PANTHER HUNT

People and the Planet
Lessons for a Sustainable Future

INTRODUCTION

Whether panthers in a forest, ants in the soil or humans on the Earth, all species face limits to their population size based on the amount of resources available. The maximum number of a species that can sustainably live in a given area based on the available resources is called **carrying capacity**. For an animal species, carrying capacity depends on many different factors including the availability of food and competition from other animals, as well as access to shelter, water, and clean air. Humans can also be a factor impacting carrying capacity of a habitat. If human encroachment impacts the amount of prey available, reduces shelter, or pollutes the water or air, carrying capacity can decrease. On the other hand, if humans work to restore a habitat to its natural balance it may be able to support more wildlife.

MATERIALS

- 200 3-oz paper cups

PROCEDURE

This lesson is divided into two rounds. In Round 1, students explore the basics of carrying capacity through a simulation. In Round 2, students consider various human impacts that could impact carrying capacity and re-run the simulation with modifications. If time is limited, it is not necessary to complete Round 2.

ROUND 1: UNDERSTANDING CARRYING CAPACITY

1. Before class, label the bottom of each cup to represent a prey animal.

CONCEPT
Every habitat has a carrying capacity for the number of animals it can support and human actions can impact that carrying capacity.

OBJECTIVES
Students will be able to:

- Define carrying capacity and explain how it relates to an animal species.
- Examine how human actions can impact the carrying capacity of a habitat.

SUBJECTS
Science (life, Earth and environmental), social studies, math

SKILLS
Modeling natural systems, analyzing data, identifying trends and patterns, observing, comparing and evaluating

METHOD
Students act as panthers hunting for food in a model habitat to learn about carrying capacity and explore changes that occur because of human actions.

For classes of 25 students: use 200 cups and label them as follows:

80 cups marked S
60 cups marked R
36 cups marked P
22 cups marked B
2 cups marked D

For other class sizes: multiply the number of students participating by 8. This is your total number of cups.

Mark 40 percent of the total cups with an S
Mark 30 percent of the total cups with an R
Mark 18 percent of the total cups with a P
Mark 11 percent of the total cups with a B
Mark 1 percent of the cups with a D

2. Write the animal each cup represents and its weight on the board.

S = Squirrel (1 kg)
R = Rabbit (2 kg)
P = Porcupine (7.5 kg)
B = Beaver (20 kg)
D = Deer (75 kg)

3. When ready to begin the simulation, indicate the area where you have set out the cups, and say, *"This is the habitat of a population of panthers and each of you represent one panther. The paper cups spread around the room represent your prey; each prey animal provides you with a specific amount of food. On my signal, you will try to collect enough food in this habitat to survive for about a month, 50 kg."*

Explain to students that 1 kg = 2.2 lbs, so 50 kg = 110 lbs. It may be helpful to show the class a picture of a panther.

Note: If you plan to include Round 2 to show human impacts on the habitat, tell students this hunting is the first of several.

4. Read aloud, from the board, what each cup represents and its weight to be sure students understand what they're hunting. Ask each student to set up a panther den by selecting a small area where they will bring their prey. This could be their desks or areas along the wall.

5. Give students the following instructions:

"Each panther must walk into the habitat to hunt. (Panthers don't run down prey, they stalk it.) When a panther finds a prey animal, they pick it up and carry it to their den. Each panther can only carry one prey animal at a time. Remember that in the wild, panthers don't fight over prey, as a resulting injury may kill them. Once the prey is in a panther's den, it is safe from other panthers (panthers don't steal). You should hunt until all the prey has been collected."

6. When all the paper cups have been gathered, the hunting is over. Students should return to their desks to calculate the total kilograms of food they collected.

7. Ask the panthers who survived (gathered 50kg or more) to raise their hands and record the number on the board. Ask students, "Is this the maximum number of panthers that can survive in our habitat? Why or why not?" (*The number of surviving panthers is likely NOT the maximum number that could have survived in the habitat. This is because some panthers most likely collected more than 50 kg. Also, if panthers were able to combine their prey, more panthers could have survived.*)

   Ask: "How can we calculate the maximum number of panthers that could survive in this habitat?" (*Add up all the prey in the habitat – 1060 kg for a full set of 200 cups – and divide by the amount each panther needs to survive, 50 kg. If a full set of 200 cups is used, 21 panthers could have survived*).

8. Explain to students that the maximum number of panthers that can survive in the habitat is called the panther's carrying capacity. Define the term, carrying capacity.

   Carrying capacity: the maximum number of a species that can sustainably live on the resources in an area.

9. To integrate more mathematics, try one of the following options:

   a. Students determine combinations of prey animals that would have allowed them to survive (get 50kg) and write algebraic expressions to show their answers. Answers can be solely based on math, and not restricted by how much of each prey was available in the class simulation.

   b. Students imagine they are wildlife biologists and would like to double the carrying capacity of panthers for the habitat. How many additional kilograms will the habitat need? How much of each type of prey will the habitat need? For a challenge, have students also maintain the balance of species from the original habitat. (Students will need to start by knowing how much of each prey was in the original habitat in order to set up a ratio.)

   c. In small groups, students make a graph to represent their prey data. You could give them parameters (i.e. they must make a bar graph, they must combine everyone's prey, they must graph total weight, etc.) or leave it open-ended and have students justify the method/s they chose for representing the data.

10. Go over the Round 1 Discussion Questions:

    a. Ask the surviving panthers to raise their hands. Do you notice anything about where these surviving panthers are located? Where are they in relation to the food supply?

       Often, the students seated closest to the paper cups will survive while those further away will not.

    b. In this simulation, the panthers' carrying capacity was determined only by food. What other resources would impact the carrying capacity of an area for a given animal species?

       Any resource that the species needs to survive – shelter, water, air, space, etc.

c. Though this simulation is about the carrying capacity of panthers in a region, do the same rules apply to humans? How are they similar and dissimilar?

Yes. Similarities include: humans are at the top of the food chain; just as the panthers compete for prey, humans compete for a number of limited resources within our own habitat, or society; in some cases, whether or not you get resources depends on how close you are to them (your access level and their availability). Dissimilarities include: humans generally don't stop "hunting" when we have enough of something (we continue competing for things that we don't really need while panthers stop when they are full).

d. This activity modeled the carrying capacity of panthers in a habitat. What are the strengths of the model we used? What are the weaknesses?

Strengths could include: we competed for prey just like panthers do in the wild; some panthers didn't survive the season; the model illustrated how there are limits to the number of species that can survive on the resources in a habitat. Weaknesses could include: panthers in the wild generally have large territories so have less competition for food; we don't know if the hunting was sustainable because we only modeled one hunting season, the model bases the panthers' carrying capacity only on food and doesn't account for other factors that impact survival.

If doing Round 2, skip questions e - g and move to Round 2: Human Impacts

e. Imagine a dam was built and diverted water away from our habitat. How might this change the habitat? How could we represent this in our model of the habitat? How would this impact the carrying capacity of panthers?

If a dam was built and water was diverted from the habitat, all the beavers would leave or die out. We could show this in our habitat model by removing all the beaver cups. With no beavers in the habitat, the carrying capacity of the panthers would drop because the panthers' food supply would be cut and therefore, fewer panthers would survive.

f. What other human actions might decrease the carrying capacity of panthers in this habitat? How could we show this in our model? How would a lower panther population impact the rest of the habitat?

Answers may include: The carrying capacity of the panther habitat might decrease if humans begin to develop the habitat (cut down trees for timber, harvest plants for medicine), hunt for sport, build a highway through the habitat, or pollute the land or water. In our model, we could remove prey cups from a corner of the room to represent human development (fewer resources available), use desks to represent a road that blocks off some of the prey, or remove some prey animals that may have been affected by pollution.

If there were fewer panthers in our habitat, the balance of the ecosystem would shift – population levels of the prey animals would increase; over-grazing would affect plant populations, causing food shortage; there would be more competition for resources, etc. One change in an ecosystem may alter the carrying capacity for many different species.

g. Imagine that the body of water in this habitat became polluted. In addition to possibly decreasing the health and number of prey animals, how else could polluted water impact the panthers?

*The panthers and all the other animals drinking the water would become sick and some may die. In addition, the panthers would have the highest concentrations of pollutants in their bodies because panthers are at the top of the food chain - they eat the other creatures that are also drinking the water. This is called **bioaccumulation**. Not only are they consuming the polluted water themselves, they are taking in all of the pollution that is stored in the tissue of each animal they eat.*

ROUND 2: HUMAN IMPACTS

1. Ask students, "What things might impact the resources in a habitat and thus influence carrying capacity? Are they natural, human-caused, or both?"

Both natural factors and human actions can impact the resources in a habitat and have an influence on carrying capacity. Natural factors such as disease or natural disasters can decrease carrying capacity, while a robust resource base or good climate conditions can increase carrying capacity. Human actions such as hunting, logging or polluting can destroy habitat, negatively impacting carrying capacity. Alternatively, humans can protect or even increase the area of habitats through actions such as planting trees, composting to create nutrient soil, or reclaiming wild areas as reserves or parks.

2. Explain to students that in this Round, you'll be investigating how the habitat, and the carrying capacity of panthers, could be impacted by human actions.

3. As a class, decide what human impact you'd like to model in the habitat. Ideas could include a development or a road being built, polluted water, etc. Have students write down predictions for how they think this change will impact the carrying capacity of panthers in the habitat.

4. Ask students to brainstorm how to change the simulation to show the impact that the class has chosen to model. They can consider changes to the rules of the game, the prey available, the set-up of the habitat, etc. The chart below includes some possible ideas.

Human impact	**Possible change and habitat adjustment**
A dam is built and there is less water	Remove beavers
A road is built through the habitat	A line of desks or tape on the floor blocks part of the habitat or divides the room and panthers can only hunt on the side where their den is located.
Water becomes polluted	Remove a lot of beavers and some of the other prey animals
Water becomes polluted and there is bioaccumulation	Use dry beans to represent pollution. Place a small number of beans under small prey animals and a larger number of beans under the larger prey animals. After hunting, panthers count their "pollution consumed" (the beans) to see the impact of bioaccumulation.
Deforestation occurs	Remove a lot of prey animals
A development is built	Remove prey animals from one section of habitat

5. Using the changes students have decided on, set-up the habitat and prey cups, and then hunt again! Students can help put the cups out to save time.

6. Follow the same procedure as in Round 1 to determine the number of surviving panthers as well as the panther carrying capacity of the habitat. Then discuss the outcome – were students' predictions correct?

7. Finally, ask students to brainstorm ways to restore the carrying capacity of panthers.

8. Go over the Round 2 Discussion Questions:

   a. How would a lower panther population in this habitat impact the other species?

      If there were fewer panthers, the balance of the ecosystem would shift – population levels of the prey animals would increase; over-grazing would affect plant populations, causing food shortage; there would be more competition for resources, etc. One change in an ecosystem may alter the carrying capacity for many different species.

   b. Do you think your idea to restore the carrying capacity of panthers in the habitat would work? Why or why not?

      Answers will vary.

   c. Imagine the population of humans increased near this habitat. What further changes might occur in the habitat? How might carrying capacity be impacted?

      More humans nearby might lead to more development, more roads, or more pollution, which would all further disrupt the ecosystem and decrease carrying capacity.

   d. Can you think of an example, either in your community or elsewhere, when human actions disrupted the balance of an ecosystem? Can you think of an example of humans protecting or restoring a habitat?

      Answers will vary.

   e. What human actions might impact the natural resources that we rely on as humans?

      Many of the actions that impact species in wildlife habitats, also impact humans. For example, humans can be impacted by deforestation, polluted waterways and oceans, lack of healthy soil, etc. Human actions also cause climate change, which threatens the health of both humans and animals on Earth.

ASSESSMENT

Students finish the following sentence starters:

The carrying capacity of a habitat is....

Two things that impact the carrying capacity of a habitat are....

FOLLOW-UP ACTIVITIES

1. Students diagram the trophic levels of the habitat. You may also want them to add a species to the habitat in order to add a trophic level (a producer or a secondary consumer).

2. Students research a habitat local to their school to learn about the species that live there and any factors that may be influencing the habitat's carrying capacity.

3. Introduce students to the story of wolves in Yellowstone National Park. After a decline in the wolf population, there was a ripple effect through the ecosystem which was only restored once scientists considered all the complex interconnections between predators, prey, and their habitats.

Adapted with permission from Joan Wagner, Science Education Consultant/Author, Focus on Learning, Albany, NY. Based on "How Many Bears Can Live in the Forest?" an activity developed by Project WILD, (www.projectwild.org) ©2000.