Inheritance of Traits

Transcription and Translation

Activity

Part I: Introduction

1. Copy the following statement below:

   "The color of the truck that was parked next to the football field was blue."

   ____

   ____

   ____

2. Based on what you did in question 1, define what you believe **transcribe** means.

   ____

   ____

   ____

3. Use the code below to fill in the blanks on the puzzle.

1 = a	2 = b	3 = c	4 = d	5 = e	6 = f	7 = g	8 = h	9 = i
10 = j	11 = k	12 = l	13 = m	14 = n	15 = o	16 = p	17 = q	18 = r
19 = s	20 = t	21 = u	22 = v	23 = w	24 = x	25 = y	26 = z	

___ ___ ___   ___ ___ ___ ___ ___ ___ ___   ___ ___
20 8 5   16 18 15 3 5 19 19   15 6

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___   ___ ___   ___ ___ ___ ___
20 18 1 14 19 12 1 20 9 15 14   9 19   12 9 11 5

___ ___ ___ ___ ___ ___ ___   ___   ___ ___ ___ ___ ___ ___.
19 15 12 22 9 14 7   1   16 21 26 26 12 5

4. What does the sentence say?

   ____

   ____

   ____

5. Based on what you did in question 3, define what you believe **translate** means.

   ____

   ____

   ____

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Part II: Overview of Protein Synthesis

In previous lessons, you learned the importance of DNA in living things. You may recall that DNA contains all of the genetic information for an organism. Most of the information in DNA is stored in segments called genes. A gene is a specific sequence of nucleotides in a strand of DNA that codes for a specific sequence of amino acids. The amino acids form chains that make certain proteins according to the order of the nitrogen bases. Just like the 26 letters of the alphabet make words, 20 amino acids can be joined together in various orders and lengths to make different proteins. Now let's discuss how that genetic information gets processed into the molecules needed to make proteins.

Proteins are some of the most valuable molecules for life. Proteins are essential to build muscle. They're found in cell membranes to help with transport. Hormones and enzymes also contain proteins. Without these vital biomolecules, life could not exist!

DNA is basically an informational molecule; it stores the information needed to produce proteins. You may remember that the DNA molecule is made of repeating nucleotides composed of a sugar, a phosphate, and a nitrogen base (adenine, thymine, cytosine, or guanine). DNA has the "plan" to make all of the proteins. However, DNA is a large molecule and it can't fit through the nuclear pores. It has to remain inside the nucleus. So how does the information get to the ribosomes for the production of proteins? That's where a molecule called RNA comes in!

RNA is known as ribonucleic acid. RNA is different from DNA in a few ways:

1.The sugar in RNA is ribose.
2.RNA is usually single stranded.
3.RNA is smaller than DNA, but it can be millions of nucleotides long.
4.RNA can leave the nucleus.
5.RNA has the nitrogen base "uracil" instead of thymine. (A uracil base pairs with adenine.

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There are three main types of RNA: mRNA (**m**essenger RNA), rRNA (**r**ibosomal RNA), and tRNA (**t**ransfer RNA). These RNA molecules have different structures and therefore have different jobs in the protein-making process (also known as protein synthesis). The process of making proteins consists of two major stages: transcription and translation.

1. Why must DNA send the instructions to create proteins through mRNA?

   _____

   _____

2. Fill in the chart below, comparing what you know about DNA to what you have just learned about RNA.

	DNA	RNA
Number of strands		
Sugar in backbone		
Nitrogen-base pairings		
Can it leave the nucleus?		

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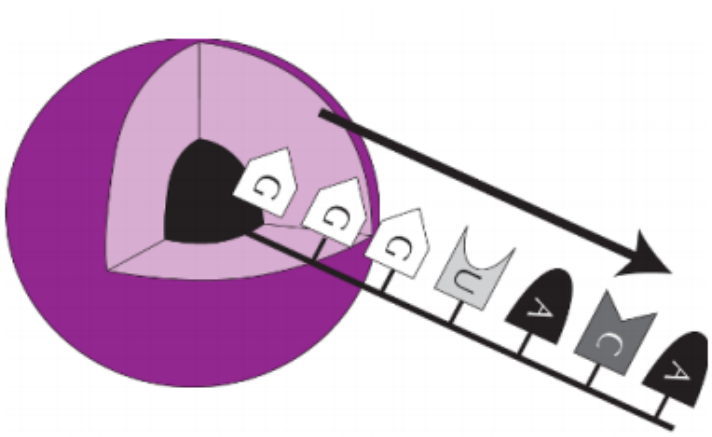
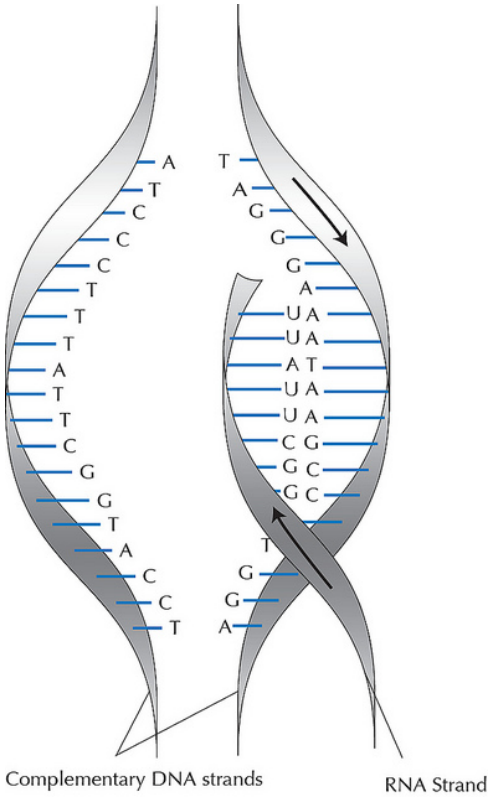
Part III: Transcription

The first step in protein synthesis is transcription. During transcription, the mRNA strand provides a way to transport the information contained in the DNA from inside the nucleus through the cell. As DNA codons are transcribed into RNA, a uracil base pairs with adenine. The process of transcription includes the following steps:

1. An enzyme, RNA polymerase, separates the DNA strands in a section of DNA that codes for a particular protein.
2. A complementary mRNA strand is formed by base-pairing to the original DNA strand.
3. Once the sequence of the DNA is copied into mRNA, the DNA zips back up.
4. The mRNA now contains the DNA “message” and leaves the nucleus.





The mRNA molecule now has the genetic code to make the protein. The mRNA strand will be read three letters at a time. These three-letter sections are called RNA codons. These codons specify a single amino acid that will be added to a string of amino acids, which will eventually make a protein.

Example:

DNA: TAC GGA TCG ATT GCG ATT

mRNA: AUG CCU AGC UAA CGC UAA

Codon Codon

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Part III: Transcription, continued

1. In the table below, write down the nitrogenous-base pairs in both DNA and RNA.

This base	pairs with this base	
	in DNA	in mRNA
Adenine		
Guanine		
Cytosine		
Thymine		

2. What do you call a set of three nitrogenous bases that will code for an amino acid?

_____

_____

3. In the table below, record the sequences that pair up with those in the coding strand.

DNA Coding Strand: **T A C C A T T T A C A G G T A A T G C A T T A A C C G A C T**

DNA	TAC	CAT	TTA	CAG	GTA	ATG	CAT	TAA	CCG	ACT
mRNA	AUG	GUA								

4. What types of results in genetic expression do you think may occur if even one nucleotide is not correctly transcribed from the DNA to the RNA? Explain.

_____

_____

_____

5. What is the purpose of transcription?

_____

_____

_____

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Part IV: Translation

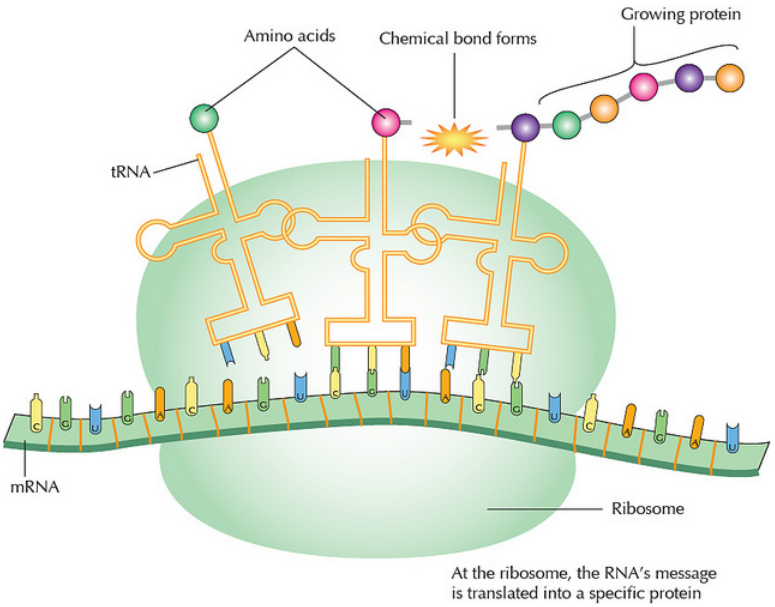
Now that the mRNA has left the nucleus, it is on its way to the ribosome. The ribosome is made of rRNA and protein, which will bind to the mRNA and help assemble the amino acids into a protein. Before the protein can be made, the mRNA codons have to be translated at the ribosome.

Here are the steps of translation:

1. Translation begins with the "Start" codon: AUG. This codon moves into the ribosome.

2. For every mRNA codon, there is a tRNA anticodon that base-pairs to the bases of mRNA. Each tRNA molecule can only carry one specific amino acid. The tRNA brings the correct amino acid to the ribosome.

3. The next codon is read. The complementary tRNA base-pairs to the codon, bringing the correct amino acid to the ribosome.

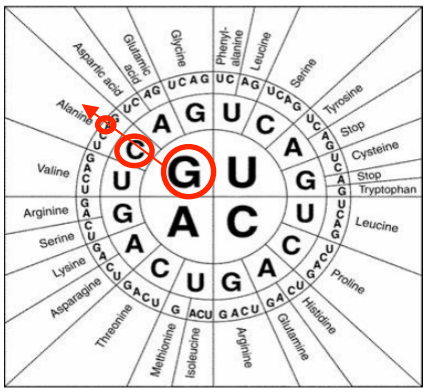


At the ribosome, the RNA's message is translated into a specific protein

4. The ribosome joins the two amino acids together. Another tRNA molecule comes in and reads the next codon. Each amino acid is connected together by peptide bonds to form a protein chain.

This process repeats and the protein will continue growing until a "Stop" codon signals the end point for making that particular protein. These proteins are what will eventually help determine an organism's traits.

To determine which amino acid each mRNA codon codes for, you must use an mRNA codon chart, like what is pictured here. To use a chart like this, start in the center of the chart and work your way outward to determine the amino acid that a particular codon will code for.



For example, the codon GCA will code for Alanine.

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Part IV: Translation, continued

1. First, transcribe DNA into mRNA, and then use the codon chart your teacher provides you to translate the mRNA into amino acids. Record your code conversion in the table.

DNA	TAC	CAT	TTA	CAG	GTA	ATG	CAT	TAA	CCG	ACT
mRNA	AUG	GUA								
Amino Acid										
Full Name										

2. What is the purpose of translation?

3. In your own words, explain the process of translating mRNA into polypeptide sequences. Use the terms mRNA, amino acid, polypeptide, ribosome, tRNA, and codon.

4. Based on the trends you have learned, do you think you could accurately predict which proteins are created from an mRNA strand? Why or why not?