

How did life on Earth begin and evolve?

The many different species of living things on Earth (and many species that are now extinct) evolved from very simple living things.

Life on Earth began about 3500 million years ago.

Evidence for evolution is provided by fossils and from analysis of similarities and differences in DNA of organisms.

The first living things developed from molecules that could copy themselves.

These molecules were produced by the conditions on Earth at that time, or may have come from elsewhere.

Evolution happens due to natural selection.

The process of natural selection involves variation, competition, increased chance of survival and reproduction, and increased number of individuals with certain characteristics in later generations.

Both environment and genes cause variation, but only genetic variation can be passed on.

The difference between natural selection and selective breeding is that people have carried out selective breeding with the aim of improving a species.

Changes can occur in genes, they are called mutations.

Mutated genes in sex cells can be passed on to offspring and may occasionally produce new characteristics.

The combined effect of mutations, environmental changes and natural selection can produce new species.

If the conditions on Earth had, at any stage, been different, evolution by natural selection could have produced different results.

How have scientists developed explanations of evolution?

When you are provided with information about alternative views on the origin of life on Earth, or the evolutionary process you should be able to:

- identify statements which are data and statements which are an explanation;
- recognise data or observations that are accounted for by (or conflict with) an explanation;
- identify imagination and creativity in the development of an explanation;
- justify accepting or rejecting a proposed explanation on the grounds that it:
 - accounts for observations;
 - provides an explanation that links things previously thought to be unrelated;
- identify a scientific question for which there is not yet an agreed answer and suggest a reason why;
- suggest plausible reasons why scientists involved in a scientific event or issue disagree;
- suggest reasons for scientists' reluctance to give up an accepted explanation when new data appear to conflict with it.

How did humans evolve? How are our nervous systems organised?

The evolution of multicellular organisms has led to nervous and hormonal communication systems.

Sensor (receptor) cells detect stimuli and effector cells produce responses to stimuli.

Nervous systems are made up of nerve cells (neurons) linking receptor cells (e.g. in eyes, ears and skin) to effector cells (in muscles/glands).

In humans and other vertebrates the nervous system is coordinated by a central nervous system (spinal cord and brain).

Nervous systems use electrical impulses for fast, short-lived responses.

Hormones are chemicals that travel in the blood and bring about slower, longer-lasting responses.

You must know two examples, in humans, of nervous and of hormonal communication.

Nervous and hormonal communication systems are involved in maintaining a constant internal environment. This is called homeostasis.

The evolution of a larger brain gave some early humans a better chance of survival.

Human evolution involves a common ancestor, divergence of hominid species and extinction of all but one of these species.

When provided with additional information about human evolution you should be able to:

- draw valid conclusions about the implications of given data for a given theory;
- recognise that an observation that agrees with a prediction increases confidence in the explanation that was used to make the prediction, but does not prove it is correct.

An observation that disagrees with a prediction indicates that either the observation or the prediction is wrong, and that this may decrease our confidence in the explanation.

Why do some species become extinct, and does it matter? What is the importance of biodiversity?

Living organisms are dependent on the environment and other species for their survival.

There is competition for resources between different species of animals or plants in the same habitat.

Changes affecting one species in a food web affect other species that are part of the same food web.

A rapid change in the environment may cause a species to become extinct, for example, if:

- the environmental conditions change;
- a new species that is a competitor, predator or disease organism of that species is introduced;
- another organism in its food web becomes extinct.

Species have become extinct (or are in danger of becoming extinct) and this is likely to be due to human activity.

You must know two examples of modern extinctions caused by direct human activity, and two caused by indirect human activity.

Maintaining biodiversity is an important part of using the environment in a sustainable way.

Biodiversity may be important for the future development of food crops and medicines.