>> Okay, we have different types of decay particles. We have our gamma, our beta, and our alpha, but we can also look at particles like the proton and the neutron. Gamma – gamma is – we think of gamma as being some real destructive particle because it's so hard to stop. We have to have either thick lead or thick concrete in order to shield ourselves from it. Also, gamma just travels for a long distance, okay? So, we think of gamma as being kind of one of those, you know, rays that we don't really want to be exposed to. Now beta, beta we don't worry quite so much about because beta can only travel for about a meteor – meter or two and then it doesn't go any further. Also, beta can be stopped by things like our lab coats and our gloves, things that are heavier materials can stop a beta particle. A paper can stop a beta particle, okay? So, beta particles can be stopped and when we're wearing our protective gear in lab, we're not – we're not worried about being exposed to beta particles, okay? Helium – helium, we really don't – you know, the alpha particle we really don't worry about it all because alpha particles only travel about a centimeter, that's about that far, you know, so they don't go very far. And then they pick up electrons and become helium molecules so, you know, after going only, you know, about what, the distance of our fingernail, they become something that we have in the air naturally and so it's no longer radioactive. Plus, helium won't even penetrate the skin, it will bounce right off. And so, we think of helium as being the safest thing to be around, okay? But let's take a look at this. This – these are factors based on biological damage. Both gamma and beta have a factor of 1, so – whereas protons and neutrons have a factor 10. In other words, protons and neutrons, for the same amount of exposure to these as to these, these are 10 times as damaging, okay? And look at the alpha particle, 20 times as much damage from one alpha particle as you would get from one gamma particle or from one beta particle. You know, we think this is not a big deal, alpha particles can't penetrate the skin. We can get them in our lungs. We can get them inside if we ingest or inhale them, they could – they create a lot of damage in our bodies. So, these are actually particles, they tell it – they – these factors tell us a great deal about the amount of damage they can do. The question is why. Why is something like helium that seems so – this innocent, little thing that hardly can travel, how can that cause so much damage? Well, let's compare these to a needle, compare these to a nail, and this to a spike. You're running around the backyard, you've got all three of these in the backyard with your bare feet. Which one would you not want to step on? I mean you wouldn't want to step on any of them. A needle hurts, I've gotten those in my feet, they hurt, okay? I've gotten a nail in my foot, that really hurts, okay? Why? Because the nail has a bigger diameter and so as the nail goes into my foot compared to getting a needle in my foot, that's like having an injection. Injections, they heal up pretty quickly. You get a nail in your foot, it leaves a hole, okay? Now that hole is a lot bigger that this. In other words, these particles make a much larger path of destruction as they travel, okay? And it – just like the nail does. Now think of the spike, a spike like a railroad spike. Those are huge, okay? That's like your helium particles, it may not go far, but where it goes, it makes destruction everywhere it does go. This is like ending up with a hole like that in

your foot. That would be very damaging. I'll go with the needle. I don't know about you guys, but I'll go with the needle. This would really hurt. Now why does this damage so much? Well, let's look at the mass. These have basically no mass, they're so tiny, just like that needle is very, very thin. These have a mass of one atomic mass unit, okay? So, now automatically, that path of destruction is going to be a little bit wider. Wherever this particle goes, there's going to be like a circular path around it of destruction because this has some mass to it. Look at the mass on helium, 4, okay? This is a very large molecule, which is why actually helium doesn't travel very far or very fast is because it's so heavy compared to everything else. These are just kind of like bing, these take off. [Inaudible] no mass, this has a mass of 4, so it's heavier, okay? So, being heavier, it doesn't go as far, but being heavier, it's also bigger, makes a much bigger path of destruction. And so, that's where we come up with these biological factors or – factors of biological damage. Now which one then is the most damaging? That spike, right? So, the alpha particle is our most damaging particle. Which one is the least? Well, I certainly wouldn't go with the 10s, would you? I would go with the damage factors of 1. So, it's either going to be gamma or beta. Now those are two different things, so think about this. Which one would be less damaging? Well, gamma will go all the way through you. So, it doesn't just go a little ways into you, it goes completely through your body, all right? Whereas beta, a beta will penetrate your body maybe your skin and then it stops. So, this could give you like a burn, but this will go all the way through to your internal organs, your DNA, everything, and come out the other side. So, which one is the least damaging of all of these? Well, out of these two, I would say this one, the beta is probably the least damaging. And then, of course, that alpha particle, that little, tiny thing that looks so innocent? That one is the most damaging.