NAME_____ PERIOD _____ DATE _____

Pocket Mouse Mutation - OL

Answer these questions as you watch the video.

1.

Why did dark-colored rock pocket mice first appear in a population of light-colored rock pocket mice?

A. They have a genetic mutation that affects their fur color.

B. There is dark lava rock in the area where they live.

C. Individuals change color to blend in with the environment.

D. Predators eat light-colored rock pocket mice.

2.

Why do dark-colored rock pocket mice on dark lava flows have white bellies?

A. There is no selection for dark bellies by visual predators.

B. Mutations causing dark bellies do not occur.

C. There is a reproductive advantage to having a dark belly.

D. White bellies are an important part of camouflage.

3.

Mutations are always

A. good.

B. bad.

C. neutral.

D. a change in an organism's DNA.

4.

What does Dr. Carroll mean when he says "while mutation is random, natural selection is not"? (Note: More than one answer is correct.)

A. Mutations are caused by changes in the environment.

B. Natural selection can favor some mutations and not others.

C. Selection can change depending on the environment.

D. Mutations for advantageous traits are more likely to be passed on to the next generation.

GENE MUTATION

A gene mutation is any change in the DNA sequence of a gene. Gene mutations can change the structure of the resulting protein. A change in protein structure can change, negate, or have no effect on function. There are several types of mutations, and they affect the amino acid sequences of proteins in different ways.

Types of mutations:

- Substitution mutation: the replacement of one nucleotide of DNA for another. Mutations that affect a single nucleotide are called "point mutations."
- Insertion mutation: the addition of one or more nucleotide(s) to the DNA gene sequence. The insertion of nucleotide(s) can result in "frame-shift" mutations.
- Deletion mutation: the loss of one or more nucleotide(s) from the DNA gene sequence. The deletion of nucleotide(s) can result in "frame-shift" mutations.

Potential effects a gene mutation has on a protein:

- Silent mutation: This mutation does not cause a change in the amino acid sequence of the protein; therefore, there is NO change in the resulting protein.
- Missense mutation: This mutation causes an amino acid in the sequence to be changed to another amino acid. This type of mutation causes a change in the primary structure of the protein (the linear sequence of amino acids), which can result in a change in the three-dimensional conformation of the protein.
- Nonsense mutation: This mutation causes the protein to be truncated (cut short) due to the incorporation of a "stop" signal into the DNA sequence. This results in translation being stopped before the amino acid sequence of the protein is completed.

5. Define a mutation.

A mutation is a change in _____

6. Define a point (substitution) mutation.

7. List the two types of frameshift mutations that can occur.

1.

2.

8. A silent mutation is a point mutation that **(does / does not)** change the protein produced. (circle the correct answer)

Directions: The table on the left is the original MC1R gene for the light color Pocket Mice. The table on the right is the mutant MC1R gene for the dark color Pocket Mice. The genes that mutated on the original gene have been circled and the changes due to the mutation are circled in the resulting mutated gene of the MC1R.

GENE TABLE 1: WILD-TYPE *MC1R* GENE (LIGHT COAT-COLOR PHENOTYPE)

	015							022
DNA	TTG	AGG	TGG	GCG	TGT	CCG	CAA	GGA
mRNA	AAC	UCC	ACC	CGC	ACA	GGC	GUU	CCU
Amino Acid	Asn	Ser	Thr	Arg	Thr	Gly	Val	Pro

	105							112
DNA	CGG	GAC	CGG	TGG	GCC	CAC	TGA	CAC
mRNA	GCC	CUG	GCC	ACC	CGG	GUG	ACU	GUG
Amino Acid	Ala	Leu	Ala	Thr	Arg	Val	Thr	Val

	154							161
DNA	TCA	TAA	CAC	TGT	GAC	GGG	GCC	CGA
mRNA	AGU	AUU	GUG	ACA	CUG	CCC	CGG	GCU
Amino Acid	Ser	Ile	Val	Thr	Leu	Pro	Arg	Ala

	209			212
DNA	GTG	TAC	GAA	CGT
mRNA	CAC	AUG	CUU	GCA
Amino Acid	His	Met	Leu	Ala

	230							237
DNA	GAA	CAG	GTG	GTT	CCA	AAG	GCT	GAG
mRNA	CUU	GUC	CAC	CAA	GGU	UUC	CGA	CUC
Amino Acid	Leu	Val	His	Gln	Gly	Phe	Arg	Leu

GENE TABLE 2: MUTANT *MC1R* GENE (DARK COAT-COLOR PHENOTYPE)

	015							022
DNA	TTG	AGG	TGG	ACG	TGT	CCG	CAA	GGA
mRNA	AAC	UCC	ACC	UGC	ACA	GGC	GUU	CCU
Amino Acid	Asn	Ser	Thr	Cyst	Thr	Gly	Val	Pro

	105							112
DNA	CGG	GAC	CGG	TGG	ACC	CAC	TGA	CAC
mRNA	GCC	CUG	GCC	ACC	UGG	GUG	ACU	GUG
Amino Acid	Ala	Leu	Ala	Thr	Tryp	Val	Thr	Val

	154							161
DNA	TCA	TAA	CAC	TGT	GAC	GGG	ACC	CGA
mRNA	AGU	AUU	GUG	ACA	CUG	CCC	UGG	GCU
Amino Acid	Ser	Ile	Val	Thr	Leu	Pro	Tryp	Ala

	209			212
DNA	GTG	TAC	GAG	CGT
mRNA	CAC	AUG	CUC	GCA
Amino Acid	His	Met	Leu	Ala

	230							237
DNA	GAA	CAG	GTG	GTG	CCA	AAG	GCT	GAG
mRNA	CUU	GUC	CAC	CAC	GGU	UUC	CGA	CUC
Amino Acid	Leu	Val	His	HIS	Gly	Phe	Arg	Leu

Directions: There are five substitution mutations in the dark-colored mutant MC1R gene (on the right). Compare the DNA sequence of the light-colored wild-type MC1R gene with the DNA sequence of the dark-colored mutant MC1R gene. The locations of the five mutations were identified by **circling the five single DNA nucleotides** that were **mutated in the mutant MC1R gene**.

Directions: Use the key to shade in the columns (DNA, mRNA, and amino acid) of the mutant MC1R gene (table on the right).

BLUE = Silent Mutation (results in no change of amino acid)

RED = Substitution Mutation (results in a change in the amino acid

QUESTIONS

1. Explain the relationship between DNA sequence, amino acid sequence, and protein structure and function. (How does one affect the other?)

   _____

   _____

   _____

   _____

2. Of the five mutations identified in the mutant MC1R gene, how many are: (enter a number on the line)

   _____ substitution mutation _____ insertion mutation _____ deletion mutation

3. Of the five mutations you identified in the mutant MC1R gene, how many are: (enter a number on the line)

   _____ point mutation _____ frameshift mutation

4. Of the five mutations you identified in the mutant MC1R gene, how many: (enter a number on the line)

   _____ result in a new amino acid _____ caused no change in an amino acid

5. Does a silent mutation affect the structure and function of the protein?

6. Explain how the mutant MC1R gene directly affects a rock pocket mouse's coat color.

   _____

   _____

7. Mutations are a source of genetic variation. In the film, Dr. Carroll says that mutations occur randomly. Explain what this statement means.

   _____

   _____

   _____

8. It is a common misconception that "all mutations are bad." Explain why this statement is not true. Use examples to support you answer.

   _____

   _____

   _____

   _____