>> Deb Feickert: Okay, everybody. So our topic this morning is tissues, and again, just a reminder one more time, we are – we are skipping the cell. We're going to do the cell lecture tomorrow during lecture, and – tissues because that's our topic for lab this morning. We will not get through this whole slideshow. It is 63 pages, 63 slides, so we're just going to get started, and then we will pick up where we left off on this lecture next Tuesday in lecture. But when we start our two of lab today that – sorry, but we'll have another slideshow introducing all the tissues that we'll be looking at. So don't worry. We will cover all of the information. It's just a lot of information, and so, we're going to do it in bits and pieces. And remember, the tissues, even though we are discussing them now for lecture, as a lecture topic for our first lecture exam, we will – you will be responsible for knowing about tissues all semester. So please, please, please start to feel confident, be looking at tissues all the time, study tissues all the time, know the information we're about to cover. If you have the lecture outline, what you're going to see is that, because this information is so vital to the rest of our semester, and there's so much of it, I have put down in the lecture outline practically all of the notes on the slideshow. So what that means is, you aren't going to have to do a lot of writing, but please don't take a nap because of that. Really follow along, especially when we're looking at photographs of the tissues, so that you can start to get a feel for what they look like, where they might be located, and their functions – very, very, very important. So, here we go. The other thing you'll notice is, because I've given you almost all of the information already, I'm not going to present this bullet by bullet. I'm going to just put every slide up on the screen so you can kind of follow along in your notes. If you are typing, if you are trying to write notes without the outline, and I'm going faster than you're writing, which is quite possible, remember I am going to post this. And you can go back and take notes. So in fact, it might even be best to just listen if you don't have the outline today, follow along, and then you can take notes later. Okay, so, definition of tissue, extremely important, please know it. But tissue is a group of similar – or another word we can use is the same. So it's the same type of cell that's grouped together, along with what are called the extra – this is bold for a reason – extracellular products, and extracellular products or material are also called intercellular. So let's make a side note, because we're going to use these two prefixes all semester for other words. So extra- means outside of, and inter- means in between. So if something is extracellular, it's outside of the cell – that is, surrounding the cell. If something is intercellular, it means in between the cells, surrounding the cells. So it means the same thing. You'll see both terms used, and – but know that extra- and inter- as prefixes are always going to mean that, no matter what the word following it is. Extra- means outside of, and inter- means in between. So tissue is a group of the same type of cell and the extracellular material that surrounds the cell that carries out a same function, a common function. So a tissue of the same type is always going to have the same function, no matter where it's found in the body. And histology – we talked about this yesterday. That suffix -ology means the study of. So histology is the study of tissues certainly, but also, we're going to talk about

function, function, function, and any modifications. That means specializations of certain types of tissue, which we'll encounter some of those today. So here are the four – here is in bold "general" types of tissue. We have four tissue types in our body. We have epithelial tissue. Let me make a note here. So there are different uses of the same word, and you'll see them spelled differently. Why are we talking about that? It's important that you're spelling correctly on tests, because too many misspellings will lose you credit on a test. So start to practice your spelling. So depending on how I'm using the word, I might see it spelled differently, but it means the same thing. So if I use the word "epithelium," epithelium is a noun, and I can just use it like that. I'm looking at stratified squamous epithelium. If I'm talking about epithelial, "epithelial" is an adjective, and so it has to be followed by a noun. So what kind of tissue am I talking about? Epithelial tissue. They mean the same thing. They are the same thing. It's just how am I using it in a sentence. So one of my general tissue types, epithelium. Another is connective. A third is muscle, and a fourth is nervous. And we're going to – so those are just the general names. We're going to be looking at very specific types of each of these tissues, and we're going to start with epithelial tissue. So I'm going to start with some general information about epithelial tissue. How would we maybe describe it, or what will I look for? What should I know about it that makes it an epithelial tissue? So the first thing is, when we see epithelial tissues, these are the things to look for when we look at the photographs. When we're looking at epithelial tissue, we're going to see that the cells are going to be next to each other, very closely joined to each other. There's not going to be space in between the cells. And we're going to – because of that, we're going to find these very closely-joined cells on the surface of our body – that is, the skin, right – the inside lining of structures, and some specializations of epithelium are glands and membranes. And so, we'll discuss this before we're finished, too. A second thing that we'll see is that – right, we just said it a minute ago, that the tissue is a group of the same kind of cell, plus the extracellular or intercellular material. In epithelium, there isn't much of that material in between the cells. Why? They're closely joined. They're touching each other. So there's not a lot of room, or no room for material in between. Epithelium is usually very richly innervated. It has a lot of nerve endings, but on the other hand, it doesn't have a lot of the blood supply. It's avascular. Side note, a- means without or no, and -vascular means a blood supply. So there's no blood supply. So – but it's living tissue, so it has to get blood. It has to get the important materials carried in the blood. So how is that happening? Diffusion or absorption. So there are nearby blood vessels, and gas exchange occurs by way of diffusion, and movement of materials, nutrients and waste products, are happening by either diffusion or absorption. Continuing – all epithelium lies on what's called a basement membrane. So the bottom layer of cells is on a membrane called basement membrane. The anatomical term is basal – excuse me, basal lamina. So you can use either of those terms, basement membrane, basal lamina, means the same thing. Basal means bottom. Lamina means layer. Bottom layer is a basement membrane. Epithelium – we aren't going to see this with all tissues, but epithelium undergoes mitosis constantly.

So it's constantly being regenerated. Why does that make sense? Remember, we said we're going to find it on the surface of our skin. We're going to find it lining the inside of structures, and it gets a lot of wear and tear. And so, because of that, the uppermost, outermost cells are going to get damage, and they need to be replaced. And lastly, epithelium is classified or another word for that is named by two things – its layering, how many layers it has. That is, one cell sitting on top of another – and what are the shapes of the cells in a specific type of epithelium. So those are general pieces of information, kind of describes what we would see in epithelium. Let's now look at this classification. Let's start with layering. So there are two ways that epithelium would be layered, and the way it's layered is going to be part of its name. So epithelium is either simple or stratified. Simple means one single layer of cells, and so, if I have a simple epithelium, one single layer, remember what we said. A lot of times, epithelium is lining, or it's a surface. But if it's a single layer of cells, it wouldn't hold up to wear and tear very well. So there's a single layer of cells. That type of epithelium is only going to be found in protected areas inside the body that aren't necessarily going to get a lot of wear and tear. They're going to line internal compartments and passageways, and we'll look at some examples. The other type of layering is called stratified. Stratified means layered. And so now, we have cells that are in two or more layers deep sitting on top of each other, and now, these are the epithelia that would be in areas that are going to come in contact with a lot of physical or mechanical stress. The other thing we're looking in terms of naming epithelium is the shape of the cell. And so, we have four shapes. We have what's called squamous. Some people say squaw-mous [phonetic]. I say squamous, right, potato, po-tah-toe [phonetic], doesn't matter. What matters – can I spell it? So I've got squamous. The word "squamous" is a thin, flat cell. So it's thin and flat, if it's a squamous epithelium cell. We have cuboidal cells. So cuboidal is describing kind of the geometric structure, right, and cube has the same height as width. And so, that's what we would see with cuboidal. Columnar cells are shaped like a column. So they're three to four times high than they are wide. And lastly, we have what's called transitional, and this is a transitional cell because the cell can change shape. Because remember what we're talking about here, cell shape. So sometimes, the cell is flat. Sometimes, it's more teardrop-shaped, but it's always going to be layered. And the layers that we will see, as opposed to the other type of epithelium that we'll see that's layered, are very irregular, kind of haphazard layering. They're not in nice, straight rows, if you will. So with that in mind, let's take a look at those terms. So over here, we're looking at layering, and over here, we're looking at shape. And so, simple epithelium – here's the basement membrane, basal lamina, and there is one row of cells on top of that basement membrane. On a stratified epithelium, here's the basement membrane, basal lamina, and then I have one row of cells on the basement, and another row of cells above that, and another row of cells. This is stratified. This is what layering looks like – thin, flat squamous, height equals width cuboidal, three to four times height as width columnar. So with that in mind, now let's name – remember, we started with general, epithelium, connective, muscle, nervous.

Now, we're going to name specific types of tissues. So here's the – here are the specific names of epithelium, and here's what else I will say to you. And this is true of all the tissues – almost all the tissues we're going to talk about. Are these all of the types of epithelium? No. There are other types. I'll mention them as we go, but these are the ones we're going to encounter and see throughout the semester. So are there other epithelia? Yes. Will there be other connectives when we get there, connective tissues? Yes, but the ones I'm presenting are the ones, for the most part, we're going to see throughout the semester. If there are others, I will make note of them to you. And these are the ones that you'll be tested on. I will not ask questions about things that I do not present in lecture. So what does that also mean in your textbook? Your textbook has way more information, as it should, than what we'll discuss. So as you're reading through your textbook, and using it as a resource, and you come across something that we haven't discussed, are you going to be tested on that? No. You'll be tested on the lecture material only. That's true in lab as well. You'll be tested on lab material that's presented to you only. Okay, so, here's our first specific epithelium, simple – simple means – right? Write it down to the side right now, one layer. Squamous means what? Write it down to the side, thin and flat. So the name of our first specific epithelium is simple squamous epithelium. So here are the things we're going to need to know, right? This goes back to our discussion on Monday, because we are studying for our first lecture exam on September 1st. What are some things I might need to know? I might need to know location, and always function. So here are some locations that I would find that simple squamous epithelium that we said – this is going to have to be inside a protected area, because it's only one layer. So what kind of places are we talking about? Let's talk about the locations, and then the functions, and then we'll talk about how that makes sense. So we might find simple squamous epithelium in the alveoli. That's a plural word – of the lungs. The alveoli of the lungs, little side note, are the little, teeny, tiny, microscopic air sacs in the lungs, where gas exchange occurs. We might find the simple squamous epithelium on the inside lining of blood vessels. Why? What's happening with the inside lining of – what's happening at blood vessels? Again, exchanging of materials, and we're going to see simple squamous epithelium helping to make up some membranes. And we'll see this before we finish. So what are the functions of simple squamous epithelium? When I have only one cell layer to move through, materials can move into and out of an area, an organ or a tissue, very efficiently, without the use of energy. And so, I'm going to find simple squamous epithelium where diffusion occurs, such as the diffusion of gases, or the diffusion of waste, or nutrient materials, and/or also where filtration occurs. And that happens at the kidney. And so, any materials to be moved very easily through different layers of an organ, or a region, or a tissue – simple squamous epithelium. Looks like this. We're going to see this again when we start lab, our actual lab today. So this is – what are we looking at? Here's my thin, flat cell. Here's a thin, flat cell. Here's a thin, flat cell. And what do we see? Tightly attached, no intercellular material. These are nuclei of that tissue, and this is – not that you have to know this right now, but this is what's called a whole mount. And so,

this might have come maybe – maybe do this in biology lab, from a strip of tissue from inside your cheek. And so, you're seeing this simple, one layer thick, simple squamous epithelium. The other way we might see it is if it's teased apart from this – I'm going to go back like this – if it's teased apart – so if we take a dissection needle and pull it apart, then we're going to see the cells by themselves. Then we can see an individual simple squamous epithelium, simple squamous epithelium, simple squamous epithelium. So the other way we will see it in lab is this teased preparation. But here's where we would see it inside the body, and we won't see this in lab. Or maybe we will see it in lab, actually. I'll add this to our slideshow this afternoon – or, actually, it's in our slideshow, or – this afternoon – in just a bit. So what would we see? We're seeing – here's a cell layer. Here's a cell layer. Here's a cell layer. One cell, one cell, one cell – these are all the squamous epithelial cells surrounding a space. In this case, this is an alveolus. That's a singular word – in the lung. So that I have very easy movement of gases, in this case, in and out of that space. So that's how we would see it in the body. Our next type of epithelium is called stratified squamous. So stratified – what do we know, right? More than one layer, two or more layers. It's still thin and flat, stratified squamous, but we're going to find it in different locations, because it's stratified. So where are we going to see it? We see stratified squamous – what did we say? On surfaces, inside linings that receive some wear and tear. So surface of the skin, we're going to see stratified squamous epithelium, and on the inside lining of our mouth, our esophagus, the vagina, areas that there would be abrasion occurring, so that the top layer can be removed, but there's still layers underneath that are healthy. And so, functions of stratified squamous – physical protection from that abrasion. What does abrasion mean? Rubbing. Physical protection, because remember, they're tightly adhered to each other from dehydration, losing water through these areas, especially these areas that are open to the outside of the body, like the mouth, the esophagus, the vagina. Those areas are constantly exposed, because they're open to the outside of the body. We don't want them to dry out, but it also provides, because it's layered, some protection against chemicals that we might come in contact with, or biological agents that we might come in contact with, so that they can't penetrate into our deeper tissues. And this is what it looks like. So make a little side note before we start. With every epithelium from now on, not simple squamous, although it is true. We just saw an open space, but they're – the way it's prepared, it may not look like an open space. But with every epithelium, because it lines something, or it's the surface of something, you're always going to see this open space. And so – and then, you'll see the cells. So here's a layer of cells. Right, it's stratified, like bricks in a wall, thin, flat, thin, flat, thin, flat, thin, flat, thin, flat. And they open up to an open space, and other identifying feature – and we'll talk about all this again in lab – because it's layered, and because it's constantly being regenerated from these cells that are deeper, we have dead cells on the surface that are always kind of flaky-looking, and sloughing is the word – off of that outside surface. The next two epithelia, simple cuboidal, one layer, and simple columnar, one layer. Again, this is the shape of the cell. So, where are we

going to find simple cuboidal epithelium? Primarily, simple cuboidal epithelia compose glands, which we're going to look at specifically in a moment, and the function is to produce the secretion of that gland. So we'll look at some examples in a moment. Simple columnar, right, three to four times height than width – where am I going to find that? Primarily in my digestive tract, in my respiratory tract, because the function, the primary function of simple columnar epithelium is absorption. So it's going to absorb fluids and solutes in the digestive tract, and gases in the respiratory tract. Now, before we move on, are there stratified examples of these? Is there a stratified cuboidal and a stratified columnar? Yes, but again, we are not discussing them. They are rare, infrequent in the body, and so, we're just discussing primary tissues. Doesn't mean they're not there, but I will not be asking you any questions about them. This is what a simple cuboidal epithelium looks like – cube, cube, cube, one cell layer around an opening. Here's my open space. Cube, cube, cube, cube, cube – here's my open space. So all of these are cuboidal epithelia cells around an open space. Simple columnar epithelium – here it is, three to four times the height as the width. Large, oval nucleus – we'll cover all of this in lab, and an identifying feature on simple columnar epithelium is a specialized cell called a goblet cell. And again, we'll talk about that in lab. Last epithelium, transitional. Remember what we said. What's the shape here? It changes. That's why it's called transitional. Transitional means changing. So we have different shapes. Where are we going to – why do we – would we need this? This is in places like the urinary bladder and ureters, which are the teeny, tiny tubes that lead from the kidney to the bladder. Because when the bladder is filled with urine, or the ureters are filled with urine, those cells can change shape without getting damaged. And then, when the urine exits, they retain their original shape. And so, this is what it looks like. Where's that open – here's the open space, open space, open space, open space, and here are the – remember, transitional's always layered. So here are the layers. Remember what else we said. As opposed to the only other layered epithelium we're going to look at, the stratified squamous, and that was nice, even rows, thin, flat cells. On transitional, we have a lot of variation in the cell shape. That cell on the edge, they might look thin and flat, but when we move a little deeper, they look more like a teardrop, which is what we – what I mentioned before. And then, as this – and it's most likely a ureter. It's filled with urine. They get pushed back, right? The space gets bigger. The cells get flattened out. So then, the cells change shape, and when the urine exits, they go back to this shape. So cool. All right, we're going to finish with some specializations of epithelium. We actually might go a little bit into connective tissue, but we'll see by how much time we have. So one of the specializations that we mentioned earlier on with epithelium are glands. And so, here's the definition of a gland. A gland is cluster, or a pocket is a good explanation, of epithelial cells. Most likely, what type of epithelium? Because we just defined it, jot it down – cuboidal. Glands are clusters of – usually, not always. So that's a – but usually, it's going to be a cuboidal, group of cuboidal cells. So there are two types of glands – general, general types of glands in the human body. We have endocrine glands, and an endocrine gland does not have

ducts. That is, a passageway to release the secretion. So how does it release its secretion? It goes directly into that inter – in between the cells – intercellular fluid and the bloodstream, and the example of endocrine secretion – this is the only kind of endocrine secretion – are hormones. So when we talk about the endocrine system, we'll be talking about a whole bunch of hormones. Right now, we're just going to say endocrine glands do not have ducts. They secrete hormones directly into the material surrounding the cells, intercellular fluid, and the bloodstream. The other general type of gland is called an exocrine gland, and the definition is that it does – an exocrine gland does have a duct. And so, the materials that are being created in an exocrine gland make their way to two places, either onto the surface of the skin, or an internal lining of an internal passageway. And so, what type of glands are exocrine glands? Sweat glands make sweat, makes its way to the surface of my skin by way of a passageway called a duct. Milk – mammary glands make their way onto the surface of the skin by way of a duct. Salivary glands – saliva makes its way into the lining of an internal passageway, my mouth, by way of a duct, and all digestive enzymes make their way onto their internal lining of the digestive system by way of a duct. So this is what a gland would look like, maybe something like a salivary gland. And inside – we'll take this little bit and highlight it. We're going to see cuboidal cells that are producing, we'll say, saliva, that they then release into a passageway called a duct that will make its way to the inside of my mouth. Another specialization of the epithelium are membranes. So we're going to talk about two membranes in particular. Please know the information about these, and we will encounter them throughout the semester, and revisit this information. But just in general, a membrane is some combination of some sort of an epithelium – this word, "epithelia,"is plural – and connective tissues. So some sort of epithelium plus a connective tissue makes up a membrane. Two of them we'll discuss in some detail. Mucous membranes – this is important. What type of epithelium is it? Depends on where it's located. So I'm going to say it to you now, that as we encounter mucous membranes throughout the semester with different systems, we will identify what type of epithelium it is. For now, we'll say in general mucous membranes are made up of different types of epithelia over – there's the connective tissue, areolar connective tissue. So where are they located? Two places – please know both of them. So I'm going to find mucous membranes as the internal surface lining of hollow organs, right, something like the stomach, and they're going to line cavities that are open to the outside of the body, right? Some of those things we just talked about – digestive tract, respiratory tract, reproductive tract, urinary tract, are open to the outside of the body, and are subject to incoming pathogens and dehydration. So, what are the functions of mucous membranes? They secrete mucus, and this is the correct spelling of mucus. This is the correct spelling of mucous membrane. They secrete mucus to form a barrier to pathogens, acids in the digestive tract, digestive enzymes, and they secrete mucus to provide moisture to prevent dehydration – very, very, very important. Know it, love it. Serous membranes, we mentioned yesterday. Now, this one is very specific. Know it too. Every serous membrane is composed of simple squamous epithelium. In this

case, it also could be called mesothelium. That is just a specific way that simple squamous epithelium has been produced internally by way of the mesoderm in an embryo – over, again, areolar connective tissue, because what did we say? Membranes are epithelium and a connective tissue. Serous membranes are always simple squamous epithelium over areolar connective tissue. Where are we going to find that? They are a double lining in closed cavities. So what are my closed cavities? Abdominal cavity – we mentioned this already. That serous membrane's called the peritoneum. Thoracic cavity is a closed cavity, and I have a serous membrane called pleura that surrounds the lungs. Pericardium – peri – side note again – means surrounding. -Cardium means heart – around the heart. Every serous membrane is made up of two layers, parietal and visceral. The parietal layer of a serous membrane lines the walls of the cavity. The word "parietal" means wall. So it attaches firmly to the wall of the cavity, and the second layer's called visceral. "Viscera" means internal organ. This layer is directly attached to the organ, or organs, right. If it's the peritoneum, it's directly attached to the upper abdominal organs. If it's the pleura, it's attached to the lungs. Pericardium is attached to the heart. What are – what is the function of serous membranes? It produces a secretion called serous fluid that reduces friction. So where am I going to find these? In places where I have organs that are always moving, and rubbing against each other, and rubbing against each other causes heat. That's called friction. I don't want heat in my body cavities, so this reduces the buildup of heat. We'll talk about them specifically when we get to the systems where they're found. Looks like this, and it's often described as looking kind of like if you punched your fist into a not-quite-filled balloon. And that part of the balloon that's touching your fist would be the visceral layer. Then this would be attached to the cavity, the parietal layer, and in between, in a serous membrane, would be the serous fluid, right? So we have that visceral layer on the heart, the parietal layer attached to the thoracic wall, and in between is the serous fluid in light blue. Same thing around the lungs, pleura, and same thing around the digestive organs in the abdominal cavity, the peritoneum. There are some other body membranes that we'll encounter when we get to these systems. So we have what are called synovial membranes that line diarthrotic joints. So when we talk about – excuse me – the joints, we'll talk about synovial membranes, and of course, the cutaneous membrane is our skin. And we're going to talk all about the skin. All right. I am going to – excuse me, excuse me. I'm going to save connective tissue, muscle tissue, and nervous tissue for our discussion in lecture next week. The things you need to know about these tissues, I will present in our next slideshow, after we take a bit of a break during lab. So I'm going to actually end our show right now. Excuse me. I'm going to end the recording.