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.

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 mutation*.
4. Students then describe the *dinosaur genetics*.
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

Name: _____ Row: _____

Date:_____ Period:_____

Mutant Dinosaur

Intro
A dinosaur is born with a new genetic mutation. Your job is to map out the genes that 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 mutation
4. Dinosaur genetics
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 to form a new species. You will draw one fossil picture of an original dinosaur and draw the fossil of the new dinosaur species. This project includes two, page-size, complete dinosaur fossil drawings. Please title and label the mutated parts. Make the drawings very detailed and precise.

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

mRNA Codon Table

1st Base	2nd Base: U	2nd Base: C	2nd Base: A	2nd Base: G	3rd Base
U	Phenylalanine	Serine	Tyrosine	Cysteine	U
	Phenylalanine	Serine	Tyrosine	Cysteine	C
	Leucine	Serine	Stop	Stop	A
	Leucine	Serine	Stop	Tryptophan	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	Asparagine	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

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).

_____

_____

_____

_____

Dinosaur 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 call chromosome mutation. You will cause a mutation by manipulating the dinosaur's chromosomes. The second type of mutation on the following page is called a point mutation.

There are five types of chromosome mutations (insertion, deletion, duplication, inversion, and translocation). Pretend the number of dinosaur chromosomes is the same as human 2N (46 chromosomes).

What type of chromosome mutation will happen to the chromosome? _____

Which dinosaur chromosome number will the mutation happen on? _____

Draw using colors for *two* original and mutated chromosomes below.

Original Chromsomes	Mutated Chromosomes

Dinosaur Genetics

Original Gene – make up original DNA sequence for the single-gene trait. Make sure there is no start or stop codons in the middle of your original DNA code (TAC, ATC, ATT, ACT).

Original Dinosaur DNA:

TAC /_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_ATT_

mRNA:

_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_UAA

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

tRNA:

_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_AUU

Original Amino Acid Sequence

_____ / _____ / _____ / _____ / _____ /

1 2 3 4 5

_____ / _____ / _____ / _____ / _____ /

6 7 8 9 10

_____ / _____ / _____ / _____ / _____

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 mutated DNA.*

Mutated DNA:

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

mRNA:

_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____

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

tRNA:

_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____/_____

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

Circle one: What type of DNA point mutation happened? insertion, deletion, or base substitution

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. Pretend your dinosaur lived today, describe the modern day environment that your dinosaurs would live in.

Current Habitat

What type of biome would your dinosaur live in? _____

List abiotic and biotic factors found in this biome.

_____

_____

_____

_____

_____

What does your original dinosaur eat? _____

Based upon the size of your mutated dinosaur, what plants or animals listed above would be the typical prey or plant of your dinosaur if it lived today? Does the diet change based upon the mutation?

_____

_____

_____

Environmental Change

An environmental change is happening to the habitat your dinosaur lives in. Select one environmental changes below that either causes a fast or slow change to your dinosaur. Please select a change where one of your mutated dinosaurs will thrive in the new habitat. *Circle an environmental change* (one *) below that you want to happen.

Slow Changes	Fast Changes
* Cooling to an ice age	* Volcano erupts causing toxic gasses
* Rise of the sea level	* Landslide isolates your habitat from rest of island
* Climate warming	* Volcano erupts causing lava flows into your habitat

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 is the dinosaur's shelter/nesting sites necessary to live and reproduce affected by the environmental change? _____

_____

_____

How would the food chain of your dinosaur's ecosystem be affected by the environmental change? _____

_____

_____

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 concept of adaptation and competition.

_____

_____

_____

What is the definition of a species? _____

_____

In order for your mutant dinosaur to become its own species, it needs to create its own gene pool. Reproductive isolation plays a key role in speciation. There are three main types of reproductive isolation: behavioral, geographical and temporal. Come up with an idea of how your dinosaur uses one or more of these types of isolation to become separate from the original dinosaur's gene pool.

_____

_____

_____

_____

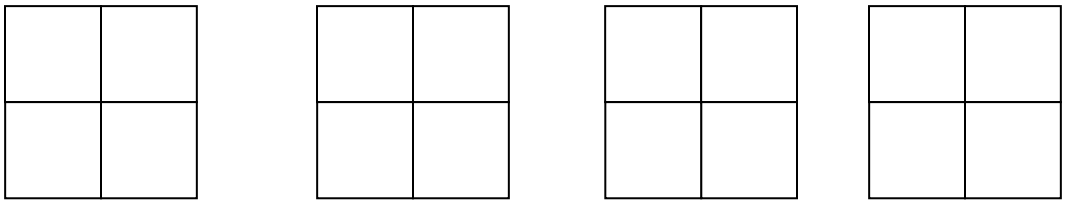
Dinosaur Speciation

Now, based upon the dinosaur habitat, the surviving dinosaurs will reproduce.

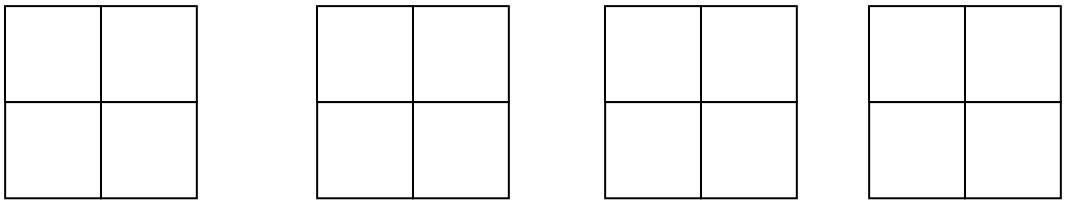
Circle one: The mutated will become dominant or recessive

What is the mutated dinosaur's genotype? _____

If the gene is dominant, the mate's genotype will be the opposite, aa. If the gene is recessive, the mate would be AA. Your dinosaur's mutation is beneficial to their survival after the environmental change. Complete the flowing punnett squares with the mutation happening in the p generation. The environmental change happens after the p generation. Using the offspring of the previous generation, take two and mate them for the next generation. The mutated gene should be passed on.



P F1 F2 F3



F4 F5 F6 F7

Assuming each punnett square represents all mutated dinosaurs for that generation, what would be the relative frequency of the mutated gene in the F7 generation? _____

What is the definition of a population? _____

_____

Since individuals with the mutation pass on their favorable traits to their offspring, over many generations the favorable traits will increase in a population. This causes the population to change over time. Explain how the amount of time between generations influences how fast a population of mutant dinosaurs will grow.

_____

_____

Short Answer Questions

Please write legibly, in complete sentences, answering each question using as much detail and evidence as possible.

1. Explain how variation *within a species* increases the species chance to survive when the environment changes.

2. Your two fossil drawings show evidence on how one species is related to another species. Explain, using concepts like homologous structures, how your dinosaur fossils are evidence for speciation.

3. Explain how natural selection acts on the *phenotype* and not the genotype of your dinosaur.

4. How did competition for resources affect your dinosaur's fitness? How did adaptation affect your dinosaur's fitness?

5. Explain how genetic drift may have affected the mutant dinosaur.

6. Pretend all the dinosaurs in this class make up a small community on an island. Explain why a larger number of different species increases the chance that at least some dinosaurs will survive a major change in the environment on the island.