

“TRANSLATION TAXI” game (This game demonstrates how ribosomes make proteins from MRNA)

You will need:

- copies of the pattern pages
- a blank piece of paper
- glue stick and a roll of tape
- scissors and an X-Acto craft knife (or razor blade)
- Six different “tokens” to represent amino acids (candies, cereal bits, nuts, dried fruits-- whatever you want to use)
Add a seventh if you want to use a token for methionine, the very first amino in every polypeptide. You will only need one per player.
ALTERNATIVE: Use paper circles to represent amino acids, and staple them together.

How to make the game:

Make enough copies of the ribosome page so that each student has a copy. Copy the taxi page and the amino acid boxes once for every two students. (If you are really pressed for time/materials, three players could possibly share a set of taxis.) Copy the mRNA page enough times so that each student will have one strip. As you can see, one page will give you five strips.

Ribosome page: Cut along the four vertical lines below the parking places, making them into slits. Also, cut a strip of paper from the blank sheet and make a long, thin paper tray extending out from above parking place P. The tray has to be just wide enough to hold your largest tokens. Don't make the tray too wide. Secure the tray with glue if you want it permanently stuck on or with tape if you want to take the tray back off so you can store the pieces for later use.

Taxis: Cut out the tRNA taxis. Fold the gray side so it becomes the bottom of the car. Unfold it temporarily and cut the trunk slits. Fold up the rims around the trunk and pull the trunk hood up. (see picture below) **TIP:** Don't apply the glue to the gray side! You'll end up getting glue in the trunk area. Apply the glue to the back of the yellow side, but being careful not to apply it to the headlight or license plate. Press the front and backs together, pressing carefully around the rim of the trunk so that the paper rims do not get folded down. The rims will help to stop the tokens from slipping out as the car is moved.

mRNA page: You can use either tape or a glue stick to put the two halves of the mRNA strips together. If you want to use tape, just put the strips end to end and apply tape around the joint. Make sure the joint is smooth. Do trimming if necessary. If you want to join them with glue stick, leave a small paper tab on the left side of each bottom strip. Apply glue to the tab and join to the top half. If the joint isn't smooth, trim with scissors so that it is. (Make sure there is nothing sticking out that will catch as the strip slides through the slots.) Notice that the strips are labeled 1-5, right above the “mRNA.” They are all different, so if you play a second or third time you can switch to a different strip if you want to.

How to set up:

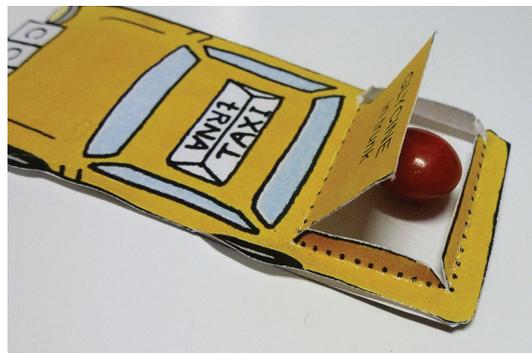
Feed the mRNA strip through the ribosome. Make sure the codons will show right under the A parking place.

Assign tokens to types of amino acids. You can use the paper boxes provided or you can make it even simpler and just use a paper square with the name of an amino written on it and place a small pile on the paper square. Each amino acid will be represented by a type of token. Colored candies are very easy and inexpensive, but you can use anything you want to. They can be edible or inedible and you can mix the two. You could even use paper circles and place a stapler above parking place P. The staples would represent peptide bonds.

Put a token in each trunk to start. Taxis are to be shared, so put them in the middle where everyone can reach them. When a trunk gets emptied it will need to be refilled from the supply pile.



General set up. Two (or three?) players can share a set of taxis.



Assembled taxi with “amino acid” in trunk ready to go.



Make sure codons can be seen under parking place A.

How to play:

Slide the mRNA tape to AUG, which means "START." The codon AUG codes for the amino acid methionine. Methionine's only job is to be the "starter" as the first amino on the string. It is not used for anything else. You can use a special token for methionine, or you can decide to skip methionine or you can simply tell the students that AUG means start and then move on to the next codon on the strip.

Look at the first codon and find its matching anticodon on the license plate of a taxi. Bring the taxi and park it in the A site. Move the mRNA over to the next codon and find the matching taxi. When the second taxi is brought to the ribosome, the taxi in the A site may then move to the P site. Now you have two taxis, one in the A site and one in the P site. Take the amino out of the trunk of the taxi in the P site and put it in the long paper tray. Then move the taxi to the Exit site. Then move the taxi in the A site over to the P site. Slide the next codon over and look for the correct taxi to come occupy the now empty A site. Bring the taxi over and fill the A site. Then you take the amino out of the taxi in the P site and add it below the others. Move all taxis one space to the left, whatever that might be. You'll have a taxi exiting, a taxi moving to the exit and a taxi moving to the P site.

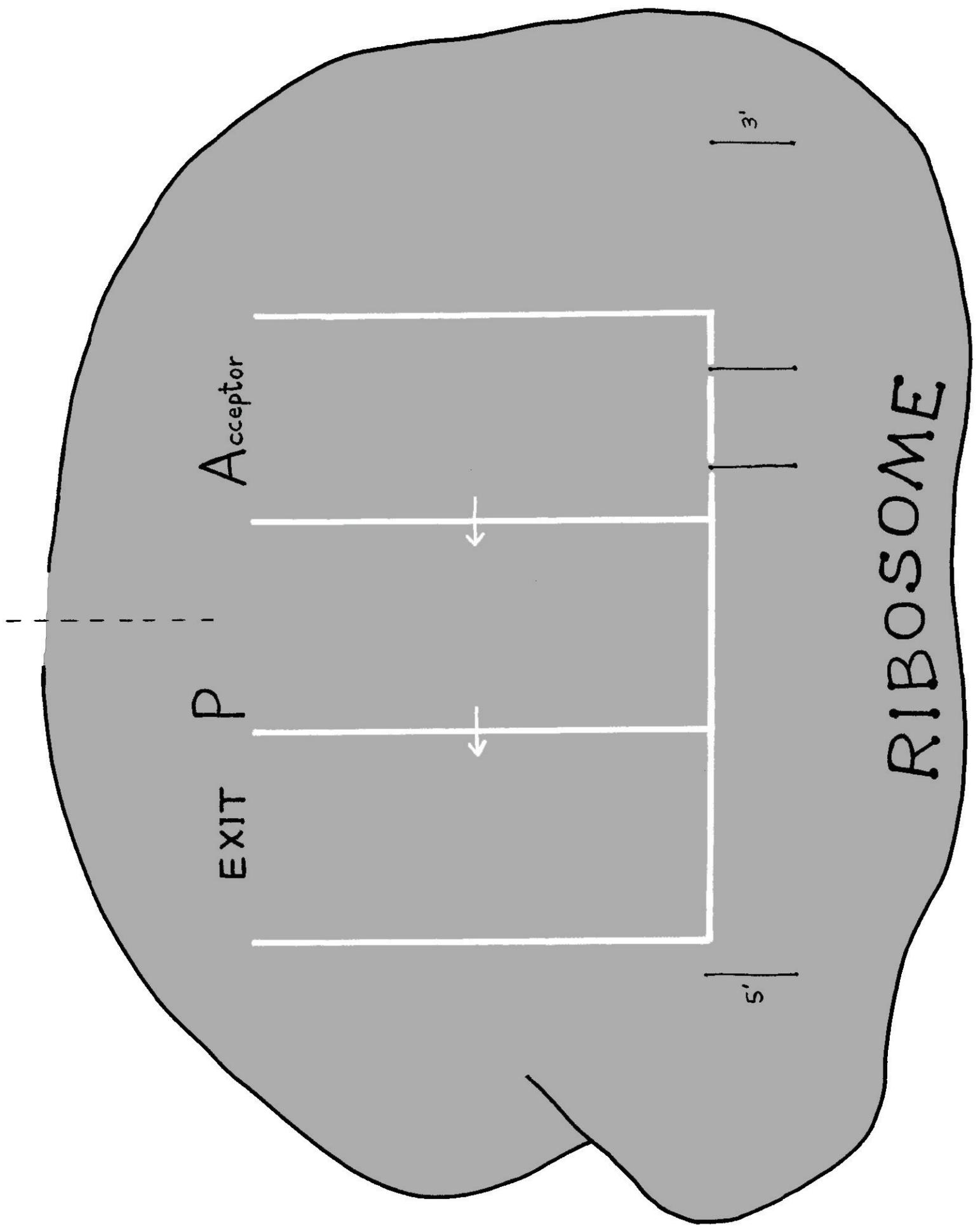
Keep going like this, remembering that an amino can NOT be added to the string unless there is a taxi sitting in the A site. Also, don't forget that the new amino must be added at the bottom, not the top of the growing string. Yes, it is a bit cumbersome to slide all the amino ups every time, but you must do it in order to get the science right. No point in learning wrong science.

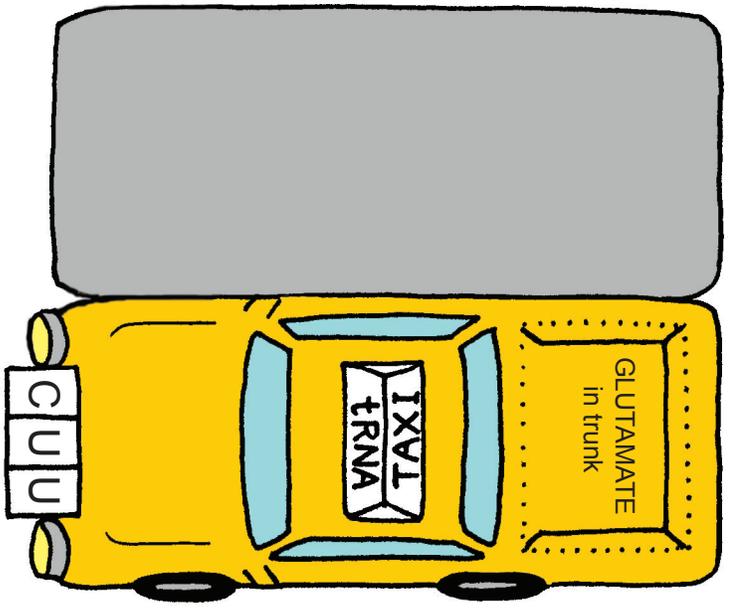
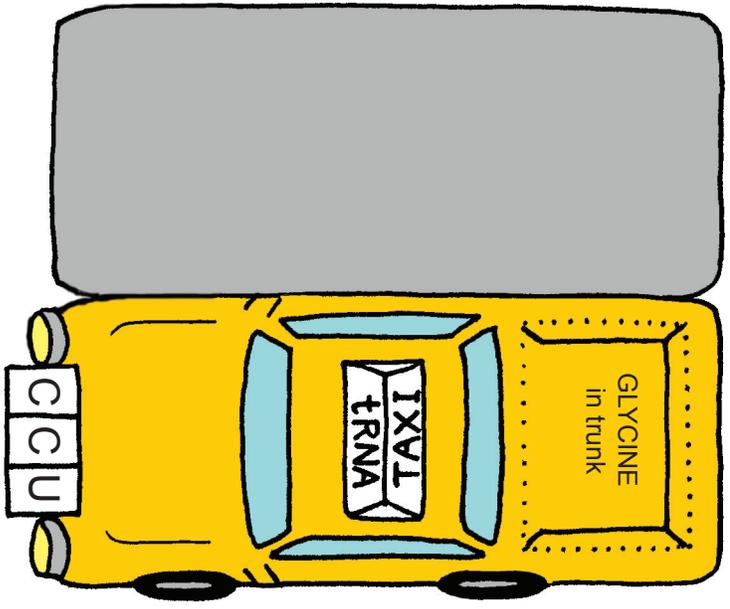
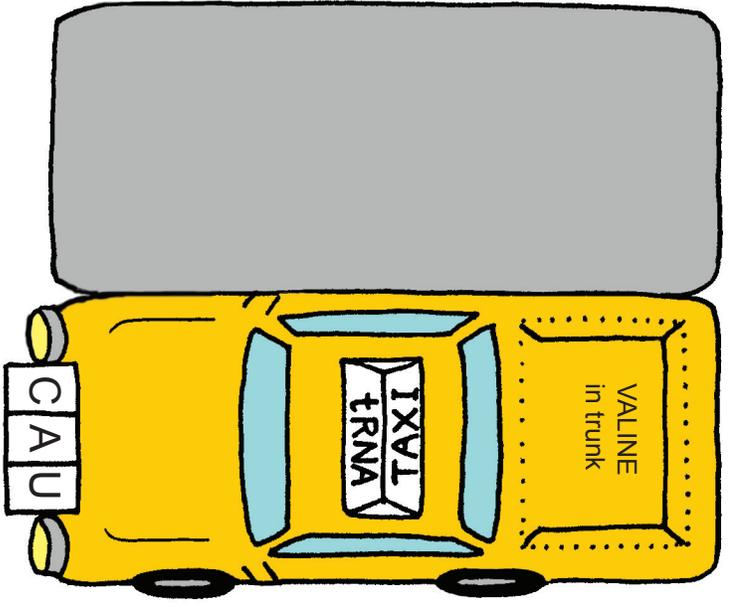
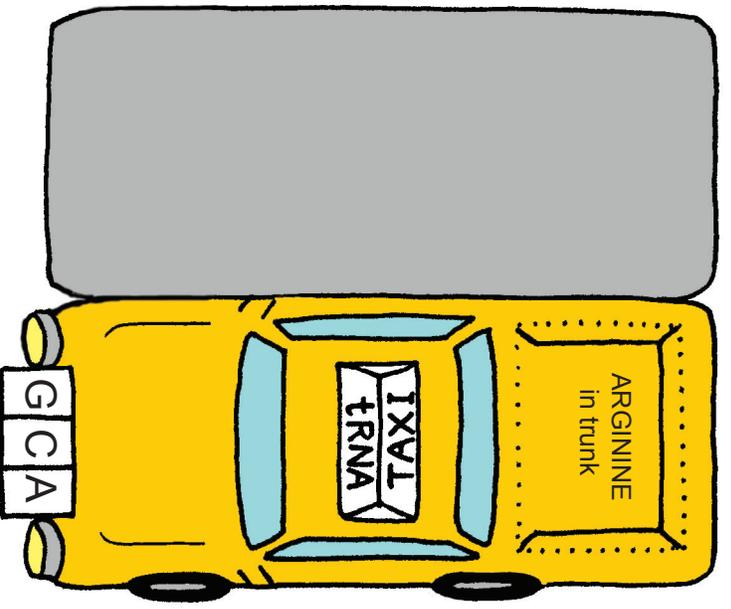
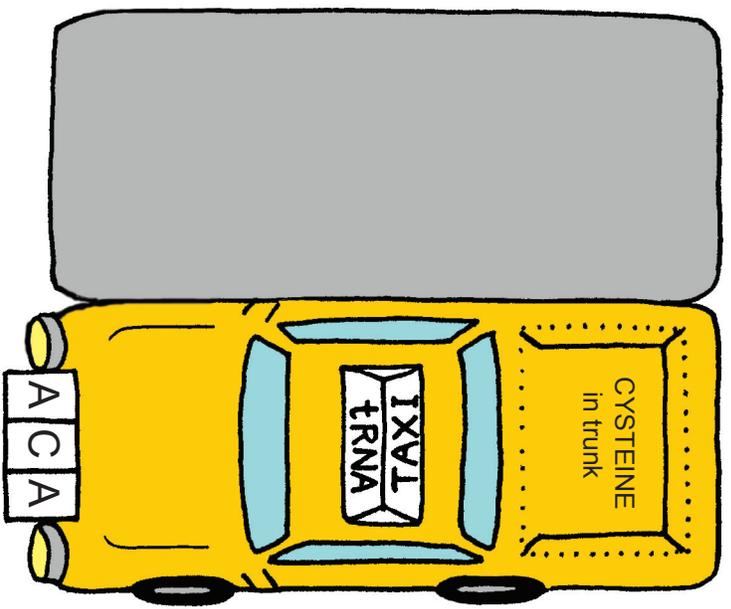
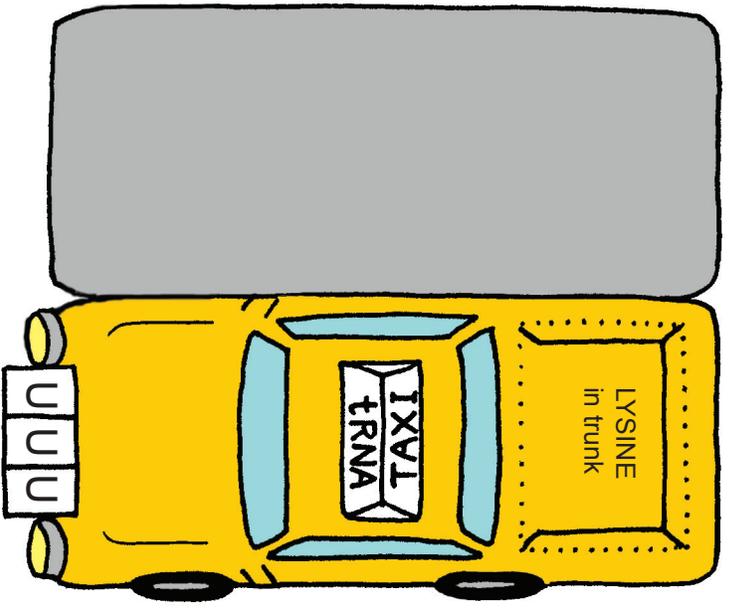
Players will have to be constantly refilling the trunks of the taxis. This simulates reality where tRNAs go out of the ribosome and find another amino acid to transport.

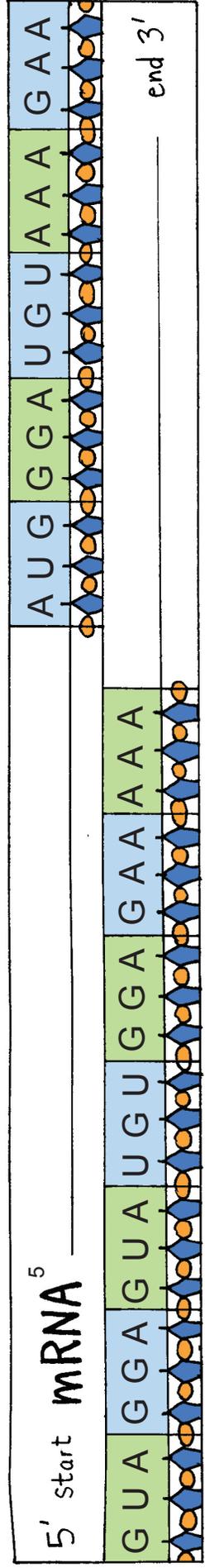
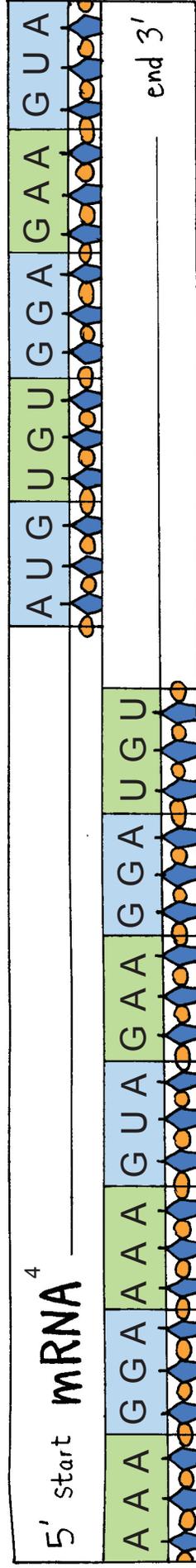
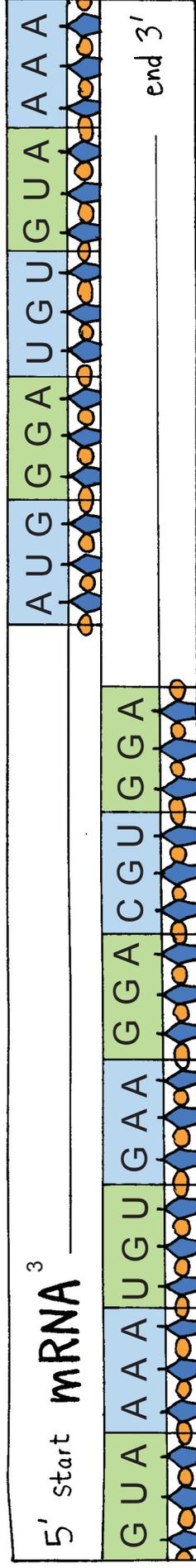
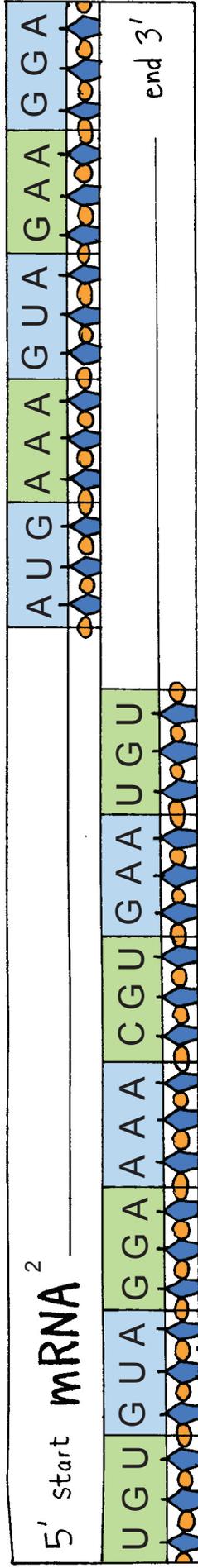
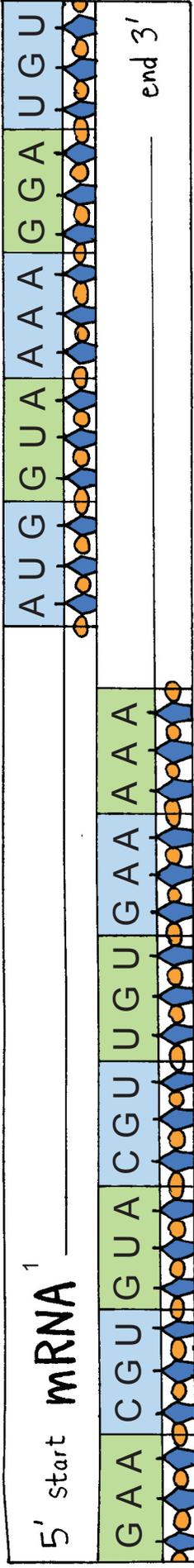
You might want to point out that lysine and valine are among the essential amino acids that you must eat. What if your diet is not providing enough of these amino acids? Can the polypeptides be made? (no) Eating a wide variety of healthy foods assures a good selection of aminos for your cells to work with.

NOTE: There is a short demo video posted on YouTube: <https://youtu.be/XWEr9xrkdOk>









CYSTEINE		

VALINE		

LYSINE		

GLUTAMATE		

GLYCINE		

ARGININE		