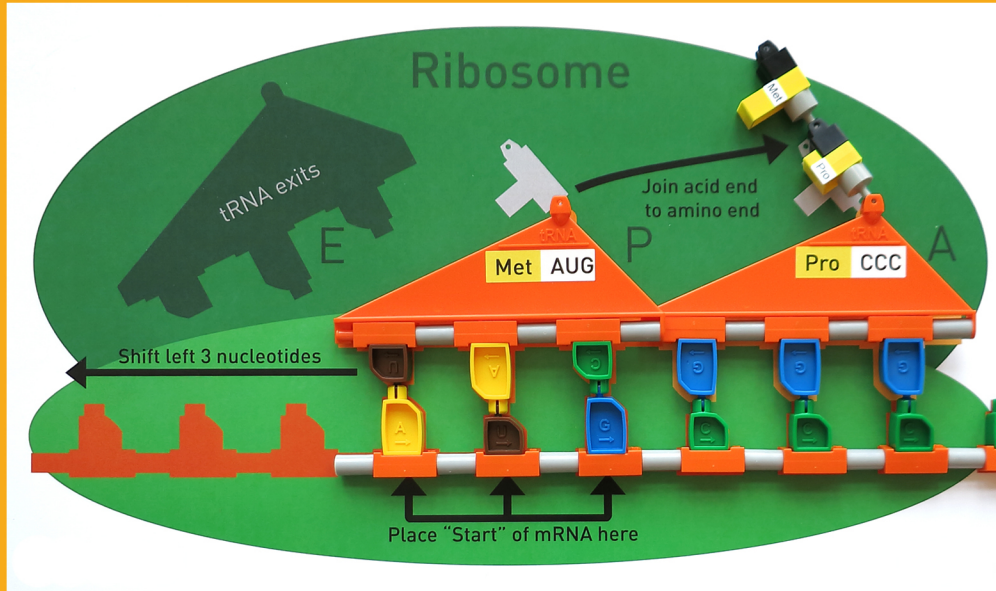


# tRNA

## Booklet 1: Protein Synthesis



Models and lessons created  
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# Using Your Booklet and Kit

**Q:** = Helpful Questions (answers on Page 38)

**Bold type** = required actions

Underlined = new vocabulary

1. Open the kit. Count the 7 orange triangle tRNA gliders.

2. Count the orange RNA nucleotides.

There are:

- 6 brown (U)
- 6 yellow (A)
- 6 green (C)
- 6 blue (G)

3. Check the 13 removable stickers in your kit:

- **Ala** GCA
- **Cys** UGU
- **Leu** CUA
- **Met** AUG
- **Pro** CCC
- **Pro** CCU
- **Val** GUA

- **Ser** AGC
- **Ser** UCU
- **Thr** ACA

- **Glu** GAA

- **Arg** CGG

- **STOP** UAG



**IMPORTANT!** Be sure you have 2 different stickers for Pro and 2 different stickers for Ser.

# Introducing the Ribosome

After the mRNA is created, it leaves the nucleus and travels to a ribosome. A ribosome is an organelle that helps build proteins in the cell. Cells have thousands of ribosomes! Ribosomes have two pieces: the large subunit that joins amino acids together, and the small subunit that reads the RNA. In the diagram, the large subunit is dark green and the small subunit is light green. The ribosome has 4 important sites for molecules:

1. Take out your ribosome mat and identify the large and small subunits.
2. Find all 4 sites on the mat using the diagram below. Notice what happens at each site.

- 1 The mRNA will bind to the ribosome here.
- 2 **P Site:** The first tRNA with its amino acid will bind here.
- 3 **A Site:** The next tRNA with its amino acid will bind here.
- 4 **E Site:** tRNAs will exit here after adding their amino acids to the protein chain.

**Q:** What is the job of the ribosome?

Outer view showing 3D shape of the ribosome

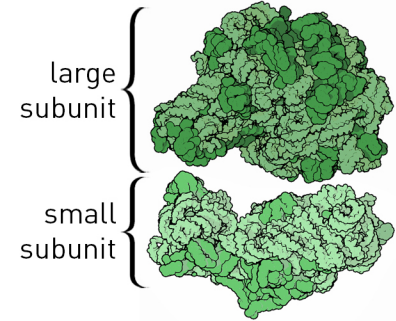
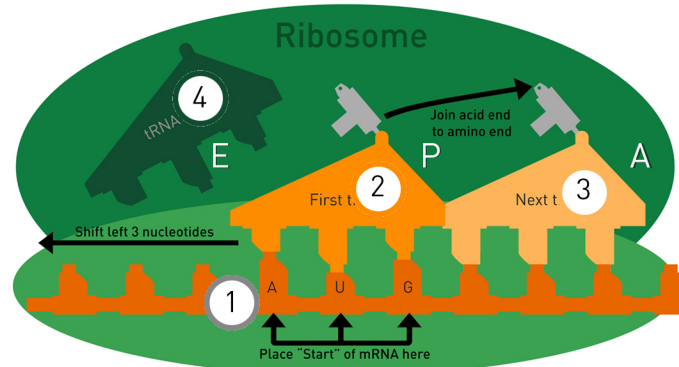


Image from the Protein Data Bank:  
<http://www.rcsb.org/>

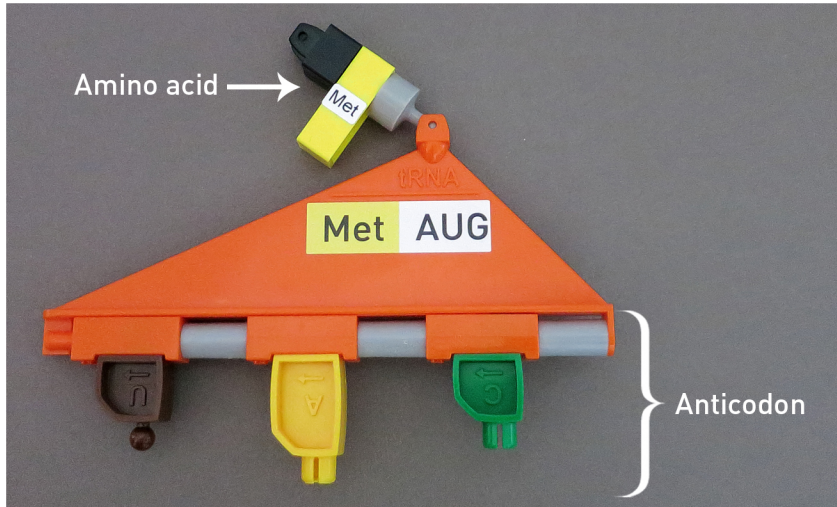




# Introducing the tRNA Molecule

Transfer RNA (tRNA) molecules carry amino acids to the correct place on the ribosome. Each tRNA carries only 1 specific amino acid, attached to the top. When a tRNA molecule has an amino acid attached, it is called a loaded, or charged tRNA. Every tRNA has 3 RNA nucleotides, called an anticodon, on the bottom. The anticodon will bind to a codon on the mRNA. The sticker on each tRNA model names the amino acid it carries and the mRNA codon the tRNA will bind to. For example, the tRNA model below carries a Met and will bind to AUG on the mRNA.

tRNA model with an amino acid



**Q:** What is the anticodon for the model tRNA above?

The 3D shape of a tRNA molecule carrying an amino acid

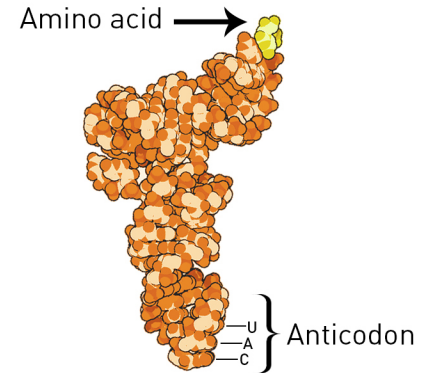


Image from the Protein Data Bank:  
<http://www.rcsb.org/>

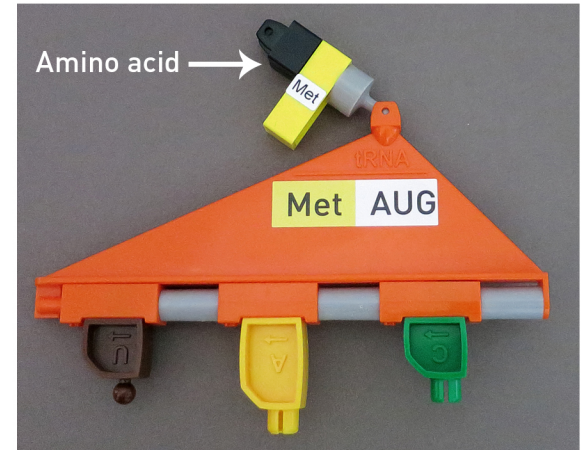
## Loading Your tRNA

Load your tRNA by attaching the correct amino acid onto each tRNA molecule.

1. Read the name of the amino acid on the tRNA sticker.
2. Find and attach the correct amino acid to the top of the tRNA. Attach the amino acid by its acid group as shown in the photo.
3. Repeat for all labeled tRNA gliders except STOP.

The STOP tRNA is actually not a tRNA molecule! It is a protein molecule called a release factor. The release factor does not have an amino acid attached.

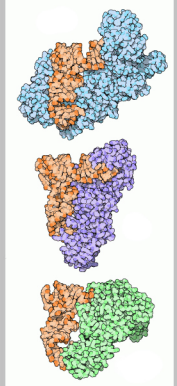
4. Turn to page 15 to start translation of the alpha or mutated alpha mRNA. Turn to page 24 to start translation of the beta or mutated beta mRNA.



### Fantastic Fact!

tRNA synthetases are proteins that load each amino acid onto the correct tRNA. There are 20 different tRNA synthetases, one for each amino acid. Three synthetases are shown on the right in blue, purple, and green, with their tRNA molecules in orange.

*Image from the Protein Data Bank:  
<http://www.rcsb.org/>*

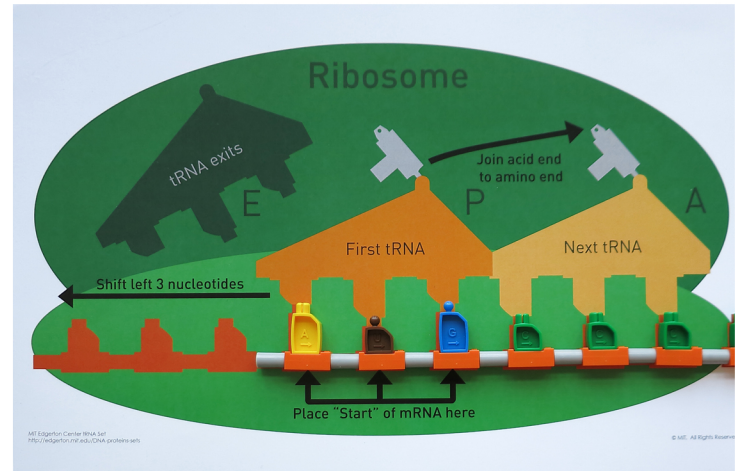


# PART III: TRANSLATION

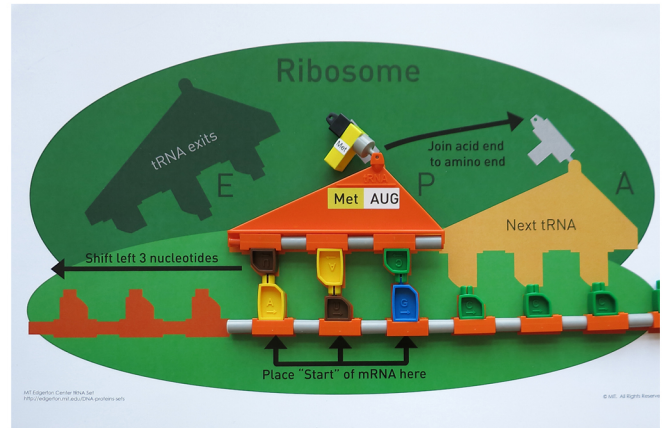
## Translation of the Alpha and Mutated Alpha Chains

After leaving the nucleus, the mRNA travels to a ribosome. Translation begins when the mRNA attaches to the ribosome. The ribosome helps to decode the nucleotides in the mRNA. In translation, the order of the amino acids is determined by the order of the mRNA nucleotides. Every group of 3 nucleotides, or codon, codes for an amino acid.

1. Place the beginning of the mRNA strand on the "Start" section of the ribosome.
2. Check that the first 3 nucleotides are AUG and the strand starts with a phosphate.



3. Place the **Met AUG** tRNA with its amino acid in the P site on the ribosome as shown. It should bind to the mRNA with all nucleotides pairing correctly.



4. If you are building the alpha chain, place the **Pro CCC** tRNA with its amino acid in the A site.

If you are building the mutated alpha chain, place the **Pro CCU** tRNA with its amino acid in the A site.

The correct tRNA should bind to the mRNA perfectly.

