>> Okay. So now, we're going to talk about how your body makes different proteins, how does your body make the proteins for your hair, your nails, your muscles, and so forth. Like I mentioned, your body links together the 20 different amino acids in different orders and different combinations to make the hundreds of proteins that your body has. How does your body know how to link these up? How does it know which order, which combination? The instructions for this is in your DNA, okay. We've all heard of DNA. DNA is in the middle of your cell, in the nucleus. Please go back to chapter three to review that. But basically, when you eat food with protein, like let's say chicken, your body will digest it and then absorb the amino acids. Now you have these amino acids floating in your blood, and then your body will grab them and make the different proteins. And there's basically three steps: self-signaling, transcription, and translation, and we'll go through. Hang tight for a minute as I go through it. If you have taken biology or anatomy and physiology, you'll go through this in much greater detail. I'm going to give you the Reader's Digest version basically, and then I'm going to tell you what you need to know for the quiz. What does this have to do with nutrition, that's the part I want you to know. So the first step is called cell signaling. Basically, your cell receives a signal that it needs to start making a protein. The next step is transcription, and this is like reading an instruction manual on how to put together something that you just bought. Let's say you bought a desk and it says, you know, connect, part A to part B, connect part B to connect part C and so forth. Your transcription in your cell all happens inside your nucleus in the DNA. Each strand of the DNA is called a chromosome, and each chromosome is then divided into units called genes. And your genes, well, it's like an instruction manual. It tells the cell I need these amino acids in this particular order to make this protein. It is the instruction manual. So your DNA, your genes specifically, dictates to the cell which amino acids to get and in which order. And I'll show you a picture of that in a minute. Okay. So that's just going over what I just said. The gene gives the instructions, which amino acids are needed and which order. The key is, you have to make sure you're eating a diet that has the amino acids because you never know when your body's going to need a specific one to make a certain protein. So again, it's hard to do this without a board where I'd show you a picture. But basically, if you've taken biology, and you can look in your textbook, by the way, in the cell, you have something called messenger RNA. Messenger RNA goes into the nucleus, into the DNA, and finds the instruction manual. It basically looks to find out which amino acids are needed in which order. Okay. It's kind of like you're going to make an apple pie. You read the recipe. You find out which ingredients do you need. So messenger RNA goes into the nucleus, reads the instructions, finds out which amino acids are needed, and then leaves the nucleus and goes into the cytoplasm. Once it's in the cytoplasm, messenger RNA then binds to something called the ribosome. The ribosome is just a structure in the cytoplasm. And the messenger RNA waits there until transfer RNA transfers over the amino acids that is needed to make that specific protein, okay. So the messenger RNA waits on the ribosome. Transfer RNA brings over the needed amino acids, and the protein is built. So the transfer RNA is kind of like your sous chef. What

do you call it? A sous chef that brings over your needed ingredient. And here is a great picture from your textbook. Here is your nucleus. Here is the DNA. Messenger RNA is coming here to find out what amino acids are needed and in what order, leaves the nucleus, travels to the ribosome, and then it sits here and waits. Translation is when transfer RNA now transfers over the needed amino acids. So these different colored balls, these are the different amino acids, and it transfers over the amino acids, and they connect them. Remember, these are all bound by a peptide bond. And this is how the protein is made. The protein is made inside the cell. Okay. And your book goes through, this is why I love the book, goes through step by step what I just talked about, how it is made. Okay. Amino acids, the building blocks of proteins, carried to the ribosome by transfer RNA. And then there you have it. This is a protein that is made. Okay. Now this is what you need to know for the quiz and for your health. Sometimes there something called a DNA error. There's an error. The messenger RNA reads either the instruction booklet. There's an error on it. There's some kind of defect. So it reads the instructions on the DNA, but the DNA was injured or damaged, and so the instructions were mangled up, so to speak. And it reads the wrong amino acids, and then a wrong or a defected protein is made. Again, going back to the cookbook. Kind of like your kid comes in and rips your page where you have a recipe, and you don't quite see all the proper ingredients. And you mess up. You think it said one thing, and it says something else. You put the wrong ingredients in, and then the wrong item is made. Instead of an apple pie, you put peaches in. You have peach pie. So the DNA in this case gets damaged, and you then read the wrong instructions. The messenger RNA reads the wrong instruction, and a defected protein is made. How does a DNA get damaged, that's the question? It's either inherited damage or you acquired it, which means you got it sometime after you were born. Inherited, an example would be sickle cell anemia. With sickle cell anemia, you inherit a DNA error in the hemoglobin that you make, which is part of a red blood cell. Rather, that hemoglobin is protein. It normally should be round, and then you'll have a round red blood cell. But in sickle cell, the person inherits a DNA error, and that now you make a sickle shaped hemoglobin. It's more narrow. And now the red blood cell has a different shape as well, and that different shaped red blood cell doesn't flow easily through your arteries and veins. They get stuck and cause blood clots and whatnot. Now what's more – Well, that's very important. But what we talk about nutrition is how to prevent DNA errors that you acquire. You can acquire DNA errors where your DNA gets damaged. How does it get damaged? And then it can cause cancer. Well, your DNA can get damaged by anything that enters your cells that shouldn't be there. For instance, you're exposed to some type of carcinogen or cancer-causing substance. That could be cleaning agents. I mentioned Roundup. You're exposed to Roundup, which increases risks of cancer, cigarette, smoke x-rays, smog, chemicals in your foods that are known to cause cancer, artificial colors and flavors and other chemicals, nitrates in bacon and other processed meats. These are all carcinogens, and they can get into your cell and cause DNA damage. And when you have a DNA damage, you can make a cancerous cell. And if your body doesn't recognize it

and kill it off, this is how tumors start growing. So the best way to prevent these damaging substances from entering cells is to eat foods that have a lot of antioxidants or phytochemicals. These are your fruits and vegetables if you remember from chapters, what, two and also four. Fruits and vegetables have a lot of different antioxidants and phytochemicals. They kind of stand guard at your cell membrane to help prevent these carcinogens from getting through the cell membrane and into the DNA. So the more fruits and vegetables you eat, the more antioxidants you can eat, the more protected your cells will be. Is it a guarantee you won't get cancer? No. You can't eat a salad and go smoke or be exposed to all these carcinogens, which we now are nowadays. So this is what I wanted to go over about DNA errors, okay. So you can read up more about that in your text, or feel free to always come by my office. Now how do we digest protein and absorb it? Just like with carbs and fats, we need digestive enzymes to break down the amino acids. Remember, they're bonded together by those peptide bonds. So the first step, you have to denature the protein. Denature means unravel it. It is a three-dimensional structure. We break down –Remember, proteins can be hundreds of amino acids long. They're made up of 20 amino acids, but they repeat themselves and combine in different orders. And you eat a piece of chicken, it could be made up of 200 amino acids. We have to break down those peptide bonds into smaller groups of amino acids, so they can be absorbed in the small intestinal wall through the villi. What breaks down those peptide bonds are the digestive enzymes and also cooking. I mean, think of a piece of a raw meat. It doesn't look like something you could probably digest very well. And as you cook it, those bonds are broken. This is just showing you. It's all raveled up, and this is how we unravel it or denature the protein. So cooking, like I said, is the first step. Helps break down, in particularly, meat, the tough connective tissue so that your body can break down into the component amino acids and absorb it. Remember from chapter three, if you don't break down the food before, you know, you're chewing it and digesting it, you're just going to poop it out. Okay. There's digestive enzymes in the stomach. First of all, we definitely need stomach acid for particularly protein, and we also need pepsin. Again, p for protein. So the first step, you chew it in your mouth, hopefully enough to break it into smaller pieces. The protein then goes to your stomach. Stomach acid will help break it down further into smaller pieces and also the pepsin. Remember, as you get older, after the age of about 30-ish, you have less and less acid and pepsin. And some people find it hard to digest certain proteins like steak. You can purchase digestive enzymes in a health food store, and that might help you. I think there was a test question on that. You need stomach acid and pepsin in the stomach to help break down the proteins. So the pepsin breaks apart the peptide bonds. They break them into shorter – You go from hundreds of amino acids down into much smaller groups of amino acids. The next step is the small intestine. And in the small intestine, you have now trypsin. Trypsin is another digestive enzyme for protein. And, again, you went from hundreds of amino acids to pepsin, and acid breaks it down into maybe groups of 50 or 20. And now, trypsin breaks it down even further into groups of one to three amino acids can then absorb

through the villi of the small intestinal wall. Whatever you don't digest, again, is going to go into the large intestine, and you're going to poop it out. So the way I remember which enzyme comes where, p comes before t. So pepsin is in the stomach, trypsin is in the small intestine. And then once these amino acids are absorbed through the small intestinal wall, they then go to the liver via the portal vein. Remember that the liver helps purify and detoxify whatever you've eaten before it enters the bloodstream. Your book nicely goes through each step. Again, in the stomach, you've got the stomach acid and the pepsin. Your pancreas release trypsin and other enzymes. Your liver, of course, releases bile. Gallbladder stores the bile. And the small intestine will further break it down. Anything not broken down and absorbed here will then go into the large intestine and then out the body. Okay. Once again, I'm going to stop the tape here, and we'll pick up these last few slides in part three.