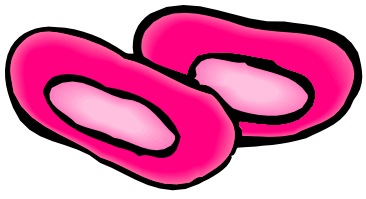
Name: _____ **Date:_____**

Activity 1 Worksheet

Directions:

1. Determine the different combinations of alleles that can be present for each blood type and enter this information in Column 1.
2. Determine the number of students in your class with each blood type and enter this information in Column 2.
3. Determine the percent of students with each blood type and enter this information in Column 3. (Number of students with blood type divided by the total number of students in the class times 100).
4. Enter the type of inheritance involved in Column 4.

Blood Type	1 Possible Allelic Combinations	2 Number of Students	3 % of Students	4 Type of Inheritance
A				
B				
AB				
O				



Red Blood Cell

Name: _____ **Date:_____**

Activity 2 Worksheet

Directions:

1. Divide each of the following mRNA strands into codons.
2. Using The Genetic Code table, write the amino acid sequence for each mRNA strand below the codon.
3. Identify the codon on the sickle cell mRNA strand that is different and draw a circle around it.

Normal Hemoglobin Allele

GUUCAUUUGACACCCGAAGAA

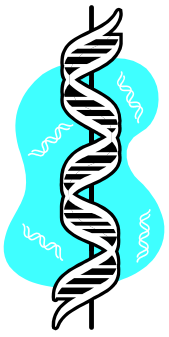
The amino acid sequence is:

Sickle Cell Allele

GUUCAUUUGACACCCGUAGAA

The amino acid sequence is:

4. In the space below, identify they type of mutation that has occurred and write a short explanation of how this mutation has affected the formation of a new protein.



Name: _____ **Date:_____**

Activity 2 Worksheet
(*ANSWER KEY*)

Directions:

1. Divide each of the following mRNA strands into codons.
2. Using The Genetic Code table, write the amino acid sequence for each mRNA strand below the codon.
3. Identify the codon on the sickle cell mRNA strand that is different and draw a circle around it.

Normal Hemoglobin Allele

GUUCAUUUGACACCCGAAGAA

The amino acid sequence is:

Valine-Histidine-leucine-threonine-proline-glutamic acid-glutamic acid

Sickle Cell Allele

GUUCAUUUGACACCCGUAGAA

The amino acid sequence is:

Valine-Histidine-leucine-threonine-proline-valine-glutamic acid

4. In the space below, identify they type of mutation that has occurred and write a short explanation of how this mutation has affected the formation of a new protein.

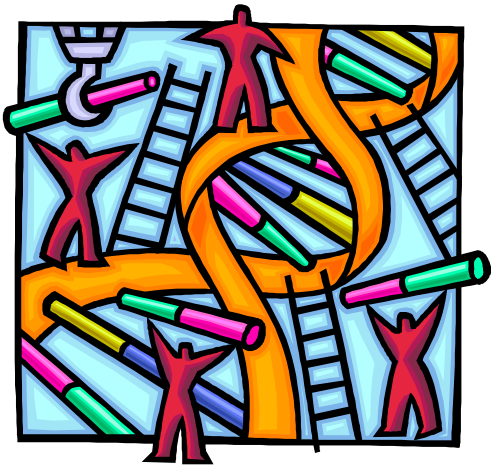
(1)A point mutation has occurred. (2) The substitution of uracil for adenine has caused the change from glutamic acid to valine. (3)This change in the structure of the protein causes the red blood cell to "sickle" when the body is under stress. The red blood cell is unable to carry the maximum amount of oxygen to the cells of the body due to this alteration in structure.

Grading Rubric

Step 1 1 point for each allele
Step 2 2 points for each allele
Step 3 1 point for correctly circling GUA on the sickle-cell allele
Step 4 1 point for the mention of any one of the 4 points marked in the answer given above; 2 points for the mention of any two of the items; 3 points for writing about all 4 items.

The Genetic Code

1st Base In Codon	2nd Base In Codon: U	C	A	G	3rd Base in Codon
U	Phenylalanine	Serine	Tyrosine	Cysteine	**U**
	Phenylalanine	Serine	Tyrosine	Cysteine	**C**
	Leucine	Serine	*STOP*	*STOP*	**A**
	Leucine	Serine	*STOP*	Tryptophane	**G**
C	Leucine	Proline	Histidine	Arginine	**U**
	Leucine	Proline	Histidine	Arginine	**C**
	Leucine	Proline	Glutamine	Arginine	**A**
	Leucine	Proline	Glutamine	Arginine	**G**
A	Isoleucine	Threonine	Asparagine	Serine	**U**
	Isoleucine	Threonine	Asoaragine	Serine	**C**
	Isoleucine	Threonine	Lysine	Arginine	**A**
	Methionine	Threonine	Lysine	Arginine	**G**
G	Valine	Alanine	Aspartic acid	Glycine	**U**
	Valine	Alanine	Aspartic acid	Glycine	**C**
	Valine	Alanine	Glutamic acid	Glycine	**A**
	Valine	Alanine	Glutamic acid	Glycine	**G**



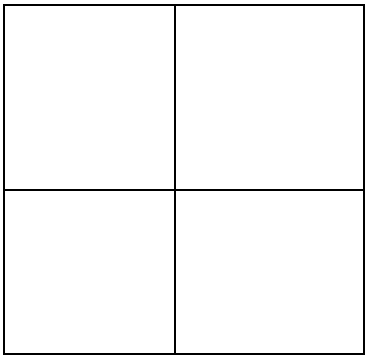
Name: _____ **Date:_____**

Activity 3 Worksheet

Directions:

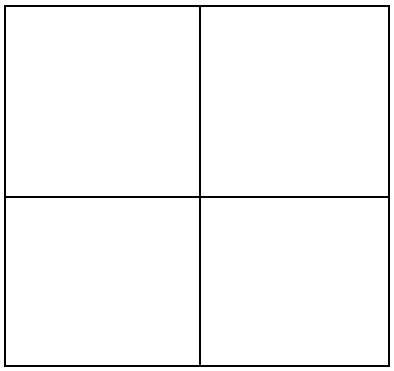
1. Using the M&Ms and raisins fill in the Punnett Squares using the following:
    a. Allele for normal red blood cell = 1 M&M
    b. Allele for sickle cell = 1 raisin
2. Replace each of the M&Ms with the letter *A* and each of the raisins with the letter *S.*
3. Fill in the information below each of the Punnett Squares.

A. Homozygous normal X Sickle Trait



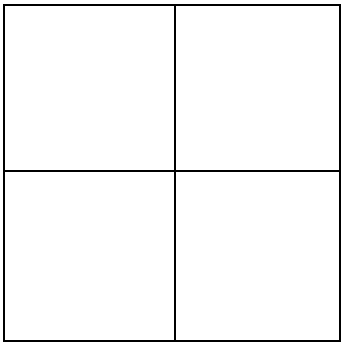
offspring homozygous normal _____
offspring sickle cell trait _____
offspring sickle cell disease _____

B. Sickle Cell Trait X Sickle Cell Trait



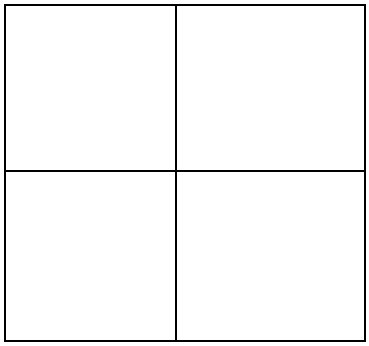
offspring homozygous normal _____
offspring sickle cell trait _____
offspring sickle cell disease _____

C. Homozygous normal X Sickle Cell Disease



offspring homozygous normal _____
offspring sickle cell trait _____
offspring sickle cell disease _____

D. Sickle Cell Trait X Sickle Cell Disease



offspring homozygous normal _____
offspring sickle cell trait _____
offspring sickle cell disease _____

Name: _____ **Date:_____**

Activity 3 Worksheet
(ANSWER KEY)

Directions:

4. Using the M&Ms and raisins fill in the Punnett Squares using the following:
    a. Allele for normal red blood cell = 1 M&M
    b. Allele for sickle cell = 1 raisin
5. Replace each of the M&Ms with the letter *A* and each of the raisins with the letter *S.*
6. Fill in the information below each of the Punnett Squares.

A. Homozygous normal X Sickle Trait

	A	S
A	AA	AS
A	AA	AS

offspring homozygous normal 2
offspring sickle cell trait 2
offspring sickle cell disease 0

B. Sickle Cell Trait X Sickle Cell Trait

	A	S
A	AA	AS
S	AS	SS

offspring homozygous normal 1
offspring sickle cell trait 2
offspring sickle cell disease 1

C. Homozygous normal X Sickle Cell Disease

	S	S
A	AS	AS
A	AS	AS

offspring homozygous normal O
offspring sickle cell trait 4
offspring sickle cell disease 0

D. Sickle Cell Trait X Sickle Cell Disease

	S	S
A	AS	AS
S	SS	SS

offspring homozygous normal O
offspring sickle cell trait 2
offspring sickle cell disease 2

Name: _____ **Date:_____**

Pre/Post Test

Multiple Choice Questions

____ 1. The type of inheritance exhibited by a person who has the sickle cell trait is
a. incomplete dominance. b. codominance.
c. heterozygous dominant.. d. homozygous recessive.

____ 2. In a cross between a parent normal for hemoglobin and an parent who has the sickle-cell trait, the number of children who will have sickle cell disease is
a. 0 b. 1
c. 2 c. 4

_____3. The number of nitrogen bases that are different between the mRNA for normal hemoglobin and the mRNA for sickle-cell hemoglobin are
a. 1 b. 2
b. 3 c. 4

_____4. The amino acid that is present in sickle-cell hemoglobin but NOT in normal hemoglobin is
a. leucine b. glutamic acid
c. threonine d. valine

Short Answer Question (0-2 points)

Explain how the expressions of the sickle-cell trait and AB blood type are similar.

Extended Response Question (0-4points)

Charles Darwin listed the following criteria for evolution to occur:

A. Organisms produce more offspring that can possible survive.
B. Because of overpopulation, there will be competition for resources.
C. Some of the offspring will have adaptations .
D. Those with favorable adaptations will survive and produce offspring.

Explain how sickle-cell anemia can be both an adaptive advantage and an adaptive disadvantage.

Name: _____ **Date:_____**

Pre/Post Test
(ANSWER KEY)

Multiple Choice Questions (1 point for each correct answer)

1. b
2. a
3. a
4. d

Short Answer Question (0-2 points)

Explain how the expressions of the sickle-cell trait and AB blood type are similar.

The alleles in both the sickle-cell trait (AS) and AB blood type are codominant. The traits for both alleles are expressed. Grading rubric: Use of the term "codominant" (1 point); use of the term "codominant" and an explanation that both alleles are expressed (2 points)

Extended Response Question (0-4points)

Charles Darwin listed the following criteria for evolution to occur:

A. Organisms produce more offspring that can possible survive.
B. Because of overpopulation, there will be competition for resources.
C. Some of the offspring will have adaptations .
D. Those with favorable adaptations will survive and produce offspring.

Explain how sickle-cell anemia can be both an adaptive advantage and an adaptive disadvantage.

Answers should include:

1. Those who have the sickle-cell trait have one allele for normal hemoglobin and one allele for sickle-cell
2. The sickle-cell can not carry the same amount of oxygen as a normal red blood cell
3. One or more effects of having sickled red blood cells
4. Malaria affects normal red blood cells but does not affect sickle-cells
5. Those persons who have the sickle-cell trait have a better chance of surviving a malaria outbreak than do those who have two alleles for normal hemoglobin

Grading rubric:

1 point – Student has included two of the points listed above in his/her answer
2 points – Student has included three of the points listed above in his/her answer
3 points – Student has included four of the points listed above in his/her answer
4 points – Student has discussed all of the points listed above in his/her answer