NCEA Level 3 Biology – Speciation (AS91605) Practice Exam (Sample)

Study Guide

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Questions

1. What best describes the role of polyploidy in speciation?

- **A. It causes hybrid infertility among closely related species**
- **B. It allows for rapid adaptation to environmental changes**
- **C. It leads to the formation of new species from a single population**
- **D. It results in increased genetic diversity within a population**

2. What impact does human activity have on speciation?

- **A. It promotes reproductive isolation among species.**
- **B. It enhances genetic variation within populations.**
- **C. It disrupts gene flow and reproductive isolation.**
- **D. It stabilizes ecosystems to support biodiversity.**

3. What is the outcome of a nonsense mutation?

- **A. It produces a functional protein**
- **B. It leads to a truncated protein**
- **C. It has no effect on protein synthesis**
- **D. It only changes one amino acid**

4. Which of the following is an example of a postzygotic barrier?

- **A. Temporal isolation**
- **B. Hybrid infertility**
- **C. Behavioral isolation**
- **D. Mechanical isolation**

5. What advantage do autotetraploids have over autotriploids?

- **A. Higher viability during meiosis**
- **B. Increased size and growth rate**
- **C. Ability to reproduce asexually**
- **D. More fertile due to chromosome configuration**

6. What role does natural selection play in the evolution of isolating mechanisms?

A. It stabilizes existing species without change.

B. It acts on traits influencing mating success.

C. It eliminates all forms of diversity.

D. It reduces competition for resources only.

7. What is the role of natural selection in adaptive radiation?

A. It favors traits that are harmful to the species

B. It acts uniformly across all populations

C. It drives diversification based on environmental pressures

D. It prevents any significant changes from occurring

8. Which process leads to different selection pressures in geographically isolated populations?

A. Ecological isolation

B. Genetic drift

C. Behavioural isolation

D. Temporal isolation

9. What is a mutation?

A. A gradual change in a population

B. A temporary alteration in genetic code

C. A permanent change in DNA

D. A selective advantage in all organisms

10. Which type of isolating mechanism acts before fertilization?

A. Postzygotic isolation

B. Temporal isolation

C. Prezygotic isolation

D. Gametic isolation

Answers

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

Explanations

1. What best describes the role of polyploidy in speciation?

A. It causes hybrid infertility among closely related species

B. It allows for rapid adaptation to environmental changes

C. It leads to the formation of new species from a single population

D. It results in increased genetic diversity within a population

Polyploidy plays a significant role in speciation, particularly in plants, by leading to the formation of new species from a single population. Polyploid organisms have more than two sets of chromosomes, which can arise due to errors in cell division, resulting in individuals that cannot mate with their diploid ancestors. This reproductive isolation is critical for speciation, as it provides a mechanism through which a new species can emerge without the necessity of geographical barriers, which are often required for allopatric speciation. When polyploid individuals arise, they may exploit different ecological niches or exhibit different traits compared to their diploid relatives, further reinforcing their reproductive isolation. As these polyploid organisms adapt to their environment, they can diverge genetically, facilitating the evolution of distinct species. This process demonstrates how polyploidy can contribute to speciation by creating a genetic framework for the development of new species within the same geographic area. By focusing on the mechanisms through which polyploidy enables the emergence of new species, it's clear why this option accurately describes the role of polyploidy in speciation.

2. What impact does human activity have on speciation?

A. It promotes reproductive isolation among species.

B. It enhances genetic variation within populations.

C. It disrupts gene flow and reproductive isolation.

D. It stabilizes ecosystems to support biodiversity.

Human activity significantly disrupts gene flow and reproductive isolation, which are crucial processes in speciation. Activities such as habitat destruction, pollution, and urbanization can fragment populations, making it harder for individuals of the same species to meet and reproduce. This fragmentation leads to isolation of populations, where genetic differences can begin to accumulate over time, diminishing genetic diversity. Additionally, by introducing invasive species or altering ecosystems, humans can create environments that may favor certain traits over others, further impacting the potential for speciation. In contrast, other options describe processes that are less aligned with the actual effects of human activity on speciation. For instance, while reproductive isolation is essential for the formation of new species, human actions often hinder this process rather than promote it. Similarly, enhancing genetic variation within populations is typically a result of natural processes such as mutation or migration, rather than human influence, which often leads to a reduction in variation. Lastly, while stable ecosystems can support biodiversity, human activities frequently lead to instability and degradation of these ecosystems, which is counterproductive to promoting biodiversity.

3. What is the outcome of a nonsense mutation?

A. It produces a functional protein

B. It leads to a truncated protein

C. It has no effect on protein synthesis

D. It only changes one amino acid

A nonsense mutation occurs when a single nucleotide change in the DNA sequence results in the formation of a premature stop codon. This premature stop codon signals the translation machinery to end protein synthesis earlier than it normally would, leading to a truncated protein. The truncated protein is typically shorter than the full-length functional protein and may lack important functional domains, which often results in a loss of function. This is why the outcome of a nonsense mutation is significant; the protein produced is not complete and can be nonfunctional or have drastically altered functionality compared to the intended protein. The other choices do not accurately describe the effects of a nonsense mutation. For example, if a mutation produced a functional protein, that would suggest the change did not disrupt the coding sequence, which is not the case here. Similarly, if it had no effect on protein synthesis or only changed one amino acid, those would not align with the characteristics of a nonsense mutation that leads to early termination of the protein coding sequence.

4. Which of the following is an example of a postzygotic barrier?

A. Temporal isolation

B. Hybrid infertility

C. Behavioral isolation

D. Mechanical isolation

Hybrid infertility is a clear example of a postzygotic barrier because it occurs after fertilization has taken place. In this case, even though the sperm and egg may successfully combine to form a zygote, the resulting offspring are unable to reproduce successfully. This could manifest as the offspring being sterile, as seen in mules (the hybrid offspring of horses and donkeys), which cannot produce viable gametes. This barrier effectively prevents gene flow between the parent species by ensuring that even if hybridization occurs, the hybrids do not contribute to the gene pool of either parent species. On the other hand, the other options represent prezygotic barriers, which impede the processes leading up to fertilization. Temporal isolation refers to species that reproduce at different times, thereby preventing mating. Behavioral isolation involves differences in mating behaviors or rituals that inhibit different species from interbreeding. Mechanical isolation occurs when differences in reproductive structures prevent successful mating. All these mechanisms occur before the formation of a zygote, distinguishing them from postzygotic barriers like hybrid infertility.

5. What advantage do autotetraploids have over autotriploids?

A. Higher viability during meiosis

B. Increased size and growth rate

C. Ability to reproduce asexually

D. More fertile due to chromosome configuration

Autotetraploids have a significant advantage over autotriploids due to their chromosome configuration, which allows for increased fertility. In autotetraploids, the organisms have four sets of chromosomes, which can pair up effectively during meiosis. This pairing facilitates normal chromosome segregation and results in viable gametes. In contrast, autotriploids possess three sets of chromosomes, creating complications during meiosis because there is an imbalance in chromosome pairing. This often leads to irregularities and the formation of non-viable gametes, resulting in reduced fertility. The proper pairing and separation of chromosomes in autotetraploids made it so they can produce more viable offspring, contributing greatly to their reproductive success. Furthermore, while increased size and growth rate, higher viability during meiosis, and ability to reproduce asexually are advantages that can be found in certain species, the defining feature that distinguishes the reproductive potential of autotetraploids is their more favorable chromosome configuration that leads to higher fertility.

6. What role does natural selection play in the evolution of isolating mechanisms?

A. It stabilizes existing species without change.

B. It acts on traits influencing mating success.

C. It eliminates all forms of diversity.

D. It reduces competition for resources only.

Natural selection plays a crucial role in the evolution of isolating mechanisms by acting on traits that influence mating success. These mechanisms can include behavioral traits such as mating calls, timing of reproductive events, and physical characteristics that align with specific preferences in mate selection. When certain traits confer an advantage in attracting mates or successfully reproducing within a given environment, individuals with those traits are more likely to pass them on to the next generation. Over time, this can lead to the development of distinct species, as individuals become more specialized to their particular mating strategies, ultimately contributing to reproductive isolation. This process enhances genetic divergence, as populations adapt to their unique environments and mating preferences, which can reduce interbreeding and further solidify species boundaries. The evolution of isolating mechanisms is therefore a direct outcome of natural selection acting on the traits that ensure reproductive success.

7. What is the role of natural selection in adaptive radiation?

A. It favors traits that are harmful to the species

B. It acts uniformly across all populations

C. It drives diversification based on environmental pressures

D. It prevents any significant changes from occurring

Natural selection plays a crucial role in adaptive radiation by driving diversification based on environmental pressures. In adaptive radiation, species evolve rapidly from a common ancestor to fill various ecological niches. Natural selection favors individuals with traits that are advantageous in specific environments, allowing them to survive and reproduce more effectively. This leads to the development of distinct adaptations tailored to different habitats, resources, or lifestyles. For instance, when a group of organisms encounters new environments, those individuals with variations that provide a competitive advantage (such as better foraging strategies, more efficient locomotion, etc.) are more likely to thrive and pass on those beneficial traits to their offspring. This process ultimately results in the emergence of new species, each well-suited to their unique ecological roles. In contrast, the other choices do not accurately reflect the role of natural selection. For example, the idea that natural selection favors harmful traits is contrary to the foundation of evolutionary theory, as harmful traits would decrease an organism's chances of survival. Similarly, the notion that natural selection acts uniformly across all populations overlooks the fact that different populations may experience varied environmental pressures, leading to different adaptations. Finally, the idea that natural selection prevents significant changes from occurring undermines the fundamental mechanism of evolution, which relies on the continuous adaptation of

8. Which process leads to different selection pressures in geographically isolated populations?

A. Ecological isolation

B. Genetic drift

C. Behavioural isolation

D. Temporal isolation

The correct answer is genetic drift. This process occurs in small populations that are isolated from one another, leading to random changes in allele frequencies over generations. As certain alleles may become more or less common purely by chance, genetic drift can contribute to the development of distinct genetic traits in these isolated populations. Consequently, these differences may lead to varying selection pressures as each population adapts to its unique environment or ecological niche. In contrast, ecological isolation refers to populations that may live in the same geographical area but occupy different habitats, leading to limited interaction. This does not necessarily involve geographical isolation that creates distinct selection pressures. Behavioural isolation occurs when populations develop different mating behaviors or rituals, preventing interbreeding. While this can contribute to speciation, it does not directly relate to the geographical isolation that leads to different selection pressures. Temporal isolation deals with populations that breed at different times, such as different seasons or times of day. While it can lead to reproductive isolation, it does not inherently create the geographical separation needed to establish varied selection pressures on isolated populations. Understanding genetic drift and its impact helps clarify how isolated populations can evolve independently, leading to speciation influenced by distinct environmental factors.

9. What is a mutation?

A. A gradual change in a population

B. A temporary alteration in genetic code

C. A permanent change in DNA

D. A selective advantage in all organisms

A mutation is defined as a permanent change in the DNA sequence of an organism. This change can occur in various forms, such as a point mutation where a single nucleotide is altered, or larger structural changes that can affect multiple genes. Mutations can arise from various factors, including errors during DNA replication, exposure to certain chemicals, or radiation. The permanence of a mutation is significant because it can be passed on to subsequent generations if it occurs in the germline cells (sperm or eggs), potentially influencing the evolution of a species over time. Some mutations can lead to new traits that may be beneficial, harmful, or neutral to the organism's fitness in its environment. In contrast, the other choices refer to concepts related to genetic change but do not accurately describe what a mutation is. For instance, a gradual change in a population typically refers to evolution through processes like natural selection or genetic drift, while a temporary alteration would not constitute a mutation, as mutations are stable changes in the genetic material. Meanwhile, the idea of a selective advantage in all organisms is too broad; not all mutations confer advantages, and whether a mutation provides an advantage often depends on the specific environmental context.

10. Which type of isolating mechanism acts before fertilization?

A. Postzygotic isolation

B. Temporal isolation

C. Prezygotic isolation

D. Gametic isolation

Prezygotic isolation refers to the barriers that prevent mating or fertilization between different species before it occurs. This type of isolating mechanism can take various forms, such as behavioral differences where species have different mating rituals, or geographical separation where species are located in different areas and cannot mate simply due to distance. In this context, prezygotic isolation is distinct from postzygotic isolation, which occurs after fertilization and may involve mechanisms that reduce the viability or reproductive capacity of hybrid offspring. Temporal isolation, while a specific type of prezygotic isolation related to differences in timing of reproduction, does not encompass all forms of prezygotic mechanisms. Gametic isolation is also a specific case of prezygotic mechanisms, which focuses on biochemical incompatibility preventing fertilization even if gametes meet. Therefore, the correct answer encompasses the broader concept of all mechanisms that prevent fertilization from occurring, making it the most appropriate choice regarding isolating mechanisms that act before fertilization.