Name _____ Class _____ Date _____

Assembling a Protein Molecule

Pre-Lab Discussion

DNA and RNA, the two types of nucleic acids found in cells, determine which protein molecules a cell makes, or synthesizes. Protein molecules, formed by sequencing twenty different amino acids in various combinations, are important to living things because they control biological pathways, direct the synthesis of organic molecules, and are responsible for cell structure and movement. DNA carries the information for the synthesis of all the proteins in code form. The three different types of RNA carry out the DNA instructions to synthesize proteins.

During *transcription,* the DNA code is transcribed by mRNA into the language of protein synthesis. Three base *codons* of mRNA carry this information to the ribosomes, where *translation* occurs. During translation, mRNA codons are translated into a protein molecule when tRNA *anticodons* bring the correct amino acids to the ribosome. The amino acids brought side-by-side by tRNA form *peptide bonds* and become protein molecules.

In this investigation you will model the process of protein synthesis carried out by the cells of your body.

Problem

How can you and your classmates carry out the different processes of protein synthesis and assemble a protein molecule?

Materials *(per class)*

Large index cards
String, 70 cm long

Procedure

1. Obtain a large index card from your teacher. On this card, you will find your assignment for this investigation. You may have the role of an amino acid, a DNA triplet, an mRNA codon, or a tRNA anticodon. Put the card around your neck and make sure you understand your role in protein synthesis.
2. Report to the area of the cell where you will carry out your role.

3. When your teacher identifies the amino acids that make up the protein to be synthesized, use Figure 1 to determine the DNA triplets that code for that protein. Complete the Data Table for the protein to be synthesized.

4. The DNA nucleotides should form a double stranded DNA molecule in which the DNA triplets will code for the announced protein.

5. The DNA molecule unzips to allow the mRNA codons to form. Once the mRNA codons form and leave the nucleus, the DNA molecule reforms.

6. The mRNA codons move to the ribosomes and line up in the correct sequence.

7. On the ribosome, tRNA anticodons with the proper amino acids pair up with the correct mRNA codons.

8. As the mRNA moves along the ribosome, peptide bonds form between the amino acids. When the protein molecule has been made, mRNA, tRNA, and the protein leave the ribosome and return to the cytoplasm.

9. Repeat steps 1 through 8 to form another protein.

Amino Acid	DNA Triplet
Alanine	CGT
Glutamine	GTT
Glutamic Acid	CTT
Leucine	GAT
Lysine	TTT
Phenylalanine	AAA
Proline	GGC
Serine	AGC
Tyrosine	ATG
Valine	CAA

Figure 1

Observations

1. Using Figure 1, complete the Data Table for each protein molecule.

Data Table

Protein	Amino Acids	DNA Triplet	mRNA Codon	tRNA Anticodon
1	Proline Glutamic Acid Alanine			
2	Lysine Glutamine Valine			
3	Leucine Proline Tyrosine			
4	Phenylalanine Glutamine Proline			
5	Lysine Serine Leucine			

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2. In what ways do DNA and RNA molecules differ? _____

3. How was mRNA formed? _____

4. How do mRNA and tRNA differ? _____

5. Where in the cell are protein molecules formed? _____

Analysis and Conclusions

1. What is the role of DNA in protein synthesis? _____

2. What is the role of mRNA in protein synthesis? _____

3. Which step in the procedure represents transcription? Explain your answer.

4. Which step in the procedure represents translation? Explain your answer.

5. What would happen to Protein 1 if the first DNA triplet was TTT instead of GGC?

Critical Thinking and Application

1. How do the processes of transcription and translation differ?

2. How do DNA replication and DNA transcription differ?

3. If an incorrect nucleotide is in a DNA molecule due to a mutation, will protein synthesis be affected? Explain your answer.

Going Further

Design a system of communication using four different colors to represent each letter of the alphabet. (*Hint:* Use the genetic triplet code as a model.)