

## Chapter 16 Study Guide

### Study Tip

Have pairs of students quiz each other on the Vocabulary terms. Suggest that students review the answers to the Key Concept questions in the Section Assessments.

### Thinking Visually

1. Genetic drift
2. Single-gene traits
3. Stabilizing selection
4. Disruptive selection

## Chapter 16 Assessment

### Reviewing Content

1. a      5. c      9. c
2. a      6. b      10. b
3. b      7. b
4. b      8. c

### Understanding Concepts

11. The relative frequency of an allele is the number of times that the allele occurs in a gene pool compared with the number of times other alleles occur. For example, there are two alleles for the gene that controls fur color in mice. If one of the alleles is present in half the members of the population, its frequency is 50 percent.

12. In sexual reproduction, alleles can recombine to produce different genotypes, resulting in different phenotypes and hence variation within a population.

13. The number of phenotypes produced for a given trait depends on how many genes control the trait.

14. A single-gene trait is a trait controlled by one gene.

15. A polygenic trait is controlled by two or more genes, and each gene often has two or more alleles. As a result, there can be many possible phenotypes, represented by a bell curve.

## Chapter 16 Study Guide

### 16-1 Genes and Variation

#### Key Concepts

- In genetic terms, evolution is any change in the relative frequency of alleles in a population.
- Biologists have discovered that there are two main sources of genetic variation: mutations and the genetic shuffling that results from sexual reproduction.
- The number of phenotypes produced for a given trait depends on how many genes control the trait.

#### Vocabulary

gene pool, p. 394  
relative frequency, p. 394  
single-gene trait, p. 395  
polygenic trait, p. 396

### 16-2 Evolution as Genetic Change

#### Key Concepts

- Natural selection on single-gene traits can lead to changes in allele frequencies and thus to evolution.
- Natural selection can affect the distributions of phenotypes in any of three ways: directional selection, stabilizing selection, or disruptive selection.
- In small populations, individuals that carry a particular allele may leave more descendants than other individuals, just by chance. Over time, a series of chance occurrences of this type can cause an allele to become common in a population.
- Five conditions are required to maintain genetic equilibrium from generation to generation: There must be random mating; the population must be very large; and there can be no movement into or out of the population, no mutations, and no natural selection.

#### Vocabulary

directional selection, p. 398  
stabilizing selection, p. 399  
disruptive selection, p. 399  
genetic drift, p. 400  
founder effect, p. 400  
Hardy-Weinberg principle, p. 401  
genetic equilibrium, p. 401

### 16-3 The Process of Speciation

#### Key Concepts

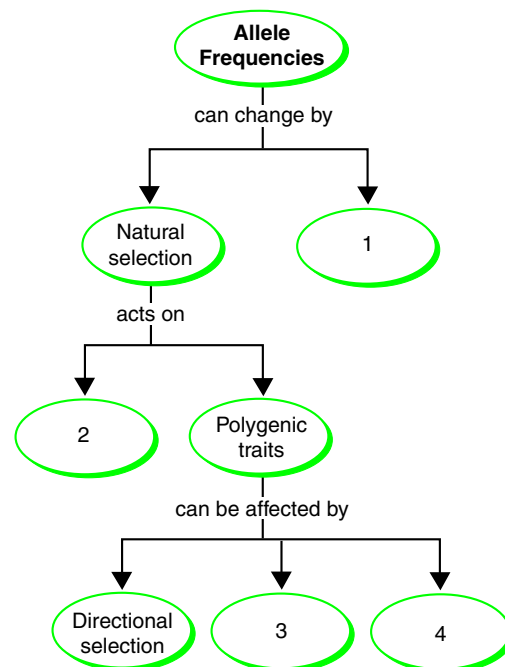
- As new species evolve, populations become reproductively isolated from each other.
- Speciation in the Galápagos finches occurred by founding of a new population, geographic isolation, changes in the new population's gene pool, reproductive isolation, and ecological competition.

#### Vocabulary

speciation, p. 404  
reproductive isolation, p. 404  
behavioral isolation, p. 404  
geographic isolation, p. 405  
temporal isolation, p. 405

### Thinking Visually

Using the information in this chapter, complete the following concept map about evolution of populations:



## CHAPTER RESOURCES

#### Print:

- **Teaching Resources**, Chapter Vocabulary Review, Graphic Organizer
- **Chapter Tests: Levels A and B**, Chapter 16 Test

#### Technology:

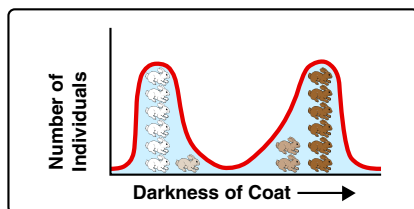
- **iText**, Chapter 16 Assessment
- **Computer Test Bank**, Chapter 16 Test

## Chapter 16 Assessment

### Reviewing Content

Choose the letter that best answers the question or completes the statement.

- The combined genetic information of all members of a particular population forms a
  - gene pool.
  - niche.
  - phenotype.
  - population.
- The success of an organism in surviving and reproducing is a measure of its
  - fitness.
  - polygenic traits.
  - speciation.
  - gene pool.
- Traits that are controlled by more than one gene, such as human height, are known as
  - single-gene traits.
  - polygenic traits.
  - recessive traits.
  - dominant traits.
- The type of selection in which individuals of average size have greater fitness than small or large individuals is called
  - disruptive selection.
  - stabilizing selection.
  - directional selection.
  - genetic drift.
- The type of selection in which individuals at one end of a curve have the highest fitness is called
  - stabilizing selection.
  - disruptive selection.
  - directional selection.
  - the founder effect.
- If coat color in a rabbit population is a polygenic trait, which process might have produced the graph below?



- stabilizing selection
  - disruptive selection
  - directional selection
  - genetic equilibrium
- A random change in a small population's allele frequency is known as
    - a gene pool.
    - genetic drift.
    - variation.
    - fitness.

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- A change in allele frequency that results from the migration of a small subgroup of a population is called
  - natural selection.
  - the Hardy-Weinberg principle.
  - the founder effect.
  - genetic equilibrium.
- A group of individuals of the same species that interbreed make up a
  - species.
  - gene pool.
  - population.
  - genetic drift.
- The evolution of Darwin's finches is an example of
  - equilibrium.
  - speciation.
  - stabilizing selection.
  - artificial selection.

### Understanding Concepts

- Explain what the term *relative frequency* means. Include an example in your answer.
- Explain why sexual reproduction is a source of genetic variation.
- Explain what determines the number of phenotypes for a given trait.
- What is meant by the term *single-gene trait*?
- Why are certain polygenic traits represented by a bell curve?
- Define evolution in genetic terms.
- How are speciation and reproductive isolation related?
- How do stabilizing selection and disruptive selection differ?
- What is genetic drift? In what kinds of situations is it likely to occur?
- What is genetic equilibrium? What conditions are required to maintain genetic equilibrium?
- Explain how isolation of groups can be involved in speciation.
- What two testable assumptions were the basis for Darwin's hypothesis about the evolution of the Galápagos finches?
- What evidence did the work of Rosemary and Peter Grant provide that strengthened Darwin's hypothesis about finch evolution in the Galápagos Islands?
- Explain how the Galápagos finches may have evolved.



If your class subscribes to the iText, your students can go online for an interactive version of the Student Edition and a self-test.

(Continued from page 412)

16. Evolution can be defined as a change in the relative frequency of alleles in the gene pool of a population.

17. Speciation occurs only when populations are reproductively isolated. Reproductively isolated populations have different gene pools and eventually form new species.

18. In stabilizing selection, individuals near the center of the curve have higher fitness than individuals at either end. In disruptive selection, individuals at both ends of the curve have higher fitness than individuals near the center.

19. Genetic drift is the random change in allele frequencies in a population. It is most likely to occur in small populations or when a small group of organisms colonizes a new habitat.

20. Genetic equilibrium occurs when the allele frequencies in a population remain constant. Five conditions are required to maintain genetic equilibrium: random mating, extremely large population size, no movement into or out of the population, no mutations, and no natural selection.

21. When two populations of a species become isolated, each group can evolve independently until they become separate species.

22. The assumptions were that there had to be enough inheritable variation to provide raw material for natural selection, and the variation, such as differences in beak size, must produce differences in fitness.

23. The Grants showed that beak size changed as a result of changes in food supply. This showed that the various Galápagos finches could have evolved from a common ancestor.

24. Students' answers should be consistent with the material on pages 408–409.



### HOMEWORK GUIDE

Section:	Questions:
Section 16–1	1–3, 11–15
Section 16–2	4–8, 16, 18–20
Section 16–3	9, 10, 17, 21–29, 30–33

## Critical Thinking

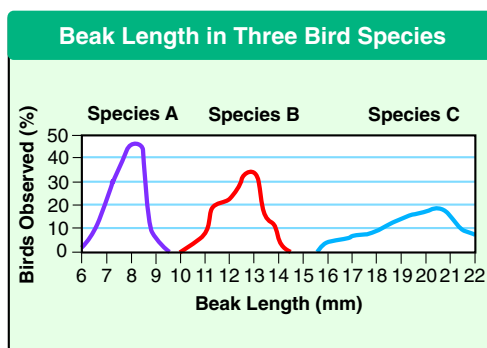
25. The shortest length of beak is 6 mm. About 2 percent of these birds have a beak this length.
26. Species A: 9.5 mm; Species B: 14.5 mm; Species C: 22 mm
27. The range is from 15.5 mm to 22 mm.
28. Species A probably eats small seeds. Species B can probably eat seeds larger than those eaten by species A. Species C can probably eat seeds that are larger than those eaten by either species A or species B.
29. The limited genetic variation in the isolated individuals might make them less able to adapt to changing conditions, and this would threaten their survival. However, by chance, they could possess genetic traits that made them especially well suited to the new environment, and this would enhance their survival.
30. The Grants tested this hypothesis by measuring the survival of birds with different sizes of beaks. Their data supported Darwin's hypothesis by showing that fitness varied with beak size.
31. It might lead to the death of the individual organism. It also might threaten the long-term survival of a species unless the species evolved the ability to use other food sources.
32. One hypothesis may be that the other violets are the result of variation arising from genetic recombination between two plant species.
33. Ecology involves the study of interactions among populations of organisms and their environment. Changes in these interactions that occur over time result in evolution.

## Writing in Science

Students' summaries should clearly and correctly explain, and also distinguish among, the three types of polygenic selection represented in the figures: stabilizing, disruptive, and directional selection.

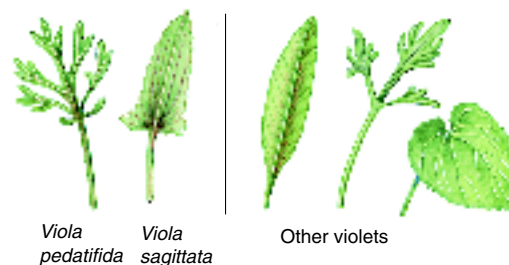
## Critical Thinking

The graph below shows data on the lengths of the beaks of three species of Darwin's finches. The percentage of individuals in each category of beak length is given. Use this information to answer questions 25–28.



25. **Interpreting Graphics** What is the shortest beak length observed in species A? About what percentage of the birds of species A have this beak length?
26. **Interpreting Graphics** What are the longest beak lengths of each of the three species?
27. **Interpreting Graphics** What is the range of beak lengths for the birds of species C?
28. **Inferring** Based on these data, what can you infer about the sizes of the seeds eaten by each of these species of birds?
29. **Applying Concepts** Suppose a rock slide isolates a very small number of animals from the rest of their population. How might this reproductive isolation impact the long-term survival of the new, smaller population? (Hint: Think of the role that genetic variation might play, both positively and negatively.)
30. **Evaluating** Darwin hypothesized that natural selection shaped the beaks of different finch populations on the Galápagos Islands. Describe how the Grants tested this hypothesis. Did their data support or refute Darwin's hypothesis? Explain.
31. **Inferring** How might a limited resource, such as food, affect the survival of an individual organism? How might a severe limitation affect the long-term survival of a species?

32. **Formulating Hypotheses** A botanist identifies two distinct species of violets growing in a field. Also in the field are several other types of violets that, although somewhat similar to the two known species, appear to be new species. Develop a hypothesis explaining how the new species may have originated.



33. **Connecting Concepts** Sometimes biologists say, "Evolution is ecology over time." Use what you learned in Unit 2 to explain that statement.

## Writing in Science

When you write a summary, you use your own words to express the main ideas of something you have read or heard. Write a summary of the ways in which natural selection operates on polygenic traits. (Hint: Use the graphs in **Figures 16–6, 16–7, and 16–8** to help identify the main ideas.)

## Performance-Based Assessment

**In Your Community** Use field guides or scientific literature to identify a species of tree, flowering plant, or insect in your neighborhood. Then investigate several examples of that species, noting the variations that you observe. Document the variations, using descriptive notes along with photographs or drawings. Describe how the variations may have contributed to the evolution of the species.

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## Performance-Based Assessment

Variations might include differences in size, shape, color, and form. In their responses, students should demonstrate an understanding of the factors that influence evolution.

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Your students can independently test their knowledge of the chapter and print out their test results for your files.