>> It is still February 17th, 2016. Our final moments last week, we introduced the idea, the concept, the science of histology. Histology is the study of tissues, which begs the question, "What's a tissue?" A tissue, a group of functionally related cells and also the material that they're situated in that is the interior cellular material. So today, we want to go further, that is, we want to reexamine the four kinds of tissue, with respect to the ways in which they might be specialized or modified and also with particular tension to the functions performed by this tissue types. So first, category 1, epithelium. Epithelium by definition forms a surface located on a free surface. This tissue is classified or subclassed according to cell shape and the degree of layering. Some shapes that come to mind, columnar, cuboidal, squamous which means flat. And layering is referenced as either being stratified multilayered or not stratified where we say it's simple. So for instance as a case in point, these cells appear to boxy, yes? And they appear to be one cell deep, yes? So the final verdict there is simple cuboidal epithelium. Now, all of these epithelial cells at some point are anchored or attached to what's called a basement membrane. The function of the basement membrane is to, in effect hold these together, that is, keep this cells anchored and keep them from flying apart. The basement membrane is manufactured by these epithelial cells. Another property of epithelium, as a rule, is epithelium tends to be pretty thin even when it's stratified and is not pervaded by blood vessels. That means blood vessels do not penetrate epithelium and therefore these cells get their nutrients from nearby blood vessels. So the single word that idea is avascular. Avascular means without blood vessels. There are special forms, special designs of epithelium, we'll call them specialized or modified epitheliums, and let's run down those by number. First, glands. Any gland that you know by name is made fundamentally of epithelial tissue. Maybe from biology, you learned about the two basic kinds of glands and those are named according to where and how they deliver their products. For instance exocrine as the name implies, these secrete to the outside of the body by we have a duct, d-u-c-t, and that duct incidentally is also made of epithelial cells. What's the other kind? Endo. Endocrine secrete not to the outside but to the nearby bloodstream, and so this have an internal secretion as opposed to an external secretion. Certainly, you should have some in mind, that is, you should know some examples. What's a good exocrine gland that you might know? Exocrine, on your skin secreting for instance, what? Sweat. And it might not have occurred to you but your salivary glands are also exocrine. You might say, "Well, they don't secrete to the outside. They secrete to my mouth." But obviously, your mouth is directly connected to the outside and often when we drool, and of course that's testimony to that outside connection. So, sweat glands? Yeah. Salivary glands, good examples. What's an endocrine gland that makes sense or is familiar? Endocrine would be names such as the one on your neck, the thyroid, the one near the kidneys, the adrenal. And interestingly, the pancreas which might have occurred to you is an interesting exception, because the pancreas is actually both exocrine and endocrine. So these are just some interesting statements, but in effect all glands are clusters or involutions of epithelial cells, and usually cuboidal, usually simple cuboidal epithelium. Now, aside from glands, there are also epithelial membranes, which are tucked in and help to find by the cavities or body spaces. And so in effect, body membranes are combinations of various types of epithelium very often reinforced or anchored to underlying connective tissue. There are two types of gla-- of membranes that we want to highlight. And one of them you can feel right now as you move your tongue on the inside surface of your mouth. That membrane you perhaps know is called the mucous membrane. The word mucous means slimy or slippery. Basically, mucous membranes are various types of epithelium, often squamous or columnar upon a base, a base of loose connective tissue. The key thing about a mucous membrane which is fairly obvious is that it secretes mucous. But essentially, these membranes lines surfaces of hollow organs, internal surfaces of hollow organs. In fact, if you think about it your digestive tract is one hollow organ all the way from your mouth to your anus, and not surprisingly it's lined along the way with a continuous mucous membrane of one kind or another. So, mucus membranes tend to be connected to, open to the outside. Now, that's in contrast to serous membranes. As we already said, the serous means filmy or watery. These are usually made of squamous epithelium, also on some form of connective tissue usually loose connective tissue. And these are, well, these are not single but a double layer, which tends to line and define closed cavities. So in contrast to mucous membranes, these are not open, what? Not open to the outside. A way to picture a serous membrane is to imagine a balloon filled with air, and if you push your fist into that balloon it would wrap itself around your hand. A serous membrane then is not a single layer but two layers. And the one that makes contact with the organ is called the visceral layer. And the one that is found outside that, the one which lines the cavity in question, that's called the parietal layer. Obviously, this is a drawing of what organ? The heart. And is the heart surrounded by a serous membrane? The name of that, you know, is the pericardium and it has two layers. So, if you're going to label this, the one which touches the heart itself, the inner layer is called the visceral layer and the one which is outermost, that's the parietal layer but they're connected. And as you can see they are continuous and they also contain a fluid which provides the basis for the function here. The function of a serous membrane is to reduce friction, to lubricate. So we find these membranes typically around organs that are doing what all the time? Moving. Is the heart

moving all the time? If yours isn't, well you're probably not too alert right now. So let's compare and contrast these two epithelium membranes. Which are not open to the outside? Serous membranes. Which are? Mucous membranes. Both of them secrete, but only one of them provides for absorption and that absorption has to do with absorption of the nutrients. Some other thing just quit on me, this projector. That's rather rude. I don't have any explanation as to why. Let's try it again. But moving on and finishing this category, what are some general generic functions for this type of tissue in general? First of all, and almost intuitive, because these cells form a surface, that surface often provides a barrier of sorts. And so, one thing that comes to mind is that these membranes, these tissues provide for physical protection. And an example would be, what? The skin which is made of epithelium. But remember, the skin is an organ so there's more than just epithelium there. Also, of course, you would have to agree that mucous membranes provide some kind of protection as well even though their primary function there is secretion and absorption. Leading us to number two, what type of epithelium secretes? Well, obviously a mucous membrane. But don't forget the previous page. What was the G word? Glands. Do glands secrete? Yes, they secrete hormones or sweat or saliva, so there are many specific examples of epithelium that provide for secretion. Absorption, meaning to absorb or transport materials across their surface, that is a specially obvious and important in mucous membranes that we find along the GI tract for instance. And next, number 4, and quiet unexpected here. Some epithelium provides for, what? Sensation and that's hard to correlate with what we said, but think of this. Is your tongue, is the surface of your tongue made of epithelium? Well, yes. And what's the most famous function of the tongue, other than speech, is provides for taste. So many types of epithelium are specialized as receptors, that is, receptors for various chemistries, that is, solutions, chemicals in the food that we eat. And think of this, what's that portion of your eye which is sensitive to light? Maybe you know it by name, the R word. The retina. Is the retina made of epithelium? Yes. And is it sensitive to light? Yes. So, providing sensation is one further function of epithelial cells. And also unexpected, but yet if you think about it, logical. Epithelium is specialized for sexual reproduction. What are the cells that we use for sexual reproduction? In men, they're called sperm. In women it's called the ovum. Now, clearly those aren't nerve cells. They're not muscle cells. They're not connective tissues, so they must be epithelium. They are special forms of epithelial tissue. So, quiet a variety of expected and unexpected functions for epithelium. How many categories of tissue? We got one down, so here is number two. Quiet a diverse heterogeneous group. Lot's of variety here. But actually, this category, the tissue is defined more by the stuff outside the cells than the cells themselves. So its classification is often based on the physical properties, not of the cells but the physical properties of the stuff outside the cells, which we're now going to call M word, matrix. The matrix assumes more importance. So just as that analogy of a kitchen tile countertop, the tiles would be the cells, the grout would be the matrix. So, in effect we're saying the grout's more important that the tile in this cases because the matrix really defines the physical properties of the tissue, whether it's hard, or soft, or gooey, or stringy. And so this matrix starts out as a basic slurry, a basic goo which is called the ground substance. This ground substance can be fluid, that means liquid and can actually be somewhat firm or semi-solid in consistency. But just as with wet cement, can you put other things in wet cement that add to its ultimate strength or behavior? The answer is yes. So, matrix is seldom just to goo but rather has some additives, some additional proteins, fibers proteins. And among the two most common proteins you'll find in matrix are collagen. Collagen's a word we've all heard and this is a electron micrograph of collagen. It's the most abundant protein in the body, it's very strong. Not rigid, it's very F word. Flexible but it's not the E word, it's not elastic. So collagen, as seen microscopically here, is basically a very strong but flexible protein which provides strength, that is, it reinforces this tissue. Its counterpart is another protein, very different called elastin. And the name suggest, what? Stretchy. So elastin is a protein like a rubber band. It is very elastic. It's resilient. It's stretchy and obviously provides some degree of-- some degree of elasticity to the tissue that we find it in. So, with that background let's get into the subcategories of connective tissue. The first of which is called loose connective tissue. Loose means just that, soft or somewhat weak, w-e-a-k. The two types of loose connective tissue that we'll begin with, first, areolar tissue. You've all had direct contact with areolar tissue. You all dissected the skin off of the rat and you saw that filmy, slimy, transparent tissue under the skin. That was, what? Areolar connective tissue. It is very wet, very soft, and cellularly it's made of so-called fibroblasts. Fibroblasts are cells, the word "blast", meaning an immature cell. Fibroblasts are cells that are, in this case making protein. And what two proteins are made by this fibroblast? Collagen and elastin. In lab you've had a chance already to see areolar tissue. And even from the back of the room, you can see there are two very different fibers that are present. There is the very dark and straight-- these are elastin proteins. And then the thicker, the ticker ones are the collagen. So in short, areolar tissue has some degree of strength by virtue of the collagen, but it also is stretchy by virtue of the elastin. Also, some quiet different cells are here as well, these are called macrophages. Macro meaning, what? And phage, meaning eater, these are phagocytes that are engaged in engulfing-- that means destroying debris fragments, fragments of cells or maybe microbes. So essentially these clean up the tissue and keep it healthy. The second kind of loose connective tissue, which is in fact one of the most abundant in the body, is called adipose. What's

the common name? Fat. Now, fat has a reputation of course of being abundant for sure. It's also one of the easiest to recognize under the microscope. The cells are fibroblast, but they're completely filled. They're completely dominated on the interior with a drop of fat, which makes them look like their empty. So these are lipid-filled, what? Lipid-filled fibroblast. Other than that, they are similar to areolar tissue. So, with your experience in lab, you recognize this image right away as being, what? Adipose. The cells look empty but the interior is basically filled with a drop of fat. This is a more realistic actual photograph of fat with a 3D scanning electron microscope and so it looks like sort of orange marshmallows wrapped up in a fishing net. But if you can touch fat what would it fee like? Would it be hard? No, it'd be like that. And so that's a function of what it's made of, a function of essentially that it's just fat-filled cells. Third type of loose connective tissue is called reticular, and these also contain fibroblasts and macrophages. But these are found in the liver and spleen and they provide a basic framework upon which other cells are situated or anchored. I often compare this to a pomegranate. You got that vision? You know that pulpy white stuff in the interior that you don't want to eat? That's a framework for the seeds, right? So that's the analogy I'm trying to use here because the reticular tissue tends to provide a framework, which allows these organs, the liver and the spleen, to engage or be involved in the removal-- the filtering of old or injured blood cells. So of course, if you've had any association about the liver, what's one of the common F words that used to describe the liver? Filter. And it filters by virtue impart of the reticular tissue. Next, we've got dense connective tissue, which the name says, must be harder than, what? Harder than loose, so it must be stronger, firmer than loose connective tissue. Two types here based upon the orientation of the fibers-- the protein fibers that are present. The first of the two, so-called irregular or dense irregular. This is basically areolar tissue which has much more-- much denser, what? Collagen. The word irregular suggests that the fibers are randomly oriented and this forms among other things, the toughest and thickest layers of your skin, which are called the, what? Dermis. We actually make stuff out of dermis. What's that stuff that we make with dermis of animals? Leather. Leather handbags, leather shoes and so forth. Is that strong? You bet. And it's strong by virtue of the protein, what protein? Collagen. So, here on the screen, you see an image of well, dense irregular connective tissue, which is this. These are collagen fibers. Are they oriented or disoriented? And so this is the dermis, which is made of dense irregular connective tissue. As opposed to dense regular, regular means the fibers are all in one direction, and this provides greater strength at least along that axis. And this, this type of tissue also features collagen, very dense collagen. But what's the difference? The P word here. Parallel. So, where is the dense regular connective tissue here? Right here. CF. CF stands for Collagen Fibers. So if you put all of the collagen in the same direction is they're going to be really strong as a result of that. Yeah. We find dense regular connective tissue, especially forming cord-like structures you know as tendons and ligaments. Tendons connect muscle to bone. Ligaments connect bone to bone, but they're made of the same stuff. Are they flexible? Yes. Are they strong? Yes. Are they indestructible? Nothing is. So can you tear a tendon? Can you tear a ligament? But you have to do a lot because collagen is very strong especially in these locations. So the function of dense regular connective tissue is to provide flexibility without elasticity, in other words, strength without being stretchy. So, tendons and ligaments benefit by the parallel nature of these fibers. Third category, still in connective tissue. Cartilage. You've all known that term. Cartilage is made of cells, not fibroblast but cells called chondroblast. Chondro-, meaning cartilage, -blast meaning immature cell. Chondroblast actually come from an earlier, simpler undifferentiated cell called an osteo, what? Osteoprogenitor cell. Now that-- that's a mouthful but it doesn't have to be terrifying. Osteo- as a prefix refers to bone, -progenitor, meaning to proceed or otherwise lead to. So osteoprogenitor cells in this case develop into chondroblast, which secrete a matrix of various composition. Cartilage as category is avascular. What's that mean? Not pervaded by blood vessels and you know it comes in three forms that you've studied or heard about in lab. So first, we have hyaline cartilage, a word which means clear or glassy. And that's because the matrix, even though it's made of collagen, it's very faint or light, very low density collagen, so the matrix looks clear. Where do you find hyaline cartilage? Well, at the surface of your knee, for instance forming the slippery surface in joints as an example. And even though this is a low power view, you can see the cells in here. The cells are called, what? Chondroblast. And the matrix looks pretty blah-- pretty uniformed and so it is a case of hyaline cartilage. And if that's not good, how about that? Is that hyaline cartilage? Bam! You should dream about that because-- well, you got to recognize it. Next is elastic cartilage which tells you something about its property. Hyaline cartilage is pretty firm, slippery but tough. Elastic cartilage has a lot more of this protein, what protein? Elastin. Therefore, logically and obviously, it has greater elasticity. Where do you find elastic cartilage, many of you know. In your outer ear and also in that flap that covers your trachea called the epiglottis. Elastic cartilage, easy to recognize because the matrix has short, fuzzy fibers of elastin. In fact, here is the best view I can offer you. To repeat, what are these cells? What are the cells called? Chondroblasts. And what are these thready things in here? They're, what? They are elastin fibers which give these tissues some resilience. The third type, which incidentally is the strongest, is called fibrocartilage. And once again, the cells are still chondroblast and collagen is the dominant protein, but the interesting thing here is that the collagen is all laid out in one direction, all

parallel. And we've encountered that idea before. When you put something-- some thready material in one direction, does that tend to make it stronger as a result? So the beauty, the advantage, the superiority of fibrocartilage, is that all the fibers, all of the collagen, parallel, and so it's the strongest of the cartilages. Who knows where you find fibrocartilage? What are those bones that make up your back? Those are vertebrae. And is there cartilage in between them? And what kind of cartilage but-- fibrocartilage. All of that said, is cartilage pretty durable then? But is cartilage indestructible? No. And in fact, when cartilage is damaged, it has a hard time repairing itself because as we have said it's not pervaded by blood vessels, it's, what? Avascular. Number four, bone and teeth which are related, and this is the hardest of connective tissue. The cells here are called osteoblasts. They are also derived from osteoprogenitor cells, but these produce more than just collagen. Yes, they produce collagen, but they also add to the mix in organic salts of, what? Calcium and phosphorous. This transforms the matrix into something relatively flexible into something that's a lot, what? Harder. Isn't bone notorious for its strength and rigidity? And it's not the collagen that provides that. What provides the strength and rigidity is the calcium and phosphorous salts. That said if your diet is low in calcium or if this matrix lacks calcium, then the bone becomes very flexible. Something we'll describe as osteomalacia, which is soft bones, also rickets if you're familiar with that term. But in short bone is pretty hard by virtue of the calcium and phosphorous salts. Still, though, and quite surprising maybe, bone is not avascular. It is very V word, it's very, what? So if you break a bone, will a bone bleed? It will and in fact, it'll also hurt because it's not only pervaded by blood vessels, it's also supplied with sensory nerves. So needless to say, bone makes up our skeleton. And already, from your experience in lab, you recognize bone immediately because of this bulls-eye concentric arrangement of the cells. The cells are called osteoblasts or osteocytes, which tend to be surrounding a hollow opening, an opening normally occupied by a blood vessel, and that channel is actually called the Haversian canal, which you can lead or read about later. But, certainly, no one would misinterpret this. This is obviously and immediately recognized as bone tissue. The final category, the final type of connective tissue is actually vascular tissue, which refers to blood or blood vessels. And you might not think of blood as being tissue at all, but it is a kind of connective tissue. There are two subtypes of vascular tissue, blood itself-- and what is blood? What are the cells that dominate blood? Erythrocytes, better known to as red blood cells, and leukocytes perhaps better known as whites. Are these cells in some sort of matrix? What is the name of that matrix, the P word up here? Plasma. And plasma is mostly H2O. So, literally, blood is a liquid connective tissue, liquid by virtue of the water in the plasma. Obviously, blood is manufactured not by the blood vessels but by other tissue specifically red bone marrow. Red bone marrow is exactly known as myeloid connective tissue which is found incidentally in bone. But this is a very important distinction. You'll hear people say that blood is made by bone. That's false. Blood is not made by bone. Blood is made by bone, what? Marrow, which is totally different. Yes it's found in bone, but the bone itself did not make the blood, rather the myeloid connective tissue did. Functions of this category, I know we've come a long way, but one of the first and obvious functions of connective is to provide strength or physical protection. Knock on your head, is that providing protection? So bone is a classic example, but there are others. I mean, certainly the skin. What's the thickest portion of skin that we make leather from? We mentioned it was the D word, dermis. Does the dermis provide physical protection? Sure. So, many examples here. Number two, support and cushioning. Give me an example of connective tissue that provides support. Bone of course. Also cushioning could be adipose. You love to sit on that. So those are easy. Certainly connective tissue ought to be involved in connection, connection and binding. What are two specific cases of connective tissue that bind tendons and ligaments, and yes even a reeler [phonetic]. A reeler connects what with, what? Skin with the underlying muscle. So there are plenty of very diverse examples here. Number four, fat and mineral storage. Well, obviously, what connective tissue stores fat and what connective tissue stores minerals? Bone. What minerals? Calcium and phosphorous. And finally, connective tissue is responsible for the production and also the removal of blood cells. What connective tissue produces blood right there? What tissue removes blood cells, that was earlier? Reticular. Good. So, quite a variety of functions here and you should have and remember some examples for each of these is five. We're on a homestretch or at least we're halfway. We've got two more categories which thankfully are not as complex. And number three then, muscle. Muscle is classified according its location in the body and also it's microanatomy. That means what it looks like under microscope. But what do all muscle tissue types have in common? What's the one thing that muscle is famous for and necessary for? Contraction, which is fundamental for movement. So we see some specializations here, but generically speaking all muscle is capable of one thing, and that's, what? Contraction. Incidentally, you'll hear people say this. They'll say muscle contracts and expands. Only half of that is true. Muscles, what? Contract. They don't expand. They contract and they relax but they don't push out. You might say, "Well, how am I able to extend my arm?" Well, that's not the pushing out, it's the pulling of a muscle that does that function. So muscles don't-- don't, what? They don't expand but they do-- C word. Contract. They shorten. In fact, the types that we're about to name are further differentiated by the speed at which they contract and the duration that they contract. So first, what's the most abundant muscle in your body, the three

types you know? The most abundant is skeletal. It's called that because it connects to and moves, what? The skeleton. And under the microscope, these cells are long and parallel. They tend to be striated. You see that word, what's that mean? Striated means to be striped and here is image from your book which shows that striation, one or more nuclei, many nuclei per cell, and so the word for that is? Multinucleated. These cells can be up to 12 or 13 inches long, one cell. And of course their function is obvious. They move or hold the skeleton. The second type of muscle is limited, that is, found only in the heart and its name is cardiac muscle. These cells are also striated, but usually only mononucleated. The cells are shorter, they tend to be branched as opposed to long and thready. But fundamentally they do contract and what is the obvious function then of cardiac muscle? Pumping blood. If that doesn't work, the rest doesn't matter. And finally, number three is smooth muscle. It's called that because the muscle is not striated. Under the microscope it has no visible stripes or banding. How many nuclei per cell? One. This type of tissue tends to be found in a circular pattern surrounding, enclosing a tubular or hollow organ. So what's a tubular or hollow organ that you can name that must me impart made of smooth muscle? I'm sorry. Small intestine, any others? Esophagus. Good, we could expend a couple of half hours here on this but esophagus, vagina, gall bladder, appendix, all of these are made contractual by virtue of smooth muscle. What about your urinary bladder? Does that contract? Must have what sort of muscle then? Smooth muscle. So this is skeletal muscle and let's just say, what do you think. Even from the back you can seen there are lots of nuclei, so this also must be? Skeletal muscle. What's this? Good. It should be just that quick. Bam! That skeletal muscle, does it have all the features that you've come to expect, what's that? Skeletal muscle. My, this is getting boring. So let's mix it up. That's not skeletal muscle. Yeah. What makes it so? All right. Good. I hear a lot of good answers. Branching, mononucleated and also the presence of these connections that are called intercalated disc, very unique. And here, then, an actual photo clearly of, what? Cardiac muscle. Smooth muscle, remember, is so-called because it's not striated. Also, the cells tend to be tapered. But as far as the nuclei we've already said they are mononucleated. And here is kind of a washed out view of smooth muscle. So the functions of muscle are fairly obvious, they all contract, but let's be more specific. They provide motility and support. And what muscles do that? Skeletal for sure. But the smooth muscle and even cardiac muscle provide for motility at least. Motility means movement. But even when you're not moving, are you using muscle to just remain standing, and clearly skeletal muscle then provide support. Pumping blood. You might think that's the exclusive domain of what muscle? You might think that's cardiac muscle and it is, but the smooth muscle assist in pumping blood. What does blood move through other than the heart? Does it move through vessels? Are blood vessels made of smooth muscle? And when you move, when you run, is that going to enhance circulation of blood, too? But that's skeletal muscle, right? So my point is that all that muscle, but especially cardiac muscle, is involved in pumping blood. And finally, squeezing. How do we get that baby out of the uterus? How to we got urine down the ureter? How do we get the urine out of the bladder? That's got to be some squeezing action? How do we get the feces out the anus? Well, that's the-- that's the providence of smooth muscle. And incidentally, this is teased smooth muscle. What does that mean to tease it? It doesn't mean to tickle, it means to take a needle and pull it apart. And the beauty of that preparation is you can see the tapered action or tapered nature of these cells. All right. We're doing well because we're about done and nerve tissue is our final destination. Certainly, the cliché, last but not least comes to mind. Nobody would minimize the importance of nerve tissue. You wouldn't be able to think or certainly study anatomy without this valuable tissue. It's classified that is the type of nerve tissue is based upon function, specifically the direction of signals you may know from biology. So, with that said, we have represented here the spinal chord. Nerve tissue that carries information to the spinal cord basically makes possible sensation and so these nerve cells are called sensory nerves. If they carry information away from the spinal chord ultimately to some muscle, then their name is motor. So by function, we mean sensory, motor or something else. Nerve tissue is the most specialized, the most remarkable of tissues. And as a result of that specialization, sadly, it's unable to, what? Reproduce as adult. So if you injure nerve tissue, are you going to get new cells tomorrow? If blow away a few million neurons with PCP or something, kiss those cells goodbye. Now incidentally, that brings to mind, what is stroke? Is stroke the result of fatalities within the brain, that is, are their nerve cells that have been lost? And with that said, you might say, "Well, I remember my grandpa, he had a stroke and he was doing real bad [inaudible]. He's better now." You might assume that he made more new nerve cells. No. He's simply doing better with those that are still, what? There. So, interesting fact that sadly, nerve tissue is not capable of repair. So people with spinal cord injury, spinal cord injury. Are they going to get better in a few years? They're going to start walking? Sadly not. So anyway, the cells that do the actual functionality, that is, those that generate impulses are called neurons. But equally important are those cells that support and surround neurons, those are called neuroglia, the word "glia" means glue. So, here, the glands is obviously a nerve cell based on everything that you've seen and read. And in fact these are also nerve cells that much the description, they are star-like or stellate. And typically, nerve tissue is soft enough to be smeared across the slides. So this is something you've seen in lab called a spinal cord smear. But finally, and rather obviously, the functions of nerve tissue are remarkable and

exceptional. In other words, nerve tissue is responsible for generating and transmitting signals, electric signals, which bring about sensation and ultimately motor function, that is, movements and the ability to know what's going on. So think about it, you know? I see this bottle of water. Does that involve nerve tissue? I read the label. Does that involve nerve tissue? I recognized what water means. Does that involve nerve tissue? I decide to buy it. Does that involve nerve tissue? I drink it. Does that involve nerve tissue? Yes and also muscle tissue, so-- and I remember how good it taste. Does that involve nerve tissue? So I'll buy that brand again. Does that involve nerve tissue? I'm being silly, you do well on the next exam. Does that involve nerve tissue? Yeah, right. So anyway, we're done for the day, and final slide. Does that look like the spinal cord? Yeah. Thanks a lot. We'll see you I'm afraid Monday, we're-- got a short week. So, have a good lab tomorrow if that's the case and we'll see you on Monday.