

## **Neurobiology**

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### **Lecture 1.7: Brain Orientations**

Hi everyone, welcome back to the online course on Neurobiology. In the last couple of videos we have looked at the organization of the nervous system and we want to now go deeper and see what each part of the brain is doing. But before we can do that we need a way of referring to different parts of the brain. We need some kind of a notation. In a geographical area we can use directions to refer to different parts. For example, this is the northern side and this is the western side and this is the northwestern side and so on.

So can we use similar directions to refer to different regions within the brain. That's what we will see in this video. So this is the image of a brain and two axes are shown here. While looking at this brain can you tell which is the front side and which is the back side.

So this side is the front side. This is called the anterior or the rostral side. This is the direction in which the person is viewing and this is where the brain would be in this orientation. So this axis can be called the front and back axis or the anterior posterior axis or also called the rostral and caudal axis. So the rostral or the anterior side is where the prefrontal cortex is located and this caudal or posterior side which is the back side of the brain that's where the visual processing area V1 is located.

This cerebellum here is also located on the posterior side. On this axis you can call it the top to bottom axis also called the dorsal and ventral axis. Or superior or inferior axis of the brain. So parts of the brain that are towards the top can be called the dorsal or the superior areas and the parts of the brain that are towards the bottom side can be called the ventral or inferior areas. And the third axis would be the one that is not shown in this screen perpendicular to the screen.

So coming out or going into the screen and that axis is called the medial axis or medial lateral axis. So things that are towards the side so that are closer to the ear here these areas are more lateral and parts of the brain that are towards the middle of the brain so that will be closer to the midline of the brain they can be called more medial. Let's take a look at the brain in 3D. So this graphic shows the brain in this red color and this is what it looks like from different angles. This

is the front part and this is the back part and at the bottom you can also see the cerebellum towards the back part of the brain the caudal side or the posterior side.

You can see that the brain has a particular shape so it folds in this structure around the ears. You can also see that it's somewhat heavier towards the back side and somewhat thinner in the front side. To see the internal structures of the brain we would need to make cuts along different planes in the brain. Try to imagine what the brain would look like if we made these cuts along different planes. So for example if I cut the brain along the horizontal plane try to imagine what the brain would look like and would it be symmetric on the left and right sides if we made that cut.

Similarly we could cut it along two other orthogonal planes. Can you guess out of these three orthogonal planes that are possible in which of the cases will the brain will have left and right symmetry? I can tell you that the brain will have left and right symmetry in two planes and will not have it in one plane. Can you guess which two will have the symmetry and which one will not have the symmetry? We'll see that in the upcoming slides. This is one of the cuts that can be made along a plane. Can you guess along which plane the brain has been cut in this case? Just take a moment to think about it.

This is a cut that is made parallel to the face of the person or parallel to the chest person or parallel to the chest like this here and this cut results in an image. So after cutting we are looking at the brain from the front and this is what the brain would look like. You see a roundish figure and the image is symmetric on left and right because you are seeing the the left side of the brain here and the right side of the brain here. So this is one of the cuts which has symmetry and this is called a coronal cut. The cut that is made parallel to the face, the coronal cut.

In this image you can also see there are these whitish tracks, the white matter and then there are these denser regions, the gray matter and these holes here are the ventricles through which the cerebrospinal fluid flows. Now here we have another cut along a different plane and this is what the image looks like. In this case can you guess where the cut has been made, along what plane? Please take a few moments to guess that before I show you the answer. So this is actually a cut that is made along the horizontal plane like this. So if I horizontally make a section through the brain and then I look at the brain from the top, this is what it would look like.

This is the front part of the brain, the anterior side and this is the posterior side and this is the right side of the brain, the left side of the brain. We can call the structures that are towards the left side or the right side as lateral structures and the structures that are near the midline can be called the medial structures. So this is the medial to lateral axis both on the left or on the right and this is the anterior posterior axis here. This kind of a cut, a horizontal cut has also symmetry

on left and right like the coronal cut and the image that we get looks kind of oval in shape. And finally this is a cut along the third plane which you can see in this figure here.

So we are looking at the brain from the top and if we cut along the midline like here then this is the image that we would get. So this kind of a cut is called the sagittal cut. You can also call it medial cut but sagittal cut is the scientific term and this now produces an image that does not have left and right symmetry. So this is the front part of the brain, this is the back side of the brain, the posterior side. You can see the cerebellum here and because we are now looking at the top and bottom the dorsal and ventral axis and the anterior posterior axis we do not see symmetry in this image.

So while the coronal cut and horizontal cut gives you images that have left and right symmetry the sagittal cut gives you an image that does not have left and right symmetry.