

## Chapter 13 Cardiovascular System

### **Cardiovascular System:**

The cardiovascular (CV) system consists of the heart, and blood vessels, arteries, capillaries, and veins.  
What is the function of the CV system?

### Heart:

The heart is a hollow, \_\_\_\_\_-shaped, muscular organ within the \_\_\_\_\_ cavity.

The average adult heart is \_\_\_\_\_ cm long and \_\_\_\_\_ cm wide.

The heart lies in the \_\_\_\_\_ under the sternum; its apex extends to the \_\_\_\_\_ intercostal space.

### Pericardium:

It is made of two layers: the outer, tough connective tissue \_\_\_\_\_ pericardium surrounding a more delicate \_\_\_\_\_ pericardium (also called \_\_\_\_\_) that surrounds the heart.

At the base of the heart, the inner layer folds back to become the \_\_\_\_\_ pericardium that lines the tough outer layer.

Between the two pericardia is a potential space called the \_\_\_\_\_ cavity and filled with \_\_\_\_\_ fluid.

### Wall of the Heart:

The wall of the heart is composed of three distinct layers.

The outermost layer, the \_\_\_\_\_, is made up of connective tissue and epithelium, and contains blood and lymph capillaries along with \_\_\_\_\_ arteries. It is the same as the visceral pericardium.

The middle layer called \_\_\_\_\_ consists of cardiac muscle and is the thickest layer of the heart wall.

The inner \_\_\_\_\_ is smooth and is made up of connective tissue and epithelium, and is continuous with the endothelium of major vessels joining the heart.

### Heart chambers:

The heart has four internal chambers: two on top and two below. A \_\_\_\_\_ divides the chambers on each side.

Upper chambers, \_\_\_\_\_, receive blood returning to the heart and have thin walls and ear-like auricles projecting from their exterior.

Below them, the thick-muscled \_\_\_\_\_ pump blood to the body and lungs.

### Heart valves:

The right A-V valve called \_\_\_\_\_ and left A-V valve called either \_\_\_\_\_ or the \_\_\_\_\_ valve have cusps to which strings called \_\_\_\_\_ attach.

These strings are, in turn, attached to \_\_\_\_\_ muscles in the inner heart wall that contract during ventricular contraction to prevent the backflow of blood through the A-V valves.

Where are the semilunar valves found?

What is their function?

### Skeleton of the Heart:

Rings of dense connective tissue lie surrounding the pulmonary trunk and aorta to provide attachments for the heart \_\_\_\_\_ and \_\_\_\_\_.

These tough rings prevent dilating of tissue in this area.

Path of blood through heart: superior and inferior vena cava, \_\_\_\_\_, \_\_\_\_\_ valve, \_\_\_\_\_, \_\_\_\_\_ valve, \_\_\_\_\_ lungs, \_\_\_\_\_, \_\_\_\_\_ valve, \_\_\_\_\_, \_\_\_\_\_ valve, \_\_\_\_\_ body. Which part is pulmonary and which is systemic?

What is the function of pulmonary circulation?

Of systemic circulation?

### **Heart Blood Supply:**

The first branches off of the aorta, which carry freshly oxygenated blood, are the right and left \_\_\_\_\_ arteries that feed the heart muscle itself.

Branches of these arteries feed many capillaries of the myocardium.

The heart muscle requires a continuous supply of freshly oxygenated blood, so smaller branches of arteries often have \_\_\_\_\_ as alternate pathways for blood, should one pathway become blocked.

\_\_\_\_\_ veins drain blood from the heart muscle and carry it to the coronary \_\_\_\_\_.

### **Cardiac cycle:**

The cardiac cycle consists of the atria beating in unison (atrial \_\_\_\_\_) followed by the contraction of both ventricles, (ventricular \_\_\_\_\_) then the entire heart relaxes for a brief moment (\_\_\_\_\_).

During the cardiac cycle, pressure within the heart chamber rises and falls with the \_\_\_\_\_ and \_\_\_\_\_ of atria and ventricles.

When the atria fill, pressure in the atria is \_\_\_\_\_ than that of the ventricles, which forces the \_\_\_\_\_ valves open.

Pressure inside the atria rises further as they contract, forcing the remaining blood into the ventricles.

When ventricles contract, pressure inside them \_\_\_\_\_ sharply, causing \_\_\_\_\_ valves to close and the \_\_\_\_\_ and \_\_\_\_\_ valves to open.

As the ventricles contract, \_\_\_\_\_ muscles contract, pulling on \_\_\_\_\_ and preventing the backflow of blood through the A-V valves.

### **Heart sounds:**

Heart sounds can be described as a “lubb-dupp” sound.

The first sound (lubb) occurs as \_\_\_\_\_ contract and \_\_\_\_\_ valves are closing.

The second sound (dupp) occurs as \_\_\_\_\_ relax and aortic and \_\_\_\_\_ valves are closing.

### **Conduction system:**

A mass of merging fibers that act as a unit is called a functional \_\_\_\_\_; one exists in the atria and one in the ventricles.

Specialized cardiac muscle tissue conducts impulses throughout the myocardium and comprises the cardiac conduction system.

A self-exciting mass of specialized cardiac muscle called the \_\_\_\_\_ node (\_\_\_\_\_ node or pacemaker), located on the posterior right atrium, generates the impulses for the heartbeat.

Impulses spread next to the atrial \_\_\_\_\_, it contracts, and impulses travel to the junctional fibers leading to the \_\_\_\_\_ node (\_\_\_\_\_ node) located in the septum.

Junctional fibers are small, allowing the atria to contract before the impulse spreads rapidly over the ventricles. Branches of the \_\_\_\_\_ bundle give rise to \_\_\_\_\_ fibers leading to papillary muscles; these fibers stimulate contraction of the papillary muscles at the same time the ventricles contract.

**ECG:**

The first wave, the \_\_\_\_\_ wave, corresponds to the \_\_\_\_\_ of the atria.  
The \_\_\_\_\_ complex corresponds to the \_\_\_\_\_ of ventricles and hides the \_\_\_\_\_ of atria.  
The \_\_\_\_\_ waves ends the ECG pattern and corresponds to ventricular \_\_\_\_\_.

**Heart rate control:**

The amount of blood pumped at any one time must adjust to the current needs of the body (more is needed during strenuous exercise).  
The S-A node is innervated by branches of the \_\_\_\_\_ and \_\_\_\_\_ divisions, so the CNS controls heart rate. Impulses from the former speed up and impulses from the latter slow down heart rate.  
The \_\_\_\_\_ control center of the \_\_\_\_\_ maintains a balance between the two autonomic divisions of the nervous system in response to messages from \_\_\_\_\_ which detect changes in blood pressure.  
Impulses from \_\_\_\_\_ or \_\_\_\_\_ may also influence heart rate, as do body temperature and the concentrations of certain \_\_\_\_\_.

**Blood vessels:**

The blood vessels (arteries, arterioles, capillaries, venules, and veins) form a closed tube that carries blood away from the heart, to the cells, and back again.

**Arteries:**

Arteries are strong, elastic vessels adapted for carrying high-pressure blood.  
Arteries become smaller as they divide and become \_\_\_\_\_.  
The wall of an artery consists of an inner endothelium layer, tunica \_\_\_\_\_ (smooth muscle), and tunica \_\_\_\_\_ (connective tissue).  
Arteries are capable of \_\_\_\_\_ as directed by the sympathetic impulses; when impulses are inhibited, smaller diameter (\_\_\_\_\_) results.

**Capillary:**

Capillaries are the smallest vessels, consisting only of a layer of \_\_\_\_\_ through which substances are exchanged with tissue cells.  
Areas with a great deal of metabolic activity (leg muscles, for example) have higher densities of capillaries.  
\_\_\_\_\_ sphincters can regulate the amount of blood entering a capillary bed and are controlled by \_\_\_\_\_ concentration in the area. If blood is needed elsewhere in the body, the capillary beds in less important areas are shut down.

Capillary Exchanges:

Blood entering capillaries contains high concentrations of \_\_\_\_\_ and \_\_\_\_\_ that diffuse out of the capillary wall and into the \_\_\_\_\_.  
Why do plasma proteins remain in the blood?

\_\_\_\_\_ pressure drives the passage of fluids and very small molecules out of the capillary at this point. At the venule end, \_\_\_\_\_, due to the proteins in the blood, causes much of the tissue fluid to return to the bloodstream. \_\_\_\_\_ vessels collect excess tissue fluid and return it to circulation.

**Veins:**

Small vessels called \_\_\_\_\_ lead from capillaries and merge to form larger \_\_\_\_\_ that return blood to the heart. Veins have the same three layers as arteries have and have a flap-like \_\_\_\_\_ inside to prevent backflow of blood. How do veins differ from arteries?

**Blood pressure:**

Blood pressure is the force of blood against the inner walls of blood vessels anywhere in the cardiovascular system, although the term “blood pressure” usually refers to \_\_\_\_\_ pressure. Arterial blood pressure rises and falls following a pattern established by the cardiac cycle. During ventricular contraction, arterial pressure is at its \_\_\_\_\_ (\_\_\_\_\_ pressure). When ventricles are relaxing, arterial pressure is at its \_\_\_\_\_ (\_\_\_\_\_ pressure). The surge of blood that occurs with ventricular contraction can be felt at certain points in the body as a \_\_\_\_\_.

**Factors that affect blood pressure:**

Explain the four factors that effect blood pressure.

**Control of blood pressure:**

Blood pressure is determined by \_\_\_\_\_ output and \_\_\_\_\_ resistance. The body maintains normal blood pressure by adjusting cardiac output and peripheral resistance. Cardiac output depends on \_\_\_\_\_ volume and \_\_\_\_\_, and a number of factors can affect these actions. Describe the factors that affect these actions.

The \_\_\_\_\_ center of the \_\_\_\_\_ in the brain stem can adjust the sympathetic impulses to \_\_\_\_\_ in arteriole walls, adjusting blood pressure.

**Mechanisms of blood return:**

Blood pressure at the venule end of a capillary is almost 0. So other factors help return the blood to the heart. Contractions of \_\_\_\_\_ muscle squeeze blood back up the veins one valve at a time. Differences in \_\_\_\_\_ and \_\_\_\_\_ pressures draw blood back up the veins.

Study analogy: Think of a juice box. The straw sucks the juice out of the container because of a difference in pressure between the drinker’s mouth and the box. But if you squeeze the box, the juice also moves up into the straw. Both are similar to what happens in the veins in our bodies.

**Arterial System:**

The \_\_\_\_\_ is the body's largest artery.

**Be able to recognize and locate the following arteries:**Principal Branches:

The branches of the ascending aorta are the right and left coronary arteries that lead to heart muscle.

Principal branches of the aortic arch include the brachiocephalic, left common carotid, and left subclavian arteries.

The descending aorta (thoracic aorta) gives rise to many small arteries to the thoracic wall and thoracic viscera.

The abdominal aorta gives off the following branches: celiac, superior mesenteric, suprarenal, renal, gonadal, inferior mesenteric, and common iliac arteries.

Arteries to the Head, Neck, and Brain:

Arteries to the head, neck, and brain include branches of the subclavian and common carotid arteries.

The vertebral arteries supply the vertebrae and their associated ligaments and muscles.

In the cranial cavity, the vertebral arteries unite to form a basilar artery that ends as two posterior cerebral arteries.

The posterior cerebral arteries help form the circle of Willis that provides alternate pathways through which blood can reach the brain.

The right and left common carotid arteries diverge into the external carotid and internal carotid arteries.

Near the base of the internal carotid arteries are the carotid sinuses that contain baroreceptors to monitor blood pressure.

Arteries to the Shoulder and Upper Limb:

The subclavian artery continues into the arm where it becomes the axillary artery.

In the shoulder region, the axillary artery becomes the brachial artery that, in turn, gives rise to the ulnar and radial Arteries.

Arteries to the Thoracic and Abdominal Walls:

Branches of the thoracic aorta and subclavian artery supply the thoracic wall with blood.

Branches of the abdominal aorta, as well as other arteries, supply the abdominal wall with blood.

Arteries to the Pelvis and Lower Limb:

At the pelvic brim, the abdominal aorta divides to form the common iliac arteries that supply the pelvic organs, gluteal area, and lower limbs.

The common iliac arteries divide into internal and external iliac arteries. Internal iliac arteries supply blood to pelvic muscles and visceral structures.

External iliac arteries lead into the legs, where they become femoral, popliteal, anterior tibial, and posterior tibial arteries.

**Venous System:**

Veins return blood to the heart after the exchange of substances has occurred in the tissues. Larger veins parallel the courses of arteries and are named accordingly; smaller veins take irregular pathways and are unnamed.

Veins from the head and upper torso drain into the \_\_\_\_\_.

Veins from the lower body drain into the \_\_\_\_\_. Both go to the \_\_\_\_\_ atrium.

**Be able to recognize and locate these veins**Veins from the Head, Neck, and Brain:

The jugular veins drain the head and unite with the subclavian veins to form the brachiocephalic veins.

Veins from the Upper Limb and Shoulder:

The upper limb is drained by superficial and deep veins.

The basilic and cephalic veins are major superficial veins.

The major deep veins include the radial, ulnar, brachial, and axillary veins.

Veins from the Abdominal and Thoracic Walls:

Tributaries of the brachiocephalic and azygos veins drain the abdominal and thoracic walls.

Veins from the Abdominal Viscera:

Blood draining from the intestines enters the hepatic portal system and flows to the liver first rather than into general circulation.

Hepatic veins drain the liver, gastric veins drain the stomach, superior mesenteric veins lead from the small intestine and colon, the splenic vein leaves the spleen and pancreas, and the inferior mesenteric vein carries blood from the lower intestinal area.

Veins from the Lower Limb and Pelvis:

Deep and superficial veins drain the leg and pelvis.

The deep veins include the anterior and posterior tibial veins which unite into the popliteal vein and femoral vein; superficial veins include the small and great saphenous veins.

These veins all merge to empty into the common iliac veins.