Evolution

Evolution occurs when heritable characteristics of a species change.

Evolution is a change in the heritable characteristics of a species over time. As heritable characteristics are encoded for by **genes**, and may be transferred between generations as **alleles**, biological evolution is a change in the allele frequency in a population's gene pool over successive generations.

Selective Breeding

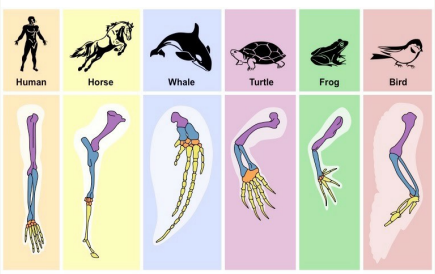
Selective breeding of domesticated animals shows that artificial selection can cause evolution

Selective breeding is a form of **artificial selection**, whereby man intervenes in the breeding of a species to produce desired traits in the offspring. It provides evidence for evolution as targeted breeds can show significant variation over a (relatively) short period of time.

Selective breeding of plant crops has allowed fro the generation of new types of foods from the same ancestral plant source. Examples include the plants of genus *Brassica*, which have produced broccoli, cabbage, kale, etc.

Selective breeding of domesticated animals has also resulted in the generation of diverse breeds of offspring. Examples include dogs, horses and cows.

Pentadactyl limp structures in different animals



Speciation

Continuous variation across a geographical range of related populations matches the concept of gradual divergence.

Within a population of any given species, there will be genetic variation that is typically continuous and follows a normal distribution curve. This is because the rate of change is gradual and cumulative.

If two populations of species become reproductively isolated, they will experience different ecological conditions and adapt to the different environmental conditions around them, gradually diverging from one another.

The degree of divergence between two species will depend on the time since the isolation has occurred. Populations the separated recently will have less variation than those who separated for a longer period of time.

Populations of a species can gradually diverge into separate species via evolution

The degree of divergence between reproductively isolated population will gradually increase the longer they are separated. As the genetic divergence between these species increases, their genetic compatibility decreases, eventually resulting in them being unable to interbreed.

Fossil Record

The fossil record provides evidence for evolution

A fossil is the preserved remains or traces of any organism from the remote past. The **fossil record** is the totality of all fossils, both discovered and undiscovered.

Fossils can be dated by determining the age of the strata they are found in, as sedimentary rock develops in a chronological order. The chronological sequence of complexity by which characteristics appear to develop is known as the **law of fossil selection**.

The fossil record is incomplete due to the specific set of circumstances required for an organism to be preserved, as well as the fact that only the hard parts of organisms are preserved. **Transitional fossils** demonstrate the intermediary forms that occurred over the evolutionary pathway taken by a single genus.

Comparative anatomy

Evolution of homologous structures by adaptive radiation explains similarities in structure when there are differences in function

Comparative anatomy of groups of organisms may show certain structural features that are similar, implying common ancestry. Anatomical features that are similar in basic structure despite being used in different ways are called homologous structures. Homologous structures show adaptive radiation, as several species diversify to utilise a specific unoccupied niche.

Comparison of the pentadactyl limb of mammals, birds, amphibians and reptiles with different modes of locomotion

A classical example of homologous structures is the pentadactyl limb in a variety of different animals. Mammals, birds, amphibians and reptiles all share a similar arrangement of bones in their appendages based on a five-digit limb

Industrial Melanism

Peppered moths *Biston betularia* exist in two distinct polymorphic forms, a light colouration and a darker melanic variant.

In an unpolluted environment, the trees are covered by a pale-coloured lichen, which provides camouflage for the lighter moths.

In a polluted environment, sulphur dioxide kills the lichen while soot blackens the bark, providing camouflage for the darker moth.

The frequency of the two different forms of peppered moth is dependant on the environment and evolves as conditions change.
- Before the industrial revolution, the environment was largely unpolluted and the lighter moth had a survival advantage
- Following the industrial revolution, the environment became heavily polluted, conferring a survival advantage to the darker moth
- Recent environmental policies in Europe are reducing pollution levels, altering the frequency of the two populations once again.

Peppered moth graph