Unit 8 – DNA Structure, Replication, and Protein Synthesis

Objective 3.01 – Analyze the molecular basis of heredity including DNA replication, protein synthesis, and gene regulation

1. Which series is arranged in order from largest to smallest?
   a. Chromosomes, nucleus, cell, DNA, nucleotide
   b. Cell, nucleus, chromosome, DNA, nucleotide
   c. Nucleus, chromosome, cell, nucleotide, DNA
   d. DNA, cell, nucleotide, nucleus, chromosome

2. Scientists have determined that the shape of the DNA molecule is
   a. a single helix  b. a cloverleaf c. a double helix d. a single strand

3. Scientists have determined that DNA is made of individual units called
   a. nitrogen bases b. nucleotides c. deoxyribose d. amino acids

4. Which compound is NOT part of a DNA nucleotide?
   a. ribose   b. thymine c. deoxyribose d. adenine

5. Which diagram best represents a basic structural unit of DNA?
   a. P
   b. P
   c. P
   d. P

6. The DNA molecule has a ladder-type structural organization. Each rung of this ladder represents
   a. ribose molecules c. alternating phosphate and glucose molecules
   b. a pair of nitrogenous bases d. a random organization of proteins and lipids

7. The four nitrogen bases found in DNA are
   a. amine, guanine, pyrimidine, ribose
   b. adenine, guanine, cytosine, thymine
   c. adenine, uracil, ribose, amine
   d. adenine, amine, guanine, cytosine

8. The diagram below represents a section of a DNA molecule
   The missing nitrogen bases are
   a. T, C, C
   b. U, G, G
   c. A, G, C
   d. A, G, G
9. The pairing of _____ in DNA is the key feature that allows for genetic variation
   a. deoxyribose   b. nitrogen bases   c. chromosomes   d. hydrogen bonds

10. The variety in the DNA code is found in the
    a. sides of the ladder           b. rungs/steps of the ladder
    c. sequence of base pairs       d. b and c

11. When does DNA replication occur?
    a. during interphase           c. just after cell division
    b. just before the cell divides d. both a and b

12. Which event takes place first during DNA replication?
    a. tRNA links to an amino acid  
    b. the DNA molecule “unzips” along hydrogen bonds
    c. free nucleotides are bonded together in the correct sequence
    d. a single-stranded RNA molecule is formed

13. Which event is NOT part of the process of DNA replication?
    a. hydrogen bonds are broken   
    b. a double-stranded molecule unwinds  
    c. nitrogenous base pairs are formed
    d. ribosomes are synthesized

14. The diagram below shows DNA replication:
    ![Diagram of DNA replication]

    The 2 new DNA molecules may be described as...
    a. one molecule is entirely “old” and one is entirely “new”
    b. each molecule has one “old” strand and one “new”
    c. the molecule is always copied with no mistakes
    d. the molecule is copied quickly

15. During DNA replication, a complementary strand of DNA is made for each original DNA strand. Thus, if a portion of the original strand is CCTAGCT, the new strand will be
    a. TTGCATC  b. AAGTATC  c. CCTAGCT  d. GGATCGA

16. Which of the following is true about DNA replication?
    a. it must occur before a cell can divide  
    b. the process is catalyzed by enzymes
    c. two identical strands are formed  
    d. all of the above

17. RNA is different from DNA in which of the following ways?
    a. RNA is single-stranded and DNA is double-stranded
    b. DNA contains thymine and RNA contains uracil
    c. DNA doesn’t leave the nucleus and RNA does
    d. all of the above
18. In the chart below, “X” indicates that a component is present within a substance:

<table>
<thead>
<tr>
<th>Component</th>
<th>Substance 1</th>
<th>Substance 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double strand</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Single strand</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Cytosine</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Guanine</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Thymine</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Adenine</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Uracil</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Phosphate</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Substances 1 and 2 are most likely
a. RNA and ATP
b. DNA and ATP
c. ATP and ICF
d. DNA and RNA

19. Which of the following is NOT a type of RNA?
a. messenger  
b. translate  
c. transfer  
d. ribosomal

20. The process by which DNA is copied to RNA is called
a. mitosis  
b. replication  
c. transcription  
d. translation

21. mRNA carries the message from
   a. the ribosome to the mitochondria  
b. the chromosomes to the ribosomes  
c. the mitochondria to the nucleus  
d. the chromosomes to the mitochondria

22. What process is being shown in the diagram below?
   a. DNA replication  
b. Transcription  
c. Translation  
d. Meiosis

23. If a sequence of nitrogenous bases on a DNA strand is TAGCCTA, the corresponding sequence on the complementary RNA will be
   a. TAGCCTA  
b. ATCGGAT  
c. UTCGGUT  
d. AUCGGAU

Use the diagram below to answer questions 24-28:

24. What process is being shown in the diagram above?
   a. DNA replication  
b. transcription  
c. translation  
d. mitosis
25. The structure labeled “1” is  
a. mRNA  b. tRNA  c. ribosome  d. amino acid
26. The structure labeled “2” is  
a. mRNA  b. tRNA  c. ribosome  d. amino acid
27. The structure labeled “3” is  
a. mRNA  b. tRNA  c. ribosome  d. amino acid
28. The structure labeled “4” will become a(n)  
a. DNA molecule  b. RNA molecule  c. protein  c. ribosome
29. A sequence of 3 nitrogen bases on mRNA that pairs with the tRNA anticodon is  
a. anticodon  b. codon  c. triplet  d. amino acid

Use the mRNA strand and the codon chart to answer questions 30-33

<table>
<thead>
<tr>
<th>1st base in codon</th>
<th>2nd base in codon</th>
<th>mRNA – CUC AAG UGC UUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
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<tr>
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<td>Ser</td>
<td>Tyr</td>
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<tr>
<td>Val</td>
<td>Ala</td>
<td>Gly</td>
</tr>
</tbody>
</table>

30. The sequence of DNA that this molecule was transcribed from is  
a. AGA CCT GTA GGA  
b. GAG TTC ACG AAG  
c. GTC TTC TCG TTG  
d. GAG UUC ACG AAG

31. The tRNA codon that pairs with the first mRNA codon is  
a. GAG  b. GTG  c. CUC  d. CTC

32. The correct sequence of amino acids is  
a. Leu Lys Cys Leu  c. Ser Arg Ser Phe  
b. Glu Phe Thr Lys  d. Leu Lys Cys Phe

33. A codon that codes for the amino acid Valine (Val) is  
a. GUA  b. UGU  c. GGG  d. GCU

Use the series of reactions shown below to answer questions 34-35:

**Molecule A** Transcription > **Molecule B** Translation > **Product**

34. In the series of reactions shown above, molecule A would be:  
a. DNA  b. RNA  c. Amino Acids  d. Enzymes

35. The final product in the series of reactions is  
a. DNA  b. RNA  c. Amino Acids  d. Cells
36. The correct order of molecules involved in protein synthesis is
   a. mRNA, tRNA, DNA, protein   c. DNA, mRNA, tRNA, protein
   b. DNA, mRNA, protein, tRNA   d. tRNA, protein, mRNA, DNA

37. All body cells in an individual organism have the same DNA but differ in
   a. types of RNA   c. functions, because cells are differentiated
   b. proteins produced   d. both b and c

For question #38, use the codon chart on the previous page.
38. A strand of DNA with the sequence AAC AAG CCC undergoes a mutation, and the
   first A is changed to a C. How will this mutation affect the amino acid sequence?
   a. one amino acid will change   c. all of the amino acids will change
   b. two amino acids will change   d. the amino acids will remain the same

39. The type of mutation shown below is called a
   \[\text{ABCDE} \rightarrow \text{ABGDE}\]
   a. frameshift mutation   b. translocation   c. deletion   d. point mutation

40. The type of mutation shown below is called a
   \[\text{ABCDE} \rightarrow \text{ABCCDE}\]
   a. frameshift mutation   b. translocation   c. deletion   d. point mutation

Cumulative Questions:
Mark “A” for true and “B” for false.

41. Energy is lost as it moves up through the food web.
42. Biomagnification increases the risks of producers to the effects of pesticides.
43. The organic molecules that provide you with energy are nucleic acids and proteins.
44. The movement of molecules down a concentration gradient is called diffusion.
45. The type of cell division that produces the gametes is mitosis.
Key:

1. B
2. C
3. B
4. A
5. B
6. B
7. B
8. D
9. B
10. D
11. D
12. B
13. D
14. B
15. D
16. D
17. D
18. D
19. B
20. C
21. B
22. B
23. D
24. C
25. A
26. C
27. D
28. C
29. B
30. B
31. A
32. D
33. A
34. A
35. C
36. C
37. D
38. A
39. D
40. A
41. A
42. B
43. B
44. A
45. B
Unit 8 Essay

DNA is an amino acid that controls all cellular activities. Chromosomes are made of DNA and are found in the nucleus of prokayotic cells. DNA is made of 3 part units called nucleotides consisting of a sugar, a nitrogen group and one of four nitrogen bases. The structure of DNA is known as a double helix...the sides of the helix are composed of alternating sugars and phosphates, and the rungs (or steps) of the DNA helix are composed of nitrogen bases. The nitrogen bases are held together by weak peptide bonds. DNA differs in organisms by the sequence of the phosphate groups. Because all cells need a copy of DNA to function, the DNA is replicated before a cell divides. DNA controls cellular activities by directing the formation of proteins for the cell. A sequence of DNA that codes for the production of a particular protein is called a chromosome. First the DNA code is replicated into mRNA which can leave the nucleus and carry the information from the DNA to the lysosomes where proteins are produced. At the ribosomes, mRNA is transcribed into a sequence of nucleic acids that will fold into a unique protein structure. In this way, the cell is able to produce enzymes, pigments, antibodies and other essential proteins.
DNA is a **nucleic acid** that controls all cellular activities. Chromosomes are made of DNA and are found in the nucleus of **eukaryotic** cells. DNA is made of 3 part units called nucleotides consisting of a sugar, a **phosphate** group and one of four nitrogen bases. The structure of DNA is known as a double helix...the sides of the helix are composed of alternating sugars and phosphates, and the rungs (or steps) of the DNA helix are composed of nitrogen bases. The nitrogen bases are held together by weak **hydrogen** bonds. DNA differs in organisms by the sequence of the **nitrogen bases**. Because all cells need a copy of DNA to function, the DNA is replicated before a cell divides. DNA controls cellular activities by directing the formation of proteins for the cell. A sequence of DNA that codes for the production of a particular protein is called a **gene**. First the DNA code is **transcribed** into mRNA which can leave the nucleus and carry the information from the DNA to the **ribosomes** where proteins are produced. At the ribosomes, mRNA is **translated** into a sequence of **amino acids** that will fold into a unique protein structure. In this way, the cell is able to produce enzymes, pigments, antibodies and other essential proteins.