



Topic: Dinosaur Evolution Project

Summary: Students pretend to evolve two dinosaurs using genetics and watch how the dinosaurs adapt to an environmental change. This is a very comprehensive project including genetics, fossils, natural selection, speciation and ecology.

Goals & Objectives: Students will be able to explain natural selection. Students will be able to map out how mutations generate new traits in a gene pool. Students will be able to innovate and to use their problem-solving skills to discover how a new species is formed.

Standards: CA Biology *5c Students know* how mutations in the DNA sequence of a gene may or may not affect the expression of the gene or the sequence of amino acids in an encoded protein. *5e Students know* proteins can differ from one another in the number and sequence of amino acids. *7a Students know* why natural selection acts on the phenotype rather than the genotype of an organism. *7c Students know* new mutations are constantly being generated in a gene pool. *7d Students know* variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions. *8a Students know* how natural selection determines the differential survival of groups of organisms. *8b Students know* a great diversity of species increases the chance that at least some organisms survive major changes in the environment. *8e Students know* how to analyze fossil evidence with regard to biological diversity, episodic speciation, and mass extinction.

Time Length: 6 days of class time for students to work on the project.

Materials:

- Photocopy large pictures of fossil drawings
- Book: Dinosaur Encyclopedia by American Museum of Natural History
- 2 blank pieces of paper
- Color pencils and white paper for drawing
- Dinosaur handout per person.
- 1 penny per group.

Teacher Setup:

1. Photocopy packet and staple together in correct order.
2. Photocopy page size pictures of complete dinosaur fossils / bones drawings.

Procedures:

1. Students should start the project by drawing the original dinosaur fossil.
2. Students then describe the *dinosaur background*.
3. Students then describe the *dinosaur chromosome mutation*.
4. Students then describe the *dinosaur gene mutation*.
5. Students then should draw the draw the mutated dinosaur fossil.
6. Students then fill in the answer sheet *dinosaur habitat*.
7. Students then fill in the answer sheet *dinosaur speciation*.
8. Students then answer six short answer questions.

Accommodations:

Students with an IEP can join another student to form a group of two students. Students who are dyslexic can write a smaller portion of the short answer and longer fill-in the blank questions and concentrate on the drawings. Students with an IEP can take their section home if they need extra time.

Evaluation:

The project is worth a total of 100 points:

20 points for their two drawings, each drawing is worth 10 points

30 points for short answer, each answer is worth 5 points

50 points for the answer sheets correctly filled in, each section is worth 10 points

Mutant Dinosaur

Intro

Your dinosaur is born with a new genetic mutation. Your job is to map out the genes that are influenced by the mutation and to discover how the new dinosaurs interact with the environment using the principles of evolution.

Order of Progression

1. Draw original dinosaur fossil
2. Dinosaur background
3. Dinosaur chromosome mutation
4. Dinosaur gene mutation
5. Draw evolved dinosaur fossil
6. Dinosaur habitat answer sheet
7. Dinosaur speciation answer sheet
8. Short answer questions

Drawings

You are going to draw how a dinosaur evolves and forms a new species. You will draw one *fossil* picture of an original dinosaur and draw the *fossil* of the new dinosaur species. The pictures need to be large in size, detailed, complete, and includes a title. ***Draw the individual bones for each fossil and label the mutated phenotype.***

Individual Grading

Drawings 20 points. Short answers 30 points. Answer sheets 50 points.

mRNA Codon Table

1 s t B a s e	U	Phenylalanine	Serine	Tyrosine	Cysteine	U C A G	3 r d B a s e
		Phenylalanine	Serine	Tyrosine	Cysteine		
		Leucine	Serine	Stop	Stop		
		Leucine	Serine	Stop	Tryptophan		
C	Leucine	Proline	Histidine	Arginine	U C A G		
	Leucine	Proline	Histidine	Arginine			
	Leucine	Proline	Glutamine	Arginine			
	Leucine	Proline	Glutamine	Arginine			
A	Isoleucine	Threonine	Asparagine	Serine	U C A G		
	Isoleucine	Threonine	Asparagine	Serine			
	Isoleucine	Threonine	Lysine	Arginine			
	Methionine	Threonine	Lysine	Arginine			
G	Valine	Alanine	Aspartic acid	Glycine	U C A G		
	Valine	Alanine	Aspartic acid	Glycine			
	Valine	Alanine	Glutamic acid	Glycine			
	Valine	Alanine	Glutamic acid	Glycine			
		U	C	A	G		
2nd Base							

Dinosaur Background

What is the scientific name of the original dinosaur? _____

What body part of the dinosaur is going to change? _____

What are you going to change about this body part? _____

What is the new name for your mutant dinosaur? _____

Explain the new trait's phenotype in detail (uses, benefits for survival, how does it work).

Chromosome Mutation

Pretend a single gene controls the body part above. This protein will cause a physical appearance change in the dinosaur. The physical change must be able to leave some skeletal or fossil evidence. *You are now going to create two mutations for this single gene.* The first type of mutation is called a chromosome mutation. You will cause this

_____ / _____ / _____ / _____ / _____
11 12 13 14 15

Mutated Gene - Mutated DNA (copy the DNA from above but mutate it by inserting, deleting or substituting one or more bases. Silent mutations are not allowed.) **Circle** the *mutation*.

Mutated DNA:

TAC / _____ / _____ / _____ / _____ / _____ / _____ / _____ / _____ / _____ / _____ / _____ / _____ / _____ / _____

mRNA:

_____ / _____ / _____ / _____ / _____ / _____ / _____ / _____ / _____ / _____ / _____ / _____ / _____ / _____ / _____
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Mutated Amino Acid Sequence – **Circle** what has changed from the original amino acid sequence.

_____ / _____ / _____ / _____ / _____ /
1 2 3 4 5
_____ / _____ / _____ / _____ / _____ /
6 7 8 9 10
_____ / _____ / _____ / _____ / _____ /
11 12 13 14 15

Dinosaur Habitat

Please use the reference page with information about your dinosaur to help answer the following questions. Look at the reference of *Habitat* and *Diet* and compare to information on biomes in your textbook.

Current Habitat

What type of habitat would your dinosaur live in? _____

List abiotic factors (climate, landscape) found in this habitat.

List biotic factors (living things) found in this habitat. _____

What does your original dinosaur eat? _____

Does the diet change based upon the mutation? If yes, explain how your mutant dinosaur's diet is different than the original dinosaur's diet? _____

Environmental Change

An environmental change is happening to the habitat your dinosaur lives in. In real life you can not choose your environmental change, but for this project pick one that your mutant dinosaur would be best adapted for. *Circle only one change (one *)*.

- * Cooling to an ice age
- * Climate warming causing a lot more rain
- * Rise of the sea level
- * Climate warming causing a long severe drought
- * Invasion of a new species that competes for resources with your dinosaur
- * Earthquakes cause the flow of a large river to go right through your dinosaur's habitat
- * Many volcanoes erupt and release toxic gasses in the middle and upper atmosphere during a 500 year period.
- * Volcanic lava flows isolate your dinosaur's habitat from rest of population on the island.

Dinosaur Habitat

Please use the reference page with info about your dinosaur to help answer the following questions.

How is the dinosaur's water sources affected by the environmental change? How would the dinosaur's habitat be affected by this change to their water sources? _____

How is the dinosaur's shelter / nesting sites necessary to live and reproduce affected by the environmental change? How would the dinosaur be affected by this change to their shelter / nesting site? _____

How would the food chain of your dinosaur's ecosystem be affected by the environmental change? How is the dinosaur's prey and predators be affected by this change to their food chain? _____

Some of the original dinosaurs do not survive the environmental change but your mutated dinosaur survives. Briefly explain why many of the original dinosaurs do not survive the environmental change. Make sure to use concepts like *adaptation* or *competition*.

Dinosaur Speciation

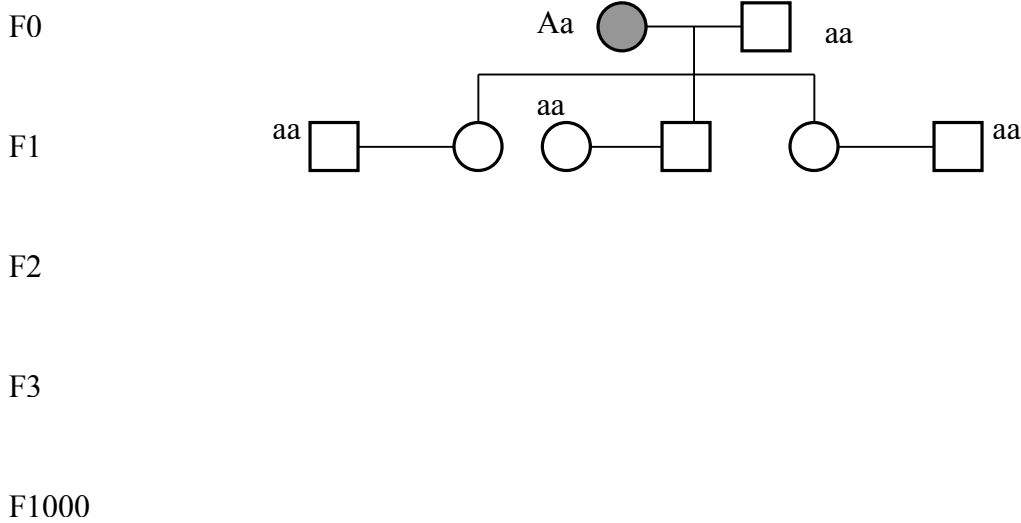
Now, based upon the dinosaur's habitat, the surviving dinosaurs will reproduce. Pretend the mutated gene created on Dinosaur Genetics page is **dominant** and causes your dinosaur to have genotype of **Aa**. Your mutant dinosaur is the shaded female in the pedigree below. Below is a pedigree showing how the mutant gene is passed on from generation to generation. The mate for your mutant dinosaur will have a genotype of **aa** because they represent original dinosaurs. Since you are demonstrating how adaptation leads to speciation, you need to follow the following four rules.

Rule 1: Half of the offspring that have the genotype **aa** die and don't reproduce.

Rule 2: All of the remaining offspring reproduce.

Rule 3: Label each of the organism's genotypes.

Rule 4: Design the pedigree go to the F3 generation and predict the F1000 generation.



What is the frequency of the mutated gene in the F1000 generation? _____%

What would the original and mutant dinosaur share in common? _____

Why did some of the recessive original dinosaurs die off above? _____

In order for your mutant dinosaur population to become its own species, it needs to be separated from the original dinosaur population so they no longer will mate with each other. Come up with an idea of how the mutant dinosaur population uses reproductive isolation to separate itself from the original dinosaur population.
