Arizona State University (ASU) BIO 345 Evolution Exam 2 Practice (Sample)

Study Guide

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Questions

1. Which factor is essential for sympatric speciation to occur?

   A. Geographic barriers

   B. Temporal isolation

   C. Resource availability

   D. Behavioral adaptations

2. What describes the progeny of haplodiploid species like bees and ants?

   A. All progeny are haploid

   B. Males are haploid, females are diploid

   C. Both sexes are diploid

   D. Only females reproduce

3. What type of selection is associated with Müllerian mimicry?

   A. Negative frequency-dependent selection

   B. Positive frequency-dependent selection

   C. Stabilizing selection

   D. Disruptive selection

4. What do fitness landscapes depict in the context of evolution?

   A. The distribution of species in various ecosystems

   B. The relationship between genotypes and reproductive success in environments

   C. The adaptation strategies of different species

   D. The direct effects of natural selection on a single species

5. Which of the following best describes divergent evolution?

   A. Different species from the same ancestor become more similar

   B. Related species become more dissimilar due to different environments

   C. Species evolve traits due to similar functional demands

   D. Species that share habitats develop unique traits

6. What is David Sloan Wilson's model of group selection primarily concerned with?

A. Enduring groups with static traits

B. Long-lived groups with complex social hierarchies

C. Short-lived, interacting groups with allele-defined traits

D. Individual selection within stable environments

7. What are the most pathogenic bacteria typically associated with?

A. Plant diseases

B. Animal diseases

C. Human diseases

D. Microbial diseases

8. In evolutionary biology, what does adaptation refer to?

A. Changes in behavioral practices

B. Physical alterations for survival in an environment

C. Temporary responses to environmental changes

D. Inheritance of traits only through sexual reproduction

9. At which position in a codon are mutations most likely to be selectively neutral?

A. First position

B. Second position

C. Third position

D. None of the above

10. What does niche partitioning allow competing species to do?

A. Coexist by utilizing the same resources

B. Eliminate one another

C. Coexist by occupying different niches

D. Adopt a mutualistic relationship

Answers

1. D
2. B
3. B
4. B
5. B
6. C
7. C
8. B
9. C
10. C

Explanations

1. Which factor is essential for sympatric speciation to occur?

A. Geographic barriers

B. Temporal isolation

C. Resource availability

D. Behavioral adaptations

Sympatric speciation occurs when a new species emerges from a single ancestral species while inhabiting the same geographical area. This process is essential when populations become reproductively isolated without geographical barriers. Behavioral adaptations play a critical role in this mechanism. For instance, if individuals within the same population develop different mating preferences or behaviors, they may begin to favor different mating partners despite potential overlap in habitat. This can lead to reduced gene flow between groups and eventually result in speciation. Behavioral factors, such as preferences for certain courtship displays or mating calls, can significantly drive this divergence, making them essential for sympatric speciation. The other options, while relevant to different types of speciation or evolutionary processes, do not fulfill the requirement for sympatric speciation. Geographic barriers are fundamental to allopatric speciation but not sympatric. Temporal isolation refers to differences in mating or flowering times, which can contribute to speciation but is not a primary driving factor in sympatric conditions. Resource availability, while important for survival and reproduction, does not inherently lead to reproductive isolation in the absence of behavioral or other mechanisms.

2. What describes the progeny of haplodiploid species like bees and ants?

A. All progeny are haploid

B. Males are haploid, females are diploid

C. Both sexes are diploid

D. Only females reproduce

In haplodiploid species such as bees and ants, the reproductive system is characterized by the differing chromosomal compositions of males and females. Males develop from unfertilized eggs and have only one set of chromosomes, making them haploid. In contrast, females are produced from fertilized eggs, resulting in two sets of chromosomes, and thus they are diploid. This unique inheritance pattern leads to notable social behaviors and reproductive strategies within these species, where males typically do not contribute to care of offspring and their main role is to mate with the diploid females. Understanding this haplodiploid system is crucial for studying the evolutionary dynamics and social structures of these insects.

3. What type of selection is associated with Müllerian mimicry?

A. Negative frequency-dependent selection

B. Positive frequency-dependent selection

C. Stabilizing selection

D. Disruptive selection

Müllerian mimicry occurs when two or more unpalatable or harmful species evolve to resemble each other, providing a mutual benefit by reinforcing the avoidance behavior of predators. In this context, positive frequency-dependent selection plays a crucial role. When a predator encounters a familiar harmful species, it learns to avoid not only that species but also others that share similar warning signals or appearances. As the frequency of these mimicking individuals increases in the population, the likelihood of the predator encountering and learning to avoid them also rises. Essentially, the more common the resemblance between these species, the stronger the reinforcement of avoidance behavior becomes for the predator. This leads to a scenario where individuals with the shared mimicry pattern are favored by natural selection, which supports the concept of positive frequency-dependent selection. In contrast, other selection types do not effectively explain the dynamics of Müllerian mimicry. Negative frequency-dependent selection, for instance, would favor rarer phenotypes, which is not aligned with the cooperative benefits seen in Müllerian mimicry. Stabilizing selection tends to reduce variation by favoring average phenotypes, and disruptive selection favors extreme variations over intermediate ones, neither of which captures the essence of how species benefit mutually through shared warning signals. Therefore, the association of Müllerian

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Fitness landscapes are graphical representations that illustrate the relationship between genetic variations (or genotypes) and the fitness (reproductive success) of those variations within specific environments. This concept is fundamental in evolutionary biology as it helps visualize how different genotypes perform in terms of survival and reproduction in a given context. In a fitness landscape, each genotype is represented as a point in a multi-dimensional space, and the height of the landscape at that point indicates the fitness associated with that genotype. Peaks represent genotypes with high fitness, while valleys correspond to low fitness. As environmental conditions change, the landscape can shift, meaning that what was once a high-fitness genotype may become less advantageous, illustrating the dynamic nature of evolution. Understanding fitness landscapes allows researchers to analyze evolutionary processes like adaptation and speciation, as they depict how populations might move towards areas of greater fitness in response to environmental pressures. Hence, this choice accurately reflects the central theme of fitness landscapes in evolutionary theory.

5. Which of the following best describes divergent evolution?

A. Different species from the same ancestor become more similar

B. Related species become more dissimilar due to different environments

C. Species evolve traits due to similar functional demands

D. Species that share habitats develop unique traits

Divergent evolution refers to the process by which related species evolve different traits and characteristics, often as a response to varying environmental pressures. This concept is best illustrated by the example of a common ancestor giving rise to multiple species that adapt to distinct environments, leading to differences in their morphology, behavior, and physiology. In this context, when related species encounter different ecological niches or environmental conditions, they adapt over time to these specific demands. This can result in the evolution of distinct traits that allow the organisms to survive and reproduce in their respective environments. For instance, the diversity observed in the finch species on the Galápagos Islands showcases how birds that share a common ancestor adapted to different food sources and habitats, leading to variations in beak size and shape. The other concepts focus on different evolutionary mechanisms. Similarity arising from a common ancestor points to a more convergent evolution scenario rather than divergent. Evolution driven purely by similar functional demands would imply convergence, not divergence, suggesting that species develop similar traits due to unrelated evolutionary pressures. Lastly, sharing a habitat and developing unique traits relates more to adaptive radiation or niche differentiation instead of the core concept of divergence stemming from common ancestry. Thus, the description of related species becoming more dissimilar due to different environments accurately

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A. Enduring groups with static traits

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C. Short-lived, interacting groups with allele-defined traits

D. Individual selection within stable environments

David Sloan Wilson's model of group selection is primarily focused on short-lived, interacting groups with allele-defined traits. This model emphasizes the role of group dynamics in the evolution of social behaviors and traits. Wilson’s approach posits that selection can operate at the group level, where the success of a group can depend on the interactions among its members and the genetic traits they possess. In this context, the model suggests that groups with certain allele-defined traits may outperform other groups in the face of competition, leading to an increase in the frequency of these advantageous traits within the group. This process can result in the evolution of cooperative behaviors, as groups that foster cooperation among their members can enhance their survival and reproductive success. The focus on short-lived and interacting groups is crucial because it allows for rapid contextual changes and adaptations based on the social environment. It highlights the significance of the groups' dynamics in shaping the evolutionary path of social traits, demonstrating how these interactions can lead to different evolutionary outcomes compared to individual selection processes in static environments or enduring groups.

7. What are the most pathogenic bacteria typically associated with?

A. Plant diseases

B. Animal diseases

C. Human diseases

D. Microbial diseases

The association of the most pathogenic bacteria with human diseases is rooted in the biological and ecological interactions that have evolved over time. Many pathogenic bacteria have specialized mechanisms that allow them to invade human hosts, evade the immune system, and cause disease. These bacteria are often adapted to colonize human tissues or produce toxins that directly harm human cells. For instance, bacteria like Streptococcus pneumoniae, Escherichia coli (certain strains), and Staphylococcus aureus are well-documented pathogens that can lead to a range of illnesses in humans, from respiratory infections to foodborne illnesses and skin infections. Research into microbial pathogenesis has shown that these bacteria possess specific virulence factors, such as adherence factors, invasins, and secreted enzymes, which enhance their ability to infect human hosts and establish disease. This focus on human diseases distinguishes these pathogenic bacteria from those primarily associated with plant or animal diseases. While some bacteria may indeed affect plants and animals, the question specifically highlights the pathogenic bacteria that most frequently cause illnesses in humans, reflecting their evolution and adaptation to us as a primary host.

8. In evolutionary biology, what does adaptation refer to?

A. Changes in behavioral practices

B. Physical alterations for survival in an environment

C. Temporary responses to environmental changes

D. Inheritance of traits only through sexual reproduction

Adaptation in evolutionary biology specifically refers to the physical alterations that enhance an organism's ability to survive and reproduce in its particular environment. These changes can manifest in various forms, such as structural modifications, physiological processes, or behavioral traits that have evolved over time in response to selective pressures. For instance, a common example of adaptation is the development of thicker fur in animals that live in cold climates, which helps them retain body heat. This process occurs over many generations through the mechanism of natural selection, where favorable traits increase an organism's chances of survival and reproduction. Unlike temporary responses to environmental changes or changes in behavioral practices, which may occur within an individual's lifetime and do not involve genetic changes, adaptations are long-term evolutionary modifications that are heritable. Additionally, adaptations are not limited to traits inherited through sexual reproduction; they can also arise from mutations and other genetic mechanisms across generations. Thus, the emphasis on enduring physical alterations for survival highlights the essence of what it means to adapt in the context of evolutionary biology.

9. At which position in a codon are mutations most likely to be selectively neutral?

A. First position

B. Second position

C. Third position

D. None of the above

Mutations are most likely to be selectively neutral at the third position of a codon due to the properties of the genetic code and the phenomenon known as codon degeneracy. Each codon, which consists of three nucleotides, corresponds to a specific amino acid or a stop signal during protein synthesis. The genetic code is often described as being redundant or degenerate, meaning that several different codons can code for the same amino acid. At the third position of a codon, changes in nucleotide sequence frequently do not lead to a change in the amino acid that is incorporated into the protein. This is because multiple codons can encode the same amino acid, and substitutions or mutations that occur at this position are less likely to affect the overall function of the protein. Thus, mutations here are less likely to be harmful or advantageous, rendering them selectively neutral. In contrast, mutations at the first or second positions of a codon are more likely to result in a different amino acid being incorporated into the protein, which can significantly impact the structure and function of the resultant protein. This change can lead to a fitness consequence, making these mutations less likely to be neutral. Consequently, the third position is recognized as the most common site for selectively neutral mutations in the

10. What does niche partitioning allow competing species to do?

A. Coexist by utilizing the same resources

B. Eliminate one another

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D. Adopt a mutualistic relationship

Niche partitioning is a process that allows competing species to coexist by utilizing different resources or occupying different ecological niches within the same environment. This occurs when species that share a habitat divide the available resources in a way that minimizes direct competition. For example, two species of birds might feed on the same tree, but one may eat insects from the lower branches while the other feeds on fruits from the upper branches. By occupying different niches, these species can reduce competition for food, allowing them to thrive alongside one another without outcompeting or displacing each other. This dynamic is crucial in maintaining biodiversity, as it enables multiple species to exist within the same ecosystem simultaneously. When species find ways to partition their niches, they reduce the likelihood of direct competition over limited resources, leading to a more stable and diverse community. Thus, niche partitioning promotes the coexistence of various species rather than their elimination or reliance on mutualistic relationships.