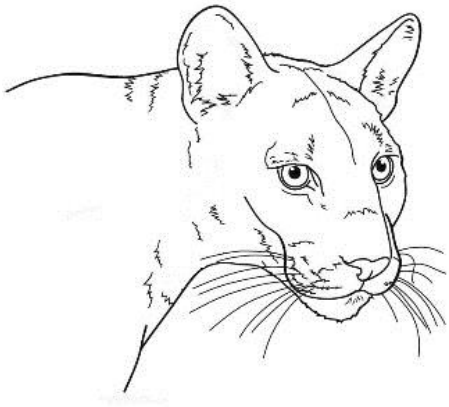

Genetic Diversity:
Why is it Important?

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(Modified from *Bottle Neck Genes*, Project WILD Curriculum Guide, Page 172)

Objectives:

Students will

- Describe biodiversity as it relates to natural systems, species or individuals.
- Articulate that genetic diversity is essential to the health of a species because it facilitates adaption to change and provides sources for new genetic material.
- Explain how natural selection favors individuals with traits adapted to their environment.
- Explain why a healthy sized habitat is needed for wildlife to have healthy size gene diversity.

Method:

Using colored beads, students will simulate gene pool diversity for a population of Florida Panthers.

Materials:

- One long-neck bottle (a one liter plastic bottle works, too. See Figure1)
- Packets of beads to match the (9) colors of the genetic characteristics (See Table 1). (Note: Pony craft beads, approximately 3/8" by 1/4" works well. If you cannot find the exact color matches pick your own and change the colors listed in the table.)
- One copy of the *Panther Gene Activity Worksheet* per group
- A set of Scenario Cards
- A container or small cup for each group (to catch the beads)

Background:

Known to the Seminoles as *coo-wah-chobee* (big cat), the panther is thought to have special powers and to be the favorite of its creator. Also known as: puma, cougar, mountain lion, painter, catamount, and panther. The Florida Panther is one of 32 subspecies in North, South and Central America and one of the 15 subspecies in North and Central America (one subspecies in the Northeast and Eastern Mid-West is considered extinct). The Florida Panther is now separated from other subspecies populations in the U.S.

Adult male panthers need approximately 200 sq. miles of wild territory to roam, while females use about 80 sq. miles. After many decades, female panthers had rarely been seen outside of South Florida. Recent documentation of a female panther north of the Caloosahatchee River occurred in 2016 and her kittens were confirmed in 2017 along with a second female panther. Young male panthers have been sighted in other areas besides south Florida in their search for territories of their own including as far as central Georgia.

Solitary, territorial animals, panthers generally range 15-20 miles per day in a zig-zag pattern and are most active between dusk and dawn. Their favorable habitat includes pinelands, hardwood hammocks, and mixed swamp forests. They tend to move from wetlands in the daytime to prairie grasslands at night. Panthers are good swimmers and use human pathways (trails, roads, and boardwalks) as travel corridors and routinely cross highways.

Two distinct stocks of DNA exist. One is found in the Everglades and commonly known as kinked tails or cowlicks. They may be descended from 7 captive South American pumas released between 1957 and 1967 from Piper collection of Everglades Wonder Gardens in Bonita Springs. The other source of panther DNA consists of the Big Cypress cats that are descended from original stock. Inbreeding caused several maladies, so eight female Texas pumas were brought into the state in 1995. Five of the eight produced healthy offspring, which provided a diverse gene pool.

Florida panthers are smaller than western cougars and have longer legs and smaller feet. The Florida Panther's skull structure, shape, and size are different from other Pumas in the Americas." Panthers have a shorter

darker coat with a tawny brown back and pale underside. Males weigh an average of 120 to 130 pounds and stand 23 to 27 inches high at the shoulder and measure 6 to 7 feet from nose to tip of the tail. Females average 6 feet in length and weigh 70 – 75 pounds. Kittens are blue-eyed at birth and have dark spots on their fur that fade as they grow into adulthood. Their average life expectancy is 12 years.

Panthers do not roar; they are quiet and occasionally chirp, peep, whistle, purr, moan, scream, growl, and hiss. They are solitary carnivores and hunt dusk to dawn. Most prey are eaten in one sitting. If the kill is especially large, the panther will cache the remains and return again to feed. Panthers eat primarily deer, but also hunt feral hog, rabbit, armadillo, birds and other animals. Panthers most often kill deer-size prey, striking a killing bite to the throat and spinal cord at nape of neck. Unlike bears and coyotes, panthers eat their prey in one place. They use their incisors to shear hair from flesh, leaving the hair neatly clipped. To stay healthy, adults need to eat one deer or hog a week. Females with kittens need twice this amount.

Panthers begin mating at 1 ½ years for females and 3 years for males. Mating pairs may remain together up to a week. Females will breed every two years. The gestation period is 90-95 days and can occur any time of year, but usually in November to March with 1 to 4 kittens born. Kittens are born in a den or thicket and do not venture out until they are about 2 months old. Once they leave the den, kittens and mothers hunt together, keeping track of each other with whistles. Kittens hunt and live on their own between 9 months and 1 ½ years. Panthers keep feral hogs, deer, raccoon, and other prey populations in check.

Panther paws can be compared to the size of baseballs; bobcat paws are the size of golf balls. Panthers are five-toed but only four toes leave tracks. Extendible/retractable claws are sheathed in fleshy pockets positioned above the toes and do not leave imprints in its tracks. (Tracks with claw marks are canine). The middle toe pad is the dominate feature of the track (aka the leading toe).

The scat is a soft blackish cord of pure meat or organ flesh 1¼ to 1 ½” thick and may be conspicuously placed to mark territories. Panthers sometimes use urine to mark its range. Additionally, a shallow rectangle trough 8” to 12” long ending with a small pile can contain the odorants deposited from

glands in the toes. Panthers may use their claws to make large scratch marks on horizontal cabbage palms. These marks are most often repeated with two areas of scratching. Scratching in not a territorial marking feature of panthers, but is a sign of panthers.

Procedure:

Pre-activity - bead colors must match color code chart and be counted in equal numbers by color and then mixed all together into the bottle.

1. Divide the class into groups of 2 to 4 students per group.
2. Review the terms "genetic diversity", and "biodiversity" (see last page).
3. Give each group a worksheet, genetic characteristics key and a small cup to catch the beads.
4. Review the gene color key to discuss the importance of each gene.
5. Quickly tip the bottle of beads over each group's cup and insure each group gets about the same number/small amount of beads (genes).
6. Each group begins sorting beads and completing the worksheet data chart and the calculation.
7. Distribute scenario cards to groups until all are used. Groups read and discuss the survivability of their panther population based on each scenario.
8. Suggested questions to ask to spark the discussion;
    a) Why is genetic diversity helpful to protect a population?
    b) Why is a bigger population better than a smaller one?
    c) Why would inbreeding make it harder for the panther survival?

Table 1: Bead Color Key to Genetic Characteristics

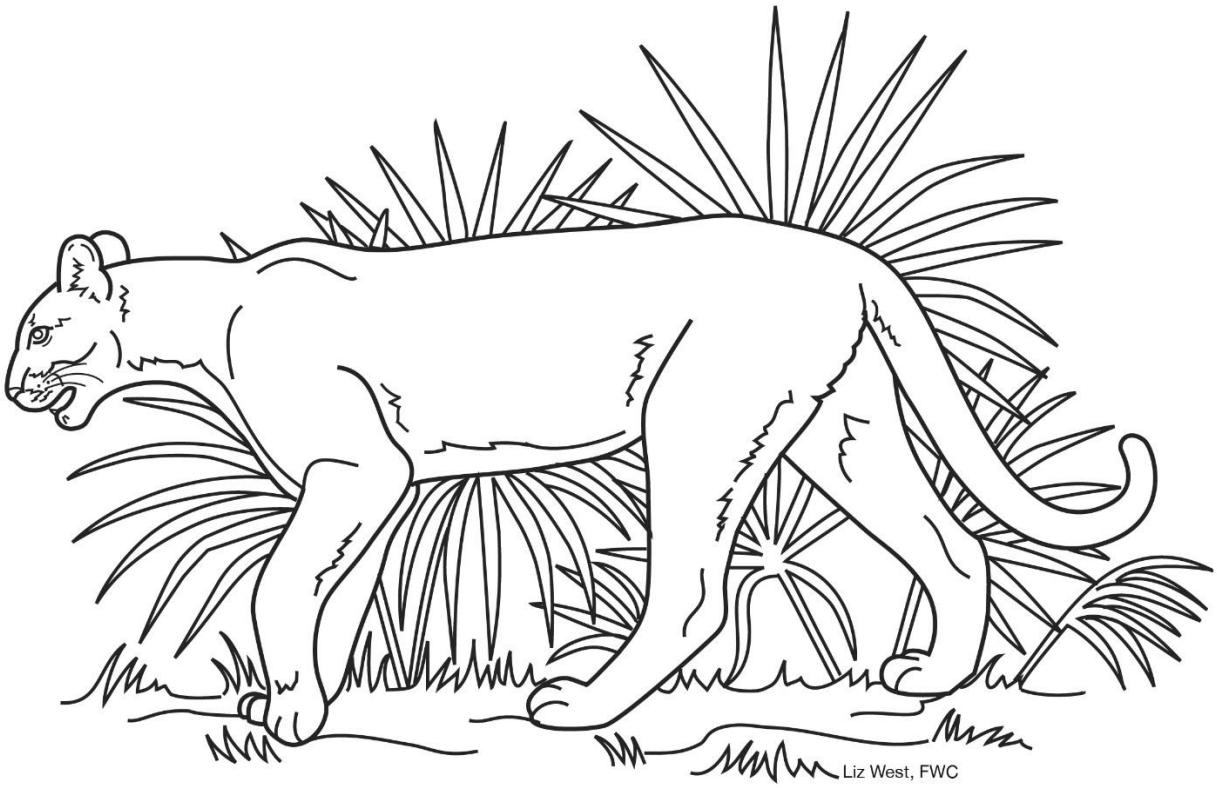
Yellow	Camouflage
Black	Precise vision
Orange	Accurate sense of smell
Pink	Ability to travel fast and for long distances
Dark Blue	No genetic heart defects
Green	Agility, strong claws and paws
Purple	Acute hearing
Red	Healthy rate of reproduction
White	Healthy immune system

Florida Panther Gene Activity

Scenario Cards

Scenario 1. Before the introduction of the female pumas from Texas, male Florida panthers were suffering from serious reproductive problems that may have been a result of inbreeding. *What genetic traits did the introduced pumas bring which would protect the population? (Healthy reproductive system)*	**Scenario 2**. Some people have negative beliefs and fears about the panther that puts panthers at risk of being killed if detected. *What genetic characteristics help panthers live undetected? (Camouflage, smell, hearing and vision are some examples)*
Scenario 3. The Florida panther has suffered from numerous health problems and infectious diseases that may be a consequence of a defective immune system. *What genetic traits are needed to restore the health of the panther? (Non-compromised immune system)*	**Scenario 4.** A busy highway runs through the Florida panther habitat. Vehicle collisions are a major cause of panther mortality. *What genetic traits could help some panthers survive? (Agility, vision, hearing – anything that would help detect and evade traffic)*

Scenario 5. At one time, serious heart defects were detected in a significant percentage of Florida panthers. Heart murmurs were observed in every kitten born in 1990, as well as 30% of adults examined. *How did the introduction of puma from outside of Florida help the Florida panther population? (No genetic heart defects)*	**Scenario 6.** A large airport as well as housing developments with surrounding roads has been built within the panther habitat that would impact the panthers in terms of food supply and range. *What genetic characteristics would help the panther overcome this change? (Ability to travel fast and long distances)*
Scenario 7. White-tail deer are the primary prey of the Florida panther. Both panthers and deer have similar tawny-colored fur and share the same habitat. *If deer were scarce, what genetic characteristics would be helpful for the panther to survive? (Ability to travel long distances, accurate sense of smell, vision, hearing, strong jaws and claws)*	**Scenario 8.** Panthers are most active between dusk and dawn, which is when some animals come out of hiding to feed. Like most cats, panthers do not make much noise when walking or hunting. *What gene characteristics would be helpful for panthers to hunt at night? (Vision, hearing, camouflage, sense of smell)*



PANTHER GENE ACTIVITY STUDENT WORKSHEET

Group Member Names:

1. Using the key below, list the colors and genes you received through the bottle.

Bead Color	Genetic Characteristic	Number of Beads
Yellow	Camouflage	
Black	Precise vision	
Orange	Accurate sense of smell	
Pink	Ability to travel fast and for long distances	
Dark Blue	No genetic heart defects	
Green	Agility, strong claws and paws	
Purple	Acute hearing	
Red	Healthy rate of reproduction	
White	Healthy immune system	

2. Calculate the percentage of genetic diversity of your population of Panthers.

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

   How many different bead gene colors did your group receive? Place that number in the first blank space and then complete the rest of the calculation below.

   _____ Genes received divided by 9 (original genes) =_____ (decimal) x 100 = _____%
   (Example: our group received 4 different colors so 4/9 = .44 x 100 = 44%)

3. List the genetic characteristics (based on bead colors) that your population received:
   (Examples: healthy immune system, strong claws and paws, good camouflage, etc.)

4. List the genetic characteristics (based on missing colors) that your population lost:
   (List the rest of the traits that your group did NOT receive)

5. Using the situation cards, discuss and predict what will happen to your population of panthers in the future. Will your panther population do well, or not, and why?

Additional Information:

Should you encounter a panther - Stand Tall and Do NOT Run! View the Florida Fish and Wildlife Conservation Commission's panther program pages for more information:
http://www.myfwc.com/wildlifehabitats/managed/panther/

Annual Florida Panther Festival – March – Naples FL – events such as Walk a Panther Mile, Living with Wildlife pavilion, buggy tours, etc.

Positive Impacts of Genetic restoration (FWC)
http://www.myfwc.com/wildlifehabitats/managed/panther/genetics/positive-impacts/

Florida Panther Identification Guide (Defenders of Wildlife)
http://www.defenders.org/sites/default/files/publications/florida_panther_identification_guide.pdf

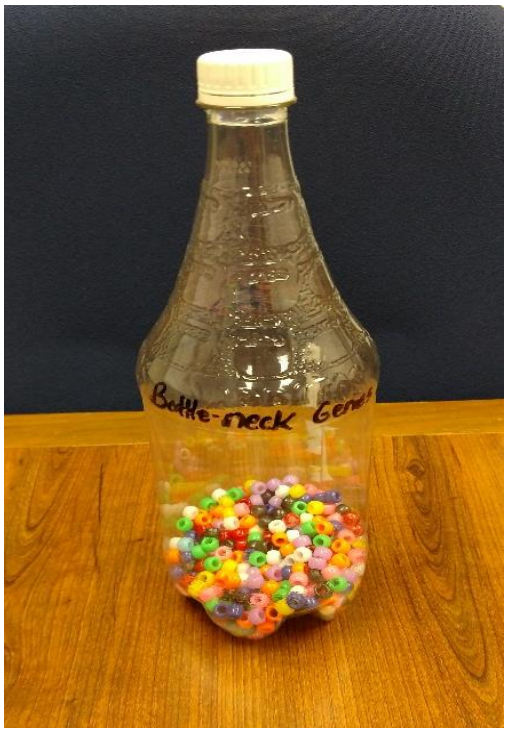


Figure 1. Bottleneck Genes

Genetic diversity is the total number of **genetic** characteristics in the **genetic** makeup of a species. In this activity each different colored bead represents more gene diversity in the population. The more colors, the greater the diversity!

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Biodiversity is the variety of living things in a given place. When a species is extinct biodiversity is less. If the Florida Panther were extinct, other life forms, including humans would face consequences. Planet earth loses **genetic diversity** when a plant or animal goes extinct. Genetic material can hold the secret to curing diseases.