Summary of Expectations

Briefly explain each of the following points.

- Variety within a population and the environment in which organisms live allow natural selection to happen. (10.1)
- Genetics and environment can affect evolution. (10.1)
- The ideas and observations of many people helped develop the current theory of evolution. (10.1)
- Natural selection is the process whereby a population of organisms changes because individuals who inherit certain traits can survive the local environmental conditions and pass on these traits to their offspring. (10.1)
- Artificial selection is the process whereby humans artificially select organisms with certain traits and these organisms pass on these traits to their offspring. (10.1)
- Observations of Charles Darwin led him to develop a theory of evolution. (10.2)
- Contributions of Cuvier, Lamarck, Malthus, Hutton, Lyell, and Wallace helped develop the theory of evolution. (10.2)
- Darwin's theory of evolution by natural selection is compared with Lamarck's theory of evolution by the inheritance of acquired characteristics. (10.2)
- Technology, such as DNA sequencing and amino acid sequencing, has provided more evidence for evolution. (10.3)
- Fossils, biogeography, anatomy, and molecular biology all provide evidence for evolution. (10.3)
- A scientific fact is data or information that have been collected, and a theory attempts to explain facts. (10.3)

Language of Biology

Write a sentence including each of the following words or terms. Use any six terms in a concept map to show your understanding of how they are related.

- evolution
- adaptation
- gene pool
- natural selection
- selective pressure
- artificial selection
- fitness
- paleontology
- catastrophism
- inheritance of acquired characteristics
- gradualism
- uniformitarianism
- biotic potential
- descent with modification
- fossil record
- transitional fossil
- biogeography
- endemic
- homologous structures
- analogous structures
- vestigial structure
- embryology
- cytochrome c
- phylogenetic tree

UNDERSTANDING CONCEPTS

1. If you teach children to look both ways before they cross the street, this action will help them survive. Is this an example of natural selection at work? Explain your answer.
2. Compare the controlling factors for artificial selection and natural selection.
3. How might the colour of a field mouse affect its survival?
4. Some caves contain fish that are blind. These fish have eye sockets and vestigial eyes. Explain how (a) Lamarck and (b) Darwin would account for the origin of sightlessness in these fish and other blind cave-dwellers.
5. How do vestigial structures provide evidence for evolution?
6. Summarize the main points of Darwin's theory of evolution by natural selection.
7. Explain, in the context of evolution and natural selection, common misunderstandings and misinterpretations about the following words: (a) evolution; (b) fitness; (c) theory.
8. Although Lamarck and Darwin explained evolution in different ways, their theories had some similarities. Describe these similarities.
9. Does evolution mean that organisms are becoming progressively better with each generation? Explain your answer.
10. Are a bird wing and an insect wing homologous structures? Explain your answer.
11. How does the study of embryology support evolution?
12. Why is it more accurate to speak of the evolution of populations rather than of individual organisms?
13. Explain why DNA is a useful tool for determining possible relationships among species of organisms. Give an example.

14. Distinguish between fact and theory.

15. Describe how the following items contributed to Darwin's thinking on evolution:

(a) his experiences on the voyage of the *Beagle*;

(b) Lyell's *Principles of Geology*;

(c) the experience of plant and animal breeders; and

(d) Malthus's essay on population.

16. Much of the theory of evolution has been developed by interpreting certain observations or making inferences about these observations. For each observation below, outline the inferences that Darwin, other scientists, and other naturalists made from this information.

(a) Populations tend to remain stable in size.

(b) No two individuals are exactly alike.

(c) Resources such as food are limited.

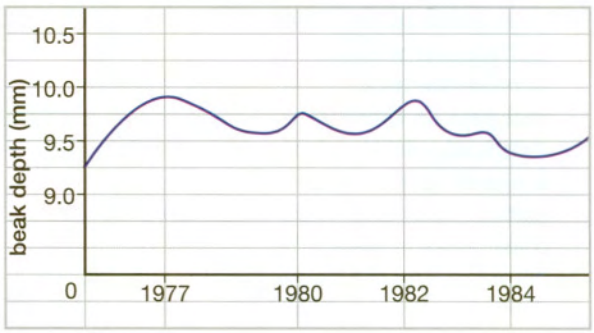
INQUIRY

17. Outline a breeding program that would help you develop a cow that produces more milk. Is your cow a new species? Explain your answer.

18. Design an experiment that would demonstrate variation within a population.

19. Examine the fossils found in the sedimentary rocks shown below. The rocks are older as you go deeper into the rock strata. Explain what these rock strata and the fossils within them can tell you about evolution.

20. You are analyzing the amino acids in the hemoglobin of various species. You find that this protein in rhesus monkeys differs by about eight amino acids from the protein in humans. The difference in this protein between mice and humans is about 26 amino acids, and the difference between lampreys (a primitive fish) and humans is about 125 amino acids. Interpret these data and explain how they relate to our understanding of evolution.



21. This graph shows how the average beak size (depth) in a population of ground finch shifted during particularly wet and dry years. 1977, 1980, and 1982 were all drought years; 1984 was a wet year.

(a) Interpret these data and explain how they relate to natural selection and the definition of evolution.

(b) An observer suggested that during drought years all the seeds were large and tough to open. This meant that birds exercised their beaks more, making the beaks stronger. Is this a plausible explanation for these data? Explain your answer.

22. Lamarck's idea of inheritance of acquired characteristics has recently gained support by some scientists. Search the Internet for information on renewed interest in Lamarck's idea as it relates to the immune system. The new ideas suggest that in some instances, characteristics acquired during one's lifetime may be passed on to offspring. Summarize these ideas.

COMMUNICATING

23. Red Island and Blue Island are hypothetical islands 500 km off the coast of South America. Red Island is volcanic in origin and is only five million years old. Blue Island separated from South America over 80 million years ago. Describe the origin of the animals on these islands and how they may be similar to or different from those of South America.

24. Create a time line showing the various individuals whose contributions eventually led to the development of the theory of evolution by natural selection. State their contributions.

25. Richard Dawkins, a popular writer and evolutionary biologist, refers to natural selection as the "blind watchmaker," meaning that natural selection is totally blind to the future. Explain what Dawkins means by this statement.

26. Explain how the examination of proteins can demonstrate relatedness among species.

27. A population of fish in which 95 percent of individuals are light-green and 5 percent are mottled grey lives primarily among kelp that grows on the ocean bottom. A disease kills the kelp, leaving the population without cover. Use a diagram or objects (such as poker chips) to describe how the population might change over several generations.

28. You are a biologist working with a student to make a collection of plants found in Hawaii. You notice that your assistant did not label the island that one of the plants was collected on. When asked, he explained that he did not think this was necessary as this particular plant was found on all of the Hawaiian islands. Write a memo clearly explaining why it is necessary to label the exact island and location where the plant was found.

MAKING CONNECTIONS

29. A tan-coloured insect lives in a sandy area. Some insects in the population show some green in their coloration. The climate begins to cool and become moister; slowly the habitat is covered by green plants. Use Darwin's theory of evolution by natural selection to explain how the insect population might evolve to be green. Use a diagram.

30. Darwin recognized that variation occurred within populations and that these variations could be inherited. He could see the results but could not explain the mechanism. Explain the advances in science and technology that would eventually make Darwin's theory of evolution even more convincing and would help fill in this missing piece of the puzzle.

31. Given your understanding of diversity within species and natural selection, explain why it is important to maintain biodiversity.

32. Two populations of flowers of the same species are found in nearby meadows. There are slight differences in the plants between the two populations, such as flower colour and leaf shape. How might Darwin have interpreted these facts?

33. A farmer sprays an insecticide on a field to combat a beetle that is destroying the crops. The spray works very well the first year it is used. However, after five years of spraying on an annual basis, the insecticide does not seem to be effective any longer and the beetles are still present. Explain how this illustrates natural selection.

34. Analyze the following data. The proteins present in four organisms are shown below. (Each letter represents a protein.) Determine which of the organisms are closely related. Explain your answer.

Organism 1	A, G, T, C, L, E, S, H
Organism 2	A, G, T, C, L, D, H
Organism 3	A, G, T, C, L, D, P, U, S, R, I, V
Organism 4	A, G, T, C, L, D, U

35. Evolutionary biologist Stephen Jay Gould said "Local environments change constantly. They get colder or hotter, wetter or drier, more grassy or more forested. Evolution by natural selection is no more than a tracking of these environments by differential preservation of organisms better designed to live in them: hair on a mammoth is not progressive in any cosmic sense." Explain what is meant by this statement.

36. Recommend ways that would help ensure that non-native plants and animals would not be accidentally brought to islands such as the Galápagos Islands or the Hawaiian Islands. What can be done once non-native plants and animals invade these types of islands?