Name _____
Date _____ Period __

***Mutations Packet*—Change in Sequence, Change in Trait**

Watch the introduction video and respond to the following when it's over:

1. If our DNA is full of errors, why do they not always appear as visible changes in traits?

2. Some mutations do take place that may show up as changes in an individual. But these changes are not necessarily passed on to their kids. How does this happen?

3. Why might a change in the sequence of DNA affect the encoded proteins?

Activity: Simple Mistake, Serious Consequences

The following is a mRNA sequence for normal hemoglobin (hemoglobin A)

AUG GUG CUC CUG ACU CCU GAG GAG AAG UCU UAC CAC GUG GAC UGA GGA CUC CUC UUC AGA

1. What is the amino acid sequence of the protein encoded in this mRNA?

The following is a mRNA sequence for sickling hemoglobin (hemoglobin S)

AUG GUG CUC CUG ACU CCU GAG GAG AAG UCU UAC CAC GAG GAC UGA GGA CUC CUC UUC AGA

2. What is the amino acid sequence of the protein encoded in this mRNA?

Analysis:

1. What is the difference between the mRNA sequence for the normal and sickling hemoglobin?

2. What is the effect on the protein?

3. What effect does the change have on the function of the protein?

4. How does this change affect the individual who carries the DNA sequence for hemoglobin S (sickling)?

5. What is the sequence of DNA for the differing codon in the gene for hemoglobin A and S? Write this above the mRNA stands!

6. Explain the relationships among DNA, protein, and trait.

DNA Mutations:

Silent Mutations, Point Mutations, and Frameshift Mutations

SILENT MUTATIONS AND HOMONYMS

Homonym - One of two or more words that have the same sound and often the same spelling but differ in meaning, such as *bank* (embankment) and *bank* (place where money is kept).

1) The following poem has homonyms that need to be corrected. Circle the homonyms and write the correct word.

An Ode to the Spelling Chequer

Prays the Lord for the spelling chequer
That came with our pea sea!
Mecca mistake and it puts you rite
Its so easy to ewes, you sea.

I never used to no, was it e before eye?
(Four sometimes its eye before e.)
But now I've discovered the quay to success
It's as simple as won, too, free!

Sew watt if you lose a letter or two,
The whirled won't come two an end!
Can't you sea? It's as plane as the knows on yore face
S. Chequer's my very best friend

I've always had trubble with letters that double
"Is it one or to S's?" I'd wine
But now, as I've tolled you this chequer is grate
And its hi thyme you got won, like mine.

2) Similar to the English Language, multiple codons code for ONE Amino Acid: Circle the Amino Acids that DO NOT have multiple codons? Use the Codon Table.

Phenylalanine	Leucine	Isoleucine	Methionine
Valine	Serine	Proline	Threonine
Alanine	Tyrosine	Histidine	Glutamine
Asparagine	Lysine	Aspartic Acid	Glutamic Acid
Cysteine	Arginine	Glycine	Tryptophan

*A change in the DNA sequence that results in the same amino acid is a SILENT MUTATION.

Template DNA Strand: TAC GGA TGA GCA ACT
mRNA: AUG CCU ACU CGU UGA
Protein Sequence: Met---Pro---Thr---Arg---(STOP)

A **Silent Mutation** of the Normal Template:

Template DNA Strand: TAC GGA TGT GCA ACT
mRNA: AUG CCU ACA CGU UGA
Protein Sequence: Met---Pro---Thr---Arg---(STOP)

Circle the changes you see!

3) Where is the silent mutation (which nucleotide) in the second DNA template? _____

What amino acid does it code for each time?

4) In the laboratory there are a number of DNA sequences. Please write down the normal template strand and make your own silent mutation of that DNA strand. CIRCLE THE BASE PAIR THAT YOU CHANGED!

Template DNA Strand: TAC GGA TGT GCA ACT
mRNA: AUG CCU ACA CGU UGA
Protein Sequence: Met---Pro---Thr---Arg--(STOP)

Mutated DNA Template: _____

*A POINT MUTATION changes one DNA base that also changes the resulting amino acid and can be classified into two categories: a) base-pair substitution or b) base-pair insertions or deletions.

*A **missense** mutation is a base-pair substitution resulting in an amino acid that makes sense but not the "right" sense.

*A **nonsense** mutation is a base-pair substitution resulting in a stop thus rendering the protein inactive or dysfunctional.

Normal Template:
Template DNA Strand: TAC GGA TGA GCA ACT
mRNA: AUG CCU ACU CGU UGA
Protein Sequence: Met---Pro---Thr---Arg--(STOP)

Point Mutation of the Normal Template:
Template DNA Strand: TAC GGA AGA GCA ACT
mRNA: AUG CCU UCU CGU UGA
Protein Sequence: Met---Pro---Ser---Arg--(STOP).

5) Where is the point mutation in this sequence? _____

What Amino Acid does it code for?

*A FRAMESHIFT MUTATION involves either inserting or deleting a base and moving the entire DNA sequence after the mistake. **Insertions or deletions** are the additions or losses of base pairs in a gene. These could have disastrous effects because mRNA is read in a series of nucleotide triplets (codon). If the reading frame is altered it is called a **frameshift mutation**.

Example: A frameshift mutation can be compared to a sentence that has lost or gained a letter or spacing. Frameshift mutations change the sentence so it makes no sense.

Original Sentence: The sun was hot.
Mutated Sentence: Thr esu nwa sho t. (insertion)
Mutated Sentence: The unw ash ot. (deletion)

In DNA, a frameshift mutation would change the protein sequence!

Normal Template:

Template DNA Strand:	TAC GGA TGA GCA ACT
mRNA:	AUG CCU ACU CGU UGA
Protein Sequence:	Met---Pro---Thr---Arg---(STOP)

Frameshift Mutation of the Normal Template:

Template DNA Strand:	TAC GGA GTG AGC AAC T
mRNA:	AUG CCU CUC AGC AAC U
Protein Sequence:	Met---Pro---His---Val---Asp

6) Is this FRAMESHIFT MUTATION a result of the addition or deletion of nucleotides?

7) How many codons or amino acids were changed as a result of the mistake?