

# Simulating Protein Synthesis

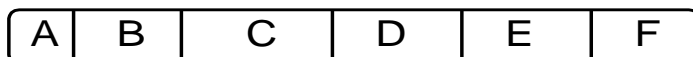
## Pre-Lab Discussion

Genes are the units that determine inherited characteristics, such as hair color and blood type. Genes are lengths of DNA molecules that determine the structure of polypeptides (the building blocks of proteins) that our cells make. The sequence of nucleotides in DNA determines the sequence of amino acids in polypeptides, and thus the structure of proteins.

In a process called *transcription*, which takes place in the nucleus of the cell, messenger RNA (mRNA) reads and copies the DNA's nucleotide sequences in the form of the complimentary RNA molecule. The mRNA then leaves the nucleus and enters the cytoplasm. The mRNA carries the transcribed code to the ribosomes, where translation takes place. The mRNA code specifies the order in which the amino acids are joined together to form a polypeptide. The code words in mRNA, however, are not directly recognized by the corresponding amino acids. Another type of RNA called transfer RNA (tRNA) is needed to bring the mRNA and amino acids together. As the code carried by mRNA is "read" on a ribosome, the proper tRNAs arrive in turn and give up the amino acids they carry to the growing polypeptide chain. The process by which the information from DNA is transferred into the language of proteins is known as *translation*.

In this investigation, you will simulate the mechanism of protein synthesis and thereby determine the traits inherited by fictitious organisms called CHNOPS. CHNOPS, whose cells contain only one chromosome, are members of the kingdom Animalia. A CHNOPS chromosome is made up of six genes (A, B, C, D, E, and F), each of which is responsible for a certain trait.

## CHNOPS



Gene A = Hairiness

Gene B = Body Shape

Gene C = Size of Nose

Gene D = Freckles

Gene E = Skin Color

Gene F = Number of Arms

## Problem

How can the traits on a particular chromosome be determined? How can these traits determine the characteristics of an organism?

## Materials (per Group)

Blue Pencil

Orange Paper

## Procedure

1. Get one DNA sequence for each gene from your teacher. Fill in your Data Table with the DNA of each gene you selected.
2. Write the sequence of nucleotides of mRNA that are complimentary to the DNA on the proper line of your Data Table.
3. Write the sequence of nucleotides of tRNA that are complimentary to the mRNA on the proper line of your Data Table.
4. In order to determine the sequence of amino acids for each gene, match each mRNA triplet with the specific amino acid in Figure 1. Use a hyphen to separate each amino acid number, record this information in the appropriate place in your Data Table.
5. Use Figure 2 to find the trait that matches the amino acid sequence. Record this information in the appropriate place in your Data Table.
6. Using all the inherited traits, sketch your CHNOPS in the space provided under Conclusions.

**Figure 1**

mRNA Triplet	Amino Acid
ACC	Thr
AGC	Ser
CGA	Arg
AAC	Asp
CAU	His
GGG	Gly
AUG	Met
AAA	Lys
UUU	Phe
GUU	Val
UAU	Tyr
CCC	Pro
AUC	Iso
CUA	Leu
GCA	Ala

**Figure 2**

Amino Acid Sequence	Trait
Thr-His-Lys	Hairy
Ser-Met-Asp	Hairless
Arg-Val-Pro	No Freckles
Arg-Phe-Pro	Freckles
Lys-Pro-Arg-Val	Orange Skin
Gly-Tyr-Leu-Ser	Blue Skin
His-Val-Iso	Plump
Ala-Leu-Tyr	Skinny
Met-His-Val-Leu	Long Nose
Asp-Phe-Iso-Ala	Short Nose
Phe-Iso	4 Arms
Pro-Arg	6 Arms

# Simulating Protein Synthesis

## Data/Observations

### Data Table

<b>Gene A</b> DNA _____ MRNA _____ TRNA _____ Amino Acid Sequence _____ Trait _____	<b>Gene B</b> DNA _____ mRNA _____ tRNA _____ Amino Acid Sequence _____ Trait _____
<b>Gene C</b> DNA _____ MRNA _____ TRNA _____ Amino Acid Sequence _____ Trait _____	<b>Gene D</b> DNA _____ mRNA _____ tRNA _____ Amino Acid Sequence _____ Trait _____
<b>Gene E</b> DNA _____ MRNA _____ Trna _____ Amino Acid Sequence _____ Trait _____	<b>Gene F</b> DNA _____ mRNA _____ tRNA _____ Amino Acid Sequence _____ Trait _____

## Conclusions

1. Distinguish between transcription and translation. \_\_\_\_\_

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2. What is the specific site for transcription and translation in the cell?

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3. How many tRNA nucleotides form an anticodon that will attach to the mRNA codon? \_\_\_\_\_

4. Suppose you knew the makeup of specific proteins in a cell. How would you determine the particular DNA code that coded for them?

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5. How could one change in a DNA nucleotide alter the formation of the translated protein?  
(Compare the DNA codes for Freckled vs Not Freckled for help)

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6. Draw your CHNOPS

