The Amazing World of

The Human Body

IMPORTANT Page Numbers for our Anatomy Models

Contents

Welcome and Thank You!

Thank you for supporting us at Evviva Sciences. Our mission is to make science fun and enjoyable. We hope to encourage a passion and love for science! We hope you enjoy this complementary Human Anatomy Book, which includes interesting facts about the human body and diagrams to help you identify the different structures in the heart, skeleton, and other major organs.

Ask A Doctor!

We are extremely lucky to have two physicians on our team at Evviva Sciences, who would be happy to answer any of your questions. If you have any educational questions about learning anatomy or about the human body, just send us an email at support@evvivasciences.com, and we will forward it to our medical advisors! Thanks so much!

Introduction to the Human Body

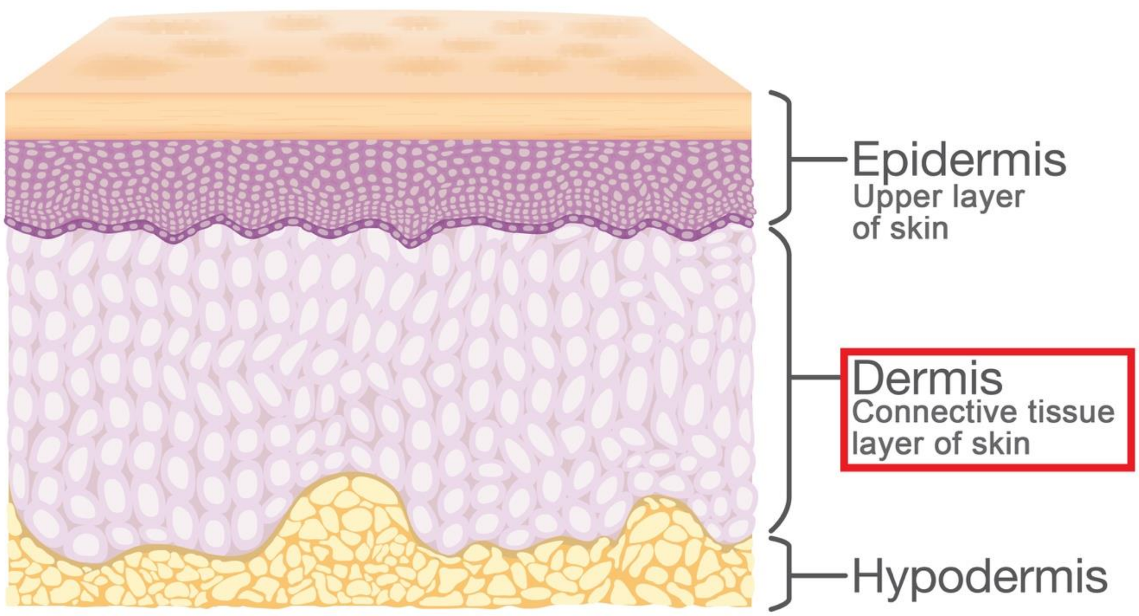
Designing the Human Body from a Cell and Up!

The best way to begin to understand the human body is to break it down to its microscopic pieces. Almost all structures in the human body are made up of cells. In fact, there are trillions of cells that make up the body, and different types of cells have important and distinct functions. If you take a group of related cells and put them together, you form a tissue. And groups of related tissues that have specific critical roles in your body are called organs. For example, the largest organ in the body is actually the skin (yes, the skin is considered an organ!). The skin consists of thousands of skin cells, many of which are termed keratinocytes. The heart is an organ made primarily from muscular tissue that includes a collection of a muscle cells known as cardiac myocytes. The liver is made of several different cell types, but primarily of cells called hepatocytes! The brain primarily includes cells called neurons! As you can see, a cell by itself may seem insignificant, but if you put them together, cells can form tissues and organs that do incredible things! Check out the images below for more information about specific types of cells.

Some Types of Cells and Tissues:

1. Connective Tissue

The body is made up of several important organs, including the brain, heart, kidneys, lungs and other critical structures. But what holds all of these pieces together? It is the connective tissue! The connective tissue is like the glue that holds the body in place. For example, check out the diagram of the skin below, and notice how it is made from so many layers. In particular, check out the layer called the dermis. This part of the skin is made out of strong connective tissue that holds the skin in place. It includes blood vessels, strong fibrous proteins, collagen, and cells called fibroblasts. In fact, there is a hereditary condition called Ehlers-Danlos syndrome, where people inherit a defect in their connective tissue. Individuals with this condition often have extremely stretchy skin along with flexible and loose joints. As you can see, the connective tissue of our bodies is really interesting and extremely important!

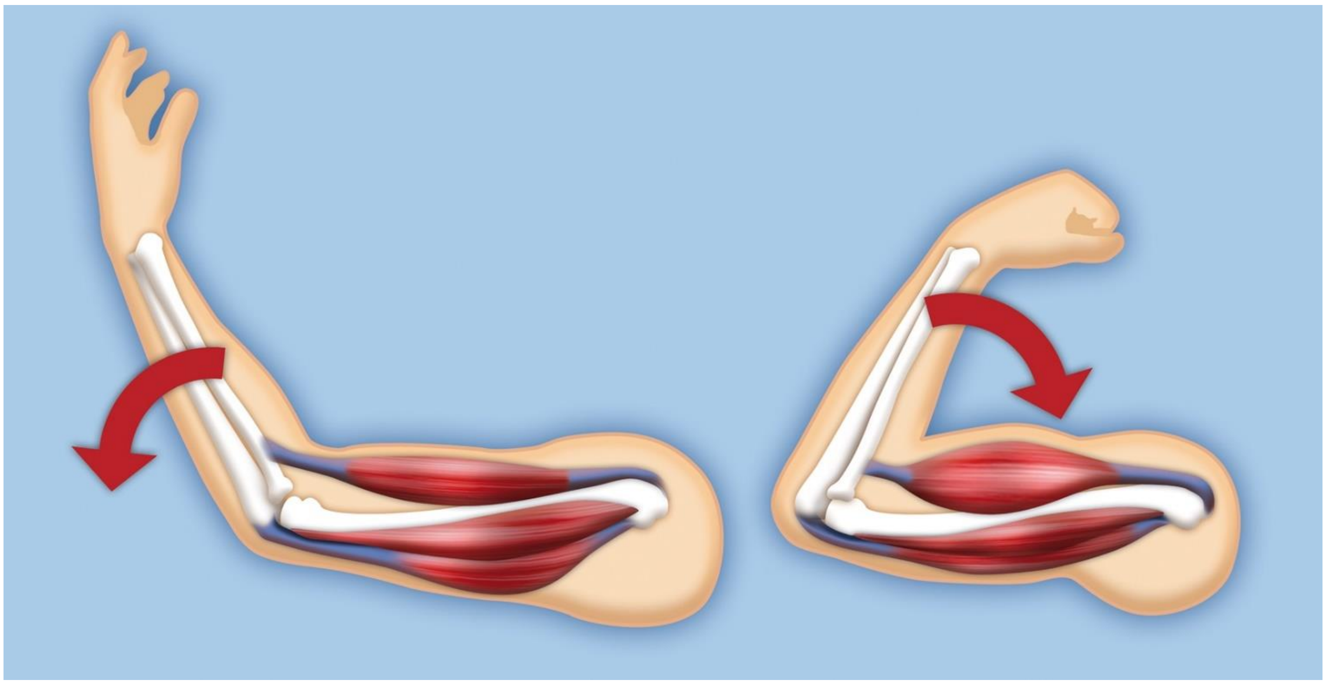


Layers of skin. *Our skin is made of many layers including the outermost layer known as the epidermis and then multiple inner layers. The dermis is a connective tissue layer just beneath the epidermis, which is critical for holding our skin in place.*

2. Muscle

We all know about muscle, but did you know that the body actually has different types of muscle tissue? The muscle that we usually think of; for example, the muscle in our arms and legs is called skeletal muscle, and this muscle allows our body to move. However, there is also muscle in our digestive tract called smooth muscle, and of course the heart is one giant muscle made up of a tissue called cardiac muscle. These muscle tissues are made up of cells called myocytes. As you know, muscles all have the ability to contract, but it is the myocytes themselves that are actually contracting. One microscopic myocyte, of course, does not have a lot of strength when it contracts, but if you put enough myocytes together, you can get some pretty strong muscles!

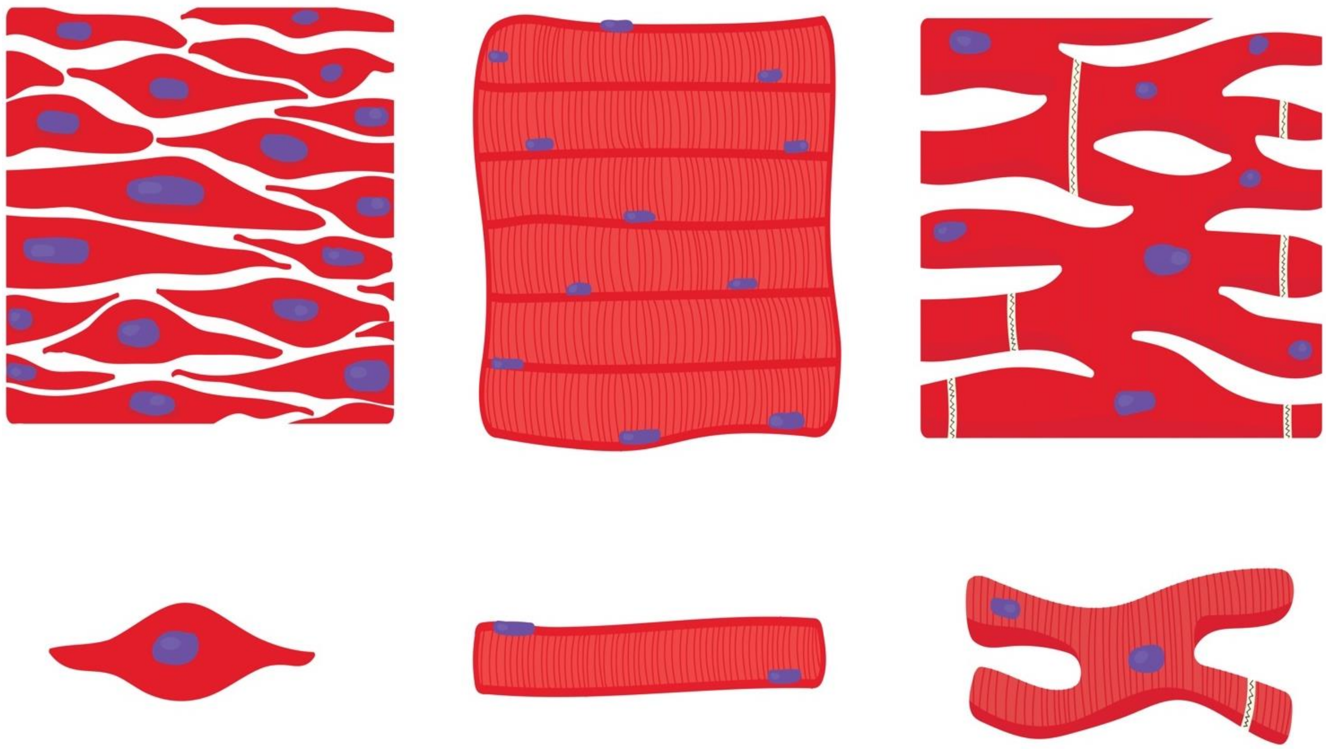
Let's quickly discuss some of these different muscle types. Skeletal muscle attaches one bone to another bone through tendons and allows our body to move. Take a look at your biceps. At one end, the biceps muscle is tethered to one of the bones in your shoulder and back called the scapula. At the other end, the biceps is attached to a bone in your forearm called the radius. When you flex your biceps, the muscle becomes shorter as it contracts and its force bends the elbow. Flex your guns and say "my biceps are bending my elbows!".



The biceps muscle is a great example of a skeletal muscle. Because of its attachments, it is responsible for bending our elbow when it contracts!

Smooth muscle lines the organs and tissues that form your digestive system including your stomach, intestine, and even a portion of your esophagus. While your brain controls when you flex your skeletal muscles, your digestive tract flexes on its own and is not something people consciously control. When this smooth muscle flexes and contracts, its movement is called peristalsis, and it propels food downward and throughout the entire digestive tract so that important nutrients can be absorbed into the blood stream.

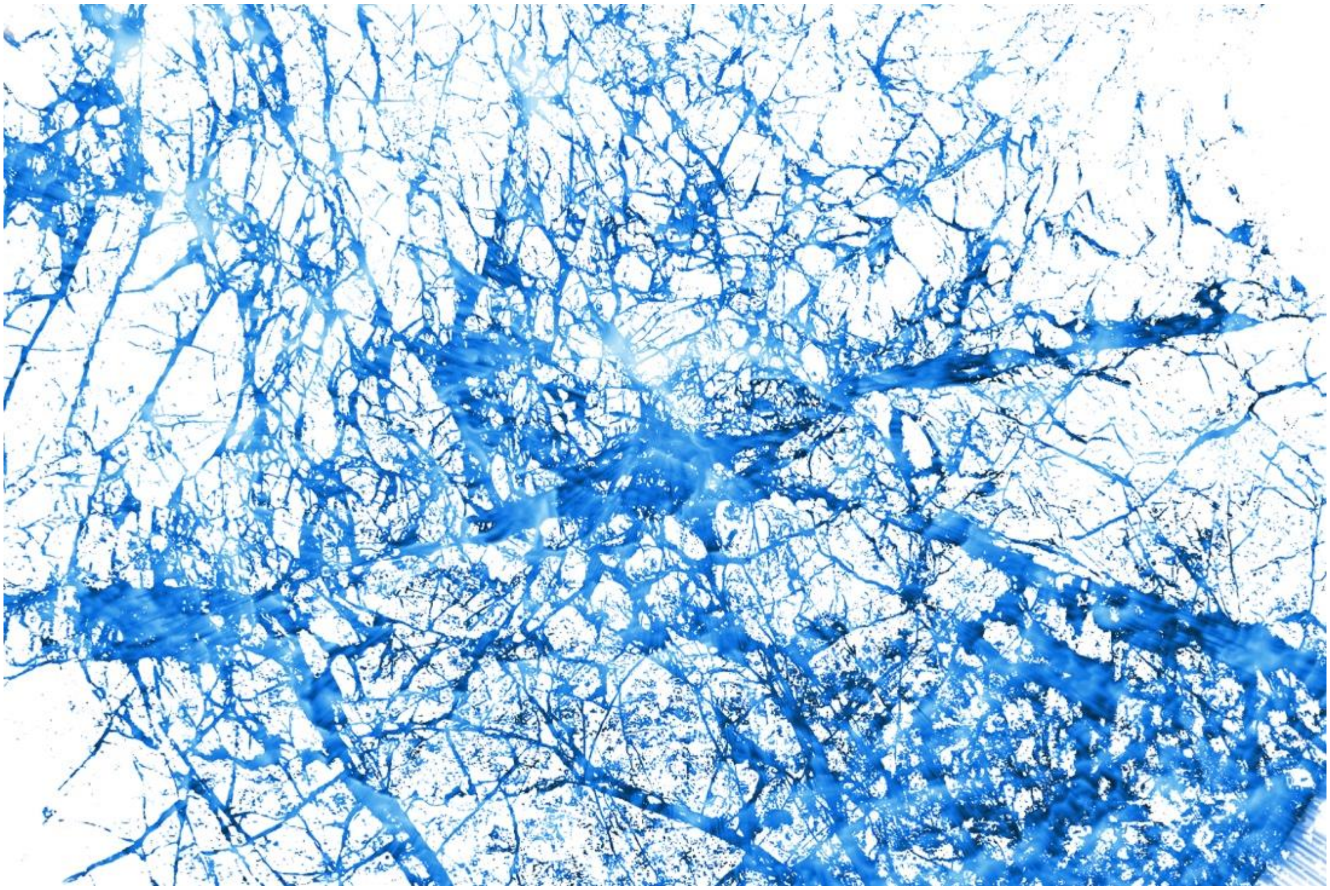
Ok now let's talk about one of the most important muscles in the human body, the heart. We have an entire chapter dedicated to the heart, so check it out for more detailed information. The heart is made of cardiac muscle and like the smooth muscle of the digestive tract, the heart contracts on its own, and is not under our conscious control. When the heart pumps, it delivers blood throughout the body which is critical for delivering oxygen and other essential nutrients. Our blood also carries wastes and carbon dioxide away from these tissues so that they can be eliminated by other organs in the body, which we will discuss in later chapters.



The three types of muscle tissue including smooth muscle (left) which is found in the digestive tract, skeletal muscle (middle) which is the muscle that makes our bodies move, and cardiac muscle (right) which is found in the heart.

3. Nerve Tissue

The diversity of cells and tissues in our body is really incredible. Nerve tissue is among the most important cell and tissue types in the body, and it is the building block of our brain, spinal cord, and peripheral nerves. Nerves are made up of long cells called neurons, which are actually able to conduct small electrical currents. When a neuron conducts its current, we say that the neuron has "fired." These currents produce inputs to and from our brain. They bring all of the body's sensory information, including pain, touch, smell, taste, and sound to our brain so we can experience them. On the other hand, neurons can fire from the brain and deliver information to other parts of our body. This is what happens when we move our muscles for example. Specific neurons in our brain fire, which leads to neurons firing in your spinal cord and then in your peripheral nerves which causes your muscles to flex. If you feel pain, it is because neurons fire from the site of pain all the way back to your brain so your brain knows the location of pain. All of this happens so fast that we don't even realize that these inputs are occurring. An extremely interesting area of scientific research is trying to understand why neurons do not regenerate well. For example, if a person injures their skin and has a bruise or a cut for example, the skin is very fast at regenerating and healing. However, if we damage our neurons, the damage is often permanent because nerve tissue does not heal well. That is why when people have spinal cord injuries or injuries to their brains, it is extremely devastating. We definitely need continued research in these areas!

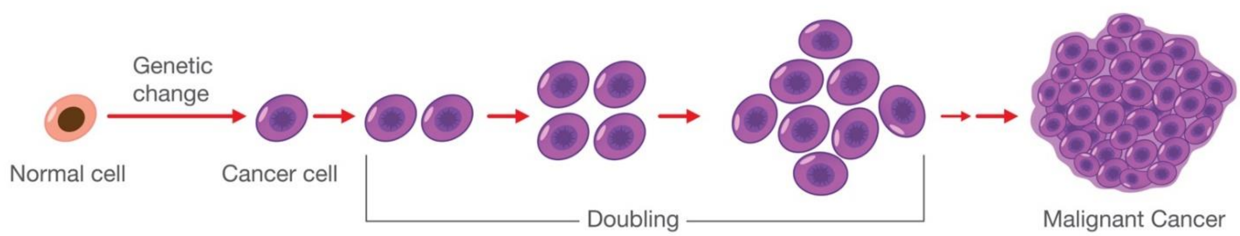


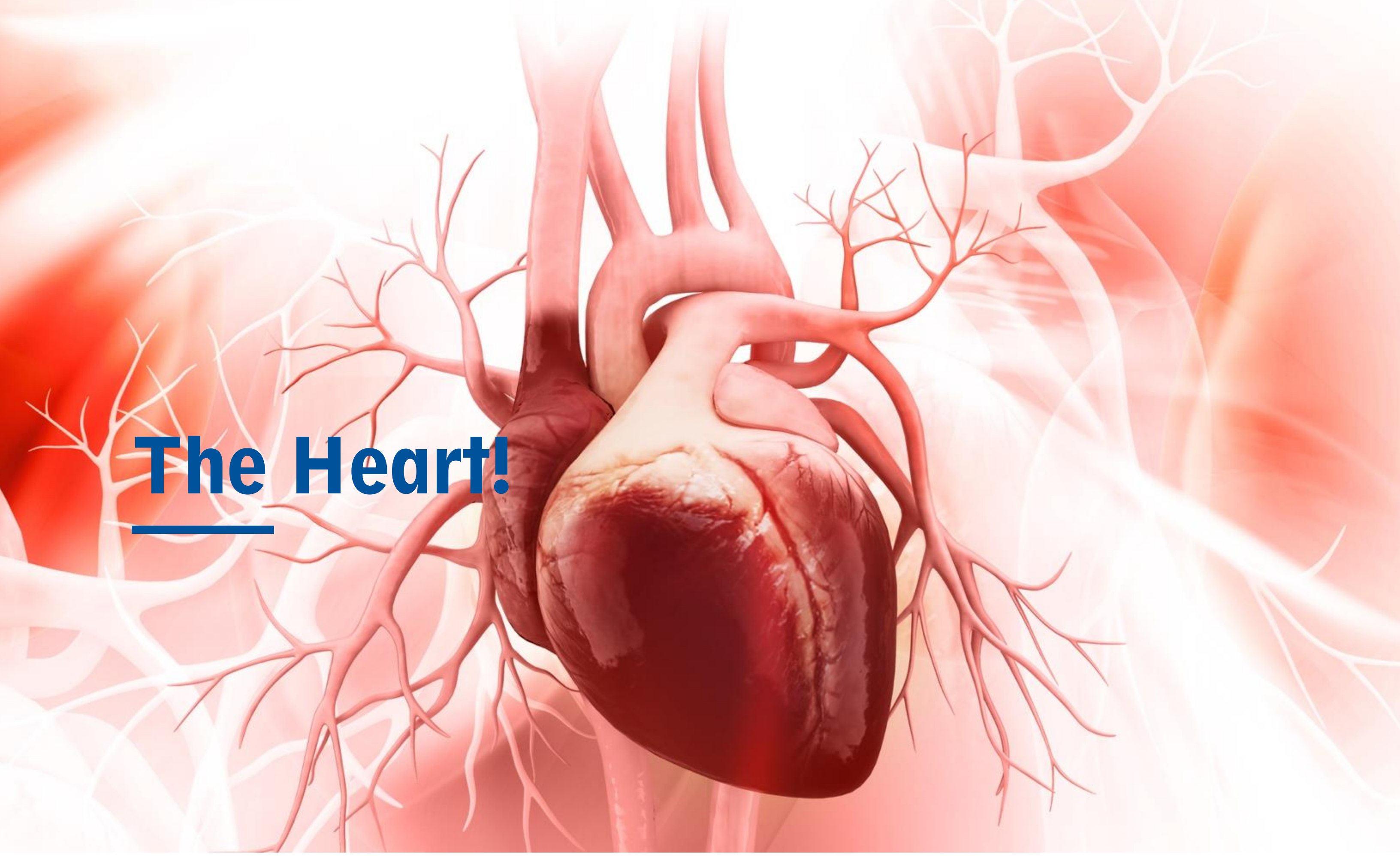
This is how some nerve tissue appears under a microscope!

What happens When Cell Growth Go Awry?

Cells form from other cells in a process called cell division. For example, if your body needs more cells, then a single cell can divide into two new cells. If this happens a lot, we can get many new cells. For example, if we injure our skin, the keratinocytes and other cells in the skin are triggered to begin dividing and producing new skin cells to heal the wound. As you can imagine, cell growth and cell division are tightly controlled processes in our bodies because we do not want cells to grow and divide when they are not supposed to.

Unfortunately, the DNA within cells can experience damaging mutations during our lifetime, and these mutations can cause cells to grow and divide in an uncontrolled way. In other words, they can start growing and producing more cells when they are not supposed to. When this happens, a terrible illness called cancer can be the result.





The Heart!

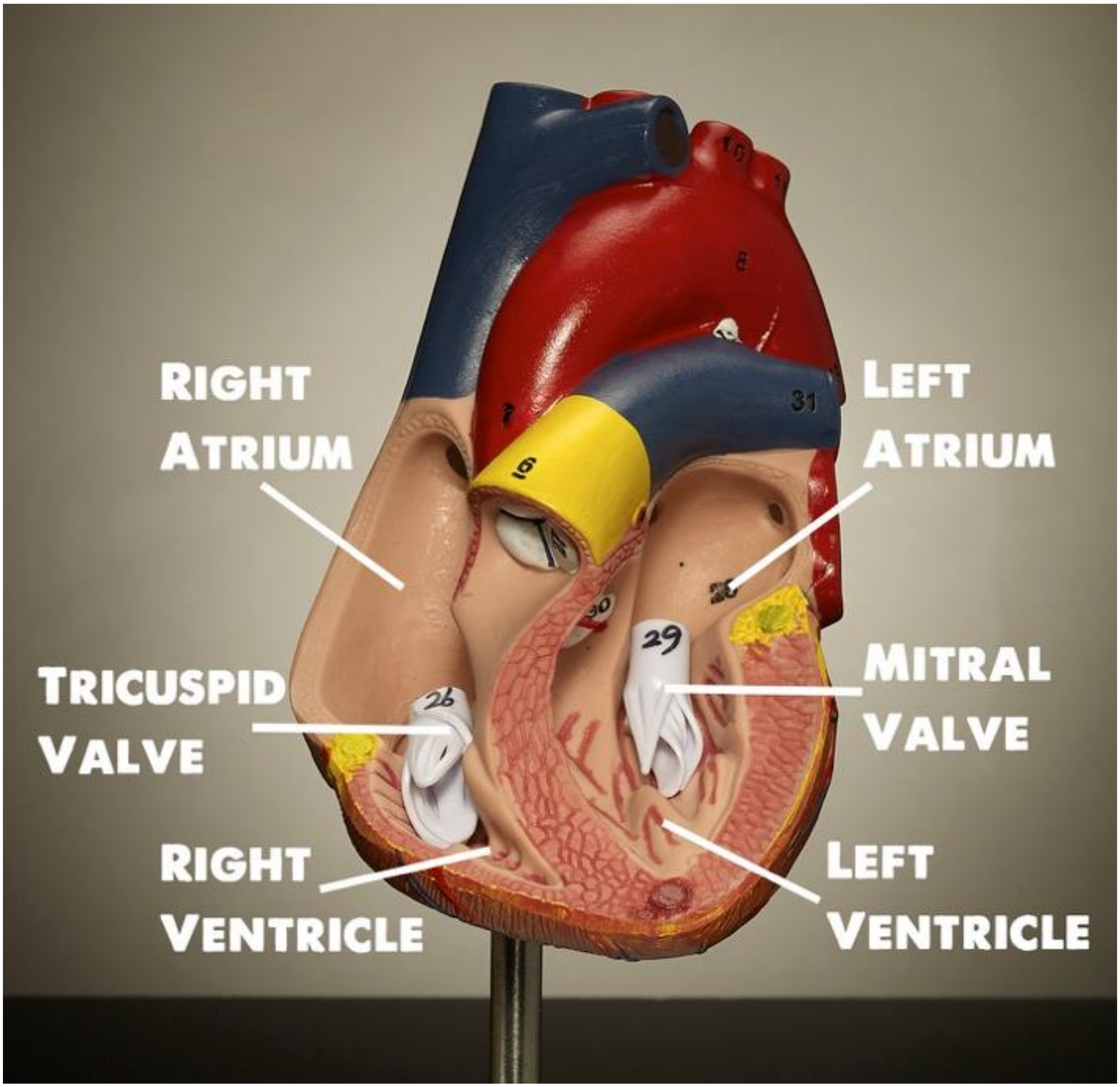
Introduction

The heart is an incredible muscular organ. It begins beating and pumping blood during the embryo phase before a person is even born and continues to beat throughout our lives. Every time that the heart contracts, it pumps blood throughout our entire body, which is critical for delivering oxygen and important nutrients to our organs and for eliminating carbon dioxide and other wastes. In an adult, the heart beats about 60-100 times per minute. If we assume that on average, the heart beats 80 times per minute, that means that it beats 115,000 times per day, 42 million times per year, and around 3 billion times throughout our lives. Amazingly, the heart pumps nearly 2000 gallons of blood every day. It is incredible that one muscle can do so much work! Let's jump right in to learn about how the heart works and to learn about its fascinating anatomy.

Cardiac Blood Flow

The Four Chambers of the Heart

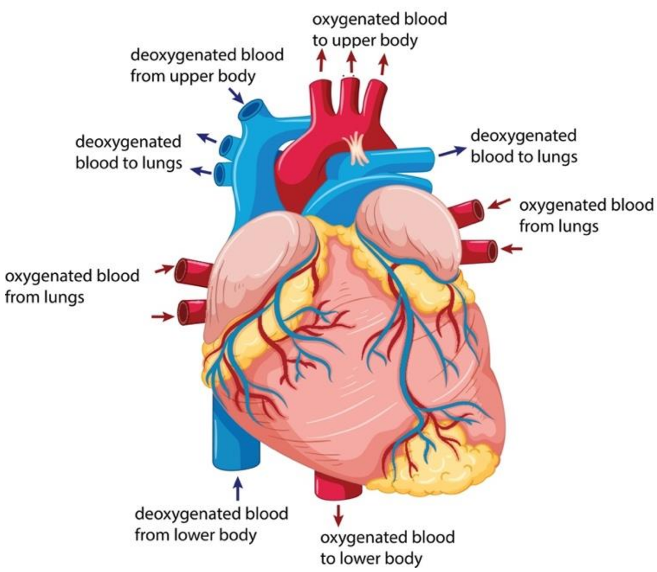
If you open up the heart and look inside you will notice that it is made up of four chambers, and it has a left and right side. When we discuss anatomy, always remember that the left and right side are from the organ's perspective in the body. In other words, the right heart is oriented towards the right side of the body in which it lies, and the left heart is oriented towards the left side. The two chambers on the top of the heart are the left and right atrium and the two chambers on the bottom are the left and right ventricles. The atria and ventricles are separated from one another by two critical valves. The valves make sure that blood flows from the atria into the ventricles and not backwards, and they regulate how much blood gets pumped into the ventricles during each heartbeat. The tricuspid valve separates the right atrium from the right ventricle, and the mitral valve separates the left atrium from the left ventricle. Check out this image below so you can see the locations of all of these structures:

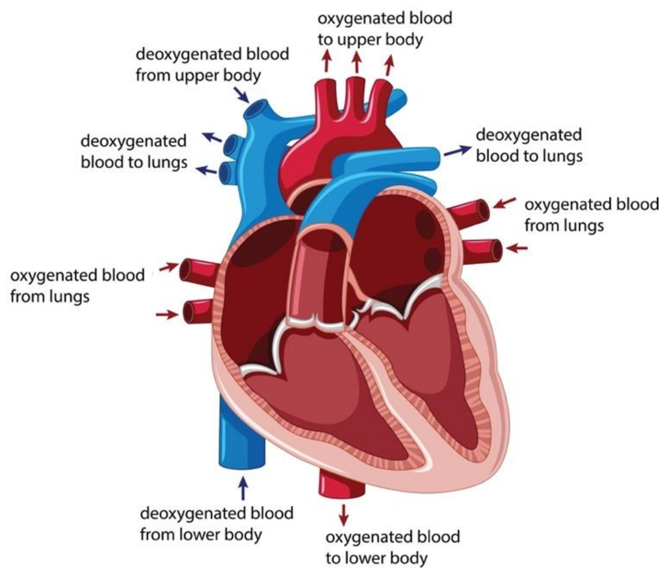


The four chambers of the heart. Notice that the heart has a left and a right side and it has four chambers: the atria and the ventricles.

A Quick Summary

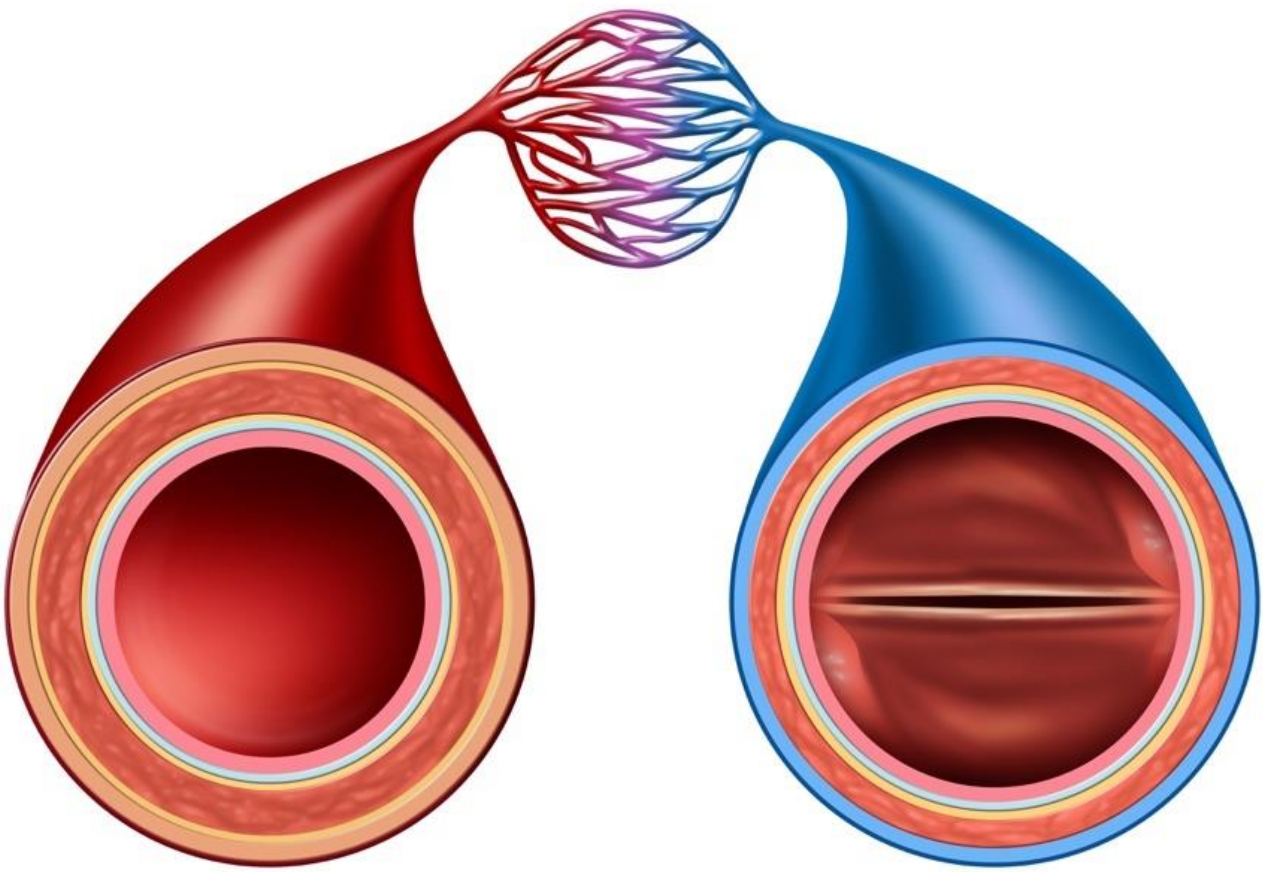
In the next few pages, we go into a lot of detail about cardiac blood flow, but first here is a quick summary so you get an idea about how it all works. First blood carries oxygen to ALL of the tissues and organs of the body. Once this has happened, the blood has no more oxygen, and we say that it is deoxygenated. This deoxygenated blood flows back to the right side of the heart through two giant veins known as the superior and inferior vena cava. The right side of the heart then pumps the deoxygenated blood directly into the lungs where it can pick up oxygen once again. Now the oxygenated blood flows BACK to the heart AGAIN, but this time it goes to the left side of the heart. The left heart pumps the oxygenated blood through a giant artery called the aorta where it goes once again to every organ and tissue to deliver oxygen. Then the cycle repeats itself again and again and again! That’s how it all works. Ok let’s learn about the details.





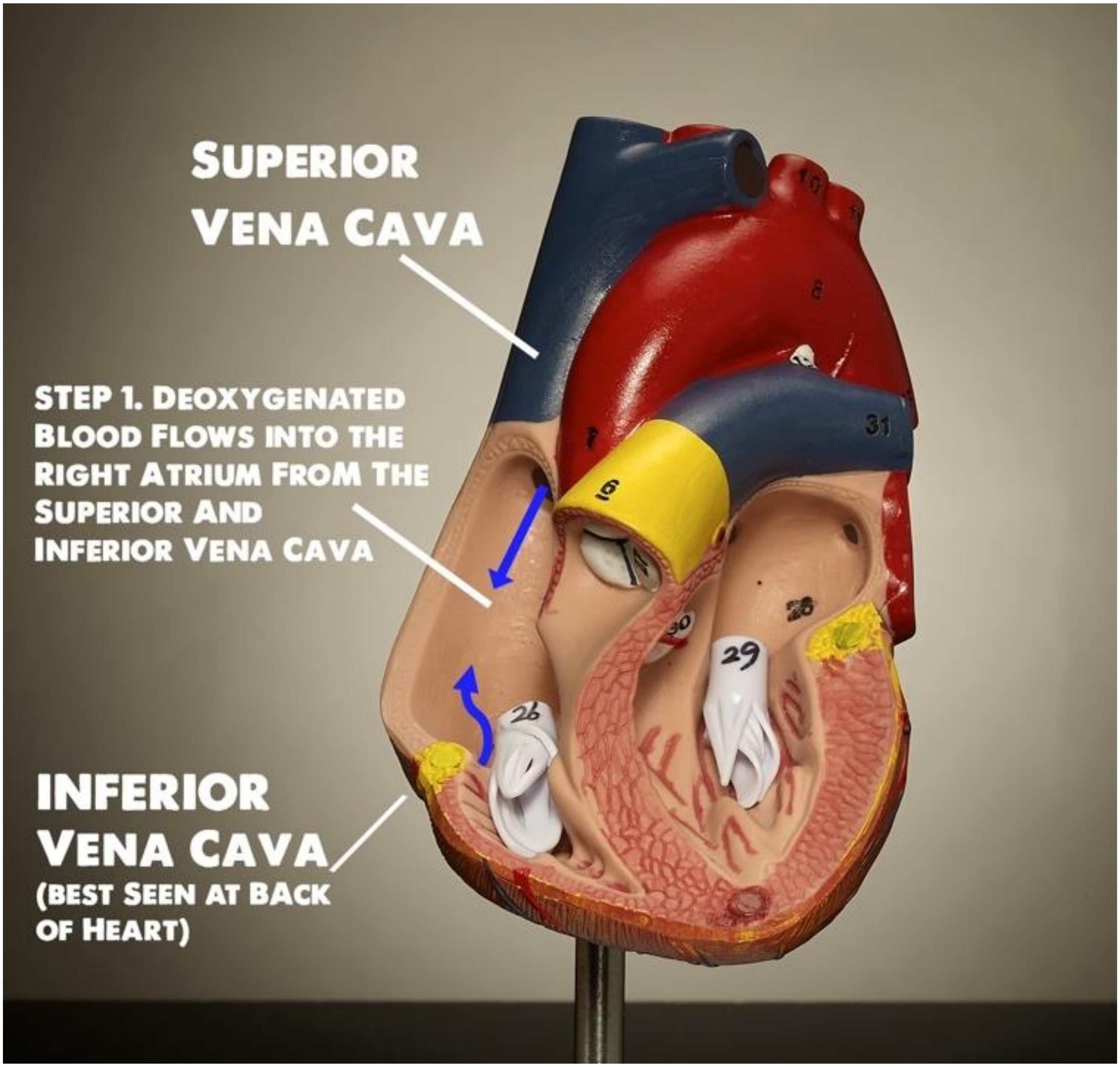
Blood Flow to The Right Side of the Heart

Blood carries and delivers oxygen to all of the organs in the body through blood vessels known as arteries. Once this happens, the blood no longer has oxygen left to carry, and we call it deoxygenated blood. This deoxygenated blood then must return back to the heart through different types of blood vessel known as veins. Check out the image below for a quick comparison of arteries and veins.



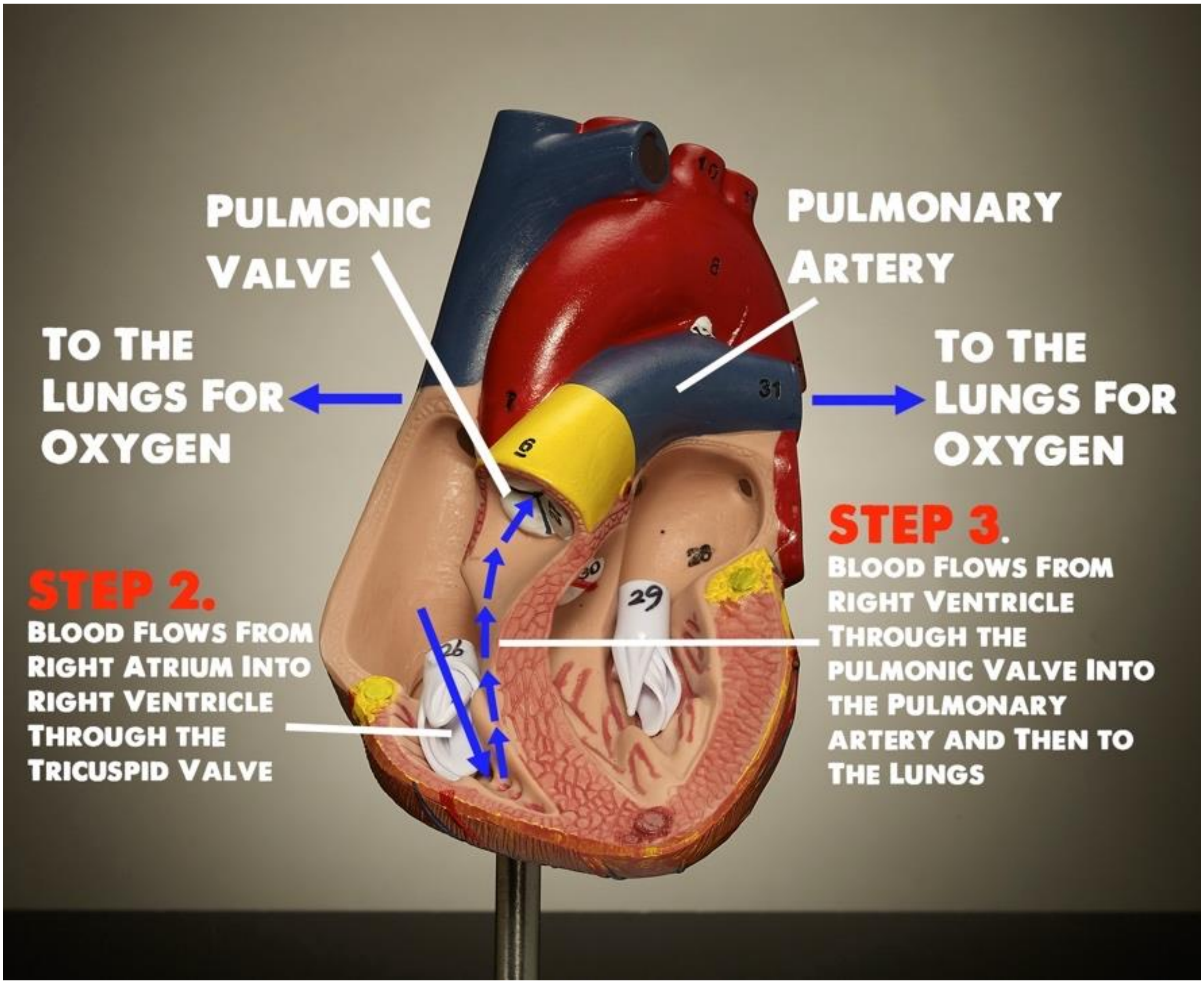
Arteries vs Veins. Arteries, as shown on the left side of this picture, are muscular and usually carry oxygenated blood away from the heart to the organs and tissues of the body. Once this happens, the blood becomes deoxygenated and returns back to the heart through veins (seen on the right side of this picture). Unlike arteries, veins are not muscular and they actually have small valves that help blood continue to move forward back to the heart.

All of the veins from the head, neck and much of the upper body ultimately join up with a giant vein known as the superior vena cava. All of the veins in the lower body join up with another giant vein known as the inferior vena cava. Together, these two veins both take the deoxygenated blood directly into the heart through the right atrium.



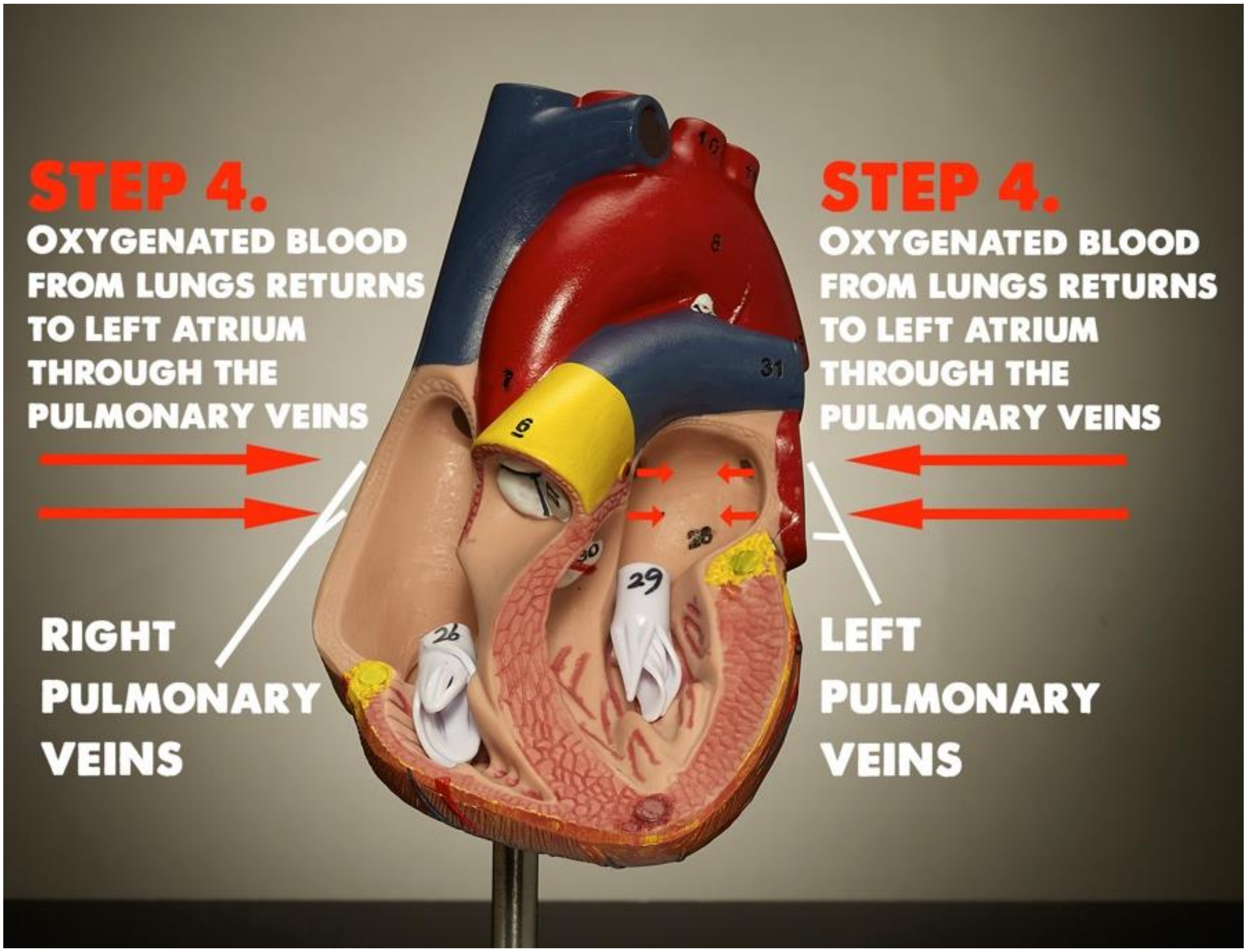
Deoxygenated blood flows back to the heart into the right atrium through the inferior and superior vena cava.

The blood in the right side of the heart has lost all of its oxygen. Where will it get more oxygen? From the lungs of course! The right side of the heart is responsible for pumping blood directly into the lungs so it can become oxygenated once again. First the blood flows from the right atrium to the right ventricle through the tricuspid valve, and next the right ventricle pumps this deoxygenated blood directly into a giant artery known as the pulmonary artery where it is taken directly into the lungs for more oxygen.



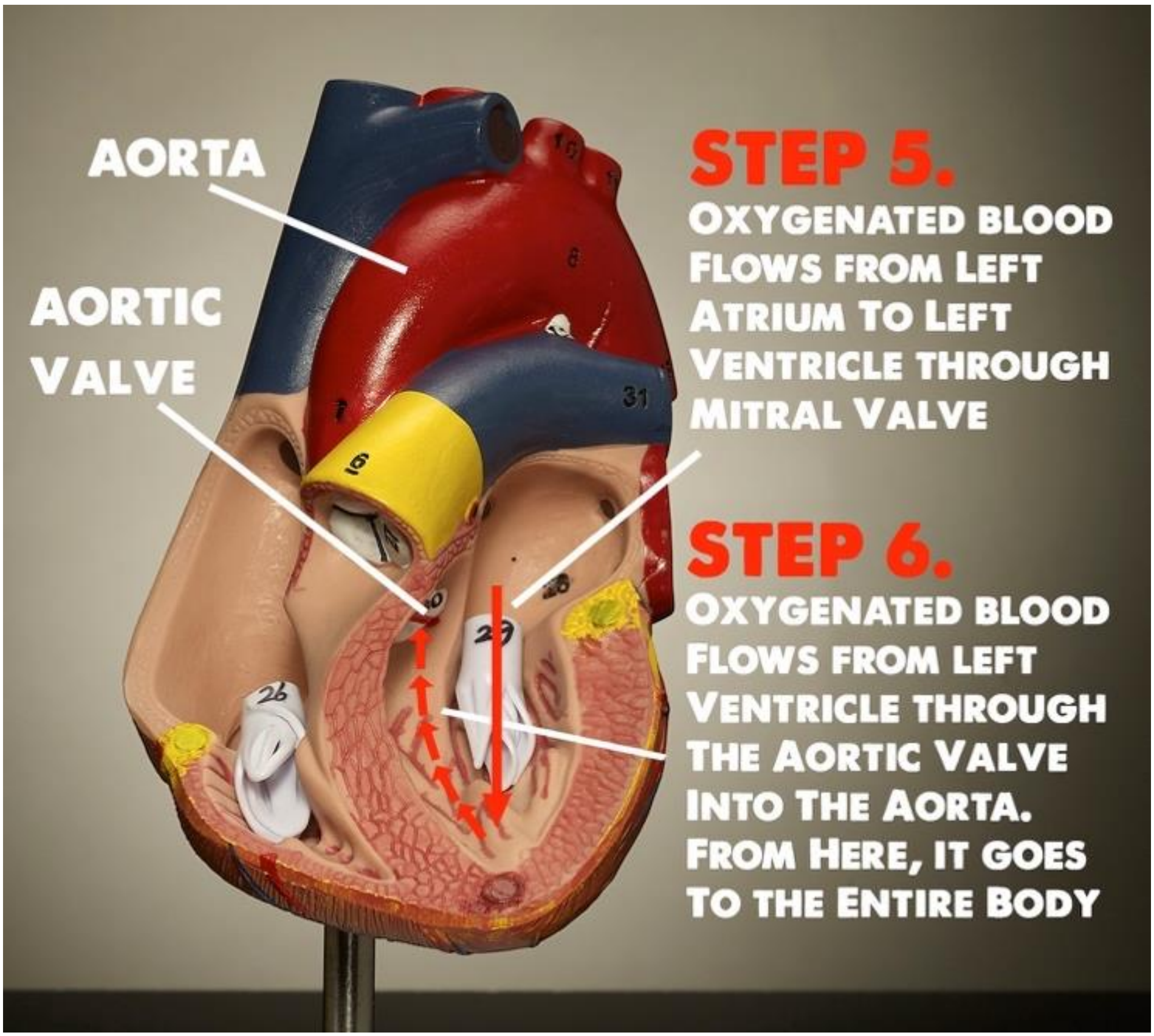
Deoxygenated blood flows from the right atrium into the right ventricle through the tricuspid valve. The right ventricle then pumps this blood through the pulmonary artery into the lungs.

Once in the lungs, the blood picks up oxygen once again! It is now oxygenated, and it goes back to the heart through veins known as the pulmonary veins. Most veins carry deoxygenated blood, but the pulmonary veins are an exception to the rule. They bring blood that is rich in oxygen from the lungs back to the heart. However, this time, the blood is brought to the left side of the heart directly into the left atrium!

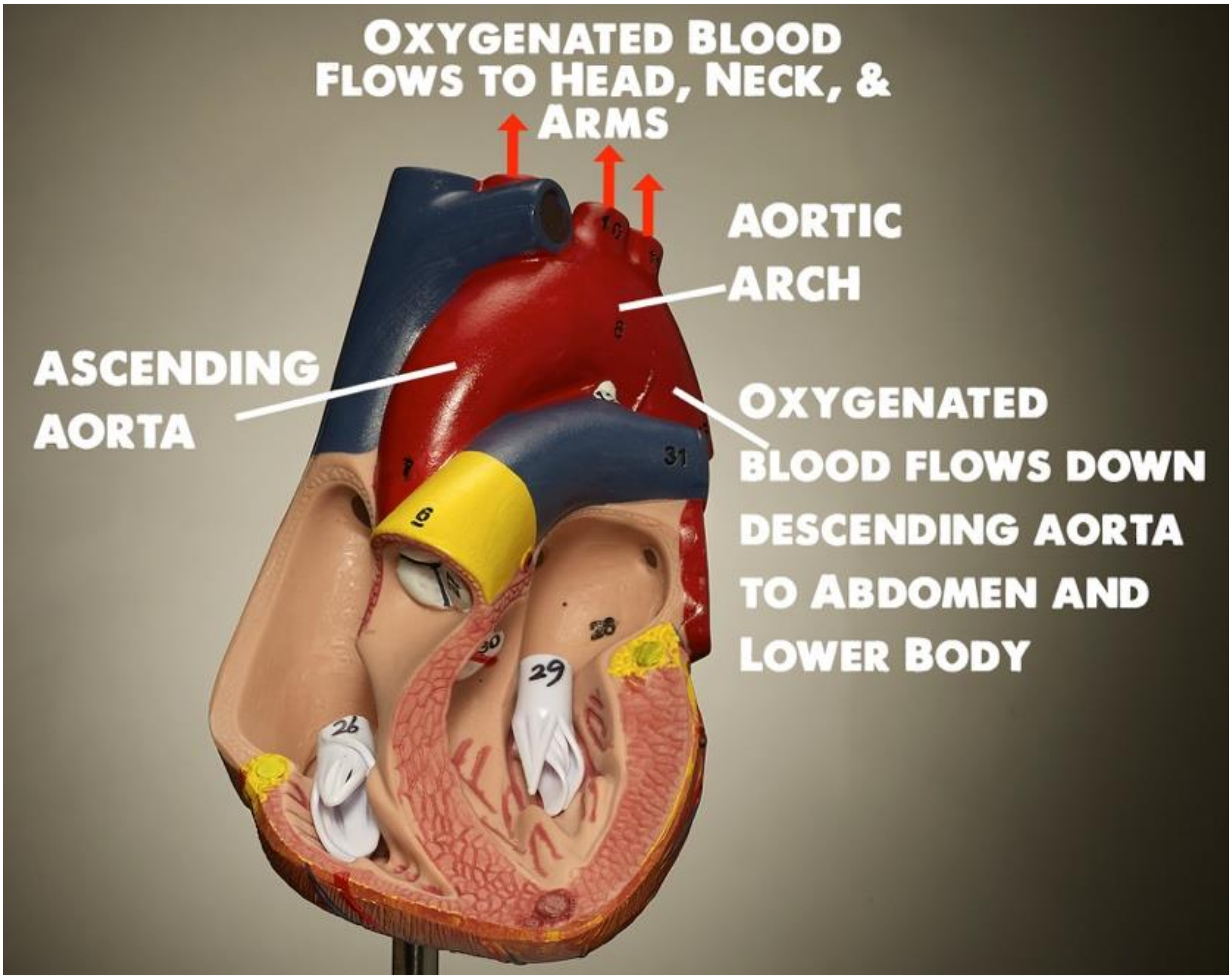


Oxygenated blood from the lungs returns to the left atrium through the pulmonary veins.

The oxygenated blood is now back in the heart in the left atrium. It then flows from the left atrium through the mitral valve into the left ventricle. Notice in the pictures how thick and strong the muscles surrounding the left ventricle are. The left ventricle is extremely muscular compared to the right ventricle, because it must pump this oxygenated blood to the entire body, whereas the right ventricle only pumps blood to the lungs. When the left ventricle contracts, it pushes blood out through the aortic valve into the largest artery of the body, the aorta. The aortic valve is extremely important because it keeps blood from leaking back into the left ventricle when the heart relaxes (because it closes). In fact, some individuals actually have a leaky aortic valve, which is a condition known as aortic regurgitation. From the aorta, oxygenated blood flows to every organ and tissue in the body. Then the blood becomes deoxygenated again and the cycle repeats itself.



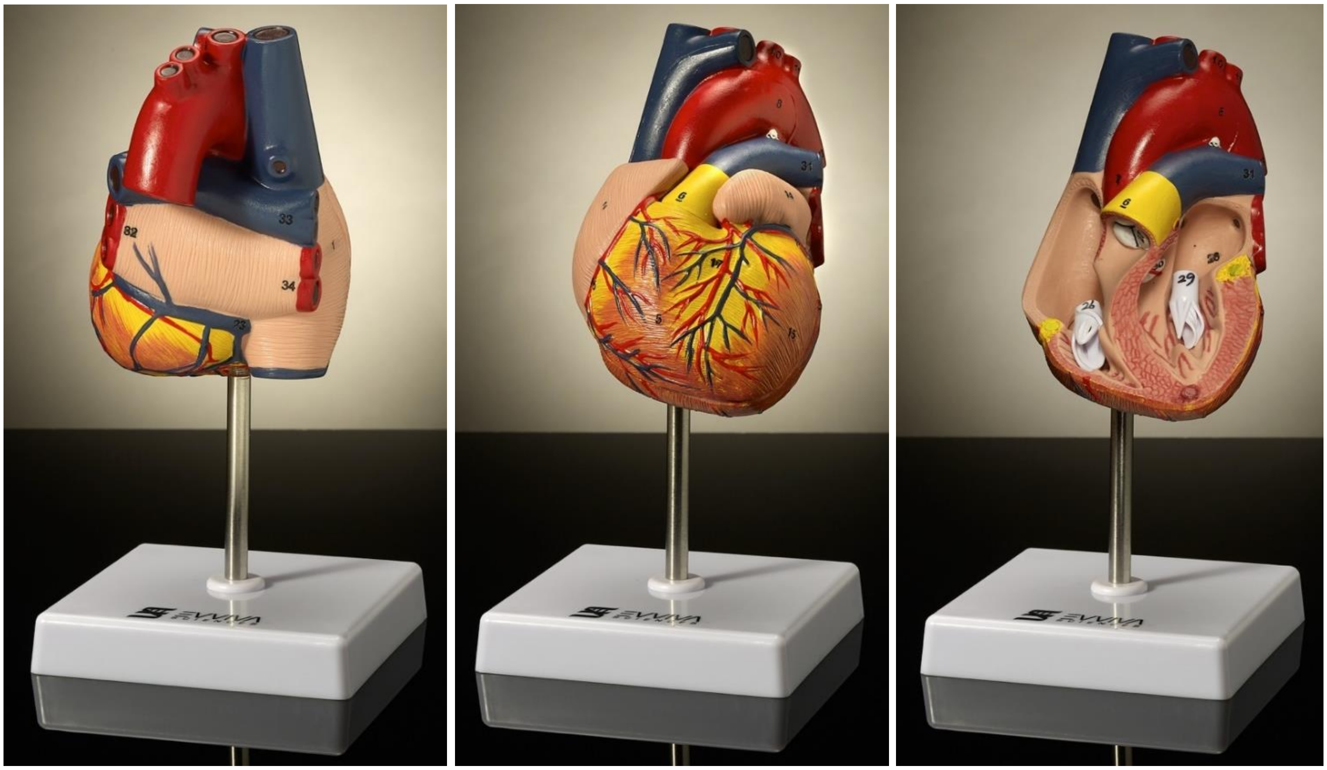
Oxygenated blood flows from the left atrium to the left ventricle through the mitral valve. The left ventricle then pumps this blood out through the aorta to the rest of the body.



The first part of the aorta is called the ascending aorta because it goes up and out of the heart. Then the aorta bends to form an arch called the aortic arch. There are three main arteries that come off the aortic arch which supply oxygenated blood to the upper body including the head, neck and arms (these arteries are identified later in this chapter). The next part of the aorta is called the descending aorta because it travels downwards into our abdomen and supplies blood to the lower body.

All Parts of Evviva Sciences' Amazing Heart Model

For those of you who have our Amazing Heart Model, below is a guide that identifies the 34 labeled parts. Quiz yourself, and remember to email us at support@evvivasciences.com if you have any questions about the heart!



1. Right Atrium: the right upper chamber of the heart where deoxygenated blood returns from the body through the superior and inferior vena cava.
2. Right Auricle: also known as the right atrial appendage, this structure is a small pouch where blood can collect within the right atrium.
3. Superior vena cava: a large vein, which carries deoxygenated blood from the upper body back to the heart and into the right atrium.
4. Inferior vena cava: another large vein, which carries deoxygenated blood from the lower body back to the heart and into the right atrium.
5. Right ventricle: the right lower chamber of the heart. Once deoxygenated blood reaches the right atrium (#1), it flows through the tricuspid valve (#26) into the right ventricle.
6. Pulmonary trunk or Main Pulmonary Artery: the very first segment of the pulmonary artery. Deoxygenated blood from the right ventricle is pumped through the pulmonic valve (#27) into the pulmonary trunk and then into the left and right pulmonary arteries (#31 and #33). From here, deoxygenated blood goes to the lungs. Most people refer to #6 as the main pulmonary artery rather than the pulmonary trunk, but both are correct.

7. Ascending aorta: the first segment of the aorta where it ascends upwards and out of the heart. Oxygenated blood flows from the left ventricle (#15) through the aortic valve (#30) into the ascending aorta.

8. Arch of the aorta: the 2nd segment of the aorta, which forms an arch-like structure. Oxygenated blood flows from the left ventricle (#15) through the ascending aorta (#7) and into the arch of the aorta.

   #9-#11: The arch of the aorta (#8) gives off three large arteries which carry oxygenated blood to the upper body. These include the brachiocephalic trunk (#9), the left common carotid artery (#10), and the left subclavian artery (#11), which are described below in detail.

9. Brachiocephalic trunk: the first large artery branch that comes off the aortic arch. This artery branches into the right common carotid artery, which carries oxygenated blood to the right side of the head and brain and the right subclavian artery, which carries oxygenated blood to the right arm.

10. Left common carotid artery: This is the second arterial branch that comes off the arch of the aorta. The left common carotid artery supplies oxygenated blood to the left side of the head and brain.

11. Left subclavian artery: This is the third arterial branch that comes off the arch of the aorta. The left subclavian artery carries oxygenated blood to the left arm.

12. Arterial ligament: a small connective tissue ligament that attaches the pulmonary artery to the arch of the aorta. During the embryo phase of human development, this structure is actually an open vessel known as the ductus arteriosus. However, once a baby is born, the vessel closes down and becomes this small ligament known as the arterial ligament.

13. Descending aorta: the third segment of the aorta. Oxygenated blood leaves the left ventricle (#15) and first goes into the ascending aorta (#7), then the aortic arch (#8), and next it goes into the descending aorta (#13). The descending aorta delivers oxygenated blood to the organs and tissues of the abdomen and lower body.

14. Left auricle: also known as the left atrial appendage, this structure is a small pouch in the left atrium (#28) where blood can collect. Some people with heart rhythm problems can get blood clots in this region, which can lead to strokes. These individuals usually take anticoagulants that reduce blood clots, but there is also a procedure known as the Watchman procedure where the left auricle is closed off so blood clots cannot form there.

15. Left ventricle: the left lower chamber of the heart. Oxygenated blood flows from the left atrium (#28) through the mitral valve (#29) into the left ventricle (#15), where it is then pumped through the aorta to supply oxygen to the entire body. Remember, when the left ventricle contracts, the aortic valve (#30) opens so that blood can be pumped into the aorta, while the mitral valve closes so that blood does not flow backwards into the left atrium.

When the left ventricle relaxes, the mitral valve opens allowing blood to flow from the left atrium into the left ventricle and the aortic valve closes to prevent blood from flowing backwards from the aorta into the left ventricle.

The Coronary Arteries: like all organs, the heart muscle tissue itself needs oxygen and the coronary arteries are small blood vessels that take care of this. Once the coronary arteries supply oxygenated blood to the heart muscle, the blood becomes deoxygenated and it is carried back to the right atrium through the cardiac veins (great, middle and small) and the coronary sinus. If a coronary artery is blocked, the heart muscle will not get enough oxygen and the tissue can die if it is not treated immediately. When this occurs**,** it is called a heart attack or myocardial infarction.

16. Right coronary artery: the coronary artery that supplies oxygenated blood to the heart muscle tissue of the right ventricle (#5).

17. Anterior interventricular branch of the left coronary artery: also known as the left anterior descending (LAD) artery, which supplies oxygenated blood directly to cardiac muscle tissue on the front (anterior) part of the heart including a large portion of the left ventricle (#15).

18. Circumflex branch of the left coronary artery: this coronary artery supplies oxygenated blood to the muscle tissue of a portion of the left ventricle (#15).

19. Great cardiac vein: one of the cardiac veins, which drains deoxygenated blood from the coronary arteries back to the right atrium (#1).

20. Middle cardiac vein: a second cardiac vein, which drains deoxygenated blood from the coronary arteries back to the right atrium (#1).

21. Small cardiac vein: a third small cardiac vein, which drains deoxygenated blood from the coronary arteries back to the right atrium (#1).

22. Posterior interventricular branch of the right coronary artery: also known as the posterior descending artery. This is a branch of the right coronary artery which supplies oxygenated blood to the cardiac tissue on the bottom of the heart.

23. Coronary sinus: the great, middle, and small cardiac veins join one another to form the coronary sinus, which empties deoxygenated blood back into the right atrium (#1) of the heart.

24. Fossa ovalis: a small piece of connective tissue that can be found in the right atrium. During the embryo phase of human development, the fossa ovalis is actually a small hole between the left atrium (#28) and right atrium (#1) known as the foramen ovale. However, when a baby is born, this hole closes up to form the fossa ovalis.

25. Opening of the coronary sinus: the location where the coronary sinus (#23) empties deoxygenated blood from the coronary arteries back into the right atrium (#1)

26. Tricuspid valve: the 3-leaflet valve that separates the right atrium from the right ventricle. When the right ventricle contracts, the tricuspid valve closes to prevent blood from going backwards into the right atrium.

27. Pulmonary valve: the valve that separates the pulmonary trunk (#6) and pulmonary arteries from the right ventricle (#5). The right ventricle pumps deoxygenated blood through the pulmonary valve (#27) into the pulmonary trunk and pulmonary arteries and then to the lungs where the blood is oxygenated once again. When the right ventricle relaxes, the pulmonary valve closes to prevent blood from flowing backwards into the right ventricle.

28. Left atrium: upper chamber of the left heart. Oxygenated blood from the lungs returns to the heart into the left atrium through the pulmonary veins (#32 and #34).

29. Mitral valve: the valve that separates the left atrium from the left ventricle. While the other valves (tricuspid, aortic, and pulmonic valves) have three leaflets, the mitral valve has two leaflets. When the left ventricle contracts, the mitral valve closes to prevent blood from flowing backward into the left atrium (#28).

30. Aortic valve: the valve that separates the aorta from the left ventricle (#15). The left ventricle pumps oxygenated blood through the aortic valve into the ascending aorta (#7). The aortic valve opens when the heart contracts, allowing blood to be ejected into the aorta. When the heart relaxes, the aortic valve closes, preventing blood from flowing backward into the left ventricle.

31. Left pulmonary artery: the artery that carries deoxygenated blood from the heart to the left lung. Specifically, the right ventricle (#5) pumps blood through the pulmonary valve (#27) into the pulmonary trunk (#6). The left pulmonary artery takes blood to the left lung, while the right pulmonary artery (#33) takes blood to the right lung for it to become oxygenated.

32. Left pulmonary veins: the veins that brings oxygenated blood back from the lungs (left lung) to the left atrium (#28).

33. Right pulmonary artery: the artery that carries deoxygenated blood from the right ventricle (#5) to the right lung.

34. Right pulmonary veins: the veins that carries oxygenated blood from the lungs (right lung) back to the heart into the left atrium (#28).

The Human Skeleton!

Introduction

The skeletal system shapes and supports our entire body. In fact, without our skeleton, we would just collapse into a pile of skin and other organs! The skeleton is a strong and rigid system that is critical for protecting our vital organs, but it also has other extremely important functions in our lives. Even though individual bones are rigid, the skeleton is a fluid system with flexible joints that allow bones to move easily passed one another. Muscles attach directly to our bones through tendons, and their contractions result in our ability to move.

We should also point out that even though bones are filled with minerals such as calcium, which give them their strength, they are also a living tissue made up of living cells. Our bones are constantly being remodeled by these cells. For example, osteoblasts are bone cells that are continually building new strong bone, whereas osteoclasts are bone cells that are responsible for removing old bone. In fact, collagen, a structural protein in our bones, renews about every seven years, so we basically have a completely new skeleton many times throughout our lives.

The interior of our bones contains the bone marrow, which is responsible for creating the blood cells in our body, including white blood cells that fight infection, red blood cells that carry oxygen to our vital organs, and platelets that are critical for forming blood clots. Many people do not realize that our bones and blood are so closely connected with one another! As you can see, the skeleton is an amazing living system with a wide range of critical roles.

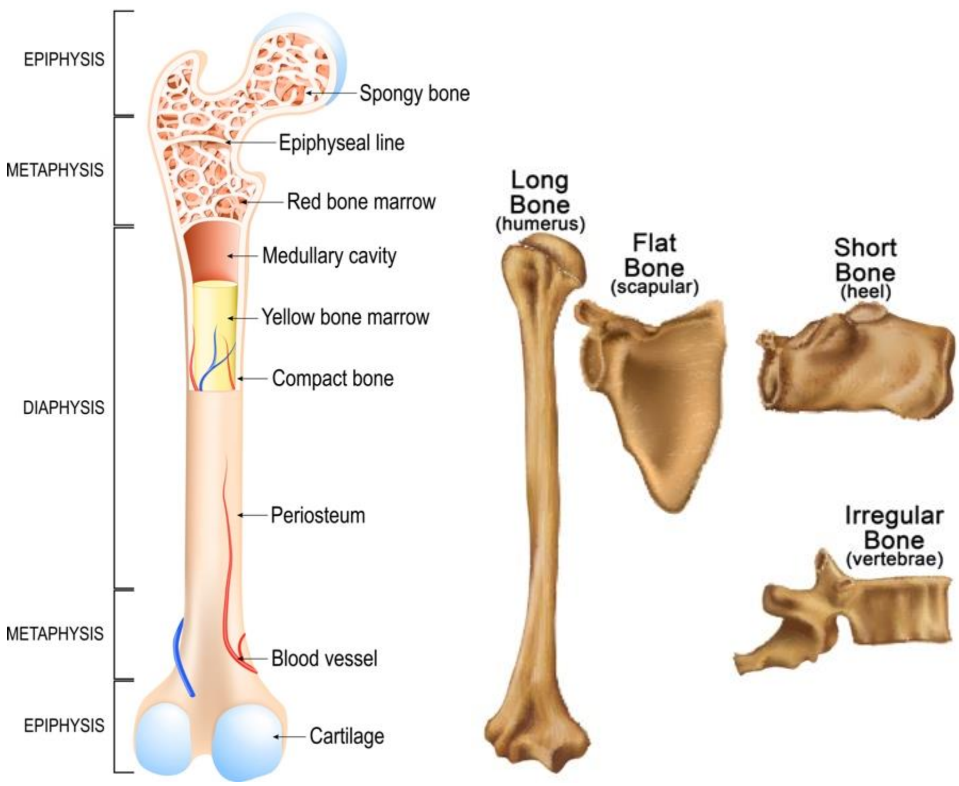
Bone Structure and Types of Bones

The figure below shows the basic structure and anatomy of a long bone (for example, the bones in our arms and legs are long bones). First notice that the length of the bone is divided into three main parts. The epiphysis marks the ends of a long bone, while the diaphysis is the long shaft in the center of the bone, and they are connected to one other by the metaphysis. The diaphysis is actually hollow and the interior is called the medullar cavity which is the location of yellow bone marrow. Its yellow appearance is due to a high number of fat cells called adipocytes. There is also red bone marrow, which has a high number of red blood cell precursors and fewer fat cells, which together result in its red color.

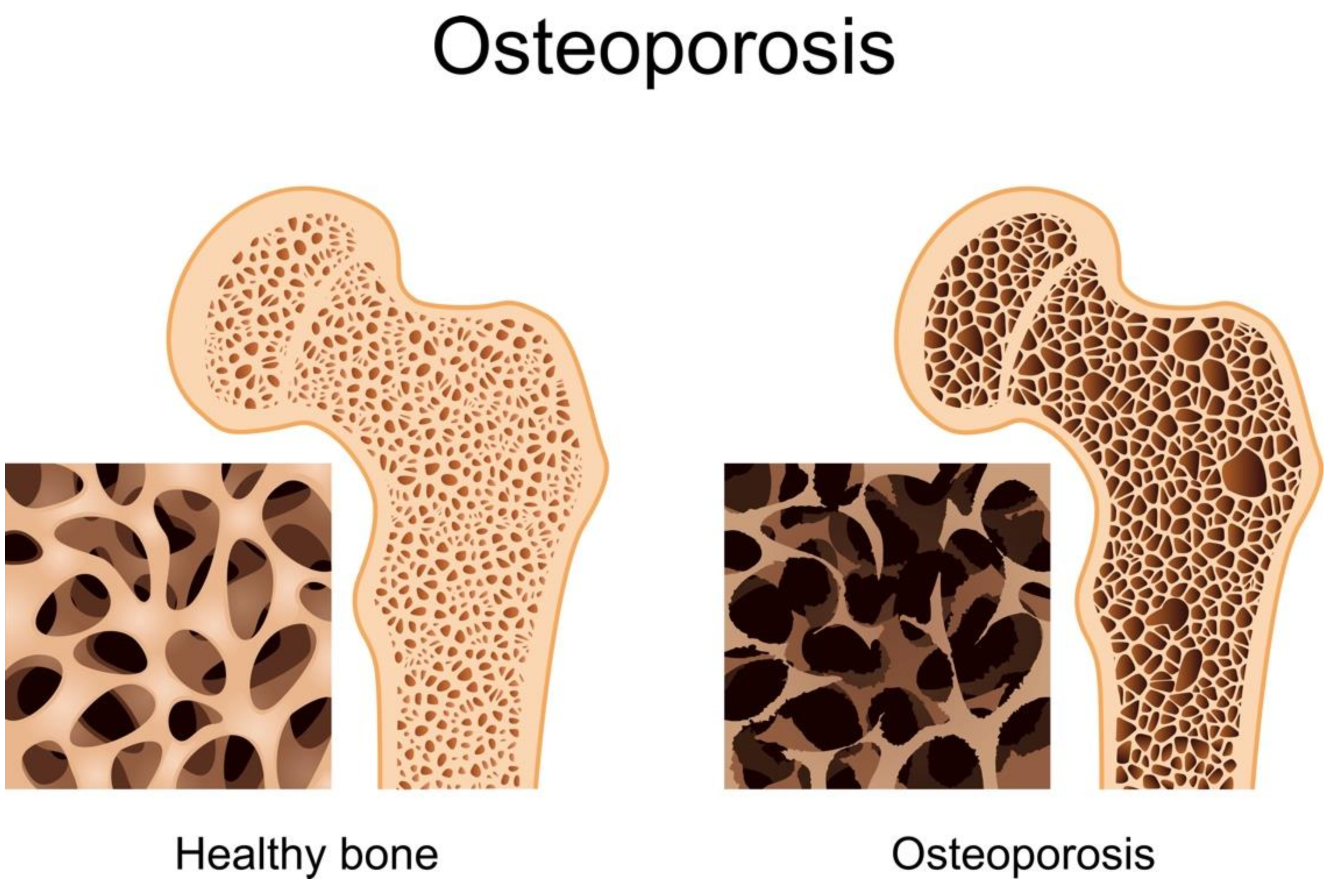
During childhood and adolescence, bones grow at a location known as the epiphyseal plate, which is a layer of cartilage, and it is also known as the growth plate. This location is where new bone formation occurs, which is how children grow bigger and taller. However, when we stop growing, the epiphyseal plate actually closes down and is replaced by bony tissue, at which point it becomes called the epiphyseal line. Check out the figure below to see the location of all of these structures!

The outer layer of bone is extremely strong and rigid and is known as compact bone. However, inside the epiphysis there is a trabeculated layer of bone known as spongy bone because it has the appearance of a sponge, with many holes and ridges. Spongy bone is also a little bit softer than compact bone. The very outside layer of compact bone is called the periosteum.

There are different types of bones that have very different shapes. For example, the bones in your arms and legs are called "long bones". The scapula or shoulder blade, which is a bone in the upper back is characterized as a flat bone, and the heel bone or calcaneus is considered a short bone. Lastly, the bones in our vertebral column are characterized as irregular bones.



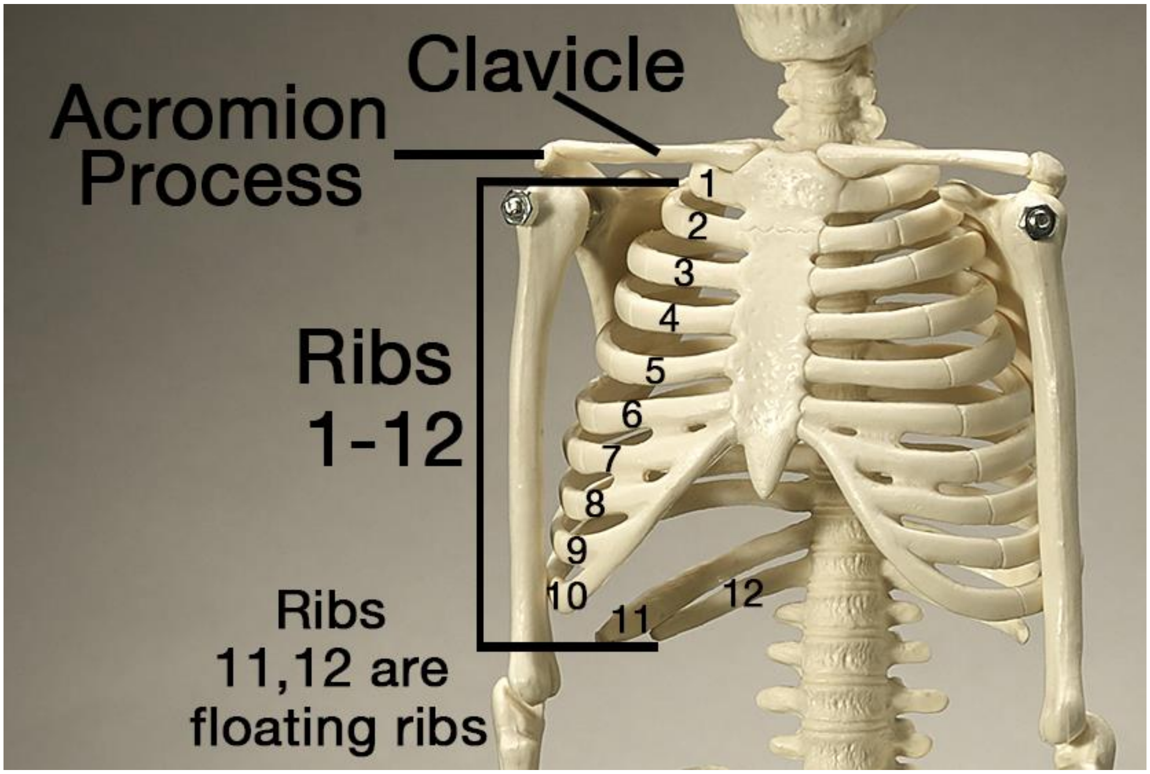
Anatomy of a typical long bone (left) and different types of bones (right).



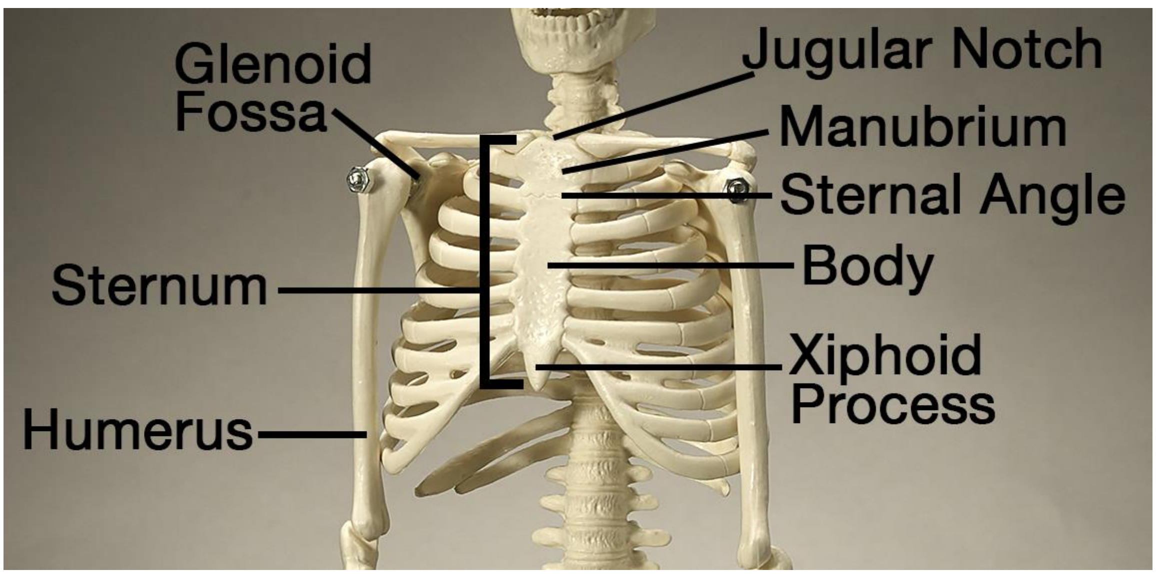
Osteoporosis is a condition where bones become demineralized and basically become thinner with age. Individuals with osteoporosis have very fragile bones that are at high risk of fracturing.

Skeletal Anatomy

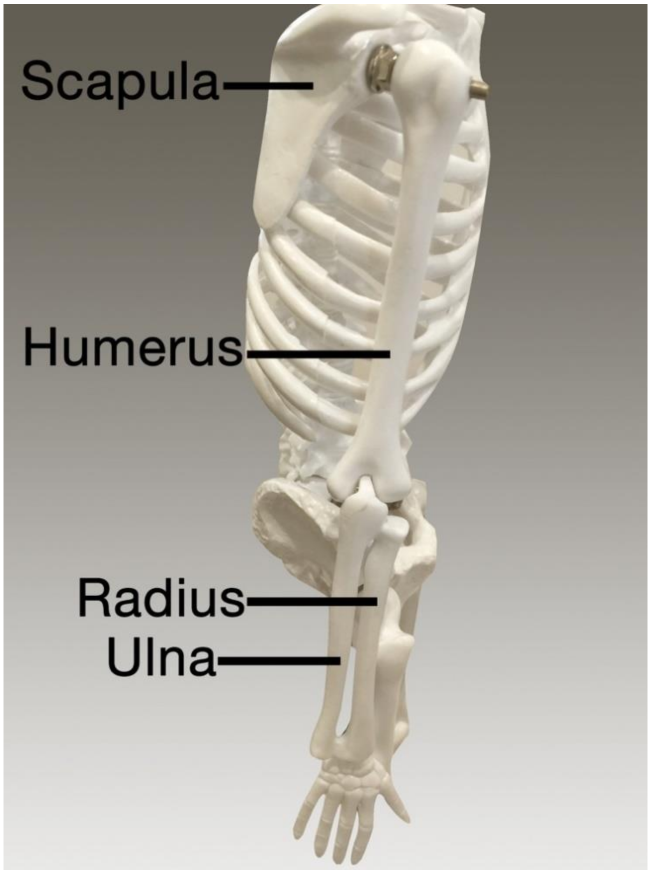
The skeleton has an amazing structure that provides both protection for our vital organs and allows for movement. Check out the figures below to learn the identifications of many of the major bones in our bodies.



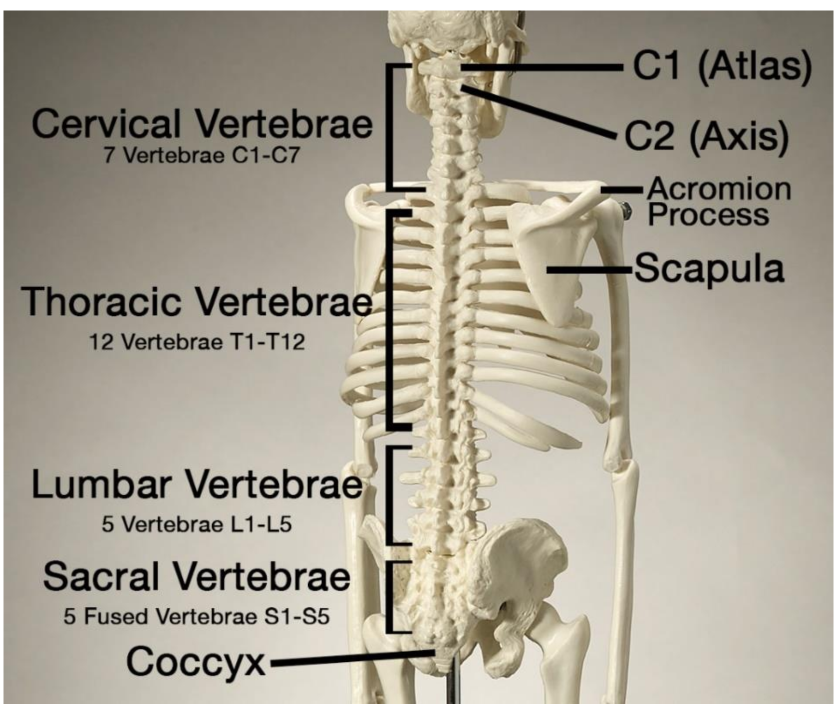
There are 12 ribs in the human body, which connect to the sternum in the front and the vertebral column in the back (see Vertebral Column Figure Below). Ribs 11 and 12 are called floating ribs because they do not have an attachment to the sternum in the front. Note the location of the clavicle, which is also called the collarbone. The clavicle attaches to the sternum at one end and to the acromion process of the scapula at the other end.



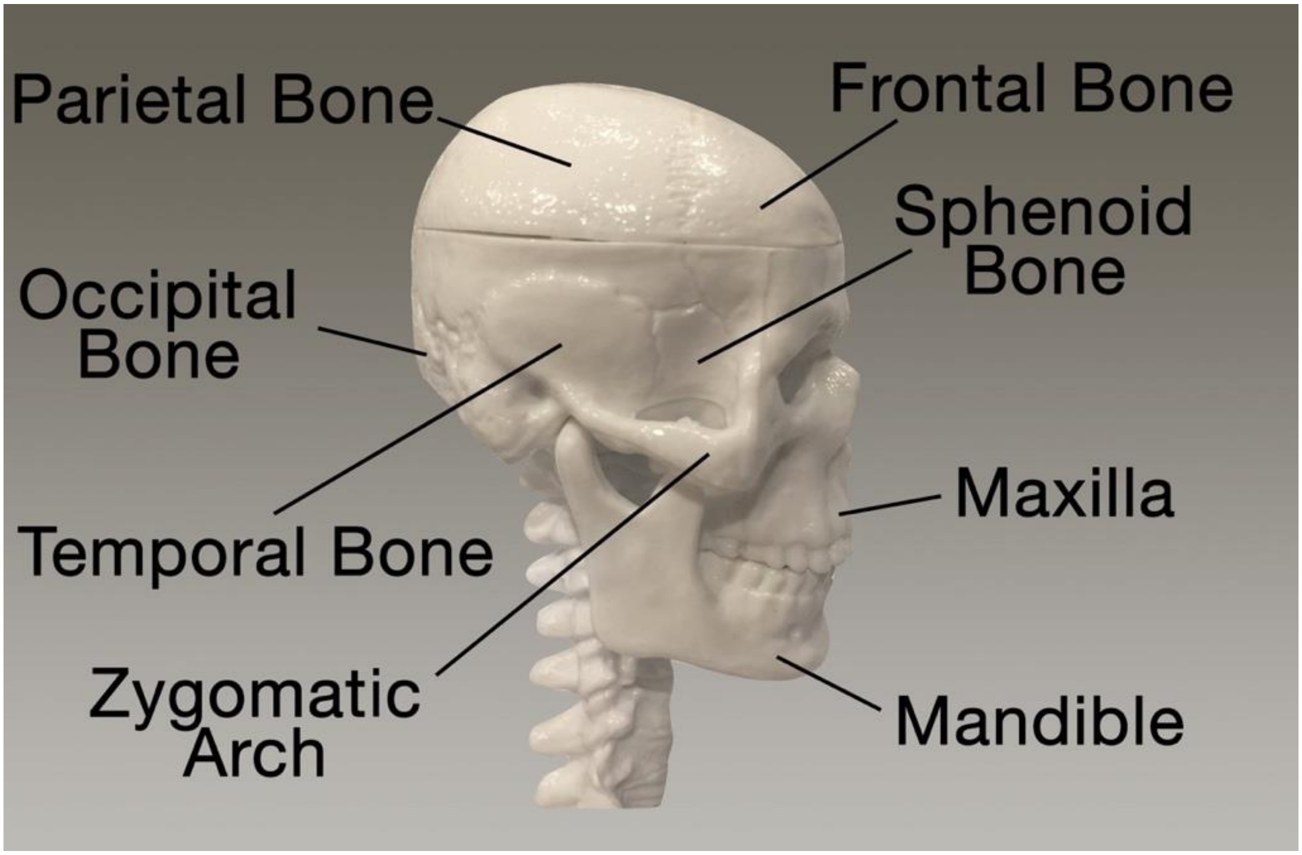
The sternum or breast bone is divided into three pieces from top to bottom, called the manubrium, the body, and the xiphoid process. The jugular notch is a small indentation at the top of the sternum, and the sternal angle is a small groove between the manubrium and the body. The humerus is the bone of the upper arm, and it forms the shoulder joint by attaching to the scapula at the glenoid fossa.



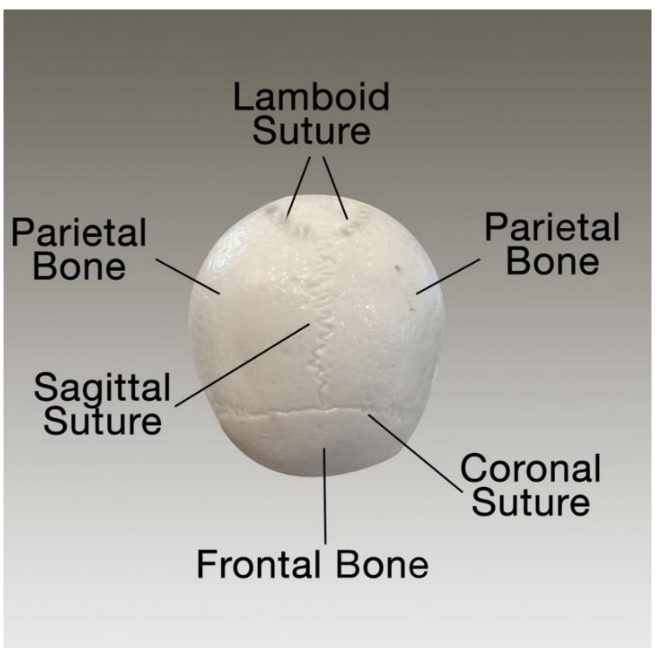
This figure shows a side view of the upper body so that we can see the bones of the arm. The humerus is the bone of the upper arm, and it attaches to the scapula to form the shoulder joint. The radius and ulna are the bones of the forearm, and they attach to the humerus to form the elbow joint. They also attach to the bones of the hand to form the wrist joint.



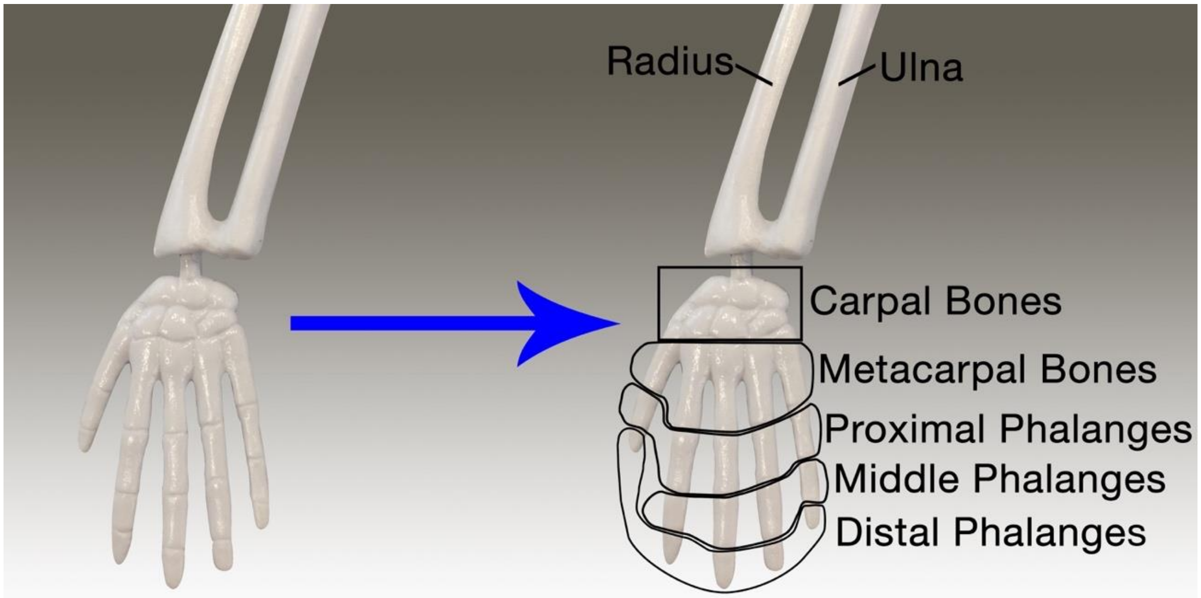
The vertebral column includes the major bones in the back that protect the spinal cord. There are four main divisions of the vertebral column including 7 cervical vertebrae (numbered C1 to C7), 12 thoracic vertebrae (numbered T1 to T12), 5 lumbar vertebrae (numbered L1 to L5), 5 sacral vertebrae (numbered S1 to S5), and lastly the coccyx or tailbone. The top cervical vertebrae, C1, is called the Atlas, while C2 is known as the Axis. The 5 sacral vertebrae (S1 to S5) are often fused together to form what is known as the sacrum. Also note the location of the scapula in our back, which is also known as the shoulder blade.



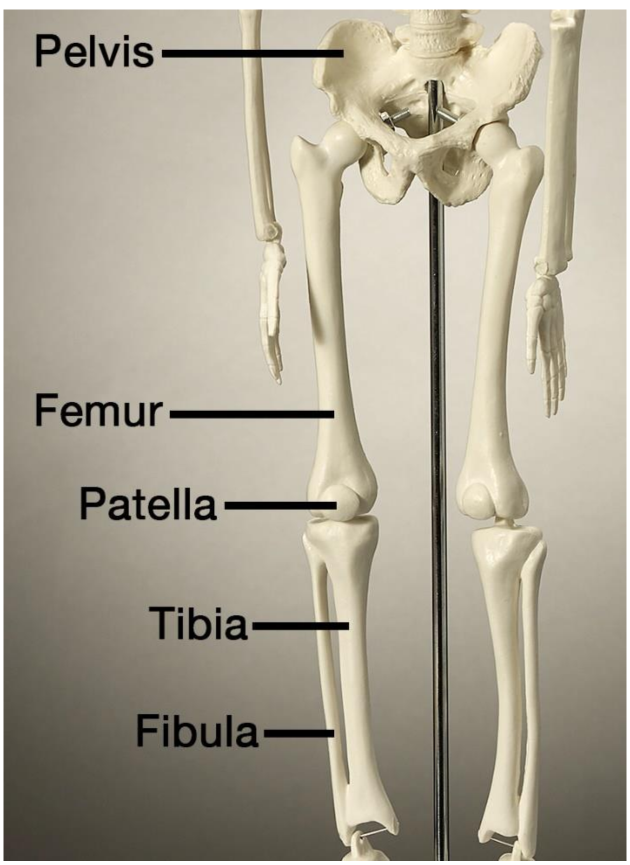
The human skull is actually formed from several different bones, many of which are attached together through small groves known as sutures (see next Figure). The mandible is the lower jaw bone while the maxilla is the upper jaw bone, and the zygomatic arch represents our cheek bones. The parietal bones, frontal bone, sphenoid bones, temporal bones, and occipital bone make up the top, front, sides, and back of the skull and are critical for protecting the brain!



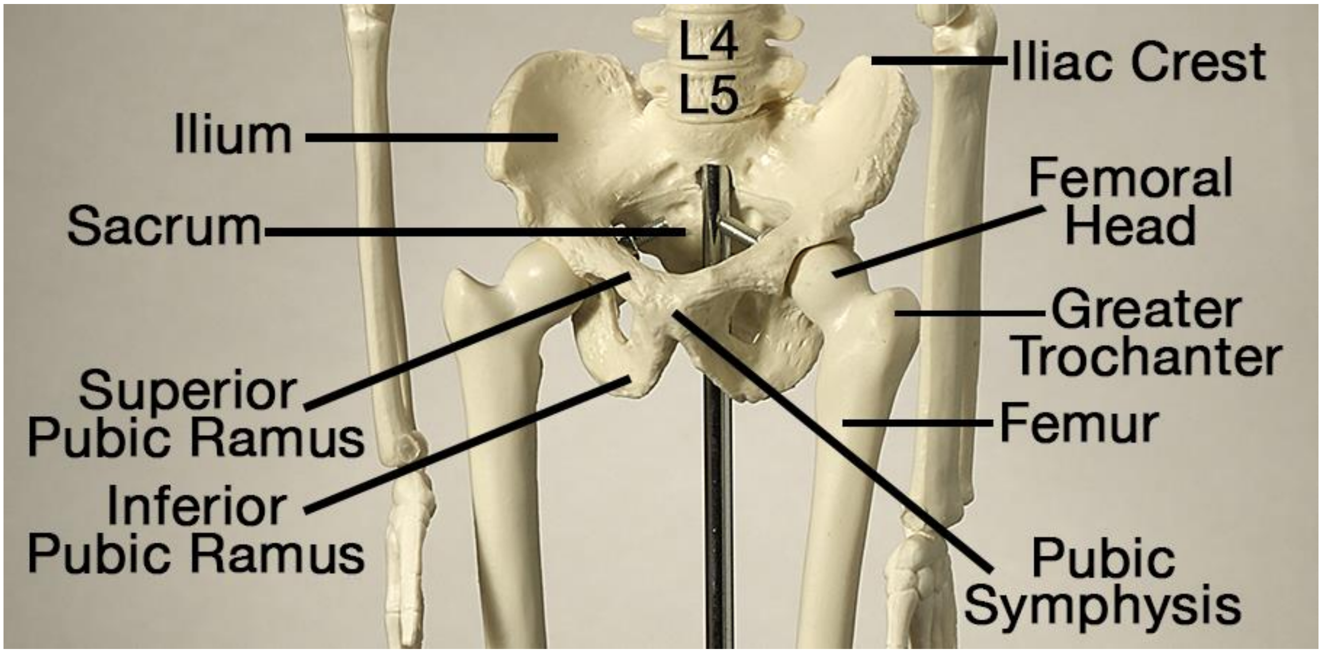
With the exception of the mandible, the bones in the skull are joined to one another through sutures, which appear as small grooves between these bones. These sutures are actually considered to be joints. However, unlike most joints in the body, sutures are immovable. Note the location of some of the major sutures in the skull above.



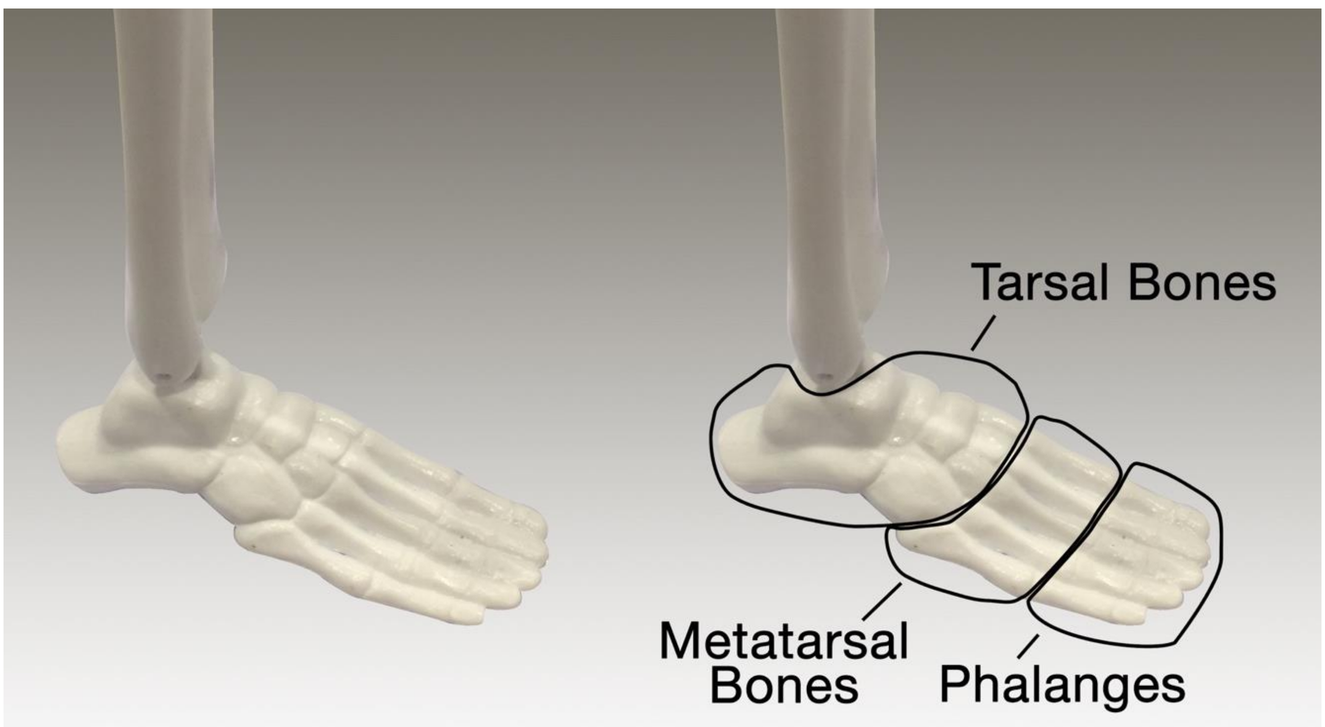
The hands are formed from multiple small bones. The first bones of the hands which are closest to the wrist are called the carpal bones. Next come the metacarpal bones, and lastly the phalanges. The thumb only has two phalanges called the proximal and distal phalanges. However, each of the other fingers have three phalanges, named the proximal, middle, and distal phalanges! Note the location of the radius and ulna, which are the two bones that form our forearm. The radius is on the same side of our arm as the thumb, which is an easy way to remember its location.



The femur is the largest bone in the body and is the bone of our upper legs. The knee cap is called the patella and our lower legs are made from two bones known as the tibia (also known as the shinbone) and the fibula. The femur attaches to the pelvis at the hip joint.



The pelvis is divided into different regions with distinct names. Check out some of these regions above including the ilium, iliac crest, superior and inferior ramus, and the pubic symphysis. Note that the femur attaches to the pelvis to form the hip bone. The top of the femur is called the femoral head and the upper side of the femur is called the greater trochanter.

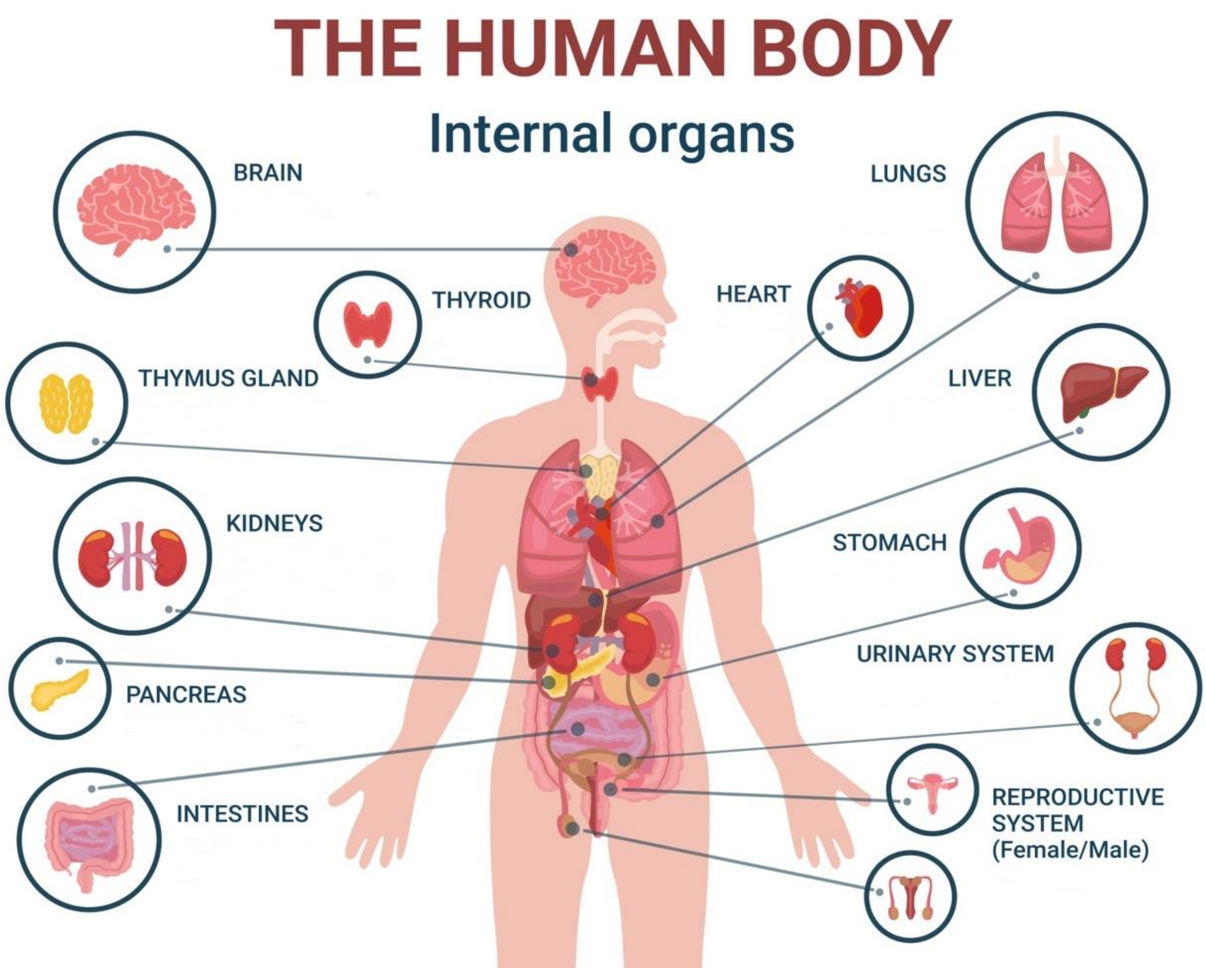


Like the hands, the feet are also made up of multiples bones. The bones that are closest to the ankle joint are known as the tarsal bones. Next come the metatarsals, followed by the phalanges. Like the thumb, the big toe only has two phalanges called the proximal and distal phalanges. However, the other toes have three phalanges called the proximal, middle, and distal phalanges.

Vital Organs of The Human Body!

Introduction

We have learned about one of the body's most important organs, the heart, and we have learned about the skeletal system and the skin. Now, we will turn out attention to many of the other vital organs in the human body including the lungs, the brain, the kidneys, and the liver. All of these organs have critical functions that include helping us to digest food, absorb nutrients from the environment, and detoxify our blood.



Quick Guide to Evviva Sciences' Torso Anatomy Model: if you have our human torso anatomy model, below is a quick guide for putting the organs back in place along with their identifications. Email us at support@evvivasciences.com if you have any questions at all!

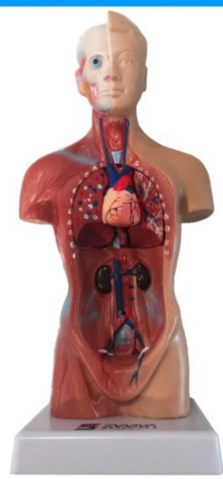
1. Lay the Torso Anatomy Model Flat on its Back on a Flat Surface

2. Add the Posterior (Back) Half of the Right Lung to the Right Chest

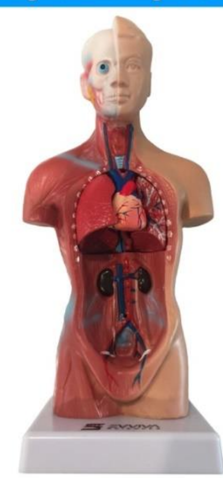
3. Add the Posterior (Back) Half of the Left Lung to the Left Chest

4. Add the Trachea/Esophagus/Aorta Piece Between the Lungs

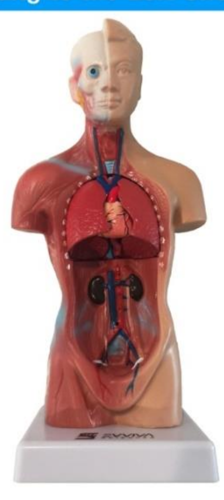
5. Next Add The Heart on Top of the Trachea Piece



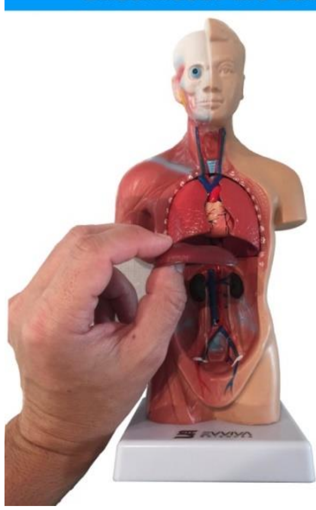
6. Add the Anterior (Front) Right Lung to the Right Chest



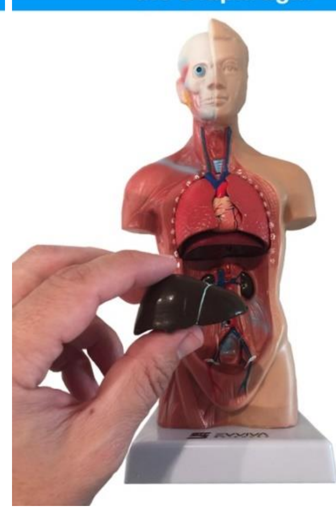
7. Add the Anterior (Front) Left Lung to the Left Chest



8. Add the Diaphragm Piece Right Underneath the Lungs



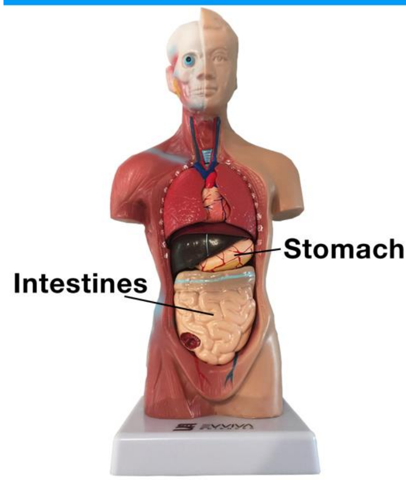
9. Add the Liver Right Underneath the Diaphragm



10. Add the Pancreas/Duodenum/ Spleen to Upper Right Abdomen

10. CONT. Location of Pancreas/ Duodenum/Spleen in Abdomen

11. Add the Intestines and Stomach

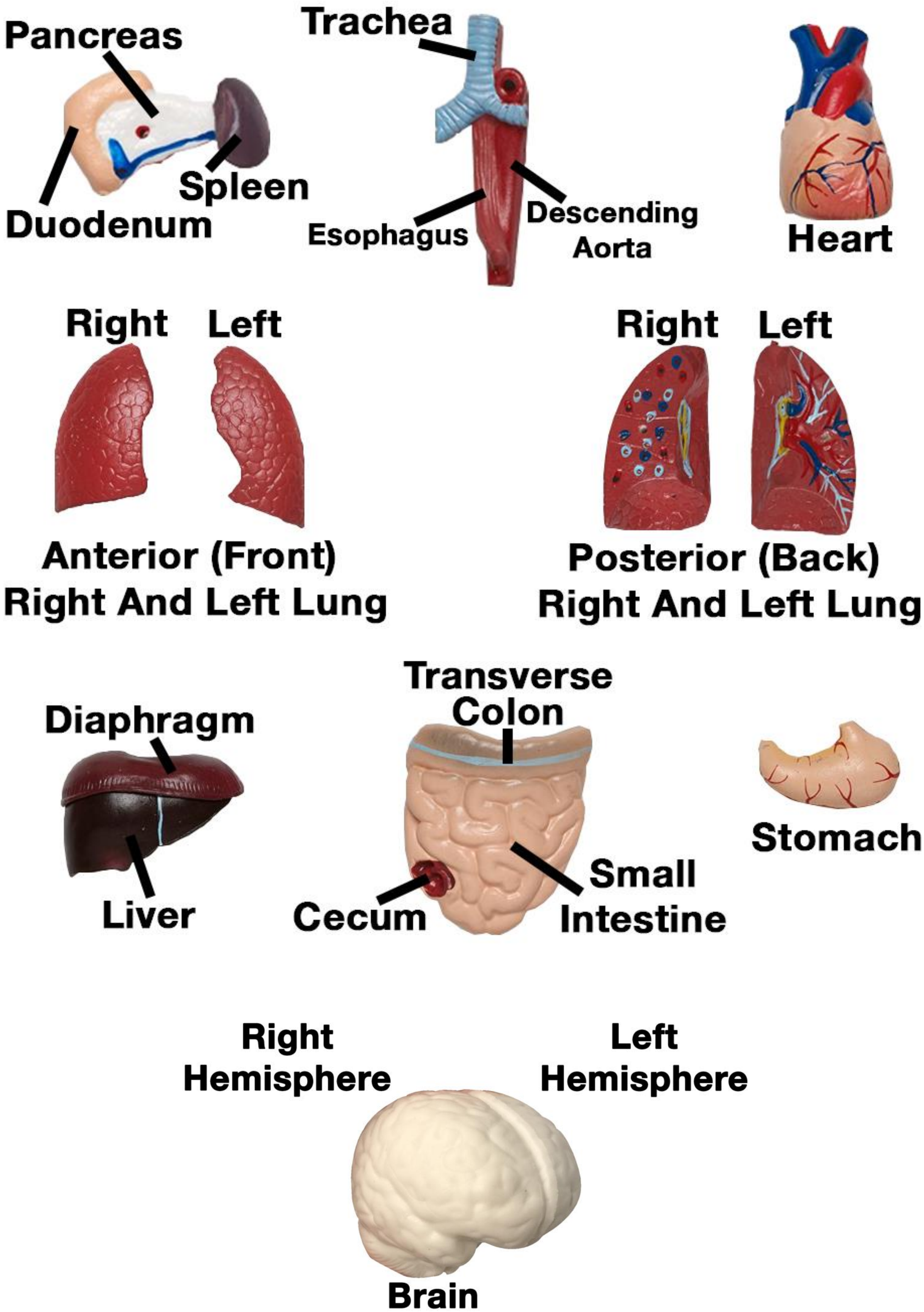


12. Face the Torso Model Downward on a Flat Surface

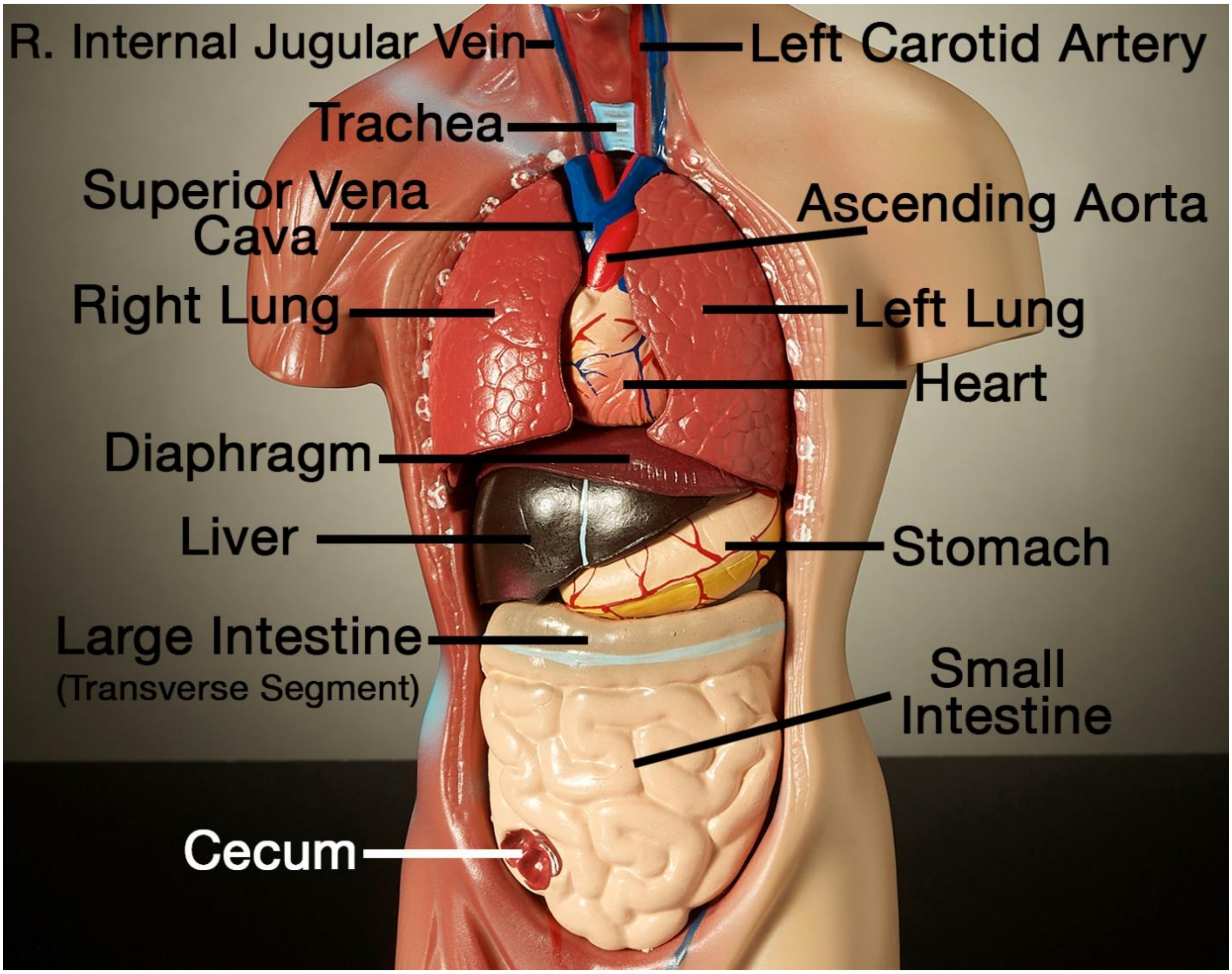
13. Add One Half (Hemisphere) of the Brain

14. Add the Other Half (Hemi- sphere) of the Brain

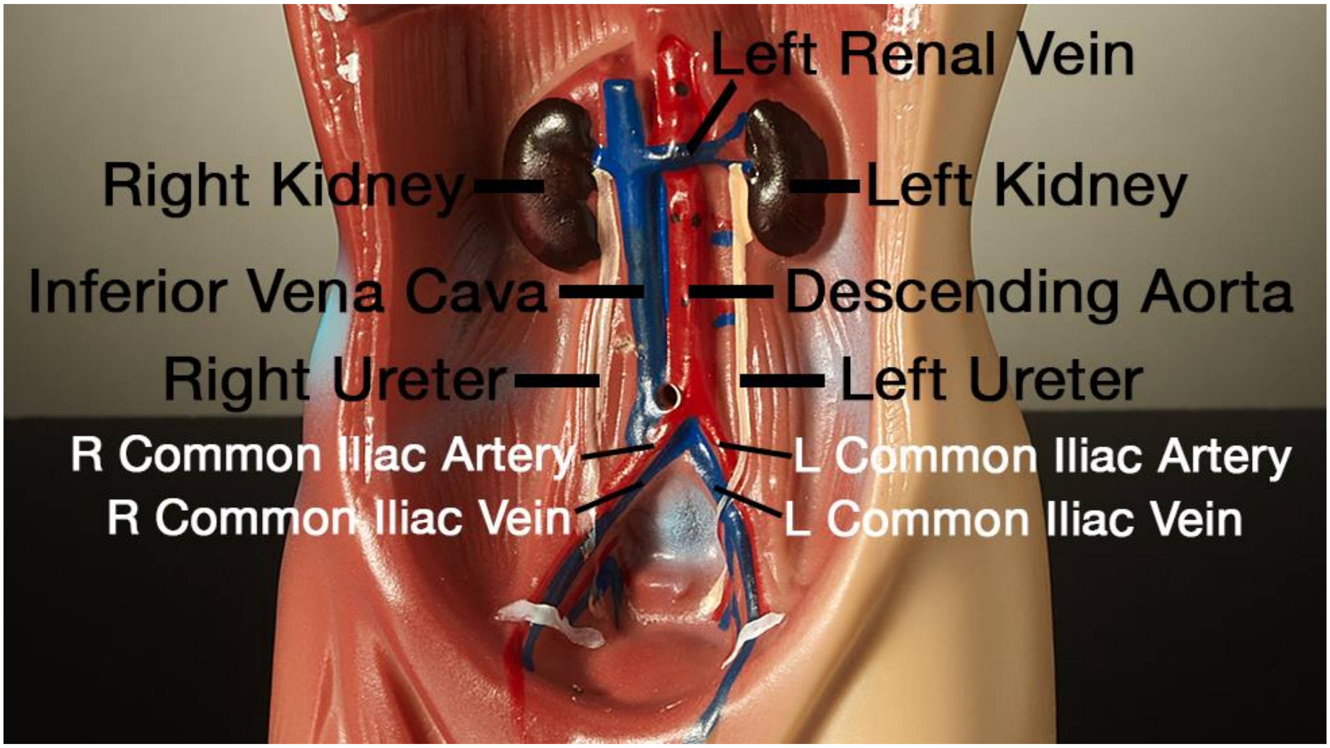
15. Add the Back of the Head



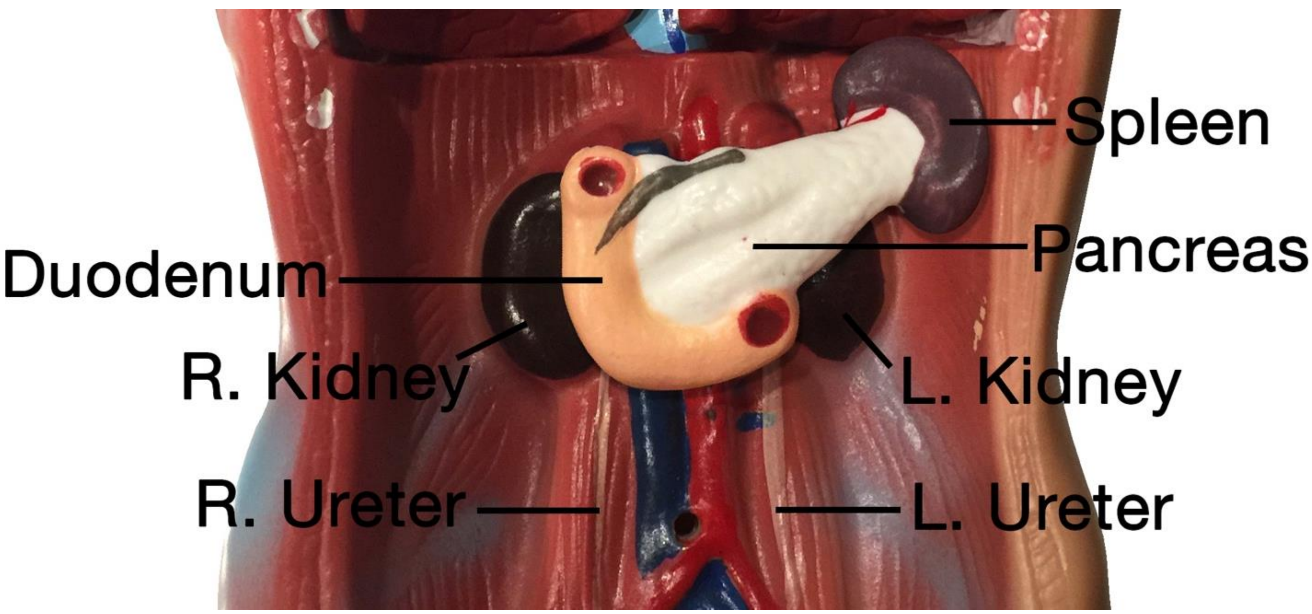
Labeled organs of Evviva Sciences' torso model.



Labeled organs in the chest and abdomen of the human body.



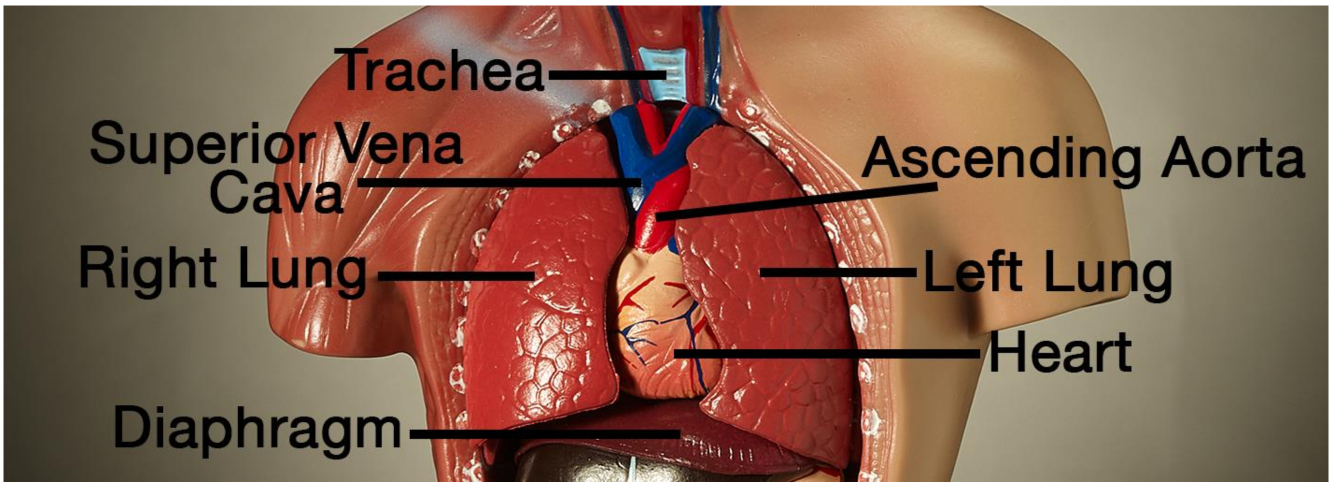
Labeled organs and other structures in the posterior abdomen.



Another view of the abdomen, which includes the spleen, pancreas, and the first segment of the small intestine, known as the duodenum.

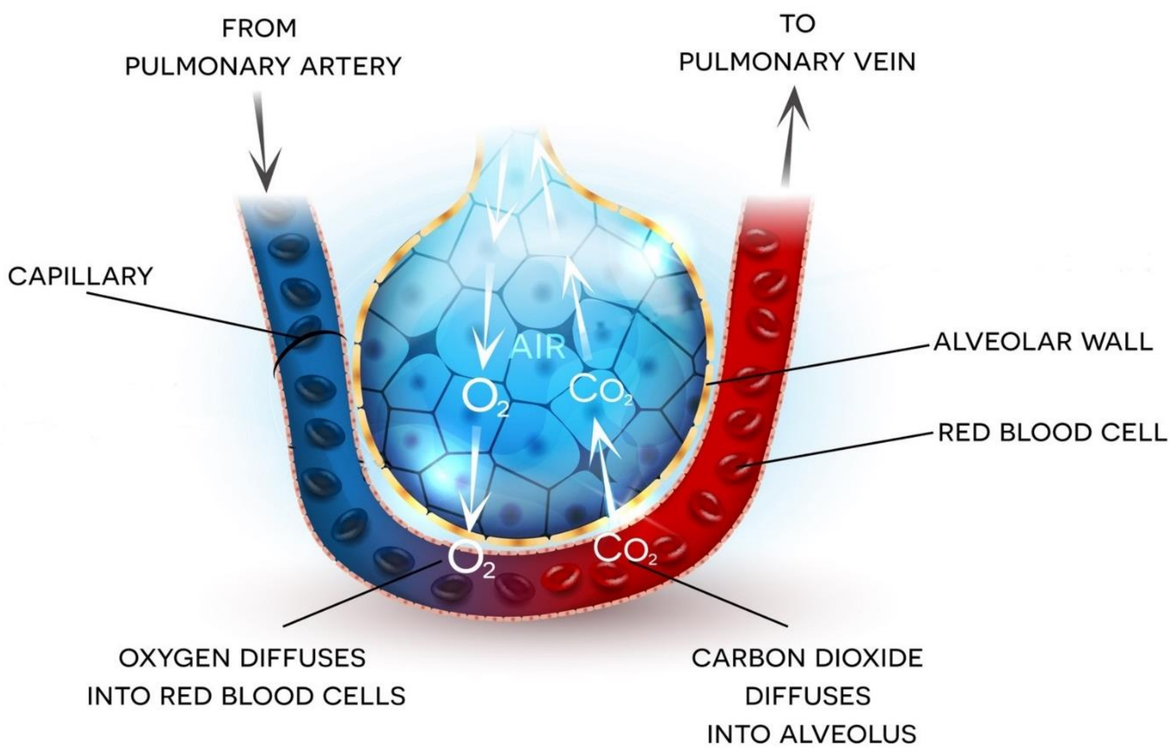
The Lungs, Heart, And Other Structures in the Chest

The major muscle that controls our breathing is called the diaphragm, and it sits just below the lungs and on top of the liver. When we inhale, the diaphragm flexes and flattens out, and this motion pulls the lungs downwards. This downward force causes the lungs to expand, which creates a vacuum effect that pulls air down the trachea, into the left and right mainstem bronchi, and then into the left and right lungs. When the diaphragm relaxes, air is pushed back out of the lungs as we exhale.



The lungs, the heart and other structures in the chest

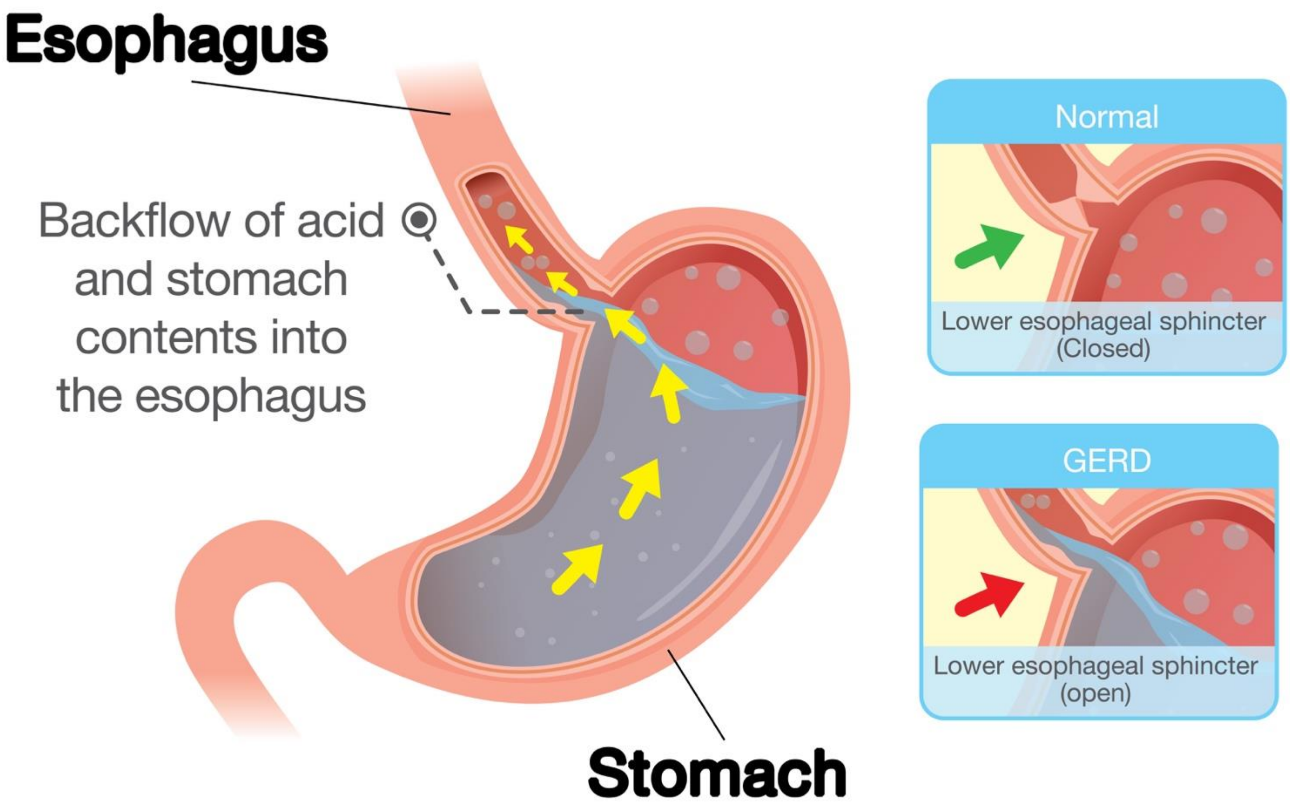
Inhaled air continues down into our lungs into small sac like structures called alveoli. These alveoli are right next to tiny blood vessels called capillaries, and a process called gas exchange occurs at these locations (see figure below). The right side of the heart pumps deoxygenated blood into the lungs through the pulmonary artery. Once this deoxygenated blood reaches these capillaries, carbon dioxide leaves the capillaries into the alveolar space, and oxygen from our inhaled air goes in the opposite direction into the blood stream. This is why we breath in oxygen, and we exhale carbon dioxide. The blood is now oxygenated, and it now flows to the left side of the heart, where it is pumped out of the Aorta to supply our other organs and tissues with oxygen.



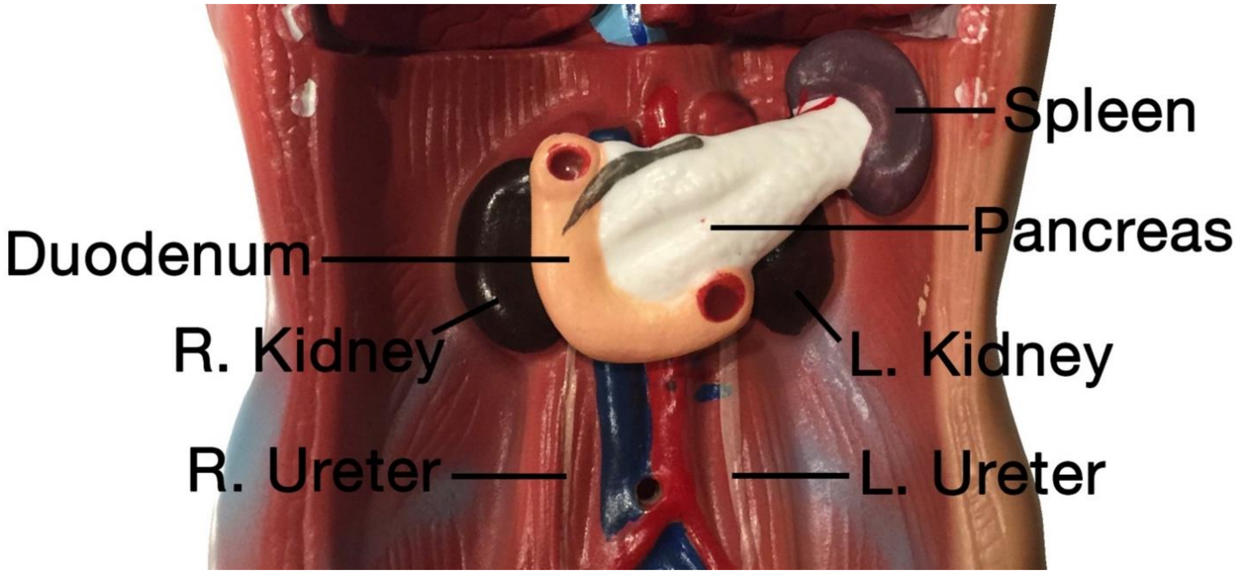
The top view of the diaphragm. Notice how there are two holes/openings in the diaphragm. The hole on the left side of the image above (which is on the right side of the body) is called the caval opening and is where the inferior vena cava passes through to reach the heart. The opening towards the center is called the esophageal hiatus and is where the esophagus passes through to reach the stomach. The Aorta also passes through the diaphragm through an opening in the back between the left and right sides.

Digestion: The Esophagus, Stomach, And Small Intestine

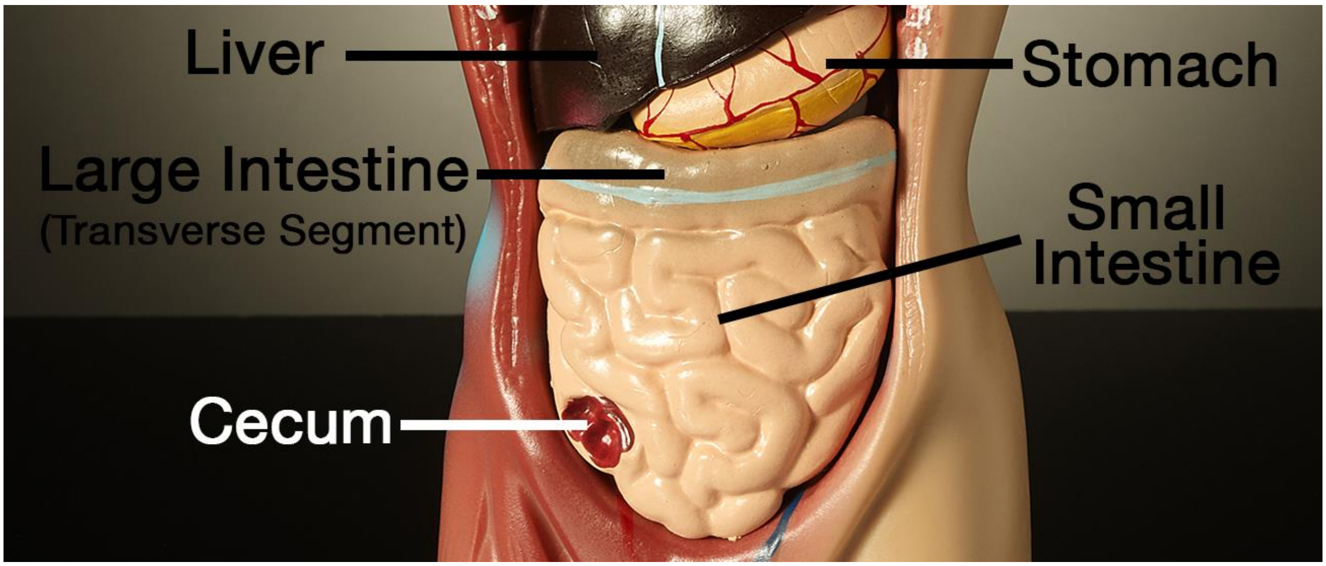
There are many organs that help us digest the food we eat and absorb essential nutrients into our bodies. The food we ingest first passes through the esophagus, which is a muscular tube that moves food downwards into the stomach through a series of rhythmic contractions known as peristalsis. At the junction between the esophagus and stomach is a small muscle known as the lower esophageal sphincter which opens to allow food to pass from the esophagus into the stomach and not backwards. A very common medical condition, known as Gastroesophageal Reflux Disease (GERD), occurs when the sphincter does not close tightly and stomach acid moves backwards into the esophagus, causing discomfort and possibly some long term problems.



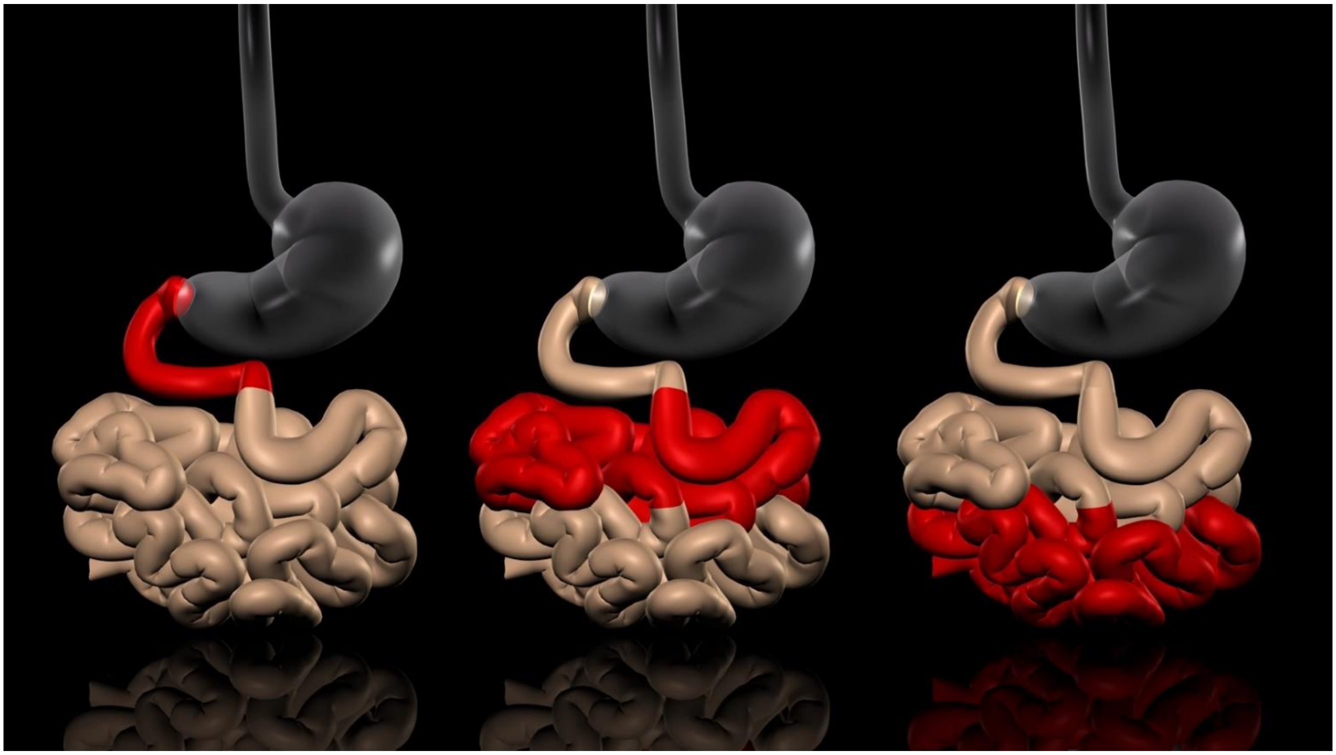
Gastroesophageal Reflux Disease (GERD) is a medical condition where food and acid flows back from the stomach into the esophagus causing a lot of discomfort. In GERD, the lower esophageal sphincter does not close well, which allows food to travel backwards.



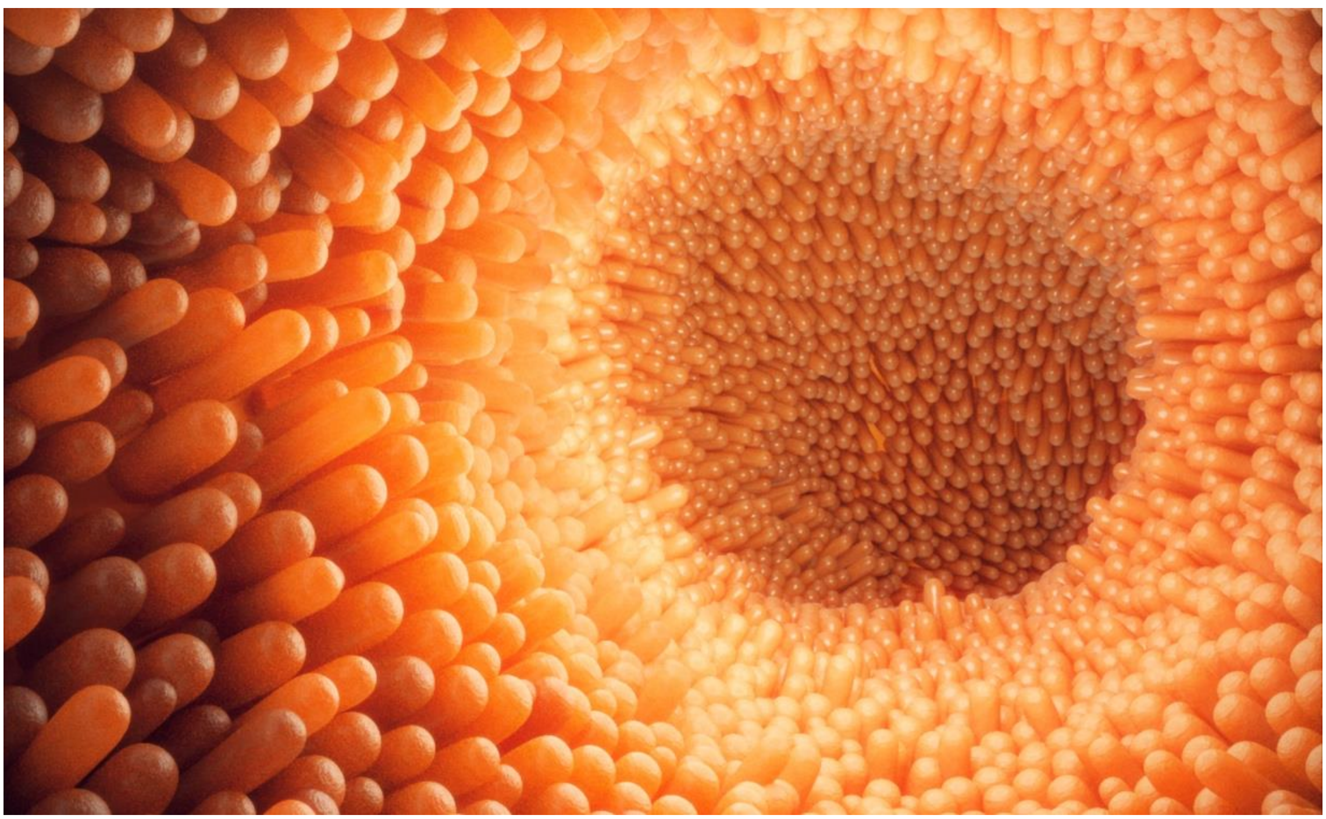
After ingested food has spent some time in the stomach, it will pass into the first part of the small intestine, which is known as the duodenum. See the image above for the location of the duodenum.



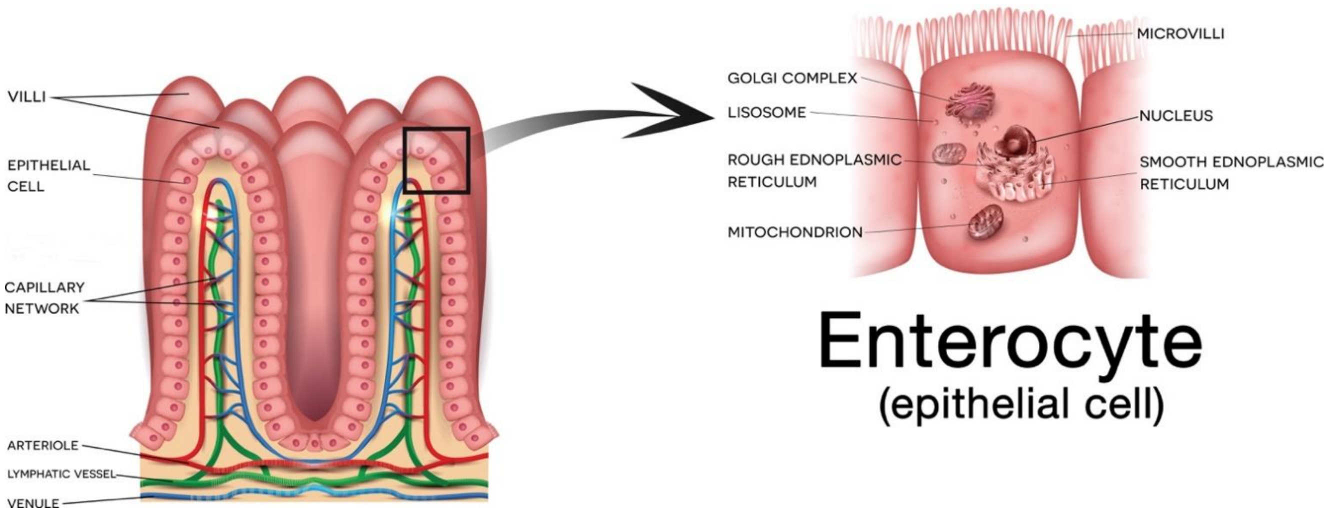
Acid in the stomach helps to break down food before it moves down into the next segment of the digestive tract known as the small intestine. The small intestine is very long, and it has numerous folds and small ridges known as villi, which help to maximize its surface area to absorb as many nutrients as possible. In fact, if we flattened out the small intestine, its total surface area would equal the size of a tennis court (~2700 square feet). The small intestine is divided into 3 segments: the duodenum is the first segment followed by the jejunum and lastly the ileum. Nutrients are absorbed throughout the small intestine into the blood stream.



The three segments of the small intestine starting with the duodenum (left image), jejunum (middle image), and ileum (right image).



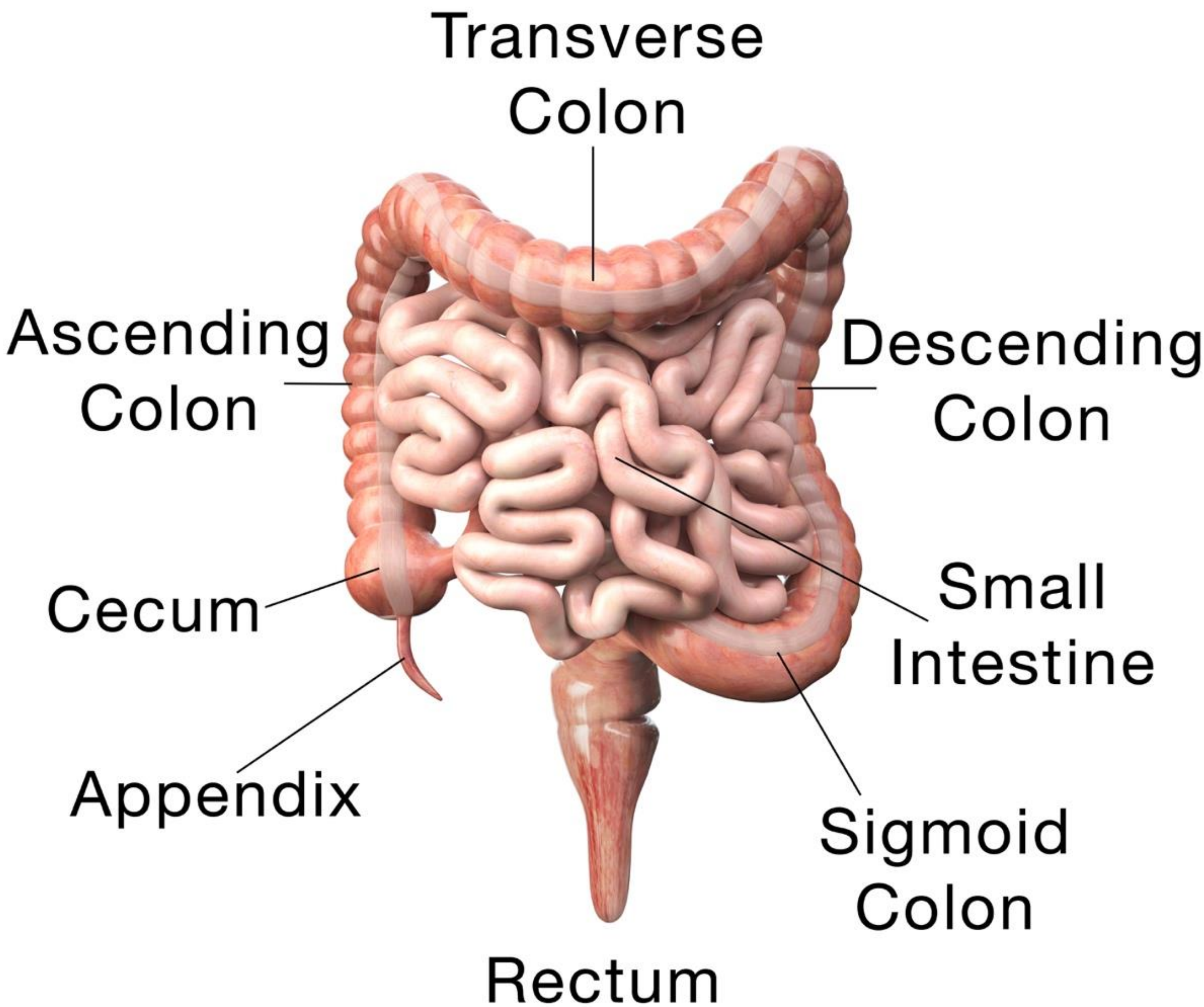
This image is an artist's vision of what it might look like to travel down the small intestine. Notice the ridges that line the intestine, called villi, which significantly increase its absorptive surface area.



The intestines are lined with small projections/ridges known as villi (left image), which maximize its surface area to absorb as many nutrients as possible. Even individual intestinal cells (called enterocytes) have small projections called microvilli, which also increase their surface area and improve nutrient absorption.

Digestion Continued: The Large Intestine (aka the colon)

After passing through the length of the small intestine, the ingested food now enters the large intestine, which is also called the colon. Here, a significant amount of water is absorbed, and the remaining waste material becomes hardened feces. The large intestine is also divided into segments or regions. The very first part, where the small intestine joins with the large intestine, is known as the cecum. A small fingerlike projection comes off the cecum known as the appendix. The appendix has an unclear role, but it may aid the immune system to help fight off infections. The waste material from our ingested food first enters the cecum, then travels up the ascending colon, followed by the transverse colon, then down the descending colon, through the sigmoid colon, and in the end, it is stored in the rectum. Finally, as you might guess, we go to the toilet to remove the waste.



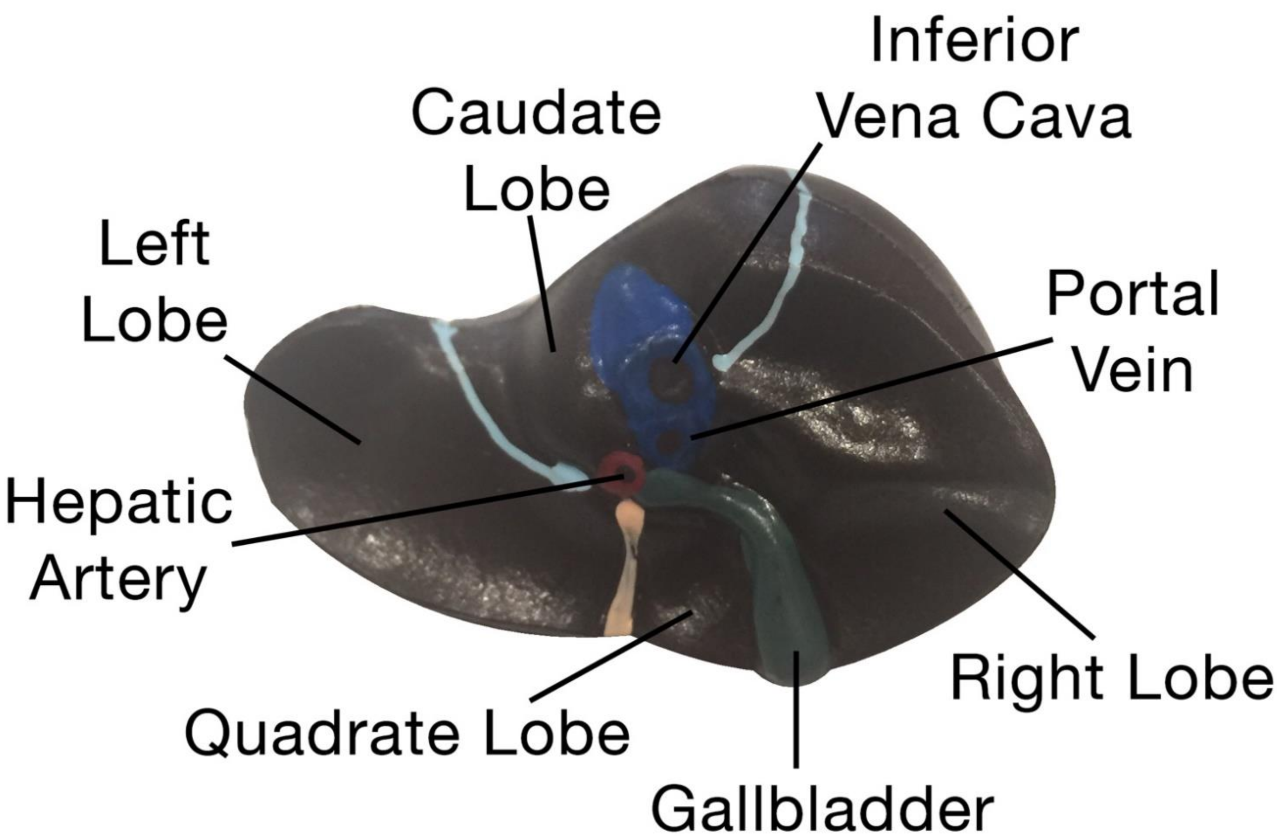
The divisions of the large intestine (colon). Ingested food enters the cecum from the small intestine, then travels up the ascending colon, across the transverse colon, down the descending colon, through the sigmoid colon, and into the rectum where it is stored as feces.

The Liver

The liver has several important roles in our body including detoxifying our blood, making various secreted proteins, and making chemicals that help in digestion. For example, many medications and toxins are metabolized or chemically detoxified in the liver and secreted into the small intestine before they have a chance to harm our bodies. In fact, when nutrients are absorbed in the intestines, their first stop is the liver through a large vein called the portal vein. The body was likely designed this way so that any potentially toxic substances we ingest would first go through the liver where they can be metabolized and eliminated before being pumped to our other vital organs by the heart. This process is called First Pass Metabolism.

In terms of digestion, the liver produces bile, which is critical for emulsifying fats and helping us to digest them. Bile is stored in the gallbladder, which can be seen underneath the liver. When we ingest fats, the gallbladder releases this bile into the small intestines.

When visualized from the front, the liver has two main lobes/sections, called the right and left lobes of the liver. However, when visualized from underneath, the liver is often divided into four sections/lobes called the left lobe, right lobe, caudate lobe and quadrate lobe. Notably, the liver is the heaviest organ in the body, weighing about 3lbs!

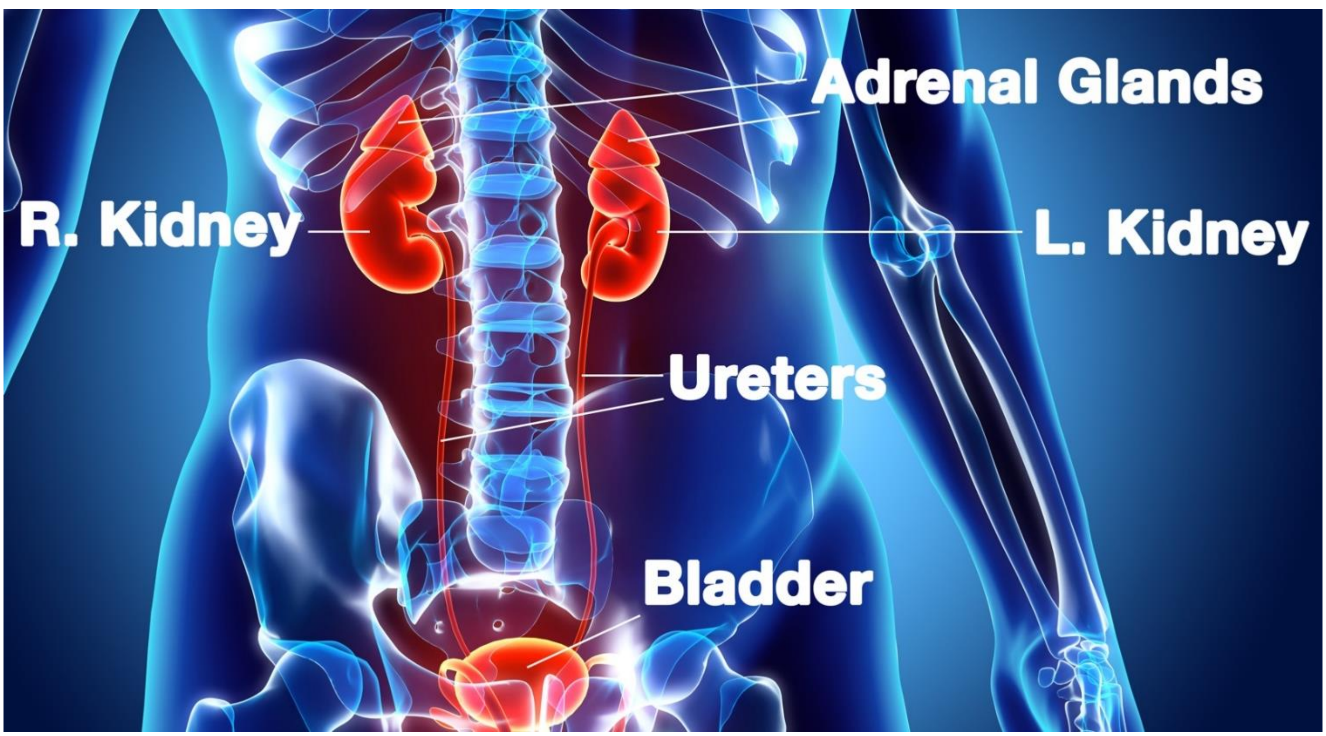


The underside of the liver. The liver can be divided into four lobes: the left lobe, right lobe, caudate lobe, and quadrate lobe. The gallbladder stores bile, which is made in the liver, and releases this bile into the small intestine to emulsify and digest fats. The inferior vena cava passes through the liver on its way to the right side of the heart, and the portal vein carries blood from the intestines into the liver so it can be detoxified. The hepatic artery supplies oxygenated blood to the liver!

The Kidneys

Like the liver, the kidneys play a really important role in filtering toxins and wastes out of our blood stream. We each have two kidneys, but technically we can survive with just one. This is why some people will donate a kidney to a patient in need! Each kidney is attached to a ureter (see image below), which is a tube that attaches from the kidneys to the bladder. When the kidneys filter wastes from your blood, that waste is carried through the ureters into the bladder, where it is eventually eliminated from the body as urine.

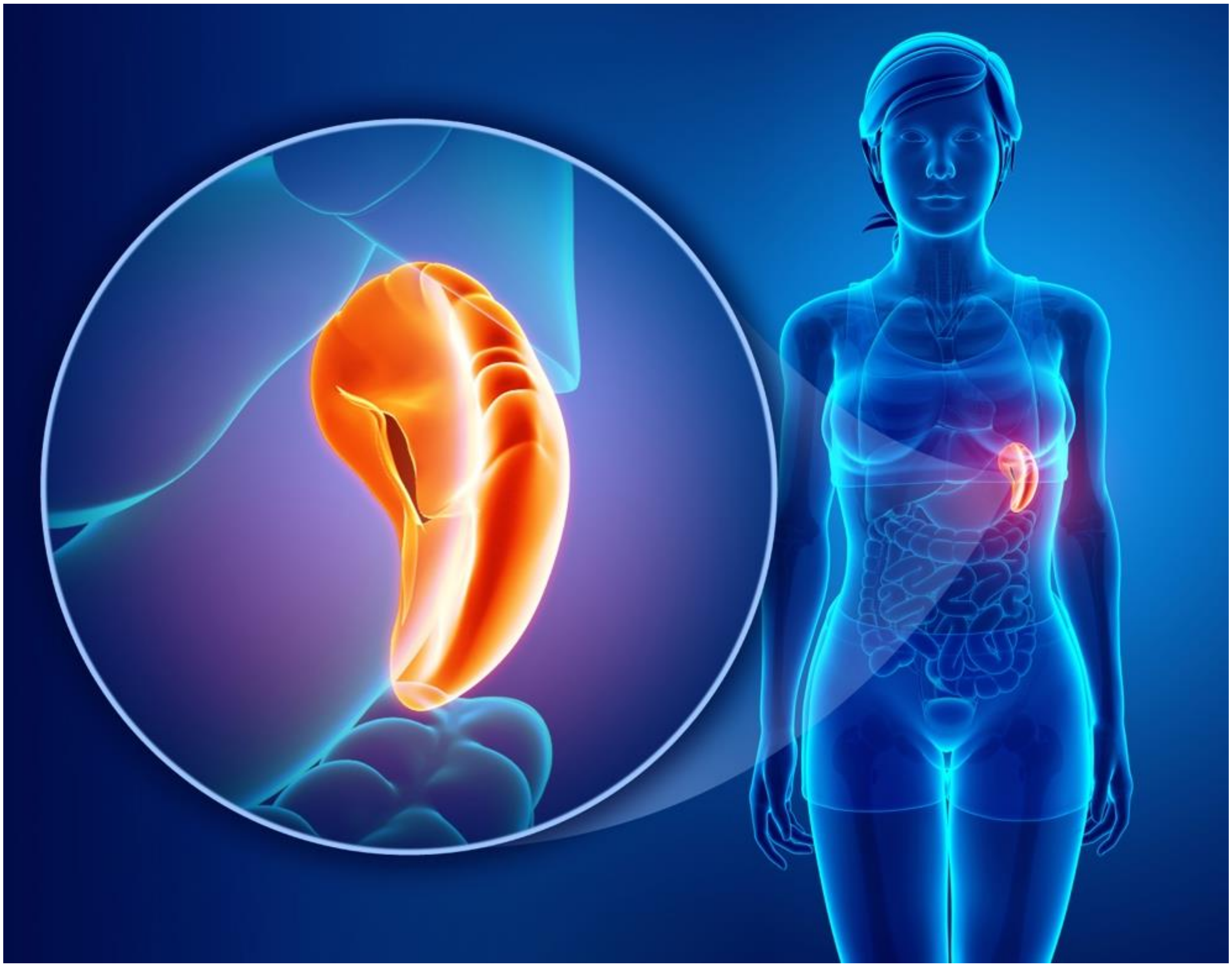
Kidneys also control the fluid levels in our body and balance important electrolytes in our bloodstream such as sodium and potassium! For example, For example, if we eat food which is high in sodium chloride (i.e. salty food), we get really thirsty because the body needs to dilute out some of that salt/sodium with water. The kidneys will also help out with this by holding on to free water to balance out the sodium. If we are really dehydrated, the kidneys will produce less urine to maintain the fluid levels in our body! However, if we drink too much water, as we all know, the kidneys will produce more urine. We are not aware of these things happening in our body because the kidneys take care of them seamlessly. However, if the kidneys are not working well, our bodies can become "fluid overloaded" which can make our hands and legs and other parts of our body really swell up with fluids (this is also known as edema).



We have two kidneys located on the left and right sides at the back of our abdomen. When the kidneys filter our blood, the wastes go from the kidneys down the ureters into our bladder, where they are ultimately eliminated from the body as urine. Also note that directly on top of the kidneys are our adrenal glands which produce important hormones such as adrenalin.

The Spleen

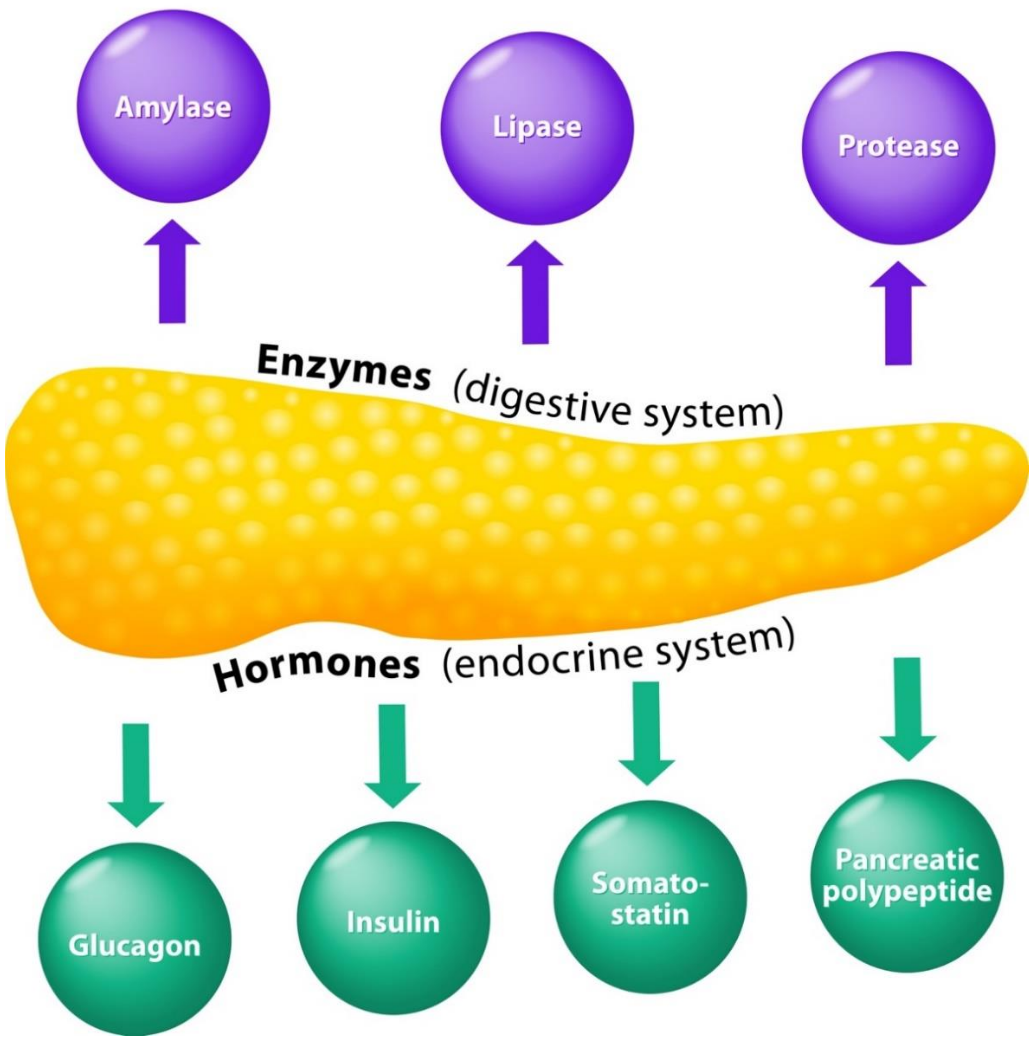
The spleen is an organ in the upper left side of the abdomen. It stores red blood cells, it helps our body recycle older red blood cells, and it helps produce white blood cells that fight infection. Remember that red blood cells are the cells in our bloodstream that carry oxygen. If you have a big injury that causes you to bleed, you are very lucky because the spleen has a reserve of blood for such emergencies! In addition, when our red blood cells get old, the spleen helps to break them down so that their components can be recycled. Red blood cells have an iron rich protein called hemoglobin, which is the major protein responsible for carrying oxygen in our blood. The spleen breaks down the hemoglobin into its amino acids and iron so that these components can be recycled. Lastly, the spleen helps with the synthesis of antibodies, which are important proteins for fighting infections.



The Pancreas

The pancreas has two major but distinct roles in our body. First the pancreas is an endocrine organ, which means that it makes several hormones including insulin, glucagon, and somatostatin. Insulin is the key hormone that allows our body to regulate our blood sugar levels. In particular, when we digest food and absorb sugar (glucose) into our bloodstream, the pancreas releases insulin which helps lower our blood sugar levels. For this reason, patients without a working pancreas have diabetes because they cannot make insulin, and their blood sugar levels become too high! Having high blood sugar levels over many years increases the risk of all kinds of medical complications, including strokes and heart attacks.

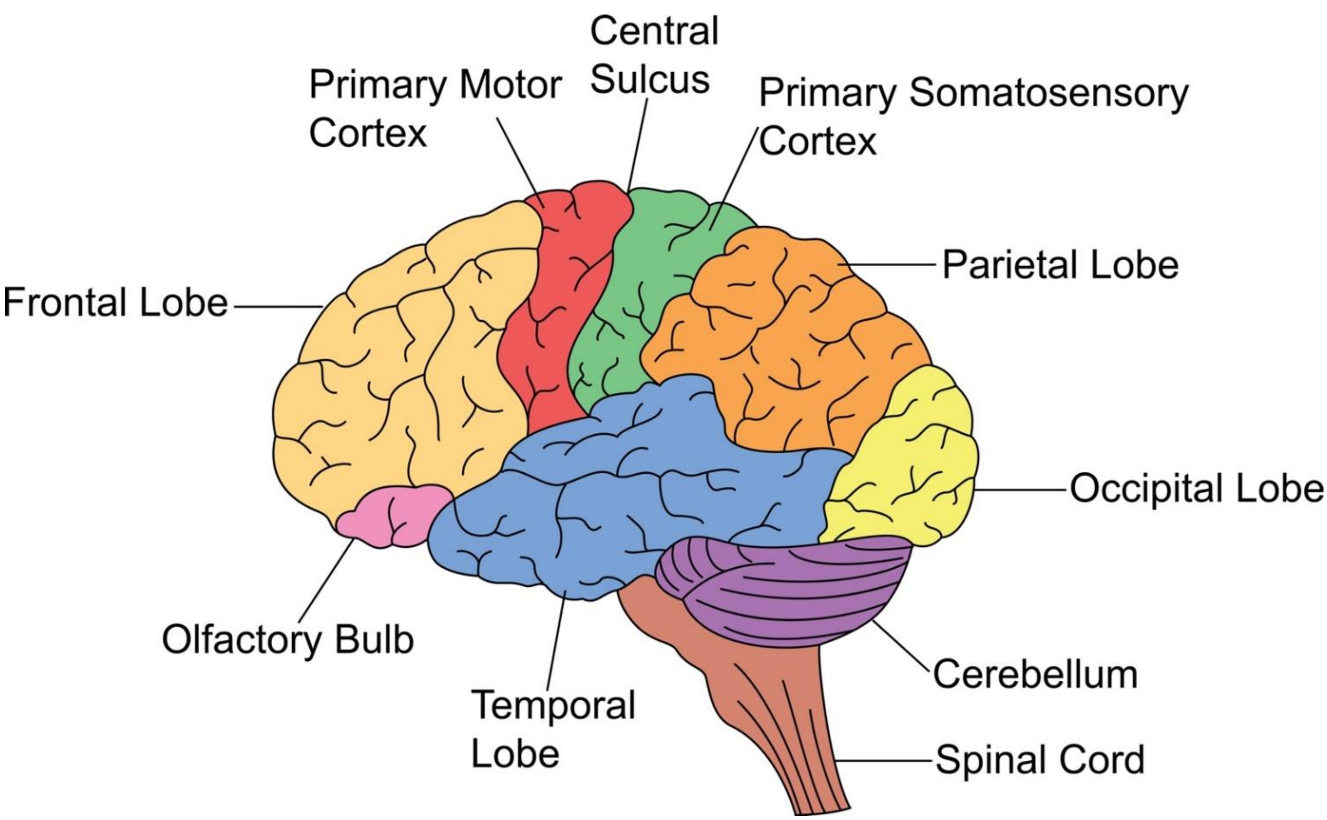
The pancreas is also an exocrine organ, meaning that it makes many proteins and enzymes that help us with digestion in the small intestine. These proteins and enzymes include amylases, proteases and lipases that digest carbohydrates, proteins and lipids, respectively.



The pancreas makes many enzymes that help with digestion (top), and it also makes many hormones that help regulate our blood sugar (bottom).

The Brain

The brain is the control center of our body that stores our memories, allows us to think, moves our muscles, and lets us experience all of the amazing sensations in this world! The brain is divided into the left hemisphere (left half) and the right hemisphere, and each side of the brain actually controls the opposite side of our body. For example, if you lift your left arm it is the right side of the brain that controls this movement! The anatomy of the brain is extremely complicated, and researchers are still trying to figure out the roles of different sections of the brain. The figure below, shows the major lobes of the brain, and each lobe is thought to have important and distinct functions. The brain is made up of billions of neurons, and there are trillions of electrical impulses that travel to and from the brain every minute. The brain truly is a super computer!



As you can see from the figure above, the brain is divided into several sections or lobes, and each lobe has distinct functions. The frontal lobe is associated with short-term memory tasks, planning, and personality. The primary motor cortex is also a part of the frontal lobe and it controls much of the body's movement! The parietal lobe plays a major role in experiencing different sensations such as touch, temperature and pain. For example, the primary somatosensory cortex, which plays a major role in feeling these sensations is at the front of the parietal lobe. The occipital lobe is at the back of the brain and helps process our vision! The temporal lobe plays a role in experiencing emotions and in preserving our memories. The cerebellum is important for our balance. The olfactory bulb is actually part of the frontal lobe and helps us experience smell!

Thank You!

Thank you so much for reading our human anatomy book! We really appreciate your support! If you ever have any questions, please contact us anytime at support@evvivasciences.com.

EVVIVA SCIENCES