Protein Synthesis Worksheet

Directions:
1st Fill in the complimentary DNA strand using DNA base pairing rules.
2nd Fill in the correct mRNA bases by transcribing the bottom DNA code.
3rd Translate the mRNA codons and find the correct amino acid using the Codon Table
4th Write in the amino acid and the correct anti-codon the tRNA molecule.
5th The answer to the questions about protein synthesis below the amino acids.

DNA

mRNA

Amino Acids

DNA

mRNA

Amino Acids

5. mRNA is synthesized in translation or transcription?
6. mRNA has codon or anti-codons?

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11. DNA
12. mRNA
13. tRNA
14. Amino Acids
   - Phenylalanine
   - Glutamine
   - Serine
   - Threonine
   - Asparagine

15. 1 or 3 codons equal one amino acid?

16. tRNA brings amino acids to the nucleus or ribosome?

17. A polypeptide is a sequence of proteins or amino acids?

18. tRNA has codons or anti-codons?

19. tRNA transfers amino acids during translation or transcription?

20. Ribosomes are the site where translation or transcription takes place?

21. DNA
22. mRNA
23. tRNA
24. Amino Acids
   - Valine
   - Leucine
   - Lysine
   - Valine
   - Stop!
BREAKING THE CODE

REPLICATION
For each of the three DNA sequences below, write the sequence of the complementary strand of DNA that results after replication.

DNA molecule #1: TACCGGATGCCAGATCAAATC
Complementary DNA #1 ATGGCCCTACGCTCAGTTTAG

DNA molecule #2: TACGGGGGGCGTAACCACAACG
Complementary DNA #2 ATGCCGCCCCATGCTGCTGATG

DNA molecule #3: TACCTGTAAAGCTACAAAATT
Complementary DNA #3 ATG GAC AAT TCG ATG TTT TAA

TRANSCRIPTION
For each of the same DNA sequences below, write the sequence of messenger RNA codons that is synthesized during transcription. Be sure to separate the codons into *triplets*.

DNA molecule #1: TACCGGATGCCAGATCAAATC
mRNA #1 AUG CUC UAC GGU CUA GUG UAG

DNA molecule #2: TACGGGGGGCGTAACCACAACG
mRNA #2 AUG CUC CCC CAG UGG UGM UGA

DNA molecule #3: TACCTGTAAAGCTACAAAATT
mRNA #3 AUG GAC AAU UCG AUG UUU UAA
TRANSLATION
For each of the mRNA codon sequences you have written, determine the sequence of tRNA anticodons that match it.

Anticodons for mRNA #1: UAC CCG AUG CCA GAU CAA AUC
Anticodons for mRNA #2: UAC GGG GGC GUA ACC ACA AUC
Anticodons for mRNA #3: UAC CUG UUA AGU UAC AAA AUC

Using the chart below, write the amino acid sequence coded for by each mRNA. (Note: The code is based on mRNA codons, not tRNA anticodons.)

Polypeptide #1: Methionine-Alanine-Tyrosine-Proline-Leucine-Valine-Stop
Polypeptide #2: Methionine-Proline-Proline-Histidine-Tryptophan-Cysteine-Stop
Polypeptide #3: Methionine-Aspartic Acid-Asparagine-Serine-Methionine-Phenylalanine-Stop

The Genetic Code
(Based on Messenger RNA Codons)

<table>
<thead>
<tr>
<th>First Base</th>
<th>Second Base</th>
<th>Third Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>Phenylalanine</td>
<td>Serine</td>
<td>Tyrosine</td>
</tr>
<tr>
<td>Phenylalanine</td>
<td>Serine</td>
<td>Tyrosine</td>
</tr>
<tr>
<td>Leucine</td>
<td>Serine</td>
<td>Stop</td>
</tr>
<tr>
<td>Leucine</td>
<td>Serine</td>
<td>Stop</td>
</tr>
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<td>Glutamine</td>
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<tr>
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<tr>
<td>G</td>
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<td>Glutamic acid</td>
</tr>
<tr>
<td>Valine</td>
<td>Alanine</td>
<td>Glutamic acid</td>
</tr>
</tbody>
</table>
REMEmBER: DNA \rightarrow \text{mRNA} \rightarrow \text{amino acid} \rightarrow +\text{RNA/}

**Proteins are made up of Amino Acids linked together.**

EX: DNA: TACGGGCACGACTACGGGATGATAAAAATTT
mRNA: AUG|CC|GGU|GCU|GUA|GCC|UAC|UAU|UUA|UAA
Protein: Met - Pro - Gly - Ala - Asp - Ala - Tyr - Tyr - Phe - Stop

1) DNA: TACCCGGGAAAATTTATCTGTTGAAC
mRNA: AUG|GGG|CC|UUU|AAA|AAU|AGG|ACC|AAA|UGA
Protein: Met - Gly - Pro - Phe - Lys - Ile - Arg - Thr - Asn - Stop

2) DNA: TACCTTACGACCCGGGAGGGGTTGACT
mRNA: AUG|GUA|GGU|GCG|GGG|CCU|CCG|CCA|CCC|UGA
Protein: Met - Gly - Gly - Gly - Gly - Pro - Pro - Pro - Stop

3) DNA: TACTTTATTTCTGCTTACAAAAATT
mRNA: AUG|AAA|AAG|AAC|AAA|GCC|GAA|GUA|UUU|UAA
Protein: Met - Asn - Lys - Asn - Lys - Ala - Gly - Val - Phe - Stop

4) DNA: TACGCCCTTGAATCCTAATTGGTGTTATC
mRNA: AUG|CGG|CAA|CUU|AGG|AUU|AAA|ACC|ACA|UAAG
Protein: Met - Arg - Glu - Leu - Arg - Ile - Lys - Thr - Thr - Stop

5) DNA: TACCGCGCGCATATACTAGAGATCTCTCAG
mRNA: AUG|GCG|CGC|UUU|AUU|CUC|UCU|AGA|GAG|UAG
Protein: Met - Ala - Arg - Tyr - Ile - Leu - Ser - Arg - Glu - Stop

(start)
Modified from a worksheet by Tom Mueller
Transcription

Ribonucleic Acid is very similar to DNA. RNA normally exists as a single strand (and not the double stranded double helix of DNA). It contains the same bases, adenine, guanine and cytosine. However, there is no thymine found in RNA, instead there is a similar compound called uracil.

Transcription is the process by which RNA is made from DNA. It occurs in the nucleus. Label the box with the x in it near the nucleus with the word TRANSCRIPTION and proceed to color the bases according to the key below.

- Thymine = orange
- Adenine = dark green
- Guanine = purple
- Cytosine = yellow
- Uracil = brown

Color the strand of DNA dark blue (D) and the strand of RNA light blue (R). Color the nuclear membrane (E) gray.

Translation

Translation occurs in the cytoplasm, specifically on the ribosomes. The mRNA made in the nucleus travels out to the ribosome to carry the "message" of the DNA. Here at the ribosome, that message will be translated into an amino acid sequence. Color the ribosome light green (Y) and note how the RNA strand threads through the ribosome like a tape measure and the amino acids are assembled. The RNA strand in the translation area should also be colored light blue, as it was colored in the nucleus.

Label the box with the X in the translation area with the word TRANSLATION.

Important to the process of translation is another type of RNA called Transfer RNA (F) which function to carry the amino acids to the site of protein synthesis on the ribosome. Color the tRNA red.

A tRNA has two important areas. The anticodon, which matches the codon on the RNA strand. Remember that codons are sets of three bases that code for a single amino acid. Make sure you color the bases of the anticodon the same color as the bases on your DNA and RNA strand - they are the same molecules.

At the top of the tRNA is the amino acids. There are twenty amino acids that can combine together to form proteins of all kinds, these are the proteins that are used in life processes! When you digest your food for instance, you are using enzymes that were originally proteins that were assembled from amino acids. Each tRNA has a different amino acid which link together like box cars on a train. Color all the amino acids (M) pink.
1. How many different kinds of bases can be found on DNA? 4
2. What base is found on RNA but not on DNA? Uracil (U)
3. How many bases are in a codon? 3
4. How many amino acids are attached to a single transfer RNA? 1
5. Transcription occurs in the nucleus; translation occurs in the ribosome.
6. The process of making RNA from DNA is called transcription, and it occurs in the nucleus.
7. The process of assembling a protein from RNA is called translation, and it occurs in the ribosome.