Neuroanatomy 1

[00:00:00.71] This is the first lecture of the neuroanatomy and neurophysiology portion of the course. We're going to start with a general orientation to the brain and nervous system, including directions in the brain and body. When you think of the nervous system, you probably primarily think of the brain, the gray wrinkly stuff inside of your skull, but there's actually a whole lot more to the nervous system than that. We can divide the nervous system up into several subcomponents. First and primarily is the central nervous system, which is the brain, everything that is enclosed inside of the skull, the spinal cord, which is everything that is enclosed inside of the spinal column inside of the vertebrae, and the retina which is the light-sensitive portion at the back of the eye. The rest of the eye is not part of the nervous system, only the retina.

[00:00:54.14] The peripheral nervous system is everything that isn't the central nervous system. Everything that is in the body that goes through your arms, and legs, and torso, and accesses all of your organs. The afferent peripheral nervous system is responsible for delivering sensory information from the body to the brain. And you can remember this because afferent information ascends to the brain. They both start with the letter A.

[00:01:24.62] The afferent peripheral nervous system takes commands from the brain and moves muscles in the body, and it can be divided into two subsections. The somatic peripheral nervous system controls skeletal muscles. These are muscles that you move consciously and voluntarily in order to move your body.

[00:01:46.61] The autonomic peripheral nervous system controls your internal organs and glands. And this is movement that is not consciously controlled, and it is not voluntarily controlled. It consists of two subsections that work in opposition to each other. The sympathetic portion of the autonomic nervous system is activated during a fight-or-flight situation. And it upregulates, or turns up, the circulation and respiration among other functions in the body in order to respond to an immediate event in the environment, such as a lion chasing you. And it turns down longer-term maintenance functions, such as digestion and reproduction because when a lion is chasing you, those aren't very useful in the moment.

[00:02:34.67] The parasympathetic nervous system does the opposite. It's when you are slowing down and dealing with some of those more long-term maintenance functions. So it turns up digestion, it turns up reproductive, and it turns it down circulation, and it turns down respiration. These two portions work in opposition to each other.

[00:02:56.18] As neural engineers, there are many different areas that we might want to tap into the central or peripheral nervous system. Into both the sensory and motor components of the peripheral nervous system. Where we tap into the nervous system when we are designing a neural engineering device depends on what we're trying to do and in what circumstances.

[00:03:18.66] So if we are working with a patient who has been paralyzed from the neck down due to damage to their spinal cord, trying to access information from the lower parts of the spinal cord or from the peripheral nervous system isn't going to be a very useful design decision for our

neural engineering device because the signals from the brain aren't reaching the body. In that case, we would need to access the central nervous system.

[00:03:44.94] However, in an individual who is only partially paralyzed or has received an amputation or other injury and we can access the peripheral nervous system, it may be beneficial to do so because the central nervous system is more complex and more susceptible to infections. These are decisions that we have to make for every neural engineering device and sometimes on a case-by-case basis for individual patients.

[00:04:12.60] Now, we're going to describe some directional words that will help us orient ourselves in the brain and describe where different parts of the brain are in relation to each other. Dorsal means towards the top of the brain and ventral means towards the bottom of the brain. But in the spinal cord, dorsal means towards the back, and ventral means towards the front-- towards the internal organs.

[00:04:35.05] This discrepancy is because, in humans and other bipedal animals, the spinal cord makes a 90-degree turn as it enters the brain. But in a quadrupedal animal, think a dog or a cat or any other animal that walks on four legs, the dorsal part of the brain and the dorsal part of the spinal cord are parallel. They are the same direction because the brain is the same like on the same plane as the spinal cord. This discrepancy only occurs in bipedal animals.

[00:05:11.64] In humans and in bipedal animals, superior means towards the top of the brain and inferior means towards the bottom of the brain. And in the spinal cord in humans, superior means toward the brain-- towards the head. And inferior means away from the head-- towards the lower part of the spinal cord. Anterior means towards the front of the brain-- towards the face and eyes.

[00:05:37.71] Posterior means towards the back of the brain. Rostral and caudal mean the same thing. Rostral means anterior, and caudal means posterior. But those words aren't used very often, and I'm not going to really use them in this class. You should still know them. However, because they appear in the name of a few different brain structures. Lateral means away from the line that divides left from right, and medial means towards the line that divides the left side of the brain and body from the right.

[00:06:12.28] Distill and axial are words that are primarily used to describe parts of the body. They're not used to describe parts of the brain. Distal means farther away from the line that divides left from right, and I generally use to describe limbs. So your fingers are the distal part of your upper limbs. Axial means towards the line that divides left from right or towards the axis.

[00:06:40.75] Ascending describes information that is traveling from the body to the brain or from more posterior or more evolutionarily old parts of the brain to the cortex. This is generally sensory information. And descending means information traveling from the cortex to those more subcortical interior areas of the brain or from the brain into the body. And this is generally motor commands or commands for the peripheral nervous system to upregulate or downregulate the sympathetic and parasympathetic portions.

[00:07:18.22] Afferent and ascending-- you can remember that afferent is sensory information traveling to the brain because afferent and ascending both start with A. Afferent is motor information traveling from the brain to the body. Finally, contralateral and ipsilateral describe the relationship of multiple brain regions to each other. Contralateral regions are on opposite sides of the brain or body. You may know that the left side of the brain is generally but not entirely associated with the right side of the body.

[00:07:51.92] So motor commands from the left side of the brain overwhelmingly are sent to the right side of the body and vice versa. And, for the most part, sensory information from the right side of the body is sent to the left side of the brain. These are contralateral functions. Ipsilateral means the opposite information that stays on the same side of the brain. So for example, smell is ipsilateral-- information that is detected on the left side of the olfactory epithelium stays on the left side of the brain. You can continue now to the next portion of this lecture in the next video.