

Names: _____

Protein Bracelet Activity

Objectives:

1. Use plastic beads to construct a representation of a “standard” sequence of amino acids based on a provided DNA sequence
2. Demonstrate the resulting effects of silent, point, and frameshift mutations in the original DNA strand on the RNA and amino acids.

Activities:

General Directions: You will be working in a group of 5 students. Remove the staple from this packet and assign one page to each member of the group. All students will need to refer to this page for the amino acid/bead conversion chart. Each student will use their assigned DNA sequence, make any required changes, and write the corresponding mRNA sequence. Use your codon chart handout to translate the mRNA sequence into an amino acid sequence. Next, consult the amino acid/bead conversion on this page to determine which bead colors are coding for these amino acids. Construct a bead bracelet that corresponds to your amino acid sequence. Answer the questions on your sheet (*you **may** work with the members of your group*). Compare your bracelet with the others in your group and then work together to answer the questions below. You may keep your bracelets as a special biology memento! ☺

Amino acid/ bead conversions

Arginine – orange	Serine – white
Histadine – black	Glutamine – green
Proline – purple	Methionine - yellow
Valine – pink	Threonine – blue
Cystine – cream	Leucine – red

Final Interpretations:

1. Which type of mutation caused the greatest change in the final protein? Explain.
2. Which type of mutation caused the least change in the final protein? Explain.
3. Why don't all mutations change the final protein?

Page 2: Standard DNA Sequence

Name: _____

Directions: Using the beads and the color chart on the first page of this packet, you will construct an amino acid chain using the “standard” DNA sequence. Be certain to show the RNA sequence you used to determine the final amino acid chain. Record the names of the amino acids and then construct the bracelet. When finished, show the beads to your teacher before moving on to the questions.

Original DNA Sequence	TAC	GAA	AGA	TGA	GAG	AGT	TGC	GAC	AGG	TGT
mRNA Sequence										
Amino Acids										
Bead Colors										

Interpretation:

1. What is special about the first codon?
2. Why does the sequence of colors repeat?
3. Does the same color bead always correspond to the same DNA sequence? Give at least 2 examples from this activity.
4. What feature of the genetic code is demonstrated by your answer to question 3?
5. Did you expect the colors to form a pattern? Why or why not?

Page 3: Same-sense (Silent) Mutations

Name: _____

Directions: Using the beads and the color chart on the first page of this packet, you will make a same-sense or silent mutation of the standard DNA sequence and then construct an amino acid chain. Be certain to show the RNA sequence you use to determine the final amino acid chain. Record the names of the amino acids and then construct the bracelet. When finished, show the bead to your teacher before moving on to the questions. Compare your bracelet to the bracelet made from the standard DNA (page 2).

To mutate this DNA sequence, change the second A in GAA below to a T. Then transcribe and translate this new sequence and answer the questions.

Original DNA Sequence	TAC	GAA	AGA	TGA	GAG	AGT	TGC	GAC	AGG	TGT
Mutated DNA Sequence										
mRNA Sequence										
Amino Acids										
Bead Colors										

Interpretation:

1. What changes in the RNA sequence were caused by the changes in the DNA?

2. What changes in amino acids were caused by the changes in the DNA?

3. What changes in the protein resulted from the mutation in the DNA molecule?

4. Explain why this type of mutation is referred to as a silent mutation?

Page 4: Insertion Mutations

Name: _____

Directions: Using the beads and the color chart on the first page of this packet, you will make an insertion or addition mutation of the standard DNA sequence and then construct an amino acid chain. Be certain to show the RNA sequence you use to determine the final amino acid chain. Record the names of the amino acids and then construct the bracelet. If you end up with a codon that only has 1 or 2 amino acids, assume that translation will stop and no amino acid will be added there. When finished, show the bead to your teacher before moving on to the questions. Compare your bracelet to the bracelet made from the standard DNA (page 2).

To mutate this sequence, add one base to the gene by adding a G between the TGC and GAC DNA triplets.

Original DNA Sequence	TAC	GAA	AGA	TGA	GAG	AGT	TGC	GAC	AGG	TGT
Mutated DNA Sequence										
mRNA Sequence										
Amino Acids										
Bead Colors										

Interpretation:

1. What changes in the RNA sequence were caused by the changes in the DNA?
2. What changes in amino acids were caused by the changes in the DNA?
3. What happens to the protein chain if the mutation results in an RNA codon or UAA, UGA, or UAG?
4. How will the changes in the amino acid sequence affect the protein that is coded for by this gene?
5. Explain why this type of mutation is referred to as a frameshift mutation.

Page 5: Deletion Mutations

Name: _____

Directions: Using the beads and the color chart on the first page of this packet, you will make a deletion mutation of the standard DNA sequence and then construct an amino acid chain. Be certain to show the RNA sequence you use to determine the final amino acid chain. Record the names of the amino acids and then construct the bracelet. If you end up with a codon that only has 1 or 2 amino acids, assume that translation will stop and no amino acid will be added there. When finished, show the bead to your teacher before moving on to the questions. Compare your bracelet to the bracelet made from the standard DNA (page 2).

Delete one base from the gene by dropping the second G in the GAG DNA triplet.

Original DNA Sequence	TAC	GAA	AGA	TGA	GAG	AGT	TGC	GAC	AGG	TGT
Mutated DNA Sequence										
mRNA Sequence										
Amino Acids										
Bead Colors										

Interpretation:

1. What changes in the RNA sequence were caused by the changes in DNA?
2. What changes in amino acids were caused by the changes in the DNA?
3. What happens to the amino acid chain if the mutation results in an RNA codon of UAA, UAG, or UGA?
4. How will the changes in the amino acid sequence affect the protein that is coded for by this gene?
5. Explain why this type of mutation is referred to as a frameshift mutation?

Page 6: Substitution Mutations

Name: _____

Directions: Using the beads and the color chart on the first page of this packet, you will make a point mutation of the standard DNA sequence and then construct an amino acid chain. Be certain to show the RNA sequence you use to determine the final amino acid chain. Record the names of the amino acids and then construct the bracelet. When finished, show the bead to your teacher before moving on to the questions. Compare your bracelet to the bracelet made from the standard DNA (page 2).

To mutate this sequence, change the first A in the third codon to a G.

Original DNA Sequence	TAC	GAA	AGA	TGA	GAG	AGT	TGC	GAC	AGG	TGT
Mutated DNA Sequence										
mRNA Sequence										
Amino Acids										
Bead Colors										

Interpretation:

1. What was the effect of this DNA change on the final bracelet?

2. If you had changed the second A of the third codon instead of the first, would you have gotten the same results? Explain.

3. Why is this mutation called a “point mutation?”

4. What other mutation done by one of your group member could also be considered a “point” mutation? Explain.