Bottleneck Genes: Black-Footed Ferrets

The endangered black-footed ferret is a member of the weasel family. It is the only ferret native to North America—the domestic ferret is a different species of European origin. Black-footed ferrets have a tan body with black legs and feet, a black tip on the tail and a black mask. It has short legs with large front claws developed for digging. Its large skull and strong jaw are adapted for eating meat.

Prairie dogs make up 90% of a black-footed ferret's diet. A ferret may eat over 100 prairie dogs in one year. Black-footed ferrets are also known to eat ground squirrels, small rodents, rabbits and birds

Black-footed ferrets once numbered in the tens of thousands, but widespread destruction of their habitat and exotic diseases (like canine distemper) in the 1900s brought them to the brink of extinction. Because black-footed ferrets eat prairie dogs and live in their burrows, they are completely dependent upon large prairie dog colonies for survival. But prairie dog colonies have been reduced to less than 5% of the area they originally occupied due to habitat destruction, poisoning, shooting, and exotic disease (sylvatic plague). The remaining colonies are relatively small and fragmented, and often separated by great distances. With the dramatic loss of prairie dogs came the loss of almost all black-footed ferrets as well. Only 18 remained in 1986.Due to the low number of ferrets, the population underwent a **genetic bottleneck**. Today, due to conservation efforts, black-footed ferrets are making a comeback, with approximately 750 black-footed ferrets in the wild, and another 250 living in captive breeding facilities (2008).

Today, you will be simulating why genetic diversity is important for the survival of species like black-footed ferrets. Some important vocabulary terms to know include:

adaptations - the ways in which living things have adjusted to their environment through biology or behavior, thereby improving their chances of survival

bottleneck effect - when a population experiences a severe change that kills off many individuals, the survivors retain only a portion of the original genetic diversity. The consequent diversity of genes, and associated genetic characteristics or traits of the new population are thus limited by the effect of this "genetic bottleneck" event

dominant gene – a gene that always shows its effect, or expression, in an organism, even if a corresponding recessive gene is also present

gene - a piece of DNA that codes for a particular trait; the basic unit of heredity

gene pool - all the genes present in a given population at a particular time

genetic diversity - variation in the genes found in individuals within a population of a single species, and the pattern of genetic variation found within different populations of the same species

recessive gene – a gene whose expression is repressed when the dominant gene is present

**Facts provided by Defenders of Wildlife , www.defenders.org, definitions from Smithsonian Institution*

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Instructions: Using the color code key below (bead color = genetic characteristic), check the genetic characteristics your hypothetical black footed ferret population received through the genetic bottleneck event. Then, answer the questions related to genetic diversity, bottleneck events, and characteristics.

□ **BLACK…** precise vision	□ **PURPLE…** acute hearing
□ **ORANGE…** accurate smell	□ **GREEN…** agility
□ **RED…** healthy reproduction	□ **YELLOW …** camouflage
□ **PINK…** strong claws / legs	□ **WHITE (B)* …** healthy jaw formation *(dominant)*
□ **BLUE…** immunity to canine distemper	□ **IVORY (b)* …** jaw deformity *(recessive)*

** Guidelines for documenting the expression of dominant and recessive genes:**

1. BB = dominant gene expressed **2. Bb =** dominant gene expressed **3. bb =** recessive gene expressed

Questions about genetic characteristics following a bottleneck event:

1. Calculate the percent (%) genetic diversity of your hypothetical black footed ferret population. 9 genes (colors) represent 100% genetic diversity in the original black footed ferret population.

a. _____ genes (colors) received / 9 original genes in the population = _____ (decimal)

b. Multiply this decimal amount by 100 = _____ %

2. Did your population have any recessive genes? Were the genes expressed?

Situation	Survival Prediction (Y/N/M)	Explain prediction

Bottleneck Genes Environmental Situations

#1: Humans building homes 10 miles away wiped out a prairie dog colony. The surviving black-footed ferrets from there invade your territory for food. Can your population defend itself?	**#2:** Ranchers allow their dogs to run loose near your population. Domestic dogs can carry diseases.	**#3:** Coyotes are common ferret predators. One decides to hunt near your colony. A good sense of smell will allow your fellow ferrets to avoid this predator.
#4: To eat prairie dogs, black footed ferrets need healthy, strong jaws to hang on and win the fight against this aggressive prey.	**#5:** Great-horned owls hunt black-footed ferrets at night. Can your black-footed ferrets remain unseen against this predator?	**#6:** A badger sneaks by your ferret colony. Can your fellow ferrets hear it coming with enough time to flee?
#7: An interstate is built between your population and your prairie dog colony. Can your population survive?	**#8:** Drought causes the prairie soil to compact and harden. To convert prairie dog burrows into suitable shelter for your ferret colony, you need strong claws and legs.	**#9:** A golden eagle hunts nearby. Does your population have good vision and camouflage to avoid being a tasty meal?
#10: A severe decline in prairie dogs caused almost half of your population to die of starvation. Now that the prairie dog colony has increased, can your population rebound?	**#11:** Several local foxes have contracted canine distemper. Does your population have a good immunity?	**#12:** Black-footed ferrets are nocturnal and leave their burrows to hunt at night. Can your population avoid being seen by a hunting bobcat?
#13: A local farmer exterminated resident prairie dogs to protect his wheat crop. Your population needs a good set of senses to locate a new food source. Can your population find more food?	**#14:** A band of coyotes killed multiple ferrets in your population. Does your population have good reproduction in order to rebound?	**#15:** To capture prairie dogs in their burrows, ferrets need to be agile and have strong jaws. Can your population survive?