HSC Biology Practice Exam (Sample)

Study Guide

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Questions

1. Which type of RNA is involved in the translation process?

A. tRNA

B. mRNA

C. rRNA

D. All of the above

2. What is the definition of a chemical that inhibits bacterial growth without harming body cells?

A. Antiseptic

B. Antibiotic

C. Antimicrobial

D. Disinfectant

3. Which molecules are found on every body cell that present antigen and signal cytotoxic T cells to destroy infected cells?

A. MHC I

B. MHC II

C. Antibodies

D. Complement proteins

4. What binds to an mRNA codon during polypeptide synthesis?

A. Ribosome

B. tRNA anticodon

C. Messenger RNA

D. Amino acid

5. Which molecule contains the information needed to make proteins?

A. DNA

B. RNA

C. Ribosome

D. Amino acids

6. What do we call a chemical or physical agent that interacts with DNA and causes a mutation?

A. Carcinogen

B. Mutagen

C. Teratogen

D. Allergen

7. What does the term "genetic technologies" encompass?

A. DNA fingerprinting, cloning, and gene therapy

B. Modern medicine, vaccines, and therapies

C. Traditional breeding and selection

D. Soil enhancement and crop rotation

8. What triggers the inflammatory response in the body?

A. Infection by pathogens

B. Pain receptors

C. Muscle contractions

D. Excessive cardiac output

9. What term describes a genetic variation where part of the chromosome is replicated?

A. Deletion

B. Aneuploidy

C. Duplication

D. Translocation

10. Which type of immunity involves the use of previously manufactured antibodies?

A. Active immunity

B. Passive immunity

C. Innate immunity

D. Adaptive immunity

Answers

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

Explanations

1. Which type of RNA is involved in the translation process?

A. tRNA

B. mRNA

C. rRNA

D. All of the above

The translation process is essential for synthesizing proteins from messenger RNA (mRNA) templates, and all three types of RNA mentioned play crucial roles in this process. mRNA serves as the template that carries the genetic information from DNA to the ribosome, where proteins are synthesized. It provides the codons which dictate the specific sequence of amino acids that will constitute the protein. Transfer RNA (tRNA) is responsible for bringing the appropriate amino acids to the ribosome. Each tRNA molecule has an anticodon that pairs with a corresponding codon on the mRNA strand, ensuring that the correct amino acid is added in the correct sequence. Ribosomal RNA (rRNA) is a fundamental structural and functional component of ribosomes, which are the sites of protein synthesis. rRNA helps catalyze the formation of peptide bonds between amino acids, facilitating the assembly of the polypeptide chain. Since all three types of RNA are integral to the translation process, each contributes a unique and vital function necessary for the successful synthesis of proteins. Thus, the correct answer encompasses all of them, highlighting the collaborative nature of these molecules in the translation process.

2. What is the definition of a chemical that inhibits bacterial growth without harming body cells?

A. Antiseptic

B. Antibiotic

C. Antimicrobial

D. Disinfectant

The definition of a chemical that inhibits bacterial growth without harming body cells is indeed best represented by the term "antibiotic." Antibiotics are substances that selectively target bacteria, interfering with their growth or reproduction while generally being safe for human cells. This selectivity is a key feature of antibiotics; they exploit differences in the cellular processes between bacteria and human cells, such as cell wall synthesis and protein production. Antiseptics, although used to prevent infection, are typically applied to living tissues. They may be more broadly effective against various pathogens, including bacteria and viruses, but their use and potential harm to body cells make them distinct from antibiotics. Antimicrobials is a broader term encompassing all substances that kill or inhibit the growth of microorganisms, including both antibiotics and antiseptics. Disinfectants are strong chemicals used to eliminate pathogens on inanimate objects and surfaces and are not safe for use on living tissues. Overall, antibiotics specifically target bacterial growth while minimizing harm to human cells, making them the most appropriate term among the options given.

3. Which molecules are found on every body cell that present antigen and signal cytotoxic T cells to destroy infected cells?

A. MHC I

B. MHC II

C. Antibodies

D. Complement proteins

MHC I molecules are indeed present on almost all body cells and play a crucial role in the immune response. These molecules are responsible for presenting endogenous antigens—peptides derived from proteins synthesized inside the cell. When a body cell becomes infected by a virus or intracellular bacteria, these pathogens produce proteins that are processed into small peptides. MHC I binds to these peptides and displays them on the cell surface. This presentation serves as a signal to cytotoxic T cells (also known as CD8+ T cells), which patrol the body for infected or abnormal cells. When a cytotoxic T cell recognizes the foreign peptide presented by MHC I, it can initiate a response leading to the destruction of the infected cell. This mechanism is a vital part of the adaptive immune system, allowing the body to target and eliminate cells harboring intracellular pathogens. In contrast, while MHC II molecules are important for presenting antigens to helper T cells (CD4+), they are not found on every body cell but are primarily expressed by antigen-presenting cells such as macrophages and dendritic cells. Antibodies and complement proteins are components of the humoral immune response but do not present antigens on cell surfaces in the same manner as MHC I. Thus,

4. What binds to an mRNA codon during polypeptide synthesis?

A. Ribosome

B. tRNA anticodon

C. Messenger RNA

D. Amino acid

During polypeptide synthesis, it is the tRNA anticodon that binds to an mRNA codon. Each tRNA molecule has a specific anticodon that is complementary to a corresponding codon on the mRNA strand. This complementary base pairing ensures that the correct amino acid is brought to the ribosome, where protein synthesis occurs. The tRNA molecule aligns itself with the mRNA strand in such a way that its anticodon matches the codon on the mRNA. This process facilitates the incorporation of the correct amino acid into the growing polypeptide chain. The accuracy of this interaction is crucial for the proper translation of genetic information into functional proteins. Thus, the role of the tRNA anticodon is essential in decoding the mRNA during translation, ensuring that the protein is synthesized accurately according to the genetic code.

5. Which molecule contains the information needed to make proteins?

A. DNA

B. RNA

C. Ribosome

D. Amino acids

The molecule that contains the information needed to make proteins is DNA. DNA, or deoxyribonucleic acid, serves as the genetic blueprint for the development, functioning, and reproduction of all living organisms. It is composed of sequences of nucleotides, which code for the synthesis of proteins through a process involving transcription and translation. In transcription, specific segments of DNA are used to produce messenger RNA (mRNA), which carries the genetic information from the nucleus to the ribosomes, the sites of protein synthesis. Therefore, while RNA is crucial for the translation process, it is not the original source of the genetic information; that role belongs to DNA. Ribosomes and amino acids, while necessary for protein synthesis, do not contain the genetic information themselves. Ribosomes are the cellular machinery that assembles amino acids based on the instructions provided by mRNA. Amino acids are the building blocks of proteins and must be ordered and linked together in the correct sequence as directed by the mRNA, which is derived from the DNA template. In summary, DNA is the molecule that holds the information needed to produce the proteins that perform essential functions in biological organisms.

6. What do we call a chemical or physical agent that interacts with DNA and causes a mutation?

A. Carcinogen

B. Mutagen

C. Teratogen

D. Allergen

A mutagen is a chemical or physical agent that interacts with DNA and causes changes or mutations in the genetic material. Mutagens can lead to alterations in the DNA sequence, which may result in various effects ranging from benign variations to severe genetic disorders. Understanding the context of mutagens is crucial. For example, not all environmental agents that affect living organisms cause mutations; carcinogens are specifically substances that can lead to cancer, but they only do so by causing mutations in certain circumstances and do not encompass all agents that directly alter DNA. Teratogens, on the other hand, are agents that cause malformations in a developing embryo or fetus, typically during pregnancy. Allergens are substances that provoke an allergic reaction and do not interact with DNA to cause mutations. Thus, the definition of a mutagen is broad and encompasses a variety of agents that can directly lead to changes in DNA, making it the correct term in this context.

7. What does the term "genetic technologies" encompass?

A. DNA fingerprinting, cloning, and gene therapy

B. Modern medicine, vaccines, and therapies

C. Traditional breeding and selection

D. Soil enhancement and crop rotation

The term "genetic technologies" encompasses a range of techniques and methods used to manipulate and analyze DNA and genetic material. This includes DNA fingerprinting, which allows for identification based on unique patterns in an individual's DNA; cloning, which involves creating a genetically identical copy of an organism; and gene therapy, a groundbreaking approach that aims to treat or prevent disease by modifying genes within an individual's cells. These techniques are fundamental to the field of genetics and biotechnology, as they enable scientists to explore genetic markers, produce genetically modified organisms, and develop innovative treatments for genetic disorders. Each of these technologies has profound implications for medicine, agriculture, and forensic science, reflecting the power of genetic manipulation in modern biology and healthcare. The other options refer to concepts that, while related to biology, do not specifically fall under the umbrella of genetic technologies. Modern medicine, vaccines, and therapies can involve genetics but are broader terms that include various health practices and innovations without specifically focusing on genetic manipulation. Traditional breeding and selection relate to agricultural practices that improve species through selective breeding rather than genetic modification. Soil enhancement and crop rotation are agricultural methods aimed at improving soil health and managing plant growth but do not involve genetic technologies.

8. What triggers the inflammatory response in the body?

A. Infection by pathogens

B. Pain receptors

C. Muscle contractions

D. Excessive cardiac output

The inflammatory response is primarily triggered by infection from pathogens, such as bacteria, viruses, and fungi. When these harmful agents enter the body, they can cause damage to tissues, which activates the immune system. This process involves the recognition of pathogen-associated molecular patterns (PAMPs) by receptors on immune cells. In response to infection, the body releases various signaling molecules, such as prostaglandins and cytokines, which contribute to the symptoms of inflammation, including redness, heat, swelling, and pain. These signals recruit additional immune cells to the site of infection, enhancing the body's ability to fight off the pathogens and heal the affected tissues. While pain receptors, muscle contractions, and excessive cardiac output can be associated with various physiological responses, they do not directly trigger the inflammatory response. Pain receptors may be activated during inflammation but are not the initiators of the response. Similarly, muscle contractions and cardiac output are involved in other bodily functions that do not directly relate to the initial immune response to infections.

9. What term describes a genetic variation where part of the chromosome is replicated?

A. Deletion

B. Aneuploidy

C. Duplication

D. Translocation

The term that describes a genetic variation where part of the chromosome is replicated is duplication. This process involves the copying of a segment of DNA, resulting in two copies instead of the standard single copy. This can lead to an increase in gene dosage, which may affect gene expression and ultimately influence the phenotype of the organism. In instances of duplication, additional genetic material can provide raw material for evolutionary processes, such as gene specialization or the development of new functions. Understanding duplications is critical in genetics, as they can play a role in various disorders and contribute to evolutionary diversity.

10. Which type of immunity involves the use of previously manufactured antibodies?

A. Active immunity

B. Passive immunity

C. Innate immunity

D. Adaptive immunity

Passive immunity involves the use of previously manufactured antibodies that provide immediate, but temporary, protection against pathogens. This type of immunity is seen in situations such as a mother passing antibodies to her infant through breast milk or placental transfer during pregnancy. These antibodies do not require the immune system to actively produce them, which is why passive immunity can quickly confer protection without the need for the recipient's own immune response to be stimulated. In contrast, active immunity occurs when the immune system is exposed to a pathogen and produces its own antibodies in response, leading to long-lasting immunity. Innate immunity is the body's first line of defense, providing immediate but non-specific responses to pathogens. Adaptive immunity refers to the tailored immune response that develops over time and includes the production of antibodies by the immune system following an exposure to specific pathogens, rather than relying on pre-made antibodies.