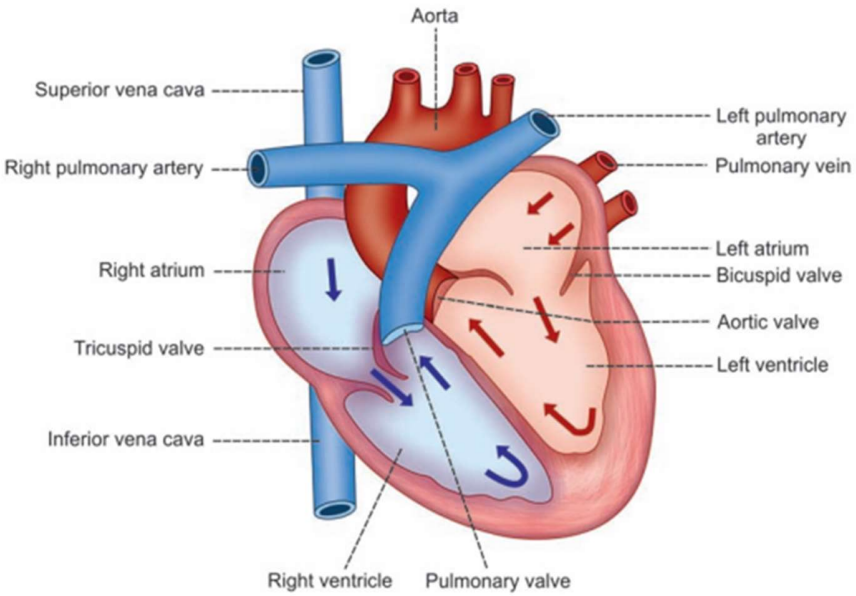
Cardiovascular System

The cardiovascular (CV) system, also called the circulatory system, maintains the distribution of blood throughout the body and is composed of the heart and the blood vessels—arteries, capillaries, and veins. The circulatory system is composed of two parts: the pulmonary circulation and 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 Blood transports nutrients and oxygen to the tissues and removes carbon dioxide and waste products from the tissues.

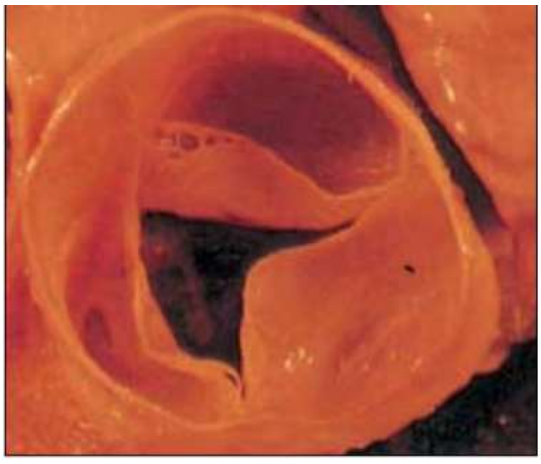
Heart

The heart is a muscular organ enclosed in a fibrous sac called **pericardium,** and located in the chest. The extremely narrow space between the pericardium and the heart is filled with a watery fluid that serves as a lubricant as the heart moves within the sac. The walls of the heart are composed primarily of cardiac muscle cells called the **myocardium.** The inner surface of the walls that incontact with the blood within the cardiac chambers is lined by a thin layer of cells **endothelial cells,** or **endocardium** (endothelial cells line the heart chambers and the entire cardiovascular system).



The heart is divided into right and left halves, each consisting of an atrium and a ventricle. Located between the atrium and ventricle in each half of the heart are the **atrioventricular (AV) valves,** which permit blood to flow from atrium to ventricle but not from ventricle to atrium.

The right AV valve is called the **tricuspid valve,** and the left is called the **mitral valve** (bicuspid valve). Valves of the heart permit the flow of blood through heart in only one direction. To prevent the AV valves from being pushed up into the atrium, the valves are fastened to muscular projections **(papillary muscles)** of the ventricular walls by fibrous strands (chordae tendinae). The papillary muscles do not open or close the valves. They act only to limit the valves' movements and prevent them from being everted. Also contain valves in the opening of the right ventricle into the pulmonary trunk called **pulmonary** valves and of the left ventricle into the aorta, the **aortic valves,** Because of the half-moon shape, these two valves are called **semilunar**. From the right ventricle, pulmonary artery arises. It carries the venous blood from right ventricle to lungs. In the lungs, the deoxygenated blood is oxygenated. Left atrium receives oxygenated blood from the lungs through pulmonary veins. This is the only exception in the body, where an artery carries venous blood and vein carries the arterial blood.



Valve partly open

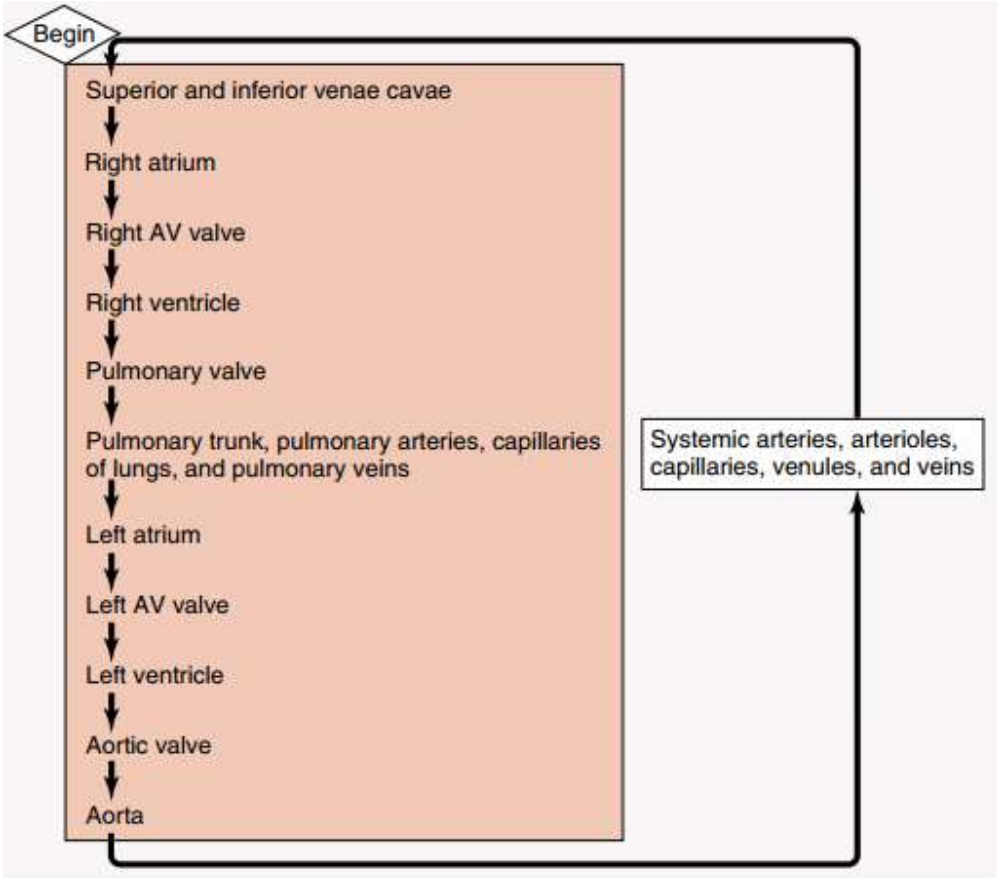
Valve almost completely closed

Right atrium receives venous (deoxygenated) blood via two large veins:

1. Superior vena cava that returns venous blood from the head, neck and upper limbs.

2. Inferior vena cava that returns venous blood from lower parts of the body.

Circulation of the blood



cardiac cycle

The cardiac cycle refers to a complete heartbeat from its generation to the beginning of the next beat. The **cardiac cycle** is the repeating pattern of contraction and relaxation of the heart and the intervening pause. The phase of contraction is called **systole,** and the phase of relaxation is called **diastole.** The two atria fill with blood and then contract simultaneously. This is followed by simultaneous contraction of both ventricles, which sends blood through the pulmonary and systemic circulations.

The frequency of the cardiac cycle is described by the heart rate (HR)

(HR = number of heart beats per one minute)

Each beat of the heart involves five major stages:

The first two stages, often considered together as the "ventricular filling" stage, involve the movement of blood from the atria into the ventricles. The next three stages involve the movement of blood from the ventricles to the pulmonary artery (in the case of the right ventricle) and the aorta (in the case of the left ventricle).

- The first stage, "early diastole," is when
  1. the semilunar valves close
  2. the atrioventricular (AV) valves open
  3. the whole heart is relaxed.
- The second stage, "atrial systole," is when
  1. the atrium contracts
  2. blood flows from atrium to the ventricle.
- The third stage, "isovolumic contraction" is when
  1. the ventricles begin to contract
  2. the AV and semilunar valves close
  3. there is no change in volume.
- The fourth stage, "ventricular ejection," is when
  1. the ventricles are contracting and emptying
  2. the semilunar valves are open.
- The fifth stage, "isovolumic relaxation time",
  1. pressure decreases, no blood enters the ventricles
  2. the ventricles stop contracting and begin to relax
  3. the semilunar valves close due to the pressure of blood in the aorta.

Throughout the cardiac cycle, blood pressure increases and decreases. Under normal circumstances, each cycle takes 0.8 seconds. At an average cardiac rate of 75 beats per minute.