

Cardiac Cycle and Cardiac Conduction System

by Sophia



WHAT'S COVERED

In this lesson, you will learn about the processes that occur in the cardiac cycle. Specifically, this lesson will cover:

1. Contraction & Relaxation

The **cardiac cycle** is a sequence of events that occurs when the chambers of our heart contract and relax. We have four chambers in our heart; the right atrium, left atrium, right ventricle, and left ventricle. When these chambers contract and relax, it acts to pump blood throughout the body. This contraction and relaxation occur at the same time on each side of the heart.

➔ **EXAMPLE** When the right atrium relaxes, the left atrium relaxes. When the right atrium contracts, the left atrium contracts.

The two phases of the cardiac cycle are:

- **Systole:** the contraction phase
- **Diastole:** the relaxation phase



TERMS TO KNOW

Cardiac Cycle

All of the events that occur during one heartbeat that drive blood flow into and out of the heart; a series of well-timed pressure and volume changes within the chambers of the heart that drive blood flow throughout its chambers.

Systole

A term used to describe an increase in pressure and work; measured in millimeters of mercury (mmHg).

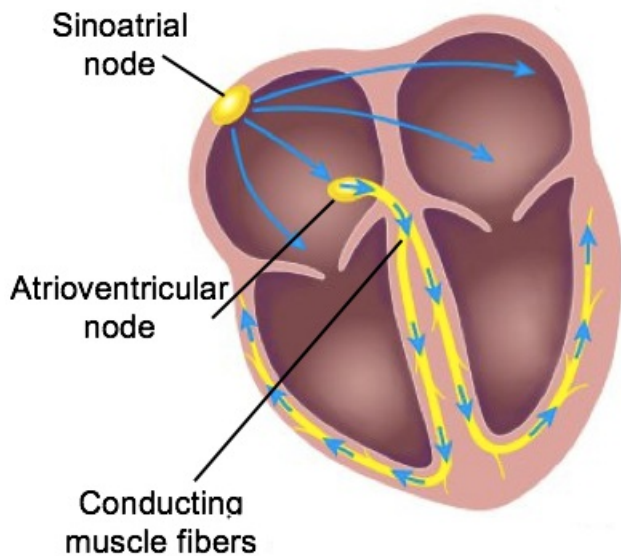
Diastole

A term used to describe a decrease in pressure and work; measured in millimeters of mercury (mmHg).

2. Cardiac Conduction System

About 1% of the cells of the heart are a part of the **cardiac conduction system**. This group of cells are self-exciting and produce electrical signals, or electrical impulses, that stimulate heart contractions. They act as a pacemaker and drive our heart contractions. More importantly, they do so independently of the nervous system. This is an interesting fact because, even if all nerves that were leading to the heart were cut, the heart would still be able to beat.

There are two places where a bunch of the specialized cardiac conduction system cells cluster, and these clusters are called nodes. Our heart beats because of the self-exciting cells in the two nodes of the heart.



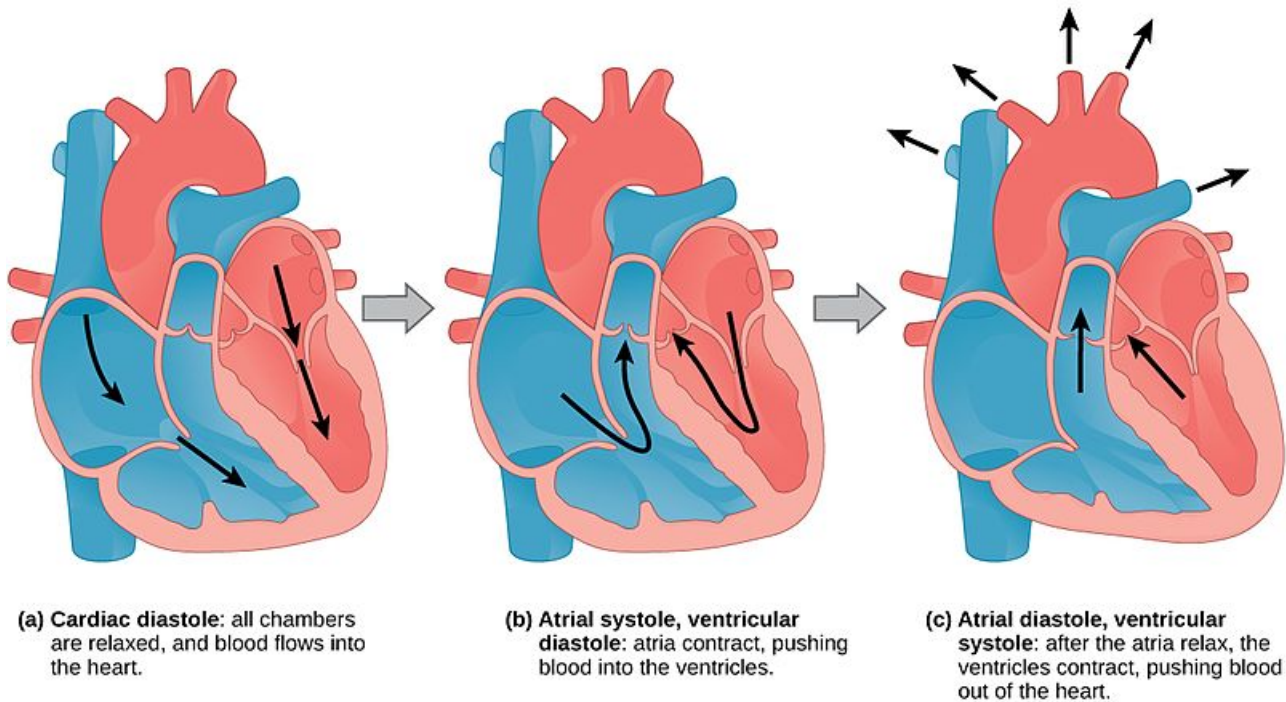
The **sinoatrial node** (also known as the SA node) produces an excitation wave that will spread over both of the atria. This signals for contraction and spreads so quickly that the cardiac muscle cells will contract together almost as one unit. When our atria contract, blood flows into our ventricles.

This wave will start to slow down when it reaches our **atrioventricular node**, which is the second node. The slower conduction in the atrioventricular node is important because it allows for the atria to have time to finish contracting before the wave travels from the atrioventricular node to the ventricles. Once the atria are done contracting and the blood has filled out the ventricles, then the wave will stimulate the ventricles to contract.

Connected to these nodes, we have conducting muscle fibers that spread throughout the atria and the ventricles.

Process of the Cardiac Cycle	
1. The pacemaker starts the cardiac cycle	The sinoatrial node depolarizes, sending an electrical impulse.
2. Systole begins	The impulse from the SA node causes the atria to contract. This pushes blood into the ventricles.
3. The propagating electrical impulse reaches the gateway	The electrical impulse reaches the AV node and slows. By the time the ventricles are done filling, the electrical impulse will have traveled far

	enough to cause the ventricles to contract.
4. <i>Systole ends</i>	The right ventricle pushes blood through the pulmonary artery (toward the lungs); this blood enters the pulmonary cycle. Meanwhile, the left ventricle pushes blood through the aorta; this blood enters the systemic cycle.
5. <i>Diastole begins</i>	Because the heart has been emptied of blood, when the muscle relaxes, this creates a negative pressure (the relaxed heart is larger in volume, but has very little blood in it). As a result, blood comes rushing in to relieve the negative pressure.



THINK ABOUT IT

Question: Have you ever known someone who has had an artificial pacemaker before? Why do you think they needed this?

Answer: It is because there is some sort of malfunction in their own SA node. The artificial pacemaker is implanted, so they still have the stimulus for these heart contraction.



TERMS TO KNOW

Cardiac Conduction System

A system of specialized cells and nodes in the heart that rhythmically pace the heart and time when the chambers contract; it includes the sinoatrial node (SA node) and the atrioventricular node (AV node).

Sinoatrial Node (SA Node)

Known as the pacemaker of the heart due to its ability to depolarize and repolarize faster than the rest of the cardiac conduction system; it is located in the right atrium of the heart.

Atrioventricular Node (AV Node)

Known as the “gateway” between the atria and ventricles; the AV node slows down the rate at which the action potential travels from the atria to the ventricles allowing for more filling time.

3. The Function of Valves

When our atria contract, they push blood into the ventricles. The atrioventricular valve (or AV valves) separate the atria from the ventricles and prevent blood from flowing back into the atria once it enters the ventricle. From there, the ventricles are going to contract and, depending on which side of the heart it is, are going to pump blood into the pulmonary artery or the aorta. The left ventricle is going to pump blood up through the aortic valves into the aorta, and the right ventricle will send blood through the pulmonary valve into the pulmonary artery. These valves will close once the blood has passed through to prevent blood from flowing back. Then the ventricles will relax, and then the atria will begin to fill again for another cycle.

If you listen to your heart, you can hear this process happening. The heart makes this lub-dub sound, and this is the sound that your heart makes because of the closing of the heart's valves. The first “lub” sound is made by your AV valves closing simultaneously. And the “dub” sound is caused by the closing of the aortic and pulmonary valves simultaneously closing.



MAKE THE CONNECTION

If you're taking the Human Biology Lab course simultaneously with this lecture, it's a good time to try the Cardio-respiratory Physiology: How can seals dive so deep for so long? Activity in Unit 5 of the Lab course. Good luck!



SUMMARY

The cardiac cycle includes all the events caused by one heartbeat. The **contraction and relaxation** of the atria and ventricles cause the heart to pump. **Valves** serve an important function in this process. They allow blood to move forward from one area to another without backflow. The sound your heart makes while beating is the sound of the valves closing.

Keep the learning, and have a great day!

Source: THIS WORK IS ADAPTED FROM SOPHIA AUTHOR AMANDA SODERLIND



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