TranslationLab Exercise

You will probably find it useful to review the Introduction to Genetics lecture PowerPoint file – particularly the section titled “From Gene to Protein.”

1. Start the Translation Lab application.

2. Click on each of the objects in the first screen and read the description of what they are/what they do (except the clock).

3. After reading the description of the objects, click the Start Experiment button.

Note: each bottle of nucleotides should change color when you select a specific nucleotide. Occasionally the color will not show up. If that occurs, select a different nucleotide and then select the correct one. The colors should look like the figure below:

The four different nucleotides are adenine (A), guanine (G) (these are the purines), uracil (U), and cytosine (C) (these are the pyrimidines).

Question 1. Why is the thymine not one of the selectable nucleotides?

a. Thymine is not a nucleotide.
b. RNA does not use thymine
c. DNA does not use thymine
d. Thymine is not a component of genetic compounds

RNA (specifically messenger RNA – mRNA) is transcribed from a section of DNA that corresponds to a gene. After it is assembled, the mRNA is translated into a polypeptide chain which is the primary structure of proteins. Every three nucleotides on a strand of mRNA correspond to an amino acid (the building blocks of the polypeptide chain. For example, the nucleotide combination of AAU translates to the amino acid asparagine (abbreviated Asn).

Question 2. You are given the following strand of DNA: GACTGGTCCA. Which of the following is the correct mRNA transcription?

a. CTGACCAGGT
b. UTGAUUAGGT
c. CUGACCAGGU
d. GUCTGGUCCA
We know that mRNA is translated into an amino acid based on the combination of every three nucleotides. However, in the Translation Lab application, it is possible to select up to four nucleotides for each experiment.

4. Select the following nucleotides

5. Click the **Make RNA** button

6. Note the mRNA sequence and click “add to notes”

7. Click the **To Translation Mix** button

8. Note the composition of the polypeptide chain. There are three different amino acids translated from the four nucleotides (AGUC) that were used in the experiment.

A special table called the RNA Codon shows how different combinations of three nucleotides can translate into different amino acids. There are three “stop” codons in the table. When translation is occurring and a stop codon is reached, the translation ends.

<table>
<thead>
<tr>
<th>U</th>
<th>C</th>
<th>A</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>UUU = phe</td>
<td>UCU = ser</td>
<td>UAU = tyr</td>
<td>UGU = cys</td>
</tr>
<tr>
<td>UUC = phe</td>
<td>UCC = ser</td>
<td>UAC = tyr</td>
<td>UGC = cys</td>
</tr>
<tr>
<td>UUA = leu</td>
<td>UCA = ser</td>
<td>UAA = stop</td>
<td>UGA = stop</td>
</tr>
<tr>
<td>UUG = leu</td>
<td>UCG = ser</td>
<td>UAG = stop</td>
<td>UGG = tyr</td>
</tr>
<tr>
<td>C</td>
<td>C</td>
<td>A</td>
<td>G</td>
</tr>
<tr>
<td>CUU = leu</td>
<td>CCU = pro</td>
<td>CAU = his</td>
<td>CGU = arg</td>
</tr>
<tr>
<td>CUC = leu</td>
<td>CUC = pro</td>
<td>CAC = his</td>
<td>CGC = arg</td>
</tr>
<tr>
<td>CUA = leu</td>
<td>CCA = pro</td>
<td>CAA = gln</td>
<td>CGA = arg</td>
</tr>
<tr>
<td>CUG = leu</td>
<td>CGG = pro</td>
<td>CAG = gln</td>
<td>CGG = arg</td>
</tr>
<tr>
<td>A</td>
<td>C</td>
<td>A</td>
<td>G</td>
</tr>
<tr>
<td>AUA = ile</td>
<td>AAC = thr</td>
<td>AAA = asn</td>
<td>AGU = ser</td>
</tr>
<tr>
<td>AUC = ile</td>
<td>ACC = thr</td>
<td>AAC = asn</td>
<td>AGC = ser</td>
</tr>
<tr>
<td>AUA = ile</td>
<td>ACA = thr</td>
<td>AAA = lys</td>
<td>AGA = arg</td>
</tr>
<tr>
<td>AUG = met</td>
<td>ACG = thr</td>
<td>AAG = lys</td>
<td>AGG = arg</td>
</tr>
<tr>
<td>G</td>
<td>C</td>
<td>A</td>
<td>G</td>
</tr>
<tr>
<td>GUU = val</td>
<td>GCU = ala</td>
<td>GAU = asp</td>
<td>GGU = gly</td>
</tr>
<tr>
<td>GUC = val</td>
<td>GCC = ala</td>
<td>GAC = asp</td>
<td>GGC = gly</td>
</tr>
<tr>
<td>GUA = val</td>
<td>GCA = ala</td>
<td>GAA = glu</td>
<td>GGA = gly</td>
</tr>
<tr>
<td>GUG = val</td>
<td>GCG = ala</td>
<td>GAG = gln</td>
<td>GGG = gly</td>
</tr>
</tbody>
</table>

RNA Codon Table
Use the codon table and the results to answer the following question.

**Question 3.** How is it possible to translate three different amino acids from an mRNA sequence of AGUCAGUCAGUCAGU?

a. In the Translation Lab application, translation can start on four different nucleotides  
b. Since there are four different nucleotides, there should be four amino acids  
c. Translation Lab used pairs of nucleotides, not triplets

**Question 4.** Did the Translation Lab application begin translation with the first nucleotide in the sequence?

a. Yes  
b. No  
c. We can’t tell for sure

9. Click the **New Experiment** button.

10. Select the nucleotides UGA (leave the fourth bottle blank).

11. Click the **Make RNA** button.

12. Note the mRNA sequence and click “add to notes.”

13. Click the **To Translation Mix** button.

14. Note the composition of the polypeptide chain. There are two different amino acids translated from the three nucleotides (AGUC) that were used in the experiment.

**Question 5.** Why isn’t the “stop” codon listed in the output?

a. It should be. The application has an error  
b. There is no amino acid associated with the “stop” codon.  
c. The translation ended before the appropriate amino acid could be added to the polypeptide chain.
**Question 6.** Use Translation Lab to create the mRNA sequence AGAGAGAGAG... and translate it. What polypeptide(s) did you get? (Use all four flasks).

a. one polypeptide (Glu-Arg-Glu-Arg-Glu-Arg-Glu-Arg-Glu-Arg)
b. two polypeptides (Glu-Glu-Gly... and Arg-Arg-Arg-Arg)
c. no polypeptides
d. one polypeptide (Gly-Lys-Lys-Gly-Lys-Gly-Lys-Gly-Lys)

**Question 7.** Which codons are involved in Question 6?

a. AAG and GGA
b. AGA and GAG
c. AGA only
d. GAG only
e. AAA and GGG

**Question 8.** Use Translation lab to create the mRNA sequence UUUUUU... and translate it. What polypeptide(s) did you get? (Use all four flasks).

a. ser
b. phe
c. lys
d. ddt

**Question 9.** Use Translation lab to create the mRNA sequence GUACGUACGUAC... and translate it. What polypeptide(s) did you get?

a. one polypeptide (Glu-Arg-Glu-Arg-Glu-Arg-Glu-Arg-Glu-Arg)
b. two polypeptides (Glu-Glu-Gly... and Arg-Arg-Arg-Arg)
c. no polypeptides
d. four amino acids on one polypeptide (Tyr-Val-Arg-Thr-Tyr-Val-Arg-Thr-Tyr-Val-Arg-)

**Question 10.** Which condons are involved in Question 9.

a. GUC, UAC, ACG, CGU
b. GUA, UAG, ACG, CGU
c. GUA, UAG, ACA, CGU
d. GUA, UAG, ACG, CGU