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

This is the fifth episode of a seven-part series on Inheritance, Variation and Evolution.

In this episode, we're going to talk about what evidence exists to support the theory of evolution.

That word theory causes a lot of issues for some people because they get confused by the meaning.

In common usage, the word theory is said in the same way you would say "idea", but to a scientist, something that's a theory has evidence.

With that in mind, we're going to cover three bits of evidence today: fossils, bacteria and extinction.

Because scientists are obsessed with fossils, we're going to start there, and they're really good for your exams.

What are fossils? Fossils are the preserved remains of dead organisms that lived millions of years ago. They're generally found in rocks. Because they are the remains of animals that lived long ago, they give us a snapshot in time, they can show us how populations have changed over the ages, giving evidence for the theory of evolution.

If fossils are found in rocks, how can you tell the difference between a fossil and a rock? This won't be on your exam but a mate of mine who's a palaeontologist – a fossil scientist – told me that, because bones that have been fossilised are dryer than the rock around it, you can sometimes use your tongue. Because some fossil bones are filled with lots of pores, so if you lick it, they suck up the water and it sticks to your tongue like really tiny Velcro.

Anyway, back to passing your exams so grab a pen.

Fossils can be preserved in three main ways:

1. Hard body parts. these are things that don't decay easily like skeletons, bones and teeth.

2. No decay. This happens in environments like amber, tar pits, ice glaciers and peat bogs. The microbes that decay organisms can't survive there, so decay can't happen.

3. Buried traces. This usually occurs when an organism is buried in a soft material like clay, like casts, burrows, footprints and impressions.

So how do fossils provide evidence for the theory of evolution?

Fossils are like snapshots; they are biological photographs over millions of years that demonstrate organisms gradually getting more and more complex over time. Fossils of the simplest organisms are found in the oldest rocks from billions of years ago, and in the rocks found more recently, more complex organisms can be found.

This supports evolution where simple life forms gradually change into more complex ones over time.

Scientists can study fossils and learn how much organisms have changed since life began on Earth.

This information is known as the fossil record.

But there are gaps in the fossil record because the very earliest forms of life that existed were soft-bodied, and so they left very little fossil evidence. This is why scientists cannot be absolutely certain about how life began. The fossil record is incomplete, there isn't a fossil of every animal and plant that ever existed.

Let's go from fossils to antibiotics.

So antibiotics are things used to fight infections caused by certain species of harmful bacteria (and not viruses).

But over time, bacteria become resistant to these antibiotics, which is something doctors and vets need to be very aware of, but it's also evidence for evolution.

How?

Bacteria reproduce at a very fast rate and random mutations in the genes produce new strains of bacteria that become resistant to certain antibiotics.

Bacterial cells with mutations that make them resistant to antibiotic medicine, mean that antibiotics no longer work to destroy the bacteria. So these resistant bacteria are therefore more likely to survive and reproduce, increasing the population size of the antibiotic-resistant strain of bacteria.

This is an example of natural selection, where a mutation has caused an organism to have a beneficial trait, and the genes for that trait are inherited by the subsequent generations of offspring.

And because bacteria are so rapid at reproducing, and generations can happen again and again and again really, really quickly, it means that they evolve new resistant strains rather rapidly – and yes, this is bad news for humans and animals who don't want to be ill.

An example of a bacteria that has become resistant to antibiotics is MRSA. It's really, really hard to get rid of, as its resistant to multiple types of antibiotics.

How do you reduce the rate of antibiotic-resistant strains developing?

There are three ways:

1. Antibiotics shouldn't be prescribed inappropriately, such as treating non-serious infections or

those caused by viruses.

2. Antibiotics should have restricted use in agriculture, like farmers not treating lots of animals before they get sick.

3. People should always finish all of the antibiotics that they're given, otherwise some bacteria might still survive and form resistant strains.

This is all really important, because scientists are constantly trying to develop more and more effective antibiotics.

This is evidence for evolution as it demonstrates the process of natural selection.

So we've got fossil records in the past and bacteria today. So what's the final piece of evidence for evolution?

Extinction

So what's extinction? Extinction is when there are no remaining individuals of a species alive.

Organisms that don't have useful traits or are poorly adapted to their environment, and therefore less likely to survive, reproduce and so on and so forth, may become extinct.

There are five things that you need to remember that might lead to extinction:

1. New diseases.

2. New predators.

3. New competitors.

4. Changes to the environment, such as climate change.

5. A single catastrophic event, like a volcanic eruption or an asteroid collision.

How do we know this? The fossil record contains evidence of lots of species that have sadly gone extinct, things like the dodo, dinosaurs and big woolly mammoths. Its only really because of the fossils that we know that they ever existed but have now gone extinct. This is evidence of evolution.

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