

Evolution

What is Evolution?

Evolution, in a biological sense, is the change in the inherited characteristics of organisms over time. Charles Darwin's famous theory on the mechanism of evolution by natural selection was based on four principles:



Variation

Individuals within a species are not identical - they differ from each other in a number of ways.

Inheritance

Offspring resemble their parents: they inherit characteristics from them.



Mortality

Usually, more offspring are produced than survive to maturity. They suffer from disease, predation and competition.

Population size

The size of a population generally remains fairly constant.

From these observations, Darwin concluded that the individuals most likely to survive in the **struggle for existence** are those that can compete best because they are well adapted to their environment. These individuals which survive longer will have a greater chance of reproducing and thus passing their genes on to the next generation. We call this process **natural selection**.

Definitions

Variation

"The differences between individuals of the same species which may be anatomical, physiological or behavioural. Variation can be caused by genetic or environmental factors".

Speciation

"The evolutionary formation of a new species. It occurs either by the division of one species into two or more genetically distinct species, or when one species evolves into a different species over time".

Reviewing the Evidence

The evidence for evolution is robust and wide ranging. Here are just a few examples:

Fossils

While far from complete, the fossil record shows that life has changed over time, increasing in variety and complexity. Fossils also provide evidence of so-called transitional forms or missing links, individuals that display characteristics that are intermediate between two known organisms and illustrate how one evolved into the other.

Comparative Anatomy

Groups of related organisms often share physical characteristics which serve as evidence that they evolved from a common ancestor (e.g. the wings of birds). It can also be shown that structures which serve similar functions in different groups, (e.g. the wings of bats) have been derived in a different way, pointing to a different evolutionary history.

DNA and Molecular Evidence

All living organisms on Earth are made up of cells and contain genetic material in the form of DNA. The basic molecular processes carried out inside cells exhibit a remarkable degree of similarity between organisms and point to the common origins of life.



Continuous and Discontinuous Variation

Living organisms exhibit an astonishing degree of variation, not only on a broad scale between species but even between individuals of the same species. Just think how different one person is from another, or how unique any animal or plant is if you look close enough. The variation between individuals of the same species can be described in two ways, depending on its characteristics: continuous or discontinuous.

Discontinuous variation describes traits which fall into two or more distinct classes, such as eye colour, blood type or gender. It is usually controlled by only one or two genes and not influenced by environmental factors - you cannot change your blood type by changing your environment. Continuous variation describes traits which have a range of values such as height and weight. This type of variation is usually influenced by a number of genes as well as environmental factors such as diet.



Amazing Adaptations

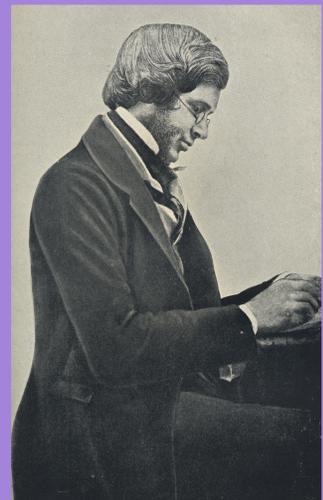
The natural world abounds with astonishing examples of the adaptations of organisms to their environments which have been derived through evolutionary processes. These may fall into a number of categories:

- Anatomical: e.g. the large size and compact shape of a polar bear which helps it retain body heat.
- Physiological: e.g. the highly efficient kidney of a camel which helps to prevent excess water loss.
- Behavioural: Including vocalisations such as whale song, used for communication.



The Theory of Evolution

Charles Darwin is famous for devising and describing the theory of evolution by natural selection, but he was not the only person to do so. Alfred Russel Wallace (right) a British naturalist several years Darwin's junior, coincidentally produced the same theory while working in the Malay Archipelago. Having deliberated about his theory for many years without publishing it, Darwin was shocked to receive a letter from Wallace outlining the very same mechanism for evolution that he had devised. The dilemma of their potential rivalry was solved as they agreed to publicise their theory jointly at a meeting of the Linnean Society of London where their paper was read on 1 June 1858. The theory achieved world renown following the publication of Darwin's book *On the Origin of Species* in 1859.



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