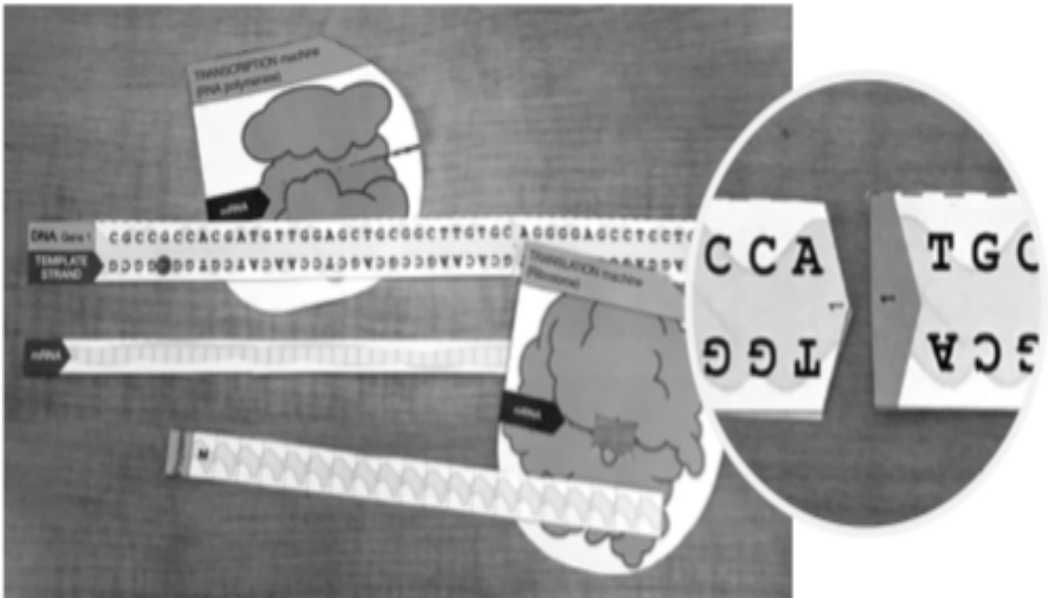
Modeling Transcription & Translation

LT: I can follow a multistep procedure in order to model transcription and translation.

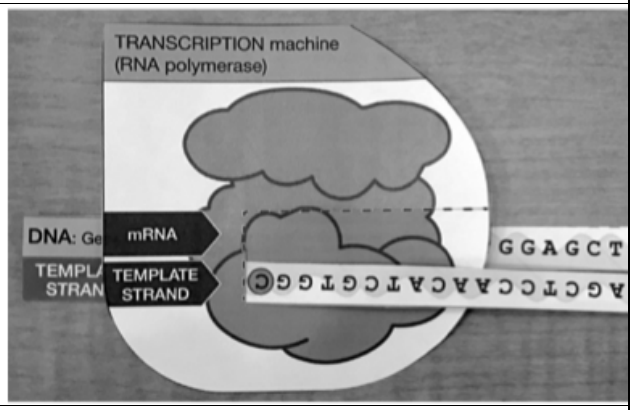
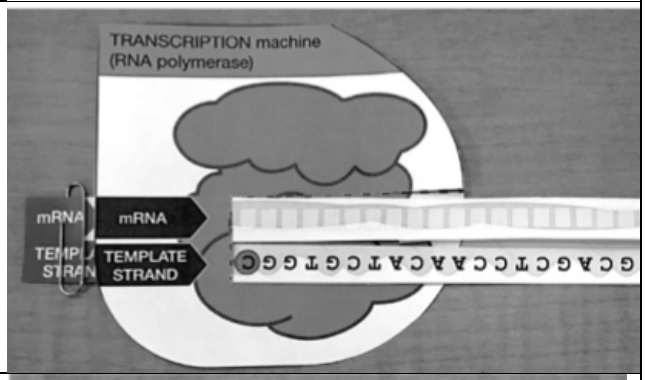
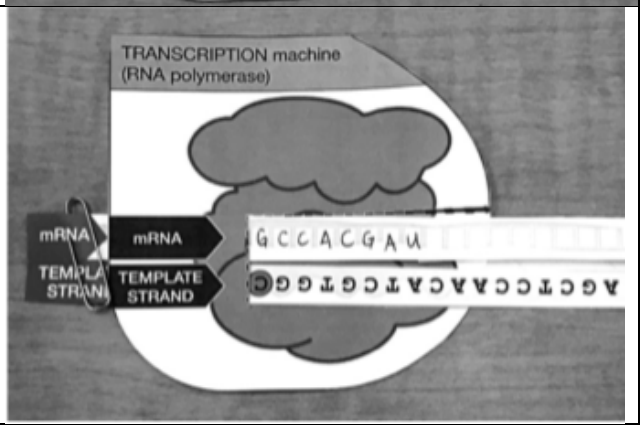
Standard: 2.1g

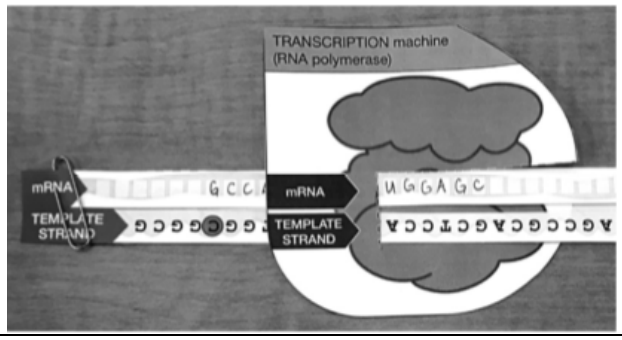
Prepare Your Materials

- Cut out the DNA strips. Match the numbered ends and tape them together.
- Cut out the mRNA strips. Tape the ends together to form one long strand.
- Cut out the Protein strip.
- Cut out the Transcription Machine and the Translation Machine, then cut along the dotted lines.

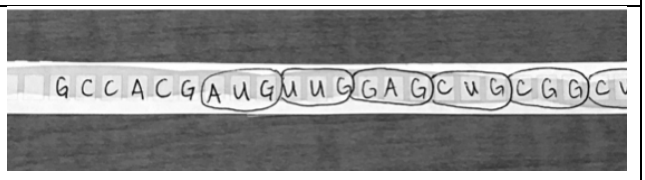
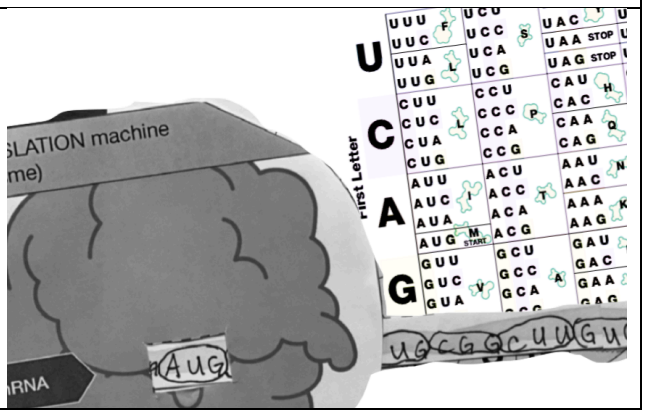


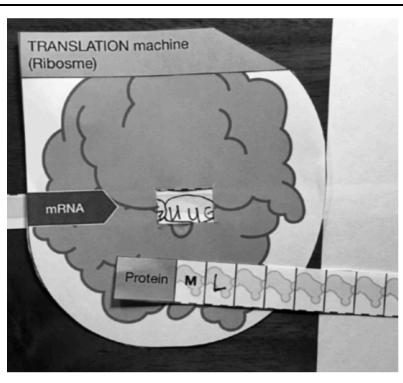
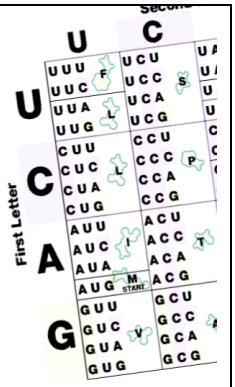
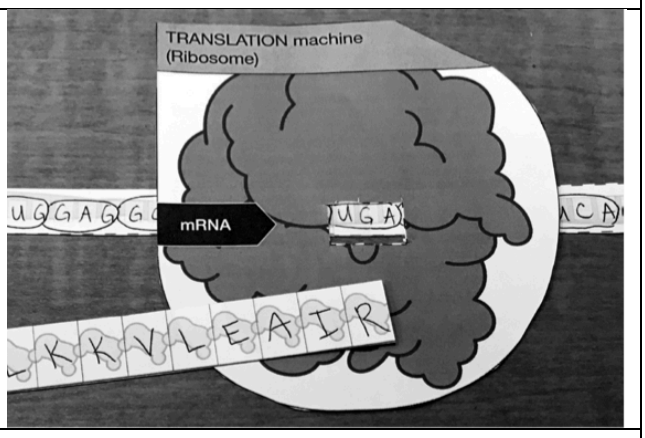
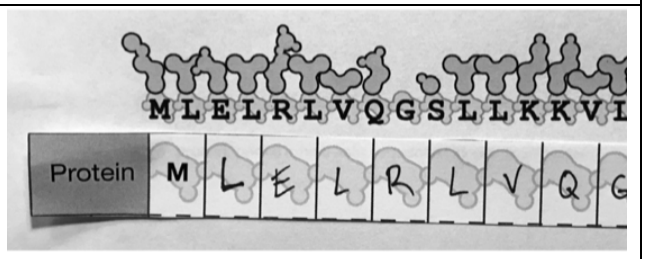
TRANSCRIPTION: A molecular machine (RNA Polymerase) attaches to a gene and makes a messenger RNA (mRNA) copy.

The cell does this:	Do this with your model:	Image
1.Transcription machinery "unzips" the DNA, temporarily separating the complementary strands. This is carried out by an enzyme called helicase which breaks the hydrogen bonds holding the complementary bases of DNA together (A with T, C with G).	Starting at the END, cut the DNA strip up the middle. After you reach the circled base, stop cutting so that the DNA stays connected at the top.	 *Your DNA sequence may be different from the one pictured.*
2.RNA polymerase wraps around the DNA template strand.	Put the DNA template strand into the Transcription machine. Slide the Transcription machine to the circled base.	
3.RNA polymerase attaches to the template strand. It will read the DNA to build a complementary strand of mRNA.	Slide the mRNA strip into the Transcription machine. Line up the ends of the DNA and mRNA strands. *TIP: Tape or a paper clip the mRNA onto the DNA strip.*	
4.RNA polymerase reads the DNA template strand, adding building blocks to the mRNA strand according to the rules of complementary base pairing.	Starting with the circled DNA base, start writing the complimentary bases on the mRNA strand (put one letter in each box). Don't shift the strands and lose your place!	

5. RNA Polymerase slides along the DNA template strand, unzipping the DNA and adding bases to the growing mRNA as it goes.	Write in the complementary bases and slide the transcription machinery as you go.	
6. Genes are typically thousands of bases long.	Detach the transcription machine and set the DNA aside (you may trim any unused bit off the end of the mRNA). You have just transcribed a small piece of an actual gene!!	

TRANSLATION: The ribosome reads the bases of the mRNA, putting amino acids together to make a protein.

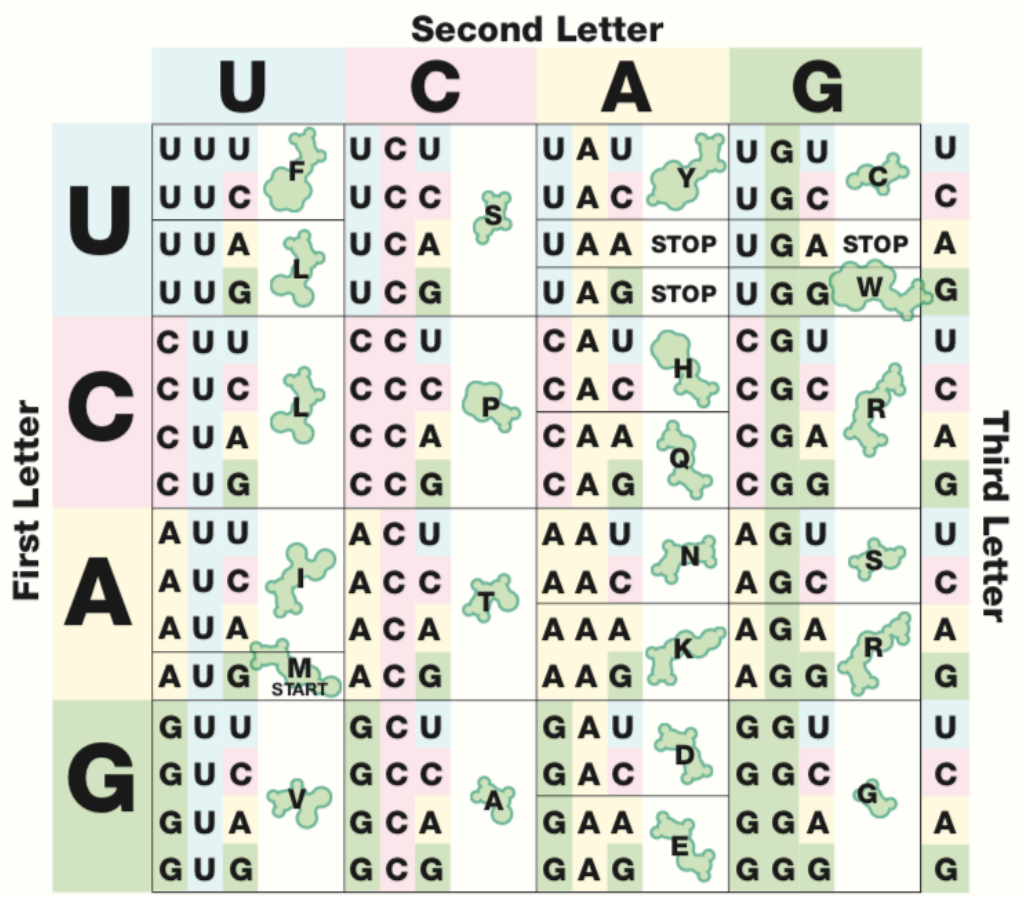
The cell does this:	Do this with your model:	Image
7.The mRNA attaches to the Ribosome. The ribosome slides along the mRNA until it finds the bases "AUG."	Starting at the beginning of the mRNA strand, scan along until you find the first "AUG." Circle it.	
8. AUG is the "start" signal for building a protein. It establishes the reading frame for building the protein.	Along the rest of the mRNA strand, circle the bases in groups of 3. Each group of 3 bases is called a codon.	
9. Transfer RNA (tRNA) molecules attach to the 3-letter mRNA codons by complementary base pairing. At the other end, they carry an amino acid.	Put the window of the Translation machine over the first AUG on the mRNA strand. Look at the Amino Acid Codon Chart; notice that AUG codes for methionine (M). M is already marked in the first square on your protein strip.	

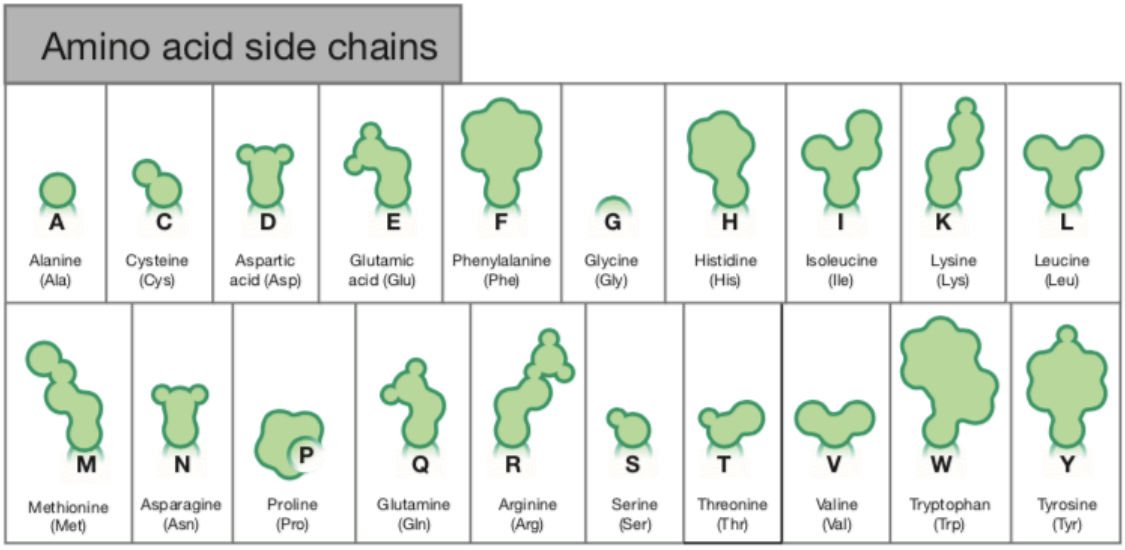
10.The ribosome slides along the mRNA, moving 3 bases at a time. Inside the ribosome, each codon recruits a tRNA molecule, which brings in the next amino acid. The ribosome links the amino acids together to start building a protein.	Slide the window of the Translation machine to the next group of 3 bases (codon). Look up the codon on the Amino Acid Codon Chart and write the one-letter code in the next square on the protein strip. *TIP: To use the chart, find the first letter of the codon in the center and read outward to find the right amino acid.*	 
11.The ribosome continues along the mRNA molecule, reading codons and adding amino acids to the growing protein chain.	Continue sliding the Translation machine along the mRNA strip, looking up each codon on the table, and writing the amino acids' one-letter code on the protein strip.	
12.When the ribosome reaches a STOP codon, the mRNA and the finished protein are released.	When you reach a codon that codes for STOP in the Table, your protein is finished.	
13.Real proteins are often hundreds of amino acids long. The cell can read same mRNA strand again to build another protein.	You have just transcribed and translated a very small piece of a real gene! Record your amino acid sequence.	

Conclusion/Analysis Tasks:

1. Record the amino acid sequence that you translated. Be sure to identify what "Gene" you were given, (Gene 1, 2, 3, 4, or 5 located on the DNA strip).
2. How do DNA and mRNA compare in terms of structure and complementary base pairing?
3. How did we model tRNA and mRNA?
4. Describe and support the following statement using multiple examples of specific data evidence from the activity: *Most amino acids can be specified by multiple codons.*
    a. Describe the multiple ways to make an amino acid using more than one codon.
    b. What is the exception? Most amino acids can be made using multiple codons. Which 2 amino acids can only be made with one codon?

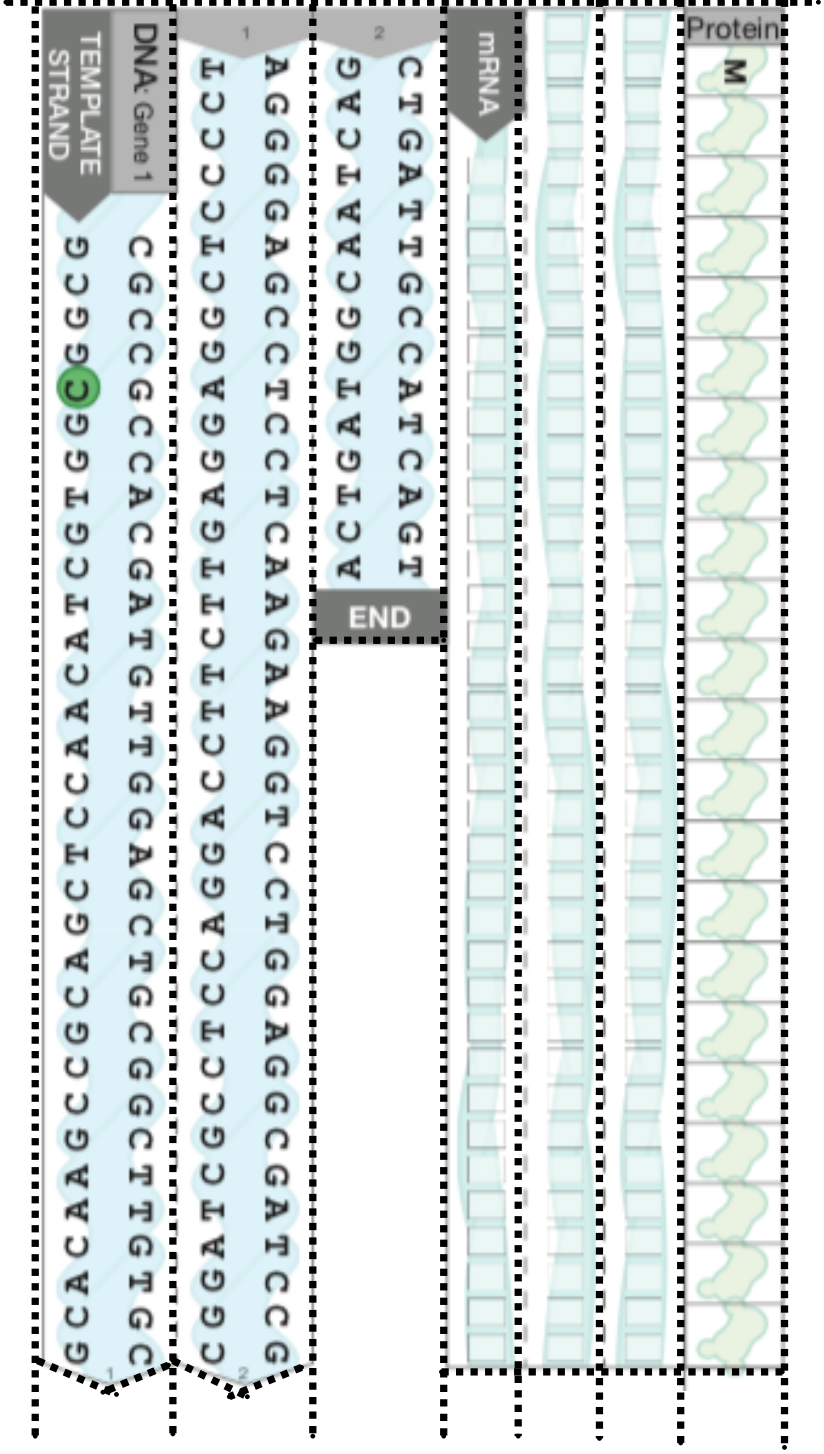
Amino Acid Codon Chart





Match the numbered ends and tape the 3 strands to make 1 long strand.

Tape the 3 strands to make 1 long strand.



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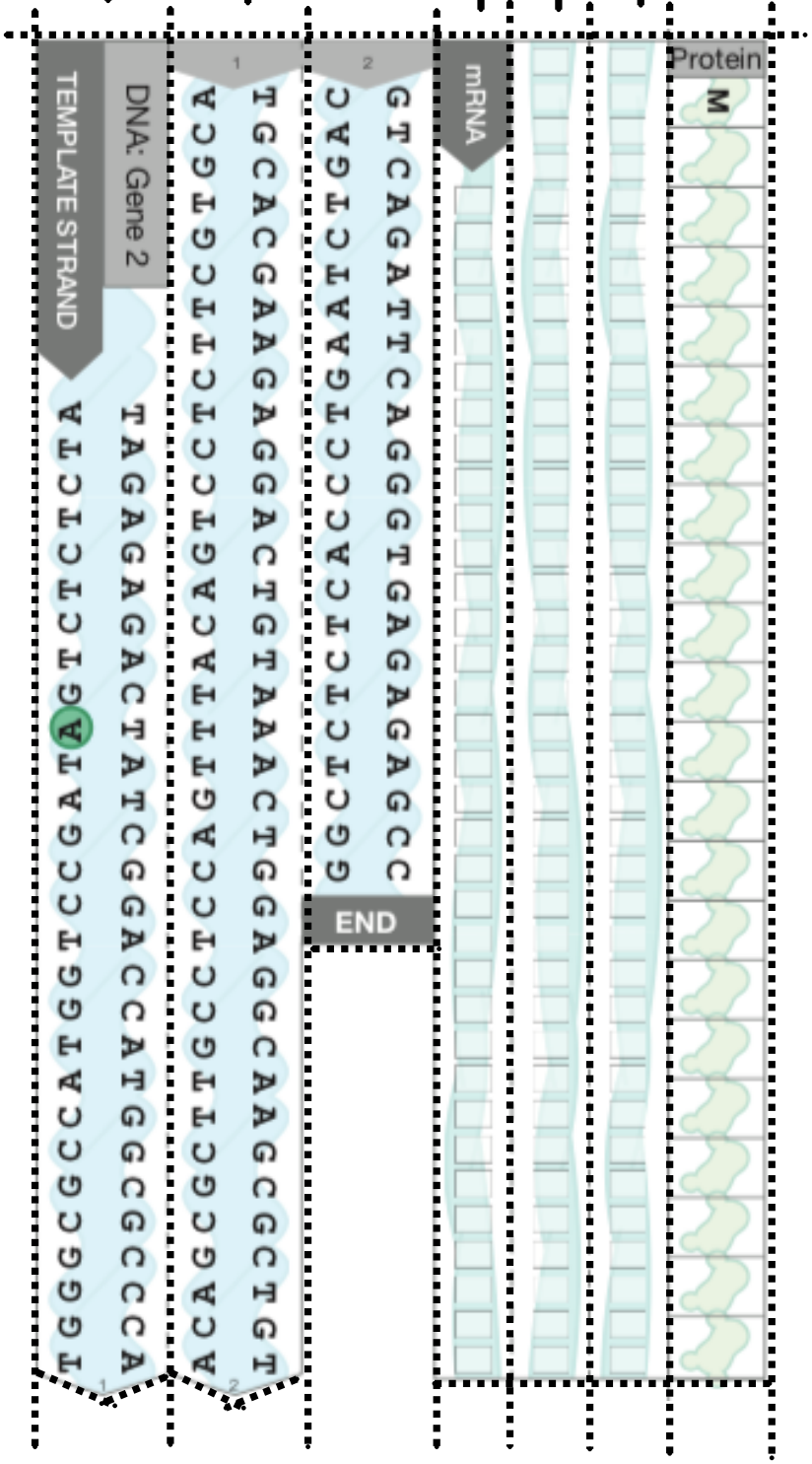

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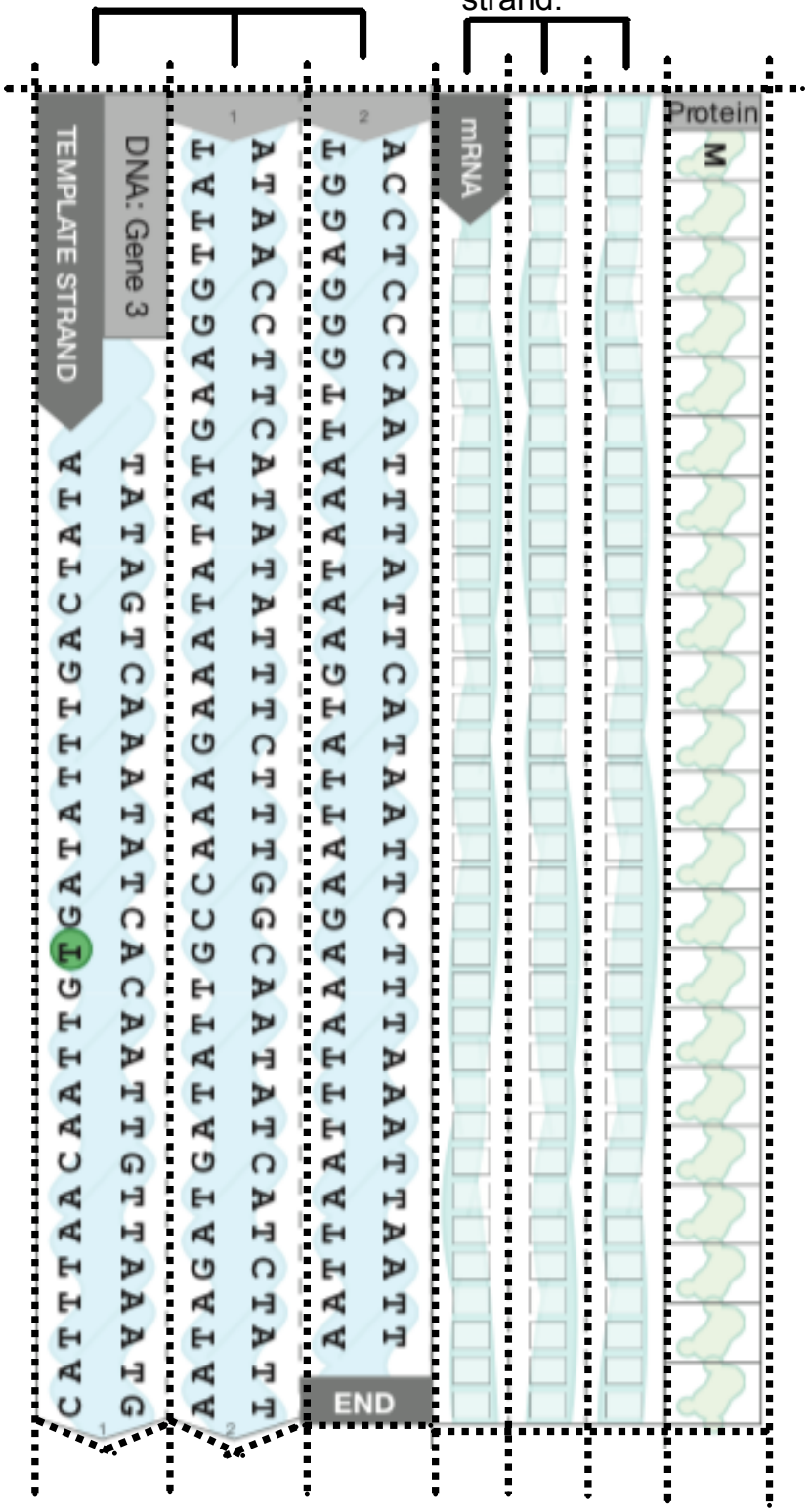

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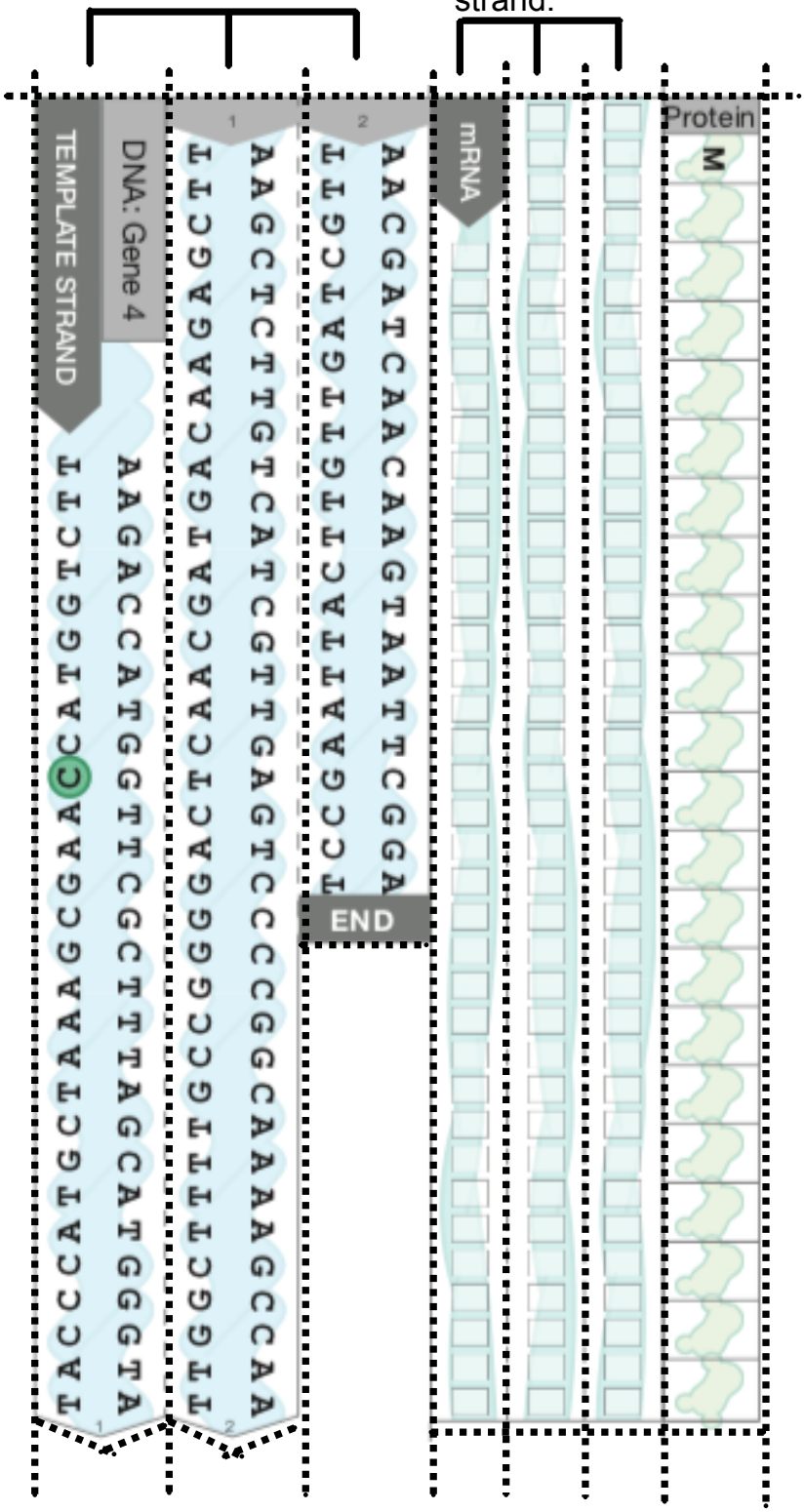

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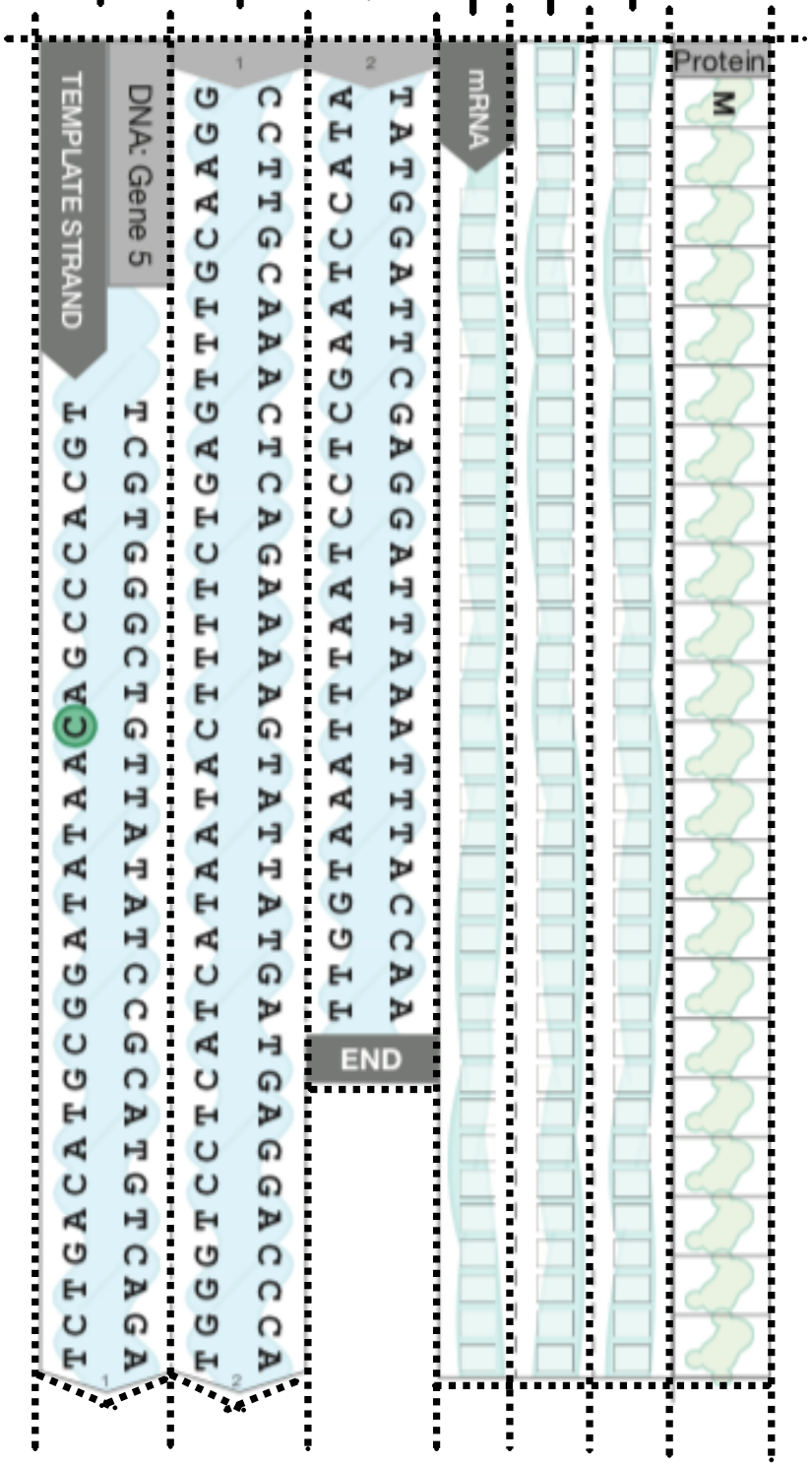

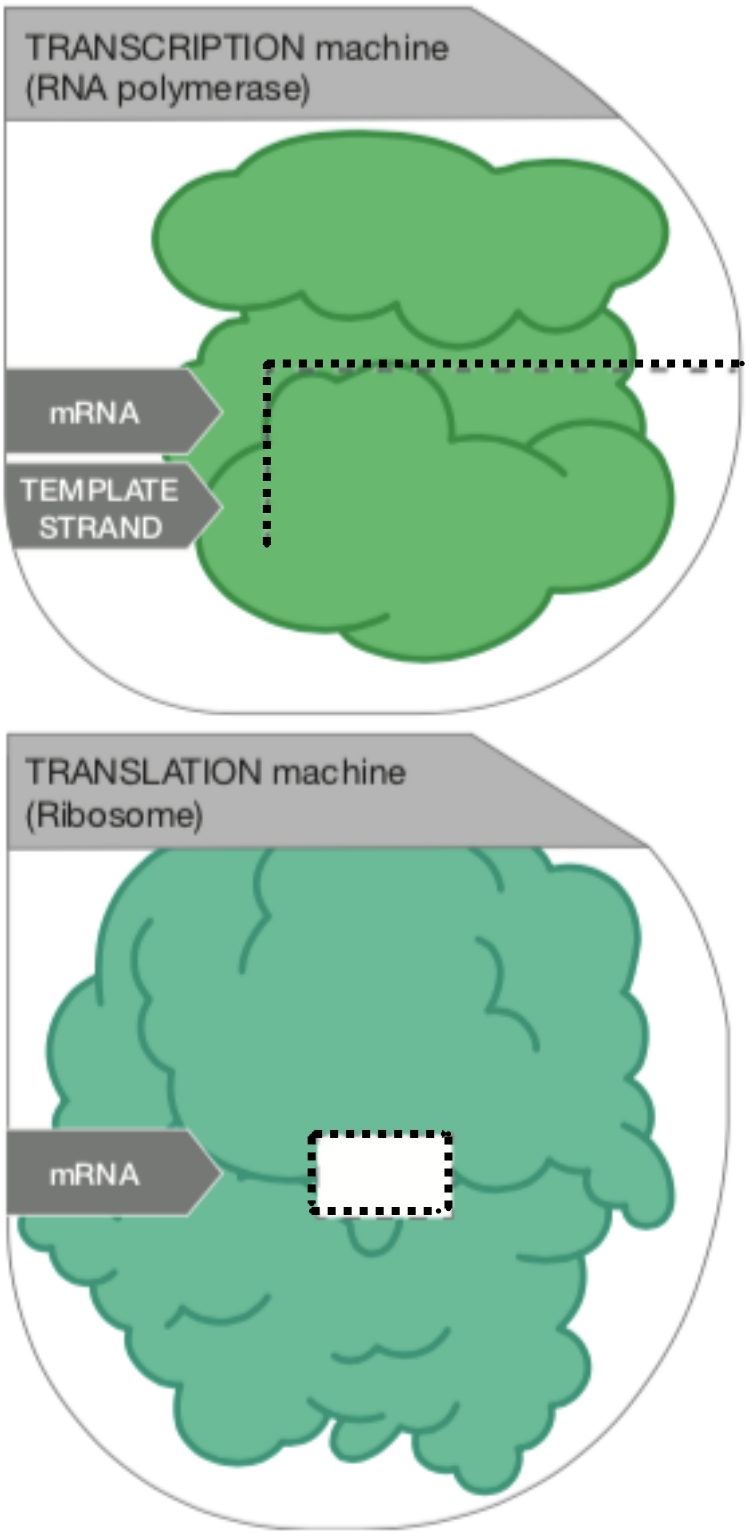
TRANSCRIPTION machine
(RNA polymerase)
mRNA
TEMPLATE
STRAND
TRANSLATION machine
(Ribosome)
mRNA

	3	2	1
Code for Protein	The amino acid sequence is thorough and correct. There are no errors.	The amino acid sequence is mostly thorough and correct. There are 1 or 2 errors.	The amino acid sequence is not thorough and correct. There are 3 or more errors.
Comparing DNA and mRNA	The structure and complimentary base paring options for DNA and RNA are thoroughly and correctly compared.	DNA and RNA are correctly compared however there is a need for more detail.	DNA and RNA are compared with error(s).
Modeling RNA	The methods for modeling tRNA and mRNa are thoroughly and correctly described.	The methods for modeling tRNA and mRNA are correctly described however there is a need for more detail.	The methods for modeling tRNA and mRNA are described with errors.
Codons	The statement is described and supported with multiple examples of specific data evidence from the model.	The statement is described and supported with specific data evidence from the model however there is a need for more detail.	An attempt to describe and supported the statement with specific data evidence is made however there are errors and/or incomplete ideas.