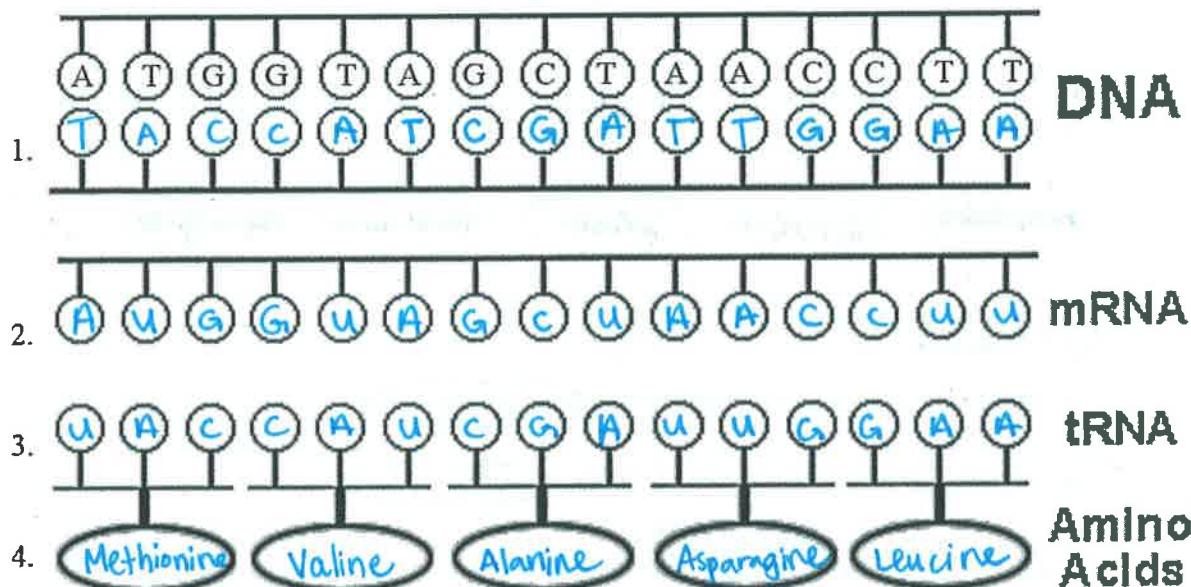


Protein Synthesis Worksheet

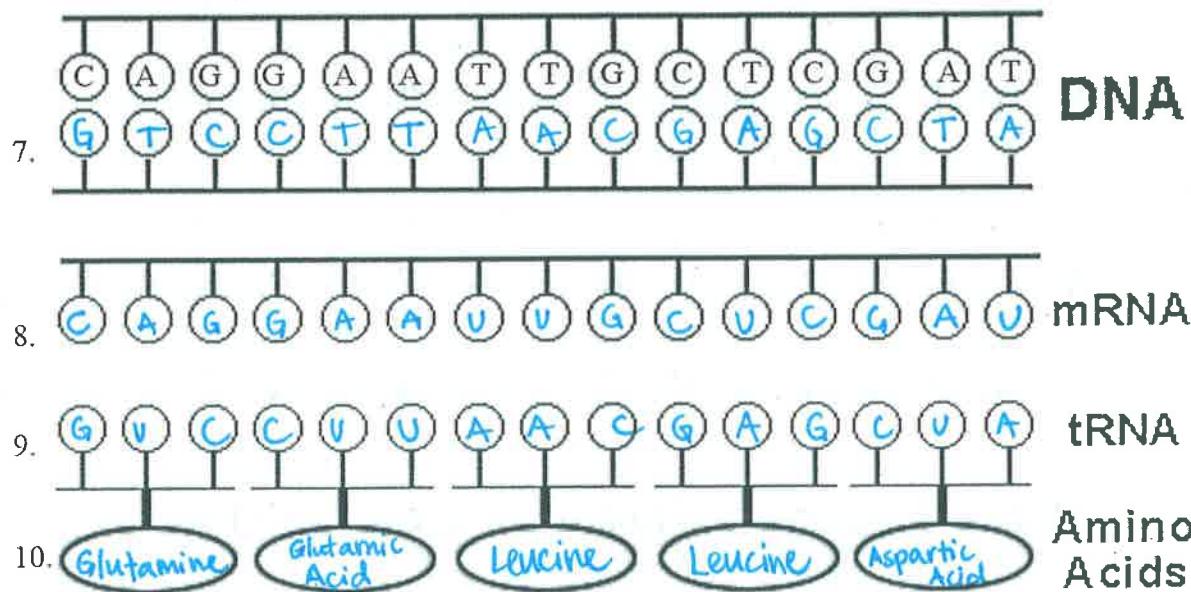
Directions:

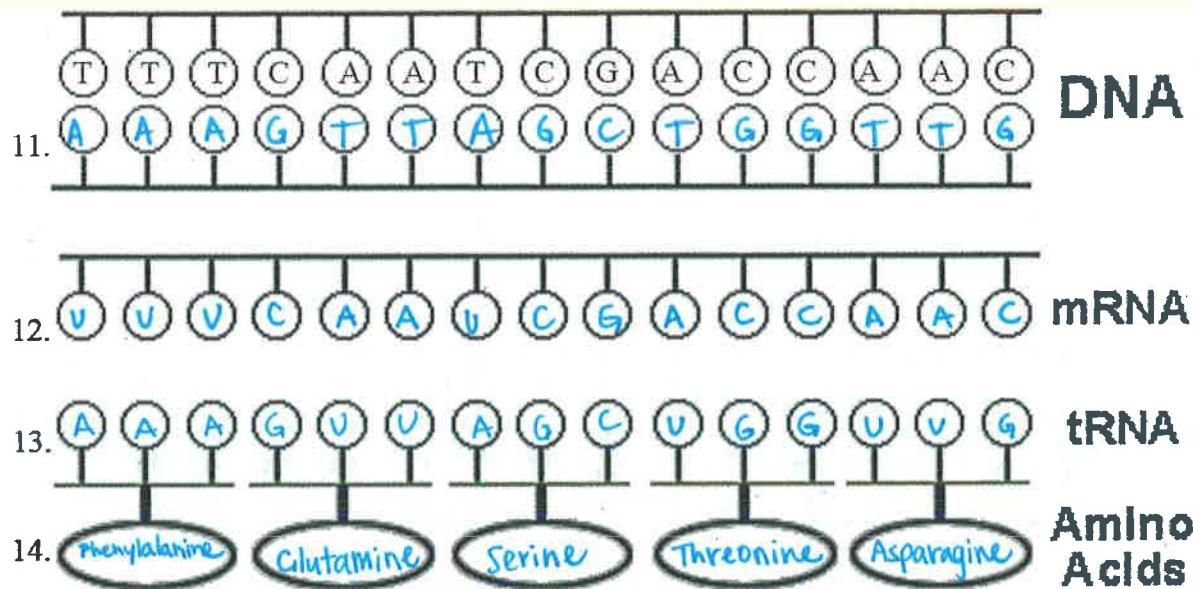
- 1st Fill in the complimentary DNA strand using DNA base pairing rules.
- 2nd Fill in the correct mRNA bases by transcribing the bottom DNA code.
- 3rd Translate the mRNA codons and find the correct amino acid using the Codon Table
- 4th Write in the amino acid and the correct anti-codon the tRNA molecule.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



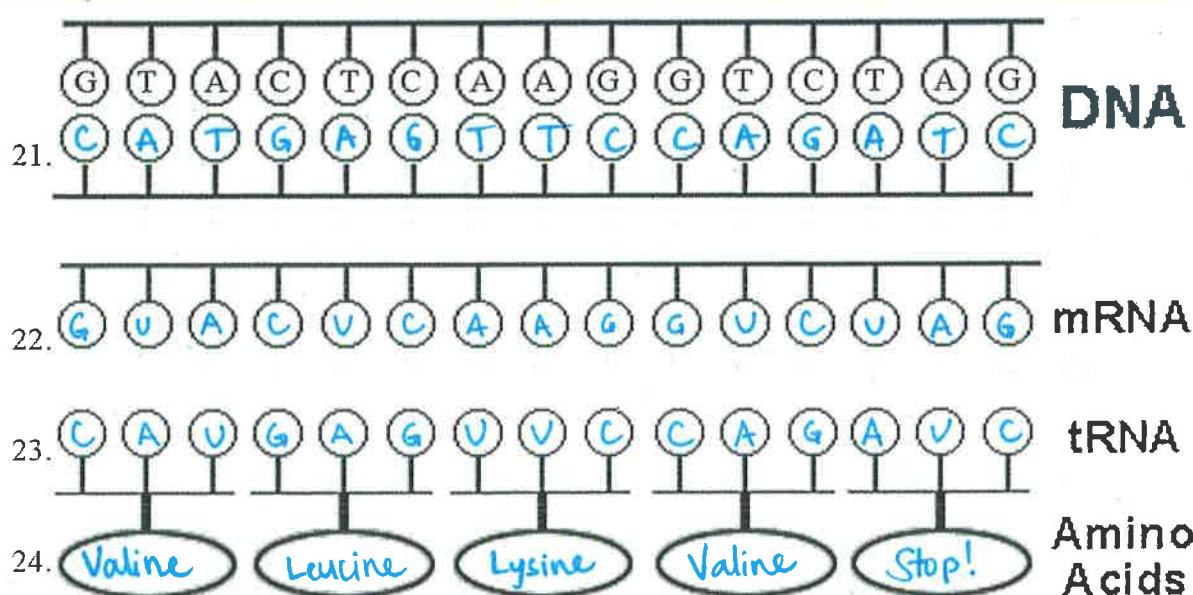
5. mRNA is synthesized in translation or transcription?

6. mRNA has codon or anti-codons?





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?



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 ATGGCTACGGTCTAGTTAG

DNA molecule #2: TACGGGGGGCGTAACCACAACT

Complementary DNA #2 ATGCCUCCGCAUTGGTGTTGA

DNA molecule #3: TACCTGTTAAGCTACAAATT

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: TACCGGATGCCAGATCAATC

mRNA #1 AUG GCC UAC GGU CUA GUU UAG

DNA molecule #2: TACGGGGGGCGTAACCACAACT

mRNA #2 AUG CCC CCG CAU UGG UGA UGA

DNA molecule #3: TACCTGTTAAGCTACAAATT

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 CGG AUG CCA GAA CAA AUC

Anticodons for mRNA #2: UAC GGG GGC GUA ACC ACA ACC

Anticodons for mRNA #3: UAC CUG UUA AGU UAC AAA AUN

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)

First Base	Second Base				Third Base
	U	C	A	G	
U	Phenylalanine	Serine	Tyrosine	Cysteine	U
	Phenylalanine	Serine	Tyrosine	Cysteine	C
	Leucine	Serine	Stop	Stop	A
	Leucine	Serine	Stop	Tryptophan	G
C	Leucine	Proline	Histidine	Arginine	U
	Leucine	Proline	Histidine	Arginine	C
	Leucine	Proline	Glutamine	Arginine	A
	Leucine	Proline	Glutamine	Arginine	G
A	Isoleucine	Threonine	Asparagine	Serine	U
	Isoleucine	Threonine	Asparagine	Serine	C
	Isoleucine	Threonine	Lysine	Arginine	A
	start Methionine	Threonine	Lysine	Arginine	G
G	Valine	Alanine	Aspartic acid	Glycine	U
	Valine	Alanine	Aspartic acid	Glycine	C
	Valine	Alanine	Glutamic acid	Glycine	A
	Valine	Alanine	Glutamic acid	Glycine	G

Biology Worksheet – Protein Synthesis (“making proteins”)
Using the Amino Acid Chart

REMEMBER: DNA → mRNA → amino acid → Protein

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

EX: DNA: T A C | G G G | C C A | C G A | C T A | C G G | A T G | A T A | A A A | A T T

mRNA: AUG | CCC | GGU | GCU | GAU | GCC | UAC | UAU | UUN | UAA

Amino Acids Protein: Met - Pro - Gly - Ala - Asp - Ala - Tyr - Tyr - Phe - Stop
(start)

1.) DNA: T A C | C C C | C G G | G A A | A T T | T A A | T C C | T G G | T T A | A C T

mRNA: AUG | GGG | CCG | UUN | AAA | AUU | AGG | ACC | AAU | UGA

Protein: Met - Gly - Pro - Phe - Lys - Ile - Arg - Thr - Asn - Stop
(start)

2.) DNA: T A C | C C T | C C A | C C G | C C C | G G G | A | G G C | G G G | T | G G G | A C T

mRNA: AUG | GUU | GGU | GGC | GGG | CCU | CCG | CCA | CCC | UGA

Protein: Met - Gly - Gly - Gly - Pro - Pro - Pro - Stop
(start)

3.) DNA: T A C | T T A | T T C | T T G | T T T | C G G | G T T | C A A | A A A | A T T

mRNA: AUG - AAU - AAG - AAC - AAA - GCC - GAA - GUU - UUN - UAA

Protein: Met - Asn - Lys - Asn - Lys - Ala - Gly - Val - Phe - Stop
(start)

4.) DNA: T A C | G C C | G T T | G A A | T C C | T A A | T T T | T G G | T G T | A T C

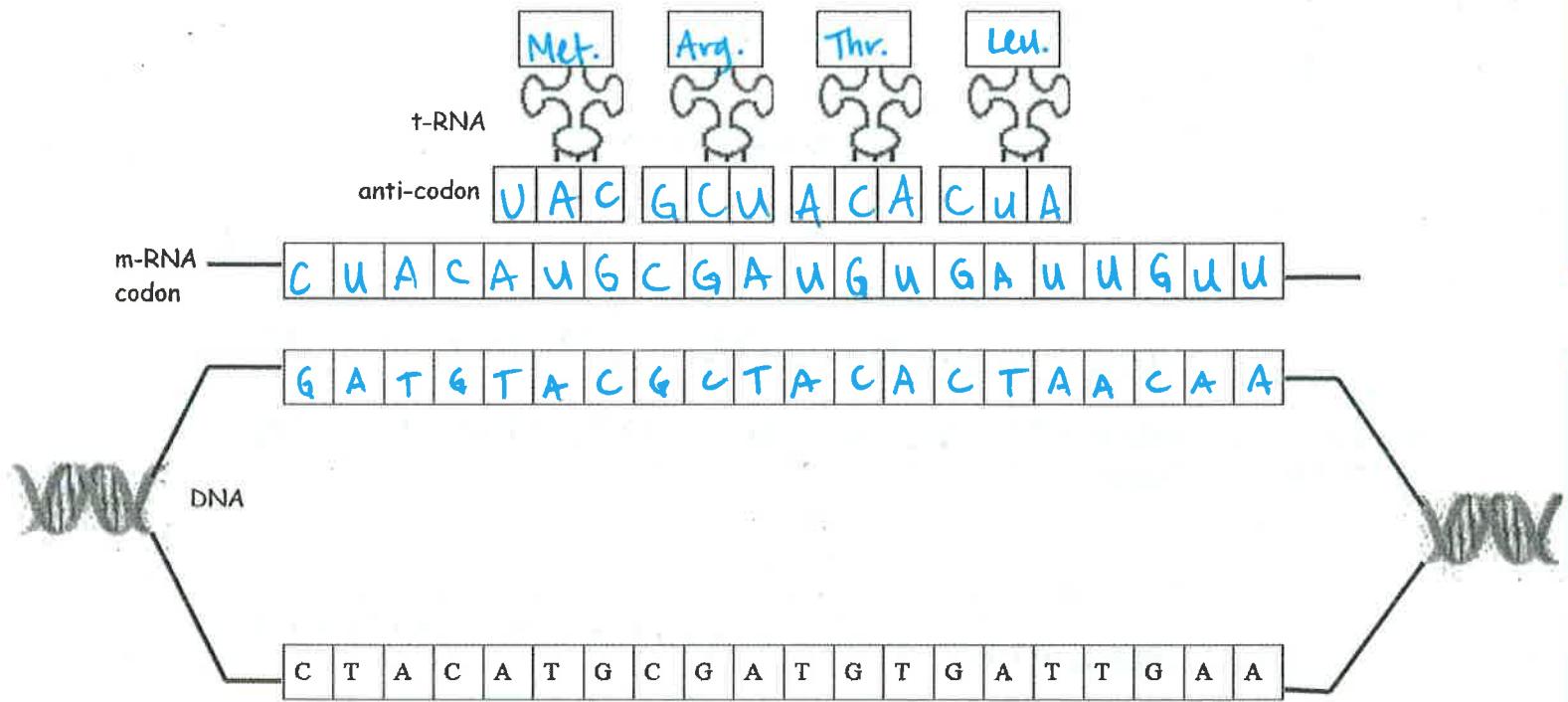
mRNA: AUG | CGG | CAA | CUU | AGG | AUU | AAA | ACC | ACA | UAG

Protein: Met - Arg - Gln - Leu - Arg - Ile - Lys - Thr - Thr - Stop
(start)

5.) DNA: T A C | C G C | G G G | A T A | T A T | G A G | A G A | T C T | C T C | A T C

mRNA: AUG | GCG | CGC | UAU | AUU | CUC | UCU | AGA | GAG | UAG

Met - Ala - Arg - Tyr - Ile - Leu - Ser - Arg - Glu - Stop
(start)



Modified from a worksheet by Tom Mueller

Transcription

R. 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.

- How many different kinds of bases can be found on DNA 4
- What base is found on RNA but not on DNA? Uracil (U)
- How many bases are in a codon? 3 In an anticodon? 3
- How many amino acids are attached to a single transfer RNA? 1
- Transcription occurs in the nucleus; translation occurs in the ribosome.
- The process of making RNA from DNA is called transcription and it occurs in the nucleus.
- The process of assembling a protein from RNA is called translation and it occurs in the ribosome.

TRANSCRIPTION AND TRANSLATION

