Chapter 9-13: The Heart

The functions of the cardiovascular system depend primarily on the activity of the heart, which distributes blood to the lungs and the rest of the body. Each day, the heart beats approximately 100,000 times, at a rate of about seventy beats per minute.

> To help you follow the pathway of blood, we have included a number of arrows that you should color as you read.

The heart pumps blood into two closed circuits of the body: the systemic circulation, which supplies the body cells, tissues, and organs with blood; and the pulmonary circulation, which carries blood to the lungs. After completing the systemic circuit, blood returns to the heart through two veins, the **superior vena cava (A)**, which comes from the head, and the **inferior vena cava (B)**, which comes from the lower body. The vena cavae meet at the **right atrium (C)**.

> We now follow the flow of blood from the right atrium into the right ventricle and out to the lungs. Continue your coloring as before.

From the right atrium, the blood flows down through the **tricuspid valve (D)**, which is also called the right atrioventricular valve. This valve has three flaps, or cusps, and one cusp is indicated. Strands of connective tissues called **chordae tendinae (F)** support the valve and prevent the cusps from flapping back into the right atrium, and the **papillary muscles (G)** hold the chordae tendinae in position.

Now the blood enters the **right ventricle (H)**, which is the smaller of the two ventricles; note that the muscle wall here is thinner. Blood flows into this ventricle and, when it contracts, the blood is forced upward, as the arrows show. Note the substantial size of the **interventricular septum (I)** that separates the right and left ventricles. The blood is forced out through the **pulmonary semilunar valve (J)**, and then into the pulmonary trunk. The semilunar valve prevents the blood from flowing back into the ventricle.

The **pulmonary trunk (K)** now divides to become the **left pulmonary artery (L)** and the **right pulmonary artery (M)**, which lead to the two lungs. This begins the pulmonary circuit. Note the direction of the arrows and color them blue.

> Blood is circulated to the lungs for oxygenation, then returns to the heart for distribution to the rest of the body. We will now follow the path of blood through the left side of the heart.

Blood returns to the heart by means of the pulmonary veins. Since the blood is oxygenated, the arrows should be colored in red. The blood now enters the **left atrium (N)**, which is the second receiving chamber. The left atrium is separated from the right atrium by the **intra-atrial septum (O)**.

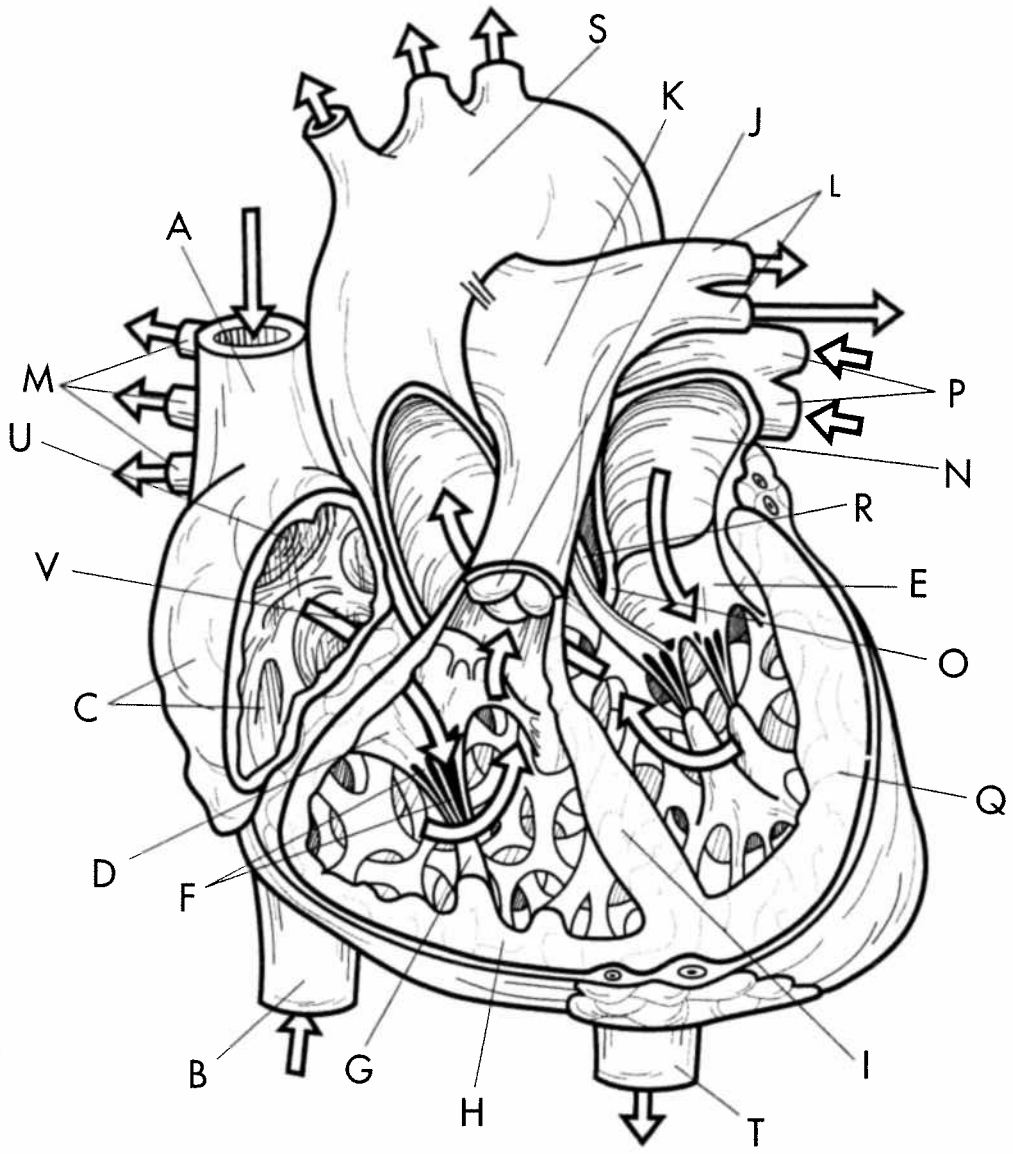
Blood now flows through the **left atrioventricular valve (P)**, which is also called the mitral valve, and enters the **left ventricle (Q)**, which is the larger of the two ventricles. When the ventricle undergoes contraction, the blood is forced up to the aorta, passing through the **aortic semilunar valve (R)**, which cannot be seen because it lies behind the pulmonary trunk.

On passing through the valve, oxygenated blood enters the **arch of the aorta (S)**. The aorta turns to the posterior region and flows behind the heart. It can be seen emerging as the **descending aorta (T)**. Arteries that arise from the aorta travel to the thorax, abdomen, pelvic cavity, and lower extremities.

> We will now briefly discuss electrical control of the heart and the heart cycle.

The cells of the heart are self-excitable, which means that they can contract without first receiving a signal from the nervous system. Their contraction is initially caused by a region of the heart called the **sinoatrial (SA) node (U)**, which is also sometimes called the pacemaker. As you can see in the art, the SA node is in the wall of the right atrium. When the SA node contracts, a wave of excitation travels through the heart wall, causing the two atria to contract in unison. At the boundary of the atria is the atrioventricular node, or **AV node (V)**. The impulse travels to the AV node, where it is delayed for a fraction of a second in order to allow the atria to empty completely, and then spreads through the ventricles via Purkinje fibers, which causes them to contract.

The heart cycle refers to the sequence of events that occur during the course of a heartbeat. There are two phases of this cycle: systole, in which the heart contracts and blood is pumped, and diastole, during which the heart is relaxed. These two phases are approximately equal in duration. The flow of blood is as follows: during the first part of systole, the atria contract and blood is squeezed into the ventricles, then toward the end of systole the ventricles pump blood into the arteries. Diastole, which comes next, allows the ventricles to refill with blood from the atria.



The Heart

- ○ Superior Vena Cava ....A
- ○ Inferior Vena Cava ....B
- ○ Right Atrium C
- ○ Tricuspid Valve.....D
- ○ Cusp of the Valve.....E
- ○ Chordae Tendinae .....F
- ○ Papillary Muscles.....G
- ○ Right Ventricle.....H
- ○ Interventricular Septum I
- ○ Pulmonary Semilunar Valve.....J
- ○ Pulmonary Trunk.....K
- ○ Left Pulmonary Artery L
- ○ Right Pulmonary Artery .....M
- ○ Left Atrium.....N
- ○ Intra-atrial Septum....O
- ○ Left Atrioventricular Valve.....P
- ○ Left Ventricle .....Q
- ○ Aortic Semilunar Valve.....R
- ○ Arch of the Aorta ....S
- ○ Descending Aorta .....T
- ○ SA Node.....U
- ○ AV Node.....V