Evolution
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Life on earth began approximately 3,500 million years ago. What do you think the earliest life forms were like?

All life on earth evolved from very simple organisms. Dinosaurs only appeared 3,325 million years later!

There are many theories of how life first appeared on Earth, but lack of evidence has made it extremely difficult to know which theory is correct.
How living things have changed over time

Press on a date to find out which living things appeared and disappeared in each time period.
How do we know life has changed?

Fossils are the preserved remains, impressions or traces of animals, plants and other organisms that lived millions of years ago. The history of life on Earth as shown by fossils is called the **fossil record**.

Although there are gaps in the fossil record, it helps to tell the evolutionary story of past and present-day organisms. It can show how the changes in an organism were linked to changes in its habitat.

The fossil record can also show how different species evolved from common ancestors.
Evidence for change

How did the horse evolve?

Click a date in the timeline to find out how gradual changes in the fossil record show the evolution of the modern horse.

- 55 million years ago
- 40 million years ago
- 17 million years ago
- 12 million years ago
- 4 million years ago

summary
Variation is the basis of evolution

There are many variations between organisms that belong to different species. These differences can help us to classify them.

Organisms that are in the same species also show variation, although they will always have more in common with each other than they will with members of another species.

What do you think causes these variations?

How do the members of your class vary from each other?
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Jean-Baptiste Lamarck (1744-1829) was a French botanist who believed that species evolved because they inherited traits acquired through the over or under-use of body parts.

How would this theory explain a giraffe’s long neck?

The short-necked ancestors of modern giraffes needed to reach the leaves on tall trees when food was scarce.

Over their lifetimes these giraffes stretched their necks; a trait which was then passed on to their offspring.
Darwin’s theory of evolution

The British naturalist Charles Darwin (1809–1882) later suggested a more persuasive argument for evolution.

Darwin proposed that evolution took place through **natural** and **sexual selection**.

Darwin developed his theory of evolution after noticing close similarities between certain fossils and the adaptations of modern day animals he saw during his round-the-world voyage on the HMS Beagle. He used creativity to turn his observations into a theory.
Who was Charles Darwin?

The life of Charles Darwin

Press on a date in the timeline to find out about significant events in Darwin's life.

- 1825–31
- 1831–36
- 1846–54
- 1859–64
- 1864–82
Darwin's theory of natural selection is based on the fact that natural variation among organisms causes them to differ in their ability to survive and reproduce. Press "start" to find out what happens.
The mechanism of natural selection

What is the order of stages in natural selection?

1. Offspring compete for food, water and mates, and have to avoid predators.

2. ...offspring with few competitive traits, which die or reproduce less.

3. Offspring with many competitive traits survive and reproduce, at the expense of...

4. Individuals produce genetically diverse offspring.

5. The frequency of the adaptive trait increases in the population.
Natural selection leads to evolution

What are the missing words about natural selection?

1. **[ ]** makes some genes more common in a population than others.

2. Some **[ ]** may be wiped out completely.

3. Over long periods, the changes caused by natural selection might lead to a new **[ ]** being formed.

4. The process in which **[ ]** change over time is known as **[ ]** characteristics.
How does Darwin’s theory explain a giraffe’s long neck?

Due to natural variation, the ancestors of modern giraffes would have had necks of different lengths.

Giraffes with longer necks would have been able to reach more food than those with shorter necks.

As a result, the long-necked giraffes were more likely to be healthy and live to produce high-quality offspring in greater numbers.

This, in turn, would increase the chances of their long-necked characteristic (an adaptive trait) being passed on to future generations.
Galápagos finches

In the Galápagos Islands, Darwin noticed that finches with different types of beak lived on each island.

- Some finches had strong, claw-like beaks, suitable for crushing seeds.
- Other had thin, delicate beaks, suitable for picking insects from holes in the ground.

Darwin thought all the finches had evolved from a common ancestor on the mainland. Natural variation meant that some finches had slightly different beaks. These finches were able to eat alternative types of food and avoid competition, making them more likely to survive and pass on their genes.
Lamarck vs. Darwin

Drag each statement to the correct scientist

Many different theories of evolution have been proposed. Two of the best known are those suggested by Lamarck and Darwin. Decide whether each statement refers to Lamarck or Darwin's theory.

Press start to begin.
Darwin knew that in religious Victorian society his findings would be controversial and blasphemous. He was unwilling to publish and risk his reputation.

However, when Darwin learned that another British naturalist, Alfred Russel Wallace, had proposed an almost identical theory of natural selection, he published his findings.

Luckily, a handful of influential scientists were convinced by Darwin's work and spoke out in public to promote his ideas.
Darwin made extensive use of specimens and fossil evidence to explain his theory of evolution, but because DNA and genes had not yet been discovered, he was unable to explain why traits varied within individuals or how they were inherited.

Victorian scientists found it difficult to test Darwin’s theory. For his theory to work, the Earth needed to be millions of years old, but its age was not known at that time.

In addition, little was known about the process of fossilization or how to explain gaps in the fossil record.
New lines of evidence

DNA from different organisms can be compared. The fewer differences, the less time since they shared a common ancestor.

98% of a human and a chimpanzee’s genes are the same. What does this tell you about their evolution?

It is a relatively short time since they both evolved from earlier mammals.
Evolution or design?

Some people reject evolution and natural selection in favour of alternative explanations such as **intelligent design (ID)**. According to ID, organisms are too complex to have arisen by evolution alone, and their development must have been guided by a higher intelligence at some point.

Supporters claim it is a valid theory based on scientific evidence, but critics say it is based on faith rather than scientific evidence.

Evolution is widely accepted because it explains a wide range of different observations, and has been discussed and tested by many different scientists. However, while this suggests that the theory is correct, it cannot be proved.
What happens when habitats change?

Adaptive evolution ensures that individuals within a species have traits allowing them to survive and reproduce in their habitat.

If the habitat changes, however, successful traits can become a disadvantage.

For example, if global warming caused Arctic snow to melt, brown rabbits may be better camouflaged and so more likely to survive than white rabbits.

Individuals that fail to reproduce, compete effectively for food or survive against new predators will eventually die out. If the last individual of a species dies, the species is extinct.
The dodo was a large flightless bird that lived on the island of Mauritius. It nested on the ground in forests, producing one egg at a time.

When human settlers arrived on the island in the mid-1600s, they brought animals such as rats and dogs to the island, which ate the dodos’ eggs.

The settlers chopped down the forests in which the dodos lived, and may have even hunted the dodo for food.

The dodo became extinct sometime in the late 1600s. What traits might have helped the dodo to survive longer?
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Evolution around us: some examples

Environmental changes, random mutations and natural selection can lead to evolution.

Press on the buttons to learn about some modern-day examples of these evolutionary changes.

- peppered moths
- superbugs
- super rats?
How do bacteria become resistant to antibiotics and turn into superbugs?

Press "start" to find out.
Genetic variation can lead to natural selection and evolution. Press on a button to find out more about the causes of genetic variation.
Selective breeding is when scientists and farmers choose a characteristic which they want to produce. They select organisms which show this characteristic well and breed them together. This usually produces offspring which have the desired characteristic.

Selective breeding and natural selection both involve a desirable characteristic being passed on to offspring.

However, in selective breeding, a person decides which characteristics are desirable, whereas in natural selection, the environment determines the desirable characteristic.
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adaptation – A special feature or behaviour that makes an organism particularly suited to its habitat.

camouflage – An adaptation that helps an organism to remain undetected by a predator or prey.

Charles Darwin (1809–1882) – A British naturalist who proposed that evolution took place through natural and sexual selection.

classification – The practice of grouping species into taxa of various sizes on the basis of shared features.
Anagrams

How quickly can you unscramble words about evolution?

Press "start" to begin.

start
What are the missing words about evolution?

1. Fossils show that all species have evolved from simple life forms over the space of 3,500 years.

2. Each population that arose showed variation due to gene mutations.

3. Natural selection allowed individuals with traits most suited to their environment to survive and breed.

4. Useful genes were passed to the next generations so new species gradually evolved.
Will you (Dar)win this quiz, or will you fall short of Lamarck?

Press "start" to begin.