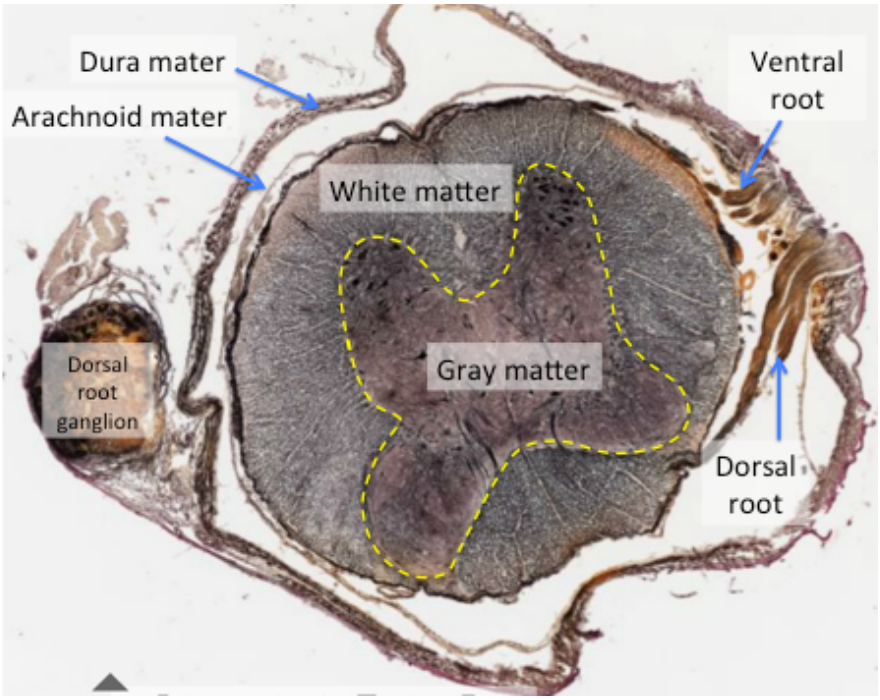
Nerve Tissue

Slide 92

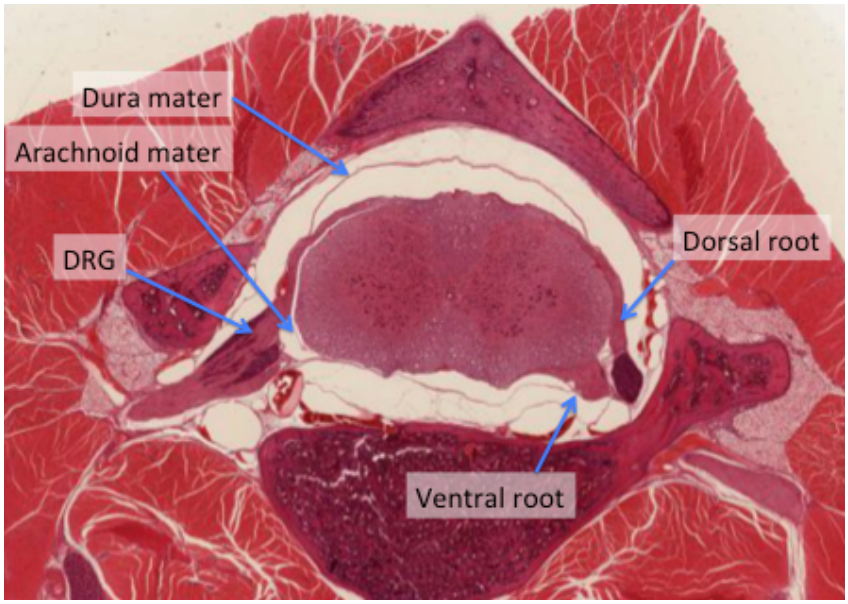


This slide shows a section of spinal cord stained with a silver stain. The ventral aspect of the cord is towards the upper part of the slide. Silver stains are particularly good at staining nerve processes. There is a dorsal root ganglion located on the left. On the right side ventral and dorsal roots can be seen. The meninges are also present. Note the shape of the gray matter in the cord, which is more or less like a butterfly, with dorsal and ventral horns. A high-power view of the gray matter shows the lacy network of black fibers, which represent dendrites and axons. Many of the neuronal cell bodies are also stained, some of them being very dark. Notice their shape and appearance, and notice that the largest of these are located in the ventral horn. These are alpha motor neurons that give rise to the ventral root axons that go to skeletal muscle. Try to identify the central canal, surrounded by columnar epithelial cells. These cells do not take up much of the stain and you cannot see the cilia on them. Next shift your attention to the white matter, which is stained gray and occupies the periphery of the cord. This mostly consists of axons cut in cross-section. On the right side of the slide follow axons of the dorsal and ventral roots. Next shift your attention to the dorsal root ganglia on the left. Notice the large cells that are the ganglion cells of sensory axons. Finally, examine the dura. Notice how thick it is and then examine the arachnoid, which is extremely thin. Normally there is no space between the dura and the arachnoid.

Slide 90

This is an H&E stained section of spinal cord. You have previously examined the muscle, brown fat and developing bone. Now examine the spinal cord itself and the dorsal and ventral roots, which are quite prominent. The dorsal side of the spinal cord is at the top of the section, and there is a prominent dorsal root ganglion on the left side. You can also see the membranes of the meninges

surrounding the cord. On high-power notice that the gray matter has many neurons that are stained blue. This is because of Nissl substance. At the center of the court you can see the ependymal cells and the central canal. Examine the shape and size of neurons and the dorsal and ventral horns. Now shift your attention to the white matter. Notice the fact that myelin is dissolved and leaves what appears to be an empty space around large, heavily myelinated axons cut in cross-section. The dorsal and ventral roots consist of tightly packed axons cut lengthwise. On the left side there is a very prominent dorsal root ganglia, with large, round ganglion cells. There's a smaller ganglion on the right. Finally, focus on the dura mater, which is intimately adhered to the arachnoid around most of the cord. On the lower left side, near the dorsal root ganglion, the very thin arachnoid is pulled away from the dura, creating an artificial space. There is an extremely thin layer of connective tissue intimately surrounding the cord. This is the pia matter.



Slide 91

This is a smear preparation of spinal cord. In the darker staining areas, identify dark blue, multipolar neurons. Try to identify and follow processes as far as you can. Notice the large number of small, heterochromatic nuclei of glial cells and the very lacy background of neuropil, consisting of processes of astrocytes and neurons.

Slide 99

This is an H&E stained section of the cerebral cortex. There is white matter at the center and gray matter surrounding it. If you use your imagination, you may get the sense that the cerebral cortex has layers. In fact, there are 6 layers of the cerebral cortex. At higher power you can see many nuclei of glial cells in the white matter. Many of these are oligodendroglial cells, but you are not expected to differentiate these from astrocytes. Next shift your attention to the gray matter, where you will see small, dark glial nuclei along with the basophilic cytoplasm of neurons. Basically, all of the cells where cytoplasm is visible in the cell body are neurons. Again, examine the pia on the surface of the brain. On the right side of

the slide, blood vessels are present in the subarachnoid space between the pia and a filmy membrane called the arachnoid. Finally, try to find capillaries within the brain substance. These are essentially everywhere. This gives you an idea of the degree of vascularity of the brain.

Slide 98

This is another part of the central nervous system, the cerebellum. The white matter is stained a purplish color. This white matter is at the center of each of the fingerlike processes that are present. Within the white matter are glial cell nuclei. Notice that adjacent to the purplish area is a layer with very dark blue stippling. This layer is comprised of billions of tiny neurons called granule cells, the most numerous cells in the brain. If you focus on high power, you will see that these neurons have very little basophilic cytoplasm and densely heterochromatic nuclei. That is, they don't look much like neurons. If you look in the region between these small, blue staining nuclei and the very lightly staining part of the cortex close to the surface of the brain, you will find a single row of very large neurons. These are Purkinje cells. This gives you an idea of the range of appearances that neurons can have. The very lightly staining area of the cortex next to the surface is called the molecular layer because there are very few neurons even though it is cortex. Again, appreciate the structure of some of the meninges: the pia and the very thin arachnoid (particularly on the upper right and lower right portions of the specimen). Also, identify the many capillaries within the substance of the brain.

Slide 93

This is a slide of an autonomic ganglion. There are portions that are dominated by axons, especially towards the center of the specimen. To the upper left and lower right are areas dominated by large ganglion cells. Many of these contain lipofuscin. These cells are surrounded by supporting cells that are called satellite cells. The cell bodies are the origins for postganglionic sympathetic axons, which will go towards target organs.

Slide 28

In many organs ganglion cells are close to or embedded within the wall of the organ. This is particularly true for the parasympathetic nervous system. Identify the layers of smooth muscle surrounding this specimen of small intestine. In between the outer longitudinal and inner circular layers there are many clusters of ganglion cells. These are particularly evident in the 11 o'clock to 1 o'clock position but can be seen elsewhere. The neurons are identifiable by large heterochromatic nuclei with nucleoli and basophilic cytoplasm.

Slide 95

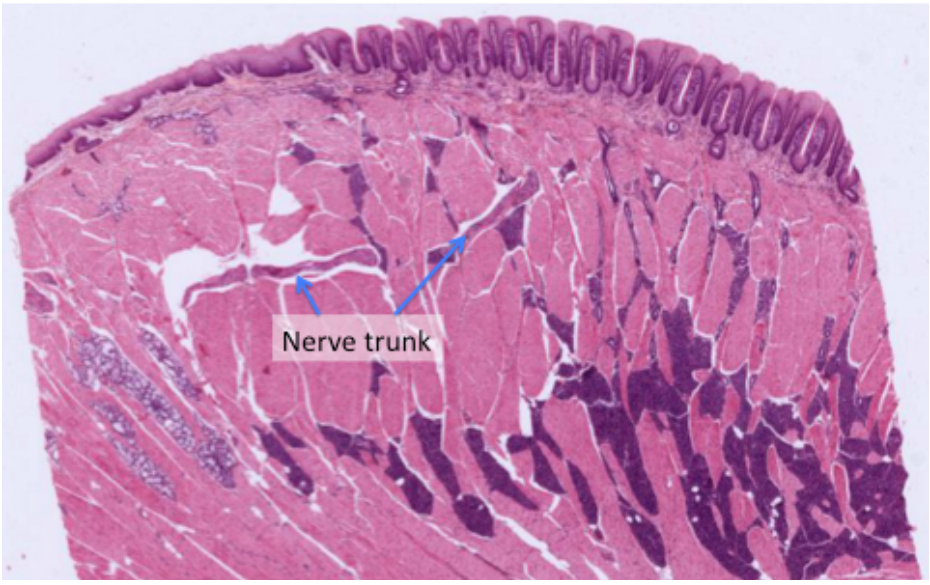
These are nerves in cross-section stained with osmium which stains myelin black. You can notice the many differently sized axons surrounded by myelin sheaths. Also notice that each nerve has connective tissue surrounding it, the epineurium, and is divided into fascicles by connective tissue septa, the perineurium.

Slide 94

Similar features can be seen on this slide, which contains nerves cut in cross-section above and lengthwise below. Most of the myelin is dissolved and appears as a foamy region around a central, slightly bluer core. This is particularly evident in cross-section but can also be seen in longitudinal section. The longitudinal section is particularly interesting because one can see the nodes of Ranvier interrupting the myelin sheath. Notice that Schwann cell nuclei are within the myelin sheath. That is because each segment of myelin is composed of a single Schwann cell. Also notice that the nerve fibers are somewhat wavy as you follow them in longitudinal section. This allows the nerve to stretch a bit without tearing. This feature is helpful in identifying nerve, and distinguishing it from collagen fibers and from smooth muscle. Notice that it is common for nerves to be cut obliquely in some areas. This leads to an appearance that is somewhat different than the straight cross-section and different than the pure longitudinal section.

Slide 77

It's not always easy to identify nerve within other tissues. In this slide of the tongue, which contains many glands, epithelium and skeletal muscle, there's a very prominent nerve. The tongue has an extensive innervation not just to control muscle but also to innervate the mucosa and taste buds.

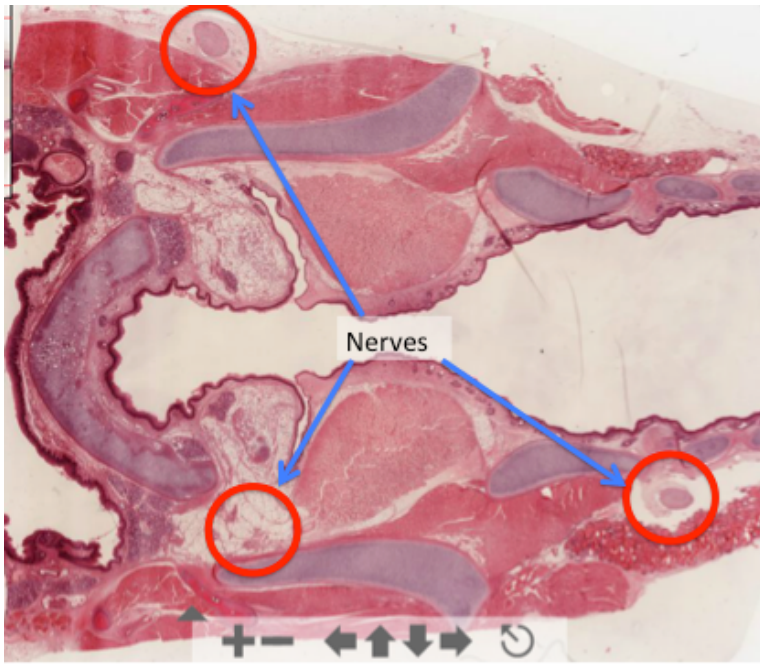


Slide 33

This slide shows a number of small nerves within connective tissue septa of the skin. There are also some nerve trunks in the deeper portion of the slide. Notice that these are often lighter in color than surrounding connective tissue because myelin does not take up stain the way connective tissue does.

Slide 65

The slide of the larynx has a number of examples of nerves within tissue. There's a large nerve located to the lower right side of the specimen. There several other small branches in the fat near the epiglottis. It's useful to look for nerves in specimens since they appear in almost all organs and tissues of the body.

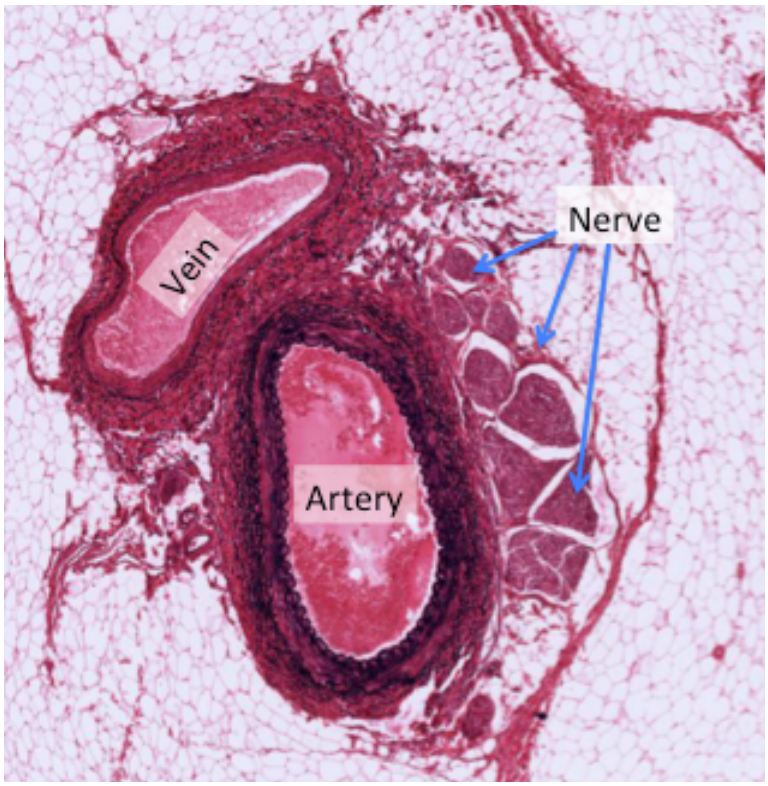


Blood Vessels

Slide 106

This is a section through the aorta stained with an elastic stain. There is a very thin endothelium one squamous cell thick on the luminal side. The remainder of the wall is dominated by dark staining elastic fibers until reaching the adventitia, where collagenous connective tissue predominates.

Slide 108



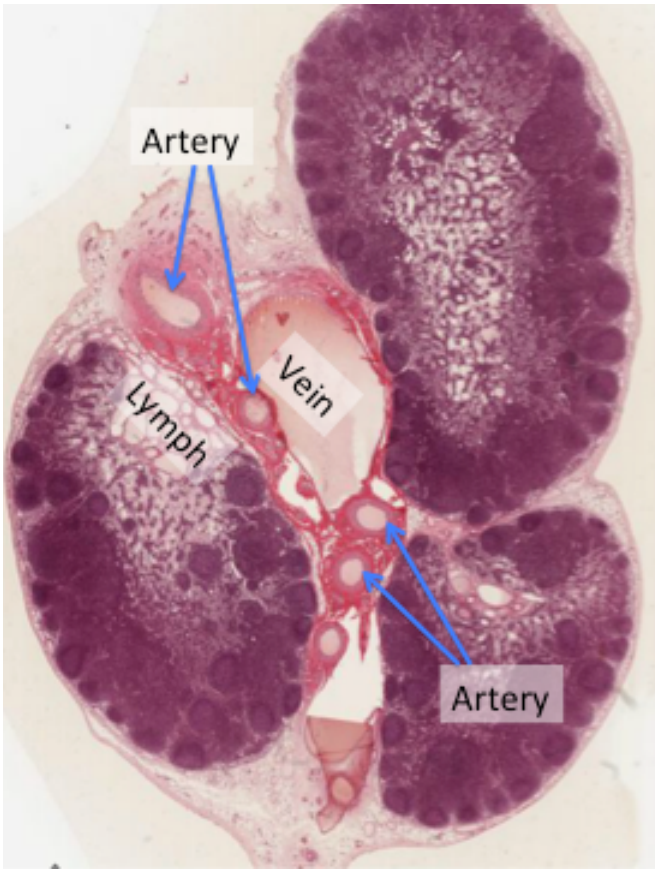
This is a slide of a neurovascular bundle with nerves to the right, an artery below and a vein above. This is also stained with elastic stain, and you will note that the muscular artery does have a fair bit of elastic tissue mostly present in the internal and external elastic laminae. In between is a layer of smooth muscle that gives this sized artery its name. Most of the named arteries of the body are muscular arteries. Notice the increasing prominence of collagenous tissue in the adventitia as one progresses away from the lumen. Notice that the vein wall is mainly collagenous tissue with less smooth muscle and elastic fibers. In the right-center of this specimen is nerve tissue which does not contain any elastic fibers.

Slide 107

This is another neurovascular bundle, but it is stained with H&E. There's one muscular artery, vein and nerve. There are quite a few

smaller arteries cut in cross-section in which you cannot identify the elastic lamina. Occasionally, you can see where it exists in an artery because of a thin translucent folded ribbon just beneath the endothelium.

Slide 120



This slide of lymph nodes shows multiple muscular arteries and a large vein near the hilum of this cluster of lymph nodes. These muscular arteries show multiple layers of smooth muscle in which an internal elastic lamina can be identified as a wavy translucent line beneath the endothelium. The vein is extremely thin-walled. Even though the vast majority of the blood cells have been washed out of the specimen, you can see some in both the arteries and veins. A group of lymphatic vessels with extremely thin walls can be seen leaving the lymph node on the left. Notice that the lymph vessels contain almost no blood cells. Finally, look for multiple nerve bundles near the blood vessels.

Slide 109

This is a whole mount specimen of mesentery. You are looking through the entire mesentery and can see multiple blood vessels within it. The largest vessel is a lymph vessel. Try to identify valves within this vessel. The medium-sized vessels are mostly arterioles and venules that parallel one another. One appears darker, and if you switch to higher power, you will notice that there appear to be stripes crossing it. These are smooth muscle cells, defining these as arterioles. Notice the many small capillaries.

Slide 126

This slide of the esophagus shows a large number of blood vessels beneath the epithelium. Many of these are veins and venules, however there are also arterioles. Additionally, you can find capillaries. It's important to get used to identifying features of blood vessels within the tissues you are studying.

Slide 110

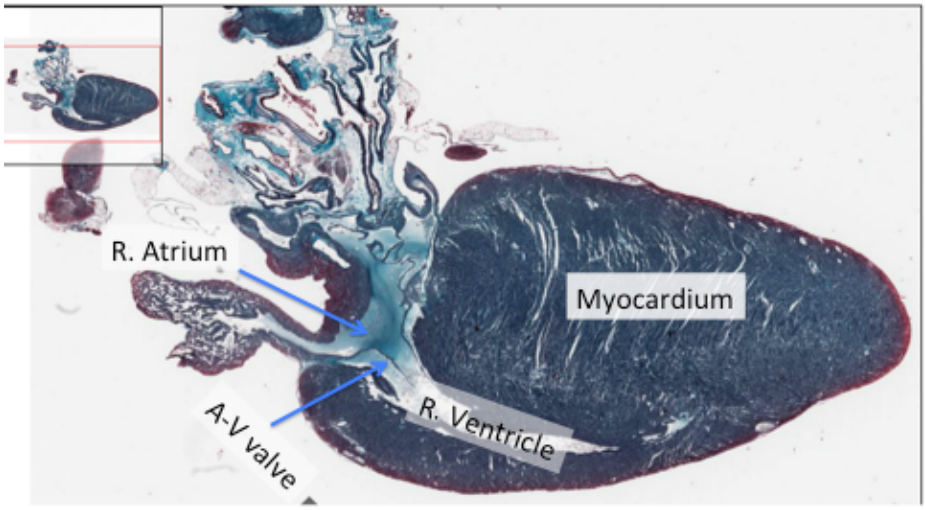
This specimen is part of the wall of the inferior vena cava. The lower side of the slide has the endothelium. Try to identify nuclei of the endothelium. There is a small amount of smooth muscle appearing in the connective tissue just beneath the endothelium but the vast majority of the wall is comprised of layers of dense connective tissue with some bundles of smooth muscle interspersed. This vein does not have the layers of smooth muscle that would be expected in an artery of this size. It also does not have elastic lamina.

Slide 110B

This is a trichrome stain of the inferior vena cava. Because collagen is stained bluish green and smooth muscle is stained a reddish brown color, you can see that the wall is mostly collagen with some interspersed smooth muscle.

Heart

Slide 114



This is a section through a rodent heart. The right side of the specimen consists mostly of myocardium. In this specimen collagen fibers are very green. Cardiac muscle is a dark bluish color. Examine the inner and outer walls of the right ventricle. Notice the very thin endocardium (with endothelium and a slight amount of connective tissue) and an epicardium on the outside of the specimen. This also contains a slight amount of connective tissue. Often the epicardium is a site of accumulation of fat around the heart, although it is not present in the specimen. This section also shows how much thinner the walls of the atria are than those of the ventricles. You can also get a sense of the delicate nature of the atrioventricular valve that allows blood to pass from the atrium to the ventricle but not vice versa.

Slide 113

This shows myocardium of the ventricle to the left and the atrium to the right. In between there is a section through a mitral valve leaflet. Notice that the mitral valve leaflet has no muscle, and that it consists mostly of connective tissue with layers of endothelium on either side. The upper part of the specimen shows fat in the epicardium surrounding blood vessels. Notice that the coronary artery has the structure of a muscular artery, and cardiac vein has a very thin connective tissue wall. There's a second vein with a blood clot located towards the right.

Slide 82

This is a slide that you have seen previously, demonstrating cardiac muscle tissue very nicely. There is some endocardium on the right side of the specimen. At the very lowest right side of the specimen, just beneath the endocardium, are some Purkinje fibers. These are cardiac muscle fibers specialized for conducting impulses. At high power appreciate the density of small blood vessels and capillaries within the myocardium.

Slide 83

This slide shows myocardium of the ventricle to the left and of the atrium to the right with a heart valve in between. Notice the fat in the epicardium on the top of the specimen and the coronary arteries and cardiac veins that reside within this fat. Notice that the cardiac muscle cells appear in bundles, although these are not all running in the same direction. At high power, look at the density of small blood vessels and capillaries within the myocardium.

Electron Microscopy/ultrastructure

Finally, take this opportunity to review the EM module concerning nerve and blood vessels on the virtual histology web site.