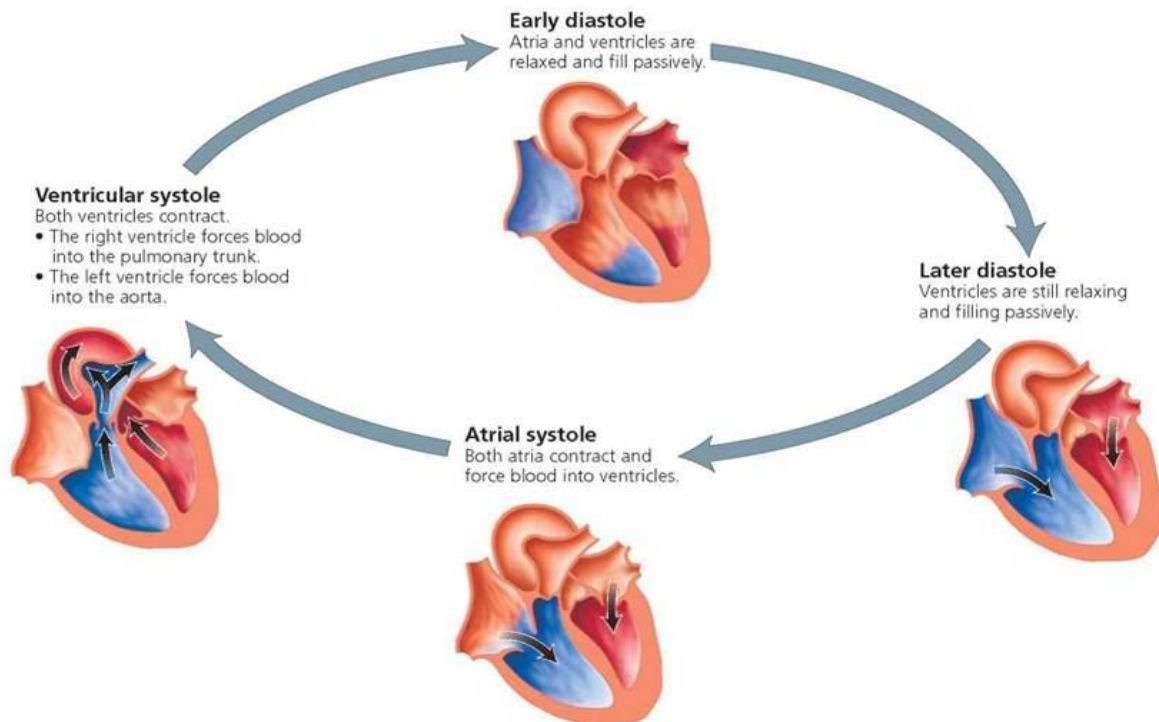


Cardiac Cycle

At a normal heart rate of 75 beats per minute, one cardiac cycle lasts 0.8 second. Under resting conditions, systole occupies $\frac{1}{3}$ and diastole $\frac{2}{3}$ of the cardiac cycle duration.



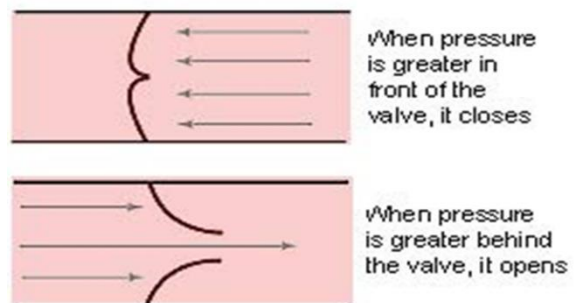
Pressure

As a chamber fills with blood, the pressure is going to rise. When a chamber contracts, the pressure is going to rise. Changes in pressure affect whether a valve is open or closed. Fluids always move from areas of high pressure to areas of low pressure.

Heart Valves

Heart valves function to ensure a one-way flow of blood through the heart. The valves are not made of muscle, but rather are composed of sheets of tough connective tissue that act like flaps. The heart valves open and close passively because of pressure differences on either side of the valve.

When pressure is greater behind the valve, the leaflets are blown open and the blood flows through the valve. However, when pressure is greater in front of the valve, the leaflets snap shut and blood flow is stopped.



Atrioventricular (AV) and Semilunar Valves

The **atrioventricular valves** (AV valves), which separate the atria from the ventricles, allow blood to flow from the atria to the ventricles, but prevent flow in the opposite direction. The right AV valve is called the tricuspid valve. The left AV valve is called the mitral valve. The opening and closing of the AV valves is dependent on pressure differences between the atria and ventricles. When the ventricles relax, atrial pressure exceeds ventricular pressure, the AV valves are pushed open and

blood flows into the ventricles. However, when the ventricles contract, ventricular pressure exceeds atrial pressure causing the AV valves to snap shut.

To ensure that the AV valves do not turn inside-out, they are attached to small papillary muscles by tough tendons called the cordae tendineae. Papillary muscles contract in synchrony with the ventricles, thus maintaining constant tension on the valve.

The **semilunar valves** (pulmonary valve and aortic valve) are one-way valves that separate the ventricles from major arteries. The aortic valve separates the left ventricle from the aorta, while the pulmonary valve separates the right ventricle from the pulmonary artery. As the ventricles contract, ventricular pressure exceeds arterial pressure, the semilunar valves open and blood is pumped into the major arteries. However, when the ventricles relax, arterial pressure exceeds ventricular pressure and the semilunar valves snap shut. This is due to the elevated pressures in the aorta and the pulmonary artery pushing the blood back toward the ventricles to close the semilunar valves.

Heart Sounds are associated with Valve Closure

Normal heart sounds are caused by the closing of heart valves. We hear these vibrations as two distinct sounds; lub-dub. The first sound, "lub", is associated with the closing of the AV valves. The second sound, "dub", is associated with the closing of the semilunar valves.

Cardiac Cycle Summary

Diastole

- Ventricles and atria are relaxed
- Semi-lunar valves close due to higher arterial pressure compared to ventricle
- AV valves open once atrial pressure is higher than ventricle pressure
- Ventricles fill passively with blood (about 80% of capacity)

Atria systole

- Atrial contraction forces the rest of the blood into the ventricles
- AV valves open
- Semi-lunar valves closed

Ventricle Systole

- Ventricle contraction occurs (after a short delay)
- AV valves close (ventricle pressure is higher than atrial pressure)
- Ventricle contraction continues and then the semi-lunar valves open once the pressure is greater in the ventricles compared to arterial pressure.
- Blood is forced into the arteries