B3.2

Transport (HL)

I. ANIMALS

A. MAMMALS

TWO body systems work together:

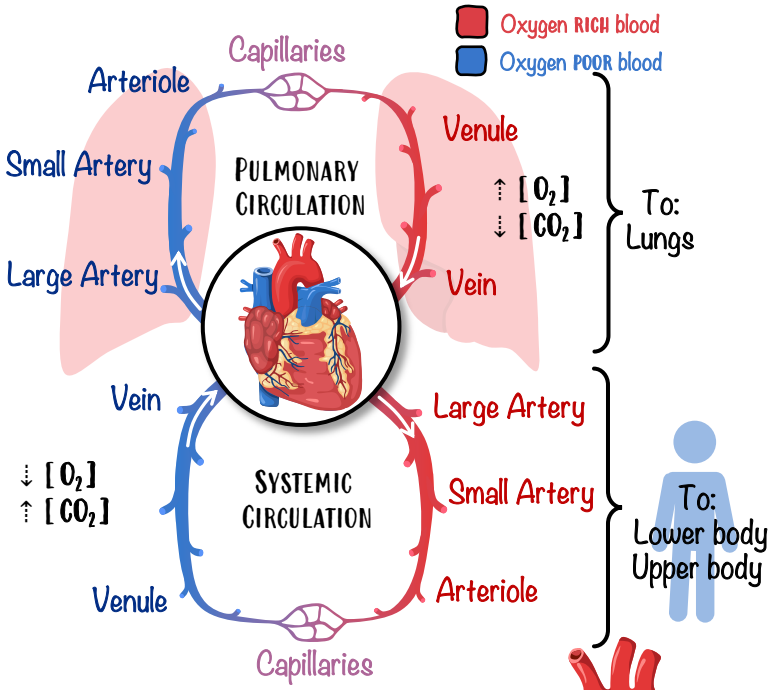
Respiratory System: Helps bring air into our body and into our blood stream.

Cardiovascular System: Helps us distribute the blood (containing nutrients & oxygen) to all cells of our body.

BIG BRAIN TIP!

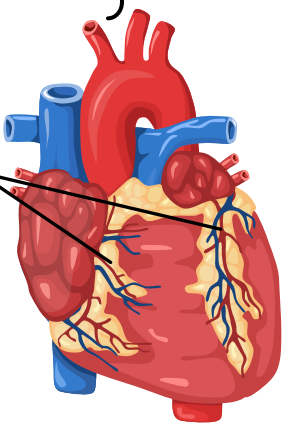
Arteries – Away from heart
Veins – ToVards the heart

The identification "artery" or "vein" is **NOT** based on the level of blood oxygenation in the blood so **NOT** color based.

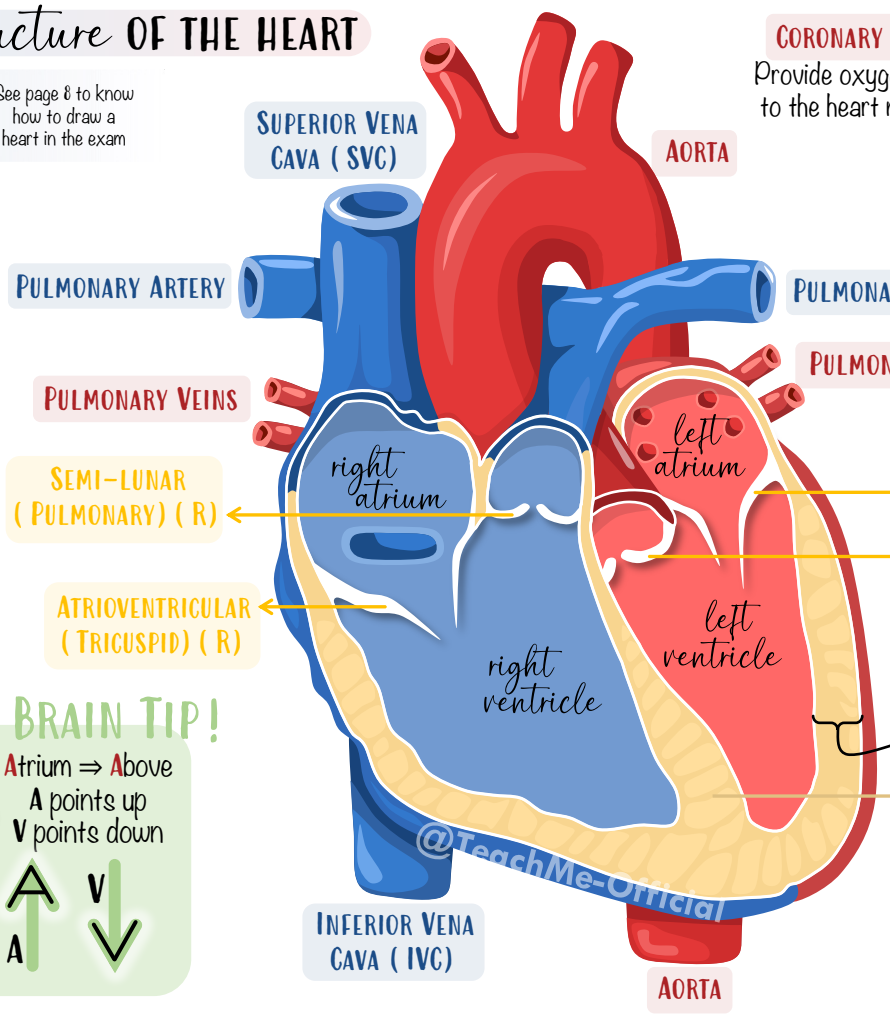


Structure OF THE HEART

See page 8 to know how to draw a heart in the exam



CORONARY ARTERIES
Provide oxygenated blood to the heart muscle itself



BIG BRAIN TIP!

Atrium ⇒ Above
A points up
V points down

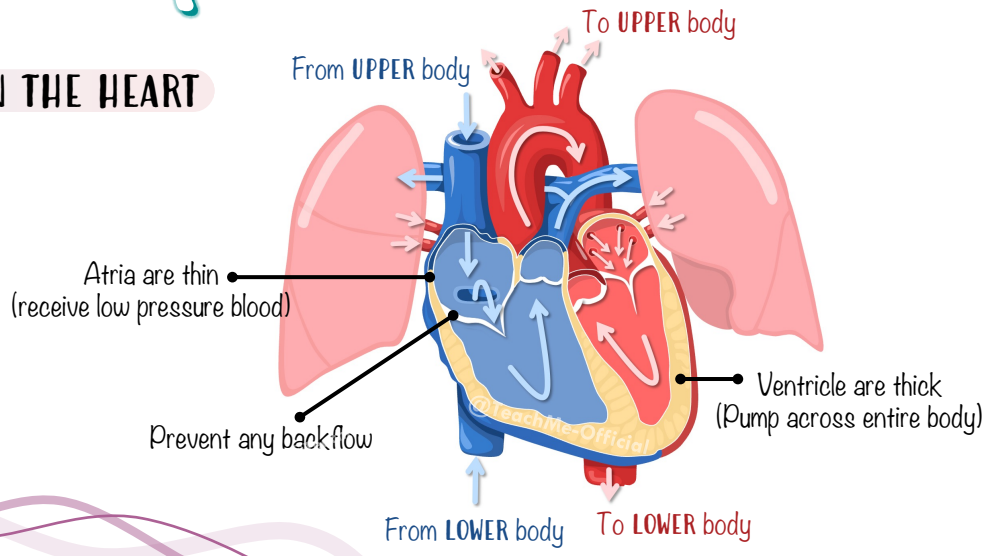
When looking at a diagram of the heart... why does it seem like the sides "RIGHT" and "LEFT" are inversed? Diagrams are made to represent a person facing you, not (you) the observer! Your right is therefore "left" on the diagram.

Transport (HL)

Blood flow WITHIN THE HEART

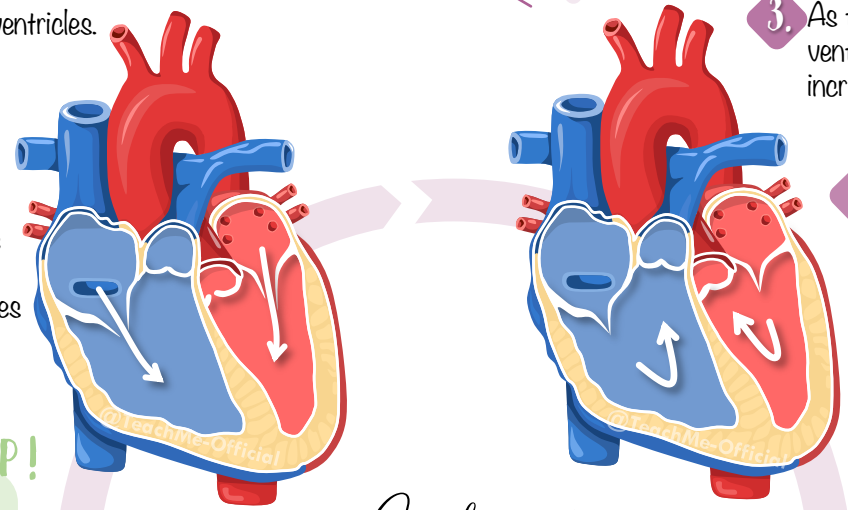
Try by yourself

DESCRIBE the flow of blood from the left ventricle all the way back to the left ventricle emphasizing on which structures are being passed *(heart chambers, valves, vessels and destination)*



The Cardiac Cycle

The sequence of the **HEART'S ACTIVITY** from the beginning of one heartbeat to the next.

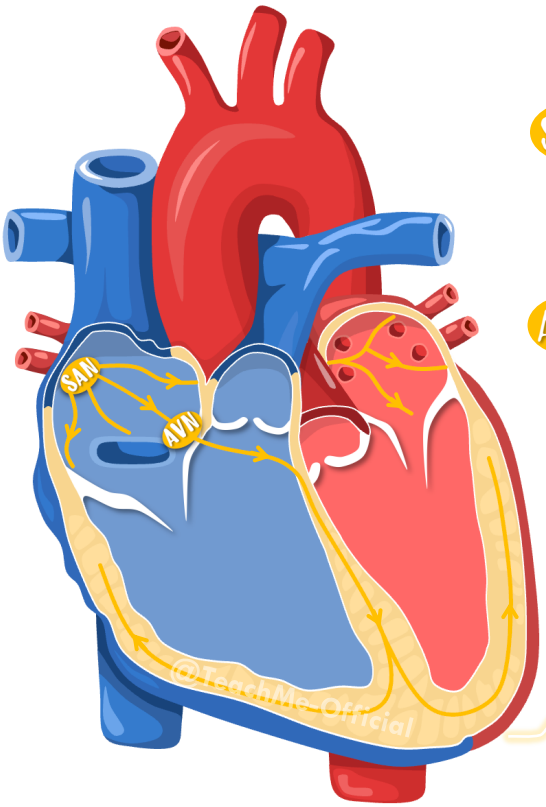


1. The muscles of the **ATRIA CONTRACT**, forcing the pressure to rise and the atrioventricular valves to **OPEN**.
2. Blood flows from the atria into the ventricles.
3. As the blood accumulates in the ventricles the pressure within it increases.
4. The muscles of the **VENTRICLES CONTRACT**, causing the pressure to rise even more.
5. The **ATRIOVENTRICULAR (AV) VALVES CLOSE**, preventing backflow to the atria.
6. Simultaneously the **SEMI-LUNAR VALVES OPEN** and blood flows gets pushed out from the ventricles into the aorta (if left side) or pulmonary artery (if right side).
7. Once most of the blood is ejected the pressure is low in the ventricles and so the **SEMI-LUNAR VALVES CLOSE** to prevent backflow of blood from aorta or pulmonary artery into the ventricles.
8. Both **VENTRICLES** and **ATRIA RELAX**.
9. Blood from the pulmonary vein and vena cava starts accumulating in the atria (left and right respectively) causing pressure to rise. Then cycle repeats from step 1.

BIG BRAIN TIP!

BOTH sides of the heart act at the same time during the cardiac cycle

Transport (HL)



The Control of the Heart Beat

SAN SinoAtrial Node

A group of modified cardiac muscles located in the thin muscle wall of the right atrium that can generate **SPONTANEOUS** electrical impulse to start each heartbeat (myogenic).

AVN AtrioVentricular Node

Located in the right atrium, in the septum between the right and left atria.

ACTION POTENTIALS are sent from the SA node (SAN) and result in the almost instantaneous contraction of the atrias. These action potentials also reach the AV node (AVN) but this node **DELAYS** by **0.1** seconds the impulse before sending out the action potentials to the ventricles and causing them to contract. This mechanism ensure that both atrias contract **BEFORE** the ventricles.

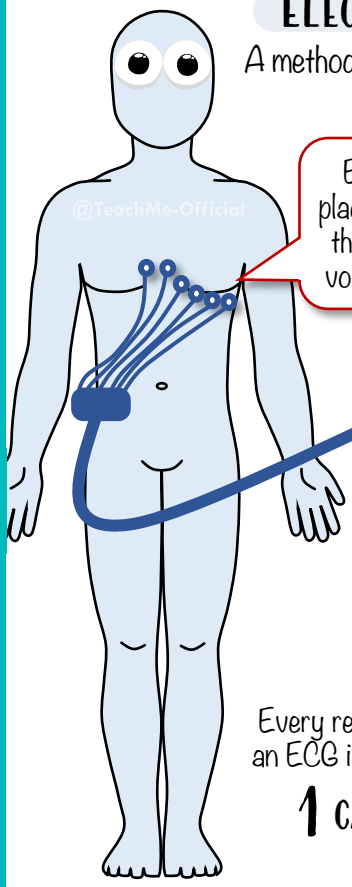
Ensures blood flows in **ONE** direction!

Did you know?

Signals from the brain can be sent to the SA node to speed up or slow down the heart rate.

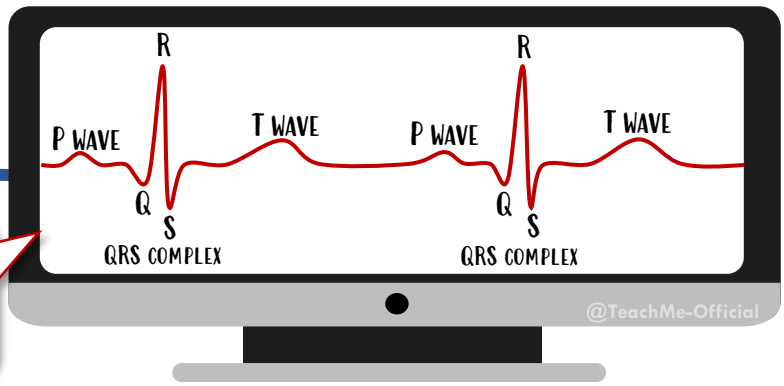
Electrocardiogram (ECG / EKG)

A method to visualise the electrical activity of the heart in real time



Electrical leads (cords) are placed in a variety of places on the skin to measure the small voltage given off by the heart.

A graph plotted in real time, showing the electrical activity of the heart (y-axis) with time (x-axis).



How to read it?

Every repeating pattern on an ECG is representation of **1 CARDIAC CYCLE**

- **P wave** – the voltage given off by the SA node: **ATRIAL SYSTOLE.**
- **Point Q** – point when the AV node sends its impulse.
- **QRS complex** – the impulse from the AV node speads down the conducting fibres in the interventricular septum and out to the cardiac muscle of the ventricles: **VENTRICULAR SYSTOLE.**
- **T wave** – the AV repolarizes in preparation to send the next electrical impulse.

Transport (HL)

Blood Pressure Measurement

Blood pressure (pressure inside the arteries) is measured using a machine with a cuff around the arm.

120 / 80 mmHg

- **Systolic blood pressure** (active period of the ventricles)
- **Diastolic blood pressure** (rest period of the ventricles)
- **Millimeters of mercury** (the units)

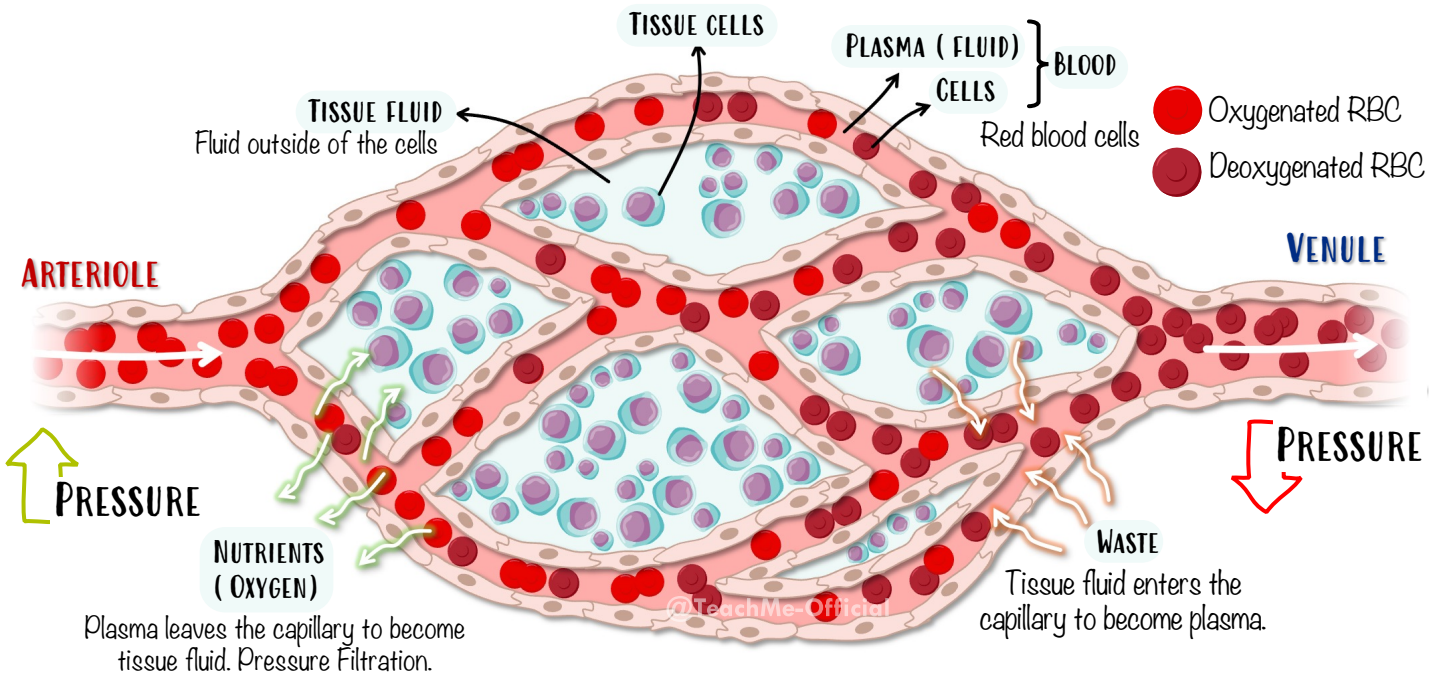
You may have seen blood pressure as:

Systole - A name given to the active process (contraction) of a chamber

Diastole - A name given to the inactive process (resting) of a chamber

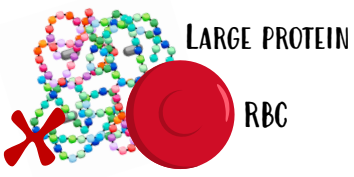
Capillaries

Capillary Bed = A collection of capillaries (a lot of branching)



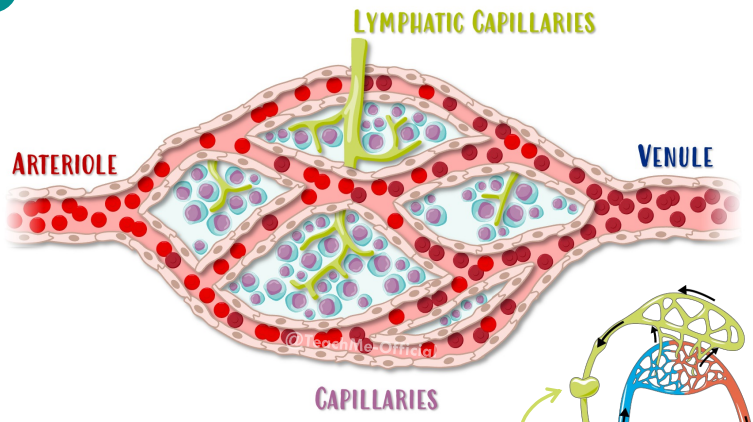
- **Structure** – Very thin and permeable.
- **Purpose** – Site of nutrient exchange.

Red blood cells (RBC) & large proteins do **NOT** exit the capillaries, because they are too large to exit through the capillary walls. White blood cells (WBC) can exit at certain times, such as during an infection



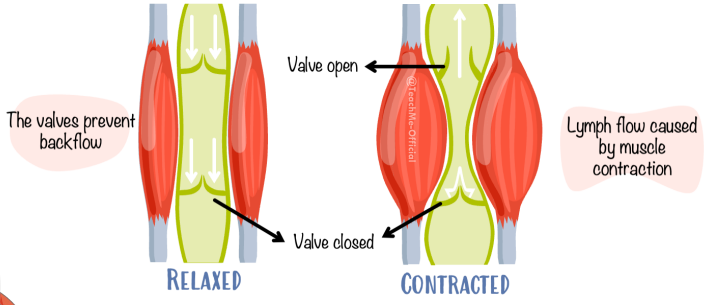
Transport (HL)

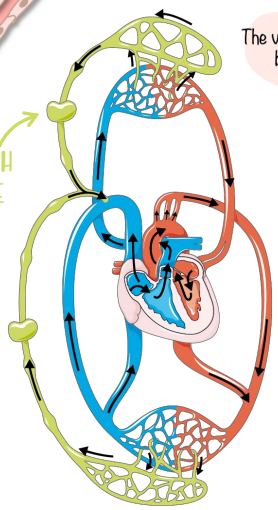
Lymphatic System



Purpose – Remove excess fluid (lymph) from tissues into lymphatic capillaries. Also forms part of the Immune system.

Lymphatic vessels contain **valves** just like veins to prevent backflow:





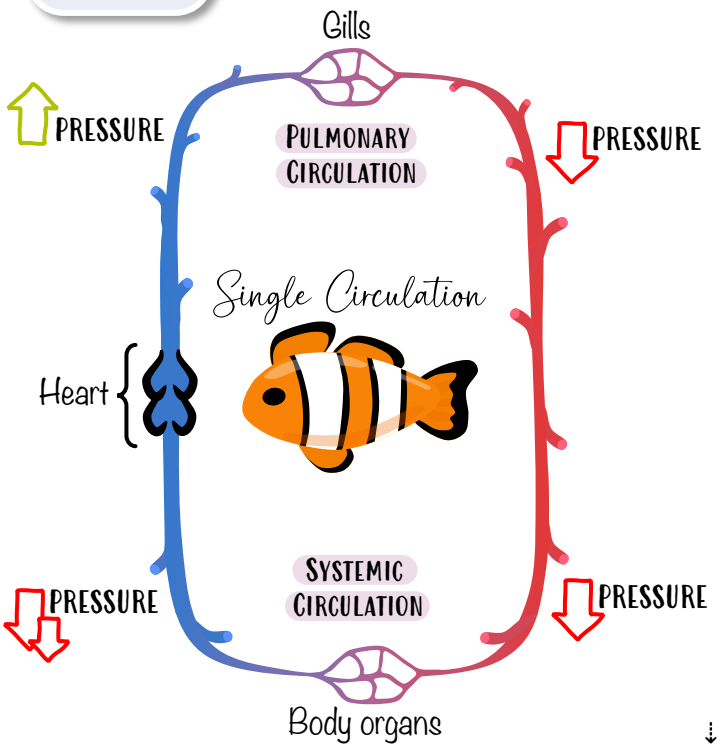
Process –

- Excess fluid drains into lymphatic capillaries.
- Join to form large lymph ducts.
- Pass through lymph nodes on the way, which filter bacteria, virus, cancer cells etc....
- Eventually returning to the veins.

Lymphoedema is a severe swelling of body tissues, usually in the arms or legs, as a result of the accumulation of tissues fluids that normally drain into the lymphatic system.

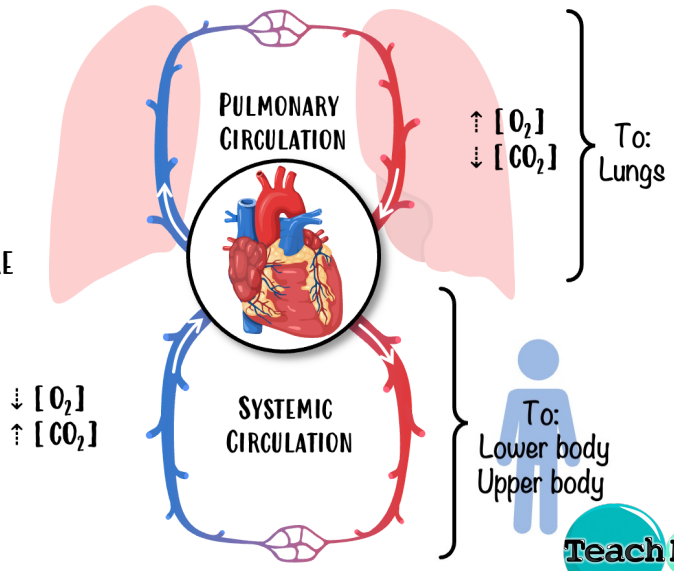
- Disease example: **Elephantiasis**

B. Fish



Limitation of this circulatory pattern –
There is a significant loss in blood pressure when the blood passes through the capillaries of the gills, causing the pressure entering the systemic circulation to be low.

However, as fish are not exposed to a strong gravitational pull as they would if they were terrestrial (like humans for example), they do not need such high blood pressure to overcome gravity.



Big Brain Tip!

Notice the differences between the fish's single circulation and the mammal's dual circulation

Transport (HL)

II. Plants

How are nutrients moved within a plant?

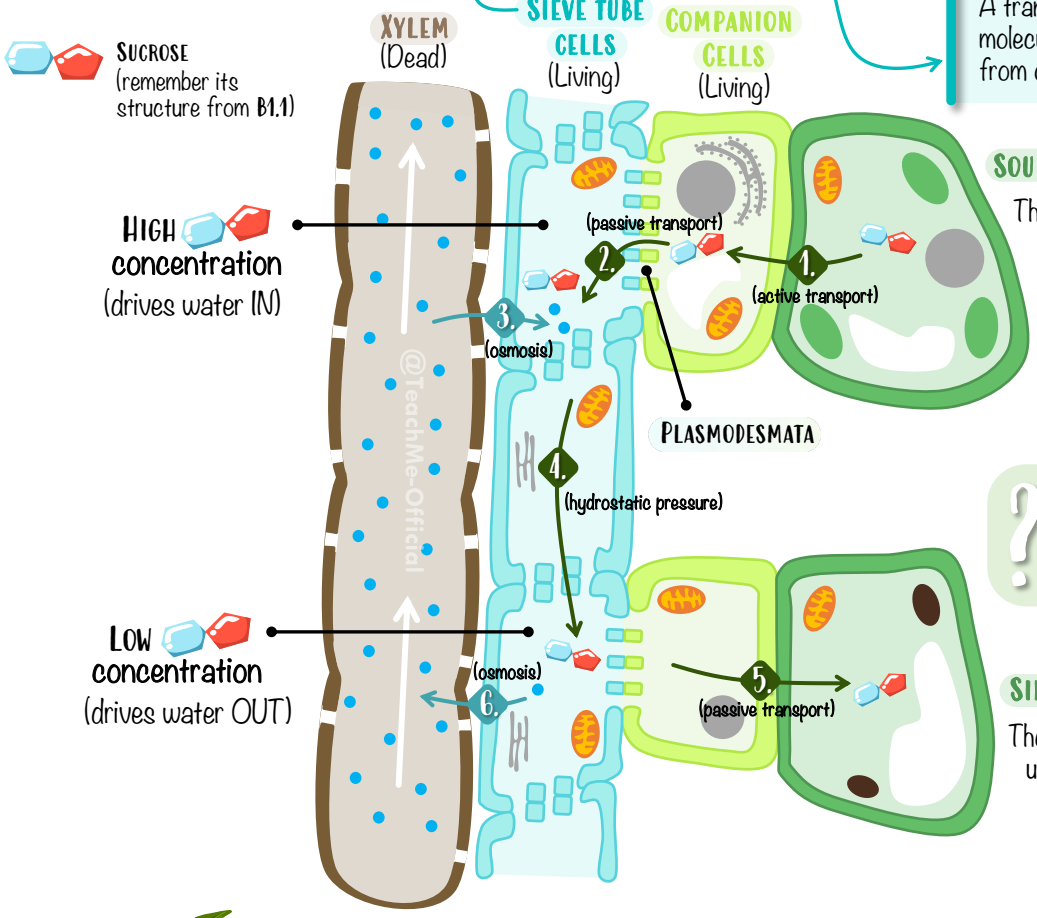
Translocation

"The movement of **organic** molecules (called sap) through the phloem tissue (sieve tube elements) of plants"

Sieve tube cells do not have nucleus and many organelles: they depend on **companion cell**'s metabolic activities

Phloem

A transporting pipe for **organic** molecules (E.g. Sucrose) of the plant from one place to another.



Source

The cell where there is a net production of sugar (by photosynthesis)

Sink

The cell that wants to use or store sugar

Big Brain Tip!

Some structures can be both a source and a sink therefore the flow is **bidirectional** in the **phloem**

Phloem Translocation Process

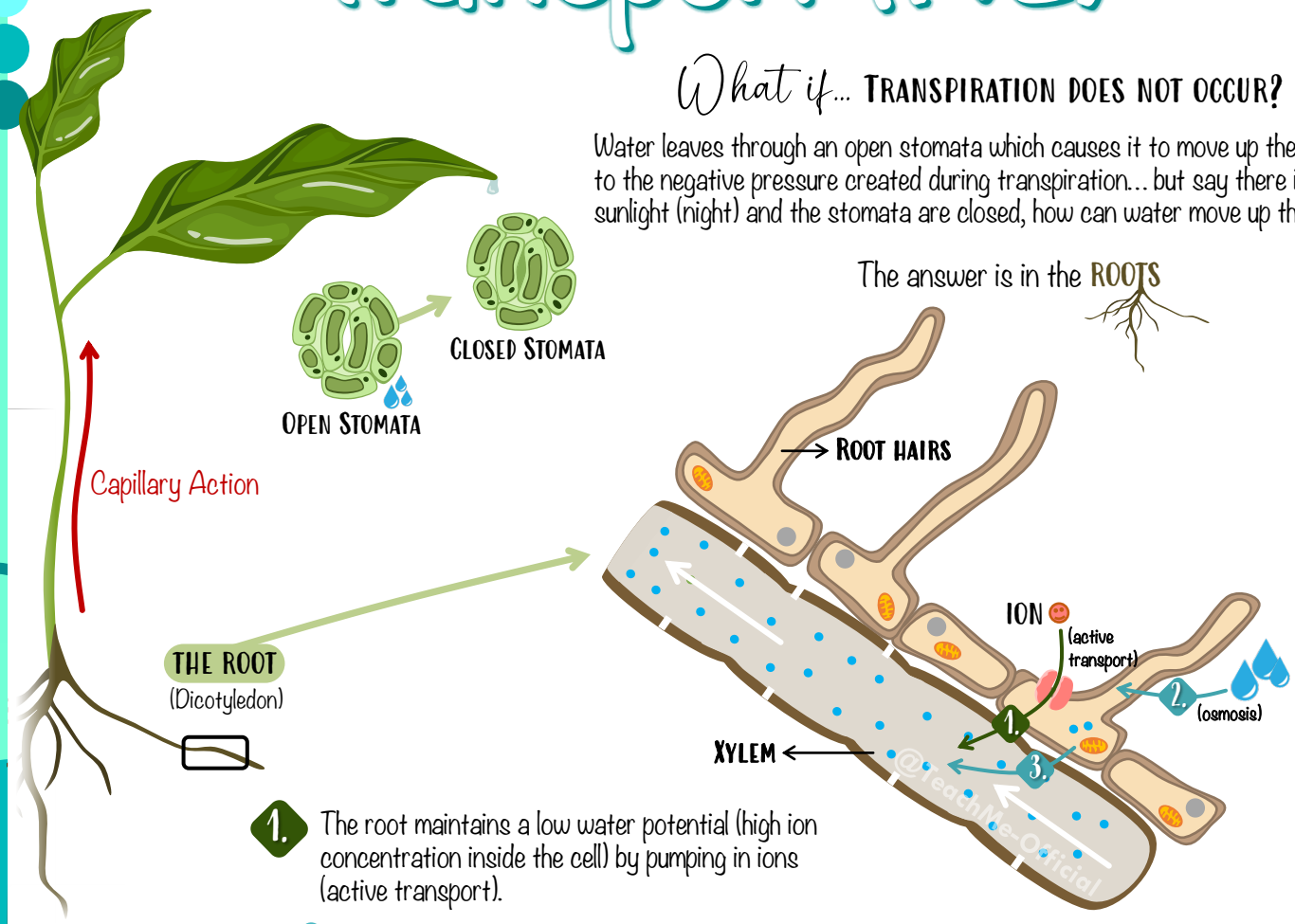
1. The **source** cell makes lots of organic molecules such as sucrose, which is transported to the adjacent **companion cell** (Active Transport).
2. The sucrose is then transported (Passive Transport) through the **plasmodesmata** to the **sieve tube elements**.
3. Here the sucrose concentration is very high, and water potential is low, stimulating **osmosis** from the xylem into the sieve tube elements.
4. Water influx causes high hydrostatic pressure, which pushes the sucrose down the sieve tube elements to the **sink**.
5. The sink cell has low sucrose concentration. This creates a gradient for diffusion of sucrose to happen into sink cell.
6. In this portion of the sieve tube elements, the water potential is higher (low sucrose) leading to osmosis in from the sieve tube into the xylem.

Transport (HL)

What if... Transpiration does not occur?

Water leaves through an open stomata which causes it to move up the xylem due to the negative pressure created during transpiration... but say there is no sunlight (night) and the stomata are closed, how can water move up the xylem?

The answer is in the **ROOTS**



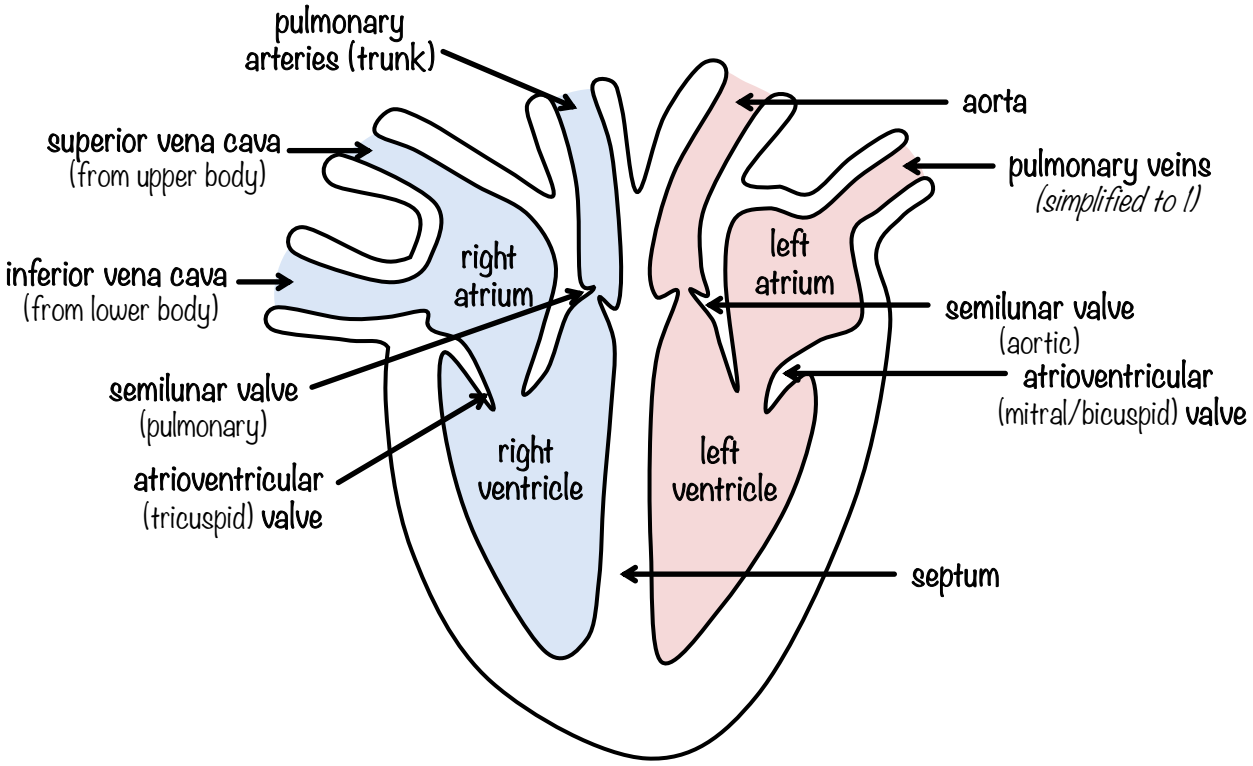
1. The root maintains a low water potential (high ion concentration inside the cell) by pumping in ions (active transport).
2. The low water potential drives the movement of water via osmosis into the cell (following the ions).
3. The water influx pushes water up the root and stem (through the xylem).

	Xylem	vs.	Phloem
Made of...	Dead (non-living) Cells		Living cells
Transports...	Water & Minerals		Food (organic things)
Carried to...	Leaves from root		Sink from source
Direction...	Upwards (Unidirectional)		Up and down (Bidirectional)

Transport (HL)

Example drawing of heart for exam

If asked to draw a heart and it's structures during the exam, you don't need artistic skills in order to earn full marks!



* For this drawing, the aorta and pulmonary artery don't need to cross like they do in reality. But make sure the ventricles are thicker than the atria.

notes