to leave the heart, circulate around either the lungs or the rest of the body, and then return to the heart.

The upper chamber on each side of the heart is called an **atrium** (plural: **atria**), or sometimes an **auricle**. The two atria receive blood from the veins. You can see from Figure **9.5** that blood from the venae cavae flows into the right atrium, while blood from the pulmonary veins flows into the left atrium.

The lower chambers are **ventricles**. Blood flows into the ventricles from the atria, and is then squeezed out into the arteries. Blood from the left ventricle flows into the aorta, while blood from the right ventricle flows into the pulmonary arteries.

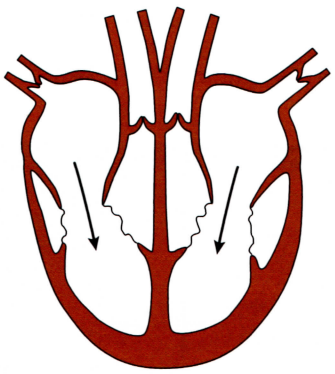
The atria and ventricles have valves between them, which are known as the **atrioventricular valves**. The one on the left is the **mitral** or **bicuspid** valve, and the one on the right is the **tricuspid valve**. We will now consider how all of these components work together so that the heart can be an efficient pump for the blood.

The cardiac cycle

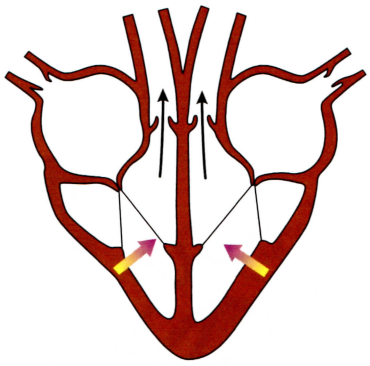
Your heart beats around 70 times a minute. The **cardiac cycle** is the sequence of events which makes up one heart beat. Figure **9.6** shows three stages in this cycle.

As the cycle is continuous, a description of it could begin anywhere. We will begin with the time when the heart is filled with blood and the muscle in the atrial wall contracts. This stage is called **atrial systole**. The pressure developed by this contraction is not very great, because the muscular walls of the atria are only thin, but it is enough to force the blood in the atria down through the atrioventricular valves into the ventricles. The blood from the atria does not go back into the pulmonary veins or the venae cavae, because these have semilunar valves to prevent backflow.

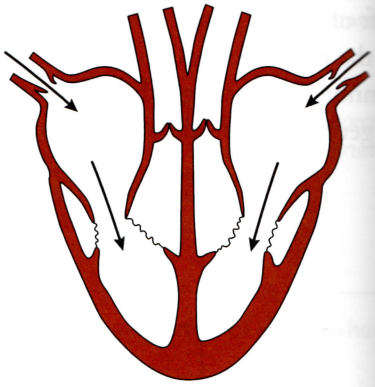
About 0.1 seconds after the atria contract, the ventricles contract. This is called **ventricular systole**. The thick, muscular walls of the ventricles squeeze inwards on



1 **Atrial systole**. Both atria contract. Blood flows from the atria into the ventricles. Backflow of blood into the veins is prevented by closure of the valves in the veins.



2 **Ventricular systole**. Both ventricles contract. The atrioventricular valves are pushed shut by the pressurised blood in the ventricles. The semilunar valves in the aorta and pulmonary artery are pushed open. Blood flows from the ventricles into the arteries.



3 **Ventricular diastole**. Atria and ventricles relax. The semilunar valves in the aorta and pulmonary artery are pushed shut. Blood flows from the veins through the atria and into the ventricles.

pressure exerted by contraction of muscle

movement of blood

Figure 9.6 The cardiac cycle. Only three stages in this continuous process are shown.

the blood, increasing its pressure and pushing it out of the heart. As soon as the pressure in the ventricles becomes greater than the pressure in the atria, this pressure difference pushes the atrioventricular valves shut, preventing blood from going back into the atria. Instead, the blood rushes upwards into the aorta and the pulmonary artery, pushing open the semilunar valves in these vessels as it does so.

Ventricular systole lasts for about 0.3 seconds. The muscle then relaxes, and the stage called **ventricular diastole** begins. As the muscle relaxes, the pressure in the ventricles drops. The high-pressure blood which has just been pushed into the arteries would flow back into the ventricles but for the presence of the semilunar valves, which snap shut as the blood fills their cusps.

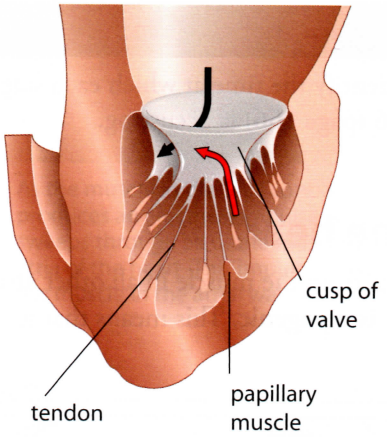
During diastole, as the whole of the heart muscle relaxes, blood from the veins flows into the two atria. The blood is at a very low pressure, but the thin walls of the atria are easily distended, providing very little resistance to the blood flow. Some of the blood trickles downwards into the ventricles, through the atrioventricular valves. The atrial muscle then contracts, to push blood forcefully down into the ventricles, and the whole cycle begins again.

Figure 9.7 shows how the atrioventricular and semilunar valves work.

During **atrial systole**, the pressure of the blood is higher in the atrium than in the ventricle, and so forces the atrioventricular valve open. During **ventricular systole**, the pressure of the blood is higher in the ventricle than in the atrium. The pressure of the blood pushes up against the cusps of the atrioventricular valve, pushing it shut. Contraction of the papillary muscles, attached to the valve by tendons, prevents the atrioventricular valve from being forced inside-out.

Key:

- atrial systole – valve open
- ventricular systole – valve shut



During **ventricular systole**, the pressure of the blood forces the semilunar valves open. During **ventricular diastole**, the pressure of the blood in the arteries is higher than in the ventricles. The pressure of the blood pushes into the cusps of the semilunar valves, squeezing them shut.

Key:

- ventricular diastole – valve closed
- ventricular systole – valve open

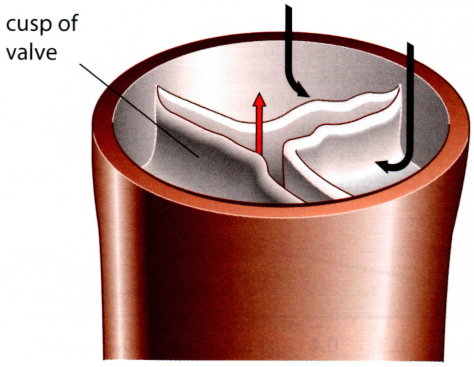


Figure 9.7 How the heart valves function.