

AP Biology
Evolution Unit Objectives

Chapter 22

The Historical Context for Evolutionary Theory

1. State the two major points that Charles Darwin made in *The Origin of Species* concerning Earth's biota.
2. Compare and contrast Plato's philosophy of idealism and Aristotle's *scala naturae*.
3. Describe Carolus Linnaeus's contribution to Darwin's theory of evolution.
4. Describe Georges Cuvier's contribution to paleontology.
5. Explain how Cuvier and his followers used the concept of catastrophism to oppose the theory of evolution.
6. Explain how the principle of gradualism and Charles Lyell's theory of uniformitarianism influenced Darwin's ideas about evolution.
7. Describe Jean Baptiste Lamarck's model for how adaptations evolve. Explain the challenges to Lamarck's ideas with respect to current understandings of biology.

The Darwinian Revolution

8. Describe how Darwin used his observations from the voyage of the HMS *Beagle* to formulate and support his theory of evolution.
9. Describe how Lyell and Alfred Russel Wallace influenced Darwin.
10. Explain what Darwin meant by "descent with modification."
11. Explain what evidence convinced Darwin that species change over time.
12. Describe the three inferences Darwin made from his observations that led him to propose natural selection as a mechanism for evolutionary change.
13. Explain how an essay by the Rev. Thomas Malthus influenced Charles Darwin.
14. Distinguish between artificial selection and natural selection.
15. Explain why the population is the smallest unit that can evolve.
16. Using some contemporary examples, explain how natural selection results in evolutionary change.

Other Evidence of Evolution

17. Describe the research that suggested to David Reznick and John Endler that the life-history traits among guppy populations are correlated with the main type of predator in a stream pool.
18. Explain how homologous structures support Darwin's theory of natural selection. Explain how biogeography and the fossil record support the evolutionary deductions based on homologies.

What Is Theoretical about the Darwinian View of Life?

19. Explain the problem with the statement that Darwinism is "just a theory." Distinguish between the scientific and colloquial use of the word "theory."

Chapter 24

What Is a Species?

1. Distinguish between anagenesis and cladogenesis.
2. Define biological species according to Ernst Mayr.
3. Distinguish between prezygotic and postzygotic isolating mechanisms.
4. Describe five prezygotic isolating mechanisms and give an example of each.
5. Explain why many hybrids are sterile.
6. Explain how hybrid breakdown maintains separate species even if gene flow occurs.
7. Describe some limitations of the biological species concept.
8. Define and distinguish among each of the following: ecological species concept, pluralistic species concept, morphological species concept, and genealogical species concept.

Modes of Speciation

9. Distinguish between allopatric and sympatric speciation.
10. Explain the allopatric speciation model and describe the role of intraspecific variation and geographic isolation.
11. Define a ring species and describe an example found in salamanders.
12. Describe examples of adaptive radiation in the Galapagos and Hawaiian archipelagos.
13. Explain how reproductive barriers evolve. Describe an example of the evolution of a prezygotic barrier and the evolution of a postzygotic barrier.
14. Define sympatric speciation and explain how polyploidy can cause reproductive isolation.
15. Distinguish between an autopolyploid and an allopolyploid species and describe examples of each.
16. Describe an example of sympatric speciation in fish.

17. List some points of agreement and disagreement between the two schools of thought about the tempo of speciation (gradualism versus punctuated equilibrium).

From Speciation to Macroevolution

18. Explain why speciation is at the boundary between microevolution and macroevolution.

19. Define exaptation and illustrate this concept with an example.

20. Explain how the evolution of changes in temporal and spatial developmental dynamics can result in evolutionary novelties. Define evo-devo, allometric growth, heterochrony, and paedomorphosis.

21. Explain why extracting a single evolutionary progression from a fossil record can be misleading.

22. Define and illustrate the concept of species selection. Explain why evolutionary trends are not directional.

Chapter 25

The Fossil Record and Geologic Time

1. Distinguish between phylogeny and systematics.

2. Describe the process of sedimentation and the formation of fossils. Explain what portions of organisms mostly fossilize and why.

3. Distinguish between relative dating and absolute dating.

4. Explain how isotopes can be used in absolute dating.

5. Explain why the fossil record is incomplete.

6. Describe two dramatic chapters in the history of continental drift. Explain how those movements affected biological evolution.

7. Explain how mass extinctions have occurred and how they affected the evolution of surviving forms.

8. Describe the evidence related to the impact hypothesis associated with the Cretaceous extinctions. Describe the hypothesized consequences of such an impact.

Systematics: Connecting Classification to Phylogeny

9. Distinguish between systematics and taxonomy.

10. Explain how species are named and categorized into a hierarchy of groups.

11. List the major taxonomic categories from the most to least inclusive.
12. Define the parts and describe the interrelationships within a cladogram. Explain how a cladogram is constructed.
13. Distinguish between homologous and analogous structures. Explain why the similarity of complex systems implies a more recent common ancestor.
14. Distinguish between shared primitive characters and shared derived characters. Compare the definitions of an ingroup and outgroup.
15. Compare the cladistic and phylocode classification systems.
16. Explain how nucleotide sequences and amino acid sequences can be used to help classify organisms. Explain the advantages that molecular methods have over other forms of classification.
17. Explain the principle of parsimony. Explain why any phylogenetic diagram is viewed as a hypothesis.
18. Explain how molecular clocks are used to determine the approximate time of key evolutionary events. Explain how molecular clocks are calibrated in actual time.
19. Explain how scientists determined the approximate time when HIV first infected humans.
20. Describe an example of a conflict between molecular data and other evidence, such as the fossil record. Explain how these differences can be addressed.

Chapter 26

Introduction to the History of Life

1. Explain how the histories of Earth and life are inseparable.
2. Describe the major events in Earth's history from its origin up to about 2 billion years ago. In particular, note when Earth first formed, when life first evolved, and what forms of life existed up until about 2 billion years ago.
3. Describe the timing and significance of the evolution of photosynthesis.
4. Describe the timing of key events in the evolution of the first eukaryotes and later multicellular eukaryotes. Describe the snowball-Earth hypothesis.
5. Describe the timing of key evolutionary adaptations as life colonized land.

The Origin of Life

6. Contrast the concept of spontaneous generation and the principle of biogenesis. Describe the biogenesis paradox and suggest a solution.
7. Describe the four stages of the hypothesis for the origin of life on Earth.
8. Describe the contributions that A. I. Oparin, J. B. S. Haldane, and Stanley Miller made toward developing a model for the abiotic synthesis of organic molecules. Describe the conditions and locations where most of these early organic reactions probably occurred on Earth.
9. Describe the evidence that suggests that RNA was the first genetic material. Explain the significance of the discovery of ribozymes.
10. Describe how natural selection would have worked in an early RNA world.
11. Describe the key properties of protobionts in the evolution of the first cells.
12. Describe the evidence that suggests that life first evolved on the sea floor near deep-sea vents.

The Major Lineages of Life

13. Describe the basis for R. H. Whittaker's five-kingdom system.
14. List, distinguish among, and describe examples from each of the five kingdoms.
15. Compare the three-domain system and R. H. Whittaker's five-kingdom system of classification.