

Spring 2016 Agriscience DNA Unit Project by C. Kohn



Name: _____ Hour _____ Date: _____ Score: + ✓ -

Directions: in teams of 3-4, create a presentation (using PowerPoint, Google Docs, or a similar program) to create a response to each of the questions on this sheet. You will be presenting your response to at least one of these questions to the class as a team. The topic you will be presenting will be selected at random on the day of the presentation. Your performance will be assessed using the attached rubric.

Be sure to use your notes as a guide as you are going through each of the following questions. Keep in mind that what is said verbally is as important (or more) as what is included on your slides. Be sure to write all information in your presentation in your own words (do NOT plagiarize or just copy and paste the information). Use your instructor as a guide while your team is preparing your presentation to make sure that your work is meeting their expectations.

1. One Holstein cow has a black and white coat. Another Holstein cow has a red and white coat. Explain how and why these two cows have differently-colored coats by addressing each of the following items:

- a. Differences and similarities between the gene for a black & white coat and the gene for a red & white coat.
 - i. Address each of the following: definition of a gene; nucleotides; sugar; phosphate; base; A-T & G-C.
- b. How information encoded in these genes becomes expressed as a specific kind of protein/trait through transcription and translation.
 - i. Be sure to address each of the following: mRNA, tRNA, ribosomes, and codons.
 - ii. Explaining a picture of transcription and translation could be an effective way to accomplish this objective.
- c. How the color created by each kind of protein is influenced by the order of amino acids in each protein.
 - i. Address the following: hydrophobicity; charge; cysteines; alpha helix; beta sheet; polypeptide.
- d. Describe how the red-colored protein formed from the original black-colored protein by summarizing how and why genes can change through mutation.
- e. Hypothesize whether this mutation is most likely a substitution, insertion, or deletion mutation. Defend your hypothesis with evidence.

2. Genetic diseases are often the result of a change to a single nucleotide base. Summarize how and why a change to only one nucleotide base (out of billions) can have such devastating effects. Be sure to address:

- a. How the information encoded in DNA becomes expressed as a protein through transcription and translation.
- b. How codons contribute to the assembly of a protein from amino acids using the information in DNA/RNA.
- c. The relationship between each of the following: 1) the information in DNA/RNA, 2) the order of amino acids in a protein, 3) the shape of the protein, and 4) the function of the protein.

3. A research team has developed a genetically-engineered bacterium that produces the enzymes that are necessary to convert the cellulose fibers in corn stalks into sugars that can be fermented into fuel. However, these bacteria exhaust their supplies of energy if they produce these enzymes at all times.

- a. Design a protein regulatory system similar to what is found in the *lac operon* so that these engineered bacteria only produce these enzymes when the corn stalk cellulose fibers are available.
- b. Summarize how this mechanism will work so that these enzymes are only produced when cellulose fibers are available.

4. A cat has a mutation that causes it to have six toes on each paw. This particular cat is heterozygous for this mutation and expresses the mutated phenotype. This cat mates with another cat that has the normal phenotype (five toes on each paw) and is homozygous recessive. They have 8 kittens. Provide responses to the questions below based on this information.



- Assuming that the kittens follow the predictions in the Punnett square, how many of the 8 kittens would be born with the mutated phenotype? How many of the 8 kittens would have the normal phenotype? Show with a Punnett Square.
- Is this mutation a dominant or recessive trait? How do you know?
- This mutation affects a repressor protein. The mutation is a substitution mutation that occurs midway through the gene.
First, summarize how a repressor protein works.
Second, explain how a single substitution mutation to a single codon could cause an entire protein to malfunction.
Third, explain how a mutated repressor protein would result in the formation of a six-toed cat.
- A mutation that causes the formation of an extra digit (such as a toe) usually has a pleiotropic effect; the cats with six digits are more likely to have other medical conditions. Summarize what it means that the gene for the mutated paws has a pleiotropic effect and what this might indicate to a veterinarian.



5. Explain what would be the most likely phenotype (*normal* or *mutated*) in each scenario. Then use what you know about mutations, transcription, translation, and protein shape and function to justify your answer.

A) A substitution mutation occurs, creating a new codon that codes for an amino acid with similar properties.

Most likely phenotype: *Normal* *Mutated* Why?

B) A substitution mutation occurs, creating a new codon that codes for an amino acid with different properties.

Most likely phenotype: *Normal* *Mutated* Why?

C) A deletion mutation occurs.

Most likely phenotype: *Normal* *Mutated* Why?

D) An insertion mutation occurs.

Most likely phenotype: *Normal* *Mutated* Why?

Be sure to address the following in this section: frameshift mutations; silent mutations; codons; amino acids; shape & function of proteins.

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Group Names (F&L): _____

_____ Hour _____ Date: _____ Score: + ✓ -

Grading: Your grade will be determined using the following considerations:

Item	Plus (100%)	Check (70-90%)	Redo (0%)
Accuracy	No errors were detected in this presentation	This presentation contained a few errors, but overall was very accurate.	This presentation contained considerable errors.
Thoroughness	No important information was omitted.	A few more details would have enhance this work.	Major topics were omitted that should have been included.
Professionalism	This presentation could be effectively delivered to a group outside of the school.	This is acceptable work for high school students but room exists for improvement.	The professionalism of this group needs significant improvement.
Group Involvement	Every member was involved with the development of the presentation as well as its delivery.	At least one more group member could have been more involved than they were.	Multiple group members clearly could have been more involved.
Effort	Effort exceeds what would be expected of a high school student.	Effort is acceptable for a high school student but room exists for improvement.	Level of effort could have been much greater than what was presented.

Remember – Please provide your instructor with this sheet when you present so that they can use it to record your grade.

Comments: