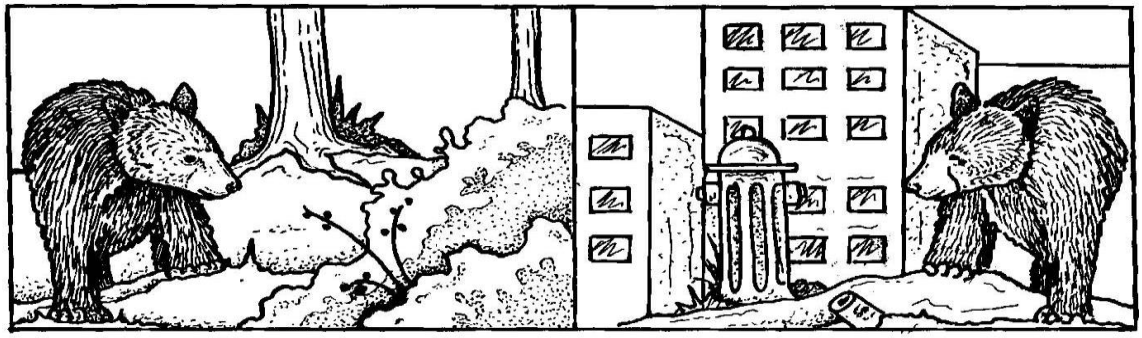
Lesson Six

Bear Barriers



Key question

How do human activities affect Florida black bear populations?

Conceptual frameworks topics

IV.D.3.	Florida black bear life cycles – Mortality rates
VI.A.	Natural limiting factors
VI.B.	Human-caused limiting factors
VI.C.	Human population growth and Florida black bear mortality
IX.B.	Strategies for reducing human-caused Florida black bear mortality

Subjects

Mathematics, Science

Time estimates

Part I: 30-60 minutes

Part II: 20-60 minutes

Key vocabulary

Population, mortality, immigration, emigration, limiting factors

Supplemental Video Clip

Time 2:45-6:13 from 60-minute video

Objectives

As part of this activity, students will:

1. Identify the natural and human-caused factors contributing to black bear mortality in Florida.
2. Make inferences regarding the relative effects of different human-caused factors on Florida black bear populations.
3. Compare mortality rates for black bears at different stages in their life cycle.
4. Describe strategies for reducing black bear mortality due to human-caused factors.

Materials

Essential:

Per class:

- 200 feet of string or rope to outline the playing area
- Limiting Factor Badges (one per student) for half of the students in the class
- Bear Cards (30 per student) for the other half of the students in the class
- Single hole punch
- One skein of yarn

- One pair of scissors
- Re-sealable plastic bags or envelopes to hold Bear Cards
- (30-40) 3x5 inch index cards or other small pieces of paper in five different colors to represent Dispersal Cards
- Five bowls or other small containers for Dispersal Cards
- 100 AIMS Friendly Bears or AIMS Counting Bears, buttons, beads, seeds, pennies, craft sticks, or other small objects to represent a population of bears

Per student:

- One "Bear Barriers" Worksheet

Supplemental:

Per class:

- One whistle
- Four marker flags

Per student:

- Calculator

Background

A **population** is a group of organisms of the same species living in the same area of habitat. The total population of black bears in Florida has changed from an estimated 11,000 individuals at the time of European settlement to approximately 4,000 individuals in 2016. Because Florida black bears prefer densely vegetated habitats and male bears can have home ranges of over 100 square miles in areas such as the Eglin Air Force Base, *exact* counts of Florida's black bear populations are not possible.

Scientists base their estimates of bear populations on several indices, including genetic analysis of hair samples collected from research stations, periodic road surveys to record evidence of bear activity, such as bite marks on food cans or tracks and scat, as well as data collected from known Florida black bear deaths. Scientists have been collecting data on Florida black bear deaths (**mortality**) throughout the state for more than 30 years. In addition to keeping track of how many known bear deaths occur each year, scientists collect data on the age, gender, size, overall health, and probable cause of mortality for each dead bear they find. This information is being used by government agencies like the Florida Fish and Wildlife Conservation Commission and conservation organizations like Defenders of Wildlife to pinpoint the types of human activities that threaten black bear populations in Florida and develop ways to minimize the number of bear deaths caused by human activities.

In natural systems, the population of organisms in an area is influenced by four factors: birth rate, death rate, **immigration** (organisms moving into an area), and **emigration** (organisms moving out of an area). In stable populations, birth rates and death rates tend to balance each other out and immigration rates usually equal emigration rates. In natural systems, a number of factors normally contribute to deaths within a population. The factors that limit the sizes of populations of organisms are called **limiting factors**. If these natural limiting factors did not exist, birth rates would exceed death rates and the population

would grow to exceed the carrying capacity of its habitat. A number of different natural events and factors control the sizes of Florida black bear populations to keep them stable. Natural factors causing death in Florida black bear cubs may including drowning, hypothermia due to den flooding, predation by older bears, starvation, falling from trees, infections from injuries, and predation by other natural predators such as bobcats and coyotes. At other stages in their lives, natural factors causing death in Florida black bears are primarily injury or death caused by aggressive encounters with other bears, but in rare cases starvation and disease. There is no accurate way to determine exactly how many bears in Florida die of natural causes each year. With the increasing population of people in Florida, the number of human-caused factors resulting in bear mortality has increased. The three main human activities directly resulting in known bear mortality in Florida (in order from most to least) are road kills, agency removal for public safety (i.e., humanely killed), and illegal kills (e.g., poisoning, shooting).

Human activities also indirectly cause bear deaths. As is the case with most other animal species, a factor threatening the success of the black bear is habitat loss due to development. As Florida's human population continues to grow, more and more bear habitats are being cleared to build new homes, schools, shopping centers, hospitals, roads, and other needed facilities for people. As a result, less and less habitat is available for bears. When natural habitats are developed for people, more bears wander into human-dominated areas and die due to road kills, agency removal, and illegal killing. In addition, more bears may also die due to starvation and aggressive encounters with other bears when they are displaced by other bears and are forced to seek out new areas of natural habitat.

When both natural and human-caused factors are considered, mortality rates for Florida black bears are highest for cubs, yearlings, and subadult males. Mortality rates for each stage of life are as follows:

- **CUBS –** Approximately 40 percent of all black bear cubs born do not survive their first year.
- **YEARLINGS –** About 30 percent of all bears that do survive their first year (yearlings) die before they are two years old.
- **SUBADULTS –** Once bears reach the age of two (subadult), mortality rates for females and males differ slightly. Over a quarter of all subadult males (35 percent) do not survive to adulthood, while only about 20 percent of subadult females die before reaching adulthood.
- **MATURE ADULTS –** 94 percent of female subadults and 72 percent of male subadults live into adulthood (6+ years old for males and 4+ years old for females).

- **OVERALL SURVIVAL RATES –** For every 100 cubs born in a given year, 85 do NOT live a normal lifespan (15 years). Less than 1 out of every 50 male cubs live a normal lifespan (0.4 percent) and 7 out of every 50 female cubs live a normal lifespan (14 percent). About 20 of the 100 cubs born each year reach adulthood (5-6 years old for males and 3-4 years old for females).

During the mid-20th century, 7 million acres of forested land was cleared in Florida. During the early part of this same period, the population of black bears in Florida declined, until successful conservation efforts were put into place. In 2012, due to those efforts the Florida black bear was removed from the state list of threatened species. To ensure the continued successful recovery of the black bear in Florida, we need to find ways to reduce bear mortality caused by human activities. In addition to conserving bear habitats, other strategies for minimizing human-caused bear mortality include creating highway underpasses (for wildlife) in areas where bears have been hit by cars, posting warning signs, reducing speed limits, increasing speeding fines, and police enforcement of speed limits on roads traversing bear habitats, limiting the number of new roads and expansion of existing roads traversing bear habitats, and convincing homeowners, landowners, beekeepers, and others that may experience human-bear conflicts to take actions to reduce or eliminate bear access to human-provided foods. As bears access food from people on a regular basis, they begin to lose their natural fear and may have to be humanely killed by the agency because they present a risk to public safety.

Advance preparation

1. Copy enough Limiting Factor Badges for half of the students in your class. One-third of the badges should be development, one-third of the badges should be highways, and the remaining badges should be equally divided among agency removal, illegal killing, aggressive adult bears, starvation, and disease. If possible, color code the badges using varying color card stock, and laminate them. Punch holes on the top left and top right corners of each badge, and tie a length of yarn to each badge to make necklaces that will fit over student's heads. (See Figure 1 for a sample badge)

2. Copy and cut out a set of 30 bear cards for each of the students in the other half of your class. If possible, laminate these cards for future use.

3. Copy one "Bear Barriers" Worksheet for each student.

4. Locate a large open area on school grounds for the role-playing activity. (See Figure 2 for a

diagram) Use string or rope to outline the borders of the playing area and mark each corner with marker flags if available.

Procedure and discussion questions

Part I:

1. Introduce the lesson by asking students to define the term **population** in their own words. Make sure students realize that a population consists of organisms of the same species living in the same habitat. Explain that many different populations (species) of organisms often share the same habitat. Next ask students what they think the population of black bears in the entire state of Florida is. Explain that about 400 years ago there were about 11,000 black bears and 350,000 people living in Florida, and today there are approximately 4,000 bears and more than 20 million people.

2. Briefly review pertinent background information regarding the four factors influencing the population of animals in a given area of habitat (birth rate, death rate, **immigration**, and **emigration**). Define the terms immigration and emigration. Develop the idea that in a stable population, birth and death rates usually balance each other out, as do immigration and emigration rates.

3. Introduce and define the terms **mortality** and **limiting factors** and explain that during this lesson, students will participate in a role-playing activity to learn more about the factors that cause mortality in Florida black bears.

4. Divide the class into two equal-sized groups. Explain that during the activity, half of the class will represent populations of bears and the other half of the class will represent natural and human-caused factors that affect bear populations. Each student in the bear group will receive a set of 30 Bear Cards. These cards represent the starting population of 30 bears for each student. Explain that during the role-playing activity students in the bear group will be representing populations of young adult bears who are trying to disperse and establish their own ranges. **The object of the game for the students in the bear group is to collect 10 Dispersal Cards (index cards) before their entire population of 30 bears is killed by natural or human-caused factors.**

5. Review the rules for the activity:
    a. When you say "Go" or blow the whistle, all students in the bear group must enter the dispersal area.
    b. Students in the bear group must stay in the dispersal area until all their Bear Cards have been given to limiting factors or until they collect 10 Dispersal Cards,

whichever comes first. When a student in the bear group has either lost all of their Bear Cards or collected 10 Dispersal Cards, they should return to the starting area until the game is over.

c. Limiting Factor students collect five Bear Cards every time they tag a student in the bear group.
d. Limiting Factor students cannot tag the same bear student two times in a row and they must stand four giant steps away from a bear student who is giving cards to another limiting factor.
e. Limiting Factor students must also stand at least four giant steps away from the Dispersal Card containers.
f. There is no "safe zone" for bears in the playing area. Bears cannot jump out of bounds and they cannot hang around the Dispersal Card containers. They must keep moving throughout the entire game.
g. Pushing, tackling, or otherwise harming other students is not allowed and students exhibiting these behaviors are disqualified. Limiting factors can only tag bears by touching their backs or arms.
h. The game is over when all students in the bear group have either lost all 30 of the Bear Cards or collected 10 Dispersal Cards.

6. Assign students to bear or limiting factor groups. Give each Bear student a stack of 30 Bear Cards and give each Limiting Factor student a Limiting Factor to wear around their neck.

7. Bring students to the outdoor playing site and review the layout of the playing area. Place the five Dispersal Card containers in the playing area as show in Figure 2. Each container should contain 30-40 index cards of a particular color.

8. Have all the students in the bear group cluster together in the starting area while the Limiting Factor students position themselves throughout the dispersal area. Signal the beginning of the game and make sure students do not jump out of the playing area or violate any of the rules while conducting the activity.

9. After the game is over, return to the classroom to discuss the results. Have students count the total number of Bear Cards they possessed at the end of the game and construct two whole-class

data tables summarizing the results (see Figure 3).
Refer to the information in the data tables and conduct a whole-class discussion addressing the following questions:

- How many total bears were there at the beginning of the activity? (30 x the total number of students in the bear group)
- How many total bears were still alive at the end of the activity? (Answers will vary)
- How many total bears were killed by limiting factors during the activity? (Answers will vary)
- Which kinds of limiting factors killed the most bears? (Normally, since there were more students representing development and highways, these two categories of limiting factors will collect more bear cards)

10. Ask students what they think about the number of bears that died during the activity. Reinforce the idea that death is a part of nature, and that natural limiting factors help control the sizes of bear populations. Next, ask students which of the limiting factors in their role-playing activity were natural and which were human-caused. Develop the idea that the increased influence of human-caused factors may cause higher than normal death rates in bear populations.

Part II:

11. Distribute a copy of the "Bear Barriers" worksheet to each student and distribute calculators if available. Have students form a circle in a comfortable area. Spread the 100 AIMS Friendly bears or other tokens representing a bear population in the center of the circle. Explain that you are going to use the tokens to help them learn more about the number of bears that die during different stages of their life cycle. Instruct students to complete their calculations and record their answers to the problems on the worksheet as you move through each step of the demonstration. Students can work on math problems in pairs or groups of three if they so choose.

12. Explain that the starting set of 100 tokens represents a starting population of 100 cubs born in the same year. Tell students to assume that half of the cubs are females and half of the cubs are males.
    - Remove 40 tokens from the circle and explain that this represents the number of

cubs that die before they become one year old.

- Remove another 18 tokens from the circle and explain that this represents the number of one-year-old (yearling) bears that die before they become two-year-old subadults.
- Explain that half of the bears that live to be two years old are males and half are females. Divide the remaining 42 tokens into two separate piles labeled "Male" and "Female" to illustrate this point.
- Remove 7 tokens from the male subadult pile and 4 tokens from the female subadult pile. Explain that this represents the number of subadult bears that die before they become mature adults.
- Finally, remove an additional 4 tokens from the male pile and 1 token from the female pile. Explain that this represents the number of mature adult bears that do not live out a normal lifespan.

13. Review the correct calculations of the "Bear Barriers" Worksheet and use questions to develop the idea that mortality rates for Florida black bears are highest for cubs, yearlings, and subadult males. Ask students how they feel about the fact that only about 20 percent of all bear cubs born in a single year live to a normal full lifespan. Next, ask students to suggest actions people could take to reduce the number of Florida black bear deaths caused by humans each year. Remind students that the two most significant human-caused factors affecting bear populations in Florida are loss of habitat due to development and road kills on highways that pass through areas of bear habitat.

14. To conclude the lesson, let students identify one strategy or action they would like to implement to reduce the impacts of a human-caused factor in the role-playing game (e.g., limiting human development and conserving more bear habitat or installing underpasses on highways crossing known bear habitats). Next, have students determine how they could represent their action in the role-playing game (e.g., having the limiting factors students wearing human development badges or highway badges sit out during the game or allowing all limiting factors students who are highways to collect only one Bear Card each time they tag a bear student). If time allows, play the game again with the proposed change and

have students compare the number of bears surviving in Round 2 with the number of bears surviving in Round 1.

Assessment suggestions

1. Ask students to list which limiting factors in the activity were natural and which were human-caused.

2. Have students describe in their own words how human-caused factors affect black bear populations in Florida.

3. Collect completed worksheets and review student responses to question 4.

4. Provide a writing prompt such as the following: "One way that people can help Florida's bears is to…" and have students write a short paragraph describing what they would do to conserve black bear populations in Florida.

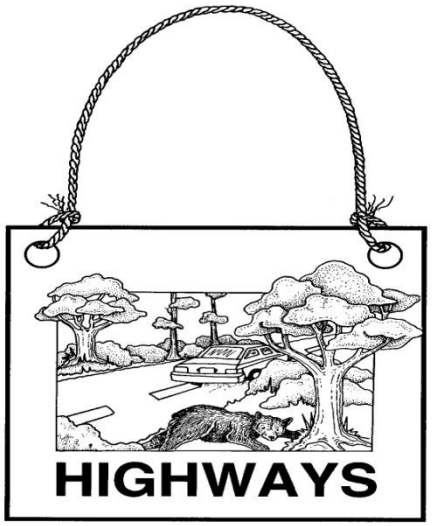


Figure 1. Sample limiting factor badge

Figure 2. Role Playing Site Layout

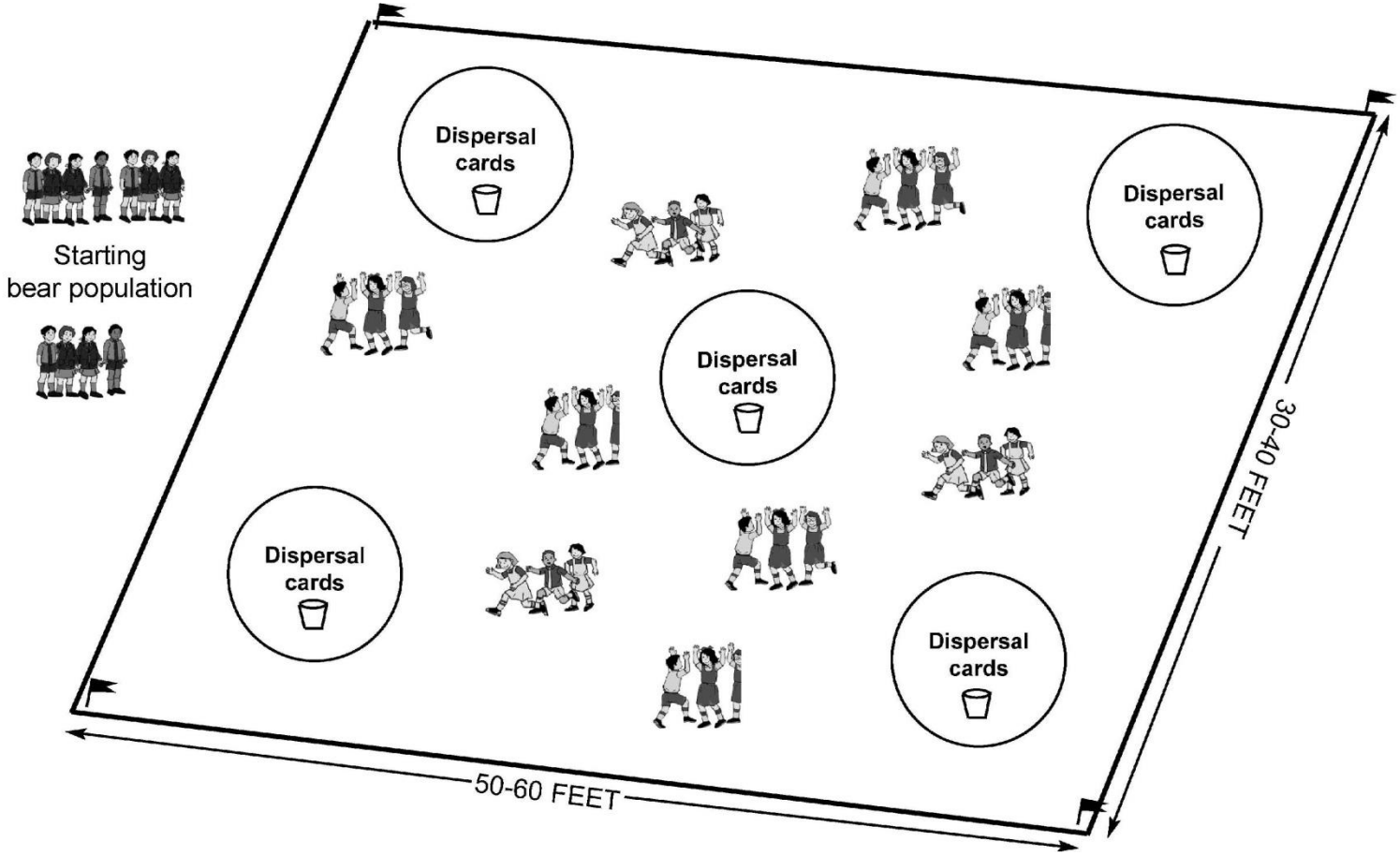


Figure 3. Sample Whole-Class Data Tables

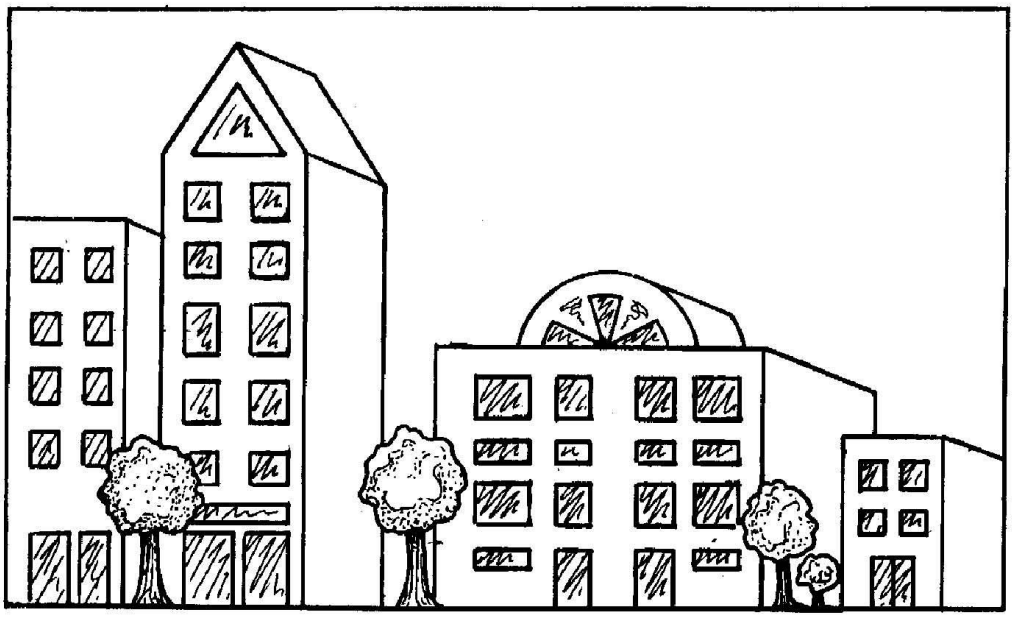
LIMITING FACTOR TYPE	TOTAL NUMBER OF BEAR CARDS COLLECTED
DEVELOPMENT	
HIGHWAYS	
AGENCY REMOVAL	
ILLEGAL KILLING	
AGGRESSIVE BEARS	
STARVATION	
DISEASE	
GRAND TOTAL	

BEAR NUMBER	STARTING POPULATION	ENDING POPULATION
1	30	
2	30	
3	30	
4	30	
5	30	
etc.		
GRAND TOTAL		

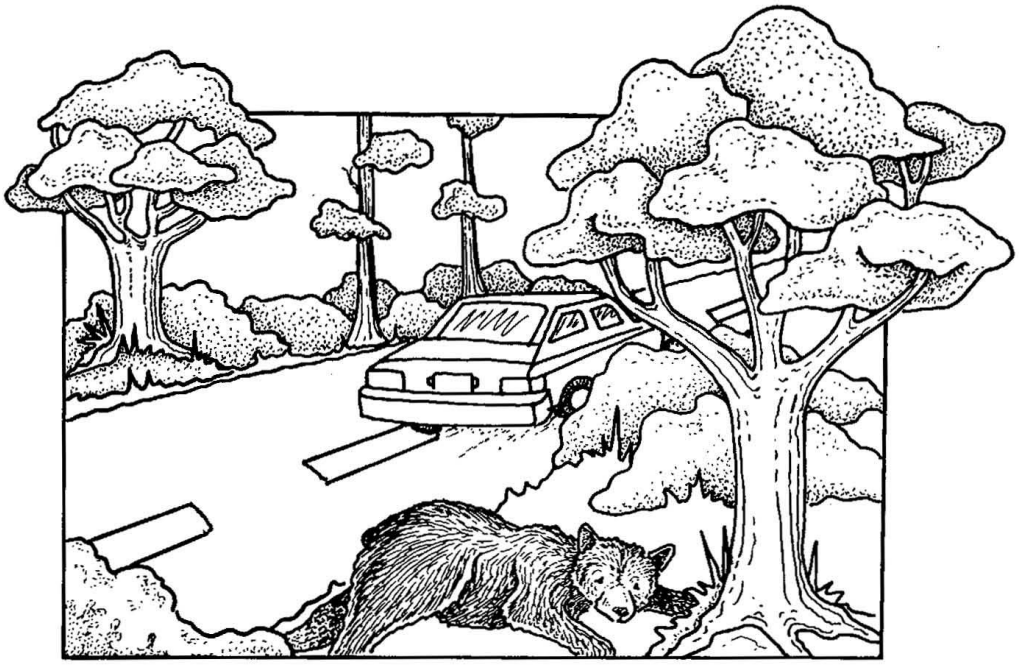
Lesson Six _____ Bear Barriers

Bear Cards

Limiting Factor Badges

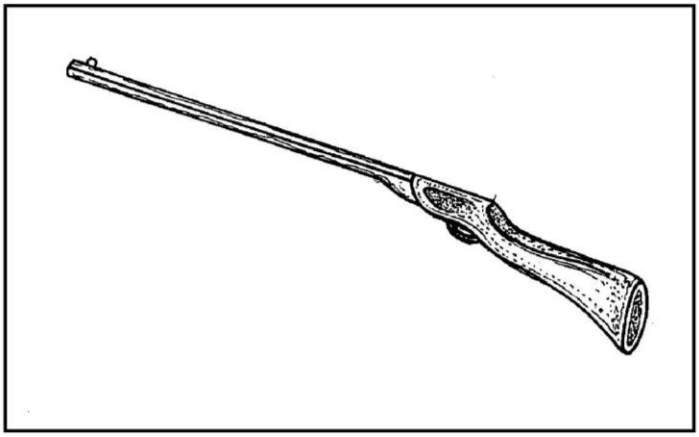


DEVELOPMENT

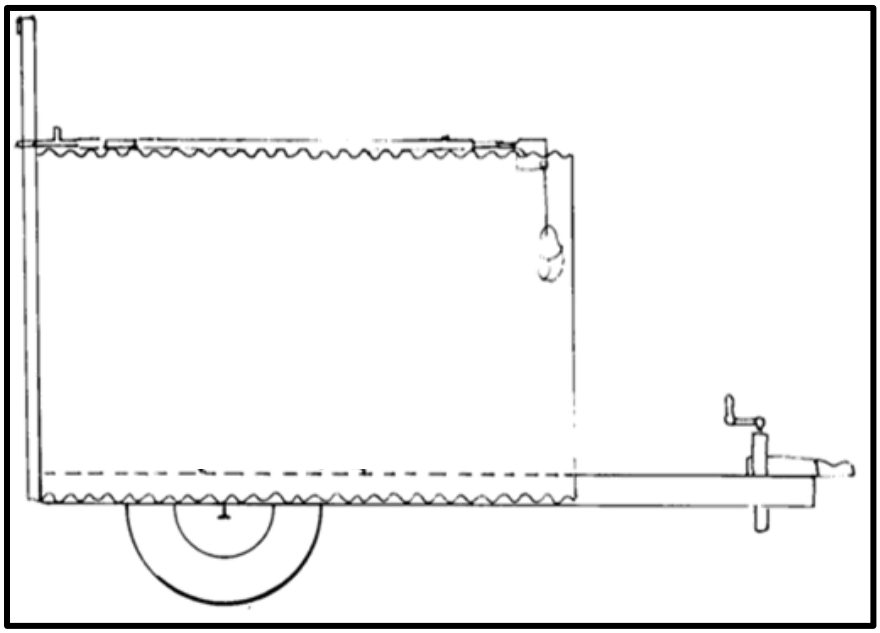


HIGHWAYS

Limiting Factor Badges

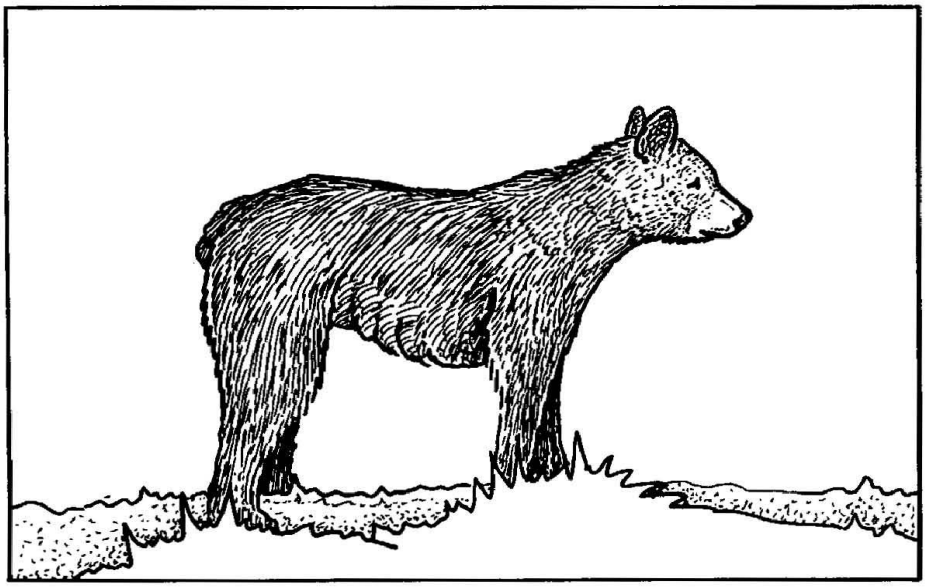


ILLEGAL KILLING

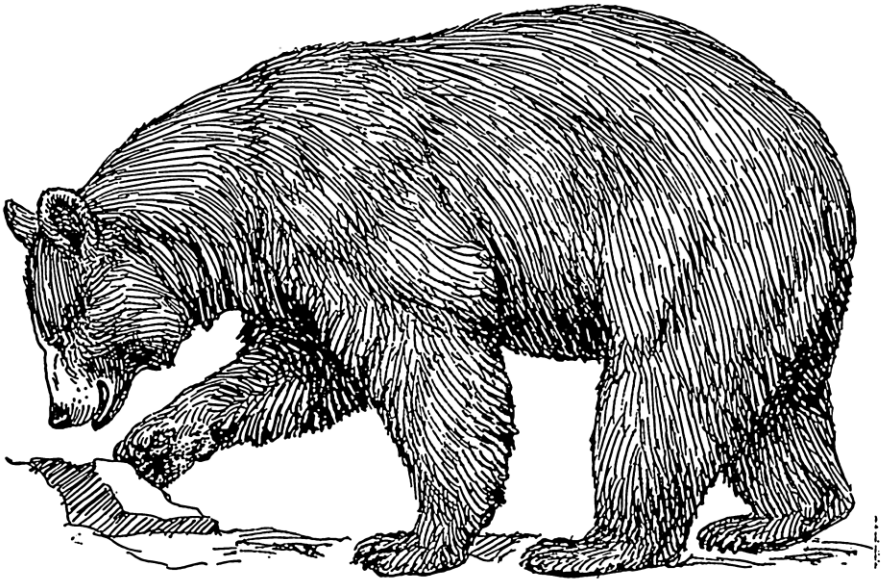


AGENCY REMOVAL

Limiting Factor Badges

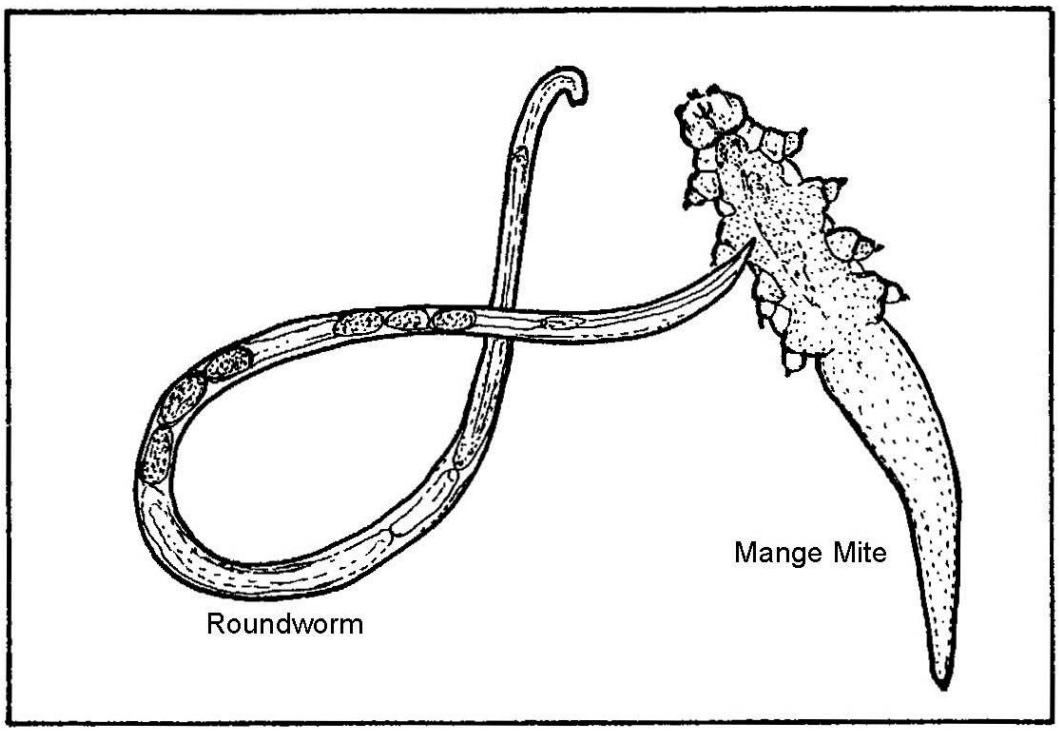


STARVATION



AGGRESSIVE BEARS

Limiting Factor Badges



DISEASE

Bear Barriers Worksheet

Name_____

Part 1 Directions: Fill in the numbers on the worksheet as your teacher does the demonstration.

Total number of cubs born
(Half are female and half are male) ☐

\- Cubs that die before age 1 - ☐

= Total number of yearlings ☐

\- Yearlings that die before age 2 - ☐

= Total number of subadults ☐

Divide this total into two equal parts

Male subadults ☐

Subadults that die before they are mature - ☐

Total number of male subadults that survive to adulthood = ☐

Males that don't live into adulthood - ☐

Total number of male bears living into adulthood = ☐

Female subadults ☐

Subadults that die before they are mature - ☐

Total number of female subadults that survive to adulthood = ☐

Females that don't live into adulthood - ☐

Total number of female bears living into adulthood = ☐

☐

Bear Barriers Worksheet

Name_____

Part 2 Directions: Answer each of these questions.

1. Of the 50 male cubs born, how many male cubs do not live a full lifespan?

_____

2. Of the 50 female cubs born, how many female cubs do not live a full lifespan?

_____

3. Of the 100 cubs born, how many total cubs live a full lifespan?

_____

4. At what stages of life (cub, yearling, subadult, or mature adult) do the greatest number of bears die?

_____

5. What might happen to the population of bears in Florida if all cubs born each year lived to become mature adults?

_____

_____

_____

_____

_____

Bear Barriers Worksheet

ANSWER KEY

Part 1 Directions: Fill in the numbers on the worksheet as your teacher does the demonstration.

Total number of cubs born (Half are female and half are male)		**100**
- Cubs that die before age 1	-	**40**
= Total number of yearlings		**60**
- Yearlings that die before age 2	-	**18**
= Total number of subadults		**42**

Divide this total into two equal parts

Male subadults		**21**	**Female subadults**		**21**
Subadults that die before they are mature	-	**7**	Subadults that die before they are mature	-	**4**
Total number of male subadults that survive to adulthood	=	**14**	**Total number of female subadults that survive to adulthood**	=	**17**
Males that don't live into adulthood	-	**4**	Females that don't live into adulthood	-	**1**
Total number of male bears living into adulthood	=	**10**	**Total number of female bears living into adulthood**	=	**16**

Bear Barriers Worksheet

ANSWER KEY

Part 2 Directions: Answer each of these questions.

1. Of the 50 male cubs born, how many male cubs do not live a full lifespan? ***(49).***

2. Of the 50 female cubs born, how many female cubs do not live a full lifespan? ***(43).***

3. Of the 100 cubs born, how many total cubs live a full lifespan? ***(20).***

4. At what stages of life (cub, yearling, subadult, or mature adult) do the greatest number of bears die? ***(CUBS, YEARLINGS , AND SUBADULT MALES).***

5. What might happen to the population of bears in Florida if all cubs born each year lived to become mature adults? ***(THERE WOULD BE AN OVERPOPULATION OF BEARS).***