NAME _____ DATE _____

Paper Transcription & Translation

Student Instructions

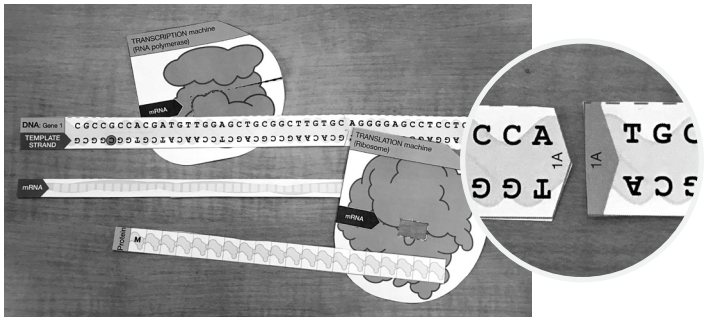
Background

Cells use the information in genes to build proteins. To do so, they first make an mRNA copy of the gene—a process called transcription. Then they decode the information in the mRNA to build a protein—a process called translation.

You will use a paper model to go through the processes of transcription and translation.

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.

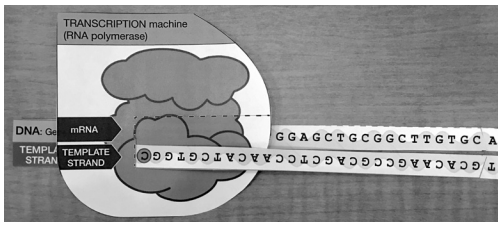


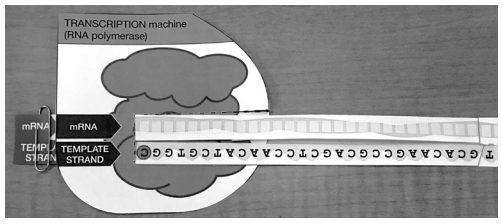
TRANSCRIPTION

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

A cell does this:	Do this with your model:
1. Transcription machinery "unzips" the DNA, temporarily separating the complementary strands.	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.
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 paper clip the mRNA onto the DNA strip.*

Your DNA sequence may be different from the one pictured.





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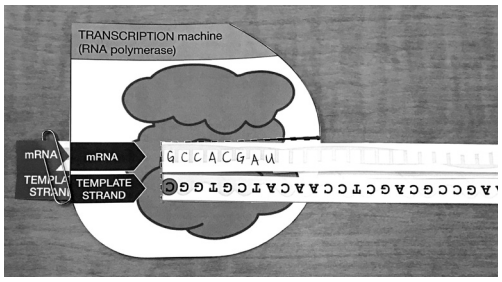
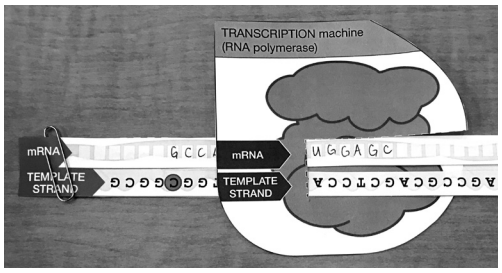
A cell does this:	Do this with your model:
4. RNA polymerase reads the DNA template strand, adding building blocks to the mRNA strand according to the rules of complementary base pairing: **G** (in DNA) pairs with **C** (in RNA); **C** pairs with **G**; **T** pairs with **A**; **A** pairs with **U**.	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. *TIP: If you lose your place, go back to the beginning and line up the first mRNA base with the circled DNA base.*
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!!

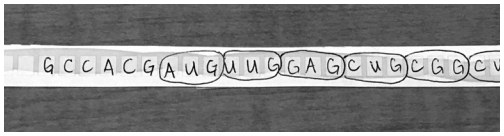




TRANSLATION

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

A cell does this:	Do this with your model:
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.



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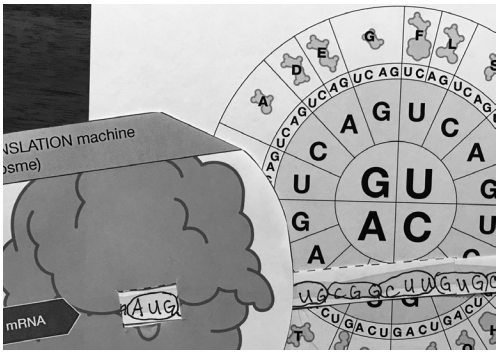
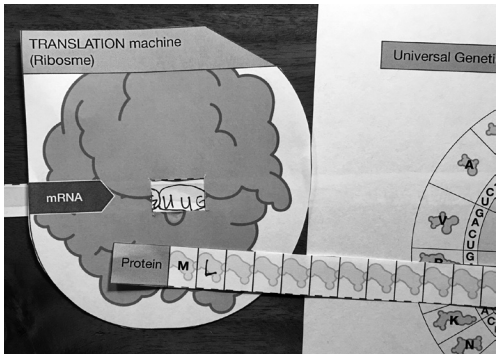
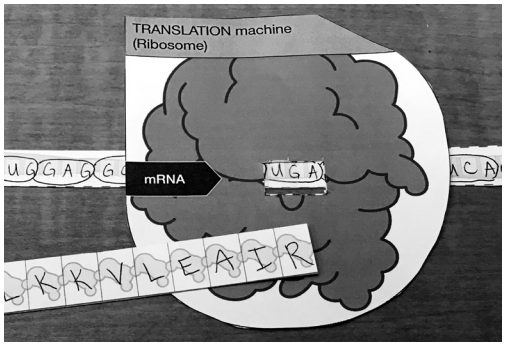
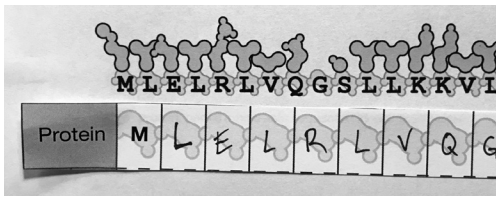
A cell does this:	Do this with your model:
9. Transfer RNA (tRNA) molecules attach to the 3-letter mRNA codons by complementary base pairing. At the other end, they carry an amino acid.	Put the window of the Translation machine over the first AUG on the mRNA strand. Look at the Amino Acid Codon Chart; 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! Compare your amino acid sequence to the 5 Protein pages to learn more about the protein youjust built, and what organism it came from.









Amino Acid Codon Chart

Circular Version

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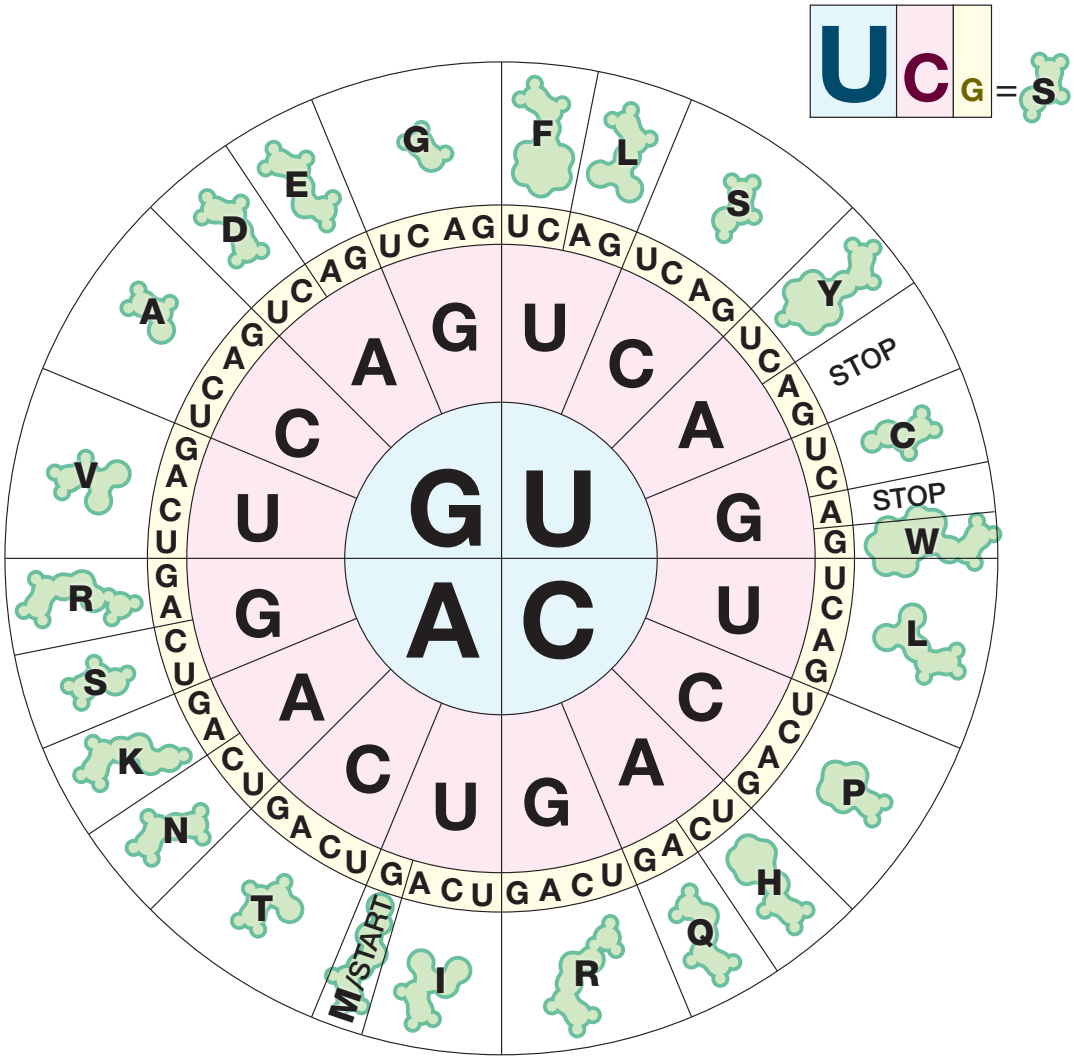
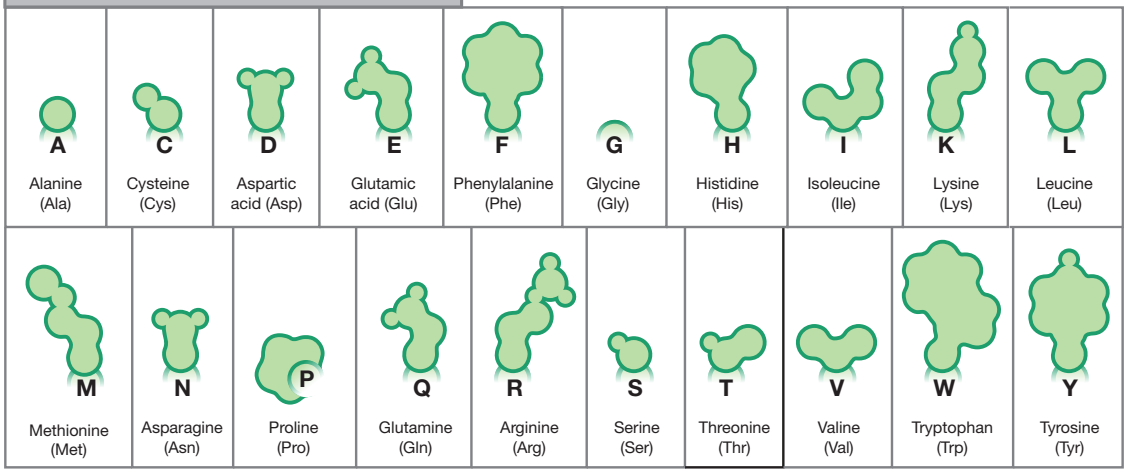


Amino acid side chains



Updated August 1, 2019

Amino Acid Codon Chart

Square Version

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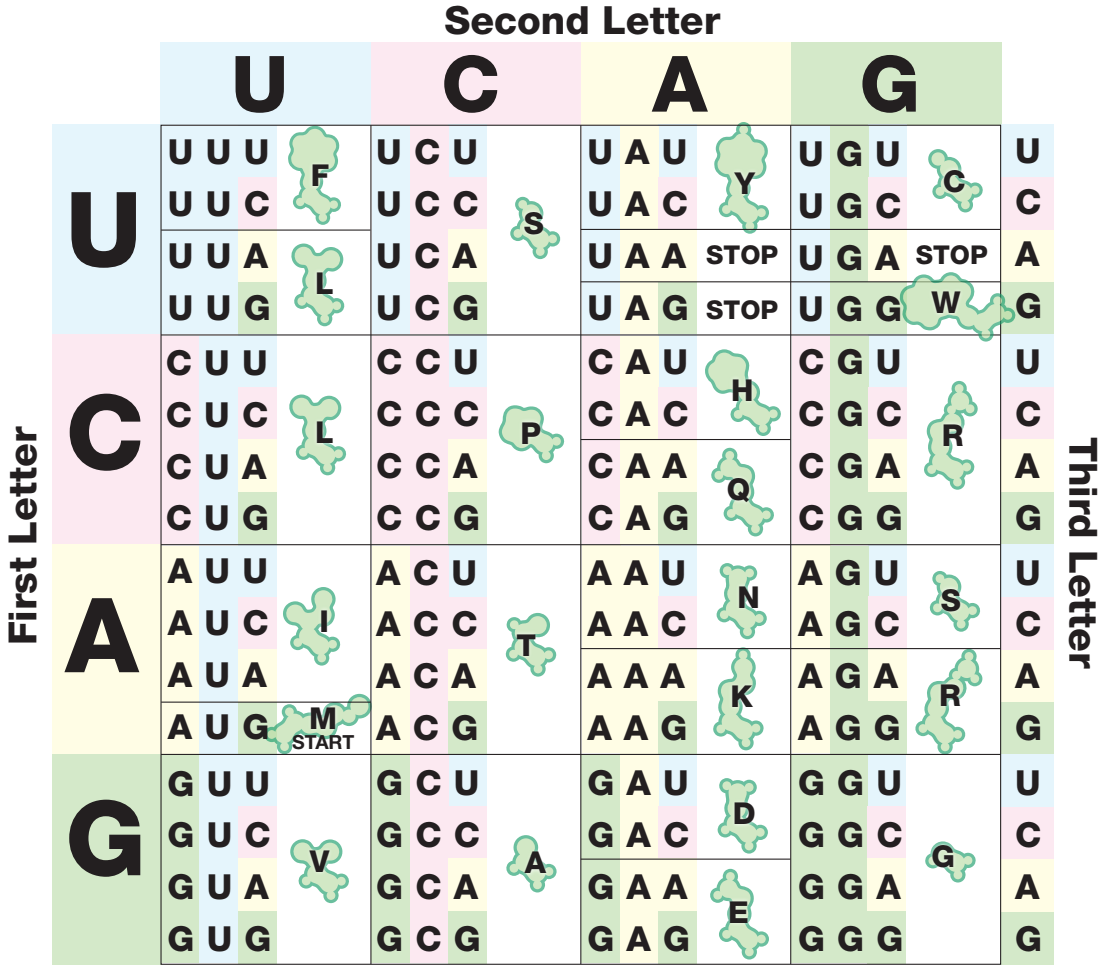

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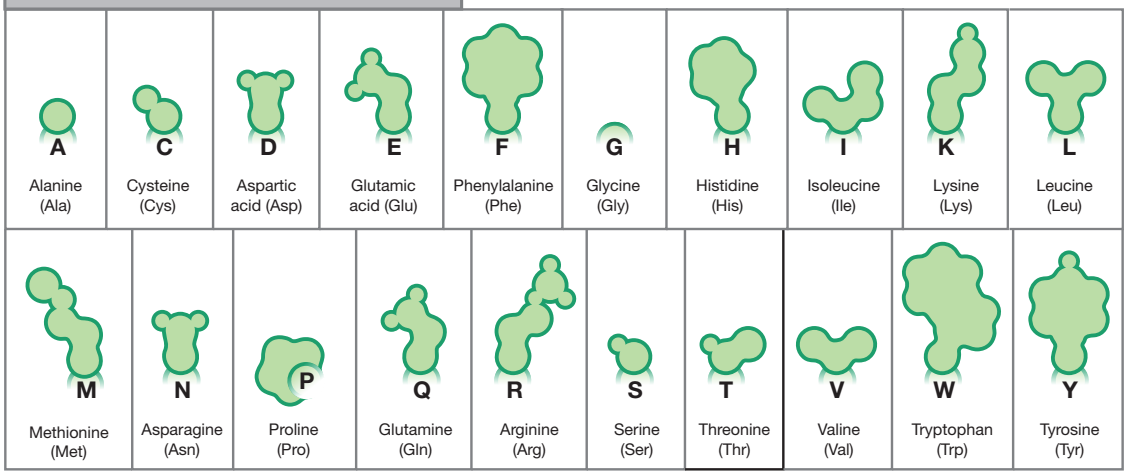

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