

CHAPTER 5

EVOLUTION AND BIODIVERSITY

Summary

1. Life emerged on Earth through two phases of development. In the first phase, there was a chemical evolution of organic molecules, biopolymers, and systems of chemical reactions to form the first cells. In the second phase, biological evolution occurred from single-celled prokaryotic bacteria, to single-celled eukaryotic creatures, and then to multicellular organisms.
2. Fossils, chemical analysis, radioactive dating, ice core analysis, and DNA comparisons all help us learn about past life on Earth.
3. Evolution is the change in a population's genetic makeup over time. Evolution forces adaptations to changes in environmental conditions in a population. The diversity of life on Earth reflects the wide variety of adaptations necessary and suggests that environmental conditions have varied widely over the life of the Earth.
4. Natural selection is a process that occurs when the genetic traits of some individuals increase their chance of survival; these traits can be passed on to their progeny. In coevolution, two different species interact, and gene pool changes in one species can lead to gene pool changes in another.
5. A habitat is the physical location where a species lives, whereas an ecological niche is a species' way of life, or its functional role in a community. The ecological niche helps a population survive by the adaptive traits that its organisms have acquired. Specialist species have narrow niches and are more prone to extinction, but they have an advantage in relatively constant environmental conditions. Generalist species have broad niches and have an advantage in rapidly changing environmental conditions.
6. Speciation results in the formation of a new species through natural selection. Allopatric speciation takes place as a result of geographic isolation, followed by reproductive isolation. Sympatric speciation occurs when two populations can no longer interbreed due to a mutation or behavioural change.
7. The extinction of species and the formation of new species constantly change the biodiversity of the Earth. Background extinctions occur at a low rate as environmental conditions change, whereas mass extinctions are widespread and affect large groups of existing species. Biologists estimate that humans have increased background extinction rates by 100 to 1000 times in the 20th century.
8. In artificial selection, desirable genetic traits are selected and plants or animals are crossbred, resulting in increased numbers of breeds, increased crop yields, milk production, and tree growth rates. This process is slow, and only traits from closely related species can be combined. Genetic engineering is faster than crossbreeding, costs less, and traits from different types of organisms can be combined. Evolution will continue to influence our environment, but the use of artificial selection and genetic engineering to evolve species may have unintended consequences that are unpredictable.
9. Humans—having complex brains and strong opposable thumbs—have had a profound influence on their environment.