BBC BITESIZE

Hello, I'm Dr Alex Lathbridge and this is Bitesize Biology.

This is the fifth episode of a nine-part series on the cell. Today, we're going to find out about protein synthesis.

You're going to need to know some information from previous episodes on DNA and the genome, so go back and listen to that a few times to let in sink in. I recommend starting with cell structure and working your way from there.

I should probably start off explaining what protein synthesis means.

Honestly, it's just a fancy way of saying: this is how your cells make proteins.

And it is really important that your cells make proteins.

Because I'm not joking when I say that proteins make everything in your body happen.

Imagine proteins as being like little machines inside your body, that are built for specific tasks.

Off the top of my head: some are used to break molecules down or stick them together (like certain enzymes, enzymes are proteins), some transport molecules around the body (like haemoglobin that carries oxygen in your red blood cells, haemoglobin is a protein), and if you squeeze your hands super tight right now, that sense of pressure that you're feeling is thanks to sensory molecules in your skin, they're proteins.

Even you, being able to listen to my voice right now, is thanks to a whole host of proteins in cells in your ears.

"But Alex, what's the difference between protein in food (like chicken or tofu) and the proteins in my body?"

Great question with an easy answer: absolutely nothing.

The proteins that your cells need and the proteins in food are different, but they're made from the same building blocks: molecules known as amino acids.

Your body can break food down and add those amino acids that you consume, to make the proteins that it needs.

And because things are always happening in your body, your cells always need new proteins to replace the old, and that's where protein synthesis, or making proteins, comes in.

In the last episode, we talked in a bit more detail about what's inside the nucleus of the cell.

The nucleus is where the genetic material is kept. This genetic material, or code, is made up of a molecule called DNA.

DNA, or Deoxyribonucleic acid.

I said it might help to think about genetic material like a cookbook.

The DNA are like words, each gene is a recipe, and the chromosome is a cookbook.

A gene is a section of DNA with the recipe, or instructions, for making one protein (synthesising one protein.)

So, we know that making proteins, or protein synthesis, is important and we know that the instructions for making the protein are written in DNA, and this DNA is inside the nucleus.

The DNA is in the nucleus. But the protein itself is made somewhere else in the cell: the ribosomes.

If we think about the cookbook again, it's a bit like having the cookbook in the bedroom when you need it in the kitchen. Easy, you might think, just take the cookbook from the bedroom to the kitchen.

But we have a problem. The cookbook contains so many recipes, that it's just way too heavy, it's too bulky, it's too big to fit through the door, it can't leave the bedroom.

The solution? Just make a copy of the recipe you need and take that to the kitchen.

So you don't need all of that genetic material, to make one protein you just need the code found in one gene.

Which is exactly what protein synthesis is: copying a single set of instructions and sending them to be made, or, in more scientific terminology that makes it sound way more complicated than it actually is, it's known as transcription and translation.

Because you shouldn't be going on about cookbooks in your exam, this is the process you need to know.

It's in two stages so here's where you grab a pen.

Stage one. Transcription.

Inside the nucleus, the section of DNA where the gene is gets unzipped (literally, two strands of DNA get split apart for a little bit) and a copy of the DNA sequence is made.

This copy is a molecule called messenger RNA (or mRNA) and it's the transcript that will be used to make the protein.

Transcription is just copying the instructions in the gene into a different format that the ribosomes can easily understand. The ribosomes need to understand it, because they are where the protein gets synthesised.

Stage Two. Translation

The copied code, the instructions, the mRNA, leaves the nucleus, and travels into the cytoplasm where it joins with the ribosomes, those little protein-making robots, they read the copied code and they begin to create proteins, placing one amino acid at a time in a specific order, like beads on a string that then fold up into interesting shapes.

And that's it: stage 1, transcription, inside the nucleus, making a small copy of the gene into mRNA.

And stage 2, translation, the copied code, the mRNA leaves the nucleus and goes to the ribosome where a protein is made. And after all this, the mRNA is broken down. It's not needed anymore, mRNA is very, very short lived.

I know you're probably wondering why I'm so hyped about this stuff, but I just think it's really cool that millions and millions of years of evolution have given our cells the ability to make everything they need out of basic building blocks.

I'm Dr Alex Lathbridge and this is Bitesize Biology. The rest of this series on the cell, and the other topics that we cover, are available on BBC Sounds.