

OSAT Biological Sciences (110) Practice Exam (Sample)

Study Guide



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Questions

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- 1. Which evolutionary pattern describes multiple species evolving from a single ancestral species?**
 - A. Divergent evolution**
 - B. Adaptive radiation**
 - C. Convergent evolution**
 - D. Parallel evolution**
- 2. Cells that have limited potential to develop into many types of differentiated cells are classified as?**
 - A. Unipotent**
 - B. Multipotent**
 - C. Pluripotent**
 - D. Totipotent**
- 3. What is the final phase of mitosis where chromosomes begin to uncoil, spindles break down, and a new nuclear membrane forms?**
 - A. Prophase**
 - B. Telophase**
 - C. Anaphase**
 - D. Metaphase**
- 4. What is an example of human-caused environmental impact characterized by precipitation with a high concentration of acids?**
 - A. Air pollution**
 - B. Acid precipitation**
 - C. Ozone depletion**
 - D. Global warming**
- 5. Which term refers to the classification system used to organize living organisms?**
 - A. Genetic hierarchy**
 - B. Taxonomic hierarchy**
 - C. Ecological hierarchy**
 - D. Biological classification**

- 6. What is the name given to the solid ball of 16 cells that forms during early embryonic development?**
- A. Morula**
 - B. Blastula**
 - C. Zygote**
 - D. Gastrula**
- 7. What is the main goal of green buildings?**
- A. Maximize energy consumption**
 - B. Reduce health impacts**
 - C. Limit pollution**
 - D. All of the above**
- 8. Which hypothesis suggests that life could arise from nonliving matter?**
- A. Cell theory**
 - B. Spontaneous generation**
 - C. Evolution**
 - D. Abiogenesis**
- 9. What is the term for a mutation involving a piece of a chromosome that breaks off and reattaches in reverse orientation?**
- A. Insertion mutation**
 - B. Deletion mutation**
 - C. Inversion mutation**
 - D. Point mutation**
- 10. What year did Alfred Wallace publish his paper on natural selection?**
- A. 1858**
 - B. 1865**
 - C. 1960**
 - D. 1953**

Answers

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

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Explanations

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1. Which evolutionary pattern describes multiple species evolving from a single ancestral species?

- A. Divergent evolution**
- B. Adaptive radiation**
- C. Convergent evolution**
- D. Parallel evolution**

The correct answer, which is adaptive radiation, refers to the process by which a single ancestral species rapidly diversifies into a wide variety of forms to adapt to different environments or ecological niches. This phenomenon often occurs when a new habitat becomes available or when a species colonizes a new area, enabling it to exploit different resources or face different selective pressures. Adaptive radiation typically leads to a burst of evolutionary change where multiple new species arise, each uniquely suited to a specific part of the environment. A classic example is the diversification of the finches on the Galápagos Islands, where different species evolved from a common ancestor to occupy various niches and develop distinct feeding adaptations. In contrast, divergent evolution describes the process where two or more related species become more dissimilar over time, often due to different environmental pressures, but it does not specifically emphasize the rapid emergence of multiple species from a single ancestor. Convergent evolution refers to different species developing similar traits or adaptations despite having different ancestral origins, typically because they face similar environmental challenges. Parallel evolution occurs when two related species evolve similar traits independently while remaining in similar environments. Both of these processes do not capture the essence of multiple species evolving directly from a single ancestral lineage in the same way adaptive radiation does.

2. Cells that have limited potential to develop into many types of differentiated cells are classified as?

- A. Unipotent**
- B. Multipotent**
- C. Pluripotent**
- D. Totipotent**

The classification of cells based on their differentiation potential is key within developmental biology and regenerative medicine. Cells that are described as multipotent have a limited ability to differentiate into multiple cell types, but not all. This means they can develop into a variety of cells that are typically related to a specific tissue type or organ. For instance, hematopoietic stem cells in the bone marrow are a classic example of multipotent stem cells. They can differentiate into various types of blood cells, including red blood cells, white blood cells, and platelets, but they cannot form cells outside of the blood system, such as nerve cells or liver cells. This distinction is important as it shows how multipotent cells play a specific role in tissue regeneration and maintenance, while other cell types like pluripotent cells can develop into nearly any cell type in the body, and totipotent cells have the potential to form any cell type, including those that make up an entire organism. Thus, identifying multipotent cells helps in understanding their functional roles and potential applications in medicine.

3. What is the final phase of mitosis where chromosomes begin to uncoil, spindles break down, and a new nuclear membrane forms?

A. Prophase

B. Telophase

C. Anaphase

D. Metaphase

The final phase of mitosis is characterized by several key processes that signal the conclusion of nuclear division. During this phase, chromosomes that are tightly coiled and condensed during earlier stages begin to uncoil, which allows them to return to their less dense form, making it easier for the cell to access the genetic information encoded within them. In addition to the uncoiling of chromosomes, the spindle apparatus, which is responsible for separating sister chromatids and moving them to opposite poles of the cell, starts to break down. This disassembly is crucial because it signifies the end of the separation of genetic material. Another crucial event occurring in this phase is the reformation of the nuclear membrane around each set of chromosomes. This leads to the establishment of two distinct nuclei in what will eventually become two separate daughter cells. These processes collectively indicate that the cell is completing the division of its genetic material and preparing for the final stage of cell division, which follows mitosis and is known as cytokinesis, where the rest of the cell divides. The other stages of mitosis — prophase, anaphase, and metaphase — focus on different aspects of chromosome alignment and separation, rather than the reformation of the nuclear envelope and the decondensation of chromosomes.

4. What is an example of human-caused environmental impact characterized by precipitation with a high concentration of acids?

A. Air pollution

B. Acid precipitation

C. Ozone depletion

D. Global warming

The correct answer is characterized by its direct association with the chemical processes that lead to the formation of acids in the atmosphere, which then fall to the ground as precipitation. Acid precipitation, commonly known as acid rain, occurs when pollutants, particularly sulfur dioxide and nitrogen oxides, enter the atmosphere. These substances can originate from various human activities, including burning fossil fuels and industrial processes. Once released into the atmosphere, these pollutants react with water vapor and other compounds to form sulfuric and nitric acids. When these acids combine with precipitation, they result in rain, snow, sleet, or hail that has a lower pH than normal, thus leading to environmental damage. This can adversely affect ecosystems by harming aquatic life in water bodies, damaging vegetation, and contributing to soil degradation. In contrast, air pollution broadly encompasses various pollutants in the air but does not specifically denote the acid precipitation phenomenon. Ozone depletion refers to the thinning of the ozone layer due to human-made chemicals, which is a separate environmental issue. Global warming relates to the increase in Earth's average temperature due to greenhouse gases, also distinct from the specific processes leading to acid precipitation. Therefore, acid precipitation specifically highlights the consequences of human activities that produce acidic compounds impacting the environment.

5. Which term refers to the classification system used to organize living organisms?

- A. Genetic hierarchy**
- B. Taxonomic hierarchy**
- C. Ecological hierarchy**
- D. Biological classification**

The term that refers to the classification system used to organize living organisms is taxonomic hierarchy. This system is fundamental in biology as it provides a structured framework for categorizing organisms based on shared characteristics and evolutionary relationships. The taxonomic hierarchy includes several levels, such as domain, kingdom, phylum, class, order, family, genus, and species. Each level represents a rank in the organization of living organisms, helping scientists communicate about biodiversity and understand the relationships among different species. Taxonomic categorization is essential for studying ecology, evolution, and conservation, as it allows researchers to classify living things systematically and facilitates the identification of species. This structure aids in the understanding of how various organisms relate to one another, based on their common ancestry. While the other options refer to different aspects of biology, such as genetics and ecological relationships, they do not specifically denote the formal system used for classifying all living organisms.

6. What is the name given to the solid ball of 16 cells that forms during early embryonic development?

- A. Morula**
- B. Blastula**
- C. Zygote**
- D. Gastrula**

During early embryonic development, the stage characterized by a solid ball of 16 cells is known as a morula. This stage follows cleavage, where the zygote undergoes several rounds of cell division without significant growth, resulting in a compact mass of cells. The morula typically forms around the third to fourth day after fertilization, with a structure that appears solid as the cells are tightly packed together. In contrast, the blastula is a later stage in embryonic development, where the morula transforms into a hollow structure filled with fluid, signaling the beginning of a differentiation process. The zygote refers to the fertilized egg just after sperm entry, and the gastrula represents a later phase where cell differentiation leads to the formation of germ layers. Thus, the correct terminology for the solid ball of cells prior to further developmental changes is indeed the morula.

7. What is the main goal of green buildings?

- A. Maximize energy consumption
- B. Reduce health impacts
- C. Limit pollution
- D. All of the above**

The main goal of green buildings is to promote sustainability and efficiency in the design, construction, and operation of buildings, which aligns with all the provided options. Maximizing energy consumption would typically be seen as counterproductive in the context of green building principles, as these aim to reduce energy use rather than increase it. However, green buildings seek to maximize energy efficiency, utilizing renewable energy sources and minimizing waste. Reducing health impacts is also a crucial aspect of green buildings. These structures are designed to improve indoor air quality, use non-toxic materials, and create healthier living and working environments for occupants. Limiting pollution is another fundamental goal, as green buildings often implement strategies to reduce emissions during construction and throughout their operational life. This includes selecting materials and practices that are less harmful to the environment. Therefore, while the answer 'D' presents a broad objective encompassing energy efficiency, health impacts, and pollution reduction, it's critical to note that the overarching aim of green buildings is sustainability, effectively integrating these components to create healthier, more efficient, and environmentally friendly spaces.

8. Which hypothesis suggests that life could arise from nonliving matter?

- A. Cell theory
- B. Spontaneous generation**
- C. Evolution
- D. Abiogenesis

The hypothesis that suggests life could arise from nonliving matter is known as spontaneous generation. This concept dates back to ancient philosophy and was widely accepted until the 19th century when scientists began to challenge and ultimately disprove it through experimental evidence. Spontaneous generation posited that living organisms could originate from inanimate objects or nonliving substances under certain conditions—examples include the belief that maggots could emerge from decaying flesh or that mice could arise from stored grain. While this idea was prominent in early science, further research and experiments demonstrated that life comes from pre-existing life, leading to the abandonment of this hypothesis in favor of more accurate explanations for the origin of life. This shift in understanding paved the way for theories that more accurately describe the development of life on Earth. In contrast, abiogenesis refers to the process by which life arises naturally from nonliving matter in a historical context, typically concerning the origins of life on Earth. It represents the modern scientific understanding that life could originate under specific conditions from simple organic molecules, which differ from the misconceptions associated with spontaneous generation. Cell theory and evolution, while fundamental to biological sciences, do not address the origin of life from nonliving matter directly. Cell theory focuses on the fundamental unit of life being

9. What is the term for a mutation involving a piece of a chromosome that breaks off and reattaches in reverse orientation?

A. Insertion mutation

B. Deletion mutation

C. Inversion mutation

D. Point mutation

The correct term for a mutation involving a piece of a chromosome that breaks off and reattaches in reverse orientation is inversion mutation. Inversions occur when a segment of a chromosome is cut out, flipped around, and then reinserted into the chromosome, changing the orientation of the genetic material in that segment. This can impact gene expression and protein function because the sequence of genes may be altered in a way that affects how they are read or processed during cellular activities. In contrast, other types of mutations include insertion mutations, where additional base pairs are added into the DNA sequence, and deletion mutations, where base pairs are removed, potentially leading to frameshifts in gene coding. Point mutations involve a change at a single nucleotide position, which may lead to a different amino acid being incorporated into a protein or a premature stop signal. The defining characteristic of inversion mutations is the rearrangement of the chromosome segment in the opposite orientation, which fundamentally distinguishes them from these other mutation types.

10. What year did Alfred Wallace publish his paper on natural selection?

A. 1858

B. 1865

C. 1960

D. 1953

Alfred Wallace published his paper on natural selection in 1858, which is a pivotal moment in the history of biology. This paper was co-published with Charles Darwin, who had been developing his own theory of natural selection for many years. The joint presentation of Wallace's and Darwin's work at the Linnean Society of London is significant because it brought wider attention to the idea of evolution through natural selection. This event laid the foundation for modern evolutionary biology and established natural selection as a crucial mechanism of evolution. Wallace's contributions, though often overshadowed by Darwin's later work, were fundamental in shaping scientific understanding of species change over time. The other years listed, such as 1865, 1960, and 1953, do not correspond to Wallace's publication of his landmark paper on natural selection.