

## ALL ABOARD FOR PROTEIN SYNTHESIS LAB

**Intro:** DNA and RNA, the 2 types of nucleic acids found in cells, determine which protein molecules a cell 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 3 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 pair 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:** large index cards  
String , 70 cm

### PROCEDURE:

1. Obtain a large index card from the teacher. On this card, you will find your assignment for the investigation. You will have one of four roles: amino acid, DNA triplet, mRNA codon, or tRNA anti-codon. 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 the 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.

**FIGURE 1**

<b>Amino Acid</b>	<b>DNA Triplet</b>
Valine	CAT
Alanine	CGC
Glutamine	GTC
Methionine	TAC
Leucine	GAA
Lysine	TTC
Phenylalanine	AAG
Proline	GGG
Serine	TCA
Stop	ATC

**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.	Methionine Proline Stop			
2	Lysine Proline Valine			
3	Leucine Phenylalanine Serine			
4	Leucine Glutamine Proline			
5	Lysine Leucine Valine			

2. How does DNA differ from RNA? \_\_\_\_\_  
\_\_\_\_\_
3. How is mRNA formed? \_\_\_\_\_  
\_\_\_\_\_
4. How does tRNA differ from mRNA? \_\_\_\_\_
5. Where in the cell does transcription occur? \_\_\_\_\_
6. Where in the cell does translation occur? \_\_\_\_\_

### **ANALYSIS AND CONCLUSIONS**

1. What is DNA's role in protein synthesis? \_\_\_\_\_  
\_\_\_\_\_
2. What is mRNA's role in protein synthesis? \_\_\_\_\_  

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3. What is tRNA's role in protein synthesis? \_\_\_\_\_  
\_\_\_\_\_
4. Which procedure step represents transcription? Explain your answer.  
\_\_\_\_\_
5. Which procedure step represents translation? Explain your answer.  
\_\_\_\_\_
6. What would happen to Protein 1 if the first DNA triplet was TTT instead of TAC?  
\_\_\_\_\_

### **CRITICAL THINKING AND APPLICATION**

1. Contrast the processes of transcription and translation. \_\_\_\_\_  
\_\_\_\_\_
2. Contrast the processes of DNA replication and DNA transcription. \_\_\_\_\_  
\_\_\_\_\_
3. If a mutation occurs in a DNA triplet, will protein synthesis be affected? Explain your answer.  
\_\_\_\_\_

## ANSWER KEY

### 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.	Methionine Proline Stop	TAC GGG ATC	AUG CCC UAG	UAC GGG AUC
2	Lysine Proline Valine	TTC GGG CAT	AAG CCC GUA	UUC GGG CAU
3	Leucine Phenylalanine Serine	GAA AAG TCA	CUU UUC AGU	GAA AAG UCA
4	Leucine Glutamine Proline	GAA GTC GGG	CUU CAG CCC	GAA GUC GGG
5	Lysine Leucine Valine	TTC GAA CAT	AAG CUU GUA	UUC GAA CAU

2. How does DNA differ from RNA? DNA is double-stranded ,contains the sugar deoxyribose and the nitrogen base thymine
3. How is mRNA formed? The DNA unzips and the mRNA nucleotides pair up with their complementary DNA base.
4. How does tRNA differ from mRNA? tRNA is found only in the cytoplasm and carries amino acids.
5. Where in the cell does transcription occur? the nucleus
6. Where in the cell does translation occur? in the ribosomes

## ANALYSIS AND CONCLUSIONS

1. What is DNA's role in protein synthesis? *DNA carries the instructions for the making of proteins*
  2. What is mRNA's role in protein synthesis? *mRNA carries the copy of the instructions to the ribosomes.*
  3. What is tRNA's role in protein synthesis? *It brings the amino acids to the ribosomes in order to assemble the protein.*
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4. Which procedure step represents transcription? Explain your answer.  
*Step 5- The DNA unzips to make a copy of the genetic instructions.*
  5. Which procedure step represents translation? Explain your answer.  
*Step 7- The tRNA translates the instructions by bringing the amino acids to the proper location.*
  6. What would happen to Protein 1 if the first DNA triplet was TTT instead of TAC?  
*A different protein would occur possibly leading to a mutation.*

## CRITICAL THINKING AND APPLICATION

1. Contrast the processes of transcription and translation. *Transcription copies the genetic instructions and translation builds the proteins according to the genetic instruction copy.*
2. Contrast the processes of DNA replication and DNA transcription. *In DNA replication, new DNA is formed. In DNA transcription, mRNA is created.*
3. If a mutation occurs in a DNA triplet, will protein synthesis be affected? Explain your answer. *Yes, the mRNA will transcribe the mutation and the instruction error will code for an incorrect amino acid during translation.*