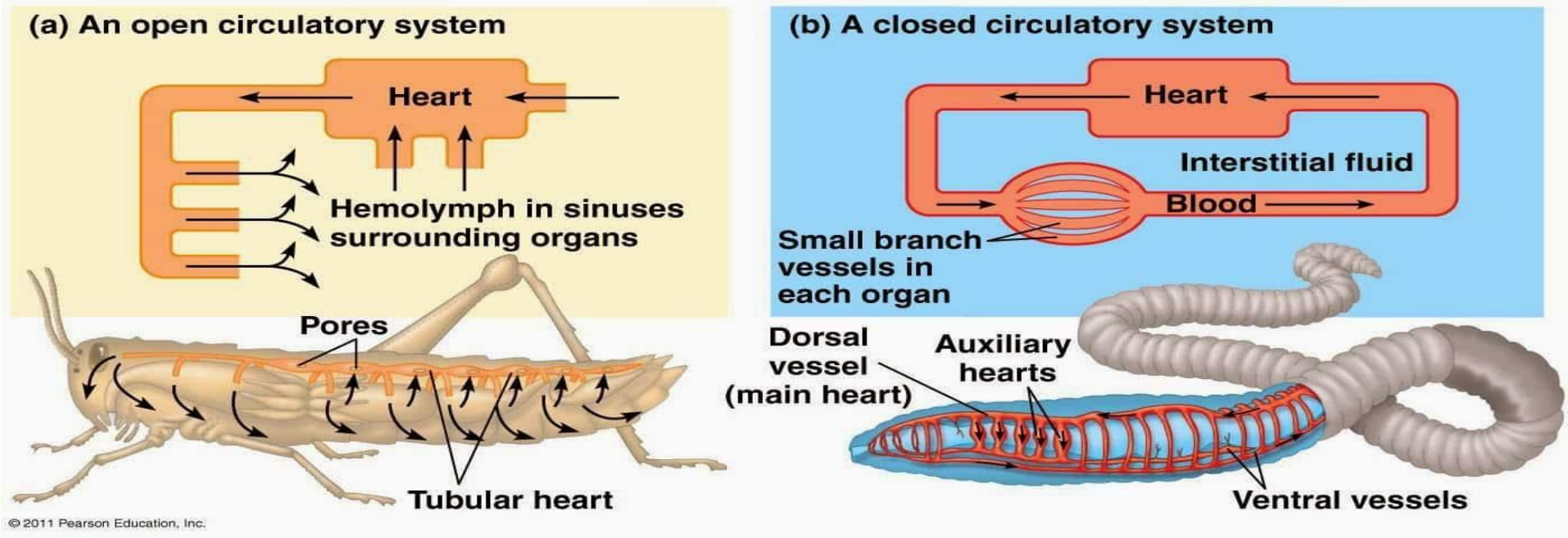
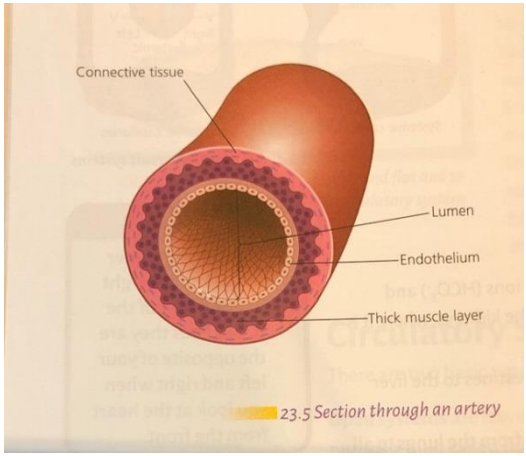
THE CIRCULATORY SYSTEM

All larger organisms require a transport (vascular) system to bring food and oxygen to the cells and to remove waste.

Humans have a **closed circulatory system**-blood circulates inside closed vessels (insects have a open system – open ended vessels). Blood can travel much faster in a closed system



Blood Vessels
3 types



- **1) Arteries**

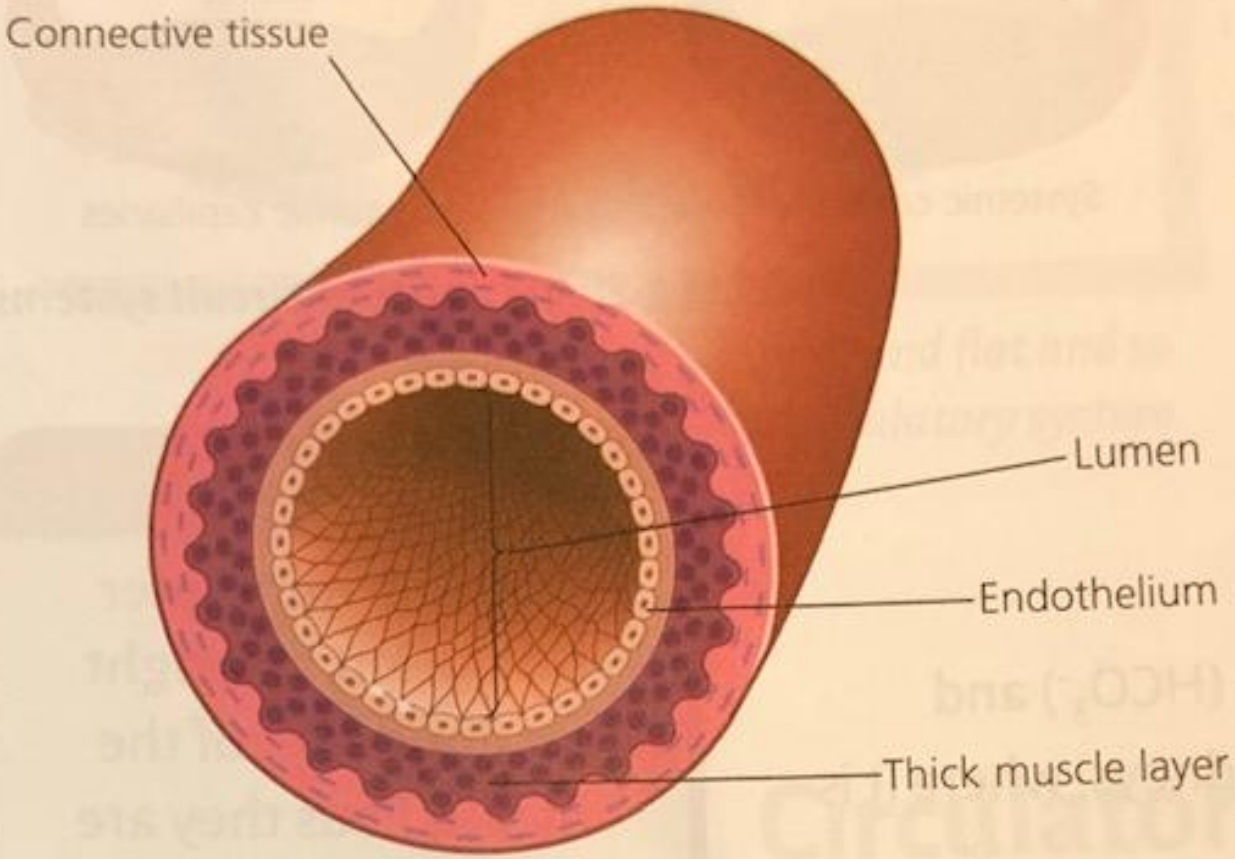
- Brings blood Away from heart under high pressure

-Have **no valves** to stop backflow

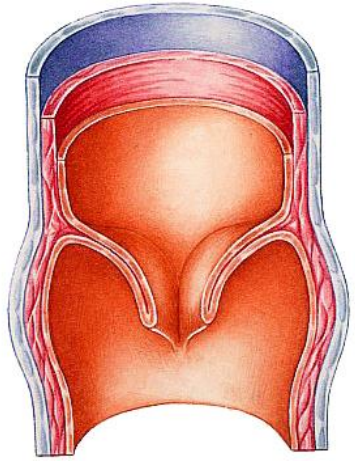
-**Thick walls** to cope with high pressure

-**Narrow lumen** (space inside)

-Arteries carry oxygenated blood (except pulmonary artery)

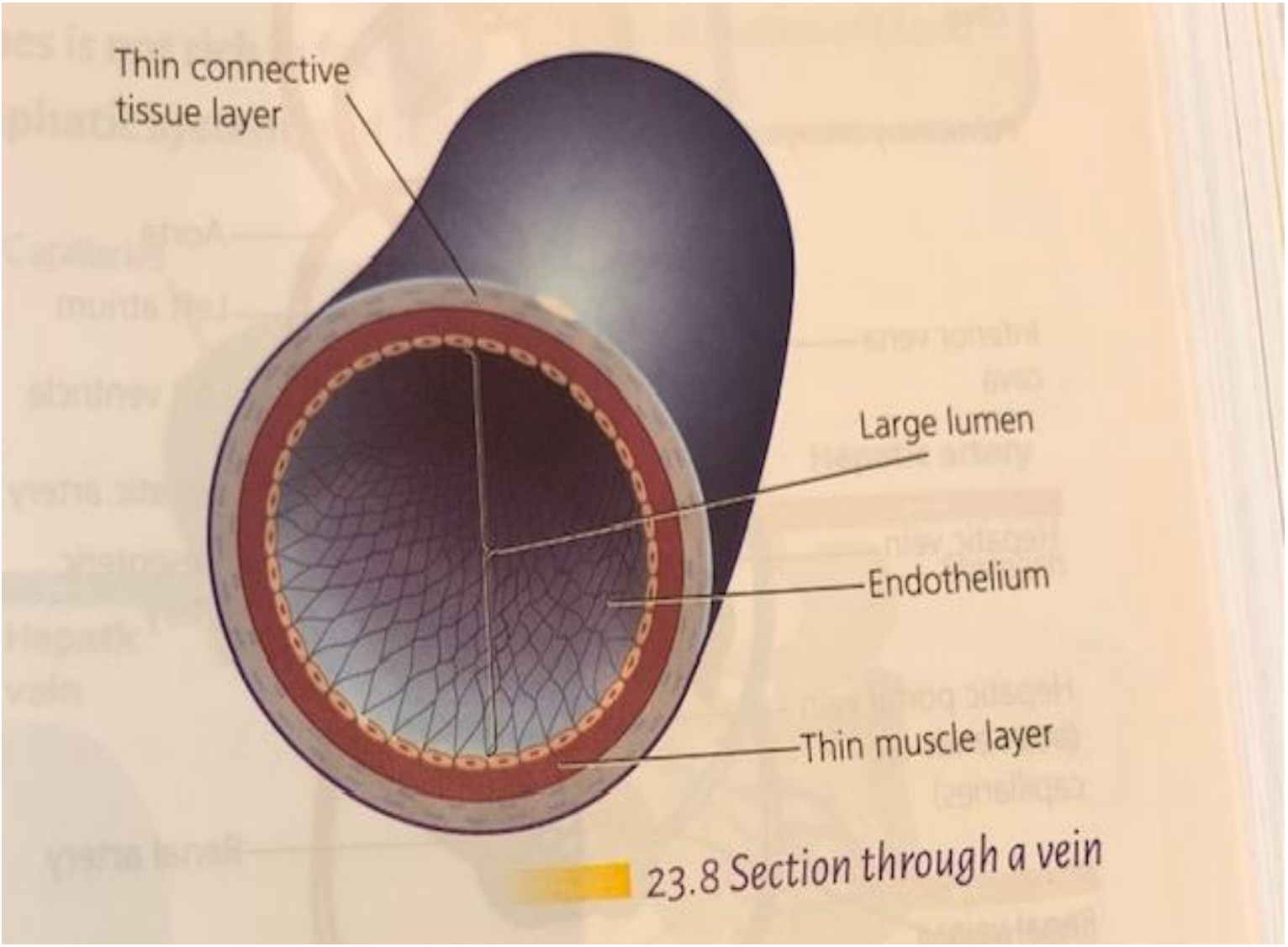


23.5 Section through an artery



- **Veins**

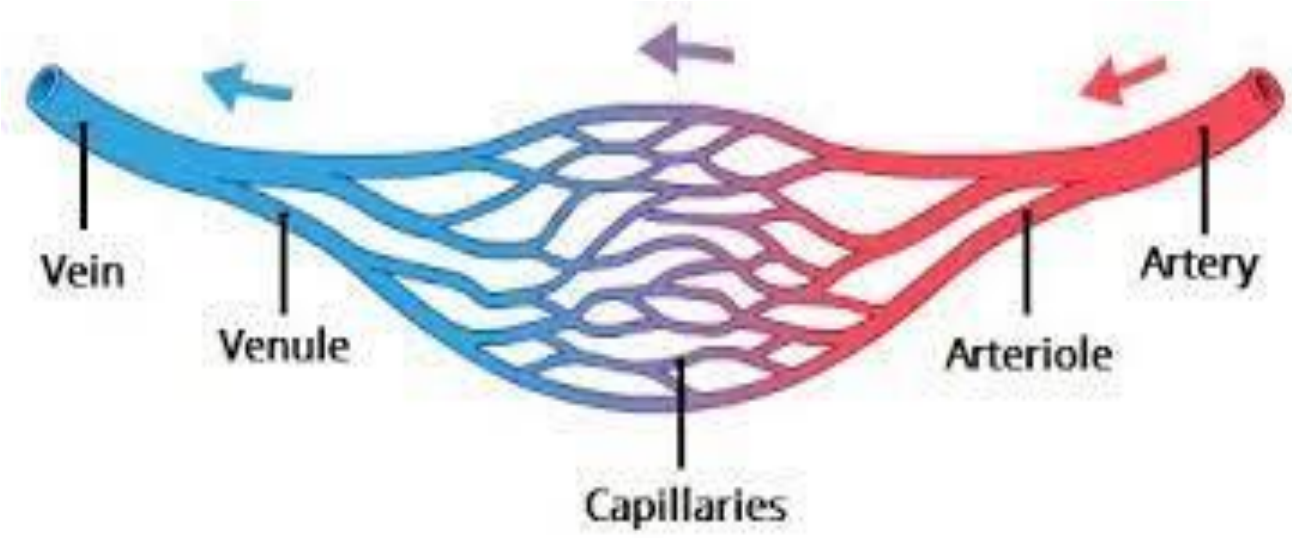
- Bring blood to heart under lower pressure
- Veins have Valves to prevent backflow of blood
- Veins have thinner walls
- Veins have a large lumen (space inside)
- Veins carry deoxygenated blood (except for pulmonary vein)



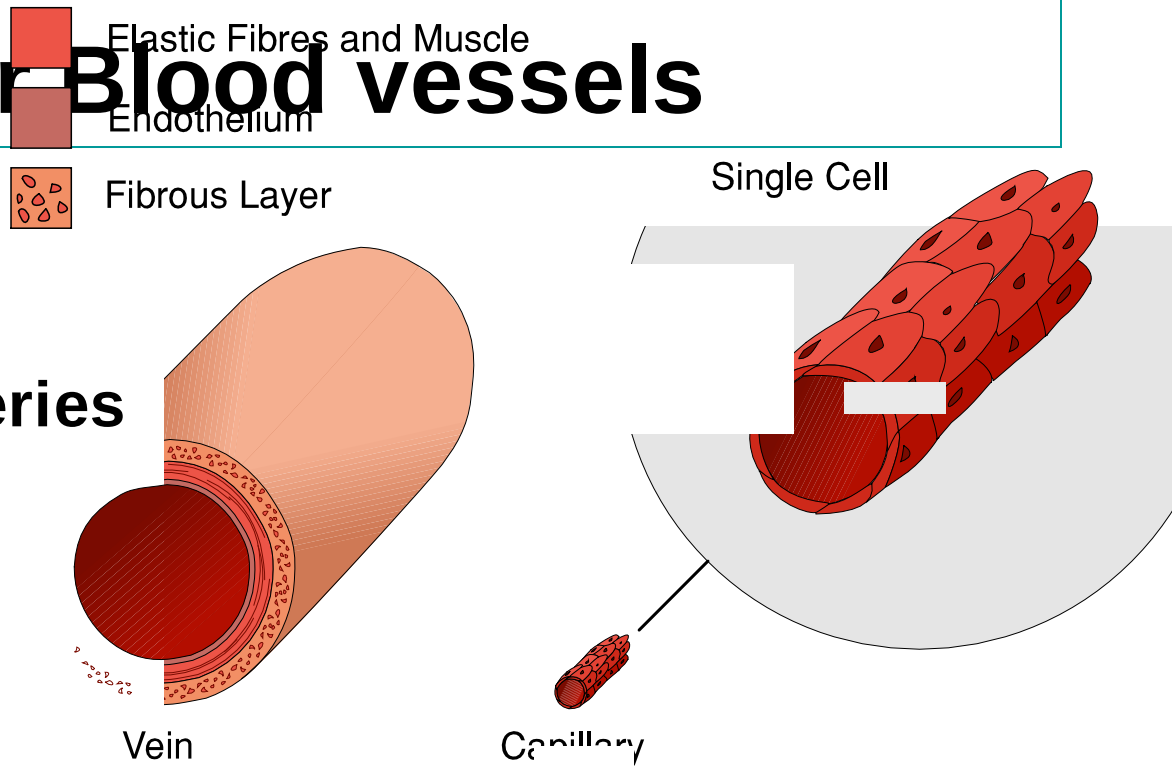
23.8 Section through a vein

Capillaries

- Thin walls-1 cell thick
- Tiny blood vessels
- They allow materials to be exchanged between the blood and cells-ex –oxygen



Smaller Blood vessels



Arterioles

Arterioles connect arteries and capillaries

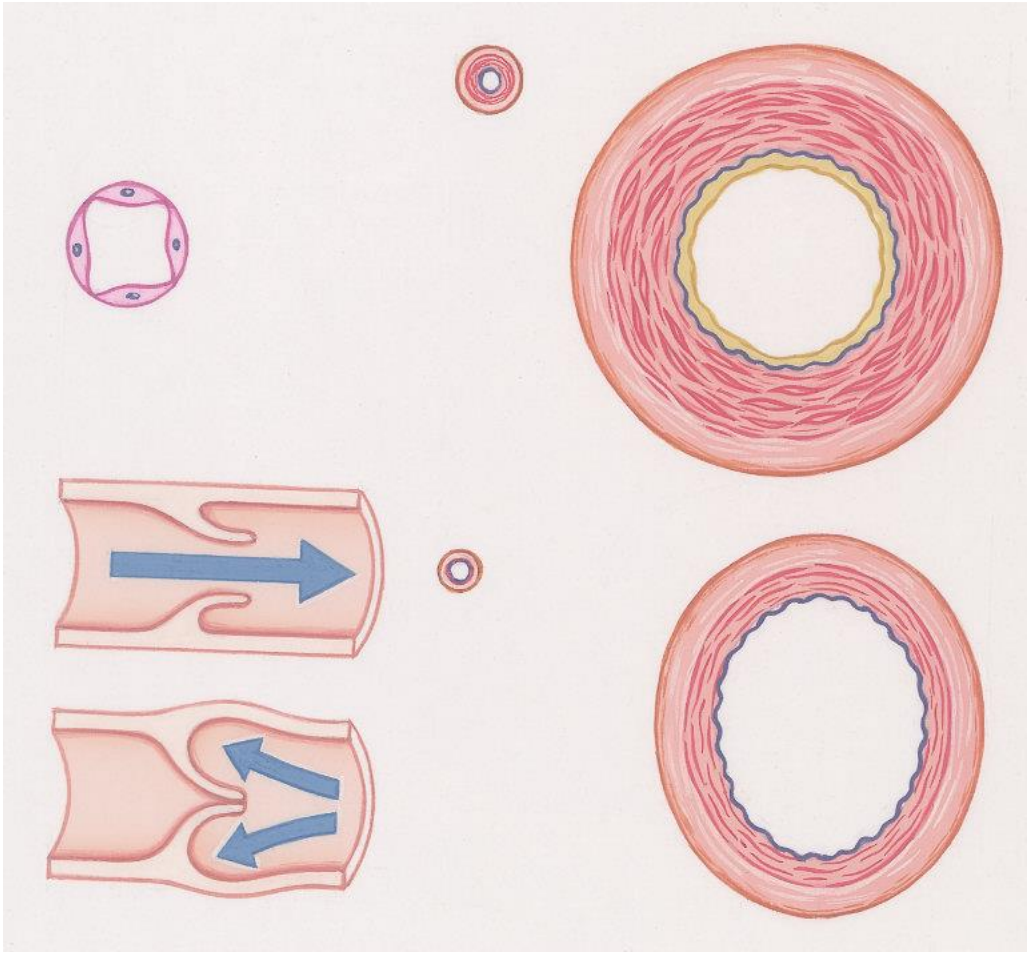
Venules

venules connect capillaries to the veins

Capillaries

Tiny blood vessels linking arterioles and venules

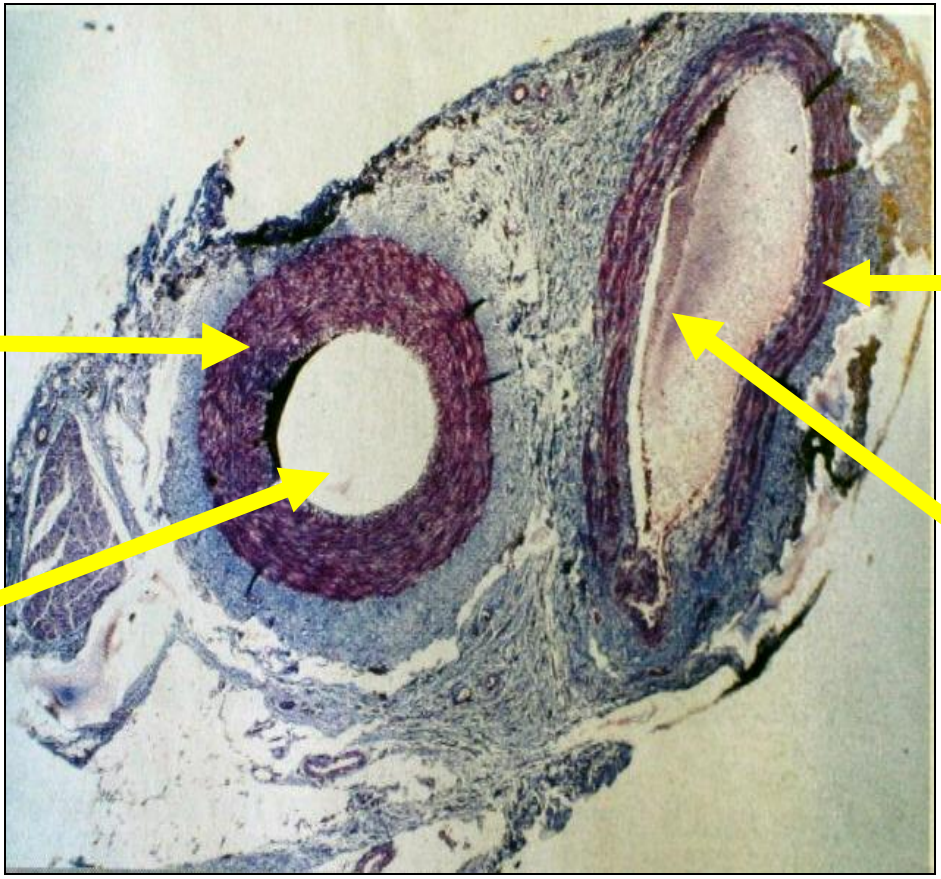
Comparison of vessels



Blood vessels under the microscope

Arteries

Veins



Thick Wall

Thin Wall

Narrow lumen

Wide lume

Learning check

Give three differences between arteries and veins

What is the function of valves in veins

Name the blood vessels that connect capillaries

Give one advantage of a closed circulation system

Blood

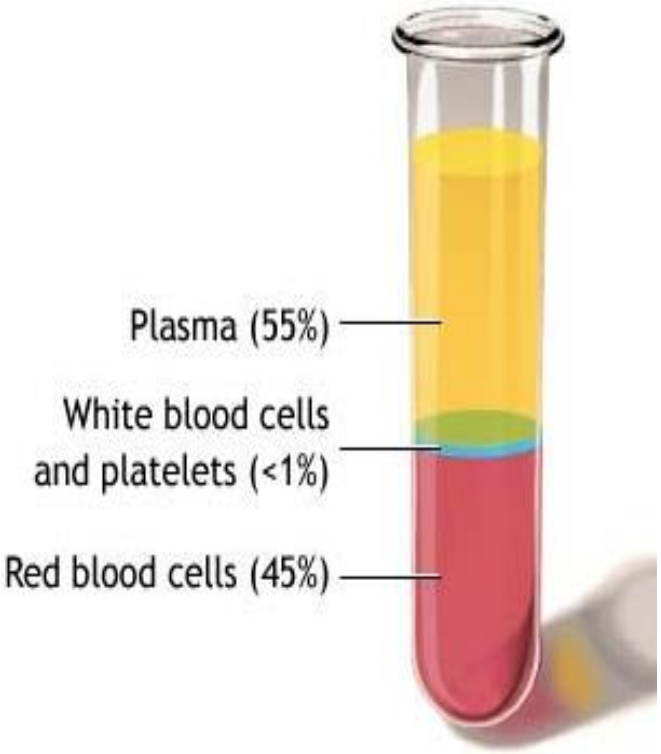
- 55% liquid called plasma (yellow in colour).
- 45% cellular components

- Three functions of blood

1-Transport

2-Temperature Regulation

3 – Defence against disease



Blood is made up of 4 parts

1) Plasma 2)Red blood Cells 3) White Blood Cells 4) Platelets

Plasma

- Transport of substances such as glucose, amino acids vitamins
- Helps keep body at optimum body temperature by transferring heat

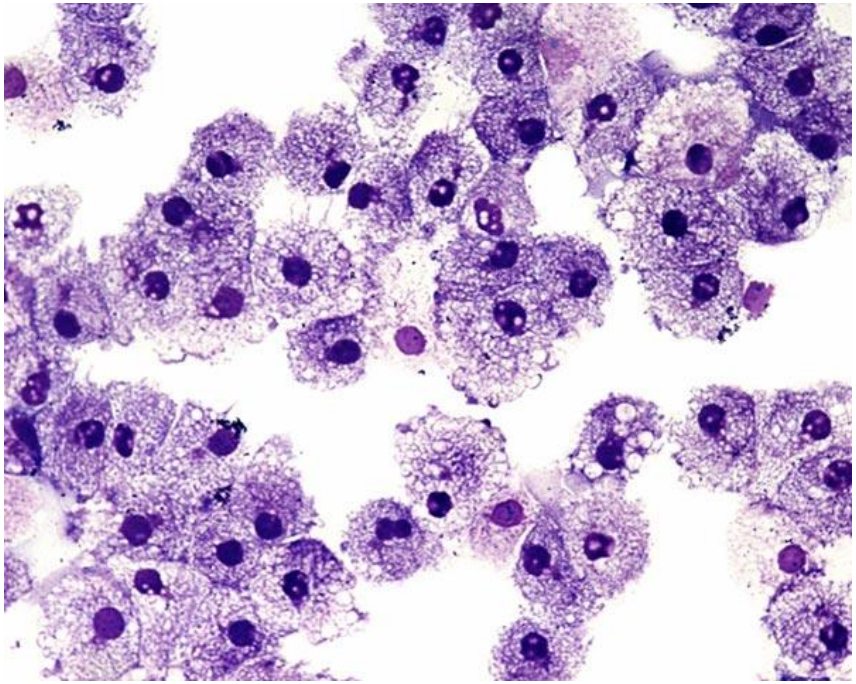
Red Blood Cells (rbc)

- Biconcave Discs
- No nucleus
- No mitochondria
- Flexible membrane
- Made continuously in red bone marrow of ribs and sternum

- Contain the red coloured iron containing hemoglobin which carry oxygen
- Anaemia-disease where blood lacks enough red blood cells to carry oxygen efficiently causing excess tiredness,
- Caused by lack of iron in diet , can also be a genetic disorder

White Blood Cells (wbc)

- Larger and less of them than red blood cells
- Have a nucleus
- Protect body against disease



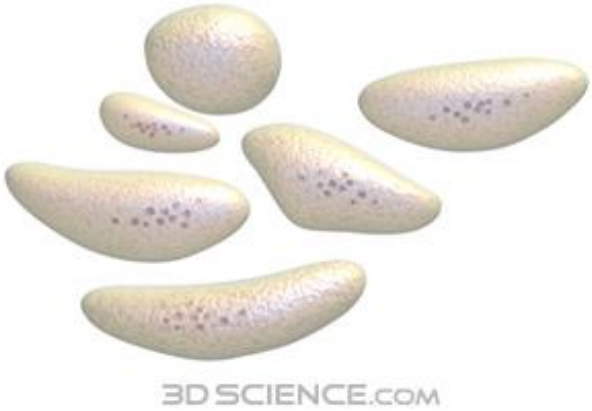
2 Types

1-Monocytes-Engulf bacteria by phagocytosis

2- Lymphocytes-Made in lymphatic system. They form antibodies, which are chemicals used to kill bacteria and viruses (More of these)

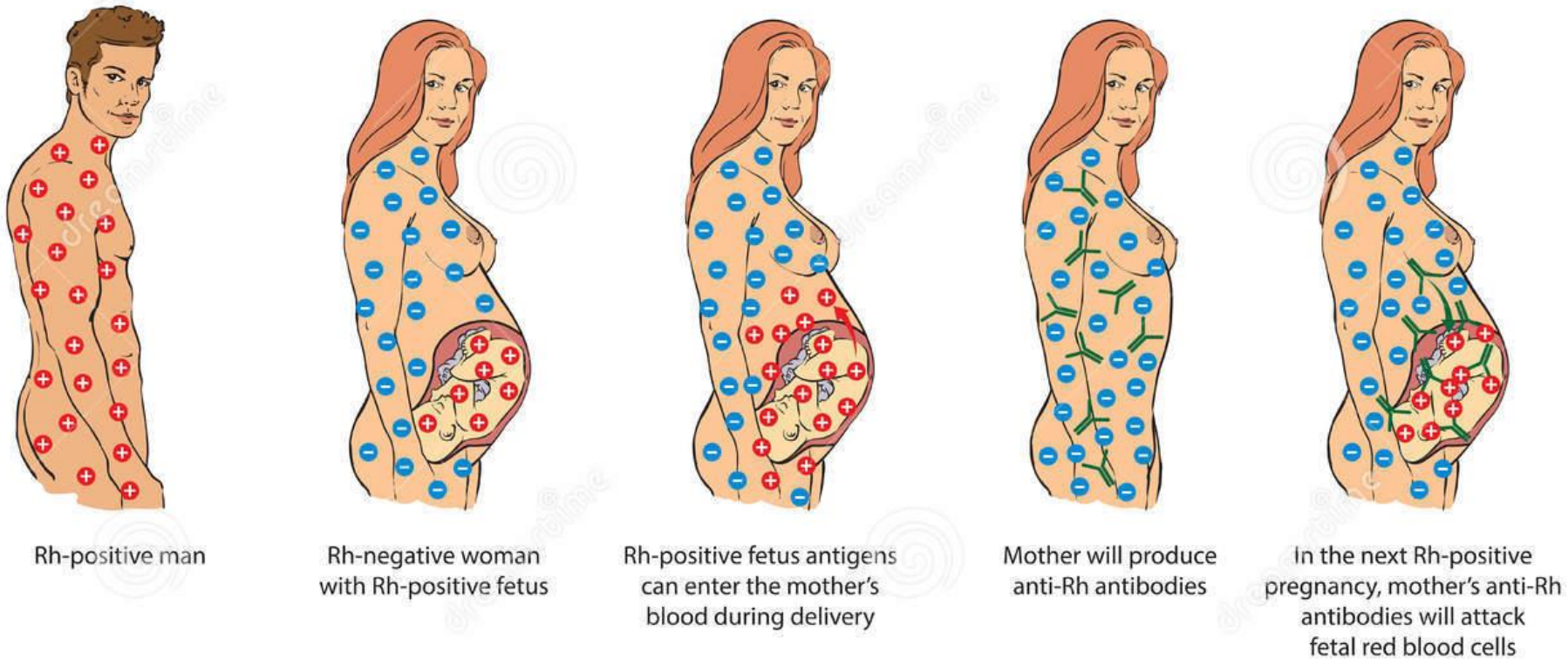
Platelets

- Fragments of larger cells formed in bone marrow.
- Important role in clotting the Blood



Blood Grouping Systems

1. ABO system – there are 4 blood groups: A, B, AB and O. O is the universal donor and AB is the universal recipient.
2. Rhesus system – humans are rhesus positive or rhesus negative. If a baby is Rh+ and its mother is Rh- it can cause complications during pregnancy and childbirth.



Anti D –injection which removes babys Rh + blood that has entered mothers system

Learning check

1. List four ways, other than colour, in which red blood cells are different from ordinary body cells

2. Name the chemical in red blood cells that has a high affinity for oxygen

3. Name two types of white blood cells and give the function of each type

Double circulation in humans:

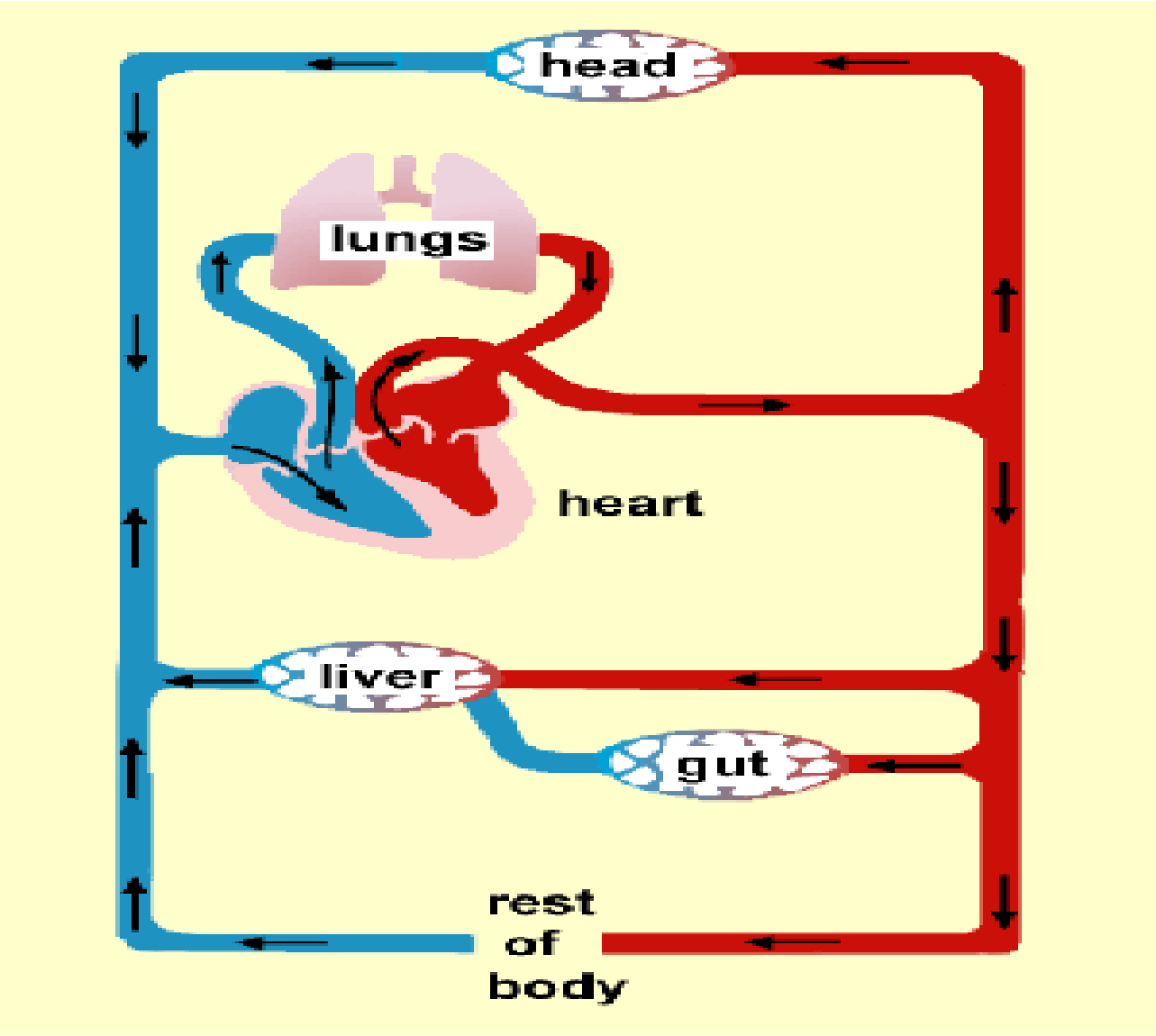
- The human circulatory system is a two-circuit system:
  - **Pulmonary circuit**

  Heart-lungs-back to heart

  - **Systemic circuit**

  Heart-to body-back to heart

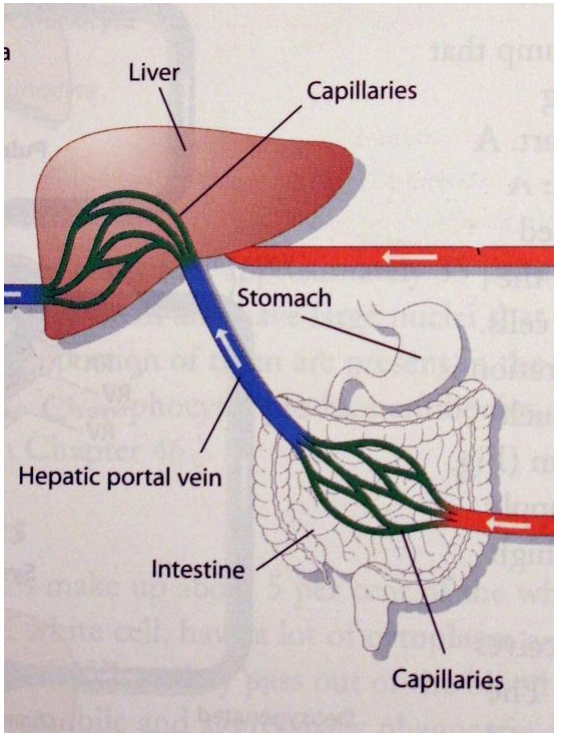
Double Circulation



Portal systems

- A portal system carries blood directly from one organ to another without going through the heart.

  E.g. Hepatic Portal System



Learning check

Name the blood vessel that connects the digestive system

Distinguish between the systemic the pulmonary blood circuits

Give one advantage of a double circulation system

The Heart

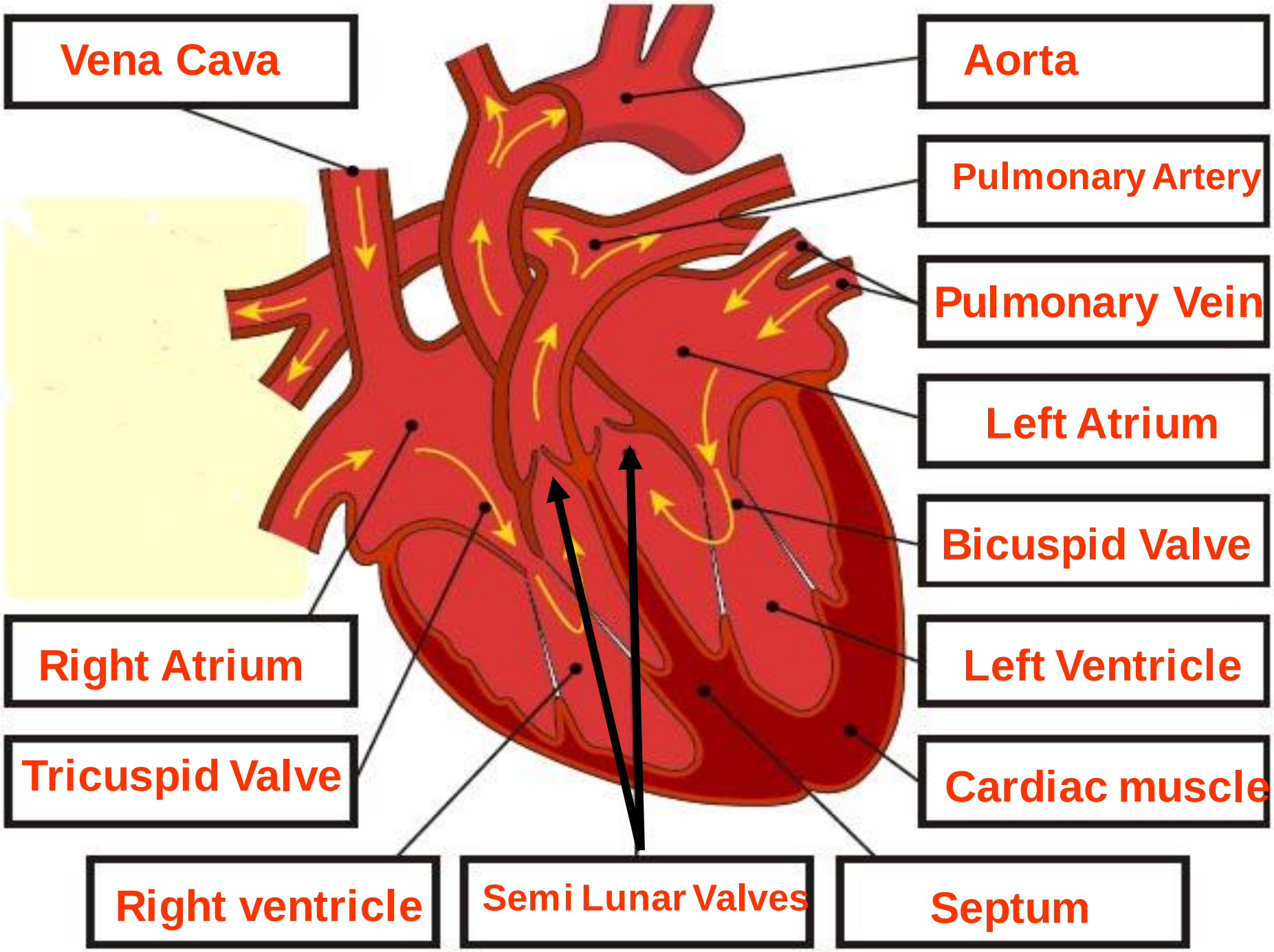
Location	Between the lungs, slightly to the left side of the thorax, above the diaphragm
Function	To pump blood around the body (has its own blood supply through coronary artery)
Structure	A hollow structure made of cardiac muscle, surrounded by a double membrane

Role of Heart Muscle

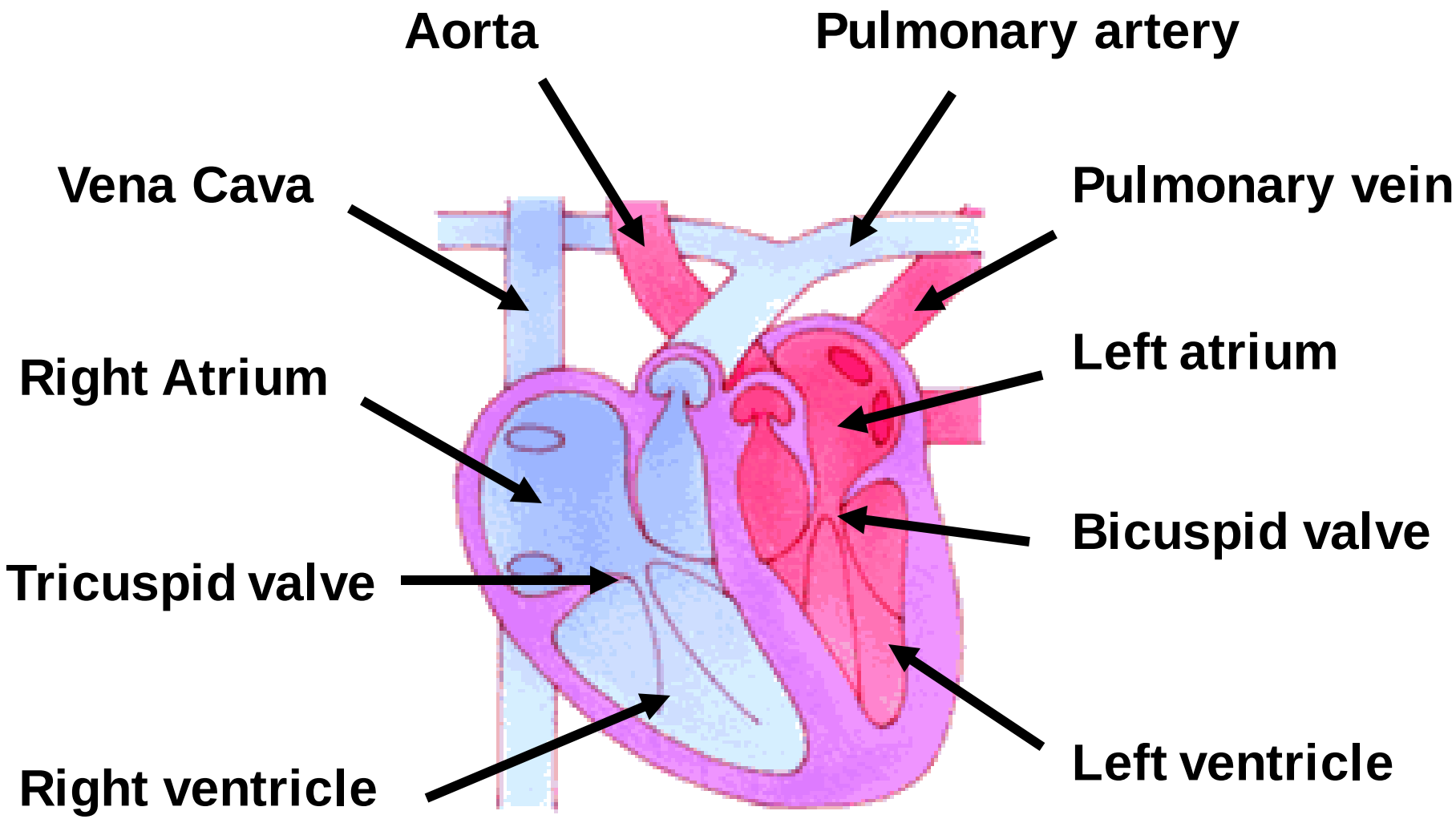
The heart wall is made of Cardiac Muscle

Contraction of the cardiac muscle drives blood around the body

Cardiac Muscle does not fatigue (tire easily)


Vena Cava
Aorta
Pulmonary Artery
Pulmonary Vein
Left Atrium
Bicuspid Valve
Left Ventricle
Cardiac muscle
Septum
Semi Lunar Valves
Right ventricle
Tricuspid Valve
Right Atrium

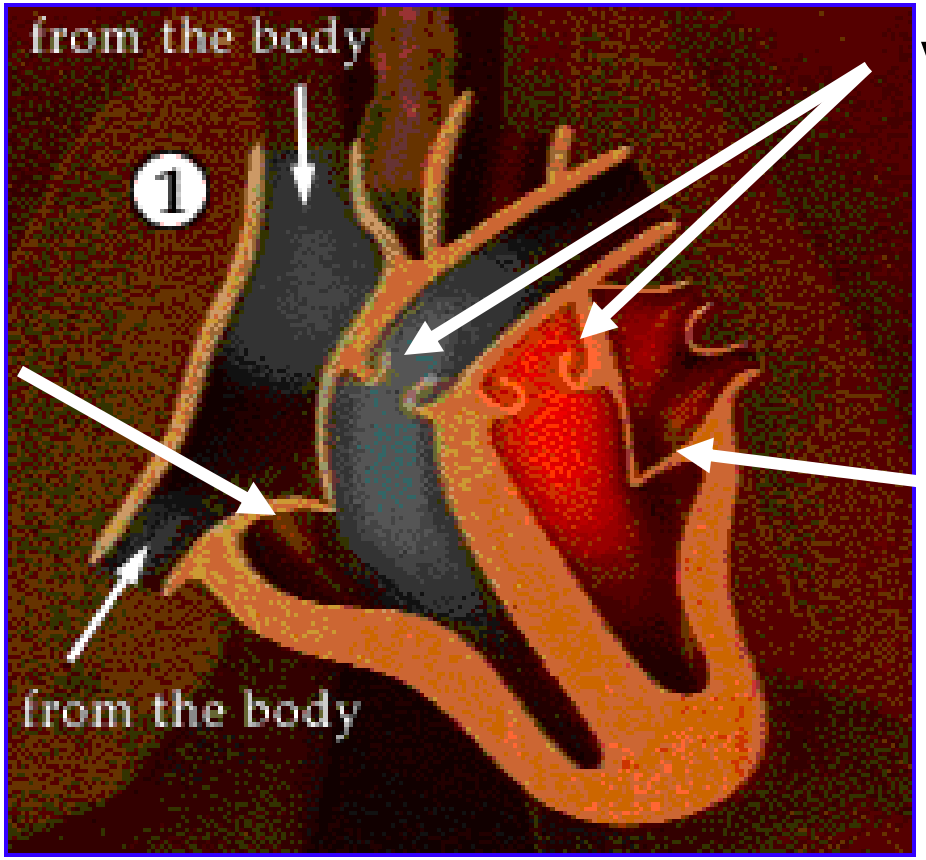
Blood pathway through heart



Role of Valves

Semi Lunar valves

Prevent backflow into heart



Tricuspid valve

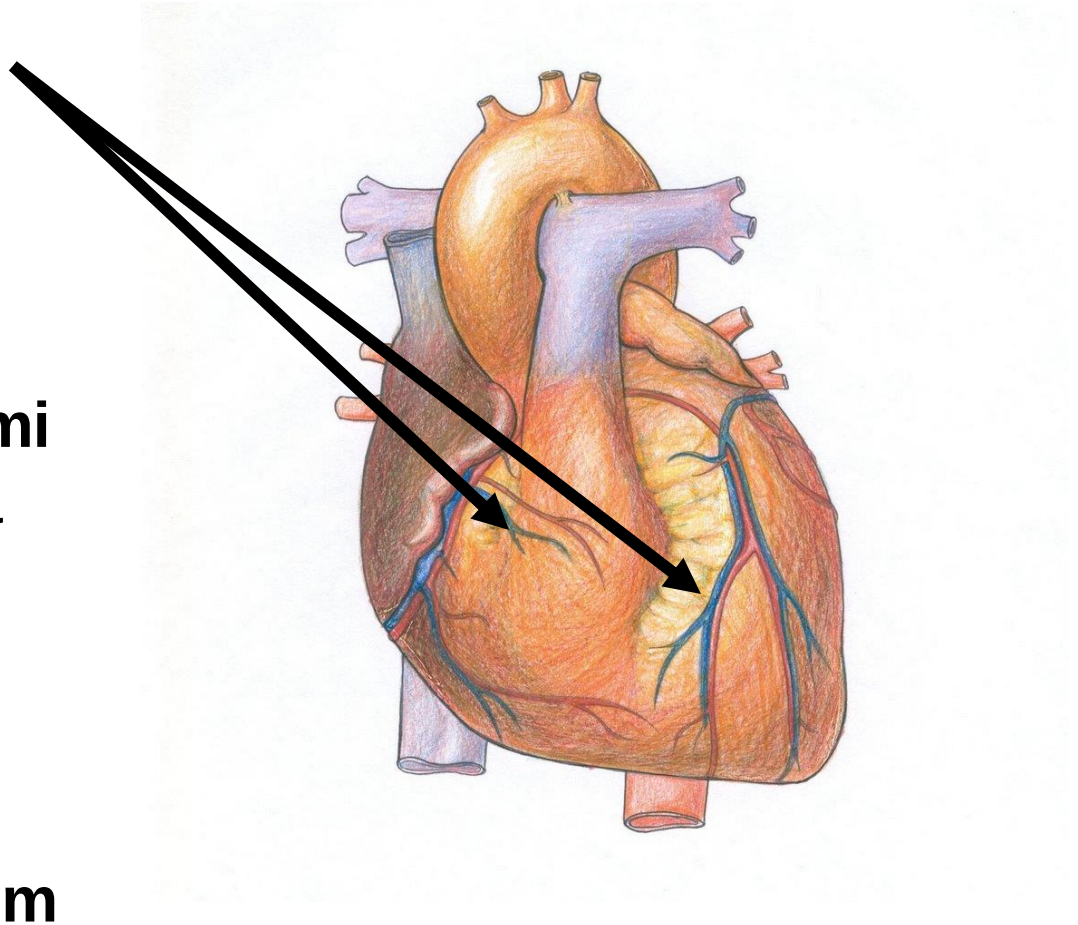
Prevents backflow into right atrium

Bicuspid Valve

Prevents backflow into left atrium

Blood supply to the heart wall

Coronary arteries



supplied with blood by the coronary arteries. These branch from the aorta just above the semi lunar valves of the aorta

Coronary veins

Drain blood from heart wall into the right atrium

Learning check

1 Where does blood go immediately after leaving the right ventricle ?

2 Name the blood vessel that enters the right atrium

3 What is the function of the coronary arteries ?

4 State the exact location of the opening into the coronary arteries

5 Name the valve between the left atrium and left ventricle

Pulse

The alternate expansion and contraction of arteries is called a pulse

Average pulse rate is 72 beats per minute

Blood Pressure

Pressure in blood due to the contraction of the ventricles which forces blood into the arteries

Blood pressure is measured with an instrument that records the pressure it takes to stop the blood flow in an artery of the upper arm

Effect of smoking on the circulation system

These puts a bigger workload on the heart

This reduces energy levels

Increase the chance of clots

Effect of Diet on the circulation

High intake of fat causes a build up of cholesterol

Cholesterol may block arterioles and lead to stroke or heart attack

Raises blood pressure which can cause heart attack

Effect of Exercise on the circulation system

Exercise strengthens the heart

This improves circulation

Exercise increases our ability to transport oxygen

This gives increased energy levels

Learning check

1 What causes the blood to be under pressure in the arteries ?

2 Explain the term Pulse

3 What controls the rate of heartbeat

4 Give two harmful effects of cigarette smoke on the circulation system

5 Explain why salt can have a negative effect on the circulation system

Role of Heart Muscle

1. The heart wall is made of Cardiac Muscle

2. Contraction of the cardiac muscle drives blood around the body

3. Cardiac Muscle does not fatigue

Factors affecting heart rate

Heart rate is increased by

Exercise

Stress

Heart rate is decreased by

Sleep

Alcohol

Heartbeat and its control

- The heart beat consists of alternate contraction and relaxation of the cardiac muscle

- The heart beat is controlled by the pacemaker in the right atrium. This sends an electrical signal to the cardiac muscle

- The heart beat sound is caused by the closing of the heart valves LUB DUB !!!!

Lub-closing of Bicuspid & Tricuspid

Heart Rate Control

Controlled by the Pacemaker (SA sino atrial Node) in the right atrium

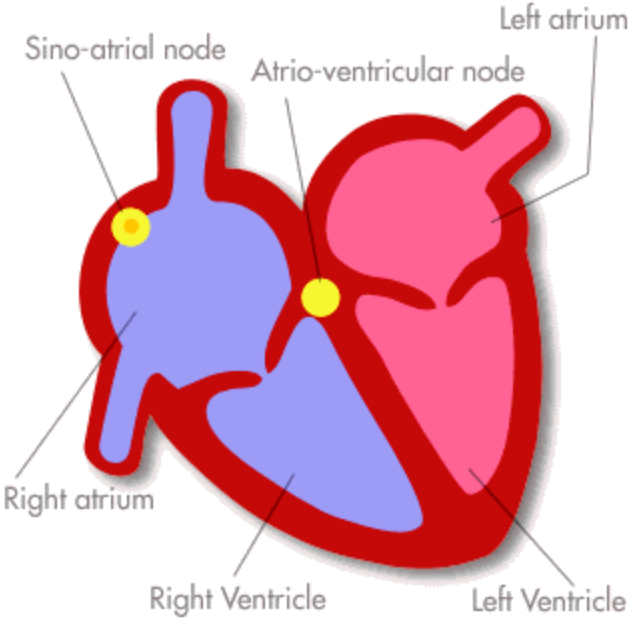
The SA- node emits an electrical signal

This causes the atria to contract

This signal is picked up by the AV atrioventricular node

The AV node sends a signal to the ventricles

Causing the ventricles to contract



Heartbeat Control (learning outcomes)

1. The location of the SA and AV nodes
2. Distinguish between Systole & Diastole
3. Be aware that cardiac muscle in the heart wall is specialised not to fatigue
4. Be able to describe the sequence of events in the cardiac cycle
5. Explain the role of the SA and AV nodes in systole and diastole

Stages of the heartbeat

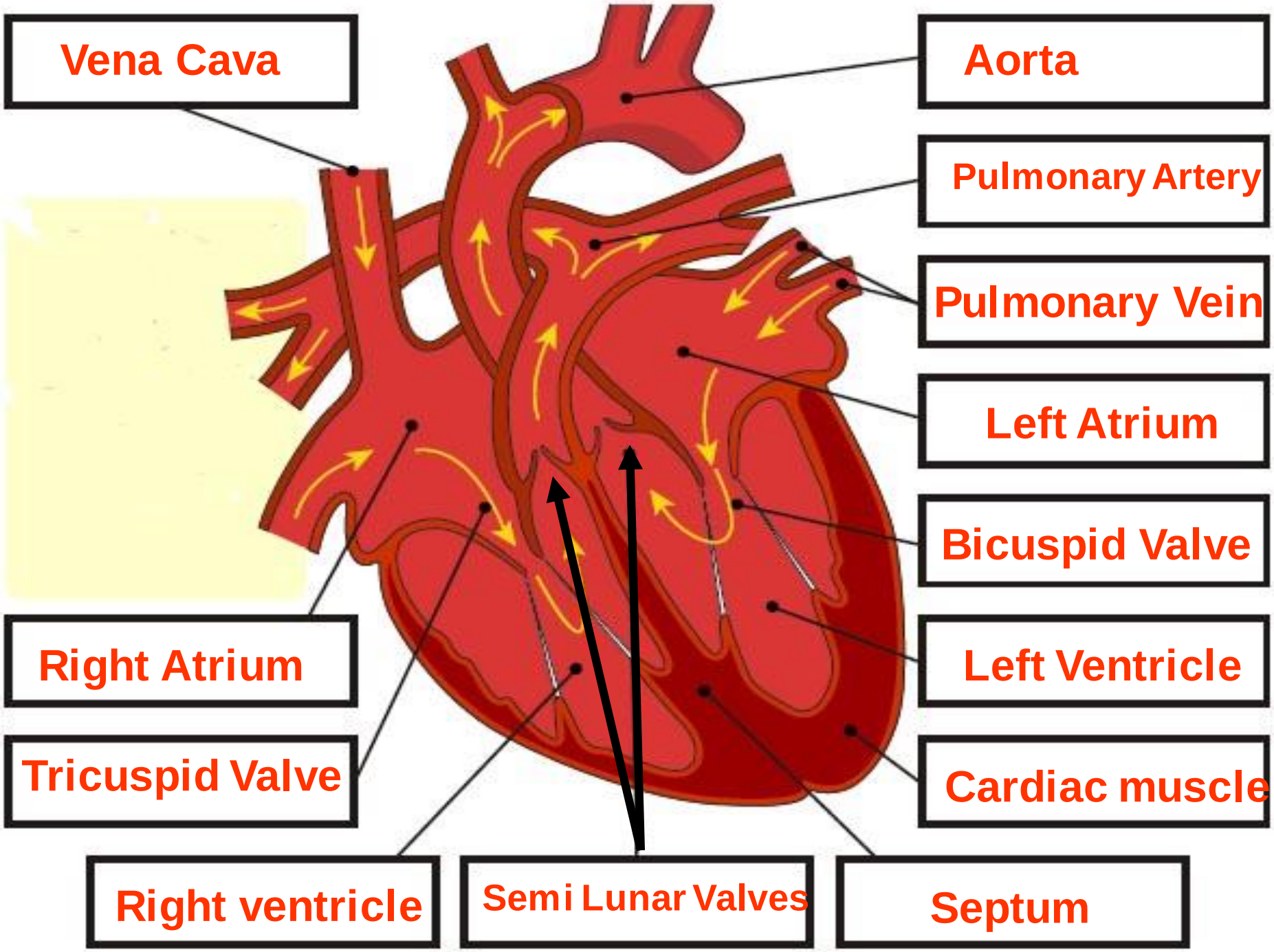
Contraction of heart muscle is called SYSTOLE
Relaxation of heart muscle is called DIASTOLE

1 **Blood enters the two atria. All valves are closed**
All chambers are relaxed. (diastole).

2. **The atria contract (systole), tricuspid and bicuspid valves open, blood is forced down into ventricles**

3. **Atria relax (diastole), ventricles contract (systole), Bicuspid and tricuspid valves close, semi lunar valves open and blood is forced into the pulmonary artery and aorta**

4 **Ventricles relax (diastole), semi lunar valves close.**
The cycle starts again


Vena Cava
Aorta
Pulmonary Artery
Pulmonary Vein
Left Atrium
Bicuspid Valve
Left Ventricle
Cardiac muscle
Septum
Semi Lunar Valves
Right ventricle
Tricuspid Valve
Right Atrium

Learning check

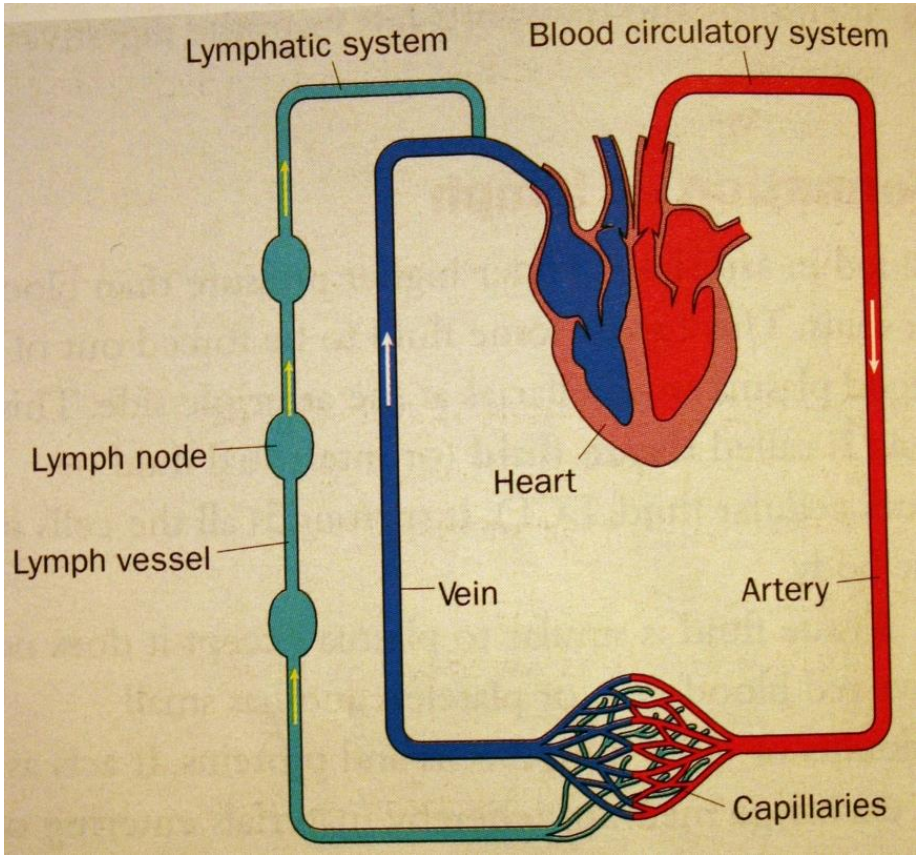
1. State the location of the SA node
2. Distinguish between Systole & Diastole
3. Name the specialised muscle in the heart wall
4. Explain the role of the SA and AV nodes in systole and diastole
5. Describe the sequence of events in the cardiac cycle

Lymphatic System

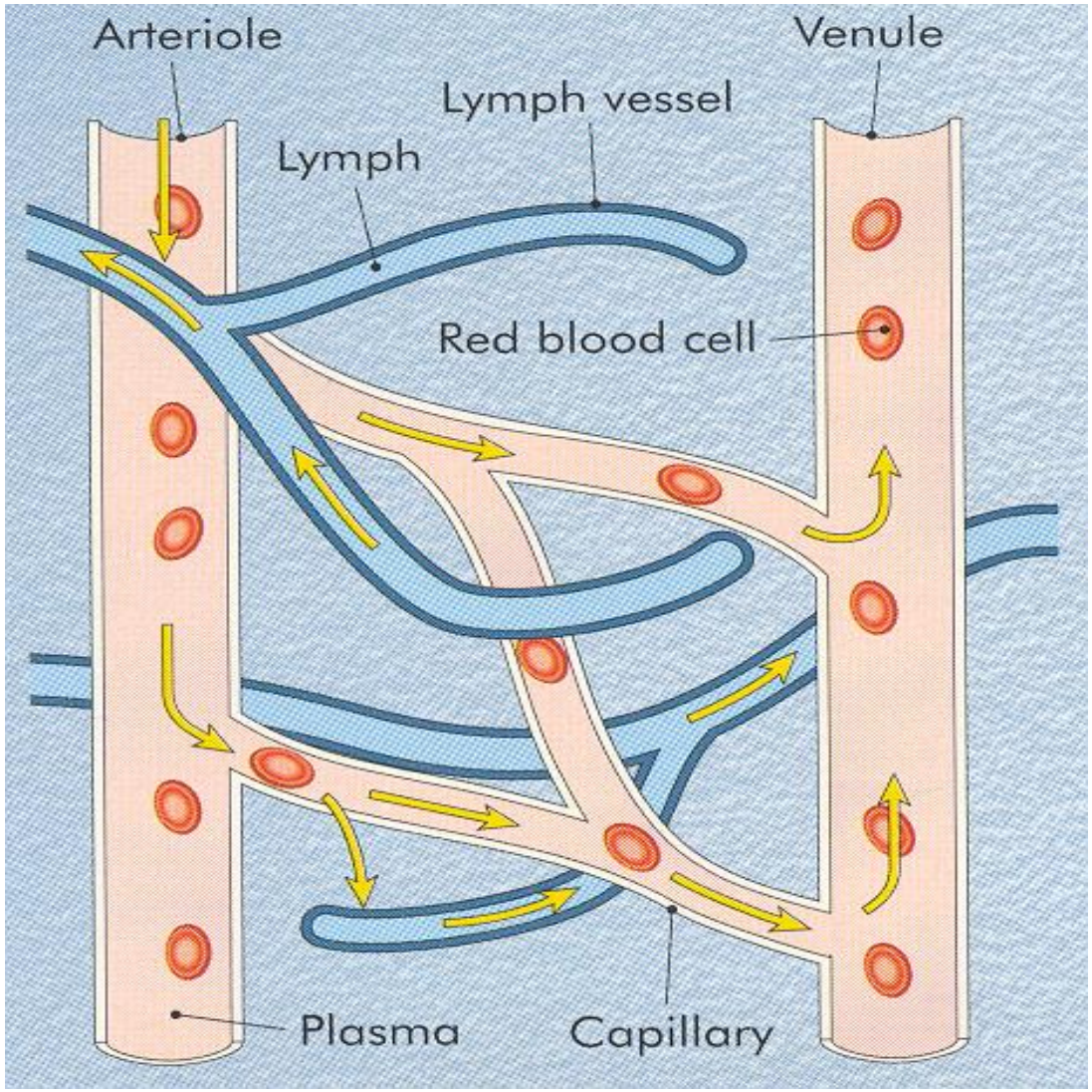
A secondary transport system consisting of one way system of vessels that collects and returns excess tissue fluid to blood system

Structure

1. Lymph vessels
2. Lymph Nodes
3. Lymph



Lymph vessels & blood vessels



Lymphatic System Functions

1) Collect tissue fluid and return it to the blood system

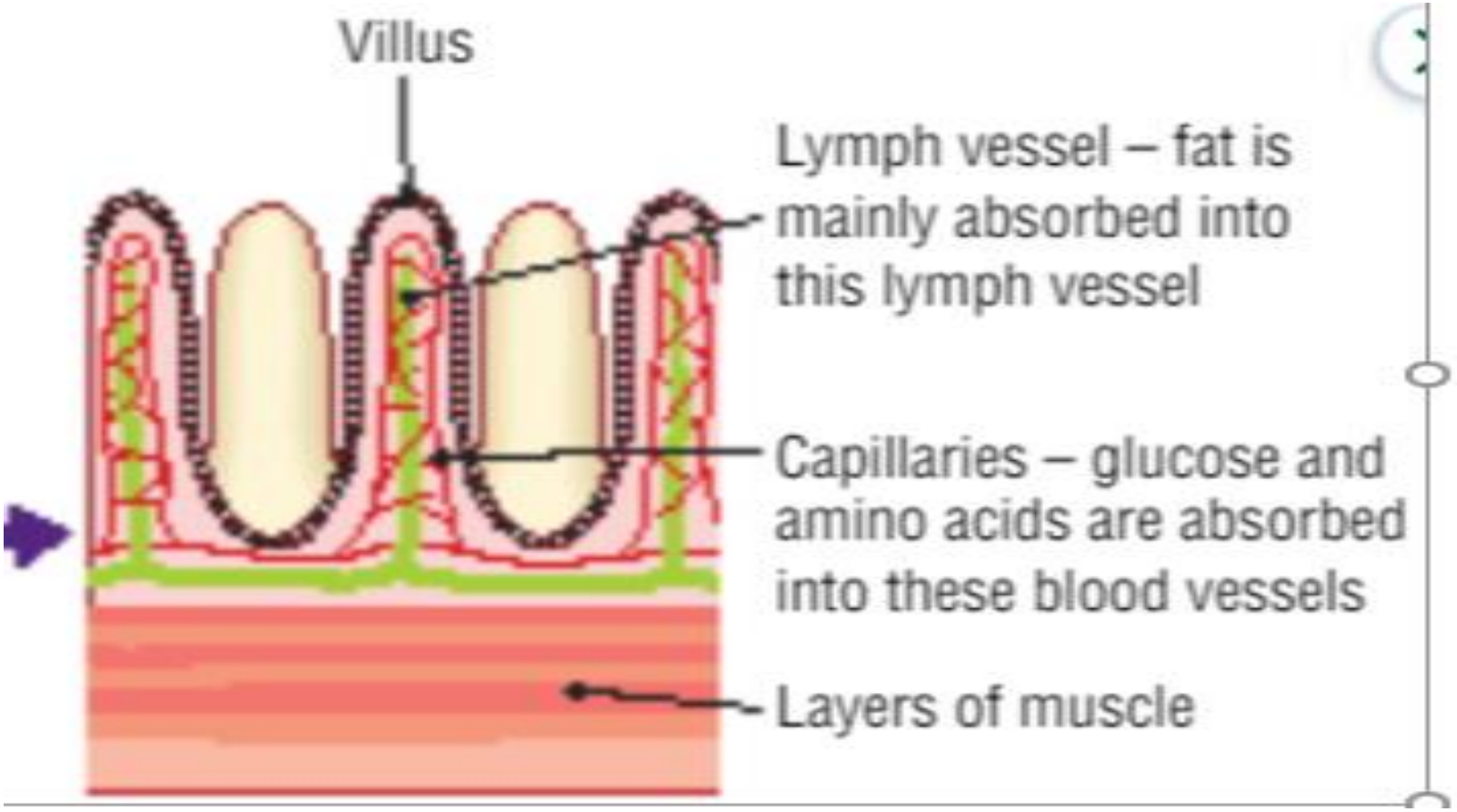
.2) Fight Infection by

(a) Filtering out microorganisms in the lymph nodes

(b) Destroying microorganisms by antibody production

(c) Mature and store lymphocytes

3. Transport digested fat away from intestine


Villus
Lymph vessel – fat is mainly absorbed into this lymph vessel
Capillaries – glucose and amino acids are absorbed into these blood vessels
Layers of muscle