كلية المستقبل الجامعة

قسم الفيزياء الطبية

المرحلة الثالثة

Medical Physics

Lecture Seven

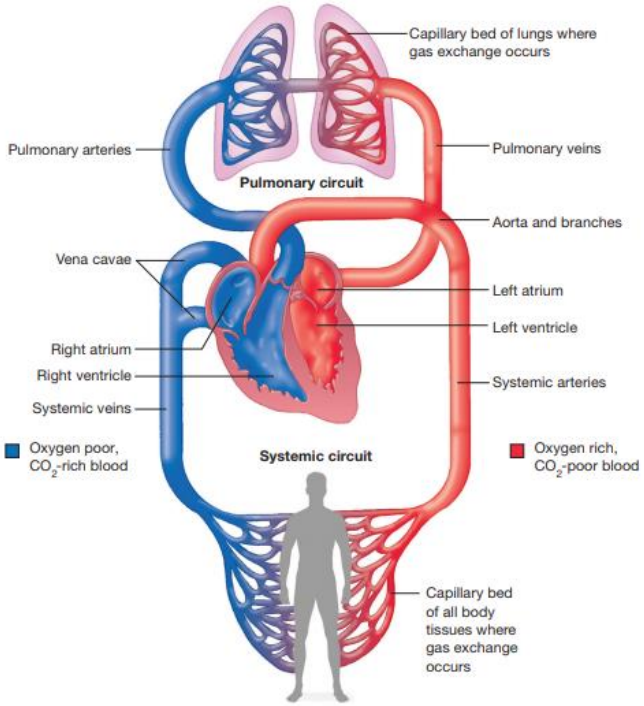
Physics of the Cardiovascular System

Assistance Lecturer : Mohammed Salih

Cardiovascular System (CVS) :

The cardiovascular system is sometimes called the blood-vascular, or simply the circulatory, system.

It consists of the heart, which is a muscular pumping device, and a closed system of vessels called arteries, veins, and capillaries. As the name implies, blood contained in the circulatory system is pumped by the heart around a closed circle or circuit of vessels as it passes again and again through the various "circulations" of the body.



Components of Cardiovascular System :

1- Heart .

2- Arteries .

3- Veins .

4- Capillaries .

Arteries :

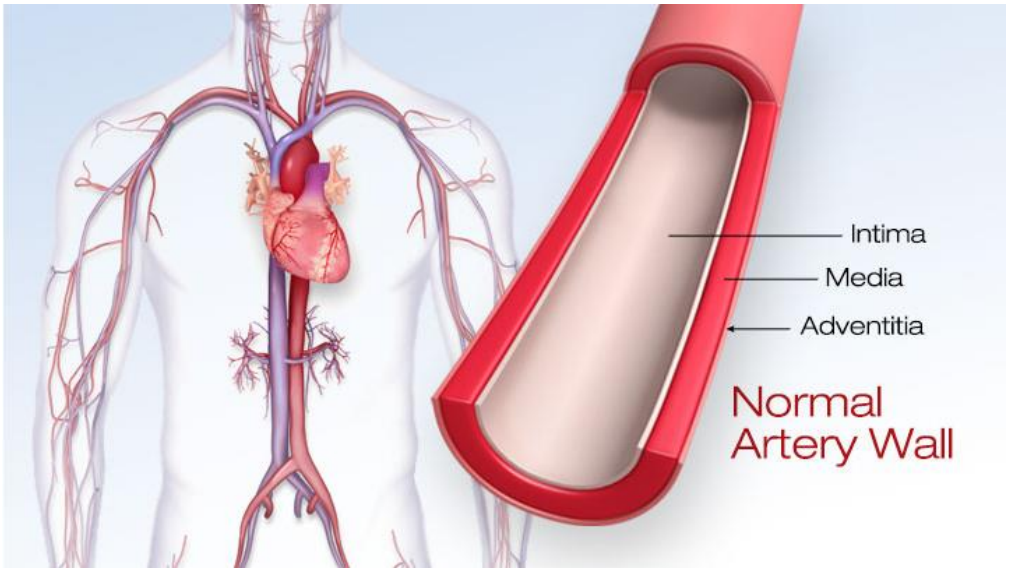
Arteries are vessels that convey blood away from the heart. The pulmonary arteries carry deoxygenated blood from the heart to the lungs, all other arteries carry oxygenated blood from the heart to all other parts of the body.

Arteries and veins have walls composed of three layers:

1- Tunica intima: composed of a single layer of endothelial cells .

2- Tunica media: made of smooth muscle .

3- Tunica adventitia: composed of white fibrous connective tissue In the arteries .



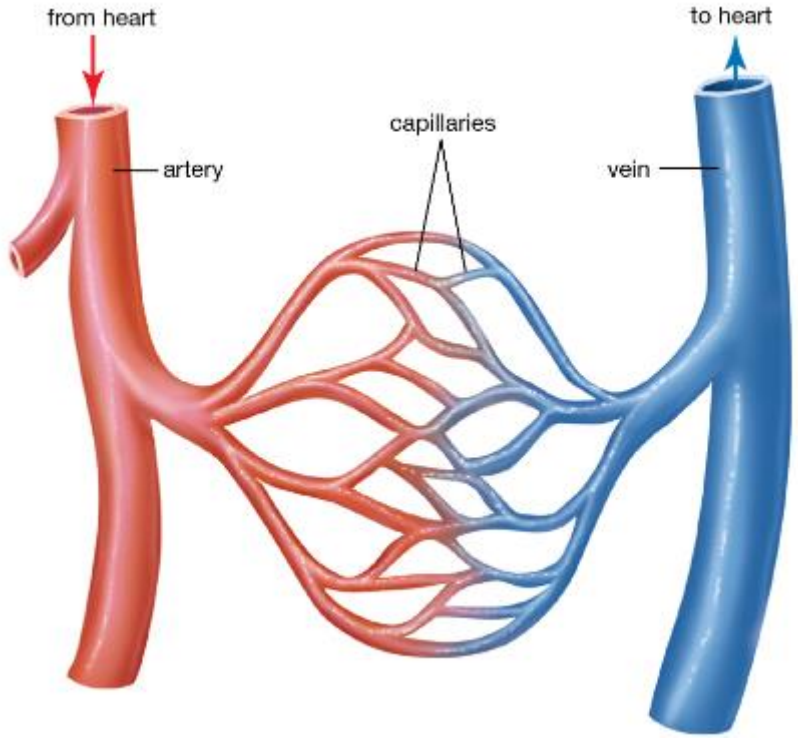
Veins :

are vessels that convey blood toward the heart. The pulmonary veins carry oxygenated blood from the lungs to the heart; all other veins carry oxygenated blood from all the other parts of the body to the heart .

Capillaries :

The smallest type of blood vessel. A capillary connects an arteriole (small artery) to a venule (small vein) to form a network of blood vessels in almost all parts of the body.

The wall of a capillary is thin and leaky, and capillaries are involved in the exchange of fluids and gases between tissues and the blood.

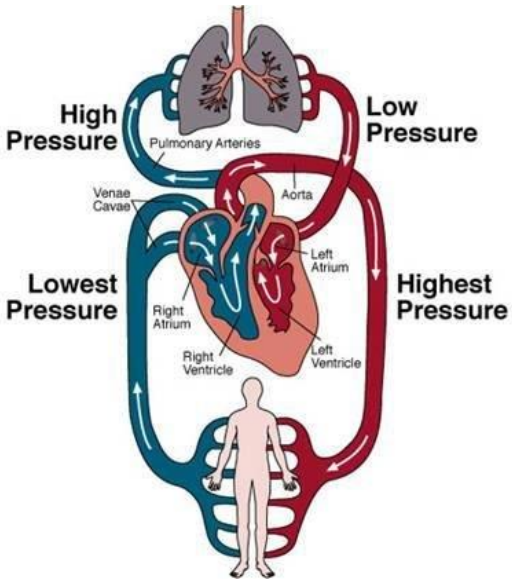


Circulatory System :

The cardiovascular (circulatory) system consists of the heart and a system of blood vessels (arteries, capillaries, veins) through which blood is transported from the heart to the tissues of the body and back again .The heart is a double pump, driving the blood through two circuits :

- **The pulmonary circuit** conveys blood from the right side of the heart to the lungs and then returns it to the left side of the heart.

- **The systemic circuit** carries blood from the left side of the heart to the rest of the body and returns it to the right side of the heart.



Function of Circulatory System :

1- Transporting various substances to and from body cells .

2- Contributes to cellular metabolism .

3- Balance (homeostasis) of fluid volume .

4- Balance of PH (hydrogen-ion concentration) .

5- Homeostasis of body temperature .

6- Defense against microorganisms.

Physics of the Cardiovascular System (CVS) :

Since the body has many billions of cells an elaborate transportation system is needed to deliver the fuel and O2 to the cells and remove the by-products. The blood performs this important body function. Blood represents about 7% of the body mass or about 4.5kg (~4.4 liters) in a 64kg person. The blood, blood vessels, and heart make up the cardiovascular system (CVS).

The cells of the body act like individual engines. In order for them to function they must have:

1- Fuel from our food to supply energy .

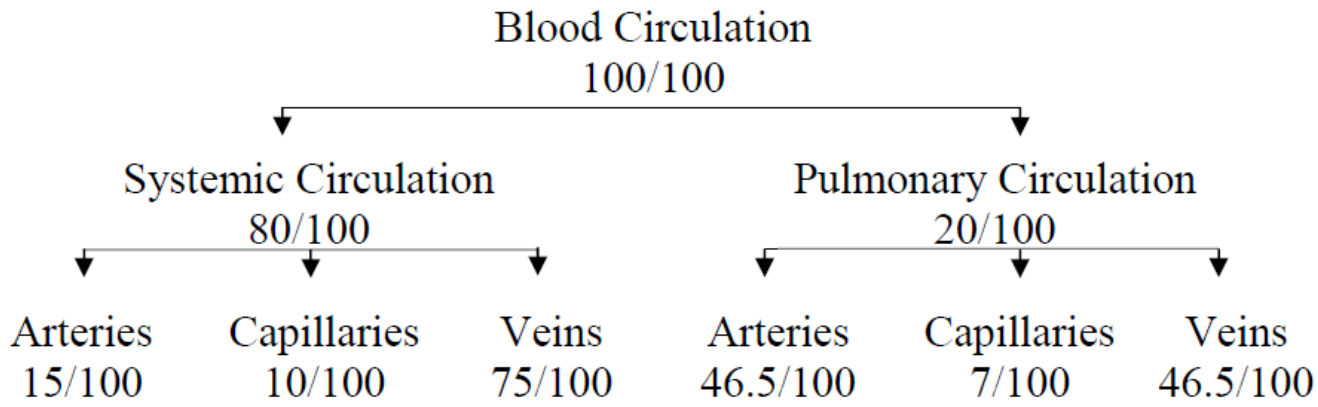
2- (O_2) from the air we breathe to combine with the food to release energy .

3- A way to dispose of the by-products of the combustion (mostly CO_2, H_2O, and heat).

The heart is basically a double pump; it provides the force needed to circulate the blood through the two major circulatory systems :

1- The pulmonary circulation in the lungs .

2- The systemic circulation in the rest of the body.



<u>Example:</u> calculate the mass of the blood in all circulation of a person his body mass is 80Kg?

Mass of Blood 80x7/100 = 5.6kg					
Mass of Blood in Systemic Circulation 5.6x80/100 = 4.48kg			Mass of Blood in Pulmonary Circulation 5.6x20/100 = 1.12kg		
Arteries 4.48x15/100 = 0.672kg	Capillaries 4.48x10/100 = 0.448kg	Veins 4.48x75/100 = 3.360kg	Arteries 1.12x46.5/100 = 0.521kg	Capillaries 1.12x7/100 = 0.078kg	Veins 1.12x46.5/100 = 0.521kg