TOPIC: STRUCTURAL EVIDENCE

Key Knowledge:

- Evidence of species relatedness: structural morphology – homologous and vestigial structures

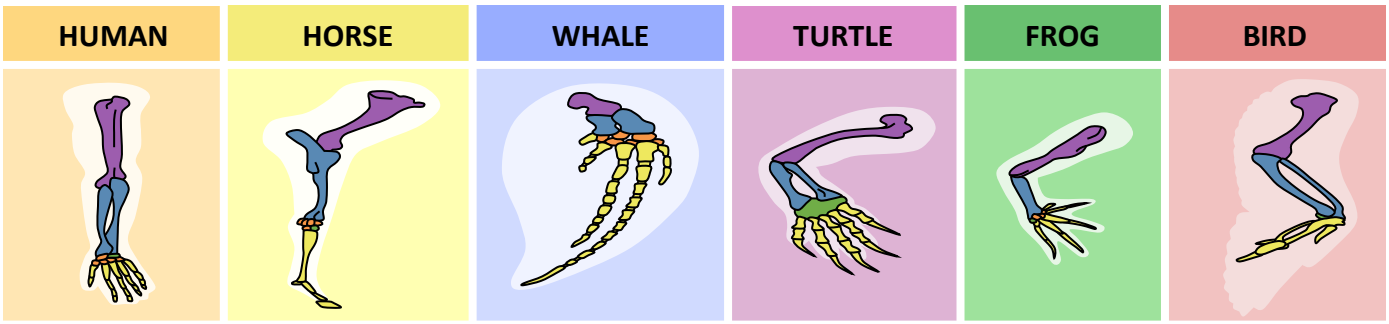
EVOLUTION EVIDENCE

Evolution is a change in the heritable characteristics of a population (or a change in the allele frequency of a gene pool). Hence, evolution can be demonstrated by identifying evidence of this change, either by:

- Showing a change in characteristics between current and ancestral species (e.g. via palaeontology)
- Identifying similarities between current species to indicate common ancestry (comparative anatomy)

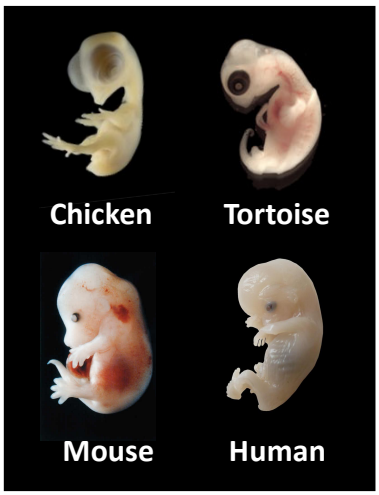
COMPARATIVE ANATOMY

Comparing the structural morphologies of groups of organisms may show similarities between structural features, implying a common ancestry. Anatomical features that are similar in basic structure despite being used in different ways are called **homologous structures**. The more similar the homologous structures are, the more closely related two species are likely to be. An example is the pentadactyl limb of vertebrates.



DEVELOPMENTAL BIOLOGY

Species that share a common ancestor will also share a similar process of biological development. These similarities in organismal development suggest that the species shared a common evolutionary pathway. When looking at the embryos of a range of animal species, it can be seen that all terrestrial animals have non-functioning gill slits (pharyngeal slits) as early embryos, suggesting aquatic origins. Additionally, some vertebrate species (including humans) demonstrate a primitive tail during the early stages of embryonic development. Some species may even retain some non-functioning remnants of structures that were once present in their ancestors – these are called **vestigial structures** (e.g. whale pelvic bone).

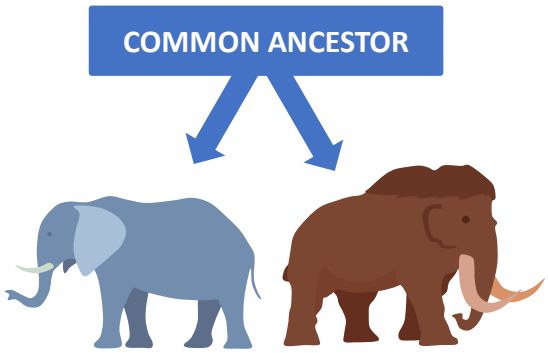


LIMITATIONS OF STRUCTURAL EVIDENCE

Structural evidence provides evidence of divergent evolution via the presence of homologous structures (commonalities in basic structure due to shared ancestry), however unrelated organisms can also show common structural characteristics (i.e. analogous structures) as a consequence of convergent evolution. Hence, structural features may be of limited value in providing evidence for evolution (molecular evidence is also required to provide a clearer picture of evolutionary relationships).

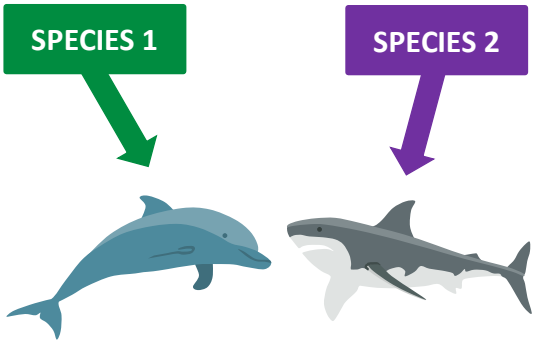
DIVERGENT EVOLUTION

Divergent evolution occurs when members of a species gradually become **more different**. Random mutations will create variation within populations, and if two disparate populations are then exposed to different environmental selection pressures (or different rates of genetic drift), the two populations will slowly begin to genetically diverge. If two species diverge to the point where they can no longer produce viable offspring, then **speciation** has occurred.



CONVERGENT EVOLUTION

Convergent evolution occurs when members of different species gradually become **more similar**. When unrelated species share a habitat and are thus exposed to common environmental selection pressures, the two populations begin to develop similar adaptations as a consequence of natural selection. While these species may look similar, they are ultimately unrelated from one another and have undertaken independent evolutionary pathways.



HOMOLOGOUS VERSUS ANALOGOUS

Divergent evolution causes common structures to appear distinctive (homologous) due to exposure to different selection pressures, whereas convergent evolution causes disparate structures to appear similar (analogous) due to exposure to a shared selection pressure.

Homologous Structures:

- Possess a **similar basic anatomy** but have evolved into distinct forms with **different functions**
- Share an evolutionary origin (**common ancestor**) from which a common underlying anatomy is derived
- Arose via divergent evolution as a consequence of being exposed to **different environmental pressures**

Analogous Structures:

- Possess **similar features and functions** but similarities are superficial (**different underlying anatomies**)
- Do **not** share a common ancestry (structures have **unrelated** evolutionary origins)
- Arose via convergent evolution as a consequence of exposure to a **shared environmental pressure**

HOMOLOGOUS STRUCTURES: DIVERGENT EVOLUTION

ANALOGOUS STRUCTURES: CONVERGENT EVOLUTION