

## CHAPTER 16—POPULATION GENETICS AND SPECIATION

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### MULTIPLE CHOICE

1. Which of the following describes a population?
- dogs and cats living in Austin, Texas
  - four species of fish living in a pond
  - dogwood trees in Middletown, Connecticut
  - roses and tulips in a garden

ANS: C                      DIF: 1                      OBJ: 16-1.2

2. Variation in genotype is caused by
- mutations only.
  - recombination of genes as a result of sexual reproduction.
  - phenotypes changing more quickly than genotypes.
  - None of the above

ANS: B                      DIF: 1                      OBJ: 16-1.3

3. The number of individuals with a particular phenotype divided by the total number of individuals in the population is the
- genotype frequency.
  - phenotype frequency.
  - Hardy-Weinberg equilibrium.
  - allele frequency.

ANS: B                      DIF: 1                      OBJ: 16-1.4

4. RR : homozygous dominant ::
- Rr : heterozygous
  - rr : heterozygous recessive
  - Yy : homozygous
  - yy : heterozygous dominant

ANS: A                      DIF: 2                      OBJ: 16-1.4

5. recessive allele frequency : dominant allele frequency :: 0.02 :
- 0.01
  - 0.04
  - 0.98
  - 1.0

ANS: C                      DIF: 2                      OBJ: 16-1.4

6. Actual proportions of homozygotes and heterozygotes can differ from Hardy-Weinberg predictions because of
- the occurrence of mutations.
  - nonrandom mating among individuals.
  - genetic drift within the population.
  - All of the above

ANS: D                      DIF: 1                      OBJ: 16-1.5

7. Which of the following conditions is required for Hardy-Weinberg genetic equilibrium?
- No mutations occur.
  - The population is infinitely large.
  - Individuals neither leave nor enter the population.
  - All of the above are required.

ANS: D                      DIF: 1                      OBJ: 16-1.5

8. Natural selection acts
- on heterozygous genotypes.
  - only on recessive alleles.
  - on phenotypes that are expressed.
  - on all mutations.

ANS: C                      DIF: 2                      OBJ: 16-2.1

9. The movement of alleles into or out of a population due to migration is called
- mutation.
  - gene flow.
  - nonrandom mating.
  - natural selection.

ANS: B                      DIF: 1                      OBJ: 16-2.1

10. Which of the following conditions can cause evolution to take place?
- genetic drift
  - migration
  - nonrandom mating
  - All of the above

ANS: D                      DIF: 1                      OBJ: 16-2.1

11. Gene flow describes the
- movement of genes from one generation to the next.
  - movement of genes from one population to another.
  - exchange of genes during recombination.
  - movement of genes within a population because of interbreeding.

ANS: B                      DIF: 1                      OBJ: 16-2.2

12. nonrandom mating : increasing proportion of homozygotes ::
- migration of individuals : gene flow
  - mutation : major change in allele frequencies
  - Hardy-Weinberg equation : natural selection
  - inbreeding : frequency of alleles

ANS: A                      DIF: 2                      OBJ: 16-2.2

13. What type of population is most susceptible to loss of genetic variability as a result of genetic drift?
- large populations
  - medium-sized populations
  - small populations
  - populations that fluctuate in size

ANS: C                      DIF: 1                      OBJ: 16-2.3

14. A change in the frequency of a particular gene in one direction in a population is called
- directional selection.
  - acquired variation.
  - chromosome drift.
  - stabilizing selection.

ANS: A                      DIF: 1                      OBJ: 16-2.4

15. The type of selection that may eliminate intermediate phenotypes is
- direction selection.
  - disruptive selection.
  - polygenic selection.
  - stabilizing selection.

ANS: B                      DIF: 1                      OBJ: 16-2.4

16. Directional selection tends to eliminate
- both extremes in a range of phenotypes.
  - one extreme in a range of phenotypes.
  - intermediate phenotypes.
  - None of the above; it causes new phenotypes to form.

ANS: B                      DIF: 1                      OBJ: 16-2.4

17. The large, brightly colored tail feathers of the male peacock are valuable to him because
- they attract potential predators.
  - they warn off potential competitors for mates.
  - they attract potential mates.
  - they attract people who provide them with food.

ANS: C                      DIF: 1                      OBJ: 16-2.5

18. A major limitation of the morphological concept of species is that
- there may be a great deal of phenotypic variability in a species.
  - organisms that actually can interbreed may have very different physical characteristics.
  - it does not consider whether individuals of a species can mate and produce viable offspring.
  - All of the above

ANS: D                      DIF: 2                      OBJ: 16-3.1

19. Speciation can occur as a result of geographic isolation because
- members of a species can no longer find mates.
  - populations that live in different environments may be exposed to different selection pressures.
  - the biological concept of species defines individuals that do not interbreed as members of different species.
  - All of the above

ANS: B                      DIF: 2                      OBJ: 16-3.2

20. Which of the following is an example of postzygotic isolation?
- A mating call is not recognized by a potential mate.
  - Mating times of potential mates differ.
  - Offspring of two individuals of interbreeding species die early.
  - None of the above

ANS: C                      DIF: 1                      OBJ: 16-3.3

21. The hypothesis that evolution occurs at a slow, constant rate is known as
- gradualism.
  - slow motion.
  - natural selection.
  - adaptation.

ANS: A                      DIF: 1                      OBJ: 16-3.4

22. The hypothesis that evolution occurs at an irregular rate through geologic time is known as
- directional evolution.
  - directional equilibrium.
  - punctuated equilibrium.
  - punctuated evolution.

ANS: C                      DIF: 1                      OBJ: 16-3.4

23. Which of the following is *not* a form of prezygotic isolation?
- different months of flowering of two wildflower species
  - species-specific recognition proteins on the surfaces of egg and sperm cells
  - different courtship rituals of different species
  - the formation of a sterile hybrid between two species

ANS: D                      DIF: 2                      OBJ: 16-3.4

24. Which of the following traits would *not* be useful to the study of the genetic variation in a population of fish?
- the length of the fish
  - the color of the fish
  - the fin size of the fish
  - the diet of the fish

ANS: D                      DIF: 2                      OBJ: 16-1.1

25. What type of speciation occurs when new species arise as a result of geographic isolation?
- allopatric speciation
  - prezygotic speciation
  - sympatric speciation
  - postzygotic speciation

ANS: A                      DIF: 1                      OBJ: 16-3.3

26. Reproductive isolation differs from geographic isolation in that
- reproductive isolation only occurs after fertilization, whereas geographic isolation occurs before fertilization.
  - members of the same species are not physically separated in reproductive isolation, whereas they are separated in geographic isolation.
  - geographic isolation never leads to speciation, whereas reproductive isolation sometimes does.
  - members of two species in which reproductive isolation occurs never try to interbreed, whereas geographically isolated ones do.

ANS: B

DIF: 1

OBJ: 16-3.3

## COMPLETION

1. \_\_\_\_\_ is the study of evolution from a genetic point of view.

ANS: Population genetics

DIF: 1

OBJ: 16-1.1

2. A \_\_\_\_\_ shows that most members of a population have similar values for a given measurable trait.

ANS: bell curve

DIF: 1

OBJ: 16-1.2

3. \_\_\_\_\_ results from flawed copies of individual genes.

ANS: Mutation

DIF: 1

OBJ: 16-1.3

4. Alternative versions of genes are called \_\_\_\_\_.

ANS: alleles

DIF: 1

OBJ: 16-1.4

5. Allele \_\_\_\_\_ is determined by dividing the number of instances of a certain allele by the total number of alleles of all types in the population.

ANS: frequency

DIF: 1

OBJ: 16-1.4

6. According to the \_\_\_\_\_ principle, allele frequencies in a population tend to remain the same from generation to generation unless acted on by outside influences.

ANS: Hardy-Weinberg genetic equilibrium

DIF: 1

OBJ: 16-1.5

7. The movement of individuals from one population to another is called \_\_\_\_\_.

ANS: migration

DIF: 1                    OBJ: 16-2.2

8. When there are only a few surviving individuals of a species, the species is vulnerable to extinction because there is little if any \_\_\_\_\_ on which natural selection can act.

ANS: genetic variability

DIF: 1                    OBJ: 16-2.3

9. \_\_\_\_\_ selection causes the range of phenotypes to become narrower, increasing the number of individuals with characteristics near the middle of the range.

ANS: Stabilizing

DIF: 1                    OBJ: 16-2.4

10. Differences in physical characteristics between males and females of the same species may indicate that \_\_\_\_\_ selection is important in the species.

ANS: sexual

DIF: 2                    OBJ: 16-2.5

11. The key element in the biological concept of species is that individuals within a species can \_\_\_\_\_.

ANS: interbreed

DIF: 1                    OBJ: 16-3.1

12. When geographic isolation occurs, \_\_\_\_\_ flow between separated populations ceases, which can then lead to speciation.

ANS: gene

DIF: 1                    OBJ: 16-3.2

13. Reproductive isolation that occurs before fertilization is called \_\_\_\_\_ isolation.

ANS: prezygotic

DIF: 1                    OBJ: 16-3.3

14. Reproductive isolation that occurs after fertilization is called \_\_\_\_\_ isolation.

ANS: postzygotic

DIF: 1                    OBJ: 16-3.3

15. \_\_\_\_\_ is the hypothesis that evolution occurs at a constant rate.

ANS: Gradualism

DIF: 1                      OBJ: 16-3.4

### PROBLEM

1. For each of the characteristics named below, describe how the characteristic might provide a selective advantage for male members of the species who possess it. Write your answers in the space below.
- larger than average antlers on a deer
  - a bowerbird's ability to build a nest more elaborate than the average nest
  - the ability of an insect to remove another insect's sperm packet from a female insect's reproductive tract

ANS:

- A male deer with larger than average antlers might be more likely to win battles with other males, sending the other males away or killing them. Or, the deer may be more likely to attract mates. Thus, a deer with larger antlers would be more likely to mate with a female deer and produce offspring.
- A bowerbird that builds a more elaborate nest than other bowerbirds is more likely to attract the attention of a female. Thus, he is also more likely to mate with a female bowerbird and produce offspring.
- A male insect that could remove another male's sperm packet from a female's body could then mate with the female himself. Thus, this male insect would be more likely to produce offspring than males that don't have this ability.

DIF: 3                      OBJ: 16-2.5

### ESSAY

1. In comparing two species that look very different, how could a comparison of the species' genes contribute to an understanding of their evolutionary relationship? Write your answer in the space below.

ANS:

Studying the species' genes would provide much more information than could be obtained by simply observing the physical appearance of the species. If the species had many genes in common, they would likely be more closely related than their physical appearance would suggest. If the species did not have many genes in common, this information would tend to strengthen the argument that the species were not closely related.

DIF: 2                      OBJ: 16-1.3

2. In a population of birds, 16 of 100 individuals suffer from a recessive genetic disorder that causes the feathers to fall off their wings. What proportion of the bird population are heterozygous carriers of the disorder? Write your answer in the space below.

ANS:

Given that 16 of 100 birds express the disorder, the proportion of the population that is homozygous recessive ( $r^2$ ) is 0.16. Based on this,  $r = 0.4$ . Since  $R + r = 1$ , then  $R = 1 - r = 1 - 0.4 = 0.6$ . The proportion of birds that are heterozygous carriers of the disorder is  $2Rr = 2(0.6)(0.4) = 0.48$ , or 48 out of 100.

DIF: 2                      OBJ: 16-1.4

3. Describe how you would determine the phenotype frequency of a certain phenotype in a population. Write your answer in the space below.

ANS:

To determine the phenotype frequency, determine the number of individuals with the phenotype and divide that number by the total number of individuals in the population.

DIF: 1                      OBJ: 16-1.4

4. An agricultural plot of land is sprayed with a very powerful insecticide to destroy harmful insects. Nevertheless, many of the same species of insects are present on the land the following year. How might evolution theory account for this phenomenon? Write your answer in the space below.

ANS:

A part of evolution theory states that genetic variations exist within a species. A small percentage of the insects exposed to the insecticide might have been immune or capable of detoxifying the substance. They survived and produced offspring that were also resistant to the insecticide.

DIF: 2                      OBJ: 16-2.1