

CHAPTER 7
 Nucleic Acids and Protein Synthesis
 Section 7-3

SKILL ACTIVITY
 Sequencing events

Protein Synthesis

Protein synthesis is a complex process. In this activity you will trace the steps that are involved in the protein synthesis of a part of a molecule of oxytocin. Oxytocin is the pituitary hormone that helps regulate blood pressure, stimulates the uterus to contract during childbirth, and stimulates the production of milk after childbirth.

A. Protein synthesis begins with DNA in the nucleus. Below is a DNA sequence that could code for part of a molecule of oxytocin. Write the sequence of messenger RNA (mRNA) codons that would result from the transcription of this portion of DNA. The arrow marks the starting point.

↓
 ACA ATA TAG CTT TTG ACG GGG AAC CCC ATT
 1 2 3 4 5 6 7 8 9 10

mRNA:
 ↓

UGU UAU AUC GAA AAC UGC CCC UUG GGG UAA

B. After transcription, mRNA attaches to a ribosome, where translation takes place. Each codon of mRNA bonds with an anticodon of a transfer RNA (tRNA) and each tRNA molecule bonds with a specific amino acid. The table below shows the mRNA codons and the amino acids for which they code. For example, if you were given the codon AGA, you can see from the table that these bases code for the amino acid arginine.

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

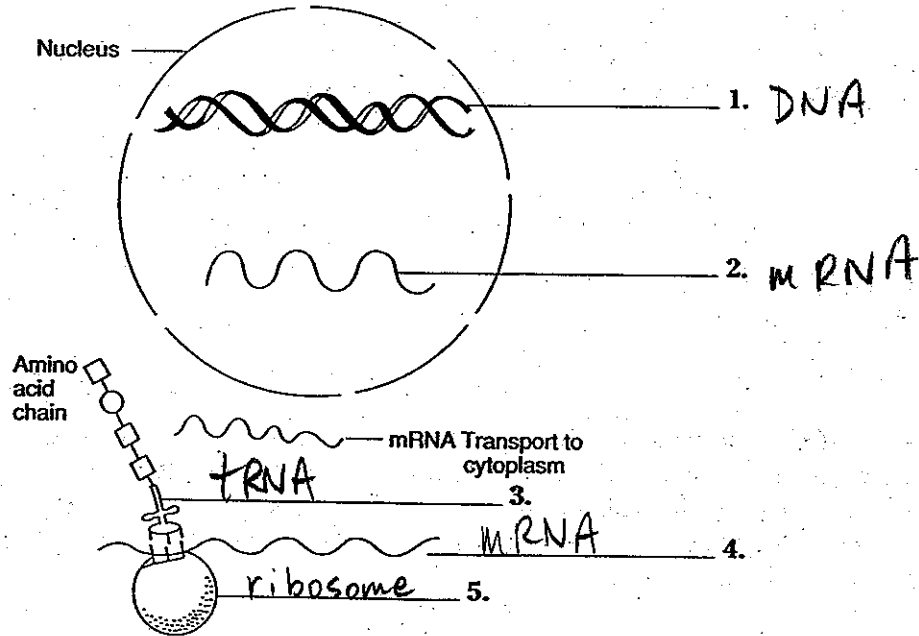
Use your mRNA sequence from A to write the sequence of amino acids in this part of the oxytocin molecule.

↓
 Cysteine / Tyrosine / Isoleucine / glutamic acid / asparagine / cysteine /
 proline / leucine / glycine / STOP

1. How many amino acids make up this portion of the oxytocin molecule? 9

2. What is the purpose of the UAA codon?
To stop the production of the protein

C. In order to get another view of the entire process of protein synthesis, label the structures on the diagram below.



D. To complete the chart below, give the name and a brief description of each step in protein synthesis that occurs in the part of the cell shown in C.

Part of cell	Name of Protein Synthesis Process	Description
Nucleus	TRANSCRIPTION	DNA 'copied' to mRNA
Ribosome	TRANSLATION	mRNA 'translated' to protein
Cytoplasm	TRANSLATION	mRNA 'translated' to protein

PROTEIN SYNTHESIS/ORGANELLE ANALOGY

Following is an example of a protein synthesis/organelle analogy, which was presented to a Biology 12 class.

The analogy started with the premise that...

"PROTEIN SYNTHESIS IS SO EASY, IT'S LIKE BAKING A CAKE!"

Tasha had a craving for a chocolate mousse cake.

- To address her craving, she went to the library. In the library in one row of books, she found a recipe for chocolate mousse cake. (What do the letters that make up each recipe represent?) (Unfortunately in this library, all the books are written in the French language. The second problem, is that these are "one of a kind books", and they can't leave the library.)
- Tasha was able to make a photocopy of the recipe. (What is the process of photocopying analogous to?) She passed through the doorway of the library, heading to the rest of the school. Since this cake was to be taken out of the school, she headed to the "to go" cafeteria to make the cake.
- Thankfully, the baker was fluent in French. When he received the photocopied recipe, he began to read the list of ingredients off to his student assistants, who gathered the ingredients and brought them to him. The ingredients were assembled (another process) forming a new chocolate mousse cake.
- Tasha pushed the cake along the counter, to an area where she started some simple decorations.
- She placed the cake in a plastic bag¹, and carried the bag to the office, where the secretaries put candles and other decorations on the cake and placed it in another plastic bag².
- Tasha carried the cake out of the school (process). Surprisingly, as she left the school, the plastic bag disappeared.
- She carried the cake down the road and entered another building. The cake was placed in another plastic bag as it entered (process) the house. Once it got here, it was able to do its job (taste good).

ASSIGNMENT

In groups of two or three, produce a list of the underlined words, with an accompanying description of which process/structure each is analogous to, as well as how/why it is analogous.

Example: The library represents the nucleus, because the nucleus is where all of the DNA (including genes) is stored, while a library is a collection of all of the information a school has.

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|------------------|-----------------------|---------------------------|-----------------------|
| 1. blood vessel | 7. transcription | 13. exocytosis | 19. secretory vesicle |
| 2. chromosome | 8. translation | 14. nucleus | 20. target cell |
| 3. tRNA | 9. amino acids | 15. endocytosis | 21. Golgi bodies |
| 4. mRNA | 10. ribosome | 16. gene | 22. cytoplasm |
| 5. nuclear pores | 11. RER | 17. bases | |
| 6. protein | 12. transport vesicle | 18. alteration of protein | |