Conservation

CHEETAH
CONSERVATION FUND

THE GENETIC BOTTLENECK

(Adapted with permission from the Smithsonian Institution's National Zoological Park school Outreach Programme, "Black-Footed Ferret Ambassador Programme, Secondary School Teacher guide," copyright 1999.)

SUBJECT AREAS:
Sciences
Mathematics

DURATION/TIME:
Activity 1: 45 min

RECOMMENDED PREPARATION:
Activity 1:
Review sheet, 'a singular species' found in the Reference section.
Prepare one set of small slips of paper labelled 1-15 and a photocopy of the 'cheetah population bottleneck' worksheet (for each group).

MATERIALS NEEDED:
Activity 1:
One set of cards and photocopy of worksheet per group.
Coloured items, 10 items per 10 different colours (paper or rocks) and a bottle

LOCATION:
Classroom

KEY WORDS TO REVIEW:
Genetic
Genes
Dominant gene
Recessive gene
Diversity
Population
Susceptible
Characteristic

OBJECTIVE:

Learners will understand the importance of genetic diversity by demonstrating the concept of the genetic bottleneck.

LESSON ACTIVITIES:

ACTIVITY 1:
The lesson will begin with a discussion on genetic diversity (what it is and why/how it occurred) in the cheetah population.
The learners will then participate in the 'cheetah bottleneck scenario' activity and complete a worksheet before presenting findings to the class.

Learning Outcomes

This activity demonstrates the importance of genetic diversity in healthy populations by simulating a genetic bottleneck event.

Teaching the Lesson

Review with the learners the sheet 'A Singular Species' found in the Reference section which discusses the lack of genetic diversity in the cheetah population. Discuss why this occurred and what it means for the cheetah populations today.

Activity 1 – cheetah bottleneck scenario

This activity will demonstrate how a population with low genetic diversity is more susceptible to changes in the environment. You will need 100 different coloured objects to represent genes (10 colours, 10 objects per colour). Use coloured jellybeans, paper or beads for the activity. An empty bottle will also be needed to distribute the coloured objects.

Previous to the activity, make up small slips of paper labelled from 1-15. You will need a set for each group. (These numbers will be used in the 'key to environmental situations.')

Procedure:

1. Have the learners break up into teams of 2 to 4 students each. Distribute the worksheet 'cheetah population bottleneck.'
2. Review the concepts of genetic diversity and population bottlenecks.
3. Distribute a random number of genes (different coloured objects) to the teams from the bottle.
4. Have each group randomly choose five numbers (cards labelled 1-15) from the slips of paper and match numbers to the teachers 'key to environmental situations.'
5. Learners include the following on the worksheet:
    a. The population's percent genetic diversity.
    b. A description of their population based on its current genetic makeup.
    c. A scenario for their population for a one-year time frame. They must address the following:
        - Is their population genetically equipped to survive in its environment? How well or poorly?
        - Does a high or low percent genetic diversity impact their population's survival?
        - How do random changes in the environment affect their population?
6. Teams present results to class.

Worksheet – cheetah bottleneck scenario

Names: _____

List each **COLOUR/GENE** received and what genetic characteristic each represents:

Colour: _____ Characteristic: _____

Colour: _____ Characteristic: _____

Colour: _____ Characteristic: _____

Colour: _____ Characteristic: _____

Colour: _____ Characteristic: _____

Pick five **numbers** from the deck of slips of paper and record the numbers below:

_____ _____ _____ _____ _____

1. **Calculate the percent (%) genetic diversity of your population.**
   10 genes (colours) represent 100% genetic diversity in the original population. Calculate the % genetic diversity of your population.

   _____ genes received / 10 original genes = _____ (decimal) x 100 = _____%

2. **Describe your new population based on the genes you have.**
   Does your population have good night vision and a poor sense of smell? Are there any recessive genes present in your population? Etc.

3. **On another piece of paper or on the back of this paper, describe what happens to your population based on the five environmental cards drawn randomly from the stack.**
   Some of the scenarios relate to environmental situations while others are related to genes. Try putting your cards in a chronological order. How well is your population genetically equipped to survive random environmental situations? Does your population survive? Struggle? Thrive?

Worksheet Answer Key- cheetah bottleneck scenario

Key to Genetic Characteristics

Yellow	*camouflage*	**Green**	*agility*
Black	*precise vision*	**Purple**	*acute hearing*
Orange	*accurate sense of smell*	**White**	*strong immune system*
Red (R)*	*dominant gene for healthy rate of reproduction*	**Pink (r)***	*recessive gene for abnormal sperm*
Dark Blue (B)*	*dominant gene for healthy heart*	**Light Blue (b)***	*recessive gene for atrial septal heart defect*

*Notes on dominant/recessive genes: (1) **BB** (or **RR**) = dominant gene active; (2) **Bb** (or **Rr**) = dominant gene active; (3) **bb** (or **rr**) = recessive gene active.

Key to Environmental Situations

1. It will be difficult for your population to find and kill your preferred prey, springbok, because they have been over-hunted in your territory.

2. In search of prey, your population will often cross a roadway. Does your population have the gene for acute hearing to avoid approaching vehicles?

3. Cheetahs have a reputation for being shy and will generally avoid human contact. Does your population have the gene for camouflage to keep well hidden from the approaching tourists?

4. A highway has been built through your populations' territory. How does this affect your populations' regular hunting path?

5. The savannah in your populations' habitat has been overgrazed and bush encroachment has taken over. This significantly reduces the available hunting territory for your cheetah population.

6. The gene for an accurate sense of smell will help your population find their prey in the thick bush habitat.

7. Scientists have decided that genetic restoration is necessary for the survival of your population and have introduced Asiatic cheetahs into your territory. These cheetahs have the dominant genes for a healthy heart (dark blue) and a healthy rate of reproduction (red). Add these genes to your list.

8. In the past, the local and national governments sponsored programs to destroy predators such as the cheetahs. Although it is now illegal to shoot the cats, some are still killed every year. Does your population have the gene for agility to escape these dangerous poachers?

9. Some cheetahs carry diseases like Feline Immunodeficiency Virus (FIY). Does your population have the gene for a strong immune system?

10. The government built wildlife underpasses beneath a busy highway which your population can now use as a regular hunting path.

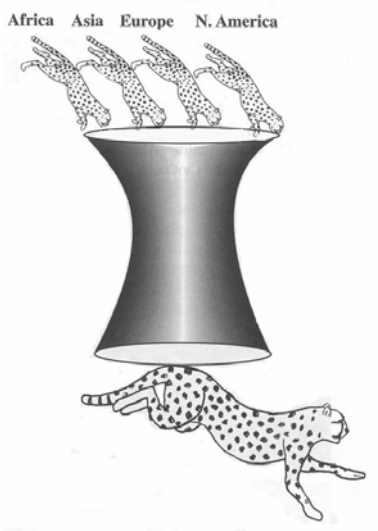
11. Cheetahs, animals high on the food chain, will ingest high levels of environmental toxins which build up in the body over time. Rabbits, a prey species for the cheetahs, are eating fish from a stream with high concentrations of mercury. How does this impact your population?

12. Territorial conflicts are a leading cause of death in male cheetahs. Does your population have the gene for precise vision to warn them of the threatening cheetah which has entered the territory?

13. Female cheetahs will have fewer offspring if the males in the population only carry the recessive gene for abnormal sperm.

14. If cheetahs carry the recessive gene for the atrial septal heart defect (hole in the heart), they risk passing on severe health problems to future generations, unless they also carry the dominant gene for a healthy heart.

15. The rapid decline of cheetahs living in the wild has caused an increase in inbreeding. Without the gene for a strong immune system, the cubs in your population will be born with many health problems.



CHEETAH: AN ANIMAL AT RISK

SUBJECT AREAS:
Sciences
English

DURATION/TIME:
Activity 1: 20 min
Activity 2: 30 min

RECOMMENDED PREPARATION:
Activity 1:
Review the 'endangered' sheet in the Reference section

Activity 2:
Photocopy of 'an animal at risk' worksheet for each learner

MATERIALS NEEDED:
Activity 2:
Photocopies of worksheet for each learner

LOCATION:
Classroom

KEY WORDS TO REVIEW:
Endangered
Extinct
Adaptations
Species
Habitat
Characteristics
Threat
Conserve
Conservation

OBJECTIVE:

Learners will discover why animals become endangered and what can be done to save the endangered cheetah from extinction.

LESSON ACTIVITIES:

ACTIVITY 1:
Discussion on why species become endangered, why the cheetah is at risk and what we can do about it.

ACTIVITY 2:
Continues discussion on 'an animal at risk.' Use various sheets in the Reference section to aid discussion. Have learners complete 'an animal at risk' worksheet.'

Learning Outcomes

In this activity learners will look at the main reasons many animals become endangered. They will then look specifically at reasons why the cheetah is at risk and what will need to be done to save the cheetah.

Teaching the Lesson

Activity 1 – discussion

Endangered species are ones that exist in low numbers and could go extinct if they are not protected and managed. Unfortunately, thousands of species are endangered, and each year more species become extinct. The cheetah, pangolin, black rhino, wild dog and Cape Vulture are a few endangered species.

As human populations increase, we change our planet at an ever faster rate, and many species of plants and animals suffer. Extinction has always been a natural process (for example, the dinosaurs went extinct before humans lived on the earth) but the current rate of extinction has increased dramatically. The introduction of exotic species, over-exploitation, and habitat loss are all responsible for the mass destruction of species occurring today. People are responsible for these problems. And people are capable of finding the solutions. But to find effective solutions and implement management programs wisely, we must understand why animals become endangered so that we can change our actions and prevent their extinction.

The number of cheetahs has decreased from 100,000 at the turn of the century to ±12,500 today. The cheetah suffers from habitat loss, declining prey bases, a lack of genetic diversity, conflicts with livestock farming, and an inability to survive in parks and reserves because of the presence of larger predators. If we learn more about the natural threats posed to the cheetah and work to reduce conflict with the species, we can reverse the current trends and save the cheetah from extinction.

Activity 2 – an animal at risk

1. Ask learners to identify problems that face cheetahs in the wild and in captivity. Identify threats that endanger the species in both environments. **(Answers: lack of genetic variation, high infant mortality, loss of habitat, declining prey numbers, illegal trade or poaching, human development and conflict with livestock and agricultural interests, and low reproduction in captivity all threaten the cheetah. Lack of genetic variation and high infant mortality affect the species in both the wild and captive environments.)**

2. Discuss with the learners why cheetahs are in trouble and have them complete the worksheet ‘an animal at Risk.’ The fact sheets ‘Cheetah Fact Sheet’ and ‘Cheetahs and Farmers’ (found in the Reference section) may also be useful for learners.

Worksheet – an animal at risk

Name: _____ Date: _____

Many animals are endangered because of humans and their activities. In addition to threats caused by humans, some species are endangered because of their special adaptations and/or habitat requirements. Animals and plants that are more likely to become endangered share certain characteristics. For example, they:

- have limited geographical ranges
- suffer from overuse or poaching
- live in specialized habitats and eat special foods
- exist in low population numbers
- lack genetic variation
- come into conflict with humans and development or are affected by human disturbances; are sensitive to environmental changes
- have high mortality
- have few offspring and long gestation periods

Animals that have one or more of the special biological characteristics listed may not suffer adverse effects until people start to interfere with them by destroying habitat, polluting environments, poaching, over-utilizing through trade or hunting, or eradicating because of misconception or interference with development. Many carnivores have been endangered by human fears and misconceptions about their behaviours, and therefore have suffered adversely from predator control programmes.

Instructions: Mark all of the characteristics that threaten the cheetah.

_____ Limited geographical range	_____ Habitat Loss
_____ Lack of genetic diversity	_____ Over-utilization
_____ Specialized food and habitat needs	_____ Trapping by humans
_____ Sensitive to environmental changes	_____ High mortality
_____ Few offspring & long gestation periods	_____ Poaching
_____ Low population numbers	_____ Declining prey numbers
_____ In conflict with humans and development	

1) How many characteristics did you check? Is the cheetah an animal that is prone to extinction?

2) Do you think the cheetah may need special help to survive? Why or why not?

3) Which of the characteristics do you think poses the biggest threat to the cheetah?

4) Based on what you know about the cheetah, could it become extinct in the wild?

5) What can YOU do to help conserve the cheetah?

_____ Limited geographical range	__x__ Habitat Loss
__x__ Lack of genetic diversity	_____ Over-utilization
__x__ Specialized food and habitat needs	__x__ Trapping by humans
__x__ Sensitive to environmental changes	__x__ High mortality
_____ Few offspring & long gestation periods	__x__ Poaching
_____ Low population numbers	__x__ Declining prey numbers
__x__ In conflict with humans and development	

1 & 2) How many characteristics did you check? Is the cheetah an animal that is prone to extinction? Do you think the cheetah may need special help to survive? Why or why not?

Nine characteristics. Yes, the cheetah is an animal prone to extinction.

Answers will vary:

Yes, many answers are possible.

3) Which of the characteristics do you think poses the biggest threat to the cheetah?

Conflict with humans and development, sensitive to environmental changes; and lack of genetic diversity.

4) Based on what you know about the cheetah, could it become extinct in the wild?

Yes, the cheetah could become extinct in the wild. The cheetah's survival depends on people and their willingness to manage the population and secure habitat for the species in the wild. The species' lack of genetic variation makes it susceptible to diseases and viruses. In addition it is less able to adapt to environmental changes or ecological disruptions. The cheetah is a survivor and has lived on this earth for four million years. But in order for it to survive, the cheetah must have habitat and a healthy prey base, and it must be allowed to increase in the wild so natural selection can strengthen the population.

5) What can YOU do to help conserve the cheetah?

Answers will vary:

1) Help protect its habitat and ensure a place for it on African farmlands; (2) aid in the conservation of the wild prey base; (3) halt the indiscriminate capture and removal of the cheetah; (4) improve livestock management; and (5) educate everyone about the need to conserve biological diversity and the predator's unique role in healthy ecosystems.

FARMERS & CHEETAHS: CAN THEY LIVE TOGETHER?

SUBJECT AREAS:
Sciences
Agriculture
English

DURATION/TIME:
Activity 1: 30
Activity 2: 20
Activity 3: 20

RECOMMENDED PREPARATION:
Understand the role play and look up the sheets on 'cheetahs and farmers,' 'a place for predators' and 'conservation efforts' in the Reference section to assist with the activities and discussion.

MATERIALS NEEDED:
Activity 2:
Possible paper and/or art supplies for conservation ideas

Activity 2:
Worksheet 'farm management and planning for predators' photocopied for each learner

LOCATION:

KEY WORDS TO REVIEW:
Conservation
Management
Technique
Play-trees
Livestock
Wildlife
Conflict
Over-hunting
Guard

OBJECTIVE:

Learners will discuss the cheetah's threats to survival and come up with possible solutions to the cheetah's decrease in population.

LESSON ACTIVITIES:

ACTIVITY 1:
Role play/drama on Anatolian Shepard guard dogs and discussion.

ACTIVITY 2:
Ideas for cheetah conservation are listed. Learners can choose one of the ideas to take action and help save the cheetah from extinction.

ACTIVITY 3:
Learners complete the worksheet 'farm management and planning for predators' and how farmers and cheetahs can live together.

Learning Outcomes

This role play lesson is designed to begin the discussion on possible solutions to the cheetah's decrease in population. It also allows learners to discuss how cheetahs and farmers can live together.

Teaching the Lesson

Review with learners the threats to the cheetah's survival from the previous lesson.

Activity 1 – Anatolian Shepherd role play/drama

Ask for a 10 volunteers from the class: 1 'farmer' (male learner), one 'cheetah' (female learner to play female cheetah), one 'Anatolian Shepherd' (larger learner than 'cheetah') and about six 'sheep' (any of learners can be called up for this) and one 'springbok.'

Call the six sheep up first and explain that they are the farmer's herd. Every time you, the educator, say sheep they are to baa. Then call up the farmer. He works long hours a day, starting early in the morning and ending late at night. This is necessary in order to be able to support his family. During this long day he takes a rest from looking after his sheep in order to have his lunch. The farmer then stands to one side of the room having "lunch." Before going off to lunch the farmer must count his sheep aloud. The next volunteer is designated as a female cheetah going out to find food for her cubs. The last volunteer is called aside so that the class cannot hear, told that he/she is a livestock guarding dog and when the cheetah is approaching the sheep looking for food, he/she is to go out and place itself in between the sheep and cheetah, barking and growling in order to scare off the cheetah.

With the sheep in one corner with the dog guarding, and the farmer away eating lunch, the cheetah approaches looking for food. In the far distance is a springbok (either a learner or a cut-out), but the sheep are nearer at hand and the cheetah is very tired and very hungry. The cheetah approaches the herd, but the dog comes out barking and scares her away.

When the "dog" starts barking the "cheetah" should get a fright, as she is not expecting this and back away from the herd. As the educator, you then ask her if she was frightened, and would she approach the herd again or go away looking for prey without the dog guarding it. Then call up the farmer and ask him if he had a good lunch and while he was away did he lose any of his sheep. Have him recount them out aloud. Was he happy with the dog, and if he had lost no sheep would he then go out and shoot the cheetah?

DISCUSSION:
Lead this role-play into a discussion on how CCF uses the Anatolian Shepherd as a protection for the cheetah on the Namibian farmlands. Guide the learners in a discussion/brainstorming session on other ways to protect the cheetah, both in Namibia and South Africa, using the fact sheets in the reference section (listed in the lesson cover page) to stimulate ideas if necessary.

Activity 2 – ideas on cheetah conservation

Ask the learners to write a letter to Cheetah Outreach or the Cheetah Conservation Fund submitting their ideas for cheetah conservation. The Cheetah Conservation Fund will respond with a letter acknowledging receipt, thanking them for the letter and reinforcing cheetah conservation. (The address for Cheetah Conservation Fund can be found on the cover page of this book.)

Learners can then commit to individual / class actions. Ideas are:

- letter to government official
- poster
- poem
- song
- fund-raiser for CCF

Activity 3 – worksheet 'farm management and planning for predators'

In this worksheet learners look at common management problems faced by farmers. They then try to match management techniques that would begin to solve these problems.

Answer Key for Worksheet – farm management and planning for predators

2, 3, 5, 6, 7	1) Carnivores have access to domestic livestock during calving time
10	2) Drought has caused the death of a large amount of wildlife on your farm and cheetahs have begun to attack small stock for food
1	3) Cheetahs are killing young hartebeest in your game farm. They have managed to get through the game fence by crawling through warthog holes in the fence
2, 4, 5, 6, 7	4) Heifers continue to lose a large number of calves to predators each year
2	5) Cows giving birth in camps (where cheetah tracks are seen) that have play-trees lose more young calves than those in camps closer to the homestead that have only acacia trees
11	6) Over-hunting of wildlife on a farm to provide more grazing area for cattle has caused predators in the area to hunt livestock

Worksheet – farm management and planning for predators

Name: _____ Date: _____

Instructions	You are a member of the Cheetah Conservation Fund team. Find the best management technique(s) that you might use to reduce cheetah/human conflicts. Write the correct numbers of the management techniques you would recommend next to the management problems. There may be more than one correct number for each problem.

Farm Management Problem

_____1) Carnivores have access to domestic livestock during calving time
_____2) Drought has caused the death of a large amount of wildlife on your farm and cheetahs have begun to attack small stock for food
_____3) Cheetahs are killing young hartebeest in your game farm. They have managed to get through the game fence by crawling through warthog holes in the fence
_____4) Heifers continue to lose a large number of calves to predators each year
_____5) Cows giving birth in camps (where cheetah tracks are seen) that have play-trees lose more young calves than those in camps closer to the homestead that have only acacia trees
_____6) Over-hunting of wildlife on a farm to provide more grazing area for cattle has caused predators in the area to hunt livestock

Management Techniques

1. Electrify fence and barb the lower wires to prevent warthogs from digging holes.
2. Reduce calf losses by moving calving herds out of the areas where play-trees are located.
3. Bring cows closer to the homestead during calving times.
4. Keep a few older cows with heifers, because many losses of calves in herds occur because the heifers are inexperienced.
5. Keep a larger concentration of livestock in camps during calving to help protect the calves.
6. Keep a few cows or oxen with horns together with the calving herd.
7. Place a few female donkeys with calving herds, as donkeys are aggressive toward intruders and chase away cheetahs.
8. Rotate livestock more rapidly through camps.
9. Promote more aggressive breeds of cattle such as the Brahman and Afrikaner.
10. Employ herders and large breeds of livestock guard dogs with small stock.
11. Promote wildlife repopulation on farms, because farms with larger wildlife populations experience fewer predator problems.