

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Student Exploration: RNA and Protein Synthesis

### Prior Knowledge Questions

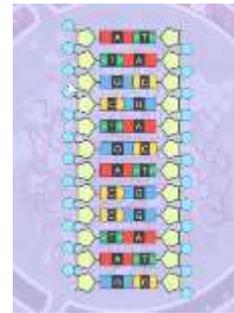
Gene expression – where the information stored in DNA becomes a visible genetic trait – involves 2 main steps: transcription, translation, and protein function.

1. What type of molecule is made during transcription? \_\_\_\_\_
2. What type of molecule is made during translation? \_\_\_\_\_
3. What are some of the functions of proteins? \_\_\_\_\_

### Gizmo Warm-up

1. DNA is a double strand composed of the bases adenine (A), cytosine (C), guanine (G), and thymine (T). RNA is a single strand composed of adenine, cytosine, guanine, and uracil (U).

Look at the SIMULATION pane. Is the displayed segment a part of a DNA or RNA molecule? How do you know?



<b>Activity A:</b> <b>Transcription</b>	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>• If necessary, click <b>Release enzyme</b>.</li> </ul>	
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**Introduction:** The first stage of building a protein is **transcription**, where DNA is used to make mRNA.

### Question: What occurs during transcription?

1. **RNA polymerase** is an enzyme. Click the **Release enzyme** button, and describe what happens first.  
 \_\_\_\_\_
2. **Build:** Use the RNA nucleotides to build an mRNA strand that is complimentary to the DNA sequence on the right. **DO NOT CLICK “CONTINUE”**.
3. **Observe:** In molecules of RNA, **uracil** takes the place of the DNA base \_\_\_\_\_.
4. **Record:** What is the nucleotide sequence of the mRNA strand you built?  
 \_\_\_\_\_

5. Apply: Suppose a template strand of DNA had the following sequence:

T A C G G A T A A C T A C C G G G T A T T C A A

What would be the complementary strand of mRNA?

\_\_\_\_\_

6. Analyze: Compare and contrast the structures and functions of mRNA and DNA:

A. What monomer are they BOTH made of, and what type of macromolecule are they BOTH? \_\_\_\_\_

B. What are two differences between the mRNA and DNA molecules?

\_\_\_\_\_

\_\_\_\_\_

C. How is the function of DNA different than the function of mRNA?

\_\_\_\_\_

\_\_\_\_\_

7. Predict: Would a change to the sequence of nucleotides in a DNA segment affect the mRNA transcribed from the DNA? Explain. \_\_\_\_\_

\_\_\_\_\_

<p><b>Activity B:</b> <b>Translation</b></p>	<p><u>Get the Gizmo ready:</u></p> <ul style="list-style-type: none"> <li>Once the mRNA strand has been built, click <b>Continue</b>.</li> </ul>	
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**Introduction:** The second stage of protein synthesis is **translation**, where the strand of mRNA is used to build a chain of amino acids.

**Question: What occurs during translation?**

1. Observe: Examine the strand of mRNA on the SIMULATION pane. Every group of **three bases** of mRNA is called a **codon**.

In the table at right, list the nitrogen bases in each codon. (Hint: Start from the top of the strand and read down.) The first mRNA codon is called the *universal start codon*.

Codon	3 mRNA bases
1	A U G
2	
3	
4	



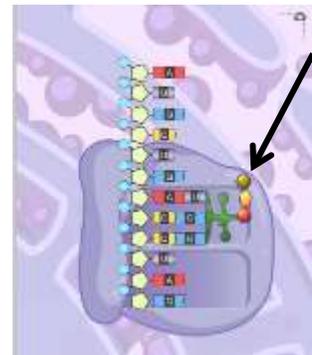
2. **Predict:** Click “Continue”.

- Translation starts when a **ribosome** (the purple structure on the SIMULATION pane) binds to a strand of mRNA.
- **Transfer RNA**, or tRNA, begins bringing amino acids into the ribosome.
- Each tRNA molecule carries only one kind of amino acid.
- This amino acid is determined by the tRNA’s **anticodon**, a set of three bases that must be complimentary to the mRNA codon.

Which anticodon do you think would attach to the mRNA’s start codon? \_\_\_\_\_

Use the Gizmo to check your answer.

3. **Observe:** Place the next two tRNA molecules on the mRNA strand. What does the growing chain (arrow) on the last tRNA represent?



4. **Describe:** UAG (as well as UAA and UGA) is an example of a *stop codon*. Molecules called *release factors* bind to stop codons. Place the release factor on the mRNA molecule.

Click **Continue**. Your protein is now complete. Most actual proteins consist of sequences of hundreds of amino acids.

5. **Infer:** If the DNA molecule is changed, the mRNA molecule will also be changed. How could this affect the chain of amino acids made during translation, and how might this affect the protein? (Hint: Protein shape depends on its sequence of amino acids.)

6. **Summarize:** Sort the following words into the correct categories (transcription or translation):

- amino acid      cytoplasm      DNA      mRNA      nucleus      protein  
 ribosome      trait      tRNA      RNA polymerase

<u>Transcription</u>	<u>Both</u>	<u>Translation</u>
1.	1.	1.
2.		2.
3.		3.
		4.
		5.

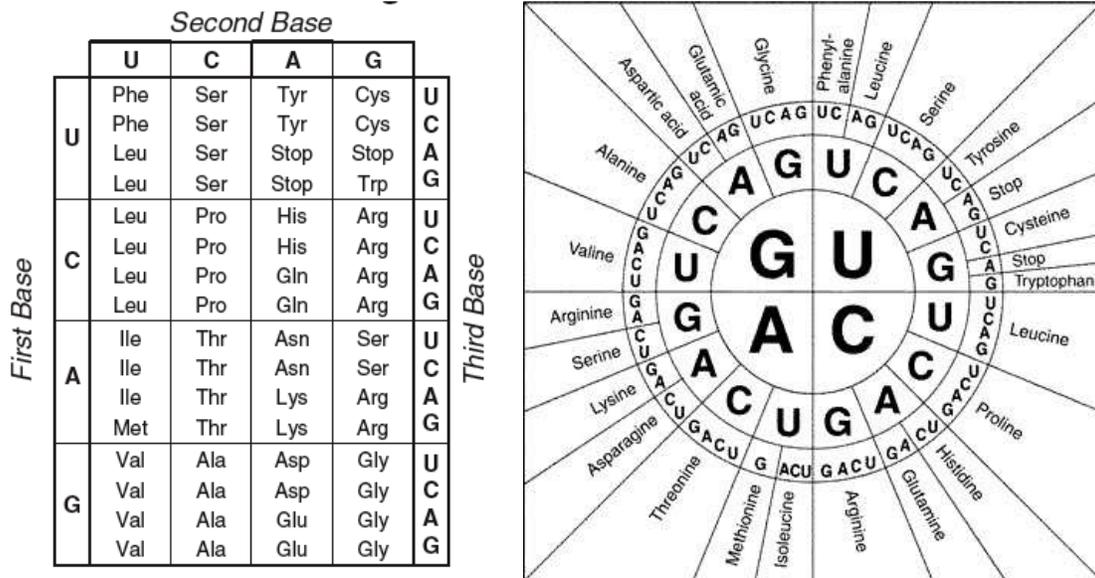


<b>Extension:</b> <b>Genes and traits</b>	<u>Get the Gizmo ready:</u>	
	<ul style="list-style-type: none"> <li>You will not need to use the Gizmo for this activity.</li> </ul>	

**Introduction:** A sequence of DNA that codes for a specific protein is called a **gene**. By coding for proteins, genes determine an organism's inherited traits.

**Question: How do genes code for specific proteins and traits?**

- Translate: Each codon codes for one of 20 amino acids. For example, the mRNA codon GGU codes for the amino acid glycine. Examine the codon charts below to see which codons code for which amino acids.



What amino acids do the following codons code for?

AUG: \_\_\_\_\_ CUG: \_\_\_\_\_ ACC: \_\_\_\_\_ UAG: \_\_\_\_\_

- Apply: Suppose you wanted a protein that is coded from the following DNA sequence:

**TAC CTC TTT GTG**

Give the mRNA complimentary sequence that would be transcribed from this template DNA, and then give the amino acid sequence that would be translated from the mRNA.

**mRNA:** \_\_\_\_\_

**amino acid:** \_\_\_\_\_

- Summarize: Why do offspring typically have similar traits to their parents? Explain in terms of DNA replication, transcription, and translation. (Hint: Genes hold information for making proteins. Proteins are responsible for producing hereditary traits like eye color.)

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