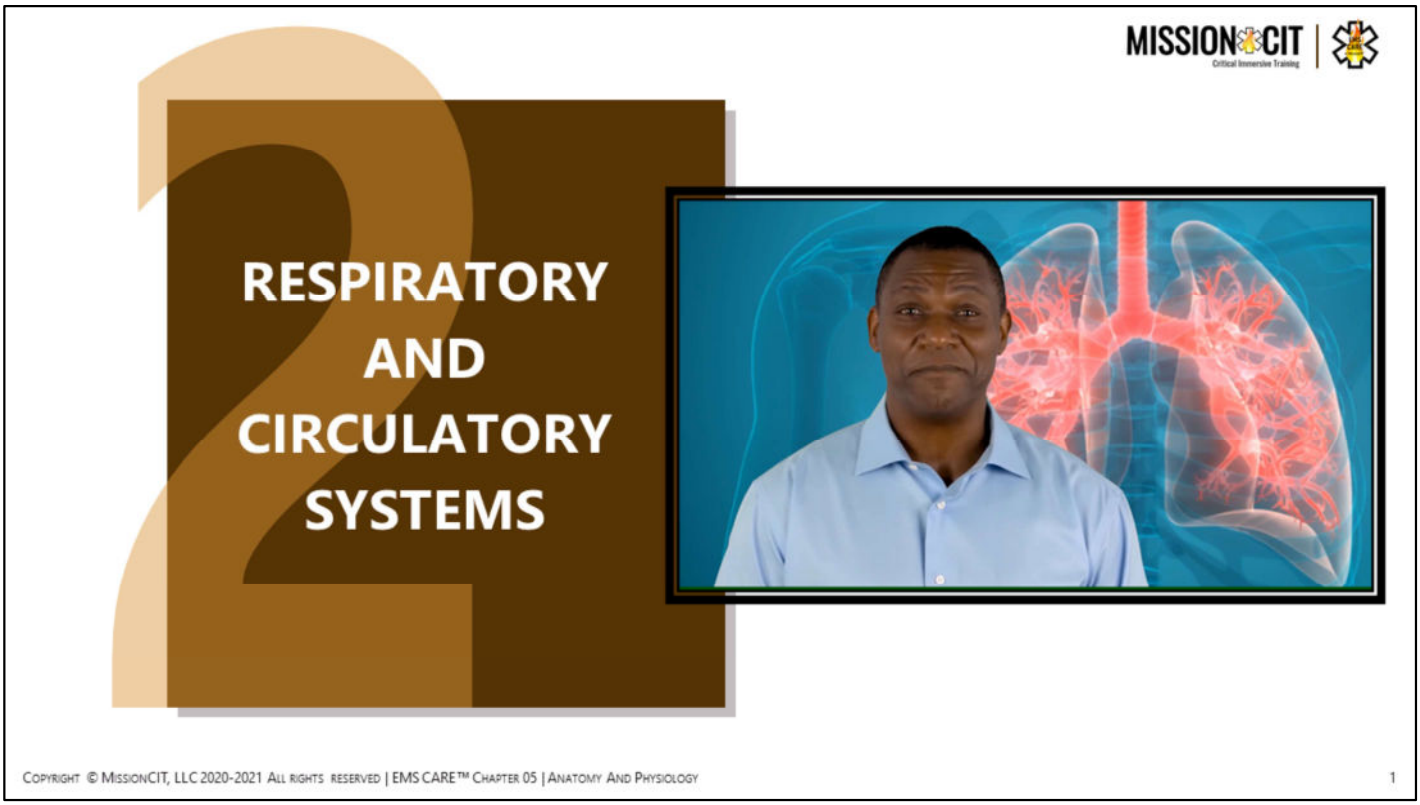
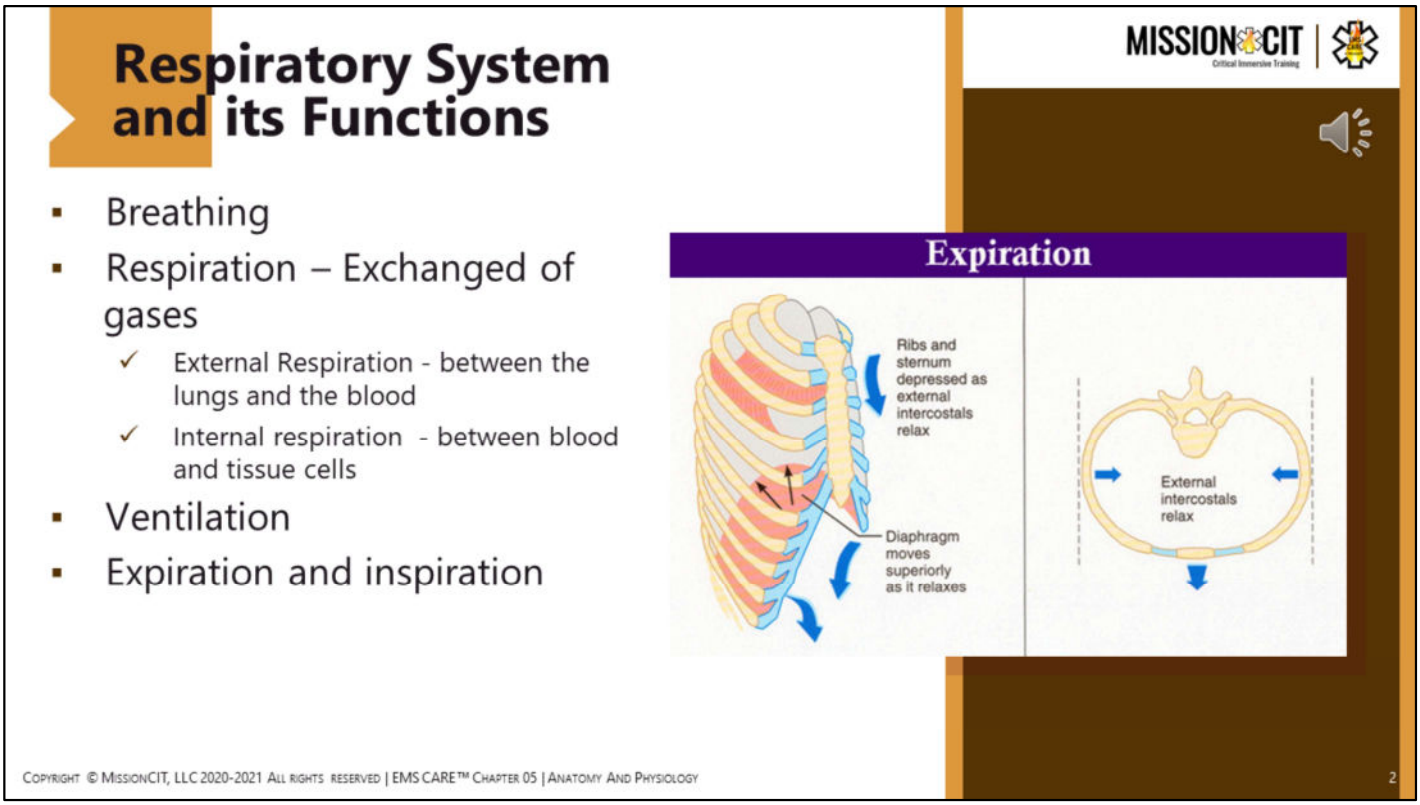


Thank you, Missah! Welcome to this lesson where we talk about respiratory and circulatory systems.



The respiratory system consists of all the structures that contribute to the process of breathing. But that's not its sole function. The body cells need a continuous supply of oxygen for the metabolic processes needed to maintain life, and the respiratory system works in conjunction with the circulatory system to provide this oxygen and to remove the waste products that are generated in the process.

Two important and interdependent functions of the respiratory system are respiration and ventilation.

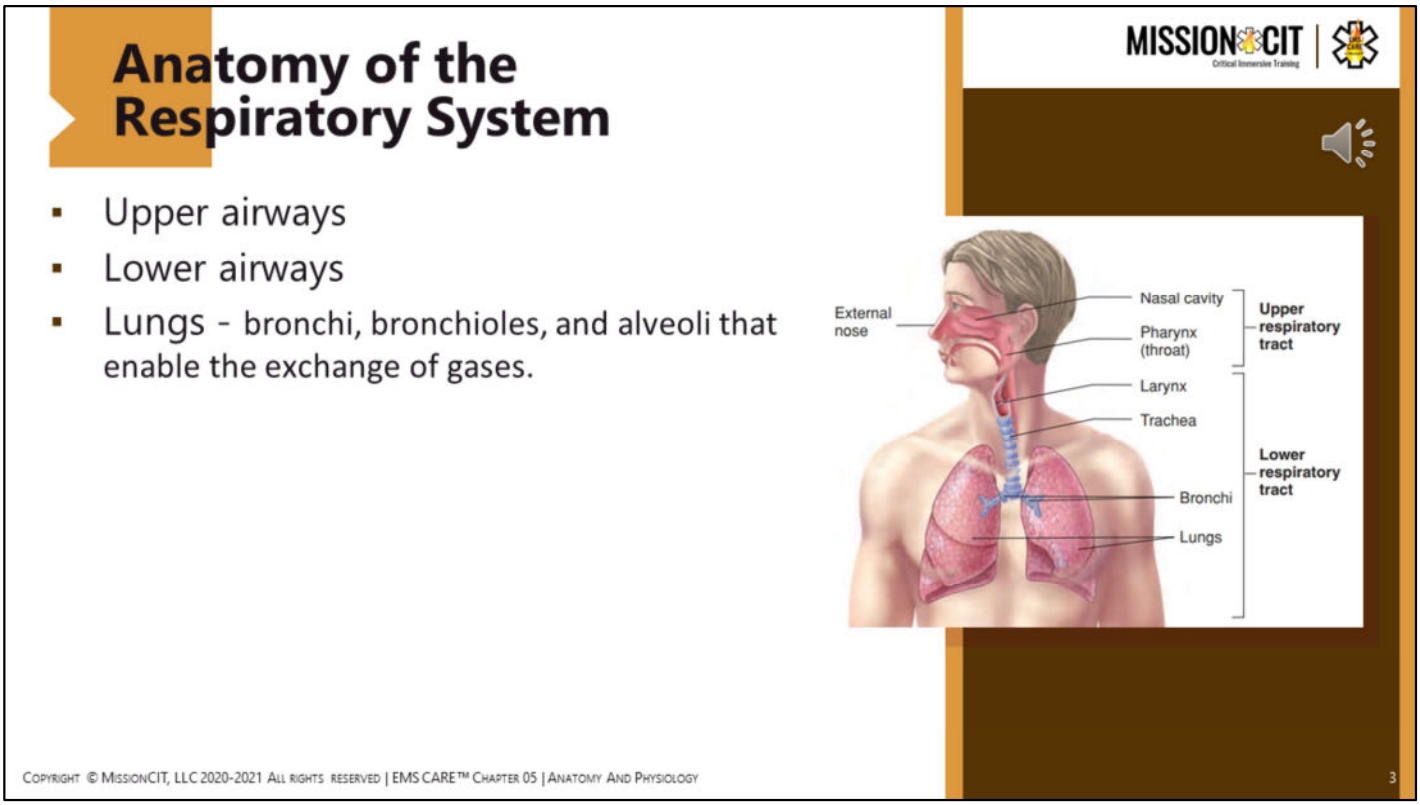
Respiration is the sequence of events that results in the exchange of oxygen and carbon dioxide between the atmosphere and the body cells. Every 3 to 5 seconds, nerve impulses stimulate the breathing process, or ventilation, which moves air through a series of passages into and out of the lungs. After this, there is an exchange of gases between the lungs and the blood. This is called external respiration. The blood transports the gases to and from the tissue cells. The exchange of gases between the blood and tissue cells is internal respiration. Finally, the cells utilize oxygen for their specific activities: this is called cellular metabolism, or cellular respiration. Together, these activities constitute respiration.

Ventilation, or breathing, is the movement of air through the conducting passages between the atmosphere and the lungs. The air moves through the passages because of pressure gradients that are produced by the contraction of the diaphragm and thoracic muscles.

Pulmonary ventilation is commonly referred to as breathing. It is the process of air flowing

into the lungs during inspiration (inhalation) and out of the lungs during expiration (exhalation). Air flows because of pressure differences between the atmosphere and the gases inside the lungs. Atmospheric pressure is the pressure of the air outside the body. Intra-alveolar pressure is the pressure inside the alveoli of the lungs. Intrapleural pressure is the pressure within the pleural cavity. These three pressures are responsible for pulmonary ventilation.

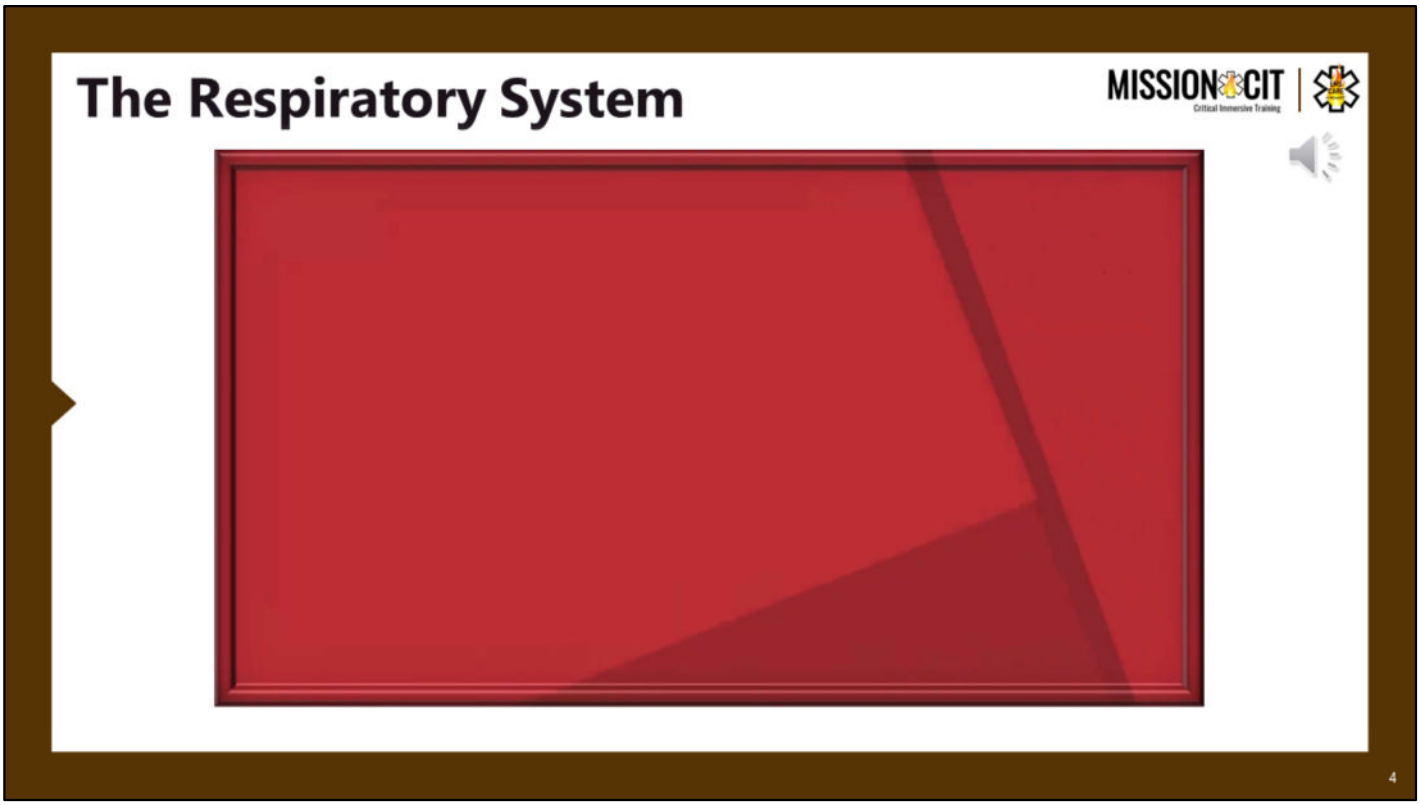
Inspiration or inhalation is the process of taking air into the lungs. It is the active phase of ventilation because it is the result of muscle contraction. During inspiration, the diaphragm contracts, and the thoracic cavity increases in volume. This decreases the intra-alveolar pressure so that air flows into the lungs. Inspiration draws air into the lungs. Expiration or exhalation is the process of letting air out of the lungs during the breathing cycle. During expiration, the relaxation of the diaphragm and elastic recoil of tissue decreases the thoracic volume and increases the intra-alveolar pressure. Expiration pushes air out of the lungs.



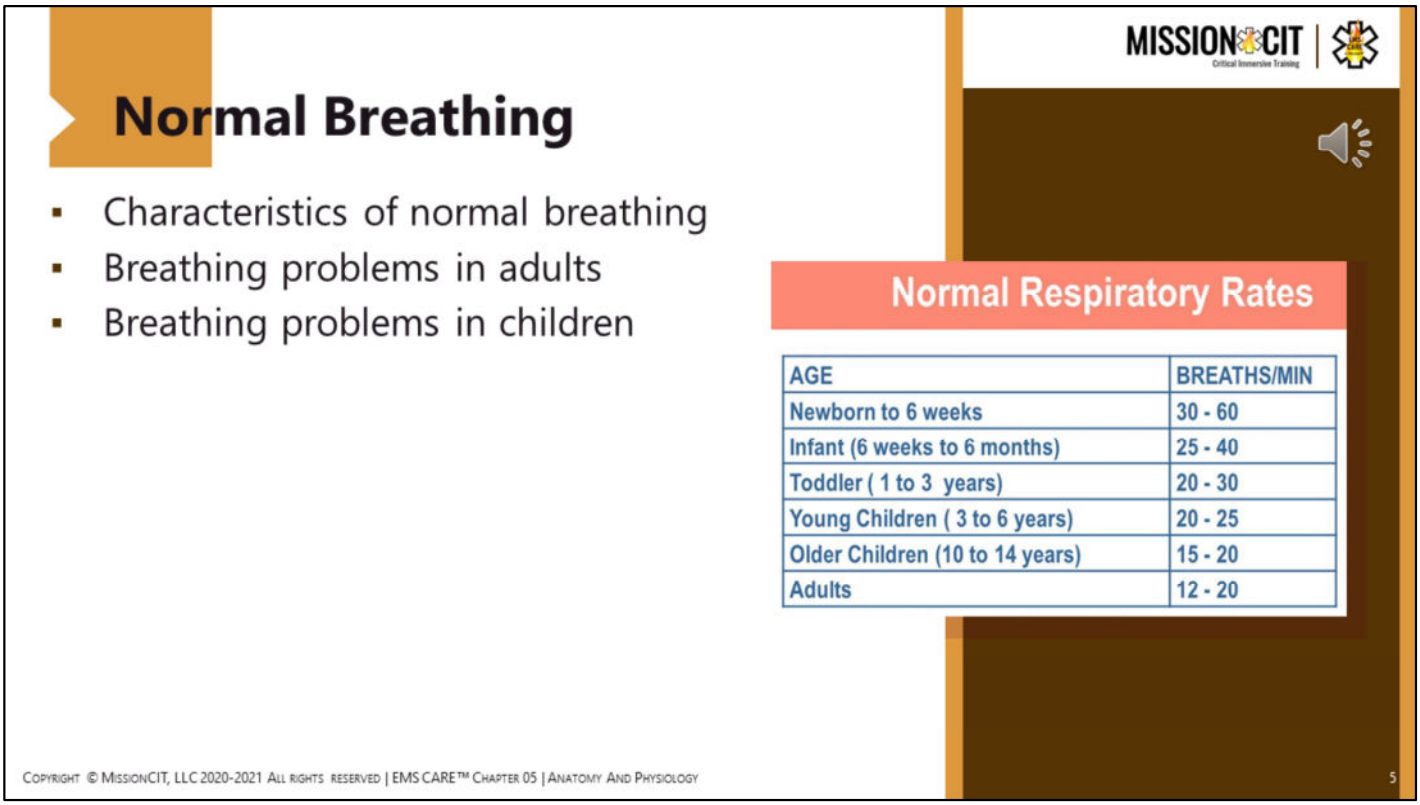
The respiratory system can be broadly divided into the upper airways, lower airways, and lungs. The upper airways consist of the nose, mouth, tongue, jaw, larynx, pharynx, trachea, and esophagus while the lower airway consists of the thyroid cartilage or Adam's apple, the cricoid cartilage present below the thyroid cartilage, and the trachea that ends at the carina to divide into the right and left bronchi that in turn leads to bronchioles.

The lungs are divided into lobes, and each contains bronchi, bronchioles, and alveoli that enable the exchange of gases.

The process of breathing is facilitated by the diaphragm and intercostal muscles. Other muscles involved in the breathing process are the cervical, abdominal, and pectoral muscles.



The function of the respiratory system is gas exchange: to gather oxygen from the environment for the body and expel carbon dioxide (a waste product) from the body. The diaphragm is the large muscle inside that lies between the chest and abdomen. The intercostal muscles are between ribs. Breathing in (inspiration) starts when the diaphragm and intercostal muscles contract, expanding the chest and sucking air in through the nose and mouth. Air then passes through the voicebox (larynx) into the windpipe (trachea) to the right and left main air tubes (bronchi). The bronchi then divide further, into smaller tubes called bronchioles and eventually, capillaries. Capillaries are extremely thin. Oxygen and carbon dioxide pass through the capillaries in the lungs, accomplishing gas exchange. After inspiration, the diaphragm and intercostal muscles relax, and the person exhales.



Under normal conditions, the average adult takes 12 to 15 breaths a minute. A breath is one complete respiratory cycle that consists of one inspiration and one expiration.

Factors such as age, sex, body build, and physical conditioning influence lung volumes and capacities. Lungs usually reach their maximum capacity in early adulthood and decline with age after that.

Some of the characteristics of normal breathing are:

- Normal rate and depth, also known as the tidal volume
- A regular rhythmic pattern of inhalation and exhalation
- Clear and audible breath sounds from both sides of the chest
- Regular rise and fall movement on both sides of the chest
- Movement of the abdomen

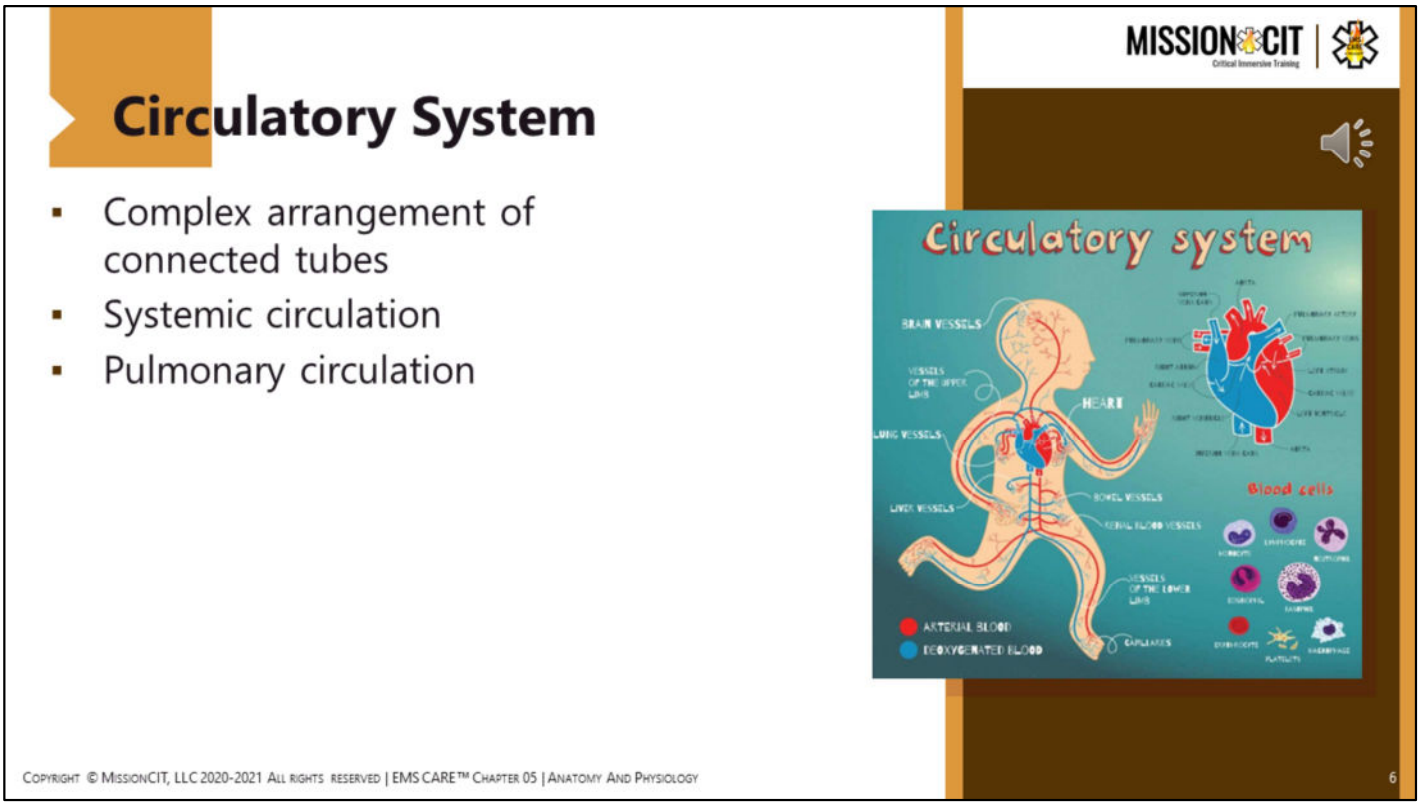
The following signs in adults tell you that the patient is suffering from breathing problems.

- Labored breathing
- Muscle retractions
- Pale, cyanotic, cool, and damp skin

- A patient in a tripod position
- Gasps between breaths

In children, you may notice the following additional symptoms as well to indicate abnormal breathing.

- Increase in the number of breaths per minute
- An increased heart rate that indicates low oxygen levels
- A bluish color around the mouth
- Grunting sounds, wheezing, and stridor
- Nose flaring
- Sweating
- Change in mental status and alertness levels

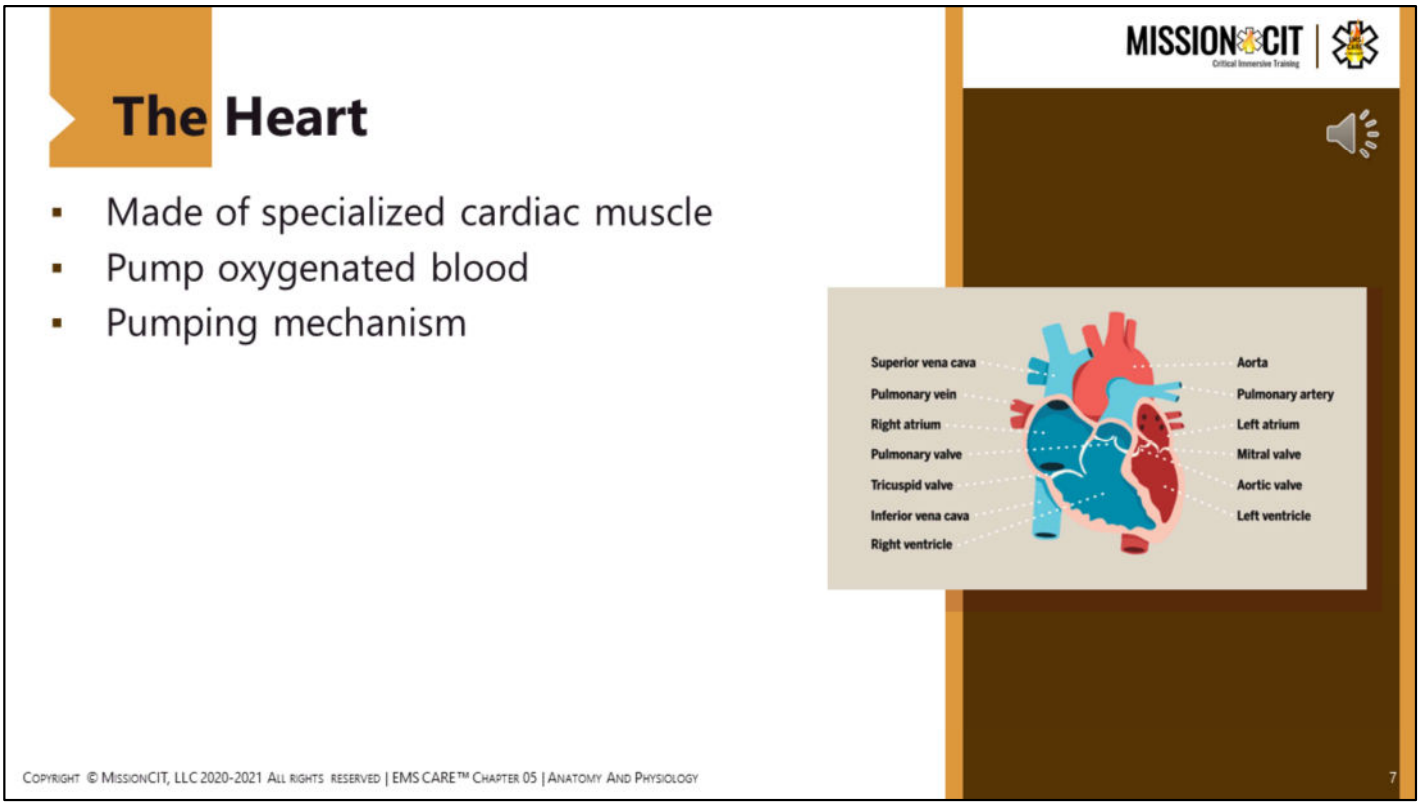


The circulatory or the cardiovascular system is a complex arrangement of connected tubes such as arteries, veins, capillaries, venules, and arterioles that take the oxygen to the cells and remove carbon dioxide from them.

This process of circulation can be divided into systemic and pulmonary. Pulmonary circulation moves blood between the heart and the lungs. It transports deoxygenated blood to the lungs to absorb oxygen and release carbon dioxide. The oxygenated blood then flows back to the heart.

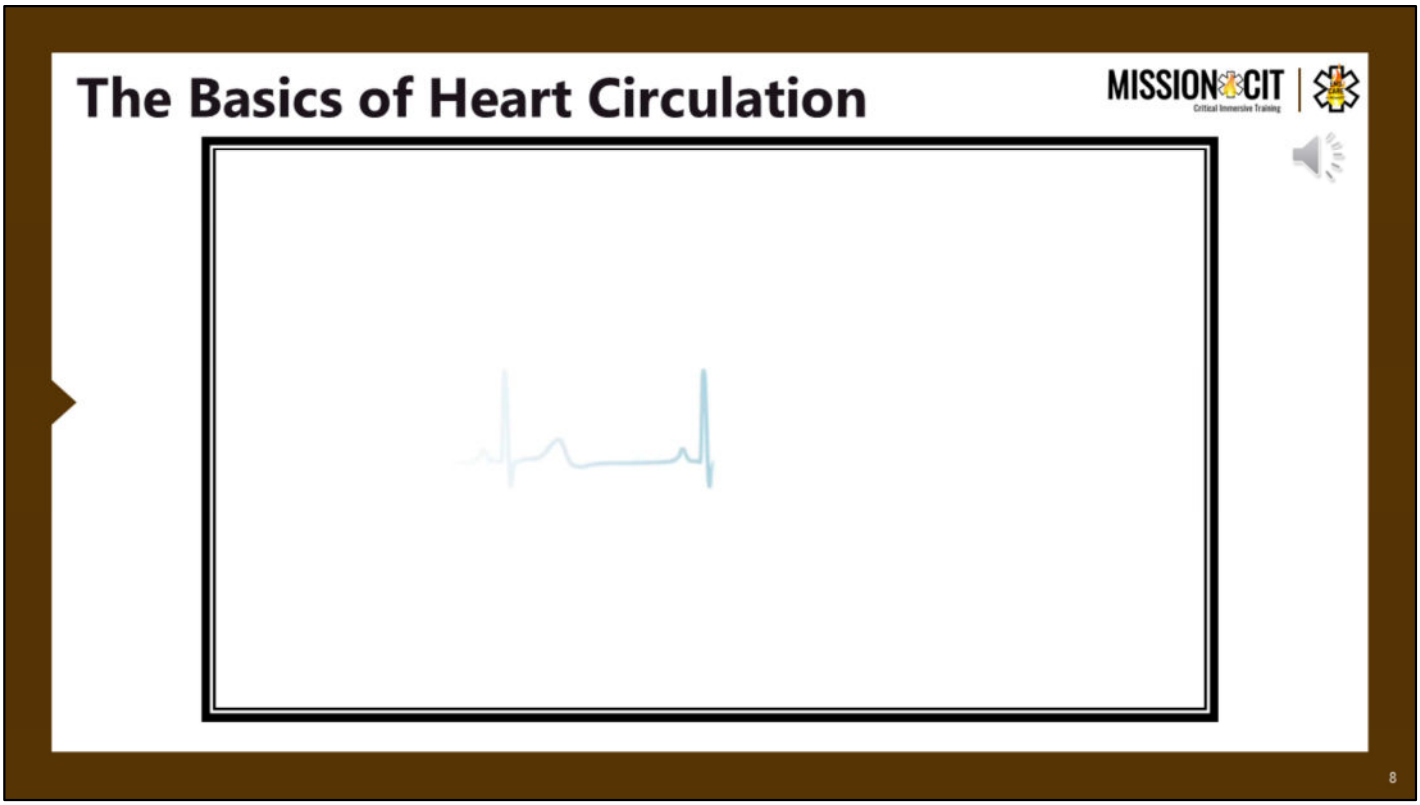
Systemic circulation, on the other hand, moves blood between the heart and the rest of the body. It sends the oxygenated blood out to cells and returns deoxygenated blood to the heart.

To accomplish this function, the circulatory system comprises the heart, arteries, veins, capillaries, blood, and spleen.

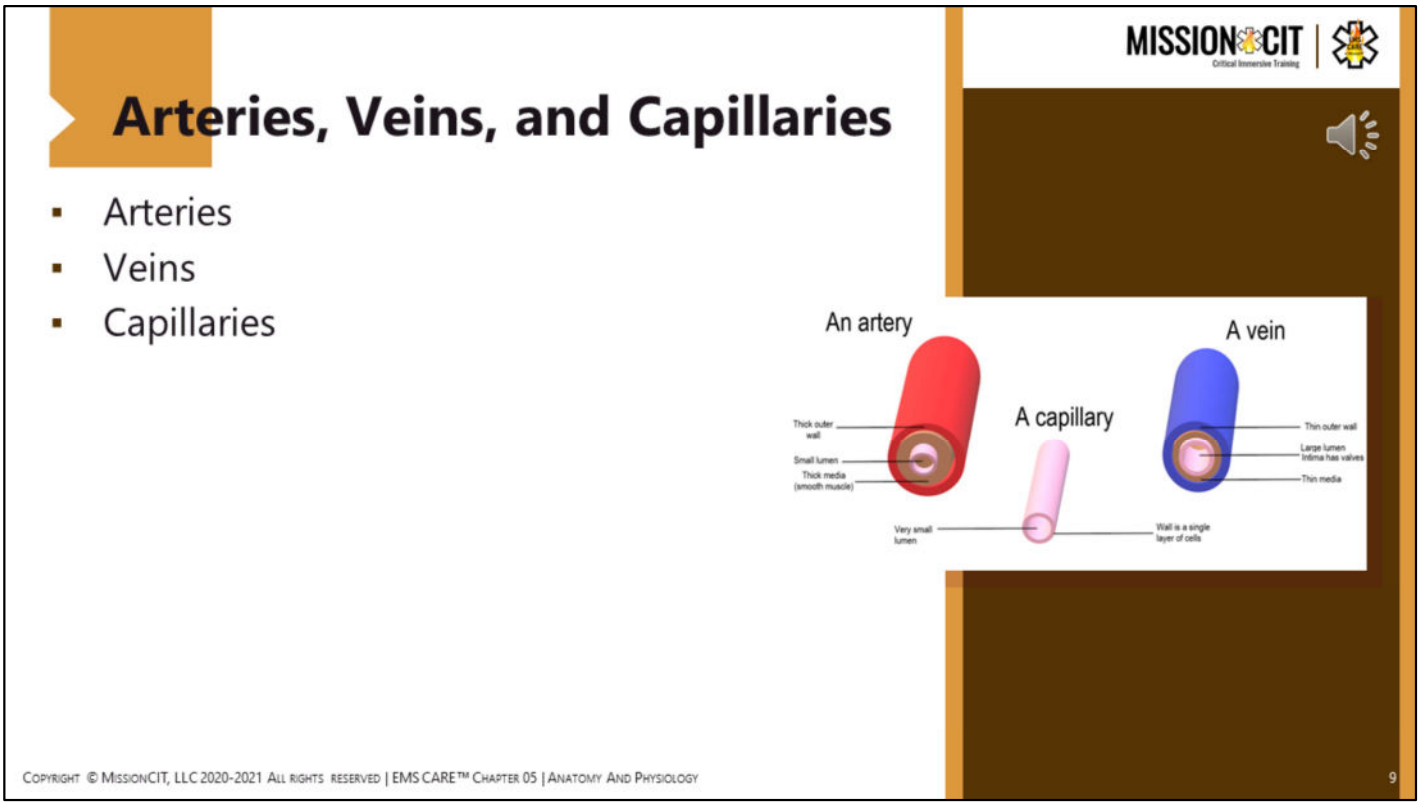


The heart is a muscle pump that's made up of specialized cardiac muscle. It works as a paired pump. The septum is the heart divides into right and left sides and each side is divided into upper and lower chambers. In all, the human heart has four chambers, namely, the upper and lower atrium and the upper and lower ventricles respectively. The central function of the heart is to oxygenate the blood and send it to the cells. To do this, it receives blood from the aorta. The right side of the heart receives deoxygenated blood from the veins while the left side receives oxygenated blood from the lungs. Its role is to move the deoxygenated blood to the lungs and move the oxygenated blood to the cells. It accomplishes this through the electrical conduction system that causes smooth and coordinated contractions. In turn, the contractions produce the pumping action.

This is done through a pumping mechanism that is considered as the heart rate. In normal and healthy adults, this heart rate ranges from 60 to 100 beats per minute. The stroke volume is the amount of blood moved in one heartbeat while the cardiac output is the amount of blood moved in one minute. A pulse is created by the forceful pumping of blood from the left ventricle into the major arteries and is palpated mostly at the wrist, neck, and groin.



Most of us never stop to think how our heart and circulation really works. However, when you understand the basics of circulation, you can make much better decisions about your heart health, disease prevention, and treatment options for heart disease. Here's an illustrated one minute overview of the basics of circulation from the American Heart Association.

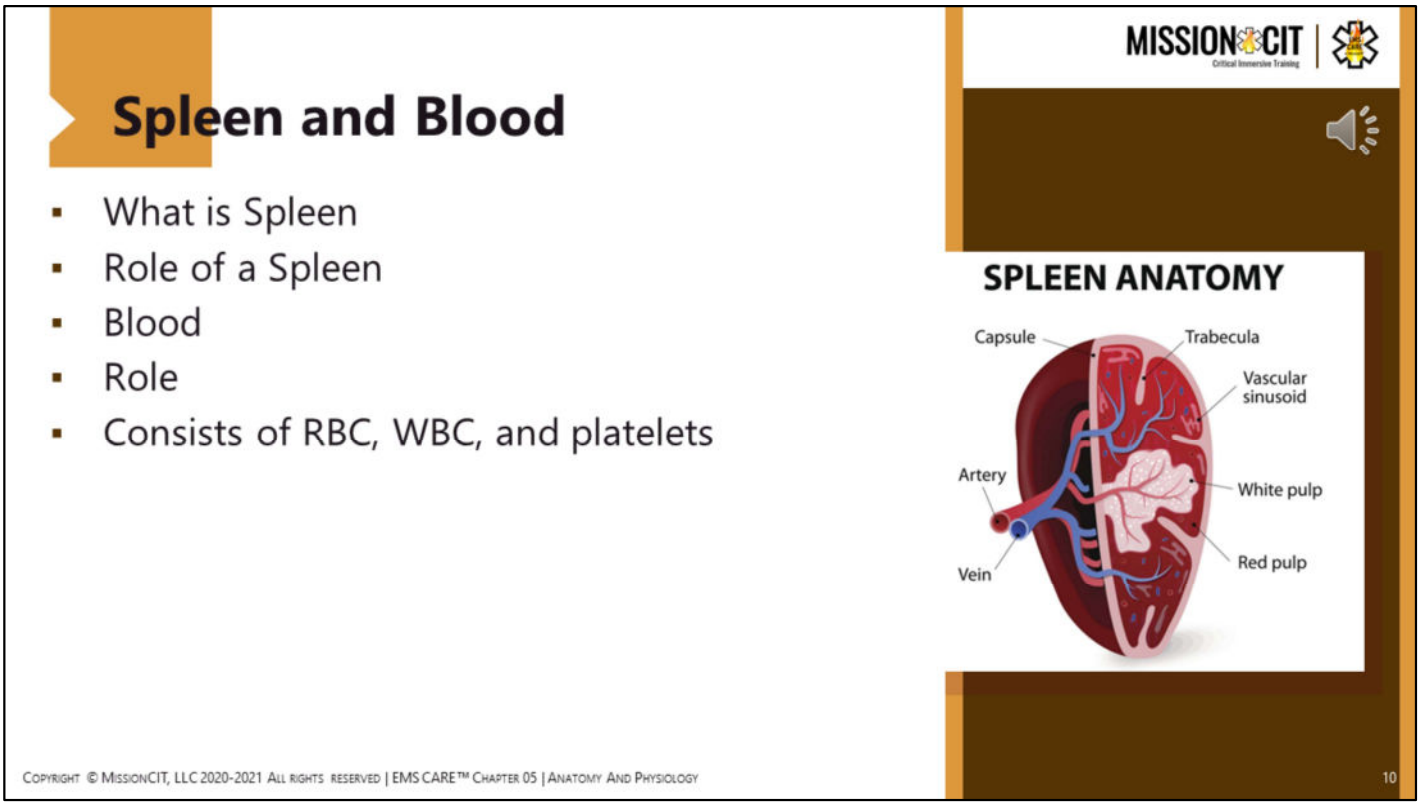


Besides the heart, the circulation system consists of arteries, veins, and capillaries.

The arteries carry blood from the heart to all body tissues. These arteries branch into smaller arteries and then to arterioles. Further, these arterioles branch into smaller vessels until they connect to the capillaries. Out of the many arteries, the pulmonary artery is a prominent one that carries oxygen-poor blood to the lungs.

The veins are responsible for returning the oxygen-depleted blood to the heart. The superior vena cava carries blood returning from the head, neck, shoulders, and upper extremities while the inferior vena cava carries blood from the abdomen, pelvis, and lower extremities.

The capillaries are small structures that connect the arterioles to the venules to allow contact between the blood and the cells.



The spleen is a solid organ located under the rib cage and it is responsible for filtering blood. It has three prominent roles in the circulatory system, and they are:

- Clearing the microorganisms and particulate antigens from the bloodstream
- Removing abnormal red blood cells
- Synthesizing components such as IgG, properdin, and tuftsin

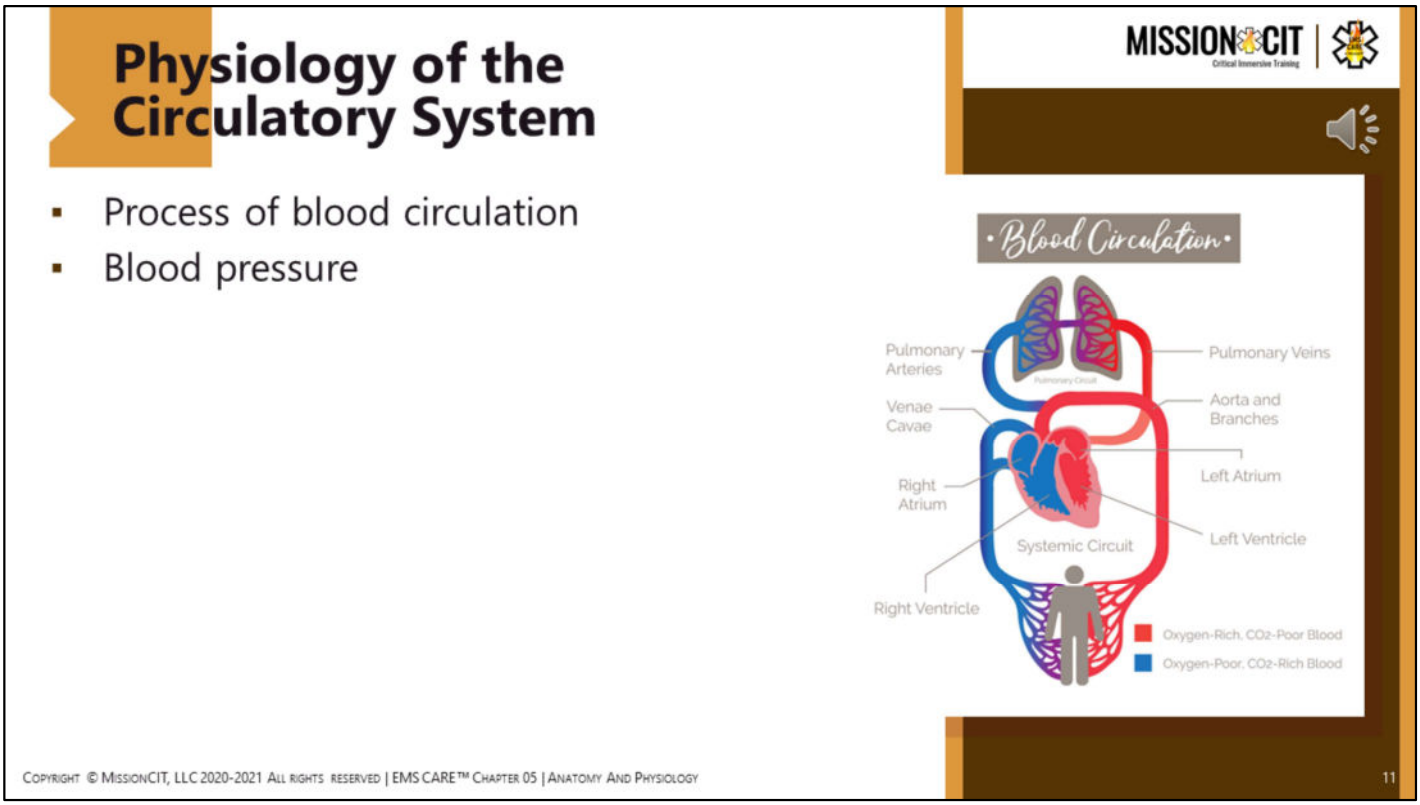
It is particularly susceptible to injury from blunt trauma and can quickly lead to severe internal bleeding.

Finally, the blood is the fluid of life, transporting oxygen from the lungs to body tissue and carbon dioxide from body tissue to the lungs. Blood is the fluid of growth, transporting nourishment from digestion and hormones from glands throughout the body. Blood is the fluid of health, transporting disease-fighting substances to the tissue and waste to the kidneys. Because it contains living cells, blood is alive. Red blood cells and white blood cells are responsible for nourishing and cleansing the body. Without blood, the human body would stop working.

It comprises red blood cells, white blood cells, and platelets and its functions include,

- Perfusion

- Transporting oxygen, carbon dioxide, wastes, and nutrients to and from the cells
- Clotting



The right upper chamber (atrium) takes in deoxygenated blood that is loaded with carbon dioxide. The blood is squeezed down into the right lower chamber (ventricle) and taken by an artery to the lungs where the carbon dioxide is replaced with oxygen.

The oxygenated blood travels back to the heart, this time entering the left upper chamber (atrium). It is pumped into the left lower chamber (ventricle) and then into the aorta (an artery). The blood starts its journey around the body once more.

Blood pressure refers to the amount of pressure inside the circulatory system as the blood is pumped around. It is divided into systole and diastole, where the systole occurs when the left ventricle contracts while the diastole occurs when the left ventricle relaxes. The systolic blood pressure is measured at the high point of the wave while the diastolic pressure is measured at the low point of the wave.

In healthy adults, the circulation is automatically controlled, as the blood enters the organs and tissues through the arteries and leaves through the veins. Perfusion is the adequate circulation of blood to meet the oxygen needs of each cell. The system is well-regulated and can often adjust to minor variations, but with a large loss of blood or other complications, the body is unable to adjust, and the patient can go into a shock.

This brings us to the end of this lesson and in the next one, Missah will talk about the nervous and integumentary systems.