Activity: Color by Codon

Sheet 1: Original Genotype & Phenotype

Step 1: Let us draw and color the original phenotype of a flowering plant using RNA codons! Grab Sheet 1 and your crayons (Figure 1).

Step 2: Explore Sheet 1! At the bottom of the page, you will see the DNA Template for the flower and the replicated RNA instructions (Figure 2). The RNA instructions are what you will be interpreting to draw the different features (phenotypes) of the flower.
To interpret what the RNA instructions mean, you will need the ‘Codon Instructions ’ found on the left side of the page (Figure 3, blue circle). These instructions will help you read and interpret each codon in the RNA instructions! Finally, on the right side of the page, you will see a grid (Figure 3, red square). This is where you will be drawing the flower!

Figure 3. Codon Instructions are circled in orange. The drawing grid is indicated by the purple square.

Step 3: Time to start drawing the flower’s different phenotypes based on its genotype! Begin at the Start Codon or ‘AUG’ on the RNA strand. Go to the Codon Instructions and find ‘AUG’. The instructions give you permission to START translation. Great! This means that you can go to the next codon in the RNA sequence. This time, the codon is ‘CAG’. Go to the Codon Instructions and find ‘CAG’. What do you need to do? Use the gridded section of your paper to draw or color the flower based on the Codon Instructions!
Step 4: Read and follow the instructions for every codon in the sequence provided to create the final picture showing the original phenotype of the flower. Keep in mind, if you find a ‘UGA’ codon along the RNA strand, you must STOP translating the RNA instructions, even if there are more codons after the ‘UGA’. The ‘UGA’ is a STOP codon.

Step 5: Now that we know the original phenotype of the flower, what would happen if a mutation or genetic modification occurred in the flower’s DNA? What would the flower’s new phenotypes look like? To answer these questions, let us move on to Sheet 2 (Figure 4)!
Sheet 2: Genetic Mutation & Phenotype

Step 6: Explore Sheet 2! You will see that Sheet 2 looks very similar to Sheet 1, except for a few changes. At the bottom of the page, you will see that the original RNA instructions have undergone mutagenesis! There are now Mutant RNA instructions (Figure 5)! This may lead to new phenotypes for the flower! Let us find out!

Figure 5. The original RNA Instructions (top) and the new, mutated RNA Instructions (bottom).

Step 7: Just like you did on Sheet 1, except now using the Mutant RNA instructions, start at the first codon and begin following the Codon Instructions to draw and color the phenotype of the flower. Pay close attention to the point mutation where the 'G' nucleotide is now a 'U' nucleotide. Also, pay close attention near the end of the Mutant RNA strand where a frame-shift insertion has occurred (a 'G' nucleotide has been inserted).

Step 8: Once you are finished with Sheet 2, let the workshop leaders know. We will discuss the results of the activity as a group. As you wait, look to see if there are any differences in phenotype between Sheet 1 and Sheet 2.
Sheet 1: Original Genotype & Phenotype

Codon Instructions

AUG: START translation
CAG: 2-unit long stem grows straight up
UUG: 3 roots grow into the soil.
GCU: color #1 bulb grows at top of the stem, about 2 units wide
GCC: 4 leaves sprout from the stem
GAA: 8-color #2 petals sprout from the center
CUC: Each root grows two off-shoots
CGU: A second stem grows from the first one
UCU: New stem gains a color #2 bulb, 2 units wide
GGA: New bulb gains 4 color #1 petals.
ACG: The second stem gains one leaf
UGA: STOP translation
CAU: 4-unit long stem grows straight up
UGG: The first stem grows thorns
UUC: Each root off-shoot grows twice as long
AGU: The newer stem grows two more leaves

Soil

DNA Template

RNA instructions:
Sheet 2: Genetic Mutation & New Phenotype

Codon Instructions

AUG: START translation
CAG: 2-unit long stem grows straight up
UUG: 3 roots grow into the soil.
GCU: Color #1 bulb grows at top of the stem, about 2 units wide
GCC: 4 leaves sprout from the stem.
GAA: 8-color #2 petals sprout from the center
CUC: Each root grows two off-shoots
CGU: A second stem grows from the first one
UCU: New stem gains a color #2 bulb, 2 units wide
GGA: New bulb gains 4-color #1 petals.
ACG: The second stem gains one leaf
UGA: STOP translation
CAU: 4-unit long stem grows straight up
UGG: The first stem grows thorns.
UUC: Each root off-shoot grows twice as long
AGU: The newer stem grows two more leaves

Mutagenesis

RNA instructions:

Mutant RNA instructions: