BBC BITESIZE

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

This is episode three of a seven-part series on inheritance, variation and evolution. In this episode we're going to talk about variation: why there are differences between individuals in one species.

I'll be going through two causes of variation, genetic and environmental, and a combination of both.

A species is a group of organisms that's able to interbreed and produce fertile offspring.

My dog Ollie is a mix of lots of different breeds of dogs. His father was a working golden retriever and his mother was a cross between a Labrador and an English Springer Spaniel. So that means he's technically a Golden Springador, which is really funny because his fur is black. Dogs – no matter how different – are all examples of one species, which is why they can be crossed to make amazing individuals like Ollie.

Ok more about my perfect baby boy in a bit but let's talk about something far less interesting: humans.

Humans are all the same species, but like dogs, individuals within the same species still have lots of variations. Humans look similar to each other, but we're not identical.

Some variation is caused by genetics, what you inherit from your biological parents, and some variation is caused by the environment, how an individual grows up and interacts with its surroundings. And some variation is caused by a combination of both genetics and the environment.

Let's first have a look at genetic variation. Grab a pen and write this down.

It's the combination of genes from the two biological parents that gives us genetic variation. We talked about this in the first episode of the series, and it's really important so a quick recap:

Each of the human sex cells, or gametes, contain 23 chromosomes – this is half of the full number of chromosomes in a normal cell, which is 46. So sex cells are known as haploid.

The sperm and egg, the sex cells, fuse together during fertilisation to form offspring. And the parents' genes are combined in that new cell, which has the full 46 chromosomes, and is known as a zygote, and it's a diploid cell, meaning it has all 46 chromosome, 23 pairs.

So, which characteristics are caused by our inherited genes and lead to genetic variation?
Things like eye colour, hair colour, blood groups, skin colour, even if your ears are lobed or not.
And as I mentioned in the last episode, your biological sex, whether you're physically female or male, is genetically determined.

Let's take a look at variation caused by environmental factors, the type of environment an individual lives in, which can lead to differences, or variation, within a species.

For instance, I have scar on my little finger from when I was six years old because I wanted to test the hypothesis that if an electric pencil sharpener could make a pencil sharp – could my finger also be made into the ultimate weapon? Suffice it to say, my first scientific experiment was terminated very quickly.

Characteristics of animals and plants can be affected by lots of different environmental factors, whether it's hot or cold, the amount of food they have, life circumstances.
Plants are really affected by environmental factors. Every so often, I lie to myself and say that I can take care of one of those basil plants that you can buy at the supermarket. But every time, a week later after I've brought it home, I've either watered it too much or not enough and its leaves have turned yellow or maybe it's not had enough sunlight (because the UK doesn't get a lot of that in winter) and then it wilts, and I feel bad.

In humans, variation might be caused by environmental things like your diet, or an unfortunate injury might lead to scars or missing teeth, or your accent can be determined by where you live. This has nothing to do with genetic factors – it's all about environment. These factors won't be inherited, your children won't have a scar just because you do. So variation is caused by genetic factors and environmental factors.

But, the majority of variation in animals and plants is really caused by a combination of the two. For example, your mum might be really tall, and you inherit her genes for height. But in this hypothetical example, you might also have had a poor diet growing up, meaning you don't grow very well. So even though genetically, you might be predisposed to being tall, the environmental factor of not having a proper diet also affects your height.

Likewise, if Ollie was compared to any of his brothers or sisters from the same litter, chances are that he might be taller than some, able to jump higher than a few, or have a better sense of smell. All because they've all grown up in different environments, despite having incredibly similar genetics.

Before I go to take Ollie to the park, I want to tell you about when genes change – also known as mutations.

You might hear the word mutation and it sounds bad, right? It's really not, mutations are what make the world so different.

Mutations are random, spontaneous changes in the structure of a gene or chromosome. They lead to genetic variation within a species. But not all mutations will affect the characteristics that an individual has.

Because sometimes only a tiny part of a gene is altered, and so the characteristic that the gene represents doesn't change. In this instance, a mutation has changed the genotype (the genes), but the phenotype (the characteristic) has not been affected by the mutation. Genotype = genes. Phenotype = physical characteristic.

In other situations, the mutation of a gene might have a small effect on the phenotype, for example an eye colour might be slightly more brown, so the both the genotype and phenotype are altered by the mutation.

In very rare cases, a genetic mutation will have a big effect on the phenotype. Some genetic health conditions like sickle cell are caused by a genetic mutation that affects how red blood cells develop. So if you have sickle cell disease, your normally round red blood cells are shaped differently. Meaning that they can get stuck in blood vessels, which causes a lot of pain and health issues.

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

All episodes are available on BBC Sounds.