

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

- 22.1 *Compare Darwin's concept of descent with modification to the prevailing ideas of his time.*
- 22.2 *Explain how, over time, natural selection results in organisms' adaptation to their environment.*
- 22.3 *Use examples to show how evolution is supported by scientific evidence.*

As you study this chapter, read several paragraphs at a time to catch the flow of ideas and understand the reasoning described. In some places, the text describes a narrative or story regarding the events that led to Darwin's theory of evolution. Therefore, first read the narrative to absorb the big picture and then return to answer the questions that accompany this material.

Study Tip: Can you find the Malaysian orchid mantis in the opening figure? Can you guess what a dead-leaf mantis looks like? Explain how the phrase *descent with modification* helps explain similarities and differences among species.

Concept 22.1 *The Darwinian revolution challenged traditional views of a young Earth inhabited by unchanging species*

LO 22.1: *Compare Darwin's concept of descent with modification to the prevailing ideas of his time.*

1. Darwin set out to explain three key observations about life. What are those three observations?
2. Define evolution broadly, and then give a more specific definition that came about after the field of genetics was better understood.
3. Take a second to think about evolution as both a *pattern* and a *process*.
 - a. What is the *pattern* of evolution?
 - b. What is the *process* of evolution?
4. How did each of the following sources view the origin of species?

Aristotle and Scala Naturae

The Old Testament

Carolus Linnaeus

5. Explain the role of *fossils* in *rock strata* as a window to life in earlier times.
6. How would Georges Cuvier have explained the appearance of the record of life shown in the rock strata?
7. James Hutton and Charles Lyell were geologists whose ideas strongly influenced Darwin's thinking. What were the ideas each of them contributed?

James Hutton

Charles Lyell

8. Lyell and Hutton gave Darwin "the gift of time." How would time play an important role in Darwin's development of a theory of evolution?
9. *Jean-Baptiste de Lamarck* proposed a mechanism for how life changes over time. Explain the two principles of his mechanism.

use and disuse

inheritance of acquired characteristics

10. Although Lamarck's mechanism of evolution does not explain the changes in species over time, his thinking has been influential. What is the importance of his ideas?

Concept 22.2 *Descent with modification by natural selection explains the adaptations of organisms and the unity and diversity of life*

LO 22.2: *Explain how, over time, natural selection results in organisms' adaptation to their environment.*

11. What role did Darwin's voyage on the HMS *Beagle* play in his thinking about life on Earth?

12. Why are the Galápagos Islands often cited as being critical to Darwin's development of the idea of *descent with modification*?
13. Charles Darwin proposed that the mechanism of evolution is *natural selection* and that it explains how *adaptations* arise. What are *adaptations*? Give two examples of them.
14. Explain the process of *natural selection*.
15. Use Figure 22.8 in your text to explain the role of extinctions in understanding current life on Earth.

Scientists estimate that _____ of all species that have ever lived are now extinct.

16. Let's try to summarize Darwin's observations that drive changes in species over time:

Observation	Cite an Example
1. Variations in traits exist.	
2. These variations (traits) are heritable.	
3. Species overproduce.	
4. There is competition for resources; not all offspring survive.	

17. From these four observations, what two inferences did Darwin make?

Inference #1

Inference #2

18. It is important to remember that differences in heritable traits can lead to *differential reproductive success*. This means that the individuals who have the necessary traits to promote survival in the current environment will leave the most offspring. How does *differential reproductive success* affect the match between organisms and their environment?
19. What are three key features of natural selection?
20. To demonstrate your understanding of this section, complete the following sentences:

_____ do not evolve. _____ evolve.

Study Tip: Take out your highlighter and mark the information in the previous box. Hold these ideas firmly in your brain! If you are ever asked to explain Darwin's theory of evolution by natural selection, do *not* pull out the phrase "survival of the fittest." Instead, cite the points made in question 16 and explain the inferences that are drawn from them.

Concept 22.3 *Evolution is supported by an overwhelming amount of scientific evidence*

LO 22.3: *Use examples to show how evolution is supported by scientific evidence.*

21. Use Inquiry Figure 22.13 in your text to explain how research with soapberry bugs demonstrated observable evolutionary change.

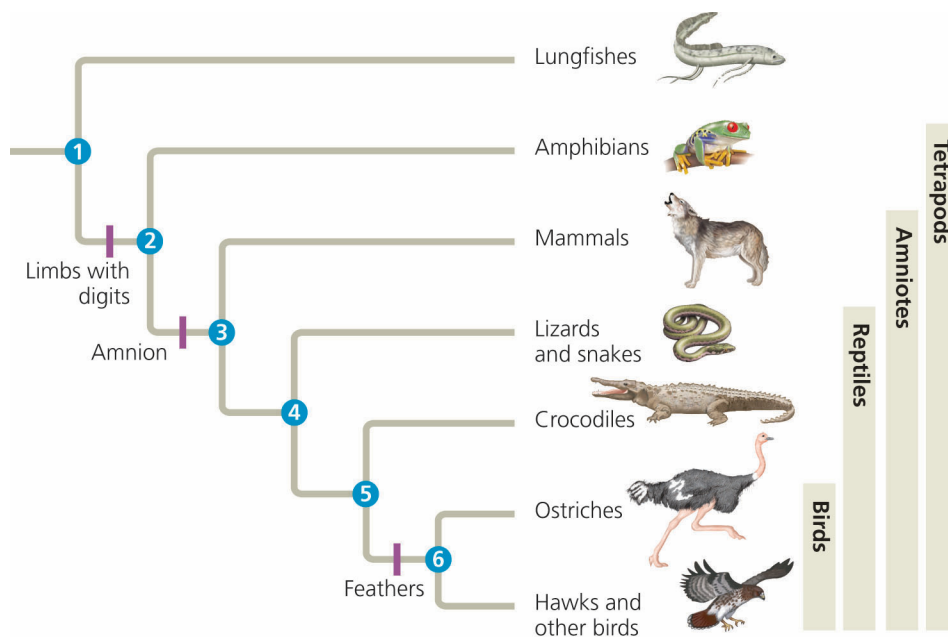
Describe what each graph shows, and the method used to determine mean beak length prior to introduction of a new food source.

What evidence was given to indicate that natural selection can occur very rapidly?

22. Antibiotic resistance has become a serious medical concern and is an example of evolution in bacteria. Your text explores this problem with a look at antibiotic resistance in MRSA. What do the initials MRSA mean?
23. How did MRSA become so dangerous? Explain the evolution of MRSA's resistance to methicillin.
24. *S. aureus* and soapberry bugs provide examples that highlight three key points about natural selection. Explain the three key ideas.
25. Do antibiotics *cause* bacteria to become resistant? Explain your response.
26. What is meant by each of the following? Give an explanation and example of each.

Term	Explanation/Example
Homologous structures (Fig. 22.15)	
Vestigial structures	

27. Figure 22.17 shows an evolutionary tree. Mark each branch point in the following figure. What is indicated by each branch point? What is indicated by the hatch marks?



28. What number represents the common ancestor of mammals and birds? _____ Why are mammals more closely related to birds than to amphibians?
29. Use the tree in question 27 to answer this question: Are crocodiles more closely related to lizards or birds? Explain your response.
30. To develop an evolutionary tree, what are two distinct types of evidence that are used?
31. Organisms that are only distantly related can resemble each other. Explain *convergent evolution*.

32. Describe how *analogous structures* can arise and give an example.
33. *Convergent evolution* might be summarized like this: *Similar problem, similar solution*. Can you give two examples of convergent evolution?

Study Tip

Homologous structures show evidence of relatedness (whale fin, bat wing).

Analogous structures are similar solutions to similar problems but do *not* indicate close relatedness (bird wing, butterfly wing).

33. What is *biogeography*?
34. How is the concept of biogeography supported by *continental drift* and the presence of *endemic species*?
35. **Study Tip:** The primary headings of this concept list four areas of important evidence for evolution. To bring the four headings together, list the headings and give an example that supports each type of evidence.

Evidence for Evolution	Example

36. Evolution is not “just a theory.” Explain the difference between the scientific meaning of the term “theory” and the way the term is used in everyday language.

Let’s wrap up all of these ideas with a final summary.

ORGANIZE YOUR THOUGHTS

1. Evolution is a change in a species over time.
2. Heritable variations exist within a population.
3. These variations can result in differential reproductive success.
4. Over generations, this can result in changes in the genetic composition of the population.

And remember: Individuals do not evolve! *Populations* evolve.

Test Your Understanding Answers, p.485

Now you should be ready to test your knowledge. Place your answers here:

1. _____ 2. _____ 3. _____ 4. _____ 5. _____