

Evolution timeline

Darwin's theory of evolution explains how life on Earth has changed over geological time. Scientists believe this is the reason why all living things on Earth exist today. The theory is supported by evidence from fossils, and by the rapid changes that can be seen to occur in microorganisms such as antibiotic-resistant bacteria. Many species have become extinct in the past and the extinction of species continues to happen.

The basic idea behind the theory of evolution is that **different species have developed over time from simple life forms**. These simple life forms first developed more than three billion years ago (as the Earth is believed to be about 4.5 billion years old).

This timeline shows key events in the evolution of life forms on Earth, from the first bacteria to the human species.

You can see a more detailed [history of life timeline on BBC Nature](#).

Document

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Charles Darwin is famous for his theory of evolution, but he was not the only person to develop such a theory.

Darwin's theory

Charles Darwin was an English naturalist. He studied variation in plants and animals during a five-year voyage around the world in the 19th century. He explained his ideas about evolution in a book called *On the Origin of Species*, which was published in 1859.

Darwin's theory caused controversy among his contemporaries and his ideas were only gradually accepted, although some people still do not believe them today. The reasons for skepticism include:

- Darwin's theory **conflicted with religious views** that God had made all the animals and plants on Earth
- Darwin did not have enough evidence at the time to convince many scientists
- it took 50 years after Darwin's theory was published to discover how inheritance and *variation* worked.

Lamarck's theory

Jean-Baptiste Lamarck was a French scientist who developed an alternative theory of evolution at the beginning of the 19th century. His theory involved two ideas:



Charles Darwin (1809 - 1882)

1. A characteristic which is used more and more by an organism becomes **bigger and stronger**, and one that is not used eventually **disappears**
2. Any feature of an organism that is improved through use is **passed to its offspring**.

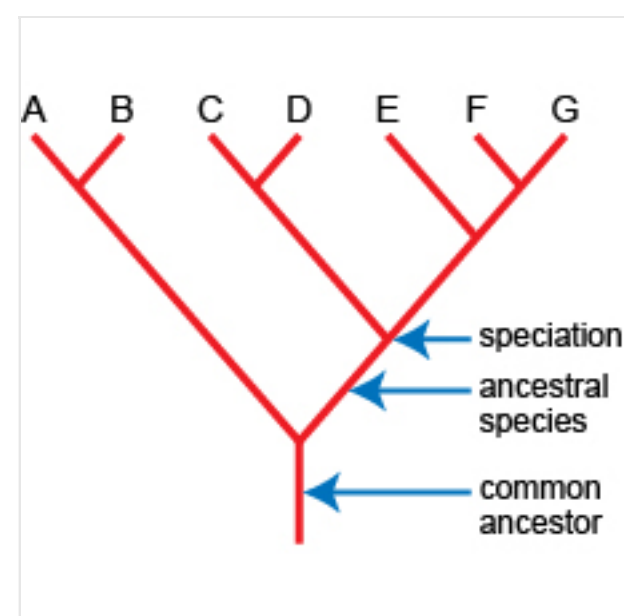
However, we now know that in most cases this type of inheritance cannot happen.

Lamarck's theory cannot account for all the observations made about life on Earth. For instance, his theory implies that all organisms would gradually become complex, and simple organisms disappear. On the other hand, Darwin's theory can account for the continued presence of simple organisms.

Different organisms can be classified by studying their similarities and differences. These studies also help us to understand the evolutionary relationships between different organisms.

Evolutionary trees

Evolutionary trees are used to represent the relationships between organisms. The diagram shows an evolutionary tree.



An evolutionary tree

In this evolutionary tree, species A and B share a common ancestor. Species F and G share a common ancestor, which itself shared a common ancestor with species E. All seven species share a common ancestor, probably from the distant past.

The theory of evolution states that evolution happens by natural selection. The key points are that:

- individuals in a species show a wide range of variation
- this variation is because of differences in their genes
- individuals with characteristics most suited to the environment

are more likely to survive and reproduce

- the genes that allow these individuals to be successful are passed to their offspring.

Individuals that are poorly adapted to their environment are less likely to survive and reproduce. This means that their genes are less likely to be passed on to the next generation. Given enough time, a species will gradually evolve.

You need to remember that variation can be caused by both genes and the environment. But it is only variation caused by genes that can be passed on to the next generation.

Conditions on Earth

Life on Earth today exists because of the conditions that were present when life was evolving. If in the

past the conditions had been different, evolution by *natural selection* could have produced some very different results. For example, if the Earth had been hotter, colder, bigger or smaller, our bodies would have changed to suit those conditions.

Mutations cause changes in genes. When new forms of a gene appear because of mutation, a rapid change in a species may happen if the environment changes. Such rapid changes support the theory of evolution by natural selection.

Peppered moths

Before the industrial revolution in Britain, most peppered moths were of the **pale variety**, meaning that they were camouflaged against the pale birch trees that they rest on. Moths with a mutant black colouring were easily spotted and eaten by birds. This gave the white variety an advantage and they were more likely to survive to reproduce.

Airborne pollution in industrial areas then blackened the birch tree bark with soot. This meant that the mutant black moths were now camouflaged, while the white variety became more vulnerable to predators. The black variety now had the advantage and were more likely to survive and reproduce. Over time, black peppered moths have become far more numerous in urban areas.



The pale peppered moths camouflage well against the pale birch tree



The darker mutant peppered moths camouflage well against the blackened birch tree

Antibiotic-resistant bacteria

Microorganisms such as bacteria and viruses reproduce very rapidly. They can evolve in a relatively short time. One example is the bacterium **E. coli**. Its *DNA* can be damaged or changed when it reproduces. Most of the time this causes the death of the bacterial cell.

Occasionally, the mutation is beneficial for the bacterial cell. For example, it may allow resistance to an antibiotic. When that antibiotic is present, the resistant bacteria have an advantage over bacteria that are not resistant.

Antibiotic-resistant strains of bacteria are an increasing problem in hospitals.

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