

Bottleneck Genes Biodiversity Activity

Objectives: Students will

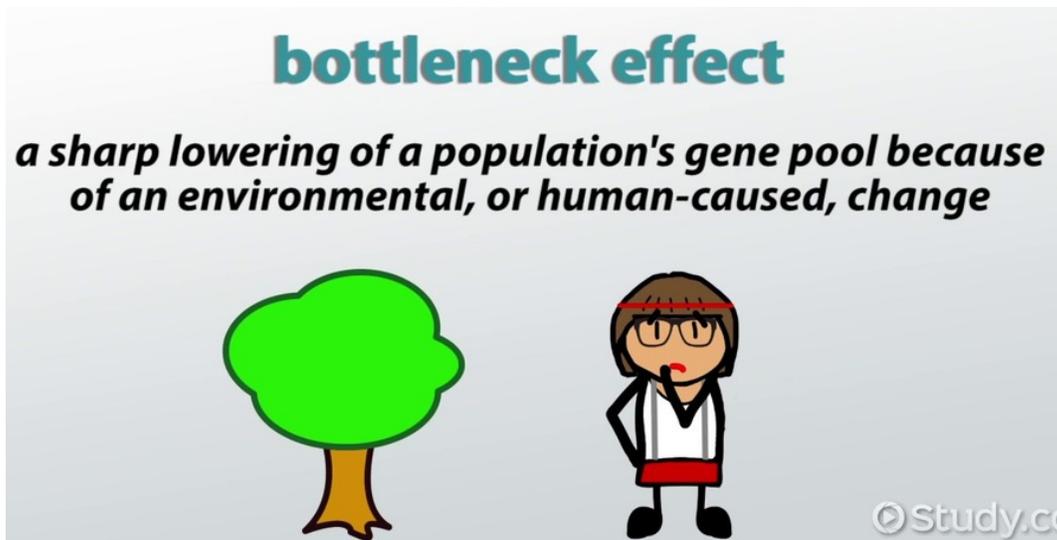
- 1) Describe biodiversity as it relates to natural systems, species, or individuals.
- 2) Articulate that genetic diversity is essential to the health of a species because it facilitates adaptation to change and provides sources for new genetic material.
- 3) Explain how natural selection favors individuals with traits adapted to their environment.
- 4) Explain that for a wildlife population to sustain itself, there must be enough habitat to support a healthy sized population that will carry a healthy sized gene pool.

Task:

Students will simulate what happens when a population of black-footed ferrets begins to decrease in size, and they will examine how this decrease affects the genetic diversity within the group. Following the simulation, the students will look at the effects of limited genetic diversity on the population in a changing ecosystem over the period of a year.

Background:

*In the world of “survival of the fittest”, an organism must have the genetic resources that allow it to survive immediate changes in its environment and that allow the species to adapt to long-term changes. The only way to ensure this will happen is to make sure that the genetic options in the population are numerous enough to have the greatest variety of attributes passed along to the individuals in the next generation. **The best way to ensure a large and healthy population with enough gene options is to have sufficient habitat to support it.** When the number of individuals decreases, the genetic pool also decreases, causing what is called a **“bottleneck”** in the population, or a decrease in the variety of gene options in the gene pool.*





Black-footed Ferret Bottleneck Scenario

Key To Genetic Characteristics	
Yellow	Camouflage
Black	Precise Vision
Orange	Accurate Sense of Smell
Pink	Strong Claws and Forearms
Dark Blue	Healthy Jaw Formation
Green	Speed and Agility
Purple	Acute Hearing
Red	Healthy Rate of Reproduction
White	Immunity to Canine Distemper

1. Your teacher will give you a dish with colored beads in it. **DO NOT LOSE ANY OF THE BEADS.**
The beads represent the genes that your group's ferret population possesses.

2. On the Key to Genetic Characteristics Table, circle the colors and genetic characteristics your population received through the bottleneck.

3. Calculate the percentage of genetic diversity of your population:

Nine genes (colors) represent 100 % genetic diversity in the original population.

_____ genes received ÷ 9 possible genes = _____ (decimal) x 100 = _____ %

4. List the genetic characteristics that your population received through the bottleneck: (Colors received)

Color	Characteristic
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____



5. What is the total number of gene traits (colors) your black-footed ferret population received?

6. List the genetic characteristics that your population lost when it came through the bottleneck:
(Colors not received)

Colors not received	Characteristic
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____

7. Randomly select five **Environmental Situation Cards** and write those five situations on the chart below. Write down the response that would be needed to survive the situation. Using the five environmental situations, identify the genetic characteristic needed by your population to survive each situation and write a prediction about what happens to your population during the coming year. (Some environmental situations might require your population to have a combination of genes, not just a single gene).

Population Predictions

Environmental Situation	Response Needed to Survive Situation	Survival Prediction and Reason
<i>For example: Situation #1: A farmer tries to protect his wheat fields by exterminating resident prairie dogs.</i>	<i>In this situation, the black-footed ferret population would need to respond by moving to another location where food (prairie dogs) is available.</i>	<i>The population might need speed and agility, acute hearing, and accurate sense of smell to move and locate another prairie dog colony. My population only possess speed/agility and accurate sense of smell. We believe our population may be able to survive, but may have trouble evading predators.</i>



ANSWER THE FOLLOWING QUESTIONS IN COMPLETE, WELL-WRITTEN, LEGIBLE SENTENCES. Show me that you understand the information presented in the activity and from the videos.

8. How do the random changes in the environment listed on your cards affect the population?

9. If all of these situations occurred in one year, would your population survive? Explain why or why not.

10. How does a high or low percentage of genetic diversity affect the population's chances for survival?

11. How does a Species Survival Plan® (SSP®) help minimize loss of genetic diversity in populations of endangered species? If necessary, review the captive breeding program at http://www.thefutureschannel.com/dockets/realworld/the_blackfooted_ferret/

12. Describe the "bottleneck effect" and how it affected the ferret population when either the poisoning occurred or when the sylvatic plague hit.