# Transport systems in animals

## Scope

| Topic | Breakdown of topic |
|---|---|
| **Transport systems in animals** | Transport system/circulatory system<br><br>Blood circulation system<br><br>Pulmonary and systemic (double, closed)<br><br>circulatory systems heart and associated blood vessels<br><br>heart: internal and external structure related to functioning,<br><br>cardiac cycle: flow of blood through the heart |

# Transport systems in animals

Notes

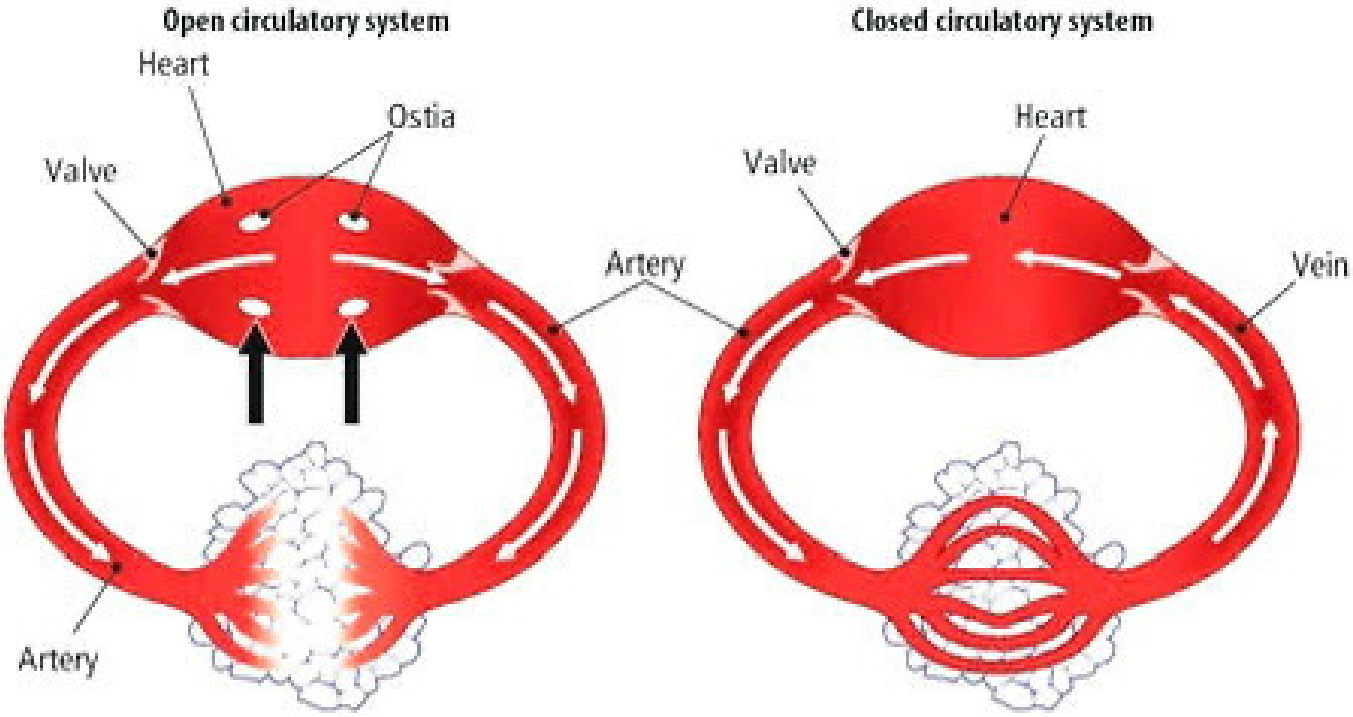
Large animals require a transport system to get food and oxygen to the body and cells. A transport system must also move carbon dioxide and nitrogenous wastes away from the body cells. The **human circulatory system** transports these substances via the blood stream.

## Open circulatory system

Arthropods and mollusks have an **open circulatory system** since the blood is not confined to blood vessels only. They have blood-filled spaces called haemocoels (blood cavity). Organs are found within the haemocoels. These organs become submerged with blood and in this way, obtain oxygen and food from the blood by diffusion. Carbon dioxide and nitrogenous wastes diffuse out of these organs and are transported away by the blood.

## Closed circulatory system

All vertebrates, including mammals have a **closed circulatory system**. Blood is confined to blood vessels only, which are **arteries**, **veins** and **capillaries**.




*Normal arteries carry oxygenated blood while normal veins carry deoxygenated blood*

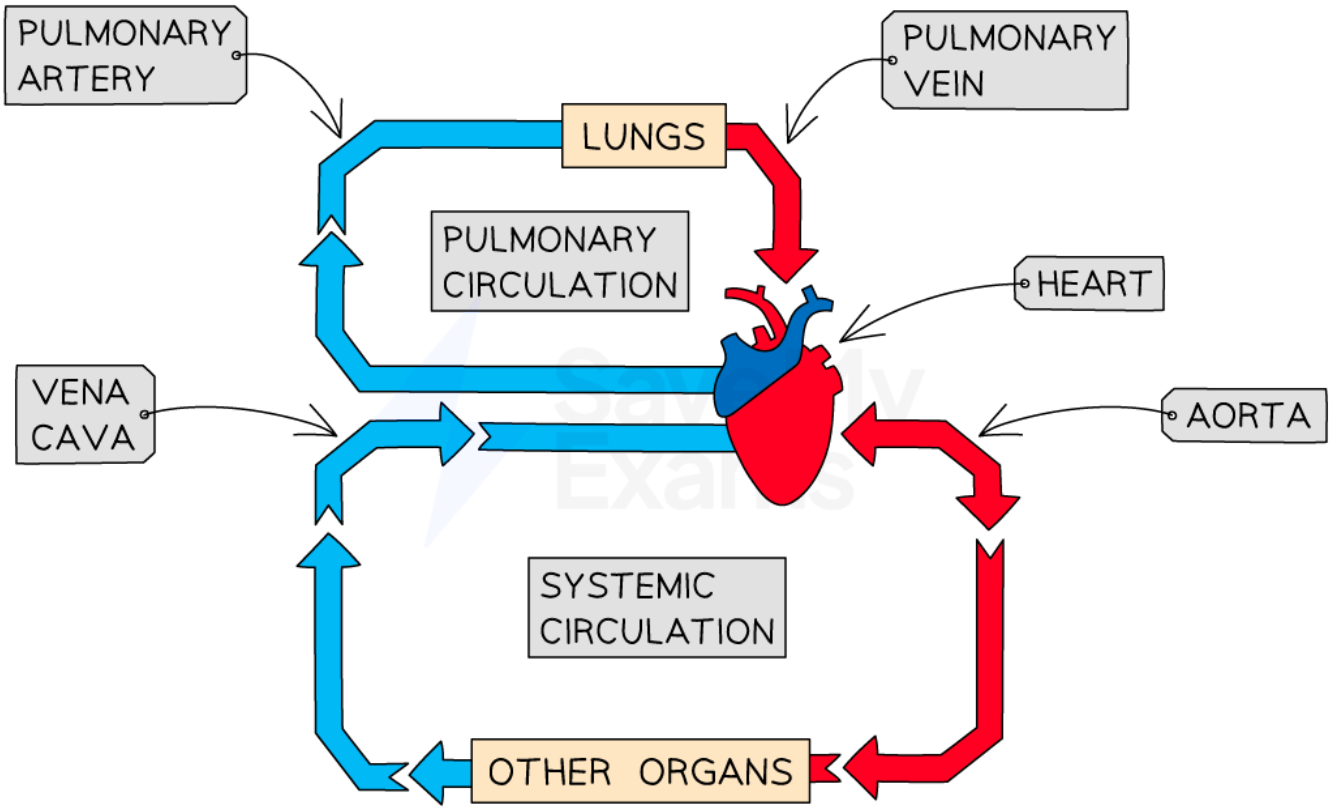
# Transport systems in animals

Notes

## Double Circulatory system

Humans have a double circulatory system since blood is pumped from the heart along two circuits.

- The first is the **Pulmonary Circuit**, where deoxygenated blood moves from the heart to the lungs and returns to the heart as oxygenated blood.
- The second circuit is the **Systemic Circuit**, where oxygenated blood is pumped throughout the body and returns to the heart as deoxygenated blood.



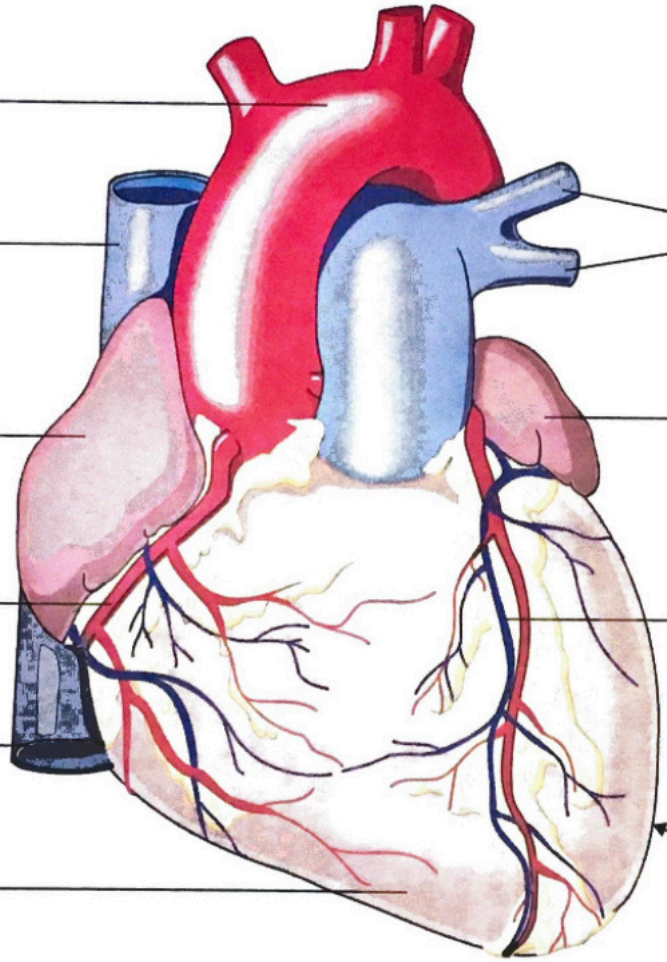

Blood passes the heart twice hence - double circulation

# Transport systems in animals

Notes

## The heart

**The external structure of the heart**. You should know all parts & their functions.



**aorta**
carries oxygenated blood to all parts of the body

**superior vena cava**
carries deoxygenated blood from upper part of body (head and arms) to heart

**right atrium**
receives deoxygenated blood from the superior and inferior vena cavae

**coronary artery**
supplies oxygenated blood to muscles of the heart

**inferior vena cava**
carries deoxygenated blood from lower part of body to heart

**wall of ventricle**

**pulmonary arteries**
carry deoxygenated blood to lungs

**left atrium**
receives oxygenated blood from the lungs

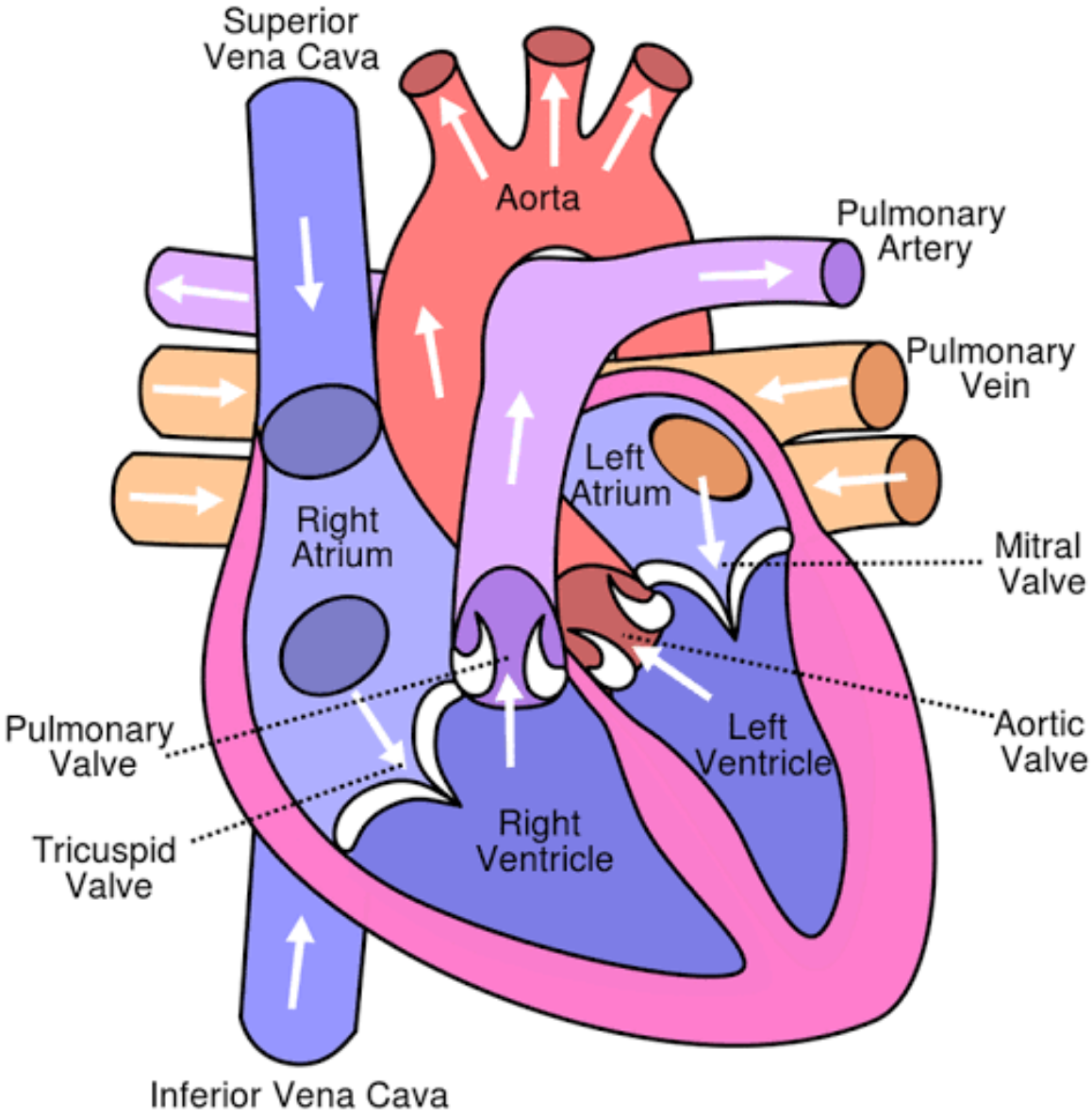
**coronary vein**
carries deoxygenated blood from the heart muscle

**pericardium**
membrane that encloses and protects the heart

# Transport systems in animals

Notes

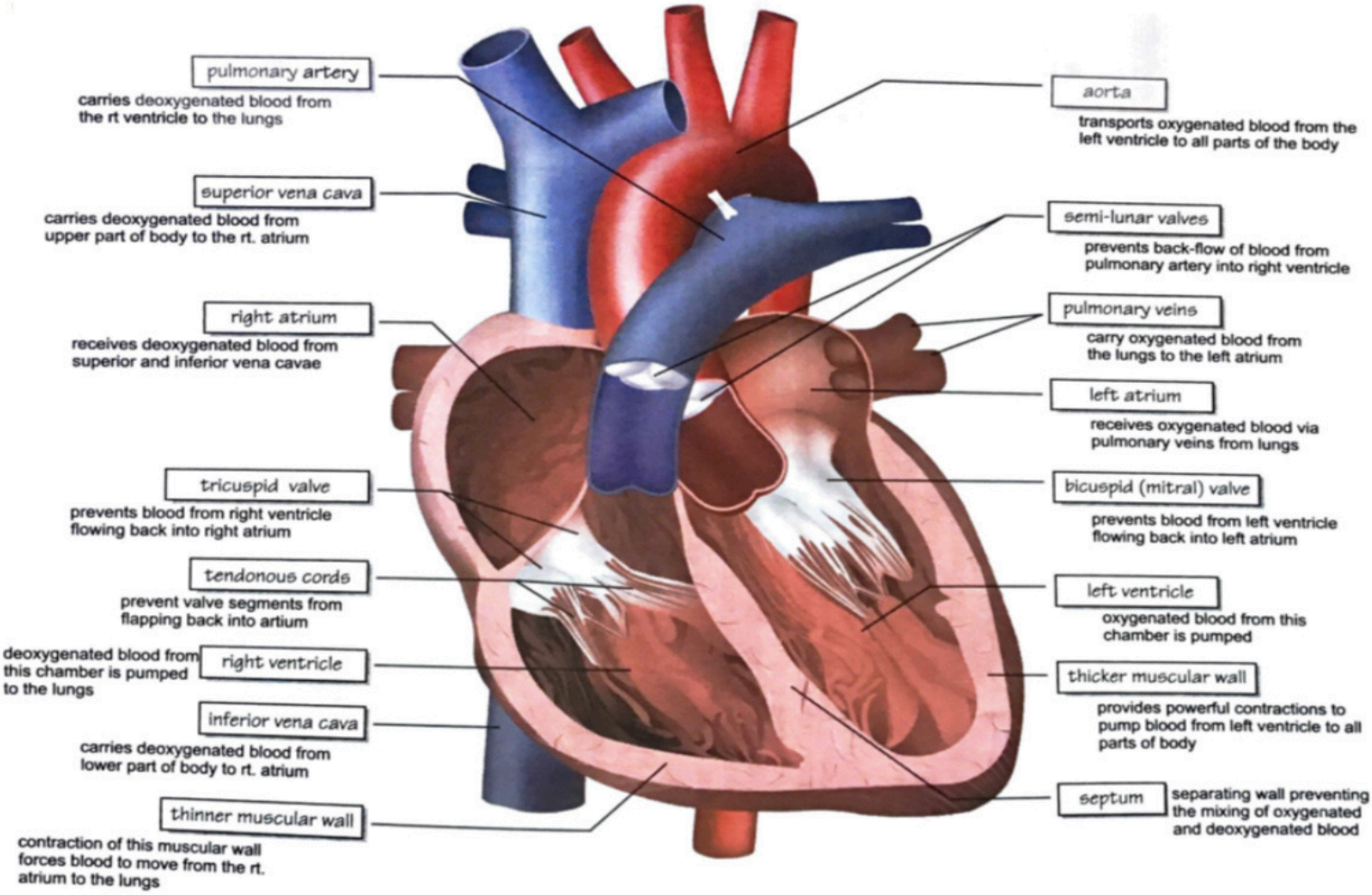
The internal structure of the heart. You should know all parts & their functions.



# Transport systems in animals

Notes

The internal structure of the heart. You should know all parts & their functions.



# Transport systems in animals

Notes

## Cardiac cycle

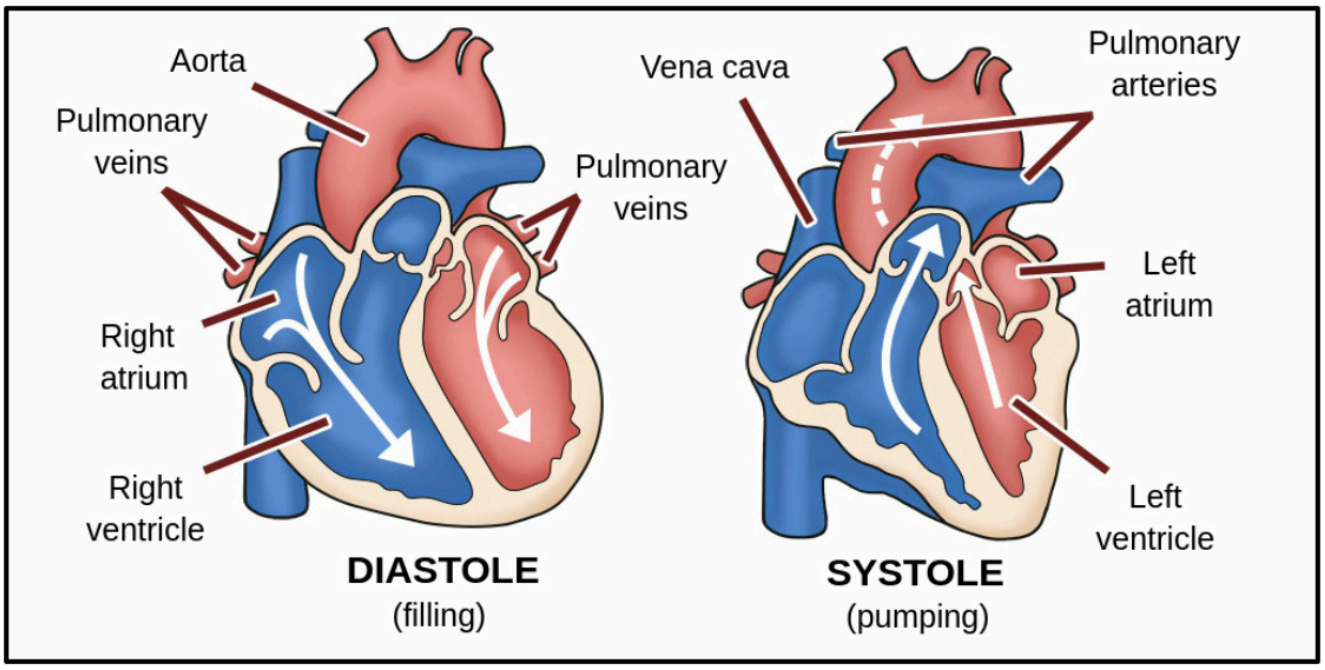
At the beginning of the **cardiac cycle**, both the atria and ventricles are relaxed (diastole). Blood is flowing into the right atrium from the superior and inferior vena cava and the coronary sinus. Blood flows into the left atrium from the four pulmonary veins.

The cardiac cycle involves:

- **systole** – contraction of the heart muscle
- **diastole** – relaxation of the heart muscle.

The heart beats twice:

- **atrial systole** forces blood through the heart into the ventricles
- **ventricle systole** forces blood out of the heart.




Your heart beats around 70 times a minute. The cardiac cycle is the sequence of events which makes up one heartbeat.

The cardiac cycle *refers to the contraction and relaxation of the heart muscles* (heartbeat). Making a "lub-dub" sound of a beating heart, which is the closing of the valves as the atrial and ventricular muscles contract.

The wall of the right atrium has a group of specialized cells called the **Sino – Atrial node** (SA Node) which acts as a pacemaker. It determines the rate of contraction of the atria and the ventricles and coordinates the contraction of the heart muscles.

# Transport systems in animals

Notes

## Cardiac cycle

There are three stages in this cycle.

1. Atrial systole
2. Ventricular systole
3. Atrial and Ventricular diastole

**ATRIAL SYSTOLE**

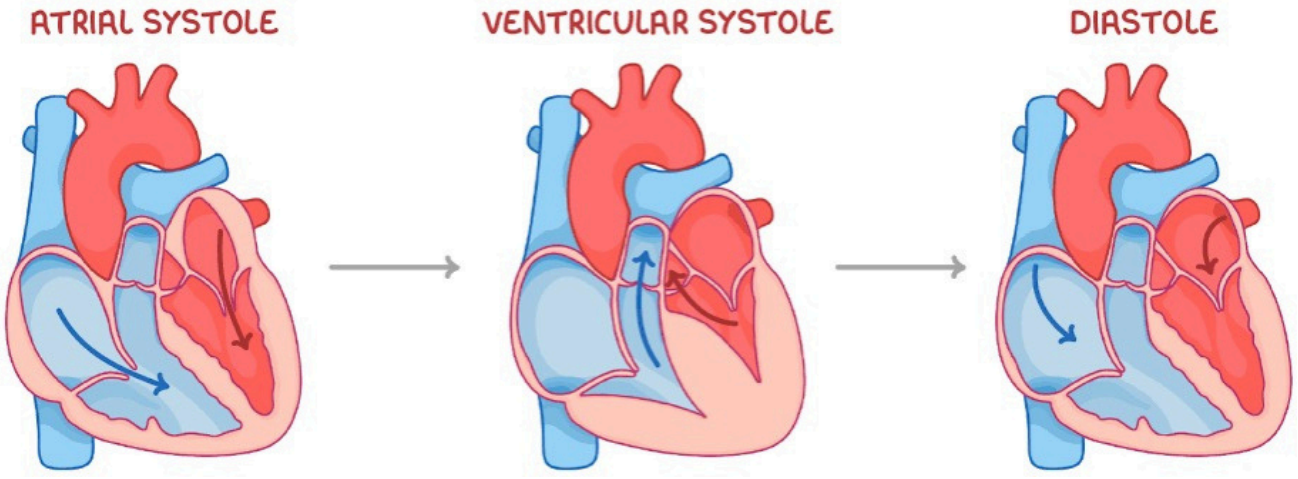
- The muscles of the atria **contract**.
- The tricuspid and bicuspid valves are forced open to allow blood to flow from the atria into the ventricles.
- Duration is 0,1seconds

**VENTRICULAR SYSTOLE**

- Muscles of the ventricles **contract**.
- Both the tricuspid and bicuspid valves close (**the lub sound**).
- Semi-lunar valves of the pulmonary artery and aorta are open.
- Deoxygenated blood from the right ventricle is forced up the pulmonary artery and moves to the lungs.
- Oxygenated blood from the left ventricle is forced up the aorta and moves to all parts of the body.
- Duration is 0,3 seconds.

**ATRIAL AND VENTRICULAR DIASTOLE**

- Muscles of the atria and ventricles **relax**.
- Semi-lunar valves in aorta and pulmonary artery close to prevent any back flow (**the dub sound**).
- Deoxygenated blood from the vena cava fills the right atrium and oxygenated blood from the pulmonary veins fills the left atrium.
- The cycle then starts again.
- Duration is o,4 seconds.



# Transport systems in animals

Notes

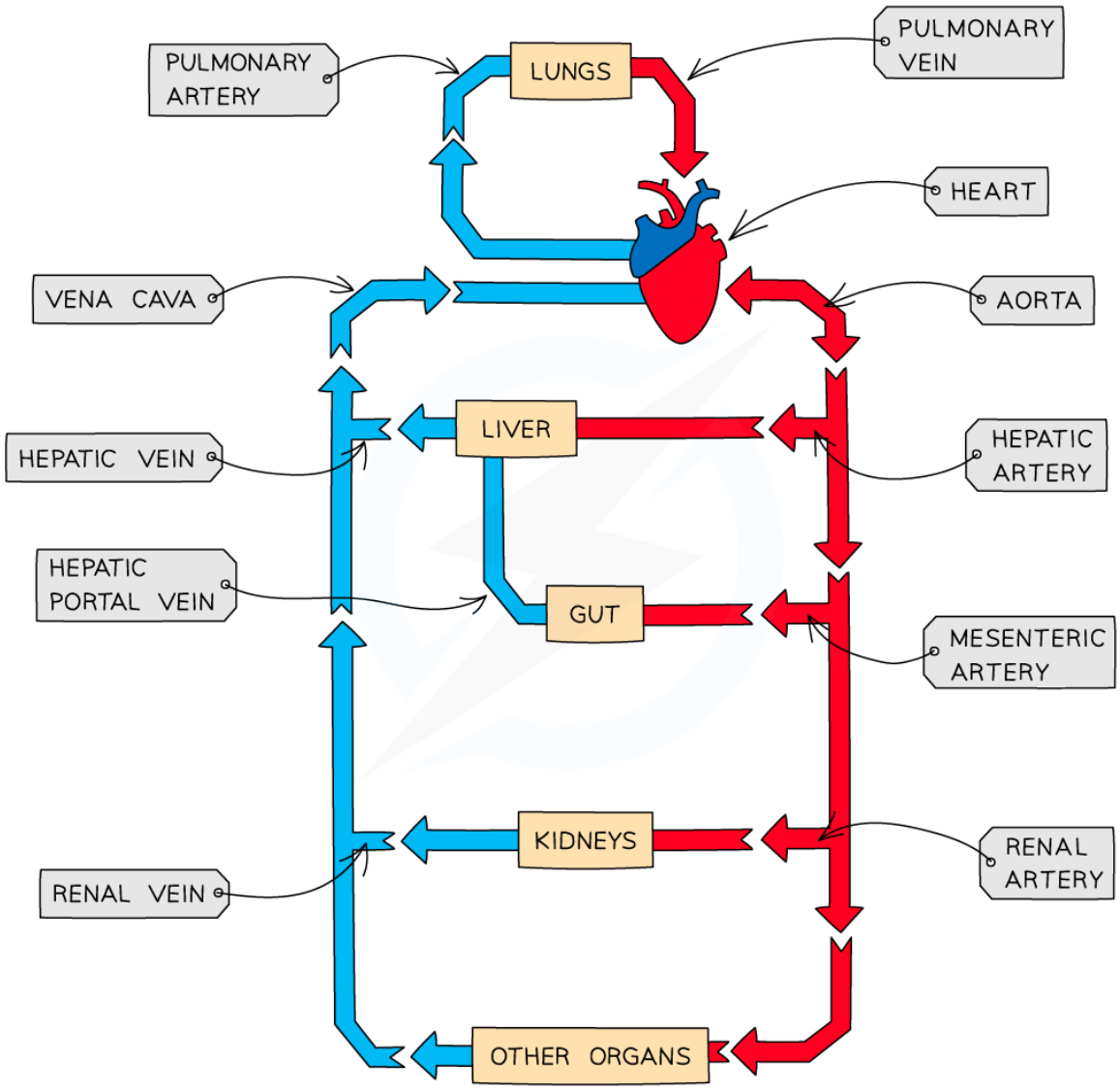
## Direction of blood

Humans have two circuits of blood flow. This is called **double circulation**. This means that blood flows in two different directions at the same time.

<u>These two circuits of blood flow are:</u>

- The pulmonary circuit.
- The systemic circuit.

In the **pulmonary circuit** blood flows from the heart to the lungs and back to the heart.
In the **systemic circuit** blood flows from the heart to all parts of the body and back to the heart.



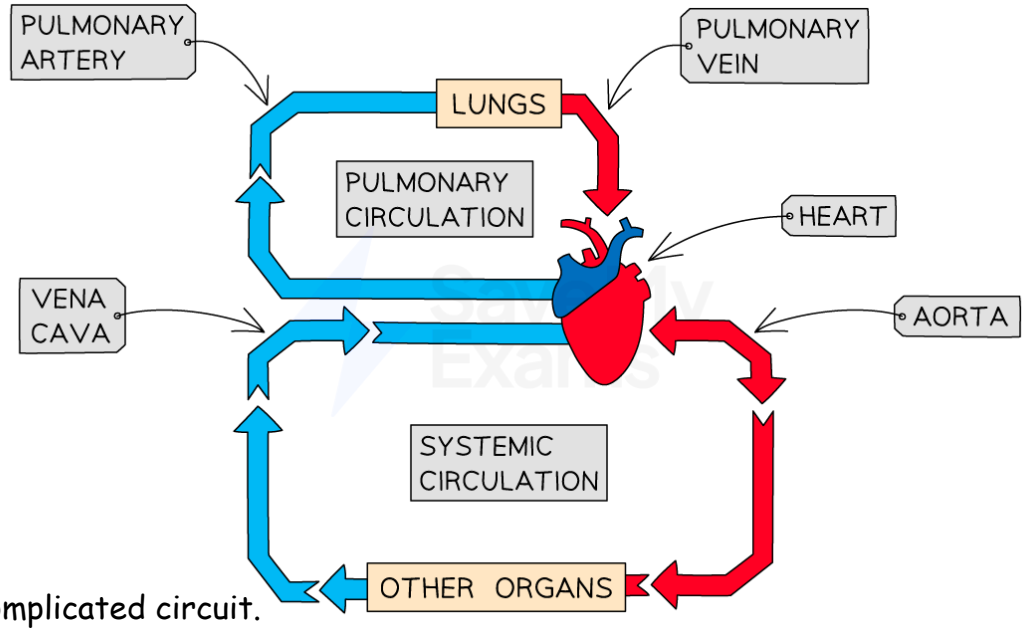
# Transport systems in animals

Notes

## Direction of blood

The pulmonary system

Deoxygenated blood from the right ventricle is forced into the pulmonary artery.
The pulmonary artery branches as it *leaves the heart* and one branch enters each lung.
In the lungs, the artery branches until it forms tiny capillaries.
These capillaries carry the deoxygenated blood to the alveoli.
The carbon dioxide diffuses out of the capillaries into the alveoli.
Oxygen then *moves out* of the alveoli and into the capillaries.
The blood in the capillaries is now oxygenated.
The capillaries join and rejoin to form larger and larger veins as they *leave the lungs.*
These veins leave the lungs as the pulmonary veins.
The pulmonary veins from each lung *enters* the left atrium of the heart.




The systemic circuit

• much larger and more complicated circuit.

Oxygenated blood from the left ventricle is forced into the aorta. The aorta *leaves the heart* carrying the oxygenated blood. The aorta branches and rebranches until it forms smaller arterioles that carry oxygenated blood to all *parts of the body.*

These arterioles branch and they form capillaries that supply the cells in all the parts of the body with oxygen. Oxygen *moves out of* the capillaries into the cells and carbon dioxide *moves out* of the cells and into the capillaries.

The blood in the capillaries is now deoxygenated. The capillaries from the lower half of the body join and rejoin to form veins leading to the inferior vena cava carrying deoxygenated blood to the right atrium (heart).

The capillaries in the upper half of the body join and rejoin leading to the superior vena cava carrying deoxygenated blood from the upper half of the body to the right atrium of the heart.

# Transport systems in animals

## Terminology

| Biological term | Description |
|---|---|
| **Aorta** | A blood vessel that carries oxygenated blood to the rest of the body |
| **Atrial systole** | A stage in the cardiac cycle where blood is forced into the ventricles from atria |
| **Atrium** | Upper chamber of the heart |
| **Capillaries** | Blood vessels that connect arteries and veins |
| **Cardiac cycle** | Sequence of events that make up one heartbeat |
| **Closed circulatory system** | Circulatory system in which blood is enclosed in vessels |
| **Coronary artery** | An artery that supplies the heart muscles with oxygenated blood |
| **Coronary vein** | A vein that carries deoxygenated blood from the heart muscles |
| **Deoxygenated blood** | Blood rich in carbon dioxide and waste |
| **Diastole** | When both atria and ventricles are relaxed |
| **Heart** | An organ that pumps blood |
| **Mitral valve/ Bicuspid valve** | Prevent backflow of blood from left ventricle to left atrium |
| **Open circulatory system** | Circulatory system in which blood is not confined to blood vessels |
| **Oxygenated blood** | Blood rich in oxygen and nutrients |
| **Pericardium** | A membrane that encloses and protects the heart |
| **Pulmonary artery** | A blood vessel that carries deoxygenated blood to the lungs from the heart |
| **Pulmonary circuit** | A system in which blood flows from the heart to the lungs and back to the heart |
| **Pulmonary vein** | A blood vessel that carries oxygenated blood from the lungs to the heart |
| **Semi-lunar valve** | A valve that prevents blood backflow from pulmonary artery to right ventricle |
| **Septum** | A wall that separates left and right parts of the heart to prevent oxygenated blood from mixing with deoxygenated blood |
| **Sino-atrial node** | Specialised cells in the walls of the right atrium that act as a pacemaker |
| **Systemic circuit** | A system in which blood flows from the heart to all parts of the body and back to the heart |
| **Systole** | Contraction of the heart muscles |
| **Tricuspid valve** | Prevents backflow of blood from right ventricle to right atrium |
| **Vena cava** | Large veins in the heart carrying deoxygenated blood from the body |
| **Ventral systole** | A stage in the cardiac cycle where the ventricular muscle force deoxygenated blood into pulmonary arteries |
| **Ventricle** | Bottom chambers of the heart |