Decoding DNA

Part 1: DNA Structure

Use the template DNA sequence to determine the complementary DNA sequence created during DNA replication.

<table>
<thead>
<tr>
<th>tDNA</th>
<th>5'- GGC</th>
<th>TAC</th>
<th>TTA</th>
<th>AAG</th>
<th>CGC</th>
<th>CCT</th>
<th>ATA</th>
<th>ACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>cDNA</td>
<td>3'- GGC</td>
<td>ATG</td>
<td>AAT</td>
<td>TTC</td>
<td>GCG</td>
<td>GGA</td>
<td>TAT</td>
<td>TGA</td>
</tr>
</tbody>
</table>

Part 2: Protein Synthesis

For each of the following sequences, use the Universal Genetic code to determine the amino acid sequence coded for by the template DNA strand.

In some problems, you will need to use the information provided to determine the sequence of the template DNA strand. (NOTE: tDNA = template DNA; cDNA = complementary DNA)

1. Basic Decoding:

<table>
<thead>
<tr>
<th>tDNA</th>
<th>5' - TAC</th>
<th>TAA</th>
<th>CAC</th>
<th>GAT</th>
<th>GTA</th>
<th>TAT</th>
<th>GGT</th>
<th>ATG</th>
<th>AGC</th>
<th>ACT -3'</th>
</tr>
</thead>
<tbody>
<tr>
<td>mRNA</td>
<td>AUG</td>
<td>AUU</td>
<td>GUG</td>
<td>CUA</td>
<td>CAU</td>
<td>AUA</td>
<td>CCA</td>
<td>UAC</td>
<td>UCG</td>
<td>UGA</td>
</tr>
<tr>
<td>AA</td>
<td>met</td>
<td>Ile</td>
<td>Val</td>
<td>Leu</td>
<td>His</td>
<td>Ile</td>
<td>Pro</td>
<td>Tyr</td>
<td>Ser</td>
<td>---</td>
</tr>
<tr>
<td>Letter</td>
<td>START</td>
<td>D</td>
<td>E</td>
<td>C</td>
<td>O</td>
<td>D</td>
<td>I</td>
<td>N</td>
<td>G</td>
<td>?</td>
</tr>
</tbody>
</table>

2. Decoding with anti-codons:

<table>
<thead>
<tr>
<th>cDNA</th>
<th>3' - AGC</th>
<th>CCC</th>
<th>CCG</th>
<th>TGT</th>
<th>TAT</th>
<th>GTT</th>
<th>GGA</th>
<th>TAA - 5'</th>
</tr>
</thead>
<tbody>
<tr>
<td>tDNA</td>
<td>5' - TAC</td>
<td>TCG</td>
<td>GGG</td>
<td>GGC</td>
<td>ACA</td>
<td>ATA</td>
<td>CAA</td>
<td>CCT</td>
</tr>
<tr>
<td>mRNA</td>
<td>AUG</td>
<td>AGC</td>
<td>CCC</td>
<td>CCG</td>
<td>UGU</td>
<td>UAU</td>
<td>GUU</td>
<td>GGA</td>
</tr>
<tr>
<td>tRNA</td>
<td>UAC</td>
<td>UCG</td>
<td>GGG</td>
<td>GGC</td>
<td>ACA</td>
<td>AUA</td>
<td>CAA</td>
<td>CCU</td>
</tr>
<tr>
<td>AA</td>
<td>Met</td>
<td>Ser</td>
<td>Pro</td>
<td>Pro</td>
<td>cys</td>
<td>Tyr</td>
<td>Val</td>
<td>Gly</td>
</tr>
<tr>
<td>Letter</td>
<td>START</td>
<td>W</td>
<td>H</td>
<td>I</td>
<td>T</td>
<td>N</td>
<td>E</td>
<td>Y</td>
</tr>
</tbody>
</table>

a. How is the cDNA similar to the mRNA?
The cDNA and the mRNA sequences are the same, except U (instead of T) is complementary to A in RNA.
b. What is tRNA’s role in protein synthesis?
Transfer RNA carriers the correct amino acid to the ribosome to be added to the growing polypeptide chain.

c. Which DNA strand?

<table>
<thead>
<tr>
<th>tDNA</th>
<th>5' - TAC</th>
<th>AGG</th>
<th>CAC</th>
<th>ACC</th>
<th>CAA</th>
<th>TTT</th>
<th>AAT</th>
<th>AAG</th>
<th>GAG</th>
<th>GGA -or- GGG</th>
<th>ATC -3'</th>
</tr>
</thead>
<tbody>
<tr>
<td>cDNA</td>
<td>3' - ATG</td>
<td>TCC</td>
<td>GTG</td>
<td>TGG</td>
<td>GTT</td>
<td>AAA</td>
<td>TTA</td>
<td>TTC</td>
<td>CTC</td>
<td>CCT -or- CCC</td>
<td>TAG -5'</td>
</tr>
<tr>
<td>mRNA</td>
<td>AUG</td>
<td>UCC</td>
<td>GUG</td>
<td>UGG</td>
<td>GUU</td>
<td>AAA</td>
<td>UUA</td>
<td>UUC</td>
<td>CUC</td>
<td>CCU -or- CCC</td>
<td>UAG</td>
</tr>
<tr>
<td>tRNA</td>
<td>UAC</td>
<td>AGG</td>
<td>CAC</td>
<td>ACC</td>
<td>CAA</td>
<td>UUU</td>
<td>AAU</td>
<td>AAG</td>
<td>GAG</td>
<td>GGA -or- GGG</td>
<td>AUG</td>
</tr>
<tr>
<td>AA</td>
<td>Met</td>
<td>ser</td>
<td>Val</td>
<td>Trp</td>
<td>val</td>
<td>Lys</td>
<td>Leu</td>
<td>Phe</td>
<td>Leu</td>
<td>pro</td>
<td>---</td>
</tr>
<tr>
<td>Letter</td>
<td>START</td>
<td>F</td>
<td>E</td>
<td>U</td>
<td>E</td>
<td>R</td>
<td>B</td>
<td>A</td>
<td>C</td>
<td>H</td>
<td>!</td>
</tr>
</tbody>
</table>

3. Which side of DNA is used for transcription? The template DNA strand.
4. Reverse Decoding:

<table>
<thead>
<tr>
<th>tDNA</th>
<th>5' - TCA -or- TCG -or- TCT -or- TCC</th>
<th>GGT -or- GGA</th>
<th>CGA -or- CGG</th>
<th>TAA -or- TAG -or- TAT</th>
<th>GAA -or- GAT -or- GAC</th>
<th>AAA -or- AAG</th>
<th>ACA -or- ACG</th>
<th>CTA -or- CTT -or- CTC</th>
<th>ATC-3'</th>
</tr>
</thead>
<tbody>
<tr>
<td>mRNA</td>
<td>AGU -or- AGC -or- AGA -or- AGG</td>
<td>CCA -or- CCG</td>
<td>GCU -or- GCC</td>
<td>AUU -or- AUC -or- AUA</td>
<td>CUU -or- CU -or- CUG</td>
<td>UUU -or- UUC</td>
<td>UGU -or- UGC</td>
<td>GAU -or- GAC -or- GAG</td>
<td>UAG</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AA</th>
<th>Ser</th>
<th>Pro</th>
<th>Ala</th>
<th>Ile</th>
<th>Leu</th>
<th>Phe</th>
<th>Cys</th>
<th>Asp</th>
<th>---</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter</td>
<td>W</td>
<td>I</td>
<td>L</td>
<td>D</td>
<td>C</td>
<td>A</td>
<td>T</td>
<td>S</td>
<td>!</td>
</tr>
</tbody>
</table>

**d.** Will everyone have the same mRNA and tDNA for this problem? Explain.

Not everyone will have the same sequences because there are multiple codons that code for the same amino acid.

5. Create your own message: answers will vary

<table>
<thead>
<tr>
<th>tDNA</th>
<th>5'</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>mRNA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Letter</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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![The Universal Genetic Code Table]

*NOTE: Amino acids do NOT really have letters, these letters and symbols are provided to help you better visualize the protein as a whole, functioning unit.