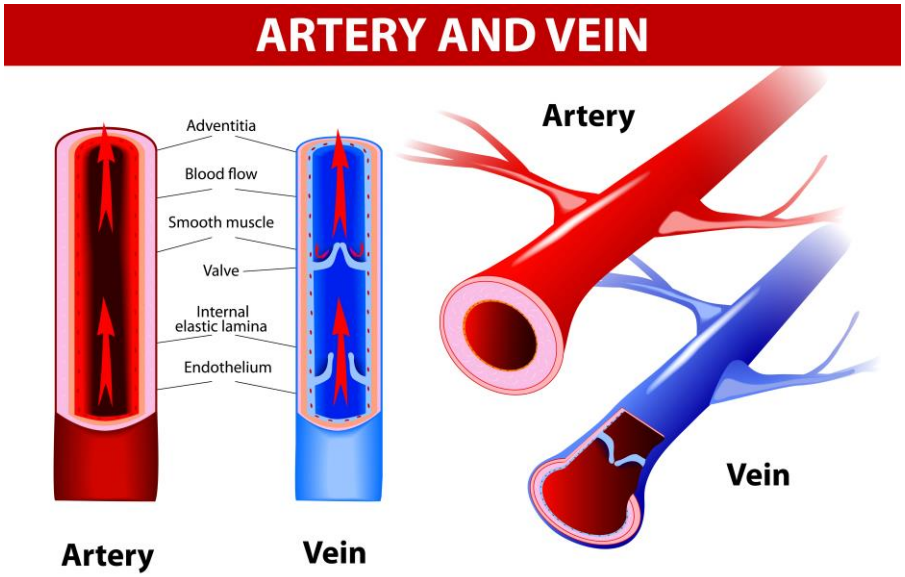
# Pulmonary circulation

- Blood circulates from the right ventricle of the heart to the lungs through the **pulmonary artery**. The pulmonary artery carries deoxygenated blood.
- Exchange of gases occurs with the delicate alveoli tissue of the lungs, through the single celled capillary network.
- Oxygenated blood is then carried through the **pulmonary veins** back to the left atrium of the heart, from where it circulates initially through the **aorta** to the body.

# Blood vessels

## Arteries

- The blood vessels that transport blood away from the heart to the head and body.
- They have a  thick muscular wall  and elastic tissue, which permits the vessels to stretch under the high pressure of the blood being pumped by the heart.
- These vessels gradually become smaller and form arterioles.

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# Blood vessels

## Capillaries

- The smallest arterioles eventually become capillaries.
- Capillaries have one single layer of cells which permit water and other small molecules to pass through.
- The capillaries form a network to exchange substances between the blood and tissue fluid.
- Blood cells and larger molecules do not usually pass through capillary walls.
- Eventually capillaries link back to venules the smallest vein to return the circulation to the heart.

# Blood vessels

## Capillary exchange

- Oxygen is carried from the lungs to the tissues where an exchange takes place.
- Oxygen diffuses from the blood through the capillaries walls into the tissues.
- Carbon dioxide diffuses into the blood into the capillaries from the tissues.
- Carbon dioxide is transported back to the lungs for excretion.
- Other nutrients required by cells pass through the semi-permeable capillary membrane by osmosis or diffusion into the tissues to bathe the cells.

# Blood vessels

## Veins

- **Venules** gradually form veins and return blood under low pressure back to the heart.
- Veins have thinner walls than arteries.
- Some veins have valves which prevent the back flow of blood, especially important in the lower limbs.
- The surrounding skeletal muscles also helps to push the blood back the the heart when the muscle tissue contracts around the vein.

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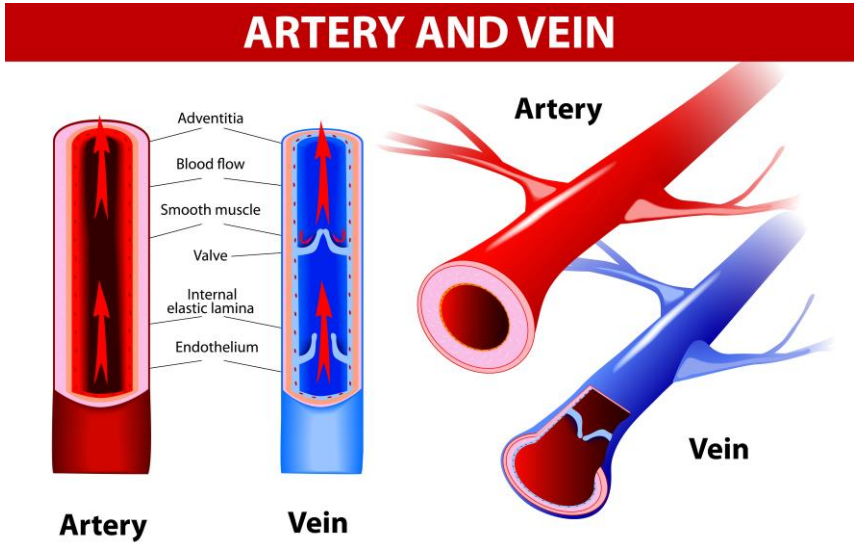


Under normal circumstances, approximately 2/3s of the body’s blood is in the venous system.

# Functions of blood

Blood circulates continually around our bodies. It **transports**:

- **oxygen** from the lungs to the tissues and **carbon dioxide** from the tissues to the lungs for excretion
- **nutrients** from the alimentary canal to the body
- **cell waste** to the excretory organs
- **hormones** to their target organs
- **heat** produced by cell metabolism to maintain the body as a consistent temperature
- **antibodies** and other **protective molecules** for **defense**
- **clotting** factors to prevent bleeding.

# Composition of blood

**Plasma**

- 55% of blood.
- A clear, straw-coloured liquid water fluid.
- Plasma is around 90% water, with dissolved substances suspended in it including:
    - proteins
    - inorganic slats
    - nutrients
    - water materials
    - hormones
    - Gases.

# Composition of blood

45% of our blood are cells which are suspended in the plasma.

**Erythrocytes:** red blood cells.

- They are biconcave in shape and have no nucleus.
- Main function is to transport oxygen and to a lesser degree carbon dioxide.
- Produced in the bone marrow, have a short life span of around 120 days.

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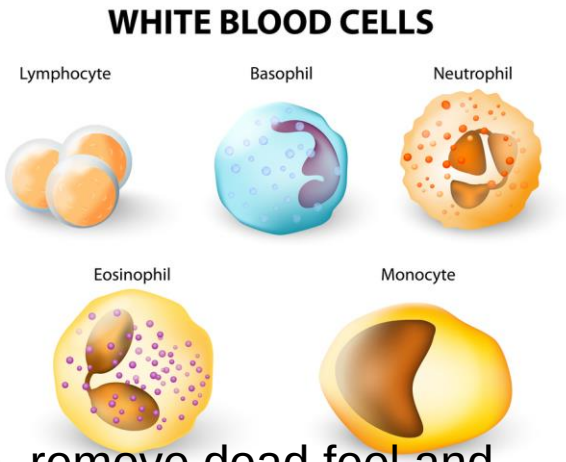
# Composition of blood

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**Leukocytes:**

- Important in defense and immunity.
- Largest white cells, there are two types:

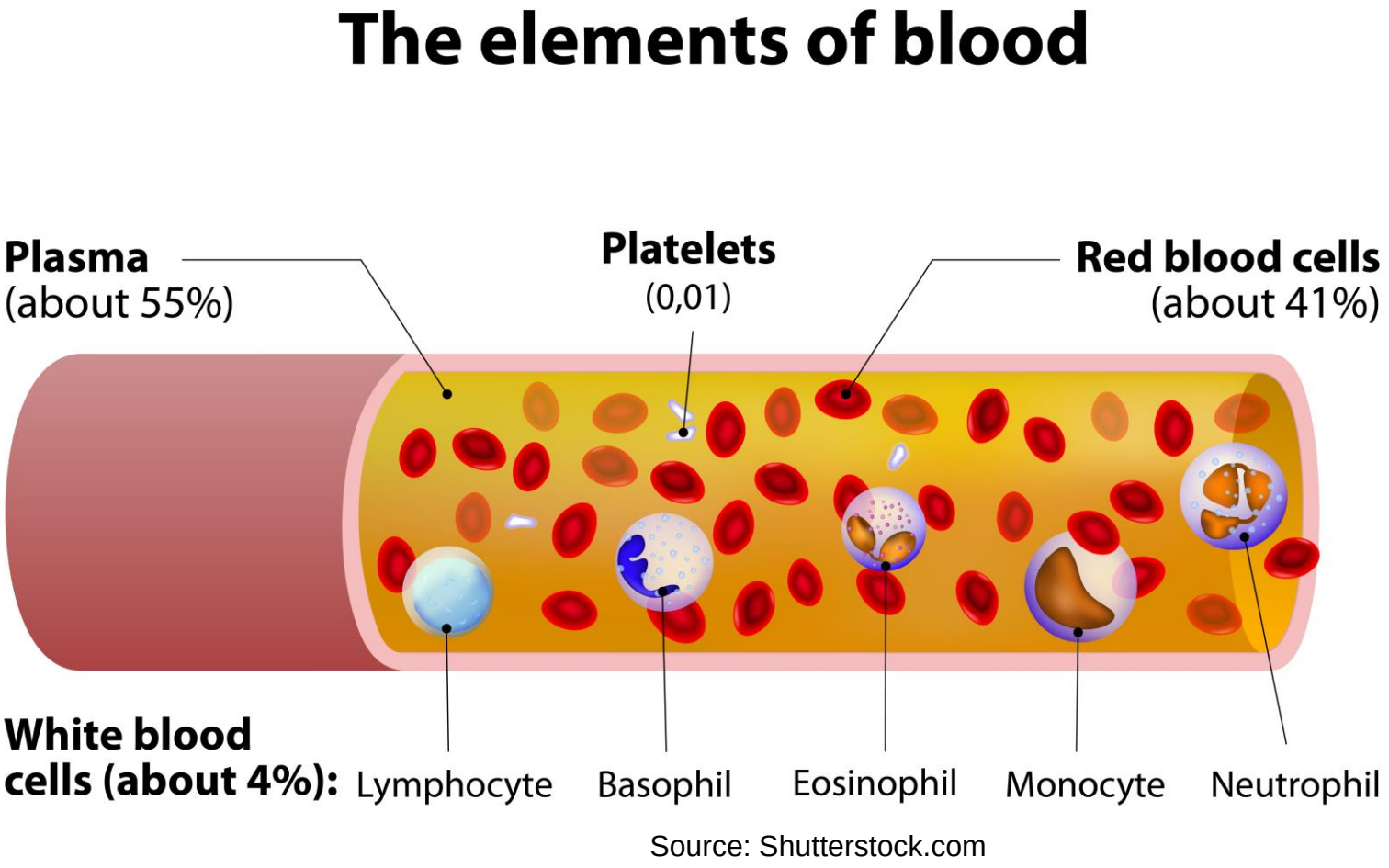
1. **Granulocytes**
   - **Neutrophils** protect against bacterial invasion, remove dead feel and debris from the tissues.
   - **Eosinophils** phagocytosis, elimination of parasites, capable of releasing toxic chemicals to fight infection.
   - **Basophils** promote inflammation (heprin and histamine).
2. **Agranulocytes**
   - **Monocytes** largest of the white blood cells. Diverse range of protective functions, some phagocytic, others develop into macrophages.
   - **Lymphocytes** present in large numbers in lymphatic tissue, developed in the red bone marrow and activated in lymphatic tissue. Respond to antigens. B-lymphocytes and T-lymphocytes have special functions.

# Composition of blood

## Thrombocytes (platelets)

- Small ‘fragments’ contain a variety of substances that promote blood clotting.
- Short life span of 8-11 days.
- 1/3 of our thrombocytes are stored in our spleen to be released should excessive bleeding occur and need to be controlled.

# Composition of blood

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