BBC BITESIZE

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

This is the fourth episode in a seven-part series on inheritance, variation and evolution.

In this episode we're going to be talking about evolution. We're going to look at what evolution is, and a process called natural selection, the main accepted theory of how evolution works.

We spoke about genetic variation in the last episode, Episode 3. And if you need a refresher, you've got time to listen to it again.

I'm going to keep it really simple to begin with. What is evolution?

Evolution is a change in the heritable characteristics of a population over time, from one generation to the next. That's it.

Right, but how does evolution work? Because millions of years ago, life on earth was limited to single celled organisms that survived in water.

So how did we go from that, to now, with humans, dogs, whales, sunflowers, pigeons, lettuce, pandas, naked mole rats, and every other living thing under the sun?

What drove that change? Was being a single celled organism that bad?

Well, let's get into it.

Charles Darwin was a scientist who spent a lot of time travelling around the world in the 1800s, studying fossils and animals.

Exploring lots of different places by ship, he noted that there were different characteristics that helped organisms to survive, depending on their environment.

Collecting lots of evidence during his travels, he came up with the idea that normal variation in certain heritable traits meant that populations can adapt and survive in different environments and so a species gradually changes.

And given enough time, these small changes can add up in a population, to the extent that a new species altogether can evolve altogether.

Or more simply, he came to the conclusion that evolution is driven by the natural process of gradual change over time and that is Darwin's theory of natural selection.

You need to understand the four stages of Darwin's theory of natural selection, so grab a pen and write this down:

1. Variation. Individuals within one species show lots of variation. This is caused by differences in genes.

2. Environment. Because of this large amount of variation, some individuals will have a useful characteristic, or trait, that makes them better adapted to their environment, and this gives them an advantage.

3. Survival. Individuals who possess this useful, advantageous trait are more likely to survive.

4. Offspring. The individuals that are more likely to survive, are more likely to successfully produce offspring.

These offspring will inherit the genes from their parents and so will also possess the advantageous, useful trait.

So that's variation, adaptation to the environment, survival, offspring.

So, over a very long period of time, the useful characteristic can become very common within the population, and so a new species may evolve.

And remember there are also individuals who are poorly adapted to their environment, and are less likely to survive and reproduce to create offspring. And their genes are less likely to be passed on to the next generation.

And that's how natural selection works. Let's see what it looks like in the real world.

Imagine a herd of plant-eating animals living somewhere that they can thrive, our environment is a land with lots of bushes, shrubs, trees, and whatnot.

Now, some of those individuals might be a taller than others, thanks to differences in their genes. That's variation.

Taller individuals can eat from the trees that the shorter individuals can't reach (that's an adaptational advantage) they're more likely to survive and breed.

This means that their offspring are likely to inherit that trait and also be tall, because this is the trait that increased their parents' chances of survival in the environment. And that'll happen again and again and again.

So, what does that process look like over millions of years?

Yes, that's right. The evolutionary journey resulting in the tallest land animal on the earth, the giraffe, through the natural selection of genes producing the long neck it needs to survive in the savannah.

But how do all of these random, useful, advantageous characteristics suddenly appear in individuals that make them better suited to their environment? How did giraffes go from ancestors with short necks to end up with the long things that they have now?

It's all down to mutations.

Mutations are randomly and constantly occurring within a population, some good, some bad and many are just neutral.

Animals aren't choosing to have mutations, in the same way that we're not choosing to have mutations. It's just down to luck.

Mutations cause changes in genes, the genotype, and this can lead to changes in characteristics, the phenotype.

So, in natural selection, a mutation that is beneficial to individuals can make them more likely to survive in an environment.

Therefore, more likely to reproduce, and that selects the useful gene naturally to be passed on to future generations of offspring.

So, one specific butterfly might have a random mutation that enables it to camouflage really well in its environment, meaning it is less likely to be eaten by other animals.

The lucky butterfly has a better chance of surviving due to this mutation, it then goes on to successfully breed and the offspring will inherit gene that camouflages them.

Over time, the gene for the useful characteristic will become very common within the population, because of survival.

The genes are doing the hard work here. So, you shouldn't write down in an exam "the advantageous trait" gets passed on.

The genes that produce that trait are passed on from parent to offspring.

I'm Dr Alex Lathbridge and this is Bitesize Biology. You can listen to the rest of the episodes on BBC Sounds.