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***Biological Science*, 3e**
Chapter Quiz – 25

1. A population is _____.
HINT: Understanding the concept of a population is key to understanding evolutionary change. Review the introductory passage of Chapter 24 for an idea of how the textbook uses this term.
a. any group of many individuals of the same species
Incorrect. The definition of a population is more specific than this. Would you expect the population of humans in Manhattan to include everybody that lives in Los Angeles?
b. a group of individuals that live in the same area and regularly interbreed
Correct. Within a species, if there are two groups of individuals that don't interbreed, they are not part of the same population.
c. a group of interacting species that live in the same area
Incorrect. A population is composed of individuals of the same species. A community is a group of interacting species.
d. two or more groups that regularly interbreed
Incorrect. The concept of a "group" is vague; populations are composed of individuals of the same species that live in the same area.

2. If the frequency of allele A_1 in a population is 0.4 and the frequency of allele A_2 is 0.6 in the same population, what is the frequency of the heterozygotes A_1A_2 in the next generation?
HINT: Review the frequency of genotypes in the Hardy-Weinberg principle.
a. 0.16
Incorrect. This is the frequency p^2 of the genotype A_1A_1.
b. 1
Incorrect. This is the frequency of the three possible genotypes: A_1A_1, A_1A_2, and A_2A_2.
c. 0.36
Incorrect. This is the frequency q^2 of the genotype A_2A_2.
d. 0.48
Correct. This is the frequency $2pq$ of the heterozygote A_1A_2.

3. The Hardy-Weinberg principle acts as a null model because it describes the relationship between allele and genotypic frequencies under what circumstances?
HINT: When do genotypic frequencies conform to Hardy-Weinberg proportions?
a. when none of the four evolutionary forces is acting, and mating is random
Correct. This is the circumstance that causes genotypic proportions to conform to Hardy-Weinberg predictions.
b. when new species differentiate
Incorrect. Species differentiation is not relevant to the Hardy-Weinberg principle. Although evolutionary processes can lead to speciation, this is not a circumstance where the Hardy-Weinberg model acts as a null hypothesis.
c. when evolution by natural selection increases the fitness of individuals
Incorrect. When natural selection occurs in a population, genotypic proportions may not conform to Hardy-Weinberg proportions.
d. when individuals in a population are not mating randomly with respect to the *HLA* genotype
Incorrect. A population that is not mating randomly will not conform to Hardy-Weinberg genotypic expectation.

4. Which of the following is *not* a null model?
HINT: Consider that the Hardy-Weinberg principle represents a null model.
a. the Hardy-Weinberg model
Incorrect. This *is* a null model because it describes what happens when no evolutionary processes occur.
b. a model of what happens to a locus with no genetic diversity
Incorrect. This *is* a null model of what happens when no evolutionary forces are acting.
c. a model that describes what happens during an artificial selection experiment
Correct. This is not a null model because it describes what happens when evolution occurs. If a scientist can't reject a hypothesis about evolution, then we say, "We can't reject the null model."
d. a model of what happens when no evolutionary forces are acting in a population
Incorrect. This *is* a null model of what happens when no evolutionary forces are acting.

5. Which statement is the best contemporary definition of evolution?
HINT: Remember that evolution is a pattern that is observed.
a. Evolution is natural selection in two populations.
Incorrect. Natural selection is one of the four processes that result in evolution.
b. Evolution is the same as Hardy-Weinberg equilibrium.
Incorrect. Hardy-Weinberg equilibrium occurs when there is no evolution.
c. Evolution is a change in allele frequencies over time within a population.
Correct. This is the best definition of evolution. Notice that there is a quantifiable pattern, but no mechanism (or process) is described.
d. Evolution is an example of Mendelian inheritance.
Incorrect. Mendelian inheritance causes no change in allele frequencies.

6. Which scenario illustrates heterozygote advantage?

HINT: Compare the fitness of heterozygous and homozygous individuals when there is heterozygote advantage.

a. A population consists of more heterozygous individuals than expected under the Hardy-Weinberg principle.

Incorrect. Heterozygote advantage may result in this situation, but other processes may, too.

b. Individuals heterozygous at a given locus are more fit than homozygous individuals.

Correct. Heterozygote advantage is a pattern of natural selection that tends to maintain genetic diversity within a population.

c. Individuals in a population are nonrandomly mating without inbreeding depression.

Incorrect. Heterozygote advantage is a type of natural selection.

d. Parents with similar *HLA* alleles produce more offspring than parents with dissimilar *HLA* alleles.

Incorrect. This example illustrates a condition that is the opposite of heterozygote advantage.

7. Which of the following is *not* a result of disruptive selection?

HINT: Recall Figure 25.4a–c, figures representing the distributions of traits before and after selection, when answering this question.

a. Disruptive selection causes a change in the mean value for a trait.

Correct. Changes in the mean value of a trait are the result of directional selection.

b. Disruptive selection is the result of individuals with extreme phenotypes having higher fitness.

Incorrect. Disruptive selection is the result of individuals at the extremes of the trait distribution having higher fitness.

c. Disruptive selection, like stabilizing selection, causes no change in the mean value of a trait.

Incorrect. There is no change in the mean value for a trait with either stabilizing or disruptive selection. However, stabilizing selection reduces variation in a population.

d. Disruptive selection results in increased variation in a population.

Incorrect. Disruptive selection does cause an increase in variation.

8. Which of the following examples of natural selection in action would tend to *increase* the genetic variation in the population?

HINT: Remember that natural selection requires variation to operate.

a. Natural selection causes dragonflies to evolve longer tails.

Incorrect. This is an example of directional selection, which tends to *reduce* the genetic diversity of a population.

b. Alpine skypilots evolve large flowers above the timberline and small flowers below the timberline.

Correct. Disruptive selection or selection for extreme phenotypes tends to increase variation in that trait.

c. Natural selection simultaneously selects against heavy field mice (they starve during winter) and light field mice (they freeze during winter).

Incorrect. This is an example of stabilizing selection, which tends to *reduce* genetic variation in a population.

d. Natural selection acts on beak size in finches such that those individuals able to eat small, soft seeds survive through the winter.

Incorrect. This is an example of directional selection.

9. Which statement most fully characterizes the fundamental asymmetry of sex?

HINT: The fundamental asymmetry of sex is an important component in theories of sexual selection.

a. Female fitness is limited mostly by the ability to get resources for producing eggs and rearing young, while male fitness is limited by the ability to attract females.

Correct. This is the fundamental idea of the asymmetry of sex in a nutshell.

b. Female fitness is limited mostly by the ability to attract males, while male fitness is limited by the ability to get resources for provisioning the female.

Incorrect. Female fitness is not generally limited by the ability to attract males.

c. Female fitness is limited mostly by the ability to get resources for producing eggs and rearing young, while male fitness is limited by the ability to get resources for provisioning the female.

Incorrect. Male fitness may be limited by the ability to get resources, but this is only one way of attracting mates.

d. Female fitness is limited mostly by the ability to attract males, and male fitness is limited by the ability to attract females.

Incorrect. There is no asymmetry in this statement.

10. Which populations would be affected most by random genetic drift?
HINT: Genetic drift is often studied in island populations.
a. large populations
Incorrect. The larger a population is, the less random genetic drift affects allele frequencies.
b. small populations
Correct. Random genetic drift affects allele frequencies more drastically as population size decreases.
c. migrating populations
Incorrect. Whether or not a population migrates does not influence genetic drift.
d. fixed populations
Incorrect. "Fixed" in the evolutionary sense means that an allele has reached a frequency of 100 percent; the other allele would be lost and have a frequency of 0 percent. If there is no variation, then drift cannot change allele frequencies.

11. Which population would *not* be affected by a founder effect?
HINT: What is a founder event?
a. finches that colonized the Galápagos Islands
Incorrect. These finches emigrated to a new geographic area and founded a new population, so they would be affected by a founder effect.
b. Tahitians and English mutineers on the Pitcairn Islands
Incorrect. These individuals emigrated to a new geographic area and founded a new population, so they would be affected by a founder effect.
c. Ashkenazi Jews that settled in Eastern Europe
Incorrect. These individuals emigrated to a new geographic area and founded a new population, so they would be affected by a founder effect.
d. survivors of a typhoon in the Pingelap Atoll
Correct. This population did not move to a new geographic area. Instead, it experienced a reduction in the number of alleles in the population and thus would be affected by a genetic bottleneck.

12. Which pattern observed in natural populations is *not* caused by a genetic bottleneck?

HINT: A genetic bottleneck is an example of genetic drift.

a. lack of variation in whooping crane vocalizations

Incorrect. The worldwide population of whooping cranes recently became much smaller, reducing allelic diversity in this species.

b. Fixed loci in endangered plant populations

Incorrect. Bottlenecks are a major concern because they reduce genetic diversity in endangered species. Small populations are more susceptible to the effects of genetic drift.

c. long, thin necks in giraffes

Correct. Bottlenecks are unlikely to lead to adaptive traits such as long necks in giraffes. Long, thin necks in giraffes are the result of natural selection.

d. extremely low genetic diversity in cheetahs

Incorrect. A genetic bottleneck probably caused the observed low genetic diversity in cheetah populations worldwide.

13. An important consequence of gene flow in natural populations is that it _____.

HINT: Consider that gene flow is a movement of alleles, carried by individuals, between populations. How does gene flow affect populations?

a. increases the mutation rate among sedentary organisms

Incorrect. Mutation is a random process and occurs independent of gene flow.

b. moves individuals from one habitat to another on a seasonal basis

Incorrect. Gene flow refers not to seasonal movement but to movement of alleles.

c. tends to separate allele frequencies among populations

Incorrect. Gene flow tends to homogenize allele frequencies among populations.

d. tends to reduce genetic differences among populations

Correct. This is the major effect of gene flow. On one hand, the consequences of increased gene flow for endangered populations might be beneficial if genetic diversity is being lost by drift. On the other hand, increased gene flow might homogenize populations that are distinct because they are adapted to local conditions.

14. Genetic diversity is required for natural selection to act, but natural selection can reduce or eliminate diversity. What forces restore or maintain diversity of a population?

HINT: Consider the four evolutionary mechanisms described in Chapter 25.

a. Hardy-Weinberg equilibrium

Incorrect. Hardy-Weinberg equilibrium occurs when allele frequencies don't change over time—the absence of evolution.

b. inbreeding

Incorrect. Inbreeding, where like genotypes only mate with like genotypes, does not change allele frequencies. By itself, inbreeding does not affect diversity within a population.

c. sexual selection

Incorrect. Sexual selection is usually a form of directional selection that tends to reduce genetic diversity in loci that code for mate choice traits.

d. gene flow

Correct. Gene flow can introduce new alleles and maintain diversity in populations.

15. Which of the following scenarios, involving mutation, may cause evolutionary change?

HINT: Consider the average mutation rate in humans, and what effect mutation has on allele frequencies in a population.

a. a mutation that occurs in areas where there is high UV radiation, causing thymine dimers, so only human populations in those areas are affected by mutation

Incorrect. There are many different mutagens. Only those mutations that are transmitted to offspring via gametes, not in somatic cells, can be passed on to offspring and have the potential to change allele frequencies within a population.

b. a mutation that confers antibiotic resistance in bacteria

Correct. A mutation like this would result in a selective advantage for individuals with the mutation.

c. a mutation that occurs in a single individual within a small population

Incorrect. In a small population, alleles are more likely to be lost due to drift than in large populations.

d. a population that experiences no mutation

Incorrect. Although highly unlikely, mutation is the ultimate source of genetic variation. Without mutation, evolution would eventually stop.

16. Which evolutionary process is *least* important for conservation biologists concerned about the future direction of evolutionary change in endangered populations?

HINT: Think about what processes cannot be managed or influenced by conservation scientists.

a. migration

Incorrect. Introduction of new individuals into an endangered population can be beneficial or detrimental. This process is an important consideration.

b. genetic drift

Incorrect. This process can be controlled by changing the number of individuals in a population. It is very important to conservationists.

c. mutation

Correct. Mutations do not occur often enough to cause major evolutionary change.

d. inbreeding

Incorrect. This process can be regulated in captive breeding programs and is very important for conservation scientists.

17. Which of the following biological processes leads to adaptation?

HINT: Over the long time scale, adaptive evolution is probably the most important factor in making the world the rich, diverse place that it is.

a. mutation

Incorrect. Mutation causes random changes, not adaptive change.

b. gene flow

Incorrect. Gene flow does not cause adaptive change.

c. genetic drift

Incorrect. Drift causes random changes, not adaptive change.

d. natural selection

Correct. Only selection can lead to adaptive evolutionary change.

18. Which of the following is *not* associated with inbreeding?

HINT: What is inbreeding?

a. Allele frequencies change in a population.

Correct. Inbreeding does not change allele frequencies. This means that inbreeding is not a mechanism for evolution, although inbreeding can cause fitness reductions in individuals, a phenomenon known as inbreeding depression.

b. The frequency of homozygotes increases in a population.

Incorrect. Homozygous genotypic frequencies increase in inbreeding populations, reducing the amount of genetic diversity within individuals.

c. Individuals in a population experience reduced fitness.

Incorrect. Inbreeding depression is a fitness reduction that happens to the offspring of related parents.

d. Individual plants self-fertilize.

Incorrect. Self-fertilization is the most extreme form of inbreeding.

19. Which characteristic is common to both inbreeding and sexual selection?
HINT: Review the impact of inbreeding on sexual selection.
a. They both lead to adaptation.
Incorrect. Only sexual selection produces adaptive change.
b. They both cause evolutionary change.
Incorrect. Inbreeding alters genotypic frequencies, not allele frequencies, so it doesn't result in evolution.
c. They both affect all loci in a genome.
Incorrect. Inbreeding affects all loci, whereas sexual selection affects only loci that code for mate choice traits.
d. They are both forms of nonrandom mating.
Correct. This is the only true statement. Nonrandom mating has very different consequences for a population, depending on whether it occurs because of sexual selection or because of inbreeding. What are these different consequences?