DNA Structure

Multiple Choice
 Identify the choice that best completes the statement or answers the question.

1. Because of base pairing in DNA, the percentage of
a. adenine molecules in DNA is about equal to the percentage of guanine molecules.
b. thymine molecules in DNA is about equal to the percentage of adenine molecules
c. adenine molecules in DNA is much greater than the percentage of thymine molecules.
d. cytosine molecules in DNA is much greater than the percentage of guanine molecules.

<table>
<thead>
<tr>
<th>Nitrogenous Bases (%)</th>
<th>A</th>
<th>G</th>
<th>T</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td>19.9%</td>
<td>29.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicken</td>
<td>28.8%</td>
<td></td>
<td>29.4%</td>
<td></td>
</tr>
<tr>
<td>Bacterium (S. lutea)</td>
<td>13.4%</td>
<td></td>
<td></td>
<td>21.5%</td>
</tr>
</tbody>
</table>

2. The table in Figure 12–3 shows the results of measuring the percentages of the four bases in the DNA of several different organisms. Some of the values are missing from the table. Based on Chargaff’s rule, the percentages of guanine bases in chicken DNA should be around
a. 28.8%
b. 19.9%
c. 21.5%
d. 13.4%

3. Based on Chargaff’s rule, the percentage of cytosine in the DNA of the bacterium, S. Lutea in Figure 12–3, should be around
a. 26.6%.
b. 73.2%.
c. 36.6%.
d. 29.4%.

4. What structural problem prevents adenine from pairing with guanine?
a. The bases are both short.
b. They lack phosphate groups.
c. They lack the deoxyribose group.
d. The bases are both long.

5. Which two bases pair together in DNA?
a. adenine and guanine
b. guanine and thymine
c. thymine and cytosine
d. cytosine and guanine

6. Which scientist made x-ray diffraction photos of DNA?
a. Franklin
b. Chargaff
c. Watson
d. Avery
7. What would happen to the percentage of G in Figure 12–4 if the percentage of A rose to 25%?
a. G would drop to 19%
b. G would drop to 25%
c. G would rise to 29%
d. G would rise to 32% 

8. What did Rosalind Franklin contribute to the effort to identify the structure of DNA?
a. models made of cardboard and wire showing the shape of DNA
b. the ratios of the two sets of nucleotide pairs in DNA
c. radioactive evidence that DNA carried the genetic code
d. x-ray diffraction photos of the DNA molecule 

9. Watson and Crick discovered the two strands in DNA
a. run in perpendicular directions.
b. run in the same direction.
c. run in opposite directions.
d. run in random directions.

10. DNA replication results in two DNA molecules,
a. each with two new strands.
b. one with two new strands and the other with two original strands.
c. each with one new strand and one original strand.
d. each with two original strands.

11. During DNA replication, a DNA strand that has the bases CTAGGT produces a strand with the bases
a. TCGAAC.
b. GATCCA.
c. AGCTTG.
d. GAUCCA.

<table>
<thead>
<tr>
<th>BASE</th>
<th>A</th>
<th>C</th>
<th>G</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of Total DNA</td>
<td>22</td>
<td>_</td>
<td>28</td>
<td>_</td>
</tr>
</tbody>
</table>

Figure 12–4

Figure 12–5
12. In Figure 12–5, what nucleotide is going to be added at point 1, opposite from thymine?
   a. adenine
   b. thymine
   c. cytosine
   d. guanine

13. In Figure 12–5, what is adding base pairs to the strand?
   a. histones
   b. nucleosomes
   c. DNA polymerase
   d. chromatin

14. Which bacteria killed the mice in Griffin’s transformation experiment?
   a. live, harmless bacteria and heat-killed, harmful bacteria
   b. live, harmless bacteria and heat-killed, harmless bacteria
   c. live harmful bacteria and heat-killed, harmless bacteria
   d. live harmless bacteria, and live, harmful bacteria

15. Griffith called the process he observed transformation because
   a. the mouse had been transformed.
   b. the harmful bacteria had been transformed.
   c. the harmless bacteria had been transformed.
   d. the experiment had been transformed.

16. What did Avery conclude caused transformation?
   a. DNA was the transforming factor.
   b. A protein was the transforming factor.
   c. A carbohydrate was the transforming factor.
   d. A lipid was the transforming factor.

17. Why did Hershey and Chase label the viral DNA with radioactive phosphorous and not radioactive sulfur?
   a. DNA contains phosphorus and no sulfur.
   b. Proteins contain phosphorus and no sulfur.
   c. DNA contains sulfur and little phosphorous.
   d. Proteins acids contain sulfur and little phosphorous.

18. Avery’s experiments showed that bacteria are transformed by
   a. RNA.
   b. DNA.
   c. proteins.
   d. carbohydrates.

19. What did Griffith observe when he injected a mixture of heat-killed, disease-causing bacteria and live harmless bacteria into mice?
   a. The disease-causing bacteria dies.
   b. The mice developed pneumonia.
   c. The harmless bacteria died.
   d. The mice were unaffected.

20. What would Hershey and Chase have concluded if both radioactive $^{32}$P and $^{35}$S were found in the bacteria in their experiment?
   a. The virus’s protein coat was not injected into the bacteria.
   b. The virus’s DNA was not injected into the bacteria.
   c. Genes are made of protein and carbohydrates.
d. Both the virus’s protein coat and its DNA were injected into the bacteria.

___ 21. Avery’s experiment worked because bacteriophages and bacteria share which component?
   a. proteins
   b. carbohydrates
   c. DNA
   d. lipids

___ 22. In the Hershey-Chase experiment, what happened to the bacteria that had been infected by viruses that had radioactive DNA, and to the bacteria that had been infected with viruses that had been marked with radioactive proteins?
   a. The bacteria infected with viruses that had radioactive DNA had become radioactive. The bacteria that had been infected with viruses marked with radioactive proteins were not radioactive.
   b. The bacteria infected with viruses that had radioactive proteins had become radioactive. The bacteria that had been infected with viruses marked with radioactive DNA were not radioactive.
   c. The bacteria infected with viruses that had radioactive DNA had become radioactive. The bacteria that had been infected with viruses marked with radioactive proteins had also become radioactive.
   d. The bacteria infected with viruses that had radioactive DNA had not become radioactive. The bacteria that had been infected with viruses marked with radioactive proteins had also not become radioactive.

___ 23. What is the chronological order of the important discoveries in the structure of DNA?
   a. Franklin makes an X-ray diffraction photo of DNA → Chargaff’s ratios of nucleotides → Watson and Crick identify the double helix
   b. Franklin makes an X-ray diffraction photo of DNA → Watson and Crick identify the double helix → Chargaff’s ratios of nucleotides
   c. Chargaff’s ratios of nucleotides → Watson and Crick identify the double helix → Franklin makes an X-ray diffraction photo of DNA
   d. Chargaff’s ratios of nucleotides → Franklin makes an X-ray diffraction photo of DNA → Watson and Crick identify the double helix

**Modified True/False**

*Indicate whether the statement is true or false. If false, change the identified word or phrase to make the statement true.*

___ 24. DNA is a nucleic acid made up of nucleosomes joined into long strands or chains by covalent bonds.

___ 25. The three parts of a DNA nucleotide are the phosphate group, deoxyribose, and the base.

___ 26. Watson and Crick discovered that covalent bonds hold base pairs together at the center of a strand of DNA.

___ 27. The replication of a DNA molecule results in four copies of the same gene.

___ 28. A DNA strand that had the sequence TACGTT would have a complimentary strand ATCGAT.
**Completion**

*Complete each statement.*

29. The Watson and Crick model of DNA is a(an) ______________________, in which two strands are wound around each other.

30. ______________________ are weak bonds that hold the two strands of DNA together, but also allow the DNA to separate and replicate.

**Short Answer**

31. What are the roles of covalent bonds and hydrogen bonds in the structure of DNA?

32. How did X-ray technology enable scientists to better understand the structure of DNA?

33. If the percentage of guanine in the DNA of a certain species decreased by 5 percent over time, what would you expect to have happened to the percentage of adenine in that DNA?

**Other**

<table>
<thead>
<tr>
<th>Source of DNA</th>
<th>A</th>
<th>T</th>
<th>G</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streptococcus</td>
<td>29.8</td>
<td>20.5</td>
<td>18.0</td>
<td></td>
</tr>
<tr>
<td>Yeast</td>
<td>31.3</td>
<td>18.7</td>
<td>17.1</td>
<td></td>
</tr>
<tr>
<td>Herring</td>
<td></td>
<td></td>
<td>22.6</td>
<td></td>
</tr>
<tr>
<td>Human</td>
<td>29.4</td>
<td></td>
<td>19.8</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 12–12*

34. **Interpret Tables In** Figure 12–12, what do the A, T, G and C stand for?

35. **Calculate** Approximately what percentage of adenine would you expect to find in herring in Figure 12–12?