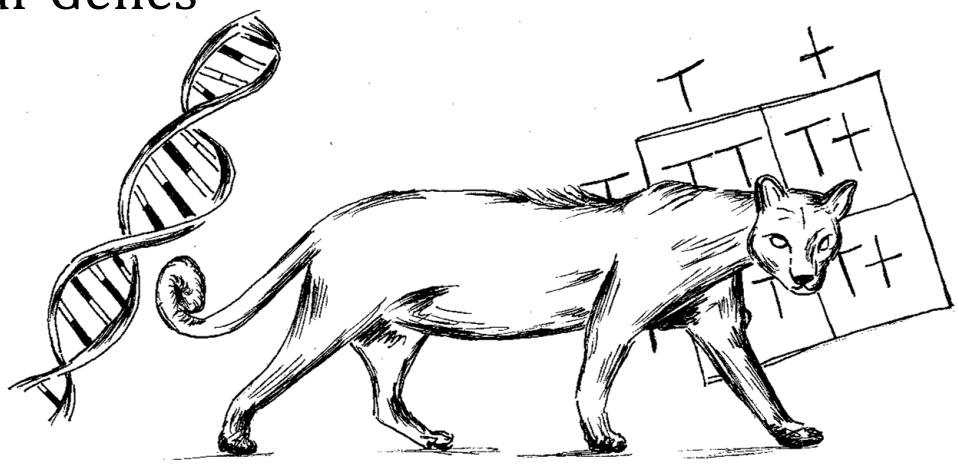
Lesson Five

It's in Your Genes



Key Question

How does the size of the Florida panther population affect the genetic health of the species?

Subjects
Science

Time Estimate
60-90 Minutes one day

Key Vocabulary
population, genetic diversity, inbreeding, extinction, genetic restoration, inheritance, recessive, dominant, allele

Sunshine State Standards

Science
SC.7.N.1.5 Describe the methods used in the pursuit of a scientific explanation as seen in different fields of science such as biology, geology, and physics.

SC.7.L.16.1 Understand and explain that every organism requires a set of instructions that specifies its traits, that this hereditary information (DNA) contains genes located in the chromosomes of each cell, and that heredity is the passage of these instructions from one generation to another.

SC.7.L.16.2 Determine the probabilities for genotype and phenotype combinations using Punnett Squares and pedigrees.

SC.7.L.16.4 Recognize and explore the impact of biotechnology (cloning, genetic engineering, artificial selection) on the individual, society and the environment.

Reading/Language Arts
LA.7.1.7.3 Determine the main idea or essential message in grade-level or higher texts through inferring, paraphrasing, summarizing, and identifying relevant details.

LA.7.1.7.8 Use strategies to repair comprehension of grade-appropriate text when self-monitoring indicates confusion, including but not limited to rereading,

Objectives

In this activity, students will:

1. Read a case study about genetics and the Florida panther.
2. Discuss the genetic restoration of the Florida panther.
3. Recreate mock panther breeding seasons with the class before and after a genetic restoration.

4. Discuss the results of the mock breeding seasons.
5. Complete a genetics worksheet.
6. Discuss the future of the Florida panther and other endangered organisms in terms of genetic diversity.

Materials

Each student will need:

- A Case Study to read
- Worksheet

Panther cards for round 1 and 2.

Background

The Florida panther once lived throughout the Southeastern United States, and scientists estimate that there were once at least 1,360 panthers living in Florida. After European settlers came to Florida, the panther population started to decline due to hunting. As Florida's **population** began to boom in the late 1800s and early 1900s, development and continued hunting decimated the numbers of panthers left and the few remaining cats were pushed down into the wilderness of South Florida.

Unregulated hunting of panthers continued until 1958, when so few panthers remained that it was listed by the state of Florida as an endangered species. By the 1970s, despite this protection and the federal endangered species act, there were perhaps fewer than 30 Florida panthers left in the wild and survival of the large cats seemed unlikely.

True conservation of the Florida panther began in the early 1980's when scientists began radio collar studies. The Florida panther was now seen as a crucial component of Florida's habitat and efforts were being made to conserve and increase the remaining population. Large areas of land had been conserved by local, state, and federal government, but the Florida panther did not seem to be recovering.

Scientists realized that the Florida panther was in big trouble. The population was so small that the **genetic diversity** of Florida panthers was dangerously low and **inbreeding** was causing major health problems. Kinked tails and cowlicks (hair standing up on the back) were noticeable signs of inbreeding, though they were not seriously deleterious. Many panthers had more serious issues such as holes in their hearts, and males had un-descended testicles and low fertility. Additionally, the immune system function of the Florida panther population was poor as a result of genetic defects. The Florida panther seemed doomed to **extinction**.

Genetic diversity needed to be increased. In 1995, 8 female Texas cougars were released into Southwest Florida. They were allowed to breed two times with Florida panthers and were then removed from the population. The estimated 30 kittens that these cougars had with male Florida panthers gave the Florida panthers the health boost they needed, and the population began to recover.

Even though more people were living here than ever before, the Florida panther was doing better than it had in decades. In 2001, the panther population grew to around 70 individuals. By 2006, the panther numbers had increased to around 80. It was slow growth, but the panther was recovering. In 2007, it was estimated that there were over 100 panthers.

In 2020 the population was estimated between 120-230 and still too small to sustain itself over the long term without human intervention. Eventually, inbreeding may again become a serious issue and another **genetic restoration** (bringing in cougars from outside of the Florida population) may be needed.

In this activity, students will simulate 2 panther breeding seasons: one before and one after the genetic restoration. They will look at the **inheritance** of 2 hypothetical genes for a kinked tail and a heart defect. In both cases, the defect is

caused by a **recessive allele**, while the **dominant** allele is normal. *This is simplified from the actual complexity of genetic defects within Florida panthers. These defects, however, do occur, and they are a result of recessive alleles.*

Advance Preparation

Prepare copies of the Case Study and of the worksheet for students. Print and cut out 1 Florida panther card for every student in the class and 6 Texas cougar cards total.

Procedure

1. Instruct students to read the Case Study carefully. Have a class discussion about the history of the panther and make sure students understand why panthers are endangered. Discuss the concept of inbreeding – why does it occur and what are the consequences?

2. Question students about the genetic restoration of Florida panthers and check comprehension of the concept. Review Punnett Squares with students and discuss their use to predict the offspring outcome of a breeding pair of adults.

3. Play round 1 of the mock panther breeding season. Round 1 will simulate a breeding season prior to the genetic restoration. Hand each student a Florida panther card. Group students into pairs of two. Have partners compare their genotypes and complete Round 1 on the worksheet.

4. As a class, discuss the outcome of round 1 by calculating the class percentage of kittens with kinked tails and the percentage with heart defects. For ease of calculation, suppose that each pair students produces 4 kittens (remind students that panthers average 2 kittens in South Florida but can have up to 4). Leave your calculations on the board.

5. Play round 2 of the mock panther breeding season. Inform students that round 2 will simulate a breeding season after 6 Texas Cougars have been released into the population of Florida panthers. Collect all panther cards back from students and remove 6 Florida panther cards, replacing them with 6 Texas cougar cards. Mix up the cards and pass out 1 card to each student. Group students into pairs of two (can be different or the same as round 1). Have partners compare their genotypes and complete Round 2 on the worksheet.

6. As a class, discuss the outcome of round 2 by calculating the percentages of genetic defects just as in round 1. Compare the outcome of rounds and instruct students to complete the final questions on their worksheets.

7. Ask students how the activity differed from the actual genetic restoration. How was it similar? Why might another genetic restoration be needed in the future?

It's in Your Genes — Case Study

The Florida panther once lived throughout the Southeastern United States, and scientists estimate that there were once at least 1,360 panthers living in Florida. After European settlers came to Florida, the panther population started to decline due to hunting. As Florida's population began to boom in the late 1800s and early 1900s, development and continued hunting decimated the numbers of panthers left and the few remaining cats were pushed down into the wilderness of South Florida.

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Florida Panther Genotype: normal Tail (T), kinked tail (t) normal heart (H), heart defect (h)	**Florida Panther** Genotype: kinked Tail (t), kinked tail (t) heart defect (h), heart defect (h)	**Florida Panther** Genotype: normal Tail (T), kinked tail (t) normal heart (H), heart defect (h)
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Panther Cards

Florida Panther Genotype: normal Tail (T), kinked tail (t) normal heart (H), heart defect (h)	**Florida Panther** Genotype: kinked Tail (t), kinked tail (t) heart defect (h), heart defect (h)	**Florida Panther** Genotype: normal Tail (T), kinked tail (t) normal heart (H), heart defect (h)
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Texas Cougar Genotype: normal Tail (T), normal tail (T) normal heart (H), normal heart (H)	**Texas Cougar** Genotype: normal Tail (T), normal tail (T) normal heart (H), normal heart (H)	**Texas Cougar** Genotype: normal Tail (T), normal tail (T) normal heart (H), normal heart (H)
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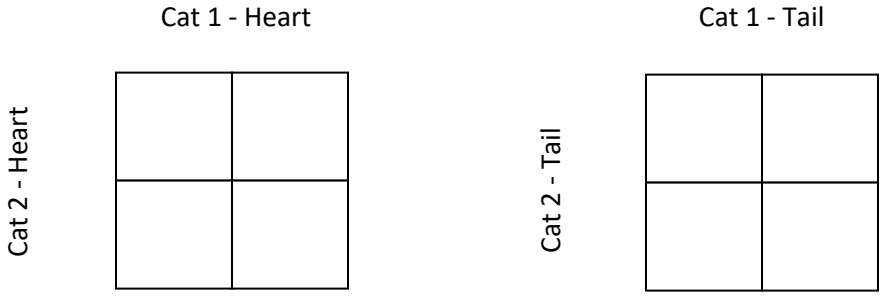
It's in Your Genes Worksheet

Your Name: _____

Round 1: Breeding Florida Panthers

1. Your genotype = _____ Your partner's genotype: _____

2. Use the Punnett Squares provided to predict your offspring's traits:



3. If you had 4 kittens, how many would be expected to have a kinked tail? _____

4. If you had 4 kittens, how many would be expected to have a heart defect? _____

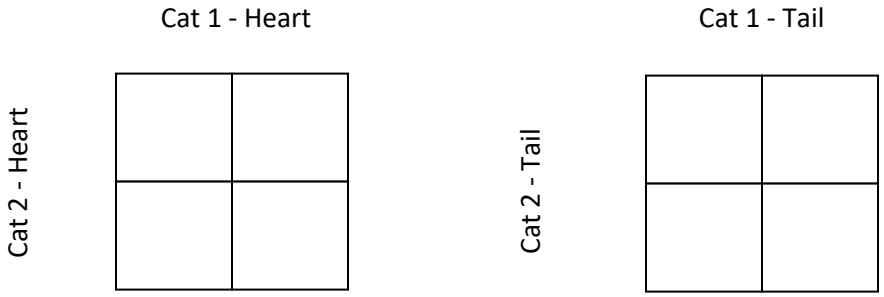
Round 2: Breeding Florida Panthers and Texas Cougars

1. Are you a Florida panther or Texas cougar?

2. Is your partner a Florida panther or Texas cougar?

3. Your genotype = _____ Your partner's genotype: _____

4. Use the Punnett Squares provided to predict your offspring's traits:



5. If you had 4 kittens, how many would be expected to have a kinked tail? _____

6. If you had 4 kittens, how many would be expected to have a heart defect? _____

Compare your results to the rest of the class.

1. How did the outcome of Round 2 differ from Round 1?

2. How did the Texas cougars change the outcome?

It's in Your Genes — Example Answers

Example 1: The following 2 genotypes become partners.

1

Florida Panther

Genotype:

normal tail (T), kinked tail (t)

normal heart (H), heart defect (h)

2

Florida Panther

Genotype:

normal tail (T), kinked tail (t)

normal heart (H), heart defect (h)

The resulting Punnett Squares:

Cat 1 - Heart

Cat 2 - Heart	H	h
H	HH	Hh
h	Hh	hh

Cat 1 - Tail

Cat 2 - Tail	T	t
T	TT	Tt
t	Tt	tt

If you had 4 kittens, how many would be expected to have a kinked tail? 1

If you had 4 kittens, how many would be expected to have a heart defect? 1

Example 2: The following 2 genotypes become partners.

1 Florida Panther: normal tail (T), kinked tail (t), normal heart (H), heart defect (h)

2 Texas Cougar: normal tail (T), normal tail (T), normal heart (H), normal heart (H)

The resulting Punnett Squares:

Cat 1 - Heart

Cat 2 - Heart	H	h
H	HH	Hh
H	HH	Hh

Cat 1 - Tail

Cat 2 - Tail	T	t
T	TT	Tt
T	TT	Tt

If you had 4 kittens, how many would be expected to have a kinked tail? ___0____

If you had 4 kittens, how many would be expected to have a heart defect? ___0____