>> Deb Feickert: And I also just want to open up the chat, so if you have any questions I can see it. All right. So again, our discussion today is a little bit more specifically talking about the tissue of bone, bone connective tissue, and how bones are put together and actually grow and develop. And so with that in mind, we'll start as always with just some general information and what do we know. We know that a system is composed of different organs that have the same function. And so certainly, and we'll see this in a moment in our notes, the primary organs in the skeletal system are bones, but we are going to see some other connective tissues besides bone connective. And as always, as we are starting out to get into our systems, we are going to be identifying tissues. And that is – I keep saying I know it's so important. We are going to be talking about tissues and identifying tissues in a test situation all semester. So when we see tissues being shown to us, we need to make a particular mark. And I was mentioning this to one of the labs yesterday, maybe in during lecture, afterwards, when you're looking at your notes that you use a same highlighter every time for tissue, so that every time you see that whatever you choose pink highlighter, you know that that is a tissue that you need to identify. So let's try be organized and combine this – all of this information in some way that starts to make more sense for us. So, there it is. Connective tissue is the primary type of tissue. It's also called osseous. So we've seen that word osteo, never seen this word osseous, every – anything that has that kind of sound is going to be bone. So again, the bone connective tissue is the major component of the skeletal system. And we want to remember because we've been looking at them in lab, and they're not alive anymore. So then we think that bones are inert, but they aren't. They are organs made up of living tissues, living cells that might become diseased or need repair. So, always keep in mind that bones are living organs. So, now let's talk a little bit about the tissue called bone connective tissue. We have two types of bone. And we've been looking at compact bone. So the bone that we've been seeing in lab, the bone that we're going to spend most of our time today on is compact bone. And compact bone is very hard in terms of physical properties. It gets hard and dense. Dense means there's not a lot of space. It's very hard and dense. The other name for compact bone is cortical. The other type of bone is called cancellous or spongy. And so this is not going to be hard. It's not going to be dense. It's going to have as the name implies, spongy, lots of little holes of it. And so we're going to look at the different examples of these two types of bones. And then in lab, after our discussion today over the next few labs, I'll show you some examples of what that means. Spongy versus critical. Cancellous versus compact. But again, we're going to spend our time talking about compact bone. And we're going to look at it microscopically. We've done it already. This is a bit of a review then. Hopefully it's looking familiar. And with that said, we're going to add a bit more specific information about that compact bone. This we already know, because we talked about this when we talked about tissues. And we said that one of the things we have to know that all connective tissues is what is the arrangement. And so the arrangement of compact bone are dense, again, no space, dense, concentric circles. Those dense, concentric circles are in groups called osteons, or Haversian systems. We've seen

this already. We've identified this already. So within a single osteon, here are the structures we should be aware of. We have the Haversian canals, which is the central, longitudinal – remember this word means, longitudinal means long. So it passes along the length of the bone, each of these Haversian canals. And so they are channel, an opening and Haversian canal. What is in this opening? This is where blood vessels and nerve fibers are going to be found. And again, it's important because bone is living tissue. So we have to have blood supply. We have to have a nerve supply. And the nerves and blood vessels pass through very hard, dense compact bone in these Haversian canals. We have osteo – oh, there it is again, osteo. Osteo mean bone, cytes in our cells, osteocytes. And we know that osteocytes are the mature bone cells. And they do what we say maintain the matrix. We're going to talk about the osteocytes in just a moment. But we have used this term for to this idea of maintaining the matrix that is maintaining the health and integrity of the tissue doing the jobs that all cells do. These osteocytes are trapped in little pockets called lacunae. Remembering again that this is a plural with an E. I mean if it's just A lacuna, that would be singular. That word lacuna means cave. And so we've seen these little pockets of the osteocytes are trapped in. And then there's some cracks that we can see in an osteon called canaliculi. And so those cracks in the matrix are going to connect the lacunae, the pockets, the case to the Haversian canal. Why is that important? The osteocytes are in the lacunae, they are living cells. They need to be supplied with blood and nerve fibers. And those branches of blood vessels and nerve fibers are going to travel through the little cracks called canaliculi from the Haversian canal to each of the osteocytes. And lastly, we have what are called lamellae. Again, a plural lamella would be singular, and the word lamella – lamellae – lamina means layers. And so here's that prefix inter. So these are my rings of matrix. And matrix is found in between the cells, intercellular matrix. So those are my concentric rings, concentric circles, those are in layers called lamellae. So a diagrammatic view of what we just talked about that are – those blood vessels, nerve fiber, my lamellae, my layers of matrix, my osteocytes, trapped in lacunae, and then the cracks, the canaliculi that are connecting to the blood and nervous supply to supply the osteocytes. This is what it looks like under the microscope. We've seen this before. All of the same structures that we just mentioned. So Haversian canal, some of you noticed this already, also called the central canal, absolutely fine. Those are synonymous terms. So, either one is correct. We have those concentric rings of matrix. Those are the lamellae. The little dark areas are the lacunae. And inside of each lacuna would be an osteocyte. What's connecting my blood supply and nerve supply to my osteocytes? These cracks called canaliculi that I've seen all through the layers. So, what else do I need to know? Let's talk about the matrix in particular, because we said the matrix of bone is specialized. And it's not just protein fibers, but it also contains these calcium crystals that are called hydroxyapatite. And so two-thirds of the weight of bone are these mineral crystals. And hydroxyapatite is a combination of calcium phosphate and calcium hydroxide. So, this is absolutely fine to use this term when asked about the composition of the matrix. So, you could either say hydroxyapatite or you could do this combination, calcium phosphate, calcium hydroxide. And here's what the – So here's my composition, part of it, we're not done. This is my composition. And because of these crystals, these hydroxyapatite crystals, these are physical properties that bone has because of those crystals. Those crystals make bone hard and resistant to compression. What does compression mean? It doesn't smoosh down. So – And I'm walking, my bones don't get shorter and shorter and shorter over time because they aren't compressing. The other part of matrix are the protein fibers. Almost all with few exceptions – remember that we said we're – that do not have fibers, that were nonfibrous have one or more protein fibers. And in bone, the protein fibers are collagen. So a third of the matrix – the weight of the matrix is made up of collagen fibers. So the collagen fibers, we already know this. We already know what collagen fibers bring to a connective tissue. Collagen fibers are flexible, and they resist stretch. So there's a little bit of bend, but we can't pull on our bones and make them longer, right? Resistant to stretch. No Stretch Armstrongs happen in here. So, so far, I've got hydroxyapatite, collagen fibers make up the composition and matrix. What are four of my physical characteristics are resist compression, flexible, resist stretch. And then when I combine these two compositions, that makes bone strong. So when I combined the hydroxyapatite and collagen, now I have a fifth physical characteristic, strong. Bone is extremely strong. All right. We haven't even talked – We talked a little bit about the cells. But we have more than just a couple of cells in bone. So now let's list all of them. We've talked about the osteocytes several times already. It goes to the mature cells. The ones that the work is maintain the tissue. So all those jobs that every cell has in every type of tissue having to do with metabolism and homeostasis, that's what the osteocytes do. Osteoblasts, and we've talked about this before. That word blast is an active cell. It's not yet mature. It's not maintaining the tissue. What they are doing is laying down new tissue. They're producing bone tissue cell. Where am I going to find osteoblasts? And I'm going to point this out to you when we look at a couple of diagrams. We're going to find osteoblasts where bone would be laid down, and that is on the inner and outer surfaces of the bone. So I'm going to point that out to you in a second, that's where new bone would be placed. I have what are called osteoprogenitor cells. These are precursor cells. Osteoprogenitor. So, these are the cells that are also going to be found on the inner and outer surfaces of the bone. Because when they – the word is differentiate, these are stem cells for bone. When they differentiate, that is change, they are going to form osteoblasts. So I have stem cells, that when they undergo a change, they differentiate. They divide and differentiate. They form new osteoblasts. So, when I need bone laid down for some reason, we'll talk about a bit, then I'm going to have these stem cells producing more osteoblasts to lay down bone. And then lastly, we have a cell called osteoclast. And osteoclasts are large multinucleated cells that perform a function called osteolysis, lysis. The word lysis means to break down. And so these cells break down bone, the tissue bone and resorb, meaning they then engulf and resorb the bone tissue so that it can be used somewhere else. And so, a couple of things about osteoclasts and osteoblasts. We would see this – And we talked about this in lab. This is kind of constantly ongoing, where our bones are constantly remodeling. Every time I move, my bones are – and I have muscles pulling on my bone. They're remodeling, every time I start a new exercise program, and the muscle is a bit stronger on a bone than they did before, I'm going to have what's called remodeling of bone, where the bone breaks down a bit and then relays in that area where I'm getting more stress. So the other thing though that I might have with osteoclast is if my body needs some of those minerals that we talked about earlier. And so if I need some more calcium released into my blood, because I am running a marathon, and I'm sweating excessively, or I have been drinking excessive amount of water, and I'm urinating excessively, or if I'm pregnant, and I have a fetus that's growing, and I am not maintaining a correct nutrition, then – and this is all tied together with a hormone release, which we'll talk about later. Then the osteoclasts will be engaged to absorb some bone so that the calcium can be used elsewhere. So this is what we're seeing and if I look at I'm just going to pull a little piece off of this bone. It's the humerus. And I look internally and I see these osteons – these groupings called osteons. This is the outside covering of the bones. We'll talk about in a moment the periosteum. So, the osteoprogenitor and osteoblasts are underneath the periosteum on the outside surface of bone, and are going to be found on the inside surface of bone. Because if I have bone growth, bone repair, if I am resorbing bone and replacing bone, this is where it's going to most likely happen, the external surface or the internal surface of the bone. So I have different kinds of bones. We've seen them all now or most of us have seen them all now. Thursday afternoon people will see the rest of the bones today in lab. But here's how we're going to classify bones by shape, bones can be long, like the femur, the longest bone in the body. Bones can be classified as short, like the tarsals. So those of you have seen the bones in lab already, those were the bones of the ankle. Bones can be flat. The bones of the cranium are considered flat. Or bones can be irregularly shaped. They don't fall into any of these three categories and says like a vertebra is an irregular shape. Note the asterisks. What we're saying here – remember, we have two types of bone, compact bone, spongy bone. And all bones, all bones – side note please. All bones are made of both type, spongy and compact. All bones are made of both spongy and compact. And – but we classify these shaped bones as primarily one or the other. So, short bones, flat bones and irregular bones are primarily spongy. They have a compact bone outside surface, but the bulk of the bone is a spongy bone. Whereas long bones again, have both compact and spongy areas, but primarily a long bone is going to be composed of compact bone. Spongy bones. Any place where to find spongy bone? And we'll identify that in a second. It's going to be filled with red bone marrow, which is myeloid connective tissue, or adipose connective tissue. So the little holes in spongy bone, because that's why it's called spongy. It looks like a sponge. If those holes aren't hollow, they're filled with what we call bone marrow. So we're either going to find red bone marrow, which is mostly connective tissue, or we're going to find some adipose connective tissue in the holes in spongy bone. So here are examples of the bones that I mentioned to you, right. So, flat bones might be bones of the skull, like frontal bone, you know, irregular shape bone like a vertebra, longest bone of the body, the femur, and the tarsals are considered short bones, bones of the ankle. But we want to talk mostly about the long bones. And we're talking about the long bones in detail, because when we talk about the joint in lab next week, we are going to include some of the structures of long bones in our discussion. So this is my moment to say to you, you should always be checking your schedule. And for lab in particular, always look to see what's going to be happening in lab, the next day that you have lab. So that if there's something new happening, you have looked at that lab before you arrive. And we are going to look at, along with bones again next week of course, and the week after that, and the week after that, we are going to look at the joints articulations. So do make sure you take a look at that lab before you come to that lab. So, here's some structures we're going to see on long bones in lab and things that we'll be having to identify for lecture as well. So I've mentioned this now, in most of the labs as we've been looking at those bones of the appendages, that idea of the shaft, the long axis of the bone is called the diaphysis. And the diaphysis, which is the primary portion of a long bone is composed of compact bone. Then the ends of them are called epiphyses. So this is plural with an E, that's plural. If I put the I in there, I could say epiphysis. I'd have a proximal epiphysis and a distal epiphysis. But the two ends together called epiphyses, and they are composed of spongy bone. So this goes back to that comment in a moment ago, where I said that, all bones have both compact and spongy. But how much of each one would determine if we consider it primarily a compact bone or spongy bone. And again, long bones are primarily compact bone. But the ends, the epiphyses are spongy bone. Now, whereas we have spent a lot of time talking about the microanatomy of compact bone, this is all we're going to say about spongy bone. And I'm going to show this to you in lab. So spongy bone, when I look at it, when I look at spongy bone internally, it looks like a bunch of interconnected kind of net-like, very sharp needles. And those sharp interconnected needles have a name. They're called trabeculae. So the only thing we're going to say about spongy bone, whereas we spent all of this time talking about compact bone is that spongy bone is a group of interconnected projections called trabeculae. Again, this is plural. A long bone has what's called medullary canal, which is a space within the diaphysis. So a long bone isn't solid. There's a space inside the diaphysis that continuous yellow bone marrow. Whenever I have yellow bone, yellow bone marrow, we're going to talk about the bone marrows in a moment. Yellow bone marrow is adipose connective tissue. So when I have adipose connective tissue, I'm storing fat. Why do I need fat? Fat is an energy molecule. So, it's an energy storage of fat. But the other thing that this medullary canal does is it helps lighten the bone. Because if it were a solid bone – I wan you to imagine this, if I had a solid femur that was completely bone, I'd have to have huge muscles just to have move my body. So this space – this medullary canal helps lighten the bone as well. On the outside – So the medullary canal is inside, on the outside the bone are groups of holes called the nutrient foramen. And so these are holes in the outside of the diaphysis, the compact portion of the bone, because we – what did we say? Bone is dense, but it is alive. So we have to have a way for blood vessels and nerves to get into the bone where the cells are. And so on the outside of the bone are these holes called nutrient foramen that allow the blood vessels to get into the inside of the bone. And lastly, we have peri – side not, once again, let's just keep reminding ourselves with these prefixes mean. The word peri means surrounding. So surrounding the bone is a structure called periosteum. And this is a double layer of dense superficial. It's on the outside of the bone. Here we go. Here we go. Different tissues that we're seeing that make up the system dense, irregular with an I connective tissue. So the periosteum is a double layer on the outside of the bone surrounding the bone, dense with an I, irregular connective tissue. So this is what we've been talking about. So the long axis of the bone is called the diaphysis. It's composed of compact bone. The ends of a long bone are called the epiphyses. Then we have this kind of open, look to it, the holes of the spongy bone. The out – very outside the bone is covered with a material called periosteum, a structure called periosteum. And on the outside of the bone are these holes that allow blood vessels in called nutrient foramen. The center of the diaphysis is hollow, and filled with, this is indicating yellow bone marrow, which is adipose connective tissue. So let's talk about the periosteum and its jobs, multiple functions of the periosteum. Know them, love them as we should with all functions. So, the first thing the periosteum does is isolate the bone from surrounding tissues. All right now, let's talk about this when I am giving a function. When I am writing a function on a test, and the question says to me, be specific, you need to be specific. So you can't – again, you can't use one word. You can't just say isolates. And in fact, you shouldn't just say isolates the bone. Isolates the bone from what? Isolates the bone from kidnappers? No. Isolates the bone from surrounding tissues. This is a specific function. Do not be brief when you're writing specific functions. And the only functions I'm going to ask you are specific functions. So, one word is not going to cut it. Yeah, thanks, Esmeralda [assumed spelling]. It's not going to cut it. Be specific. Isolates the bone from surrounding tissues. Exact – And let me just give you an example from our test on Tuesday. The word excretion is not a function by itself. That's partial credit. What do we need to say? Excretes what? Excretes wastes. You need to expand your functions. Don't use one word. What else does the periosteum do? It's going to be a place for the attachment of our circulatory nervous supply for blood vessels and nerves. Why? The bone – What did we say? Is dense. There's no way for a blood vessel or a nerve to attach to a bone because it's too hard. So the periosteum is made of dense irregular connective tissue. Irregular meaning the collagen fibers are in many different interconnected directions. And so now my blood vessels and nerves can attach to that dense irregular connective tissue on the outside of the bone. What else? What do we say? Those osteoprogenitor cells and these osteoblasts are on the inside surface of the periosteum. So when the bone needs to be repaired, when the bone is undergoing growth, when it's undergoing its constant remodeling, that's where it's going to occur, in that inside layer of the periosteum. And lastly, another point of attachment. I have tendons. Tendons attach muscles to bone. Ligaments attach bone to bone. And again, tendons and ligaments are composed to dense within our regular connective tissue. And so the collagen fibers in the tendons and ligaments can attach into the irregularly placed collagen fibers in the periosteum. And so tendons and ligaments are going to attach to the bone by way of the periosteum. We talked about marrow. Let's define the marrow cavities. So I have red bone marrow. Red bone marrow, again, the composition, the histology, myeloid connective tissue. What is the job of myeloid connective tissue? It produces red and white blood cells. No other tissue makes blood cells. Myeloid connective tissue makes blood cells. Where am I going to find it? Locations. Locations. Possible locations. I'm going to find red bone marrow my – composed of myeloid connective tissue in the flat and irregular bones where I'm going to find the spongy bone located, so skull, ribs, sternum, vertebrae, pelvis. And – This is important, and the epiphyses of the long bones we just had, those areas of spongy bone, I'm going to find myeloid connective tissue. So skull, ribs, sternum, vertebrae, pelvis in the areas of spongy bone, and the epiphyses of a long bone. I also have yellow bone marrow. Yellow bone marrow, adipose connective tissue. Why do I have adipose connective tissue in my bone marrow? Energy storage might be in the bone, we mentioned already. And where is it going to be? That medullary canal of the long bone. So very specific location. Very specific location. So, this is where we would find a long bone, the myeloid connective tissue in the epiphyses. And this is where we're finding the yellow bone – so red bone marrow is what it's called and yellow bone marrow in the medullary canal. So, how do bones develop? How do they grow? Before six weeks of development in utero, the skeleton is cartilage primarily. There's no bone yet before six weeks in the fetus. And so that word ossification is when bone replaces existing tissue. And so we have two types of ossification. We have what's called intramembranous. All right. Intra, within. Membranous, a membrane. Inside of the membrane, we're going to have bone being laid down. Intramembranous ossification produces the following bones. Please know and be specific. So, flat bones of the skull. So, if I asked you to name a specific bone that is formed by intramembranous ossification, don't say flat bone of the skull. That's not specific. That's a whole category. You're going to name a flat bone of the skull. Some of the facial bones and I have listed the facial bones that are formed by intramembranous ossification here. Plus the clavicle and the patella are formed by this intramembranous ossification. What do I need to know besides which bones are produced? Where is this happening? This ossification. So, intramembranous ossification takes place in a membrane made of fibrous connective tissue. And in particular, D-I stands for dense irregular. So I'll have a – It looks like – please don't write this on a test. I just want to give you a visual. It looks kind of like a Ziploc baggie in the shape of the future bone. So, if I think about a Ziploc baggie – an empty Ziploc baggie, I have this sac with a space in the middle. And this dense irregular connective tissue sac has the shape of the future bone, let's say the frontal bone and the bone is being laid down inside of the sac and fills the sac of dense irregular connective tissue until it takes the shape of the sac. And then when it's all bone, it is all bone. And in the original sac, is now the periosteum. Because what is the composition of periosteum? Dense irregular connective tissue. So now this outside sac is the outside covering for the bone. Don't you love it? It's amazing. This is called intramembranous ossification. So flat bone of the skull. The parietal bone, for instance. So what we have – we'll have a sac of dense irregular connective tissue that's in the shape of the flat bone. And then it feels from the inside out with cancellous bone. And in the – Again, with this early spongy bones, there's that blood thin layer of compact bone on the outside to make it strong. And the outside, dense irregular connective tissue sac, once it's filled with bone, is now the periosteum. Boom. The other type of ossification is called endochondral, same thing. Hello, endo, inside. Chond, always means cartilage. Always means cartilage. Always means cartilage. So in endochondral ossification, what bones are formed? The bones we didn't mention already. So primarily, we're talking about upper and lower limbs. That is not a specific bone. That is a category. So if I ask you to name a specific bone, please don't say upper limb. That's not a bone. The bones of the upper limbs are the humerus, radius, ulna, those are specific bones. The os coxae bones, the bone s of the pelvis and the vertebrae are formed by endochondral ossification. So how is it different from intramembranous? Now I don't have a dense irregular connective tissue sac, I have a little replica of the bone, that is – I have a little hyaline cartilage connective tissue shape of what the future bone is can going to be shaped. And so hyaline cartilage connective tissue in the shape of the future bone. And what do I know about that? I know that hyaline cartilage connective tissue has an outside covering called perichondrium that is composed of? What kind of dense irregular connective tissue? So once the hyaline cartilage connective has been replaced by bone, the perichondrium is now called the periosteum. Isn't that different? It doesn't go away and come back again. It's always there. That when it's surrounding hyaline cartilage, it's called perichondrium, and once the cartilage has been replaced by bone, it's called periosteum. Noted. This is what it looks like. So I have a bone. This looks like it's maybe going to become the femur. And so I start off with this little replica of a bone made of hyaline cartilage, which is surrounded by perichondrium. And then I have bone that starts to be laid down diaphysis and then I have bone that starts to be laid down in the epiphyses. And so this is becoming bone. This is becoming bone. But this, is important, is still cartilage – hyaline cartilage. So I have these little areas of cartilage that are still present. And I – Let's just identify this, then if we're talking about this being the proximal end of the bone. This is the distal end of bone. This would be the – if we're looking at this, this is the – and this is the diaphysis and this is the epiphysis. Well, let me finish that thought finesse. And I think it – and it – and I'll come back to that. Good question. So what we have is bone in the diaphysis, here are my epiphysis. And so this edge of the cartilage is called the diaphyseal border. And this edge of the cartilage is the epiphyseal border. Diaphyseal border, that is – it's near the diaphysis. Epiphyseal border, near the epiphysis. So now I have bone being laid down the diaphysis, bone being laid down in the epiphysis, but I still have this little color of hyaline cartilage connective tissue. And what happens is this, bone is being laid down on this edge and this edge, the diaphyseal edge. Cartilage is still being laid down on this edge and this edge, the epiphyseal edge. So as long as

I have bone being laid down here, and cartilage being laid down here, the bone gets longer. Look, more bone here, more cartilage here, the bone gets longer until the bone that's being laid down on these edges gets laid down faster than the cartilage is being laid down and it overtakes it. And there's no cartilage left. And when that happens, no more growth will occur. So while there is still cartilage here, that's called the epiphyseal growth plate, or epiphyseal cartilage plate. And as long as there's an epiphyseal growth or cartilage plate, growth will occur. And so, yes Vanessa, it's basically what is happening is bone is pushing toward the epiphysis, cartilage is moving in this direction, but not as fast as bone. And eventually, the bone takes over. And so growing pains – yeah, what – but that is your whole body, not just your bones, certainly. So as we're growing, as your children are growing, and they kind of experiencing these aches and pains, it's because I have is very – at certain times in my life, right? I have very fast movement and changing and restructuring of my organs as I'm growing. And yeah, if it's happening too fast, right, sometimes we – you have somebody – they shoot up, right? We hear that term all the time. They shut up. And when you shoot up too fast, sometimes you don't have enough time for the muscles that are attaching to these bones, to then catch up to the increased length of the bone. So it takes a lot for the muscles to catch up. And yeah, you might feel some soreness. Amazing. It is amazing. It is amazing. We're amazing. So this is what happens in a lengthwise growth, just what I was saying, let's explain it now. Lengthwise growth of bone is going to create those epiphyseal cartilage plates, also called epiphyseal growth plates that we just looked at. And so what is the definition? An epiphyseal cartilage or growth plate is that area of hyaline cartilage connective between the diaphysis and the two epiphyses, which we just looked at. When I am undergoing this lengthwise growth? How? Why? When does it happen? Hormones. Hormones. Hormones. And we'll talk about hormones throughout the semester, but in more detail toward the end of the semester. So we know we have periods of time in our life where we are growing. When we're children, we have growth hormones that are constantly being released. And when we hit puberty, again, sex hormones being released, and now again, another real fast shoot of growth. So, the cartilage expands at the – these are the words that we use a moment ago, the epiphyseal border, right? That side of the hyaline cartilage next to the epiphyses and ossification is happening at the diaphyseal border, the edge at diaphysis. And I stopped growing. My bone stop getting longer when the diaphyseal edge, the ossification edge meets with and fuses the epiphyseal edge of the cartilage. And that leaves then a little line that we'll see them up. I don't have cartilage anymore. There's not of like plate. But what's left behind when the bone catches up is a little faint white line where the growth plate used to be. So again, ossification, ossification. This is called the epiphyseal growth plate, hyaline cartilage connective. Bone is being laid down, cartilage is being laid down. Eventually, bone gets laid down faster than cartilage. I have no cartilage left. I'm left with this faint line, epiphyseal line, epiphyseal line. If there's no cartilage, there's no more growth. This is what it looks like on an x-ray. So when we see an x-ray, and we see these faint shadows at the epiphyses of a bone, right, the ends of a bone, they kind of look like breaks. But those aren't breaks. Those are a little edge of hyaline cartilage connective tissue and as long as I'm seeing hyaline cartilage connective tissue, there is still going to be growth in that individual. So if I were to see an x-ray, and I were to be asked, is this an x-ray of an adult? Yes or no? We would say no, because we're seeing epiphyseal growth plates at the epiphyses. This is the x-ray of a growing person, most likely a child. Noted. Bone, bone. There it is. All right. Those of you that I won't see until Wednesday of next week, have a great weekend. Those of you that I'm going to see in a few minutes, I'll see you in a few minutes. And in the meantime, enjoy short break. Bye, everyone.

>> Thank you for class.

>> Deb Feickert: Bye everyone.

>> Bye professor. Thank you.

>> Deb Feickert: You're so welcome. Bye everyone. Check for your grades this weekend. Test scores will be posted this weekend.