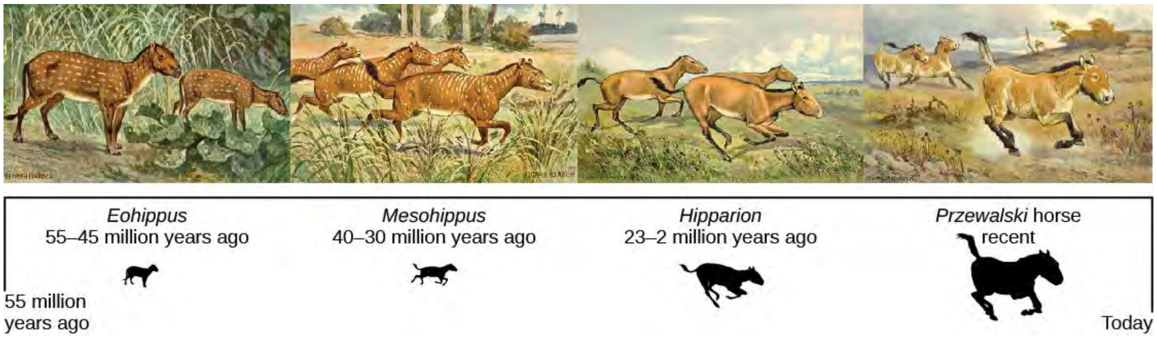

Figure 11.13 This illustration shows an artist's renderings of these species derived from fossils of the evolutionary history of the horse and its ancestors. The species depicted are only four from a very diverse lineage that contains many branches, dead ends, and adaptive radiations. (credit: Fowler et al. / [Concepts of Biology OpenStax](https://openstax.org/))

Anatomy and Embryology

Structures

Another piece of evidence that supports evolution is the presence of structures in organisms that share the same basic anatomy. For example, the bones found in the appendages of a human, dog, bird, and whale all share the same overall construction (Figure 11.14). That similarity results from a shared common ancestor. Over time, evolution led to changes in the shapes and sizes of these bones in different species. However, they have maintained the same overall layout, evidence of descent from a common ancestor. Scientists call these synonymous parts **homologous structures**. Some structures exist in organisms that have no apparent function at all and appear to be residual "leftovers" from a past ancestor. For example, some snakes have pelvic bones despite having no legs. This can be explained by understanding that snakes descended from reptiles that did have legs. These unused structures without function are called **vestigial structures**. Other examples of vestigial structures are wings on flightless birds, leaves on some cacti, traces of pelvic bones in whales, and the sightless eyes of cave animals.

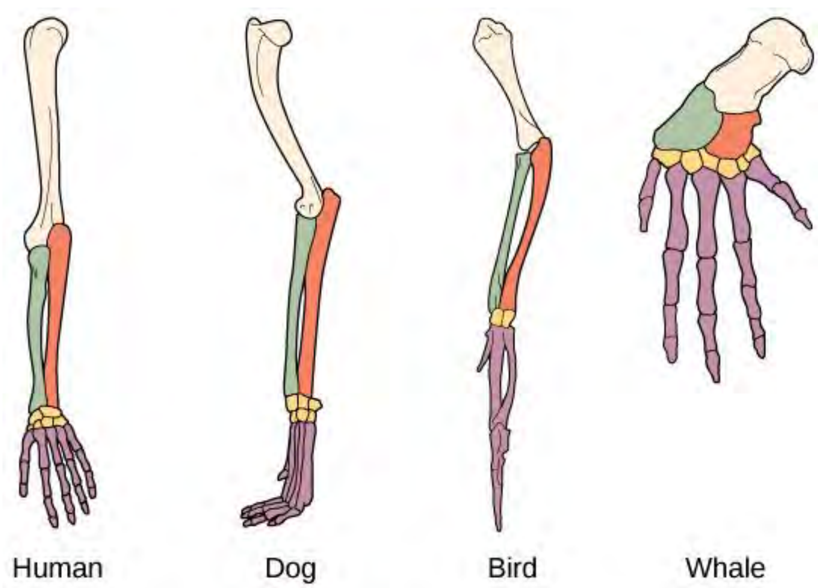

Figure 11.14 The similar construction of these appendages indicates that these organisms share a common ancestor. (credit: Fowler et al. / Concepts of Biology OpenStax)

CONCEPTS IN ACTION – Click through the activities at [this interactive site]() to guess which bone structures are homologous and which are analogous, and to see examples of all kinds of evolutionary adaptations that illustrate these concepts.

Similar environments

Another piece of evidence that supports the theory of evolution is the convergence of anatomical forms found in organisms that share similar environments. For example, unrelated animals, such as the arctic fox and ptarmigan, a type of bird, both live in arctic regions. Both have temporary white coverings during the winter to help them blend in with the snow and ice (Figure 11.15). The similarity occurs not because of common ancestry; keep in mind one has fur while the other has feathers. Rather, it is a result of similar selection pressures. They both benefit if they can blend into their environments to avoid being seen by predators.

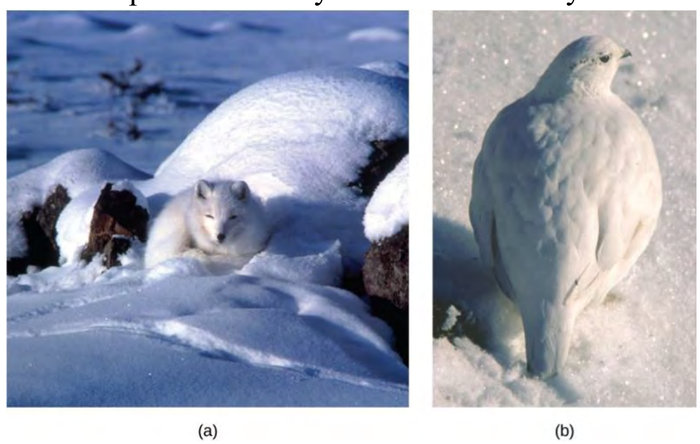

Figure 11.15 The white winter coat of (a) the arctic fox and (b) the ptarmigan's plumage are adaptations to their environments. (credit a: modification of work by Keith Morehouse / Concepts of Biology OpenStax)

Embryology

Embryology, the study an organism's development from a zygote to its adult form, also provides evidence of relatedness between divergent groups of organisms. Structures that are absent in some groups often appear in their embryonic forms and then disappear by the time the adult or juvenile form is reached. For example, all vertebrate embryos, including humans, exhibit gill slits at some point in their early development (Figure 11.16). These disappear in the adults of terrestrial groups, but are maintained in adult forms of aquatic groups, such as fish and some amphibians. Great ape embryos, including humans, have a tail structure during their development that is lost by the time of birth. The reason embryos of unrelated species are often similar is that mutational changes that affect the organism during embryonic development can cause amplified differences in the adult, even while the embryonic similarities are preserved.

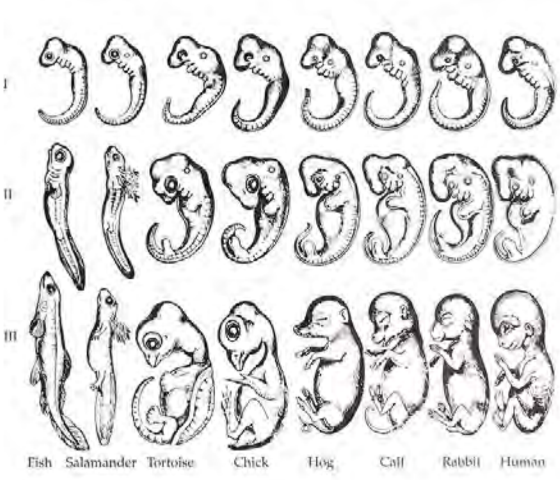

Figure 11.16 Embryo comparison. (credit: Romanes copy of Ernst Heaeckel / Public Domain)

Biogeography

The geographic distribution of organisms follows patterns that are best explained by examining evolution as it relates to the movement of tectonic plates over geological time. Broad groups that evolved before the breakup of the supercontinent Pangaea (about 200 million years ago) are distributed worldwide. Groups that evolved later, after the breakup, appear only in certain regions of the planet. For example, the unique flora and fauna of northern continents that formed from the supercontinent Laurasia and of the southern continents that formed from the supercontinent Gondwana. The presence of plants such as macadamia, a member of the family Proteaceae, in Australia, southern Africa, and South America is best explained by the plant family's presence there prior to the southern supercontinent Gondwana breaking up (Figure 11.17).

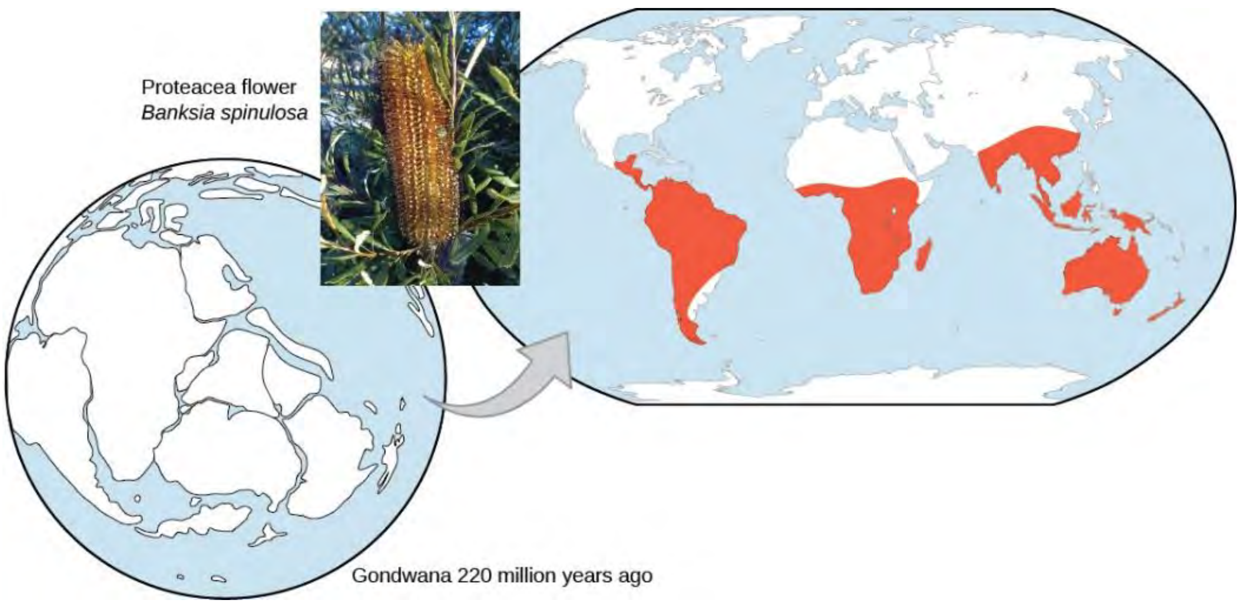

Figure 11.17 The Proteacea family of plants evolved before the supercontinent Gondwana broke up. Today, members of this plant family are found throughout the southern hemisphere (shown in red). (credit: "Proteacea flower": modification of work by "dorofofoto"/Flickr / Concepts of Biology OpenStax)

The great diversification of the marsupials in Australia and the absence of other mammals can best be explained by the fact that Australia has been isolated from other continents for many years. Australia has an abundance of endemic species, species found nowhere else, which is typical of island populations. Islands such as Australia or Hawaii are isolated by large expanses of water which prevents migration of species to other regions. Over time, these species diverge evolutionarily into new species that look very different from their ancestors. The marsupials of Australia, the finches on the Galápagos, and many species on the Hawaiian Islands are all found nowhere else yet display distant relationships to ancestral species on continental main lands.