



RISKS OF REPOPULATION: BOTTLENECK GENES

The black-footed ferret was previously believed to be extinct, but thanks to the efforts of scientists, it is now making a remarkable return. This species is being reintroduced to its native habitat on the North American plains. A big challenge for black-footed ferrets trying to grow their population and live on their own is the lack of genetic diversity. This game will help players understand the long-term effects that a lack of genetic diversity can have on the species.

What is Genetic Diversity

Genetic diversity means having a variety of genes within a living thing. These genes decide things like an animal's fur color and size. When there are many different choices for each gene, we say that a population has high genetic diversity. This is important because it helps a species adapt to changes in their environment. If all the individuals in a species look and act the same, they might have trouble dealing with new challenges. Think about an animal with white fur living in a dark forest. It might be easier for predators to spot than an animal with brown or black fur. A species with low genetic diversity means nearly all the animals look similar, which is risky if their environment changes.



Photo by Isabella Huecker/Louisville Zoo

The Population Bottleneck

A population bottleneck happens when the number of animals in a group gets really small. This means there are fewer genes available, which lowers genetic diversity. The black-footed ferrets faced a bottleneck when only 18 (11 males, 7 females) were left in the wild. To save them, scientists started a captive breeding program.



Photo by Callie Wells/Louisville Zoo

The Species Survival Plan






The Species Survival Plan® (SSP®) is a program created to help animals that might become extinct. It helps keep a healthy and diverse group of animals in zoos and other places. Each animal species in the program has its own special plan, with experts working to keep their population safe for the future. For black-footed ferrets, the SSP® has been very successful. The program makes sure that the ferrets have a lot of genetic diversity, which helps them survive in the wild. Thanks to the SSP®, the black-footed ferret population is growing. The program keeps a core group of 270 adults and uses special methods like freezing sperm to keep genetic diversity high. Since 1986, over 7,000 ferret kits have been born, and more than 2,600 have been released into the wild. This effort has helped increase the wild population to around 1,000 ferrets today. For more information, you can visit www.blackfootedferret.org.










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Materials:






-  A large plastic bottle with a narrow neck
-  270 pony beads
 - 30 beads each in the following colors: yellow, black, orange, pink, blue, green, purple, red and white
-  Situation cards
-  Black-footed ferret population predictor
-  Pencils



Instructions:

-  Divide the players into groups of 2 or 4 and give each group 1 or 2 situation cards along with the black-footed ferret population predictor.
-  Pour the beads into a bottle and shake it up so they are all mixed together.
-  Make sure all players understand what each bead stands for and how it relates to a real ferret population.
-  Give each group 14 beads to represent the genes in the breeding population of ferrets (7 genes from the females and 7 from their partners). It's okay if not every color is in each group; every ferret population is unique and may have different genes.
-  Each group should use their "genes" to fill out the population predictor and see how their ferret population would handle the situation on their card or cards. They should figure out how their population would react right away and if they could survive the scenario for a year.

Facilitator Notes

-  If you are unwilling or unable to use beads to represent genes, you can have players roll dice to determine their population's genetics.
-  Players can use a dice roller on their phones, a 10-sided die, or two 6-sided dice to generate their genetics.
-  If you choose to use dice, number the genetic characteristics 1 to 9 instead of the colors when handing out your player materials and instruct the group to roll for 14 characteristics, disregarding any rolls over 9 as "junk" DNA and rolling again.
-  The population predictor can be printed for each group and left with them as a takeaway from the activity or you can laminate them and provide dry erase markers to allow groups to reuse them.
-  If there are enough groups and enough time, you can pair the groups randomly to mix their genes and see if the new, larger ferret populations are better at handling the scenarios.



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Environmental Situation Cards

ENVIRONMENTAL SITUATION	POPULATION CHALLENGE
A farmer tries to protect his wheat fields by getting rid of resident prairie dogs	Can your population find a new source of food?
More kits survive than usual from this year's litters	As the kits grow up, can they find their own territory in nearby prairie dog towns?
Humans building homes 10 miles away wiped out a prairie dog colony	Can your population survive being invaded by another group of black-footed ferrets looking for food?
Female ferrets in your population can only produce 1 kit per year unless they have the gene for a healthy rate of reproduction	What happens to your population if it can't produce enough kits?
Humans near your population allow their dogs to run loose (hint: domestic dogs carry diseases)	Will your population die of canine distemper?
A new generation of captive-born black-footed ferrets are released near you	Will these black-footed ferrets be welcome in your habitat?
Sylvatic plague strikes the resident prairie dog colony; there is an 80% prairie dog mortality rate	Can your population find a new source of food?
A coyote prowls at night (hint: a good sense of smell will help avoid it)	Can your population avoid this predator?
An aggressive prairie dog fights back in its dark, narrow, winding burrow system	Does your population have healthy, strong jaws to hang on and win the fight?
A great horned owl relies on its keen eyesight to spot potential prey in the dark.	Can your black-footed ferrets remain unseen?
A badger sneaks around the prairie dog town.	Can your black-footed ferrets hear it coming with enough time to flee?
A prairie dog colony is established on a nearby Native American reservation.	Can your population expand into the new colony?



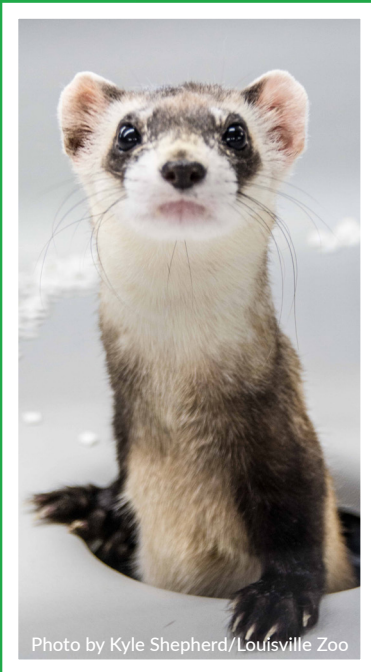
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Environmental Situation Cards

ENVIRONMENTAL SITUATION	POPULATION CHALLENGE
Severe rain floods the prairie dog burrows	Can your population survive?
An interstate highway is built nearby. Most of the prairie dog colony is across the highway	Can your population get the food it needs?
Drought causes the prairie soil to compact and harden	Does your population have strong legs to dig and adapt the burrows stolen from their prairie dog prey to make their homes?
A golden eagle hunts for a meal (hint: good vision is needed to avoid this predator)	Can your ferrets avoid capture?

Black-footed Ferret Population Predictor

Mark the Genetic Characteristics your BFF population received on the chart below:



KEY TO GENETIC CHARACTERISTICS		PRESENT?
Yellow	Camouflage	
Black	Precise Vision	
Orange	Accurate Sense of Smell	
Pink	Strong Claws and Forearms	
Blue	Healthy Jaw Formation	
Green	Speed and Agility	
Purple	Acute Hearing	
Red	Healthy Rate of Reproduction	
White	Immunity to Canine Distemper	

Use the formula below to determine how diverse your population is:

$$\underline{\hspace{2cm}} \text{ genes received} \div 9 \text{ possible genes} = \underline{\hspace{2cm}} \text{ (decimal)} \times 100 = \underline{\hspace{2cm}} \%$$

What are you missing?

KEY TO GENETIC CHARACTERISTICS		MISSING?
Yellow	Camouflage	
Black	Precise Vision	
Orange	Accurate Sense of Smell	
Pink	Strong Claws and Forearms	
Blue	Healthy Jaw Formation	
Green	Speed and Agility	
Purple	Acute Hearing	
Red	Healthy Rate of Reproduction	
White	Immunity to Canine Distemper	



Using the chart below, identify the environmental situation your ferrets must survive, discuss in your group what response is needed and decide if your ferrets can survive the situation.

KEY TO GENETIC CHARACTERISTICS		
Environmental Situation	Response Needed to Survive	Survival Prediction and Reason

If your ferrets did not survive the situation, what characteristic(s) could have helped them make it through?

Could your population breed with another nearby population of ferrets to get that trait for the future?