

DNA and its Functions

Part A. Multiple Choice

1. Nucleic acids are composed of chains of
 - A. genes.
 - B. purines.
 - C. nucleotides.
 - D. pyrimidines.
2. The fact that a DNA strand contains equal amounts of the bases A and T allows one to realize that
 - A. these molecules bond together.
 - B. DNA is a double stranded helix.
 - C. these molecules are not the same size.
 - D. one is a purine and one is a pyrimidine.
3. In the spiraling helix of a DNA molecule, each cross-member (or step) consists of two
 - A. sugars.
 - B. purines.
 - C. phosphates.
 - D. nitrogenous bases.
4. DNA molecules from the cells of a tomato and those of a potato differ in their
 - A. type of sugar.
 - B. sequence of bases.
 - C. number of strands.
 - D. order of phosphates.
5. DNA is considered to be the master molecule in cells because it
 - A. is a double helix.
 - B. is located in the nucleus.
 - C. ultimately controls all cell activity.
 - D. stores energy as high energy bonds.
6. Replication **MOST** accurately refers to the synthesis of
 - A. complementary strands of RNA for mitosis.
 - B. complementary strands of DNA for mitosis.
 - C. proteins based on the sequence of bases in RNA.
 - D. proteins based on the sequence of bases in DNA.
7. The two molecules resulting from the replication of DNA
 - A. differ in terms of function only.
 - B. differ because one is old and one is new.
 - C. are the same in every regard unless a mutation has occurred.
 - D. differ because one contains ribose and one contains deoxyribose.
8. Which of the following is mass-produced directly by cells altered by recombinant DNA techniques?
 - A. Insulin.
 - B. Glycogen
 - C. Cholesterol.
 - D. Testosterone.
9. Which of the following is **NOT** a result of recombinant DNA?
 - A. Changing a person's genetics.
 - B. Developing hybrid species of food crops.
 - C. Mass-producing molecules for medical treatments.
 - D. Producing laboratory clones of organisms for scientific investigations.

10. A polymer of nucleic acids was identified in the cytoplasm of a living animal cell. Which of the following is **MOST** likely true about this molecule?
- Helical.
 - Contains ribose.
 - Double stranded.
 - Contains thymine.
11. Which of the following is true for any given strand of DNA?
- $[A] = [C]$, $[T] = [G]$
 - $[A] = [G]$, $[T] = [C]$
 - $[A] + [T] = [G] + [C]$
 - $[A] + [G] = [T] + [C]$
12. If a species contains 23% A in its DNA, what is the percentage of guanine it would contain?
- 23%
 - 46%
 - 54%
 - 27%
13. Which of the following statements about DNA replication is **NOT** correct?
- The enzyme that catalyzes replication is DNA polymerase.
 - Unzipping of the DNA molecule occurs as hydrogen bonds break.
 - Replication occurs as each base is paired with another exactly like it.
 - The process is known as semi-conservative because one old strand is conserved in the new molecule.
14. In modern biochemical genetics, the flow of inherited information is from
- protein to RNA to DNA.
 - DNA to RNA to protein.
 - DNA to protein to RNA.
 - RNA to DNA to protein.
15. How many bases (nucleotides) are required to code for a single amino acid?
- 1
 - 3
 - 20
 - 64
16. Transcription of part of a DNA molecule with a nucleotide sequence of AAACAACCTT results in a mRNA molecule with the complementary sequence of
- TTTGAAGCC.
 - CCCACCTCC.
 - GGGAGAACC.
 - UUUGUUGAA.
17. What are ribosomes composed of?
- rRNA and protein.
 - mRNA, rRNA, and protein.
 - Two subunits each consisting of rRNA only.
 - Two subunits each consisting of several proteins only.
18. If one strand of DNA has the base sequence AAGCTT, which of the following is the correct base sequence of the complementary strand?
- UUCGAA.
 - TTCGAA.
 - AACGTT.
 - TTCGUU.

19. During the process of transcription, the information in
- RNA is converted into DNA information.
 - DNA is converted into RNA information.
 - protein is converted into RNA information.
 - RNA is converted into protein information.
20. Which of the following is **NOT** true about the Genetic Code?
- It contains start and stop codons.
 - It is different in different types of cells.
 - It has 64 different possibilities of base sequences.
 - It is composed of a triplet code of three bases per codon.
21. Initiation, elongation, and termination are three stages in
- DNA replication.
 - polypeptide synthesis
 - development of cancer
 - codon-anticodon formation
22. What signals the end of the process of translation?
- A terminator codon occurs.
 - The cell runs out of amino acids.
 - The ribosomes run off the end of mRNA.
 - Enzymes determine that the polypeptide is long enough.
23. Which of the following **BEST** describes protein synthesis?
- Transcription in the nucleus followed by translation at the ribosomes.
 - Translation in the nucleus followed by transcription at the ribosomes.
 - Transcription in the nucleus followed by translation at endoplasmic reticulum.
 - Translation in the nucleus followed by transcription at endoplasmic reticulum.
24. All of the following are true about mRNA **EXCEPT ONE**. Which one?
- It is made at the ribosomes.
 - It contains uracil in place of thymine.
 - It is synthesized from a DNA template.
 - It can be found in the cytoplasm of cells.
25. During transcription,
- deoxyribose turns into ribose.
 - uracil matches up with adenine.
 - uracil matches up with thymine.
 - deoxyribose is used in place of ribose.
26. Which of the following sequences **BEST** outlines the process of protein synthesis?
- mRNA, DNA, tRNA, amino acids
 - DNA, mRNA, tRNA, amino acids
 - DNA, tRNA, amino acids, mRNA
 - DNA, amino acids, mRNA, tRNA
27. The anticodon differs from the codon in that the anticodon
- contains thymine, but the codon contains uracil.
 - attaches to the ribosome, but the codon attaches to amino acids.
 - is a component of tRNA, where the codon is a component of mRNA.
 - stands for a particular amino acid, but the codon codes for nucleotide bases.
28. When the genetic message ATC in DNA causes the synthesis of mRNA with UAG, an amino acid will be delivered to a ribosome by a tRNA molecule bearing
- TUC.
 - AUG.
 - AUC.
 - ATC.

29. The following events occur during translation, but not necessarily in the sequence below. What is the correct sequence?

- | |
|--|
| <ol style="list-style-type: none">1. Peptide bonds form.2. Anticodons match codons.3. tRNA molecules are freed into the cytoplasm. |
|--|

- A. 3, 1, 2
B. 2, 3, 1
C. 2, 1, 3
D. 3, 2, 1
30. When using the Genetic Code to determine the amino acid sequence in a peptide, one must use the
- A. code sequence from DNA.
B. codon sequence from mRNA.
C. anticodon sequence from tRNA.
D. base sequence from the amino acids.
31. Incorrect base pairing **MOST** likely only causes a serious problem for the organism if it happens during
- A. replication of DNA.
B. transcription forming mRNA.
C. translation if rRNA misaligns mRNA.
D. translation when tRNA brings in amino acids.
32. The proteins produced at ribosomes on RER will **LEAST** likely be
- A. hormones that get secreted.
B. digestive enzymes that get secreted.
C. proteins used for structural purposes in the cell.
D. digestive enzymes that get packaged into lysosomes.
33. If the normal nucleotide sequence was TACGGCATG, what type of gene mutation is present if the resulting sequence becomes TAGGCATG?
- A. Deletion.
B. Addition.
C. Substitution.
D. Chromosomal.
34. Which of the following mutations is **NOT** a result of addition or deletion of the nucleotide sequence CATUAUCCC?
- A. ATUAUCCC.
B. CTUAUCCC.
C. CATUAUCGC.
D. CATTUAUCCC.
35. What is the correct sequence of nucleotide triplets in the messenger RNA strand that codes for the amino acid sequence below? (You will need to refer to the Genetic Code to answer this question.)
- cys – leu – phe – ala – glu**
- A. UGC CUA CCU GCU GAA.
B. UGG CUU UUU GCA GUC.
C. UGU CUC UUG GCC GAC.
D. UGU UUG UUU GCG GAG.
36. A single substitution in the third position of a triplet would have the greatest probability of a mutational effect on the codon (you will need to refer to the Genetic Code to answer this question)
- A. GUU.
B. AUU.
C. CGU.
D. AUG.

37. Which of the following amino acids has the greatest number of codons? (You will need to refer to the Genetic Code to answer this question.)
- A. Proline.
 - B. Leucine.
 - C. Tryptophan.
 - D. Aspartic acid.

38. Some geneticists consider the third base of a codon to be less important than the first two bases as a code for a specific amino acid. Which of the following statements DOES NOT SUPPORT this idea? (You will need to refer to the Genetic Code to answer this question.)
- A. There are three codons, any one of which will position an isoleucine.
 - B. Any of the bases following a CC_ sequence will position a proline into the protein.
 - C. Even though the A is replaced by a C, the triplet AGG will still position an arginine.
 - D. Even though a G replaces the last A, the triplet UAA will still terminate a polypeptide.

39. What amino acid strand is formed from the DNA strand? (You will need to refer to the Genetic Code to answer this question.)

A - T - A - C - G - A - C - A - A - G - C - C

- A. Tyrosine – alanine – valine – arginine
 - B. Tyrosine – arginine – leucine – alanine
 - C. Methionine – alanine – leucine – alanine
 - D. Methionine – arginine – glutamic acid – cysteine
40. The amino acids phenylalanine, alanine, and lysine exist in a sequence in a particular protein. Which of the following DNA sequences would cause proline to substitute for alanine? (You will need to refer to the Genetic Code to answer this question.)
- A. AAA-GGG-TTT.
 - B. AAA-CGG-TTA.
 - C. AAA-CCG-TTT.
 - D. AAA-CCC-TTT.
41. The sequence of nucleotides in DNA that codes for the polypeptide sequence Phe-Leu-Ile-Val is (you will need to refer to the Genetic Code to answer this question)
- A. TTG-CTA-CAG-TAG.
 - B. AAA-AAT-ATA-ACA.
 - C. AUG-CTG-CAG-TAT.
 - D. AAA-GAA-TAA-CAA.
42. What amino acid sequence will be generated based on the following mRNA codon sequence? (You will need to refer to the Genetic Code to answer this question.)

AUG-UCU-UCG-UUA-UCC-UUG

- A. met-glu-arg-arg-gln-leu.
 - B. met-ser-ser-leu-ser-leu.
 - C. met-arg-glu-arg-glu-arg.
 - D. met-ser-leu-ser-leu-ser.
43. Suppose the following DNA sequence was mutated from AGAGAGAGAGAGAGAGAG to AGAAGAGAGATCGAGAG. What amino acid sequence will be generated based on this mutated DNA? (You will need to refer to the Genetic Code to answer this question.)
- A. ser-ser-leu
 - B. ser-leu-ser-leu-ser-leu
 - C. glu-arg-glu-leu-leu-leu
 - D. leu-phe-arg-glu-glu-glu

Part B – Written Answers

1. A segment at the end of a complete molecule of DNA was analyzed and calculated to contain 32 Guanine molecules and 23 adenine molecules. How many nucleotides does this segment of DNA contain all together? Explain how you determine your answer.
2. BRIEFLY describe each of the following and describe its effect on the formation of a protein.
 - a. base deletion
 - b. base addition
 - c. base substitution
3. Consider the process of translation.
 - a. Draw a sketch to represent this process.
 - b. Include appropriate base sequences in your diagram.
 - c. What is the product of this process? Explain what happens to this product.
4. Consider the process of transcription.
 - a. Draw a sketch to represent this process.
 - b. Put a random base sequence on your DNA molecule.
 - c. Draw in the product of this process. Label it and identify its base sequence.
 - d. Explain what happens to the product of this process.
5. Consider the process of replication.
 - a. Draw a sketch to represent this process.
 - b. Include appropriate base sequences in your diagram.
 - c. Explain why the resulting DNA molecules are identical to each other and the parent strand.
6. Consider the three processes (in Questions 3, 4, and 5). In which one would a mutation have the most severe consequences? Explain.
7.
 - a. Define “recombinant DNA.”
 - b. Name ONE advantage and ONE possible disadvantage of this type of biotechnology.
8. What is the biological significance of each of the three functions of DNA?
9. What are start and stop codons and what are their functions?