ABCTE Biology Practice Exam (Sample)

Study Guide

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Questions

1. What is the main purpose of photosynthesis in plants?

A. Production of energy

B. Production of glucose

C. Absorption of nutrients

D. Waste removal

2. What is the significance of the 5' to 3' directionality in DNA replication?

A. It dictates the way DNA is wound.

B. It determines the fastest replication process.

C. DNA strands can only elongate in this direction.

D. It allows for simultaneous polymerase activity.

3. Which part of the DNA strand primarily consists of non-coding regions?

A. Exons

B. Introns

C. Operons

D. Regulatory sequences

4. What are the short fragments of DNA on the lagging strand called?

A. Suzuki.

B. Okazaki.

C. Osaka.

D. Hirosaki.

5. What conclusion was drawn from Beadle and Tatum's experiment with mutant bread mold?

A. Genes code for proteins.

B. Mutations are caused by radiation.

C. Enzymes can repair damaged DNA.

D. Cells need specific enzymes in order to function.

6. From which structure do gill fungi release their spores?

A. Gametangium of the mycelium

B. Cells at the tips of the hyphae

C. Furrows under the cap of the fruiting body

D. Rhizoids that anchor the mushroom to the substrate

7. What are grana in chloroplasts primarily composed of?

A. Numerous plastids

B. Liquid stroma

C. Stacked thylakoids

D. Carotenoid pigments

8. What happens to the frequency of a light wave if its wavelength increases?

A. The frequency increases

B. The frequency decreases

C. The frequency remains constant

D. The frequency becomes zero

9. The autonomic nervous system is primarily involved in which function?

A. Thinking

B. Digestion

C. Hearing

D. Walking

10. Antonie von Leeuwenhoek was the first scientist to identify:

A. A cell walls

B. B bacteria

C. C viruses

D. D plant cells

Answers

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

Explanations

1. What is the main purpose of photosynthesis in plants?

A. Production of energy

B. Production of glucose

C. Absorption of nutrients

D. Waste removal

The main purpose of photosynthesis in plants is the production of glucose. During this process, plants convert light energy, typically from the sun, into chemical energy stored in glucose molecules. This transformation occurs primarily in the chloroplasts, where chlorophyll captures light energy and uses it to drive the chemical reactions that combine carbon dioxide from the air and water from the soil to produce glucose and oxygen. Glucose serves as a vital energy source for the plant, fueling various cellular processes and providing building blocks for growth and repair. The oxygen produced is released as a byproduct, benefiting the environment and other living organisms by contributing to the atmosphere. In contrast, the other options focus on secondary processes. While energy production is a result of glucose metabolism, it is not the direct aim of photosynthesis. Nutrient absorption occurs at the root level and supports the plant but is not part of the photosynthetic process itself. Waste removal is an essential process for plants but does not relate to the core function of photosynthesis, which is primarily centered on the synthesis of glucose using light energy.

2. What is the significance of the 5' to 3' directionality in DNA replication?

A. It dictates the way DNA is wound.

B. It determines the fastest replication process.

C. DNA strands can only elongate in this direction.

D. It allows for simultaneous polymerase activity.

The significance of the 5' to 3' directionality in DNA replication is that DNA strands can only elongate in this direction. During replication, DNA polymerases, the enzymes responsible for synthesizing new DNA strands, add nucleotides to the growing chain specifically at the 3' end. This means that any newly synthesized strand is always built from the 5' to 3' direction, reflecting the natural orientation of DNA. This directionality is essential because it establishes how the template strands are copied. The two strands of the DNA double helix run antiparallel to one another, meaning one runs from 5' to 3' while the other runs from 3' to 5', leading to the necessity of different replication strategies for each strand. Understanding this concept is crucial for grasping the fundamental mechanics of DNA replication and the larger processes of cell division and genetic inheritance.

3. Which part of the DNA strand primarily consists of non-coding regions?

A. Exons

B. Introns

C. Operons

D. Regulatory sequences

The correct answer is linked to the understanding of gene structure within DNA. Introns are segments of a gene that do not code for proteins and are found between coding sequences called exons. During the process of gene expression, the initial RNA transcript includes both introns and exons. However, before this RNA is translated into a protein, introns are removed through a process known as splicing, leaving behind the coding exons that will ultimately dictate the amino acid sequence of the protein. The presence of introns is thought to play various roles in gene regulation and the evolution of new proteins by allowing for alternative splicing, which can lead to multiple proteins being produced from a single gene. This highlights their importance despite being non-coding regions. Other options refer to different aspects of genetics and molecular biology. Exons are indeed the coding portions of genes and contribute to the final protein product. Operons are units of gene expression primarily found in prokaryotes, consisting of a cluster of genes regulated together, often involved in functions like metabolic pathways. Regulatory sequences encompass regions of DNA that control gene expression but do not include the transcriptional units themselves, making them separate from the concept of non-coding regions in this context.

4. What are the short fragments of DNA on the lagging strand called?

A. Suzuki.

B. Okazaki.

C. Osaka.

D. Hirosaki.

The short fragments of DNA formed on the lagging strand during DNA replication are known as Okazaki fragments. This term honors the Japanese scientist Reiji Okazaki, who, along with his wife, made significant contributions to our understanding of DNA replication mechanics in the 1960s. During replication, the lagging strand is synthesized discontinuously in short segments as the DNA helix unwinds, which results in the formation of these fragments. The key aspect of Okazaki fragments is that they allow for the efficient replication of DNA, ensuring that both strands can be synthesized simultaneously, despite the fact that DNA polymerase can only add nucleotides in one direction (5' to 3'). On the leading strand, replication occurs smoothly, while on the lagging strand, multiple Okazaki fragments are created and later joined together by the enzyme DNA ligase to form a continuous strand. This process is a fundamental aspect of DNA replication, allowing cells to accurately duplicate their genetic material.

5. What conclusion was drawn from Beadle and Tatum's experiment with mutant bread mold?

A. Genes code for proteins.

B. Mutations are caused by radiation.

C. Enzymes can repair damaged DNA.

D. Cells need specific enzymes in order to function.

Beadle and Tatum's experiment with mutant bread mold led to the conclusion that genes code for proteins, which is a fundamental principle in genetics. They conducted a series of experiments on the mold Neurospora crassa by exposing it to X-rays, which induced mutations. By observing the growth of these mutant strains on minimal media (which contained only basic nutrients), they discovered that each mutant could not grow unless specific nutrients were added. This indicated that the mutations affected specific biochemical pathways, ultimately linking genes to the production of enzymes and proteins responsible for those metabolic processes. Therefore, the conclusion that "genes code for proteins" underscores the role of genes in determining physiological traits and functions at the molecular level, establishing the foundation for the one gene-one enzyme hypothesis. This relationship is critical for understanding how the genetic information is translated into functional products in living organisms.

6. From which structure do gill fungi release their spores?

A. Gametangium of the mycelium

B. Cells at the tips of the hyphae

C. Furrows under the cap of the fruiting body

D. Rhizoids that anchor the mushroom to the substrate

Gill fungi, also known as basidiomycetes, reproduce by producing spores in specialized structures called gills, which are located under the caps of their fruiting bodies, or mushrooms. These gills are lined with cells that bear basidia, which are the structures that produce spores through sexual reproduction. When conditions are right, the spores are released from these gills into the surrounding environment, allowing for dispersal and the potential for new fungal growth. By focusing on the gills, it becomes clear why this choice is accurate—these structures are specifically evolved for the efficient release of spores. The placement of gills increases the surface area for spore production and enhances spore dispersal through wind or water, ensuring the continuation of the fungal life cycle. In contrast, other structures mentioned, such as the rhizoids or gametangia, serve different functions in the life cycle and do not play a direct role in spore production or release.

7. What are grana in chloroplasts primarily composed of?

A. Numerous plastids

B. Liquid stroma

C. Stacked thylakoids

D. Carotenoid pigments

Grana are primarily composed of stacked structures called thylakoids. These thylakoids are membrane-bound sacs that contain the chlorophyll and other pigments necessary for photosynthesis. The stacking of thylakoids in the grana increases the surface area available for light absorption, making the process of converting light energy into chemical energy more efficient. In this way, grana play a crucial role in the light-dependent reactions of photosynthesis, where the energy absorbed by chlorophyll is used to generate ATP and NADPH, which are essential for the subsequent stages of photosynthesis. The structure of grana, therefore, is fundamental to the functionality of chloroplasts and the overall process of photosynthesis in plants.

8. What happens to the frequency of a light wave if its wavelength increases?

A. The frequency increases

B. The frequency decreases

C. The frequency remains constant

D. The frequency becomes zero

When the wavelength of a light wave increases, the frequency decreases. This relationship is governed by the equation that relates speed, frequency, and wavelength: $v = f \lambda$, where v is the speed of light, f is the frequency, and λ is the wavelength. Since the speed of light in a vacuum is constant, if the wavelength increases, the frequency must decrease to maintain the equation's balance. Thus, as wavelengths become longer, the number of wave cycles passing a given point per unit time (frequency) diminishes, leading to a lower frequency overall.

9. The autonomic nervous system is primarily involved in which function?

A. Thinking

B. Digestion

C. Hearing

D. Walking

The autonomic nervous system is primarily responsible for regulating involuntary physiological processes, including heart rate, blood pressure, respiration, and digestion. Its main role is to manage bodily functions that occur automatically without conscious control, which is why digestion is particularly relevant. When food enters the digestive system, the autonomic nervous system activates various responses to ensure that digestion proceeds smoothly, such as stimulating peristalsis (the movement of food through the digestive tract), secreting digestive enzymes, and regulating the release of hormones associated with digestion. This system operates through two main branches: the sympathetic nervous system, which prepares the body for 'fight or flight' responses, and the parasympathetic nervous system, which promotes 'rest and digest' functions. Thinking, hearing, and walking are primarily controlled by the somatic nervous system and other regions of the central nervous system, rather than the autonomic nervous system. Thus, the involvement of the autonomic nervous system in digestion makes it the correct choice in this context.

10. Antonie von Leeuwenhoek was the first scientist to identify:

A. A cell walls

B. B bacteria

C. C viruses

D. D plant cells

Antonie von Leeuwenhoek is famously recognized as the first scientist to observe and describe bacteria. His advancements in microscopy allowed him to explore the microscopic world in detail, leading to his discovery of tiny living organisms, which he referred to as "animalcules." His observations were significant because they initiated the field of microbiology and challenged the prevailing notions of life at that time. This pioneering work laid the groundwork for understanding the role of microorganisms in both health and disease. The other options pertain to entities or structures that were either unknown or not classified in the way we understand them today during Leeuwenhoek's time. While he did observe various forms of cells and other microorganisms, his most notable contribution was identifying bacteria. Therefore, this answer accurately reflects his significant role in the field of biology.