

Chapter 22: Descent with Modification: A Darwinian View of Life

9. Give two examples of adaptations.

Adaptations such as a butterfly's wing or a shark's teeth are inherited characteristics of organisms that enhance their survival and reproduction in specific environments.

10. Explain the process of natural selection.

Natural selection is a process in which individuals that have certain inherited traits tend to survive and reproduce at higher rates than other individuals because they possess these traits.

11. Summarize Darwin's observations that drive changes in species over time.

Observation	Example
variations in traits exist	ladybird beetles vary in color and spot pattern
these variations are heritable	flowers can pass on petal color to their offspring
species overproduce	a single puffball fungus can produce billions of offspring
competition for resources; not all offspring survive	not all sea turtle offspring survive to adulthood

12. Which two inferences did Darwin make from these four observations?

Firstly, Darwin inferred that individuals whose inherited traits give them a higher probability of surviving and reproducing in a given environment tend to leave more offspring than other individuals. Secondly, this unequal ability of individuals to survive and reproduce will lead to the accumulation of favorable traits in the population over generations.

13. What can differential reproductive success lead to over time?

Over time, this process will increase the frequency of individuals with favorable adaptations and hence refine the match between organisms and their environment, which may give rise to new species.

14. Explain the reasoning behind the phrase "survival of the fittest".

Individuals do not evolve. Populations evolve.

15. Explain how research on soapberry bugs demonstrates observable evolutionary change.

Researchers have studied beak length evolution in soapberry bug populations that feed on plants introduced to Louisiana, Oklahoma, and Australia. In each of these locations, the fruit of the introduced plants is larger than the fruit of the native plant. Thus, in populations feeding on introduced species in these regions, data collected in field studies suggested that natural selection had resulted in the evolution of longer beak length.

17. Explain the evolution of drug resistance to methicillin.

Methicillin works by deactivating a protein that bacteria use to synthesize their cell walls. However, *S. aureus* populations exhibited variations in how strongly their members were affected by the drug. In particular, some individuals were able to synthesize their cell walls using a different protein that was not affected by methicillin. These individuals survived the methicillin treatments and reproduced at higher rates than did other individuals. Over time, these resistant individuals became increasingly common, leading to the spread of MRSA (methicillin-resistant *Staphylococcus aureus*).

18. Do antibiotics cause bacteria to become resistant? Explain.

Drugs do not create resistant pathogens; rather, they select for resistant individuals present in bacteria populations.

19. Make a list of four evidences for evolution.

1. evolution can be observed directly, such as the evolution of resistant strains of bacteria
2. homology: similarity resulting from common ancestry, forming a nested pattern
3. fossil record: documents pattern of evolution
4. biogeography: geographic distribution of species

20. How does the fossil record give evidence for evolution?

The fossil record shows that past organisms differed from present-day organisms and that many species have become extinct. Fossils also show the evolutionary changes that have occurred in various groups of organisms.

21. What is meant by each of the following terms?

Term	Example
homologous structures	human and canine forelimbs
vestigial structures	human appendix; pelvic bone remnants in snakes
analogous structures	insect wings and bat wings

22. How do homologous structures give evidence for evolution?

Homologous structures represent variations on a structural theme that was present in a common ancestor, since such striking anatomical resemblances would be highly unlikely if these structures had arisen anew in each species. Vestigial structures are remnants of features that served a function in the organism's ancestors, and early stages of development in different animal species reveals additional anatomical homologies not visible in adult organisms. All forms of life use the same genetic language, and the genetic code is essentially universal. Organisms as dissimilar as humans and bacteria share genes inherited from a very distant common ancestor. Inactive "pseudogenes" may be present simply because a common ancestor had them.

23. What is summarized in an evolutionary tree?

Homologous characteristics form a nested pattern: All life shares the deepest layer, and each successive smaller group adds its own homologies to those it shares with larger groups. This pattern of descent can be represented in an evolutionary tree, a diagram that reflects evolutionary relationships among groups of organisms.

24. What is indicated by each branch point of the evolutionary tree?

Each branch point represents the common ancestor of the lineages beginning there and to the right of it.

25. What is indicated by the hatch marks?

A hatch mark represents a homologous characteristic shared by all the groups to the right of the mark.

26. Are crocodiles more closely related to lizards or to birds?

Crocodiles are more closely related to lizards than birds, since crocodiles, lizards, and birds are all tetrapods and amniotes, but neither lizards nor crocodiles are birds.

28. Explain convergent evolution, and describe how analogous structures can arise.

Convergent evolution is the independent evolution of similar features in different lineages. Two organisms may adapt to similar environments in similar ways, despite having evolved independently from different ancestors.

29. Can you give two examples of convergent evolution?

Flying squirrels and birds both fly using wing-like structures, but these adaptations are only superficially similar. Comparably, sharks (fish) and dolphins (mammals) both have fins.

30. How is biogeography affected by continental drift and the presence of endemic species?

Continental drift is the slow movement of Earth's continents over time. Islands generally have many species of plants and animals that are endemic, which means they are found nowhere else in the world. Most island species are closely related to species from the nearest mainland or a neighboring island.