Cardiovascular system

Circulatory system components

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The Heart , heart layers and Cardiomyocytes

The Blood Vessels

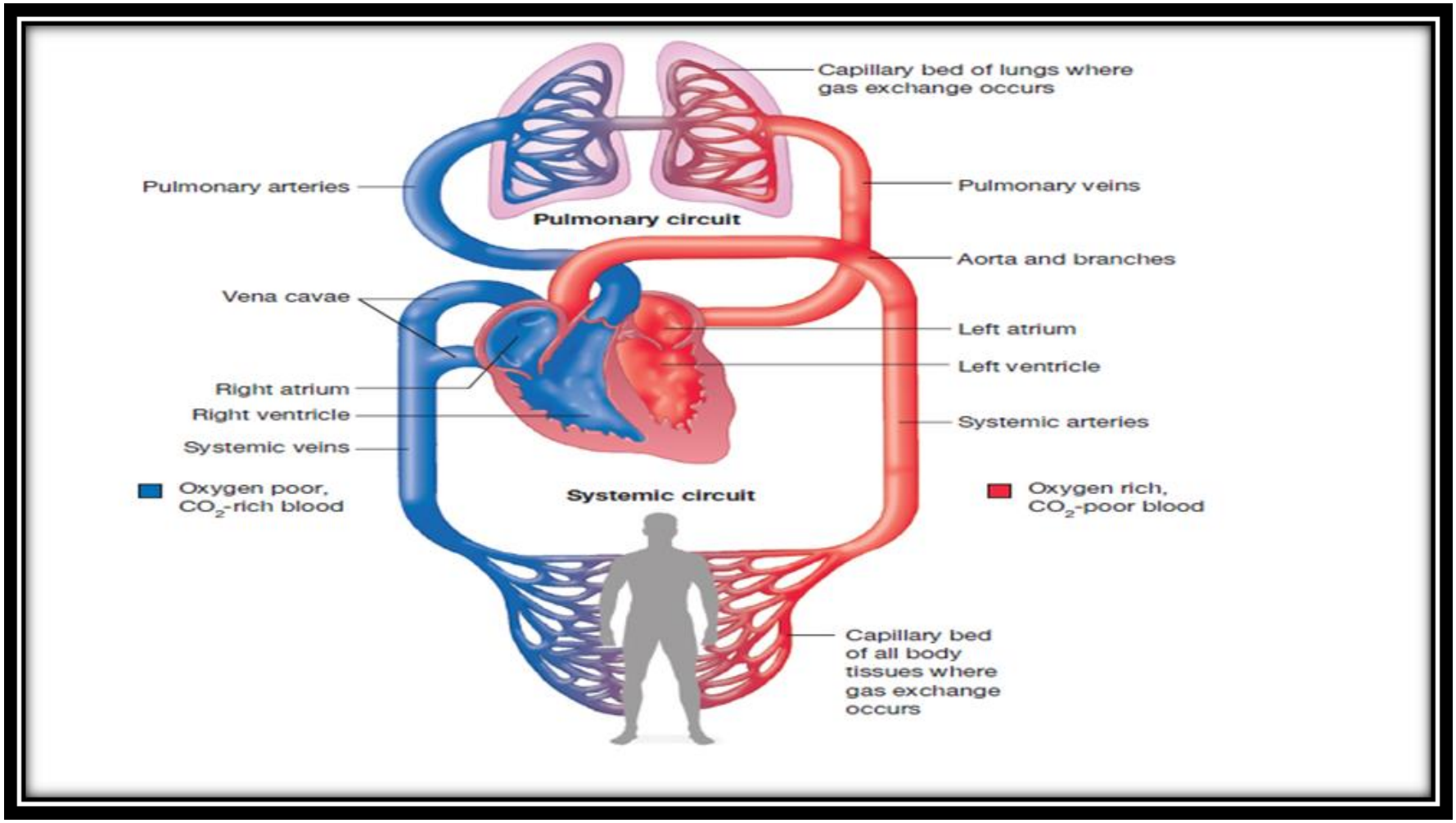
Assist Lecturer Basma Bashar Haseeb

Department of Environmental Health

Circulatory system components

The cardiovascular (CV) system, also called the circulatory system, maintains the distribution of blood throughout the body and is composed of:-

1- The heart
2- Blood vessels (Arteries, Capillaries, and Veins).


Capillary bed of lungs where gas exchange occurs
Pulmonary arteries
Pulmonary veins
Pulmonary circuit
Aorta and branches
Vena cavae
Left atrium
Left ventricle
Right atrium
Right ventricle
Systemic arteries
Systemic veins
Oxygen poor, CO_2-rich blood
Systemic circuit
Oxygen rich, CO_2-poor blood
Capillary bed of all body tissues where gas exchange occurs

The circulatory system is composed of two parts:

The pulmonary circulation

The systemic circulation.

- The pulmonary circulation (between the heart and lungs) transports deoxygenated blood to the lungs to get oxygen, and then back to the heart.

- The systemic circulation carries oxygenated blood away from the heart to the tissues and cells, and then back to the heart .

- In this way, all the body's cells receive blood and oxygen.

The Function of the system :-

The cardiovascular system, which consists of the heart and vessels , performs several functions:-

1- Distribute the blood , oxygen and other nutrients to all areas of the body.
2- Carbon dioxide and other waste products produced by metabolic reaction are transported to the lungs, liver, and kidneys, where they are eliminated from the body.

The Heart and its layers

The Heart

The heart, a muscular pump made up of cardiac muscle fibers, could be considered a muscle rather than an organ. It has four chambers, or cavities, and beats an average of 60–100 beats per minute (bpm) or about 100,000 times in one day.

Each time the cardiac muscle contracts, blood is ejected from the heart and pushed throughout the body within the blood vessels.

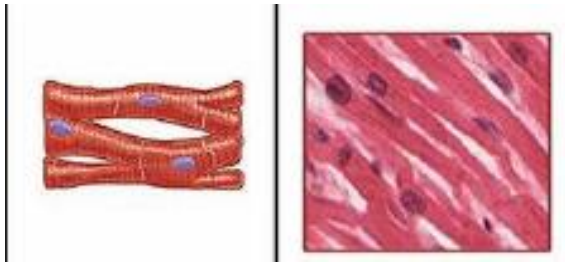
The Heart Layers

The wall of the heart is quite thick and is composed of three layers :-

1. The endocardium is the inner layer of the heart lining its chambers . It is a very smooth , thin layer that serves to reduce friction as the blood passes through the heart chambers.

2. The myocardium is the thick, muscular middle layer of the heart. Contraction of this muscle layer develops the pressure required to pump blood through the blood vessels. It is characterized by:-

- Non voluntary
- Contains Intercalated discs
- Branched and intertwined fibers

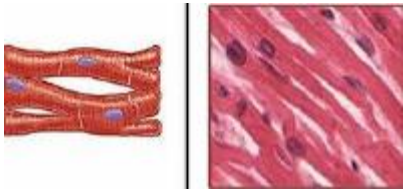


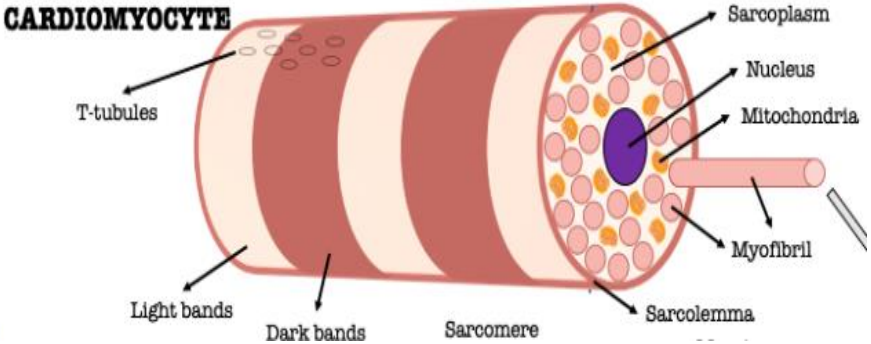
3. The epicardium is the outer layer that covers the heart and consists of a double-layered pleural sac, called the pericardium separated by fluid. The function of this fluid is to reduce friction during heartbeats.

Cardiomyocytes

- Shape and structure

Long, cylindrical, branched cells containing one or two nuclei in the middle. It contains transverse lines due to the presence of actin and myosin filaments.





- Intercalated Disc

Specialized structures that connect structures to each other Contains

Desmosome :-mechanically connect cells

Gap junctions:- Allows the passage of electrical signals that ensure the heart contracts as a single mass.

Cardiomyocytes

- Mitochondria: It is rich in mitochondria, which constitute 30 to 40% of the cell's volume, to provide the energy needed for continuous contractions.
- T-tubules : It helps the electrical signal spread quickly inside the cell.
- Sarcoplasmic Reticulum : It contributes to the regulation of calcium necessary for contraction.

Cardiomyocytes

Protein composition within the muscle fiber (Myofibril)

Cells contain contractile units known as sarcomeres made up of

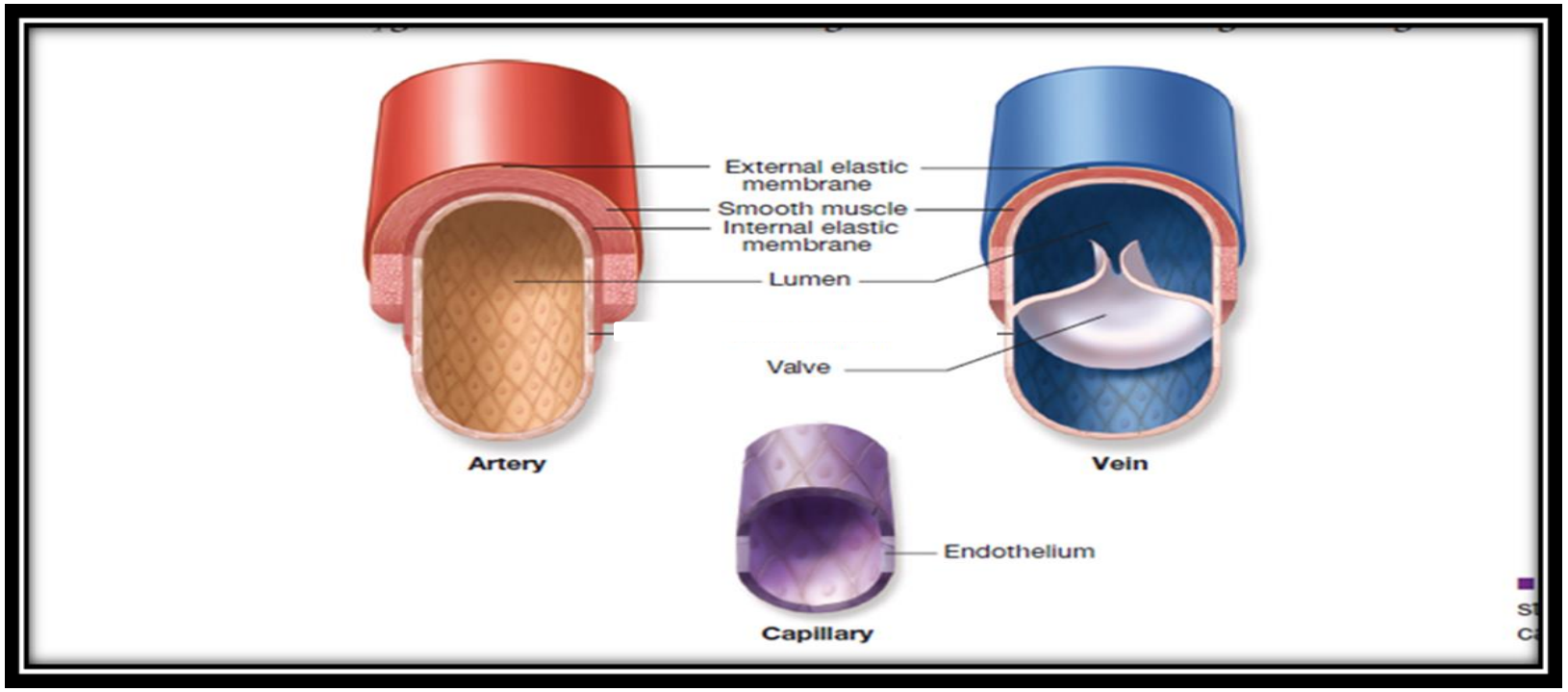
1- Actine

2- myocine

Which are arranged to give a striated appearance.

The Blood Vessels

There are three types of blood vessels: arteries, capillaries, and veins. These are the pipes that circulate blood throughout the body. The lumen is the channel within these vessels through which blood flows.



The Blood Vessels

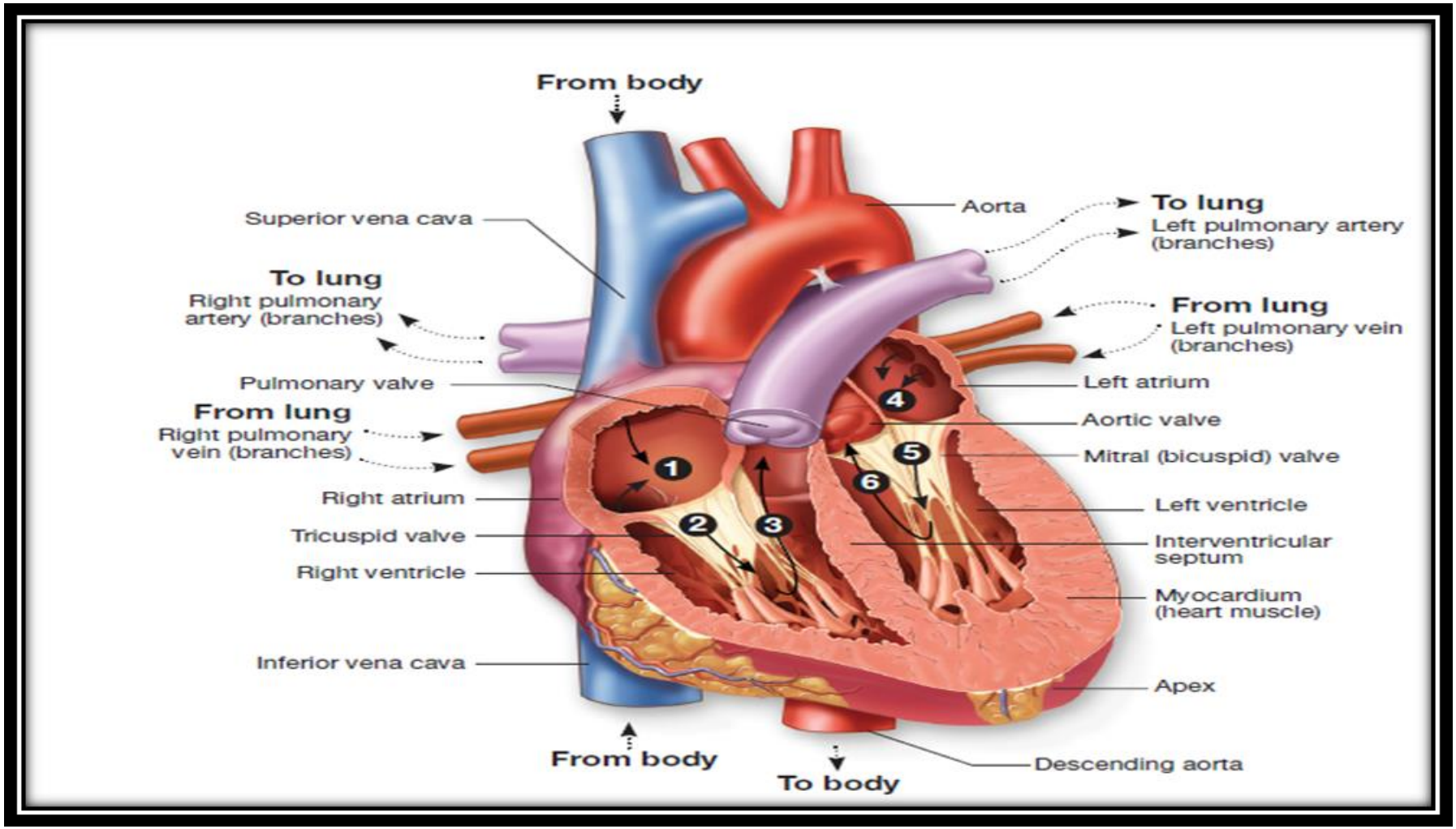
•Arteries

The arteries are the large, thick-walled vessels that carry the blood away from the heart. The walls of arteries contain a thick layer of smooth muscle that can contract or relax to change the size of the arterial lumen.

The pulmonary artery carries deoxygenated blood from the right ventricle to the lungs.

The largest artery (the aorta) begins from the left ventricle of the heart and carries oxygenated blood to all the body systems.

The arteries branch into smaller-sized arteries called (arterioles) which deliver blood to the capillaries.

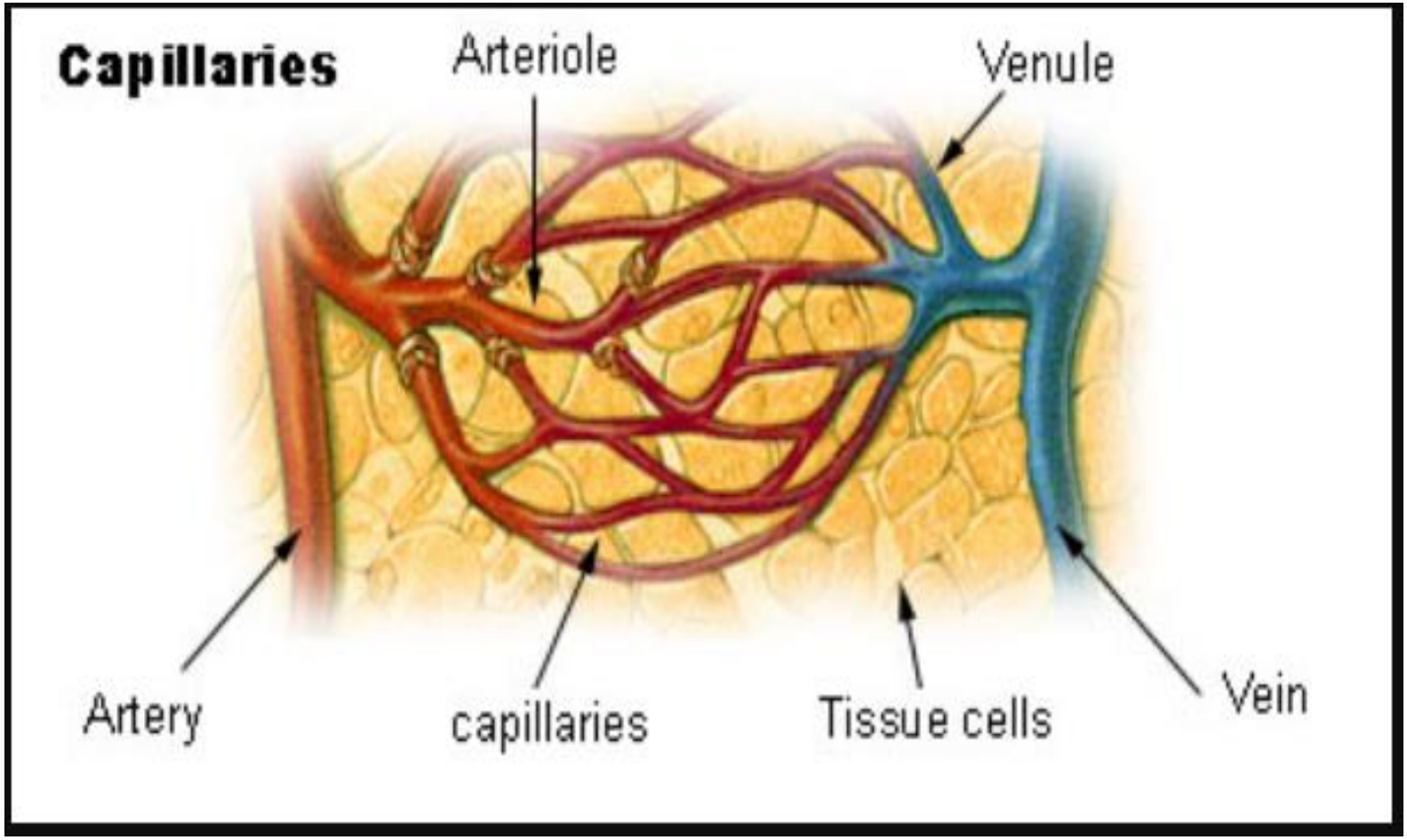

From body
Superior vena cava
To lung
Right pulmonary artery (branches)
Pulmonary valve
From lung
Right pulmonary vein (branches)
Right atrium
Tricuspid valve
Right ventricle
Inferior vena cava
From body
Aorta
To lung
Left pulmonary artery (branches)
From lung
Left pulmonary vein (branches)
Left atrium
Aortic valve
Mitral (bicuspid) valve
Left ventricle
Interventricular septum
Myocardium (heart muscle)
Apex
Descending aorta
To body
1
2
3
4
5
6

•Capillaries

Capillaries are a network of tiny blood vessels and have a very thin walled ? allowing for the diffusion of the oxygen and nutrients from the blood into the body tissues. Likewise, carbon dioxide and waste products are able to diffuse out of the body tissues and into the blood stream to be carried away.

Since the capillaries are so small in diameter, the blood will not flow as quickly through them as it does through the arteries and veins?

This means that the blood has time for an exchange of nutrients, oxygen, and waste material to take place. As blood exits a capillary bed, it returns to the heart through a vein.


Capillaries
Arteriole
Venule
Artery
capillaries
Tissue cells
Vein

- Veins

The veins carry blood back to the heart . Blood leaving capillaries first enters small venules , which then merge into larger veins.

Veins have

1- much thinner walls than arteries, causing them to collapse easily.

2- The veins also have valves that allow the blood to move only toward the heart .

3- Blood pressure in the veins is much lower than in the arteries. Muscular action against the veins and skeletal muscle contractions help in the movement of blood.

The two large veins that enter the heart are the superior vena cava, which carries blood from the upper body, and the inferior vena cava, which carries blood from the lower body.


Thanks