

ALASKA DEPARTMENT OF FISH & GAME



# Wildlife *for the* Future

Alaska Wildlife Curriculum  
Teacher's Guide

CORRELATED TO  
STATE STANDARDS AND  
NEXT GENERATION SCIENCE  
STANDARDS



Teacher Background Information, Illustrations,  
Resources, Student Activities and Investigations

Grades  
5-12





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***Wildlife for the Future*** was revised from the original 2001 version from the Alaska Department of Fish and Game's Alaska Wildlife Curriculum which include five volumes:

Alaska's Ecology  
Alaska's Forests and Wildlife  
Alaska's Tundra and Wildlife  
Alaska's Wetlands and Wildlife  
Wildlife for the Future

These materials have been field tested in classrooms throughout Alaska. Our thanks to our educator focus group of teachers, students, biologists and resource agency staff that have contributed to and reviewed these materials.

The Alaska Department of Fish and Game has additional education materials and support information on its website. For information, or to provide comments, please contact us:

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# Introduction

Welcome to Alaska's Wildlife for the Future (Revision 2016) from the Alaska Department of Fish and Game's Alaska Wildlife Curriculum series. The lessons in this curriculum have been updated to provide educators and students with accurate, engaging, and relevant lessons in wildlife biology, and the principles and practice of wildlife management in Alaska.

This 2016 revision is geared toward middle and early high school students. Each lesson is intended to build an understanding of habitats and sustainable populations of wildlife, while introducing students to current wildlife research and management. Alaska's natural resources are vital to our economy and our way of life, and this curriculum aims to inspire and empower Alaska's students to participate in discussions, decisions and responsible actions that will help maintain these valuable natural resources into the future. We hope these lessons generate and strengthen students' connection with the natural world and promote an appreciation for our natural resources, while also cultivating both an awareness and tolerance for the different ways people value and use wildlife across our vast state.

This curriculum is divided into three sections - Exploring Habitats and Biodiversity, Wildlife Population Dynamics, and Sustaining Wildlife and Communities. Students explore the social aspects of wildlife use in their communities and how those uses intersect with wildlife management decisions, regulations, and individual and community efforts to improve wildlife habitat and inform management decisions. Though the lessons are interconnected, they may also be used independently to fit a unit or standard being taught. All lessons are aligned with the Alaska State Standards and the Next Generation Science Standards. Educators may extend learning experiences by engaging one of several case studies, using information and data from Alaska Department of Fish and Game research.

This guide and supporting case studies are made available primarily online, so lessons may be updated and relevant case studies added as they become available.

[www.adfg.alaska.gov/index.cfm?adfg=curricula.awc](http://www.adfg.alaska.gov/index.cfm?adfg=curricula.awc)

Hard copies may be available upon request.

We hope you will find this new resource of value and consider braiding it into your regular lesson plans. Enjoy!

ADF&G Wildlife Education & Outreach Staff



# SECTION 1

## Exploring Habitats and Biodiversity

### LESSON 1

Habitat is Where It's At

### LESSON 2

Mapping Nearby Nature

### LESSON 3

Schoolyard Biodiversity Investigation

### LESSON 4

In Harmony with Habitat, Feeding  
Adaptations for Birds

### LESSON 5

The Habitat Times





TARGET  
GRADES  
5–8

DURATION  
20–40  
minutes

GROUP SIZE  
15–60  
students



## LESSON 1

# Habitat Is Where It's At

### LESSON OVERVIEW

Students represent parts of a habitat and learn how they must be organized in a suitable arrangement in order for humans and wildlife to survive.

*“There are so many opportunities for students to consider the dynamics of habitat and how they affect wildlife.”*

**SUBJECTS** Science, environmental education, physical education, language arts

**SKILLS** Communicate, work as a team, recall knowledge, comprehend a concept, apply a skill and evaluate.

**SETTING** Outdoors

**TERMS TO KNOW** habitat, food, water, shelter, space, *suitable arrangement*, limiting factor, home range

### STATE STANDARDS

Science Language Arts  
SL.6.1.c; SL.6.1.d; SL.7.1.b;  
SL.7.1.c; SL.7.1.d; S.L.8.1b;  
S.L.8.1c; SL.8.1.d

Physical Education  
5.E.1.3.4; 8.E.1-2.; 8.E.1-2.



### MATERIALS

- large, open space such as a gym, multi-purpose room or outside area
- strong nylon rope (a dynamic climbing rope works well)
- materials necessary for completing the evaluation including computers, poster paper, writing instruments, and art materials.

### GUIDING QUESTIONS



What is habitat?  
What is meant by suitable arrangement?  
What are the four essential components of habitat?  
How are arrangement of food, water, shelter, and space important to humans and other animals?

### OBJECTIVES

- Students will identify the components of a habitat.
- Students will recognize how humans and other animals depend upon habitats.
- Students will interpret the significance of loss or change in a habitat to people and wildlife.

## Supporting Information

People and other animals share some basic needs. Every animal needs a place in which to live. The environment in which an animal lives is called **a habitat**. An animal's habitat includes food, water, shelter, and space in an arrangement appropriate to the animal's needs.

An animal may be adversely impacted if any of the components of habitat are missing or are significantly altered. The impact will not necessarily be catastrophic, but it can be. Lack of a single component of a habitat becomes a **limiting factor**. There are additional limiting factors beyond those of suitable food, water, shelter, and space. For example, disease, predation, pollution, and climatic conditions can affect an animal's survival.

If natural species don't survive, it impacts ecosystem dynamics. Within a biological community, there are interrelationships and interdependencies between plants and plants, plants and animals, and animals and animals. These interrelationships and interdependencies are dynamic in the short term and long term within a population. Humans can interfere and create changes in the habitat to suit the needs or wishes of humans. Those changes may in turn affect wildlife negatively or positively.



### ALASKA WILDLIFE CURRICULA COMPLIMENTARY ACTIVITIES

- *In Harmony with Habitat* (Alaska Wildlife for the Future, 2nd Edition)
- *Schoolyard Habitat Map* (Alaska Wildlife for the Future, 2nd Edition)
- *Oh Moose!* (Alaska's Ecology)
- *Forest Food Web Game* (Forests and Wildlife)



8. Now demonstrate how arrangement plays into a healthy habitat. Have everyone carefully set the rope down on the ground. Group the components—food, water, shelter, and space—together by asking all the students who were food to stand next to each other taking up a quarter of the circle. All the students who were water will stand next to each other adding another quarter of the circle and so on. Now, have everyone pick the rope up again, take a step backwards and lean back so it is taut. Ask if this is a suitable arrangement for a healthy habitat.
9. Ask all the students representing water to drop the rope again. Watch an entire  $\frac{1}{4}$  of the habitat collapse. Ask the students what this means for the real world. If a habitat component is missing from a particular area or region, will it be suitable habitat to provide for humans and wildlife?
10. Finally, have the students set down the rope and let go. Double the rope on itself and ask half of the students to pick it up this time and back up until it is taut. Have the students not holding the rope to stand inside the circle. Ask them if it is comfortable standing so close to their neighbors. Ask the students which component of habitat this exercise simulates (space). Discuss **home range** and explain that different wildlife tolerate different size crowds.

## Evaluation

- Students need to describe the essential components of a habitat using a graphic, video, map, oral presentation, poster, poem, drawing or painting to illustrate what they have learned.
- When presenting the essential components of habitat above, have students explain how the suitable arrangement of food, water, shelter, and space is important to ecosystem function and survival and diversity of species. Come up with examples of how humans have changed an environment to make it a suitable place for humans and/or wildlife (i.e. in order to provide all habitat requirements). Are there health or environmental costs associated with these changes? If so, who or what paid the price?



### Additional Resources

#### Online

##### **National Geographic Habitats by Type**

<http://environment.nationalgeographic.com/environment/habitats/>

##### **National Geographic Habitat Videos**

<http://video.nationalgeographic.com/video/habitats>

##### **US Fish and Wildlife Service, Schoolyard Habitats**

[www.fws.gov/alaska/fisheries/restoration/schoolyard\\_habitat.htm](http://www.fws.gov/alaska/fisheries/restoration/schoolyard_habitat.htm)

##### **National Wildlife Federation, Garden for Wildlife**

[www.nwf.org/Home/How-to-Help/Garden-for-Wildlife.aspx](http://www.nwf.org/Home/How-to-Help/Garden-for-Wildlife.aspx)

#### **Credit**

Adapted from "Habitat Lap-Sit" Project WILD  
K-12 Activity Guide, Council for Environmental  
Education, 1992.



TARGET  
GRADES  
7–8

DURATION  
2–3 Class  
Sessions

GROUP  
SIZE  
Pairs



## LESSON 2

# Mapping Nearby Nature

### LESSON OVERVIEW

Students create a map of their school grounds or a nearby nature area, investigate which habitat/land types exist and make inferences about biodiversity in that area.

**NOTE:** Mapping Nearby Nature (this lesson) and Schoolyard Biodiversity Investigation (the following lesson in this section) are intended to be taught in sequence, as students develop an understanding of the importance of biodiversity in ecosystems. After analyzing their schoolyards, students can then apply their knowledge to understand biodiversity in local habitats, as well as in far-reaching places.

**SUBJECTS** Geography, science, mathematics, art, technology, language arts; physical education

**SKILLS** Make a map, observe, coordinate, comprehend a concept, apply a skill, communicate, hypothesize, compile, analyze and synthesize data.

**SETTING** Indoors; outdoors

### TERMS TO KNOW

Ecosystem, habitat, species, legend, key, biodiversity, limiting factors, cartographer factor, home range

### STATE STANDARDS

Science Language Arts  
SL.6.1b; SL.6.1c; SL.6.1.d;  
SL.7.1.b; SL.7.1.c; SL.7.1.d;  
S.L.8.1b; S.L. 8.1c; SL.8.1.d

Physical Education  
8.E.1-2.; 8.E.1.



### MATERIALS

- pencils (colored and regular)
- a variety of maps for students to look at (school or community maps specific to your area)
- paper for student-created maps, large butcher paper and copy of school map for large, cut-up map
- classification table of habitat/land types list
- computer access

### GUIDING QUESTIONS



What are maps?

How have maps changed over time? What types of maps exist?

How do wildlife managers and scientists use maps?

How can a map help you learn about which natural elements and manmade structures may impact wildlife?

What are some limiting factors in your school's ecosystem?

### OBJECTIVES

- Students will describe the ecosystem surrounding their school.
- Students will determine which factors support life in their schoolyard.
- Students will determine the habitat needs their schoolyard provides to wildlife.

*What are Maps—Background and Insights*

*Anchorage Urban Bear Story Map Project*

[www.adfg.alaska.gov/index.cfm?adfg=livingwithbears.anchorageurbanbears](http://www.adfg.alaska.gov/index.cfm?adfg=livingwithbears.anchorageurbanbears)



**ALASKA WILDLIFE CURRICULA COMPLIMENTARY ACTIVITIES**

- ***Schoolyard Biodiversity Investigation*** (Alaska Wildlife for the Future 2nd Ed.)
- ***Forest Learning Trail Activities*** (Alaska's Forest & Wildlife)
- ***Investigating Activities Nonliving/Living Things*** (Alaska's Ecology)
- ***Ecosystem Scavenger Hunt*** (Alaska's Ecology)



5. Tell the students to make a simple, rough sketch of the area, noting where objects are in relationship to one another. They can fill in details back in the classroom. Ask them to draw physical elements, both natural and human-constructed, from a birds-eye view. Encourage students to see their surroundings through a larger lens, rather than hyper-focus on single objects.

### Option A: Create Individual Maps of the School Grounds

1. Student partners or teams create aerial-view maps of the entire school grounds, working first to draw the main structures, boundaries, etc. and then adding details/about the surrounding habitats. The suggested classification of Habitat/Land Types list as they create descriptive layers.

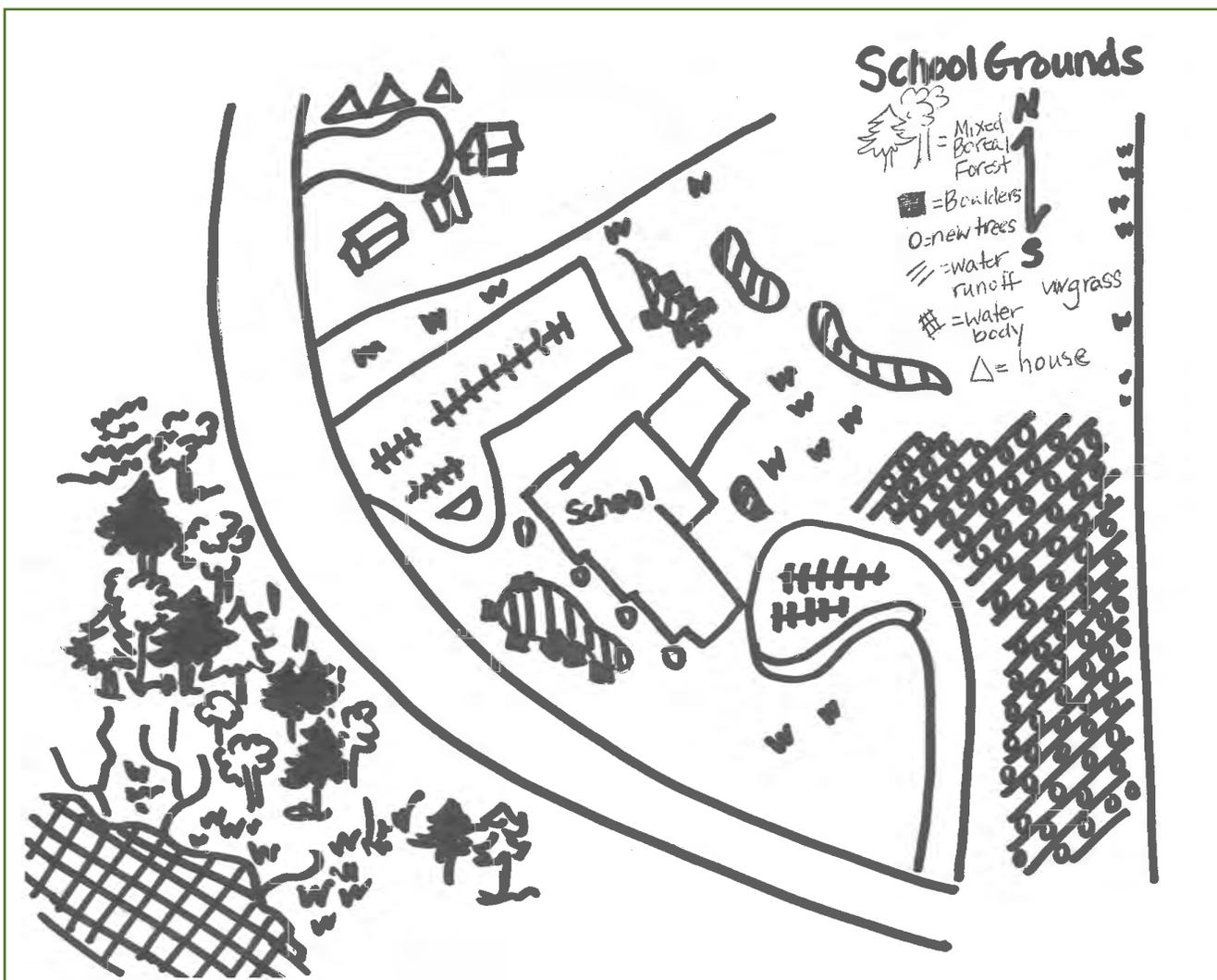
#### Suggested Classification of Habitat/Land Types:

- Grass/meadow—maintained
- Grass/meadow/shrub—not maintained (wild)
- Mixed trees/shrubs
- Forest—mostly coniferous
- Forest—mostly deciduous
- Forest—even mix of both coniferous and deciduous
- Wetland (marsh, muskeg, bog, fen)
- Sand/beach
- Agriculture/Farms
- Developed—Suburban (houses, some green space)
- Developed—Urban (little or no green space)
- Water—pond, lake, stream or ocean
- Tundra—tussocks, permafrost
- Rural—Small housing mixed with trees, shrubs, or tundra



2. As students enhance their maps, be sure they draw and label both natural and manmade features, while also labeling the habitat/land types of each area. Remind students to include a title, an approximate scale legend and the north arrow.
3. Discuss how much (percentage) of the area is developed land versus undeveloped land and what implications that has on suitable habitat and species biodiversity.
4. Once students have mapped the selected natural area, a master map can be created, incorporating information from all of the students. The master map may be created in digital mapping software programs like ArcGIS or with drawings on blueprint or butcher paper depending on available resources and depth level desired.

## Example of Student-Created Map



**Option B:**  
Teams Mapping  
Different Sections  
of the School  
Grounds

**Biodiversity Investigation**

1. The school site can be divided into sections, with different student pairs/teams assigned to each section. Students can add and label features such as trees and bushes, fill in the habitat types, and add other details.
2. An easy way to create a large master map is to project a copy of the school's site map onto a large piece of butcher paper or pieces of butcher paper taped together. If you are mapping an area other than your school site, you may want to find community land maps through your municipality or other local government office, or via the Internet.
3. Once the master map is created, lines can be drawn to divide it into sections, and it can be cut and distributed to each student team. Student pairs will conduct the vegetation and wildlife surveys in their section or plot as described in the next activity *Schoolyard Biodiversity Investigation*.

---

## Evaluation

- Student teams exchange maps with other teams and provide peer feedback about features of their maps including the use of legends, keys and habitat classifications.
  - Students should list their predictions of the types of species they would expect to see associated with habitat types. They can make a table with two columns. In the first column include plants, animals and birds they would expect to see. After making their predictions, they can use the second column to write in plants, animals and birds they actually encountered or observed.
- 

## Extensions

- A. Students may wish to alter their schoolyard ecosystem to invite or discourage certain plants or animals. See ***Can Do!*** in Section 3 for details on conducting a school project. Perhaps your schoolyard has been inundated with non-native plants. Or perhaps your schoolyard lacks avian visitors and residents. Lead a discussion of what kind of plants and wildlife your students want to have in their schoolyard.
- B. Students write or call community members, botanists, geologists and biologists for additional information.
- C. Write a proposal to school administrators for making changes to the schoolyard ecosystem. Include which kinds of plants will attract or discourage specific wildlife. If the proposal is approved, create an action plan using the U.S. Fish & Wildlife Services ***Schoolyard Habitat Project Guide***.
- D. You may want to create a longer-term citizen science project. Contact local, state and federal agencies to determine if you can add information from your schoolyard habitat to any existing scientific studies.



## Additional Resources

### Books

**Alaska in Maps: A Thematic Atlas.** Fairbanks: University of Alaska Fairbanks, 1998.

Sobel, David. **Mapmaking with Children: Sense of Place Education for the Elementary Years** Portsmouth, NH: Heineman, 1998. While geared for elementary grades, this is a valuable resource for all educators interested in place-based learning. It describes how to connect mapmaking with the developmental stages of the child.

### Online

Sobel, David. **Mapmaking from the Inside Out: The Cartography of Childhood**

[http://arts.envirolink.org/arts\\_and\\_education/DavidSobel2.html](http://arts.envirolink.org/arts_and_education/DavidSobel2.html)

This article discusses an approach to mapmaking that helps children develop a sense of place and a greater understanding for the world around them.

**Mapping Our World for ArcGIS Online**

<http://edcommunity.esri.com/Resources/Collections/mapping-our-world>

**My Maps Tutorial**

<http://earthecho.org/news/HOA-110414>

**Schoolyard Habitat Project Guide**

[www.fws.gov/cno/pdf/HabitatGuideColor.pdf](http://www.fws.gov/cno/pdf/HabitatGuideColor.pdf)

**Juneau Nature**

[www.juneaunature.org](http://www.juneaunature.org)

### Credit

The Schoolyard Biodiversity Investigation Educator Guide, Pacific Education Institute, Seattle, WA. 2010.



TARGET  
GRADES  
6–8

DURATION  
2  
Sessions

GROUP SIZE  
Whole  
Class



## LESSON 3

# Schoolyard Biodiversity Investigation

### LESSON OVERVIEW

Students set up plots to determine vegetation and wildlife abundance and biodiversity.

*“Great for a small group, the entire school or even a community.”*

**SUBJECTS** Science, language arts, physical education, math

**SKILLS** Describe, compare, comprehend a concept, apply a skill, analyze, synthesize and evaluate data.

**SETTING** Outdoors in schoolyard or nearby natural area. It is preferable to conduct the vegetation survey when plants are growing.

**TERMS TO KNOW** Plot, transect, biodiversity, monoculture, living, factor, non-living, descriptive, comparative, home range

### STATE STANDARDS

Math: Statistics & Probability  
6.SP.1; 6.SP.1; 6.SP.2;  
6. SP.5.a; 6. SP.5.b; 7.SP.1  
Physical Education  
8.E.1-2.; 8.E.1.

### NGSS STANDARDS

MS-LS2-1; MS-LS2-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem;  
MS-LS4-D Biodiversity and Humans

### GUIDING QUESTIONS



What is biodiversity?  
Why is biodiversity important?  
How can we measure biodiversity?



### MATERIALS

- Vegetation Survey data sheet
- Wildlife Survey data sheet
- clipboards
- tape measures
- stopwatches
- thermometers
- string
- wooden stakes
- flagging or 1–2 meters of plastic tubing
- a hula hoop or some other ‘frame’ to delineate the survey
- Ecology cards for trees and plants or other identification guides for plants in Alaska.

## OBJECTIVES

- Students will determine which factors support life in their schoolyard.
- Students will investigate the biodiversity of plants and animals in habitats surrounding their school.
- Students will determine the habitat needs their schoolyard provides to wildlife.



## ALASKA WILDLIFE CURRICULA COMPLIMENTARY ACTIVITIES

- *Mapping School Grounds* (use with Section 1, Lesson 2)
- *How Many Animals Live Here?* (AWC Future, 2nd ed)
- *Investigating Living Things and their Habitats* (AWC Ecology)

## Supporting Information

### Insights and Background:

- *Biodiversity & Populations—Alaska’s Dynamic Wildlife*
- *Wildlife at a Glance: What Does Wildlife Mean?*
- *Habitat—Basis for Survival*



data in different sections to determine which kinds of plants are present and how many of each variety exist.

For a **comparative investigation**, the students should choose two sites that they think have the greatest potential biodiversity and then compare and contrast these two locations in terms of the type of species present or simply the abundance of one plant in particular and how it varies between sites.

- Describe the general area, the study site, and the plot size and shape to the students. Square plots are recommended, but the size will vary depending upon the school site and the type of study/ investigation being conducted. If comparing two sites, the plots should be the same size. Students can measure plots by using paces, pre-measured string or tape measures. To designate each plot, pencils or wooden stakes with ribbon or flagging tape tied to one end can be used to mark each of the 4 corners. You may also use a hula-hoop. However, with square plots it is easier create quadrants and estimate percentages.

**NOTE:** If you plan to compare the school site to other locations, you may want to keep in mind that 1-tenth of an acre would be a square plot with 66-foot sides. While this can be too large an area for students to work with, it can be used to inform an appropriate plot size.

- In the classroom, take the students through the data collection process. It can be helpful to have students actually fill out a **data sheet**. To conserve paper, this step can be done in small groups or as a class. (**NOTE:** The Vegetation Survey is much easier to complete outdoors when students first practice and understand how to fill out the boxes, etc.)

Once students are comfortable filling out the data sheets, provide them with fresh/clean copies and have them fill out the basic information at the top of the data sheet, including name, school, date, the investigation question, their prediction/hypothesis (if desired), the site location (where it is on the school grounds), and plot size.

- Outside, students record the current weather by entering the temperature and circling the proper descriptions on the data sheet. (If each student team takes a thermometer with them, it should remain in the study area/outside for at least five minutes before reading. For consistency, determine with the class where the thermometer should be placed—such as on the ground, hung from a tree or held by a student.)
- Students should create their plots. If surveying the entire school grounds, plots should not overlap and gaps between plots should not exist.
- Once plots are established, students should document the number of different types of plants and total numbers of plants (estimating the total coverage within the plot area) on their data sheets using tally marks.
- Students return to classroom upon completion of data collection.

## Step 2 Wildlife Ecology Data Sheets

During this step, students will look for wildlife and/or signs of wildlife on the school grounds, typically within the same plots that were established for the vegetation study. The variety (different types) and abundance (amount) of wildlife help determine an area's biodiversity.

Before going outside:

1. Discussions and activities related to animal identification can be helpful. While students do not need to know the names of animals, being familiar with animal signs can be helpful. Consider using track, scat and browse identification tools for this activity.
2. Practice using the Wildlife Ecology Data Sheets.
3. Work with your students on the proper way to observe wildlife—quietly and calmly. The less they make their presence known, the more likely they are to see live critters! Remember to practice safe wildlife interactions. To learn more: **Wildlife Viewing Safety Recommendations.** [www.adfg.alaska.gov/index.cfm?adfg=viewing.tips](http://www.adfg.alaska.gov/index.cfm?adfg=viewing.tips)

### Student Instruction Sheet

4. If students have completed a vegetation survey, they will return to the same area observed for that survey to conduct the wildlife survey. (If students are conducting the wildlife survey first, see steps below starting with number 5.)
5. Before students leave the classroom, they should fill out the basic information at the top of the data sheet, including name, school, site location (where it is on the school grounds), date, survey beginning time, length of wildlife observation and number of observations the students should conduct.

Students should also determine the location(s) where they will make their stationary observation(s), marking the location(s) on the master map, if desired.

6. Once outside, students will QUIETLY and CALMLY walk to their sites, find their stationary observation location and sit down (if the ground is wet, trash bags or student-made sit-upons can be used as seats).
7. Students then record the current weather and temperature.
8. While sitting, students conduct the first (or only) observation for the designated length of time. As wildlife observations are made, students record findings on the data sheet.
9. Once the (first) stationary observation is complete, students continue to stay QUIET and CALM while moving to a second location within the site, if needed. As second and/or third stationary observations are conducted, students will continue to add to their data sheets.
10. After stationary observations are completed, students may QUIETLY and CALMLY move around the site, looking for other

animals or signs of animals. Remind them that other students may still be conducting stationary observations. Students use the second page of the *Schoolyard Biodiversity Wildlife Study* data sheet to record their findings.

11. Students return to classroom upon completion of data collection.

---

## Evaluation

- Students will use their data to describe the area sampled including species diversity and plant abundance related to their original research question. Students can use oral or written presentation media to present their data to the class and be prepared to discuss it.
- Students develop descriptive or comparative questions related to observations made while conducting the two different surveys. Time permitting, the students' questions could be developed into long-term field investigations or science fair projects.

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## Extensions

- A. Compare habitats along a line. Stretch a 100-foot-long rope "line transect" so that it crosses two habitats. Students walk along the transect and list all the species they see within 6 inches of the line (students can use a small ruler to check the distance). Use field guides to identify unknown species or make descriptive notes to research species back in the classroom. Review the transect data to determine which plants and animals are found in both habitats and which are only found in one or the other.
- B. Focus on local animals. Discuss whether common local animals have specialized habitat requirements. Discuss their abilities to travel, or disperse to other areas of similar habitat. Can they travel feet? Yards? Miles?
- C. Learn local plant knowledge. Invite a bilingual teacher, elder or knowledgeable community member to teach plant names and traditional uses in different languages and cultures.
- D. Expand on local habitat types. Discuss how different habitat types could meet the habitat requirements of different animals, using local examples.
- E. Conduct field investigations from student generated questions. To learn more: ***Field Investigations: Using Outdoor Environments to Foster Student Learning of Scientific Processes***, [www.fishwildlife.org/files/ConEd-Field-Investigations-Guide.pdf](http://www.fishwildlife.org/files/ConEd-Field-Investigations-Guide.pdf)



## Additional Resources

### Books

Armstrong, Robert. *Alaska's Fish: A Guide to Selected Species*. Anchorage: Alaska Northwest Books, 1996.

Armstrong, Robert. *Alaska's Birds: A Guide to Selected Species*. Anchorage: Alaska Northwest Books, 1994.

Smith, Dave. *Alaska's Mammals: A Guide to Selected Species*. Anchorage: Alaska Northwest Books, 1995.

Viereck, Leslie and Elbert L. *Little, Jr. Alaska Trees and Shrubs*. Fairbanks: University of Alaska Press, 1986.

Patent, Dorothy Hinshaw. *Biodiversity*. New York: Clarion, 1996.

Schofield, Janice. *Discovering Wild Plants: Alaska, Western Canada, the Northwest*. Anchorage: Alaska Northwest Books, 1989.

Pratt, Verna E. *Field Guide To Alaskan Wildflowers*. Anchorage: Alaskakrafts, 1989.

Alaska Geographic Society. *Mammals of Alaska*. Anchorage: Author, 1996.

Heller, Christine A. *Wild Edible and Poisonous Plants of Alaska*. Fairbanks, AK: Cooperative Extension Service, University of Alaska, 1993.

### Online Resources

#### Alaska Wildlife Notebook Series

[www.adfg.alaska.gov/index.cfm?adfg=educators.notebookseries](http://www.adfg.alaska.gov/index.cfm?adfg=educators.notebookseries)

#### Alaska Biological Science Center

<http://alaska.usgs.gov/index.php>

#### Alaska Natural Heritage Program

<http://aknhp.uaa.alaska.edu>

#### Animal Diversity Web

[animaldiversity.ummz.umich.edu](http://animaldiversity.ummz.umich.edu)

#### Credit

The Schoolyard Biodiversity Investigation  
Educator Guide by the Pacific Education  
Institute, Seattle, WA. 2010.



# Student Instructions for Wildlife Survey

Remember: If you want to see and hear wildlife, **BE STILL AND QUIET!**  
(Remember your wildlife safety rules!)

Once you are outside, **QUIETLY** and **CALMLY** walk to your stationary observation location and sit down.

1. Record the current weather. If necessary, wait five minutes before recording the temperature. (Remember to place the thermometer where your class determined).
2. While sitting, set your timer for the stationary observation time. Start the timer and begin making observations, recording your findings on the front page of your Schoolyard Biodiversity Wildlife Survey data sheet.
3. Every time you see or hear a species of animal:

**ON SITE** (within the boundaries of the plot):

- If it is the first time you have seen or heard this animal, place a tally mark in the column labeled TOTAL Number of DIFFERENT SPECIES of Animals ON SITE. If you don't know the name of the animal/bird, give a brief description or take a photo to look up later.
- Then place a tally in the correct ON SITE column under the TOTAL Number of ALL Animals for that first animal seen or heard.

**OFF SITE** (outside the boundaries of the plot):

- DO NOT place a tally in the left-hand column labeled TOTAL Number of DIFFERENT SPECIES of Animals ON SITE.
  - DO Place a tally in the correct OFF SITE column under the TOTAL Number of ALL Animals for that animal seen or heard.
  - **HANGING OUT:** An animal is considered hanging out if it is sitting, standing or crawling/ slithering/running but generally staying in an area.
  - **PASSING THROUGH:** An animal is considered passing through if it is flying over or moving so far away it disappears into the distance.
4. Once your (first) stationary observation is complete, stay **QUIET** and **CALM** and complete the total number of stationary observations listed on your sheet.

5. You may now walk **QUIETLY** and **CALMLY** around the site, looking for other animals or signs of animals. Be sure to describe your findings with enough detail that you will be able to write about them later.

- **REMEMBER:** Other students may still be conducting stationary observations. DO NOT DISTURB other groups.
- Don't just look down at the ground. Look up in the trees, behind bushes and even under rocks. Just remember—you're messing with somebody's home!
- **ALWAYS** be gentle and put things back the way you found them. (DO NOT completely lift large rocks. You may roll them up and look below IF it is OK with your teacher. When placing a rock back down and there are insects or other animals in its space, put a small rock towards the edge of the space and lower the larger rock down on it gently. This will ensure animals have room to move and not get squished!)
- Accurately record where you find evidence of wildlife (on or off site) by placing a tally mark in the proper column each time you find something different. For example:
  - An ongoing trail of the same-sized animal tracks = one tally mark
  - More than one cluster of animal tracks or trails of animal tracks of different sizes = more than one tally mark (each cluster or different size of track = one tally mark)
  - The remains of an animal (including bones); a cluster of feathers or tuft of fur; or something similar = one tally mark each
  - A clump of scat = one tally mark
  - If you find something that is not on the data table, such as scratches on trees, thoroughly describe it in the 'Other' section.

6. Once you have completed the wildlife survey, return to your classroom.

# Schoolyard Biodiversity Wildlife Survey

Student Name \_\_\_\_\_ Date \_\_\_\_\_

Name of School \_\_\_\_\_ Site Location \_\_\_\_\_

Question \_\_\_\_\_

Hypothesis \_\_\_\_\_

Survey Timing      Beginning Time \_\_\_\_\_ am/pm      Ending Time \_\_\_\_\_ am/pm

Stationary Observation(s) \_\_\_\_\_ min.      Number of Times to Sit/Observe \_\_\_\_\_

Current Weather      Temperature \_\_\_\_\_

(circle all that apply)

Clear      Scattered Clouds      Complete Cloud Cover      Rain      Wind: calm breezy gusty

Wildlife Seen or Heard	TOTAL Number of DIFFERENT SPECIES of Animals ON SITE	TOTAL Number of <b>ALL</b> Animals Seen or Heard:			
		On SITE		Off SITE	
		Hanging Out	Passing Through	Hanging Out	Passing Through
Birds					
Mammals					
Reptiles or Amphibians					
Insects or Spiders					

# Schoolyard Biodiversity Wildlife Survey

Evidence of Wildlife	Description What does it look like? Where exactly was it found?	Total Number	
		Found On Site	See Off Site
Scat			
Tracks			
Feathers			
Fur			
Nests			
Chewed Food			
Other (bones, scratches, ruts, etc.)			

# Schoolyard Biodiversity Vegetation Survey

Student Name \_\_\_\_\_ Date \_\_\_\_\_

Name of School \_\_\_\_\_

Question \_\_\_\_\_

Hypothesis/Prediction \_\_\_\_\_

Site Location \_\_\_\_\_ Plot Size (if needed) \_\_\_\_\_

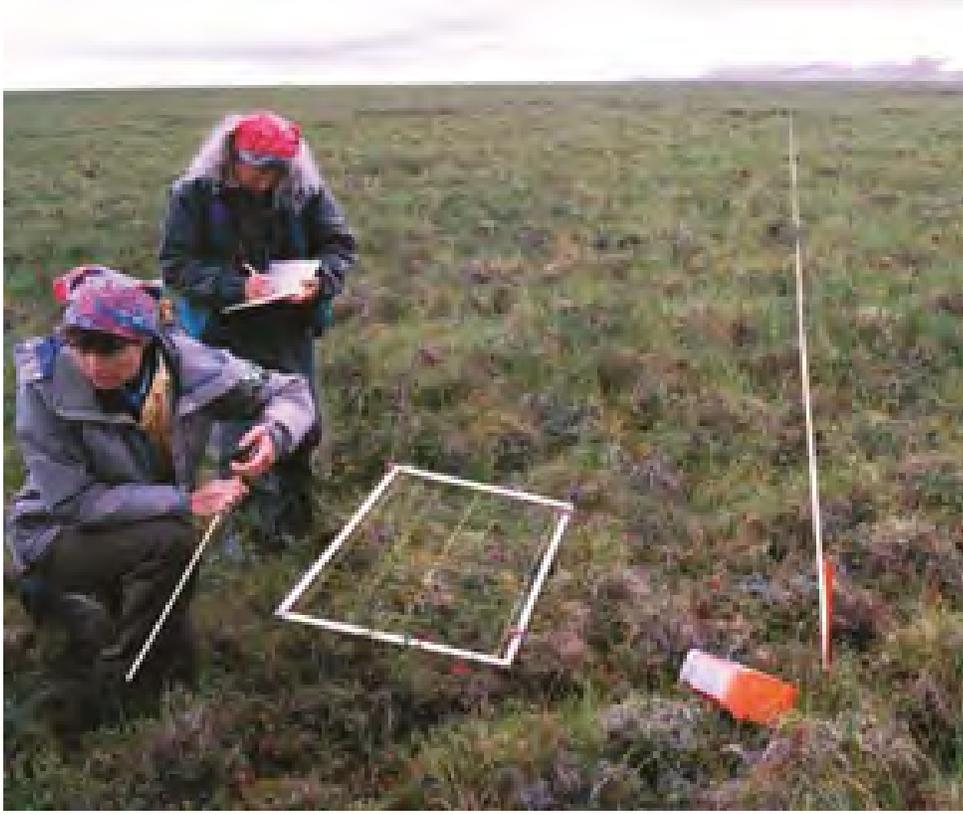
Current Weather Temperature \_\_\_\_\_ F° or C°  
(circle all that apply)

Clear    Scattered Clouds    Complete Cloud Cover    Rain    Wind: calm breezy gusty

Item/Type	Description	TALLY of DIFFERENT SPECIES of Plants	TALLY of ALL Plants Found or Percentage of Area Covered			
			Less Than 50 (COUNT AND GIVE A NUMBER)	Between 51 and 100 (GIVE AN ESTIMATE)	More than 101 (GIVE AN ESTIMATE)	Percentage of Coverage (WHEN TOO MANY TO COUNT)
*If none, X through and skip to the next Item/Type.						
Grass mowed lawn/grass						
Meadow or tall grass (not mowed)						
Flowers (annuals or perennials: not bushes or trees)						
Thick Ground Cover (outer edges less than 12" apart and less than 12" tall)						

Item/Type	Description	TALLY of DIFFERENT SPECIES of Plants	TALLY of ALL Plants Found or Percentage of Area Covered			
			Less Than 50 (COUNT AND GIVE A NUMBER)	Between 51 and 100 (GIVE AN ESTIMATE)	More than 101 (GIVE AN ESTIMATE)	Percentage of Coverage (WHEN TOO MANY TO COUNT)
*If none, X through and skip to the next Item/Type.						
	Thick brush and bushes (outer edges less than 12" apart, more than 12" tall)					
	Loosely spread out shrubs or bushes (outer edges more than 12 inches apart)					
	Trees (spread out/ not close together; planted in separate areas, etc.)					
	Wooded area (forest; trees growing in a group/close together)					
	Fungus, Mosses or Lichens					







TARGET  
GRADES  
6–8

DURATION  
2–3  
Sessions

GROUP SIZE  
Whole  
Class



## LESSON 4

# In Harmony with Habitat, Feeding Adaptations for Birds

### LESSON OVERVIEW

Students collect food using different utensils to illustrate adaptations. They will then learn about Alaska birds and determine which species might be found in their schoolyard habitat.

**SUBJECTS** Science, language arts, physical education

**SKILLS** Describe, compare, comprehend a concept, apply a skill, analyze, synthesize and evaluate data.

**SETTING** Part 1: outdoors on a field or open space; Part 2: indoors; Part 3: outdoors in a natural area nearby school

**TERMS TO KNOW** Trait, population, variation, heredity, competition, adaptation, natural selection

### STATE STANDARDS

Language Arts: Science Language  
SL.6.1b; SL.6.1c; SL.6.1.d;  
SL.7.1.b; SL.7.1.c; SL.7.1.d;  
S.L.8.1b; S.L. 8.1c; SL.8.1.d;  
SL.6.4; SL.7.4; SL.8.4

Math: Statistics & Probability  
6.SP.1; 6.SP.5.a; 6.SP.5.b; 7.SP.1;  
8.SP.1; 8.SP.2

Math: Expressions & Equations  
6.EE.9

Physical Education  
8.E.1.; 8.E.2; 8.E.3

### NGSS STANDARDS

Ecosystems, Interactions,  
Energy and Dynamics:  
MS-LS2-1; MS-LS4-6

### MATERIALS

#### PART 1

- 3 pounds of dried beans
- 25 of each: forks, spoons, knives
- Paper cups (one for each student)
- 1 stop watch
- 1 whistle
- Broom and dust pan for cleanup
- 3 copies of Bird Beak Data Sheets
- 3 clipboards with pencil tied to each

#### PART 2

- Beaks & Feet Worksheets

#### PART 3

- Alaska Ecology Cards
- Pencil
- GPS units and white or colored index cards 4 per group

## GUIDING QUESTIONS

How do physical traits make individual species more suited to their habitat?

What might happen to a species that is poorly adapted to its habitat?

Can species make adjustments to become better adapted to a given habitat? What kinds of changes are possible and how would they occur?

## OBJECTIVES

- Students will investigate physical characteristics of Alaska Birds to make assumptions about food and habitat needs.
- Students will look for appropriate habitat for various bird species in the schoolyard and/or a natural area nearby.



## ALASKA WILDLIFE CURRICULA COMPLIMENTARY ACTIVITIES

- *Habitat is Where It's At* (Section 1, Lesson 1)
- *Mapping Nearby Nature* (Section 1, Lesson 2)
- *Draw Your Tundra Animal* (Alaska's Tundra & Wildlife)
- *Animal Adaptations for Succession* (Alaska's Forests and Wildlife)

## Supporting Information

Organisms continually undergo physical and behavioral changes over time. Ever-adapting with their environment, organisms develop specialized characteristics that make them more suitable for survival. An adaptation is a trait that is very well-suited to a given environment that has, through natural selection, increased in the population over many generations.

There are several factors that influence these changes including variation (when different individuals have different traits within a population), heredity (when traits are passed on from parent to offspring through genes), and competition (when some individuals survive and reproduce more than others).

The end result is natural selection—over long periods of time, the individuals with the traits that best fit the environment are most likely to survive, reproduce, and pass on their traits to the next generation. In this way, future generations, when viewed at the level of an entire population, will have more advantageous traits and fewer disadvantageous traits compared to their parents.

In this activity, students come to understand natural selection based on having adaptations that are more or less compatible with their habitat. They will portray Alaska bird species with different beak traits.

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## LESSON 4

# In Harmony with Habitat, Feeding Adaptations for Birds



## Procedure

### PART 1

1. Make 3 copies of the “\_\_\_\_\_-Billed Bird Population Data” and fill in the blanks with “Fork,” “Spoon,” and “Blade.” Attach these data forms to clipboards.
2. Open with a discussion on what human traits might help a person be more successful doing their job. Take a basketball player. Is it more advantageous to be short or tall? Fast or slow? What about domesticated animals? Is there an advantage for a dog to be friendly? What does it mean to be more successful? Scientifically speaking, what matters in the long run is whether you survive, find a mate, and reproduce, passing on your genes to the next generation.
3. Introduce the activity. Tell the students that they will investigate a particular habitat where a certain type of food (beans) grows plentiful. They will become birds of three different species, each with a unique beak trait. Birds may be fork-billed, scoop-billed or blade-billed. Each year, the birds forage in their feeding grounds and try to eat as much as possible. For each year, the five birds that eat the most will reproduce and have babies with the same beak trait as their parent. The five birds that eat the least will die (but will be reincarnated as a baby bird of a different species).
4. Give each student a cup (stomach) and a utensil (beak). Quickly go over the rules before heading out to the feeding ground:

#### Rules

- All birds must wait outside the feeding grounds until the teacher blows the whistle.
  - Birds may only touch food with their beaks. No hands!
  - Food must make it into the stomach to count.
  - Stomachs may not touch the ground.
  - Do not hurt other birds or touch other birds’ stomachs.
  - When the teacher blows the whistle, all birds must immediately leave the feeding ground.
5. **Outside Prep:** Mark the boundaries of the feeding ground and sprinkle 300 beans within the boundaries. Place the 4 data clipboards in different locations near the feeding ground.
  6. Have students stand on the edge of the feeding ground, holding their cup in one hand and their utensil in the other. Blow the whistle and give students 20 seconds to “eat” as many beans as possible. Make sure students do not cheat by setting their cups on the ground. Blow the whistle again to signal the end of the year.
  7. Each student should go to the clipboard for their beak type, count the number of beans they ate, and enter

that information in the data table. Each group should calculate the total number of beans eaten by their group (bottom row of table).

8. Finally, all individuals will line up according to how many beans they ate. The five birds that ate the most will reproduce. The five birds that ate the least will die and come back to the next round as bird babies of those which reproduced.
9. Play five or more rounds, each round representing a year. Record the population data each time.

### Evaluation for Part 1

1. Indoors: Have students graph the data for each species with years one through five on the x-axis and the number of species along the y-axis. You might consider making a class graph.
2. Discuss the graph(s). Notice patterns such as one species population going up and another going down. See if the population is growing linearly or exponentially. Discuss reasons why one population did well while another did poorly. Is there a different scenario in which a different bird would do best?

### PART 2

1. A bird's beak and feet can tell us much about their habitat and lifestyle. If the habitat does not produce the type of food the birds' beaks can manage, they may not be as successful. Most birds are classified according to the structure of their beaks and feet.
2. Using bird species from the Alaska Ecology Cards and the Description and Function Table, make inferences about each bird's habitat and food choices.
3. Work through the Bird Beaks and Feet worksheet.

### PART 3

This part of the lesson can be conducted using GPS units (A) and/or colored index cards (B).

1. Break the class into groups of four. Allow each group to select a bird species from the Alaska Ecology Cards.
2. Give each group four blank index cards. Each group should have a different color if you are not planning to use GPS units; however, if you are using GPS units, all cards should be white. Ask the students to write each habitat component—food, water, shelter and space—on a card. Then, in their groups, read the Alaska Ecology Card out loud. Ask them to discuss the bird's habitat needs and predict whether or not the schoolyard is a suitable habitat. The groups should not share which bird species they chose with other groups, but they will report it to you.
3. Move outside to a natural area nearby to your school, ideally an area with multiple habitats (forested, muskeg, stream, pond, etc.).

#### A. Using colored index cards

With their unique color of index cards, tell the students they will have 15 minutes to identify habitat components for their bird species within the designated area.

When a group finds a component, they will place the appropriate index card at that location. Students should place their cards in an

inconspicuous way but not so hidden that they would be difficult to find. On the card, they should describe the habitat component, but they should not indicate what bird species they selected. For example, if a group selected the snowy owl and they find a small opening in the ground where small rodents have traveled, they would pull their food card and write the description from the Alaska Ecology Card: "Food. A lemming may be living in this tunnel." If a black-billed magpie were selected, the group might set their habitat card next to a spruce tree and write: "Habitat. This bird builds a domed stick nest in spruce trees." If a habitat component is not evident, ask the group to hold on to the card(s).

Ask the class to reconvene and hand you any extra cards. Now, without indicating the bird species chosen, assign each group a new color. Ask them to track down the remaining cards of that color which now have habitat clues written about a particular bird species. Once they have found and gathered the cards, ask them to return to the large group. Now, announce the possible species selected and ask each group to guess which bird's path they were following.

#### B. Using GPS Units (advanced instructions)

Spend some time familiarizing student with GPS device. What are they used for and how can we use them to help us mark areas of habitat that are important? Practice entering waypoints with the students and show them how to go back to those waypoints for navigation.

Hand each group a GPS unit and tell the students they will have 20 minutes to identify habitat components for their bird species in the designated area.

When a group finds a component, they will take a waypoint with their GPS and place the appropriate index card at that location. On the card, they should describe the habitat component, but they should not indicate what bird species they selected. For example, if a group selected the snowy owl and they find a small opening in the ground where small rodents have traveled, they would pull their food card and write: "Food. A lemming may be living in this tunnel." If a black-billed magpie were selected, the group might set their habitat card next to a spruce tree and write: "Habitat. This bird builds a domed stick nest in spruce trees." If a habitat component is not evident i, ask the group to hold on to the card(s).

Ask the class to reconvene and hand you the GPS units and any extra cards. You can keep track of which GPS unit was assigned to each group (and species), but don't let the students know. Give them a different GPS and ask them to track down each waypoint to habitat clues of a different bird species. Once they have found each waypoint and gathered cards, ask them to return to the large group. Given the species the class selected, have each group guess which bird's path they were on. Now announce the possible species selected and ask each group to guess which bird's path they were following.

### Evaluation PART 3

1. Back in the classroom, discuss whether the natural area you visited is suitable habitat for any of the selected bird species. If not, what was missing? If you broadened the space to include your whole community, would it be suitable habitat? Why or why not? Consider using the maps created in Lesson 2 of this section to notate habitat components found and add to the key.

\_\_\_\_\_ -billed Bird Population Data

**YEAR 1**

Number of birds at the start of year 1 \_\_\_\_\_

Name	Total Beans
<b>Grand Total</b>	

**YEAR 2**

Number of birds at the start of year 2 \_\_\_\_\_

Name	Total Beans
<b>Grand Total</b>	

**YEAR 3**

Number of birds at the start of year 3 \_\_\_\_\_

Name	Total Beans
<b>Grand Total</b>	

**YEAR 4**

Number of birds at the start of year 4 \_\_\_\_\_

Name	Total Beans
<b>Grand Total</b>	

**YEAR 5**

Number of birds at the start of year 5 \_\_\_\_\_

Name	Total Beans
<b>Grand Total</b>	

## Bird Beaks and Feet

Introduction: A bird's beak and feet can tell us a lot about their habitat and lifestyle. Most birds are even classified according to structural similarities between their beaks and feet. In this exercise, you will look at pictures of birds and make inferences about their lifestyles.

Description	Function
<b>Beaks</b>	
Short and rounded	Multipurpose, eating insects and seeds
Spear-shaped	Spearing fish
Chisel-shaped, flat and pointed	Drilling for insects
Flat and square-shaped	Straining algae
Long and fat, like a scoop	Scooping up fish
Hooked	Catching and tearing prey
Long and tubular	Sucking nectar from flowers
<b>Feet</b>	
Long, muscular legs	Running
Long, skinny legs	Wading
Short legs with blunt claws	Scratching, ground walking
Three toes in front, one behind	Perching
Webbed	Swimming
Large, hook-like claws (talons)	Grasping prey
Tiny, short legs	Hovering
Two toes in front, two behind	Climbing

## Bird Beaks and Feet Data Table

Bird	Type of Feet	Type of Beak	Probable Diet	Probable Habitat
Common Raven				
Ptarmigan				
Loon				
Bald Eagle				
Chickadee				
Sandhill Crane				
Belted King Fisher				
Short-Eared Owl				
Tern				
Rufous Hummingbird				
Three-toed Woodpecker				

### Analysis

What features of a hummingbird make it adapted for its style of feeding?

Imagine an ideal flying predator. What type of beak and feet would it have?

Different birds may have similar beaks and diets. Loons and kingfishers, for instance, both have long, sharp-pointed beaks for spearing fish. Their feet, however, are quite different. Describe how the loon, and kingfisher differ in the method by which they hunt for fish.

Owls have large eyes that enable it to see well at night. Both eagles and owls hunt similar things including small rodents. How do the hawk and the owl avoid competing with each other?

Ptarmigan have feathered legs and feet. How does this adaptation help them?

Examine the images of birds and write your inference about what the bird eats, and where it lives.



## Extensions

- A. Draw or find a picture of an animal in a suitable habitat. Identify and describe what the animal needs to survive, and show where and how its needs are met in the picture of their habitat.
- B. Have students explain in essay form how animals' features make them uniquely suited to their habitat and how this may or may not change over time. Have students use the activity to help support their answers.



## Additional Resources

### Books

Collard III, Snead (author); Brickman, Robin (illustrator). **Beaks!** (2002).

### Media

**The Biology Corner.** Biology lesson plans, worksheets, tutorials and resources for teachers and students.

[www.biologycorner.com/worksheets/beaks\\_feet.html](http://www.biologycorner.com/worksheets/beaks_feet.html)

### Credits

Adapted from the following resources:

Salter, Irene. **Bird Beak Buffet. My Science Box Lesson Plan.**

[www.mysciencebox.org/birdbeak](http://www.mysciencebox.org/birdbeak)

Licensed under the Creative Commons Attribution Non Commercial License.

**Bird Beaks and Feet**

[www.biologycorner.com/worksheets/beaks\\_feet.html](http://www.biologycorner.com/worksheets/beaks_feet.html)







TARGET  
GRADES  
6–8

GROUP SIZE  
**Whole Class or  
Small Groups**

DURATION

**Several sessions**  
other lessons can be added  
to this culminating activity



## LESSON 5

# The Habitat Times

### LESSON OVERVIEW

Students write stories about an animal's habitat needs and experiences and make a class newspaper to summarize their findings using desktop design software or downloading a newsletter template from any online resource.

*“A great way to integrate writing that demonstrates understanding, technology and publishing skills.”*

**SUBJECTS** Language arts, science, social studies

**SKILLS** Research, write, develop vocabulary, work in a team, recall knowledge, comprehend a concept, apply a skill, analyze, synthesize and evaluate information.

**SETTING** Indoors

**TERMS TO KNOW** Species names, habitat, article, predators

### STATE STANDARDS

Language Arts: Writing

W.6.3.a; W.6.3.b; W.6.3.c; W.6.3.d;  
W.6.3.e; W.7.3.a-e; W.8.3.a-e; W.6.4;  
W.7.4; W.8.4; W.6.5; W.7.5; W.8.5;  
W.6.6; W.7.6; W.8.6

### NGSS STANDARDS

Ecosystems, Interactions,  
Energy and Dynamics  
MS-LS2-5

### GUIDING QUESTIONS



What are the habitat requirements for some of Alaska's Wildlife?  
How do humans impact wildlife habitat? For better? For worse?

### OBJECTIVES

- Students will describe the habitat requirements of Alaska wildlife.
- Students will describe the impact of human actions on wildlife habitat.
- Students will develop written communication skills.



### MATERIALS

- chart paper
- writing materials
- paper





## ALASKA WILDLIFE CURRICULA COMPLIMENTARY ACTIVITIES

- ***Habitat is Where It's At*** (Section 1, Lesson 1)
- ***Mapping Nearby Nature*** (Section 1, Lesson 2)
- ***Habitat Grid*** (Alaska Wildlife for the Future 1st ed.)
- ***Interview a Muskox*** (Alaska Wildlife for the Future 1st ed.)
- ***Habitat Roulette*** (Alaska Wildlife for the Future 2nd ed)
- ***Ecology Cards***

## Supporting Information



***Habitat Basis for Survival***

***Biodiversity and Populations***



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## Evaluation

Have students read the paper and determine whether the correct habitat requirements are addressed in each story.

Have students compile the stories into a classroom newspaper or magazine and distribute via print or electronically to parents.

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## Extensions

- Use knowledge to write book reviews. Students read books about Alaska wildlife and write book reviews.
- Draw habitat maps. Students draw maps showing the different elements of the animal's habitat and research range maps illustrating where in the populations live in Alaska.



## Additional Resources

### Books

Alaska Geographic Society. ***Alaska's Bears***. Anchorage: Author, 1993.

Sherwonit, Bill. ***Alaska's Bears: Grizzlies, Black Bears and Polar Bears***. Anchorage: Alaska Northwest Publishers, 1998.

Armstrong, Robert. ***Alaska's Birds: A Guide to Selected Species***. Anchorage: Alaska Northwest Books, 1994.

Armstrong, Robert. ***Alaska's Fish: A Guide to Selected Species***. Anchorage: Alaska Northwest Books, 1996.

Smith, Dave. ***Alaska's Mammals: A Guide to Selected Species***. Anchorage: Alaska Northwest Books, 1995.

Geographic Society. ***Mammals of Alaska***. Anchorage: Author, 1996.

### Online

Alaska Department of Fish and Game. ***Alaska Fish & Wildlife News***  
[www.adfg.alaska.gov/index.cfm?adfg=wildlifeneews.main](http://www.adfg.alaska.gov/index.cfm?adfg=wildlifeneews.main)

Alaska Department of Fish and Game. ***Living with Wildlife***  
[www.adfg.alaska.gov/index.cfm?adfg=livewith.main](http://www.adfg.alaska.gov/index.cfm?adfg=livewith.main)

Alaska Department of Fish and Game. ***Alaska Wildlife Notebook Series***  
[www.adfg.alaska.gov/index.cfm?adfg=educators.notebookseries](http://www.adfg.alaska.gov/index.cfm?adfg=educators.notebookseries)

# SECTION 2

## Population Dynamics

### LESSON 1

How Many Animals Live Here?

### LESSON 2

Mark and Recapture

### LESSON 3

Graphic Populations

### LESSON 4

Happy Hunting

### LESSON 5

How Many Bears Can Live in this Forest?

### LESSON 6

Muskox Defense Mechanisms





TARGET GRADES  
6–8

GROUP SIZE  
Pairs

## LESSON 1

# How Many Animals Live Here?

DURATION  
Inside/Part 1: **30–45 min.**  
Outside/Part 2: **30–45 min.**  
(over multiple days)



### LESSON OVERVIEW

Students estimate population sizes by counting animals in sample areas.

*“Try setting the grid up with tape on a table top. Students can begin each class period with their population estimates of a species to reflect changes over time to create a trend.”*

**SUBJECTS** Science, math

**SKILLS** Describe, compare, comprehend a concept, apply a skill, analyze, synthesize and evaluate data.

**SETTING** Part 1: gym or larger floor space; Part 2: school yard or designated area

**TERMS TO KNOW** Survey, census, variation, population

### STATE STANDARDS

Math: Number System, Statistics and Probability, Inference and Justifying Conclusions

6.NS.2; 6.SP.1; 6.SP.2; 7.SP.1; 7.SP.2; 6.SP.5.a;

6.SP.5.b; 6.SP.5.c; S-IC.1.; S-IC.3.; S-IC.4.

Physical Education: Social Behavior that respects self.

8.E.1; 8.E.2; 12.E.1; 12.E.2

### NGSS STANDARDS

Ecosystems, Interactions, Energy and Dynamics

MS-LS2-1; HS-LS2-1; HS-LS2-2

### GUIDING QUESTIONS



How are animals counted?

How might seasonal movements impact counting?

Do we count every animal in a population or make estimates?

### MATERIALS

#### Indoors

- large open area
- beans
- popsicle sticks
- popcorn, or other objects that are easy to see, count, and clean up
- measuring sticks
- paper and pencils
- poster paper

#### Outdoors

- collecting equipment appropriate for the area (for example, a bottom scraper for ponds or lakes and a net strainer or old nylon stockings or panty hose for surface water collection)
- white collecting trays or containers
- trail cameras for terrestrial animals
- binoculars for birds, cameras
- marker sticks at least 1/2 meter long
- clipboard
- paper and pencils
- poster paper, numbers on small pieces of paper 1–36



## OBJECTIVES

- Students will practice the act of surveying a population in a controlled (inside) area, then:
- Students will count the population of animals in a small outside area.
- Students will estimate the size of the population over a larger area.



## ALASKA WILDLIFE CURRICULA COMPLIMENTARY ACTIVITIES

- **Habitat is Where It's At** (Section 1, Lesson 1)
- **Schoolyard Biodiversity Investigation** (Section 1, Lesson 3)
- **Population Dynamics** (Section 2)

## Supporting Information

### **Biodiversity and Populations**

#### **Alaska's Dynamic Wildlife** (fact sheets):

*Microhabitats & Biodiversity*

*Ideas for Collection & Field Trip Sites*

#### **Especially Wildlife Populations**

#### **New Counting Wildlife Background Sheets**

**NOTE:** Doing this activity in the classroom with objects such as beans or popcorn first will help students learn the concept and help them to understand the difference between a controlled environment and an outdoor environment. It will also allow them to think more analytically about the challenges of counting wildlife in outdoors- i.e. can we assume that individuals of a population are spread evenly throughout a study area? Why or why not? Is all habitat of equal quality in your count area? Do animals have seasonal movements? Are they all visible at the time you are counting? What time of year is it?

1. Create a population in the classroom or gymnasium using beans, popsicle sticks, popcorn, or similar items.
2. Tell the students that they will become wildlife managers who need to know the size of a wildlife's population this year, in order to know if it is increasing, decreasing, or stable.

Before the activity begins, ask students to estimate how many pieces are on the playing field just by looking at the field.

3. Explain that each group will count the animals in a small area to get an idea of how many might be in the entire area (you can explain that the area is too large and there is not enough time or resources to count every animal). In other words, students will conduct a census in a small area, which is a sample of the entire area. Then they will estimate the population in the larger area using the method listed below.

It helps them to understand why they can't count every animal in every unit. Have them imagine they are counting moose. Each unit measures 2.5 miles by 2.5 miles. They have to fly in an airplane over the sampling unit., but it's expensive and takes a long time to cover the area thoroughly counting every moose. Counting must also be done in winter when snow covers the ground (and the days are short) so moose are visible. Refer to the area photo (where is it located?) of caribou spread out over several miles. See if they can estimate how many caribou are in the photo.

## LESSON 1

# How Many Animals Live Here?



## Procedure (Indoors)

1. Ask students to estimate the total number of the item you chose to use (beans for example) in a jar before the activity begins.
2. Mark off an area about 6x6 feet. (This is an example but it can be any size).
3. Using masking tape create a grid of 1x1 foot squares. Students could be engaged to create this grid.
4. Take a jar of beans (corn, popcorn, etc)—you must know the actual number but keep it secret for now. The beans will represent animals on the ground.
5. Spread the beans around the entire grid. It does not matter if they are evenly spread or not (we will discuss this during the lesson).
6. Ask the students how they can estimate the number of beans in the entire grid without having to count every bean.
7. Can they sample a unit and then estimate the number of beans in the entire area? Why or why not? (If animals occupied every unit equally this would work, but discuss with students how that is rarely the case).
8. Divide the class into small groups. Explain that each group will count the animals in a small area to learn how many might be in the entire area. In other words, students will conduct a census in a small area, which is a sample of the entire area.
9. Give each group paper, pencils, and a clipboard to record their census data.
10. Have each group randomly select a number from 1-36 (pull numbers from a bag). This will be the grid number for their sample unit. Have each group count the animals in the unit that they selected. Then ask them to estimate the number of animals in the entire area by multiplying their count by 36. Record this number in a table.

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36

11. Each group selects another random number and counts all the animals in that sample unit. Now have them add their first and second count together, divide by two, and then multiply  $\times 36$ . What is their estimate this time?
12. Repeat this until the group has five or more random samples of the large area and a new estimate after each sample.
13. Reveal the total number of animals to the group and compare their results with the true number.

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## Evaluation

Have students answer the following questions based on their sampling.

- How close did your group come to the real number on any one of your samples?
- Did the average of the samples get closer to the real number each time you added another sample?
- Do you think that if you kept sampling your estimate would get closer to the real number? (Probably, since you were closer to counting all the animals)
- Were the beans spread evenly throughout the entire area?
- Did anyone accurately guess how many beans were in the jar at the beginning of the activity?
- Why would guessing be an inappropriate method for counting wildlife?

Now use the image of the caribou included in this activity and repeat the activity. Approximately how many caribou are in this image?

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## Extensions

- A. In real situations, wildlife biologists know that animals are spread unevenly across the landscape. There is variability in habitat quality, seasonal movements, man-made structures, and behavioral distributions. As a result, there are areas of high, medium, and low concentrations of animals even in one study area. To compensate for this variation, biologists determine areas of high, medium, and low concentrations. Then they sample from each of those areas to average out the variation.
- B. Your students can try this—take samples from a mixture of high concentrations and low concentrations and see how their samples average out against the true number.

## LESSON 1

# How Many Animals Live Here?



## Procedure (Outdoors) Uncontrolled census

IN ADVANCE, select a field trip site (see INSIGHTS Section 4: *Ideas for Collection & Field Trip Sites* fact sheet).

Determine the collecting equipment you will need to collect the animals of choice, including plot marking equipment.

1. Divide the class into small groups. Explain that each group will count the animals in a small area to learn how many might be in the entire area. In other words, students will conduct a census in a small area, which is a sample of the entire area. Encourage students to repeat their procedure for collecting data in the same method to create consistency, which results in greater accuracy of the census. By doing so, they are eliminating variability (errors) in the technique.
2. Identify the boundaries of the study site (pond, lake, rock outcrop, open field, beach, pile of leaves, stump, etc., etc.). Prior to sampling, have students name several animals they are likely to encounter in their census. Use the Alaska Ecology cards to help with this. Ask the students to guess how many animals of different types are in the area they are sampling.
3. Have students brainstorm and then determine the method they will use to count their population of animals. Animals may be hard to see or find. Counting each one may be very time-consuming and difficult. Help them think about/problem solve the challenges of being sure they have really caught or counted all the animals. Have students submit a written plan for sampling prior to beginning that is approved by the teacher.
4. Discuss with students why they would not want to change habitat (such as draining the pond to count the fish, digging up an anthill to count the ants) in order to count animals.
5. Give each group paper, pencils, and a clipboard to record their census data. Demonstrate how to use the marker sticks to outline a square sample area. Use the stick with the half-meter mark on it to measure each side of the square. Mention that each team's sample area should be at least a meter away from any other team's sample area.
6. Teams begin their census. If they are working in a pond, stream, or area of soil, students scoop bottom sediment inside the sample area to a depth of approximately 1 inch. They should rake the scoop in straight rows until the entire area is uncovered to a depth of 1 inch. The scooped sediment is emptied into a strainer and rinsed to strain out mud. The leftover scrapings are then placed in observation trays.
7. Students will draw a picture of each type of animal they observe. Students should write the number found next to the picture.
8. Reunite the groups. Give the teams a few minutes to share their discoveries. Ask them whether they would change their guess about how many animals of a certain type lived in the area.
9. For older students: Ask them to guess how many samples would be needed in order to count all of the animals in the population you are looking at. Would it be 10 times or 100 times or 1,000 times? To estimate the size of the population, students multiply the number of a species they found (for example: six water striders) by the number of samples they would need to cover the population's area (for example:

an area of 4 square meters would require 64 1/2 meter square samples). The population would be 6 x 64, or 384 water striders.

10. Return collected organisms to their habitat. Explain the importance of keeping the animals in a healthy environment while sampling and why they should be returned as soon as possible.

## Evaluation

- Use poster paper to list the species and census numbers Census Collection Grid.
- Encourage a discussion. How many species of animals were found? Which species were most numerous? Which were least numerous? Why did each team catch different types and numbers of species? (Some possible explanations are differences in sample areas, unevenness of distribution of organisms, differences in counting and scooping techniques).
- Write population on the chart and arrive at a class definition. Emphasize that a population includes only one type of animal or species.

Have students make and illustrate a "population" presentation (book/poster/ PowerPoint), using their data or numbers in sequence from steps 1 through 10 and the names of the animals in the study area. "This is the population of \_\_\_\_\_(number) \_\_\_\_\_(name of animal) in \_\_\_\_\_(name of habitat)." For example, "This is the population of 10 moose in the forest." Have students draw the population of the animals in their habitat on each page.

## Extensions

- Research local wildlife populations.** Students will research local wildlife populations. Contact the Alaska Department of Fish and Game office in your area for population data on a species of interest to students. Invite wildlife biologists, local experts, or long-term residents and Native elders into the classroom to share their knowledge. They may be willing to lead or assist on a field trip. What is the value of intrinsic observation compared to scientific research?
- Census organisms in schoolyard.** Students brainstorm ways to census or estimate highly visible organisms in the schoolyard (types of plants, insects, spiders, animals that leave tracks, birds that come to a feeder, etc.). As you discuss these, be sure to emphasize the difference between a census and an estimate (see background information).
- Compare in another season.** Students can conduct the activity during a different seasons of the year. They should compare census numbers and estimated populations and try to explain the differences.



## Additional Resources

### Books

*One Small Square: Arctic Tundra. Backyard. Pond. Woods.* (Silver)

### Online

Alaska Department of Fish and Game. *Alaska Wildlife Notebook Series*  
[www.adfg.alaska.gov/index.cfm?adfg=educators.notebookseries](http://www.adfg.alaska.gov/index.cfm?adfg=educators.notebookseries)

### Credit

Adapted from *How Many Organisms Live Here?* OBIS, Lawrence Hall of Science, University of California, Berkeley, California, 1982.



TARGET  
GRADES  
6–8

DURATION  
1–2  
Sessions

GROUP SIZE  
Small  
Class



## LESSON 2

# Mark and Recapture

### LESSON OVERVIEW

Students perform the classroom activity, Capture-Mark-Recapture, to estimate the number of beans in a jar. Students learn how mark and recapture can be used to estimate the number of animals in a population.

*“The step by step calculations were easy to follow so students are not overwhelmed.”*

**SUBJECTS** Science, math

**SKILLS** Estimating, counting, graphing, problem solving

**SETTING** Indoors

**TERMS TO KNOW** Estimate, population, capture, recapture, percent, error

### STATE STANDARDS

Math: Ratios & Proportional Relationships, Number system; Statistics and Probability; Inferences and Justifying Conclusions  
6.RP.1, 6.NS.1, 6.NS.2, 6.NS.3, 6.SP.1, 7.SP.1, 7.SP.2, S-IC.3, S-IC.4

### NGSS

Ecosystems, Interactions, Energy and Dynamics  
MS-LS2-1; MS-LS2-2; MS-ESS3-4

### GUIDING QUESTIONS



What does mark and recapture mean?  
How can mark and recapture help you estimate a population?  
Why is it important to know how many animals are in a population?  
What do we mean by scientific estimate?  
What do we mean by percent error?

### OBJECTIVES

- Students will learn one method that biologists use to count animals that are difficult to see.
- Student will discuss reasons biologists use different methods to count different species of wildlife.
- Students will use calculations to estimate the size of an animal population using the mark and recapture method.
- Students will define the terms sampling, census, estimating.
- Students will be able to explain why it may be impossible for biologists to count every animal in a population.



### MATERIALS

- jar (any size)
- beans or corn kernels
- marker, pen or pencil
- data sheet





- *Don't Put all your Eggs in One Basket* (Wildlife for the Future 1st ed.)

### Supporting Information

It can be very important for wildlife managers and/or ecologists to have a good idea how many individuals of a particular species live in a certain area. This is especially true to ensure the conservation of wildlife for animals that are hunted (managers need to know what a sustainable harvest level is so they must know how many animals exist in a population). Ecologists are also concerned about species in decline, especially threatened or endangered species, and need to track the population trend of those species.



Unfortunately, there is no easy way to count all the members of an animal population in an ecosystem. Animals move from place to place; they hide, they hibernate, and they are often camouflaged and difficult to see in their environment. Surveying a large tract of land trying to count all the members of a species can be extremely time-consuming and expensive. In other words, conducting a census, which is the counting of every single individual in a population, is simply impractical if not impossible. Therefore, researchers have developed methods that are more efficient.

One of these methods, called the capture-mark-recapture technique, is used to make a meaningful estimate of an area's animal population. With the capture-mark-recapture method, instead of trying to count every animal in an ecosystem, you randomly capture a sample group of the population, mark it, release it, and then do a series of recaptures that will allow you to estimate the entire population under study.

Biologists must capture animals carefully in an effort to avoid injury and trauma. A wide variety of techniques are used to mark animals that have been captured. Birds may have small bands put around their legs, fish may have one of their small fins clipped, voles and rats may have their tails painted or ears tagged, tortoises may have their shells tagged, and larger mammals may have collars or ear tags attached to them.

Here is how a **Capture-Mark-Recapture** population estimate works:

- A specific study area is defined- this is an area of suitable habitat for the species that is getting counted. The more uniform the habitat is throughout the study area, the better the estimate will be.
- Within the study area, random plots are selected where as many animals as possible are captured.
- These animals are the sample group. They are tagged and released back into the ecosystem where they were captured.

- Biologists then wait for a period of time- this can range from a few days to several weeks depending on the species. At the end of the waiting period, they capture a second group of the same species in the same areas.

(Note: This second capture does not have to be the exact same number captured the first time. For example, a researcher might capture 72 mice the first time and 60 mice the second time.)

- The second group, the recapture, will contain some animals that were captured the first time (they are marked) and some that were not.
- The ratio between the marked and unmarked animals is the key to estimating the species population for the entire ecosystem.

For example, as mentioned above, let's say on your second capture you get a total of 60 animals. After checking carefully, you discover that a quarter, or 15, of the 60 are marked and therefore captured the first time. This recapture should be a random representation of the entire population with the marked individuals in the recapture representing the first capture's proportion of the population. Going back to our example, this would mean that the 15 marked individuals in the recapture indicate to us that the first group captured represents 25% of the total population.

To estimate the population for the entire ecosystem, divide the number in your first capture; let's say 72, by 0.25 (25%). If you do this, you get an estimated population for the entire ecosystem of 288 individuals of the species you are counting. To get greater accuracy you would want to do several recaptures and get an average ratio between the marked and unmarked animals.

To simulate a Capture-Mark-Recapture population estimate in the classroom follow the procedure on the following page.

## LESSON 2

# Mark and Recapture



## Procedure



1. Fill a cup or jar (any size) halfway with beans (or corn kernels).
2. Take a close look at the beans in the cup and do a visual estimate of how many beans you think are in the cup. Everyone in your group should do separate estimates. Write your visual estimate on the space provided on your data-recording sheet. You will compare this estimate to your scientific estimate and to the actual count at the end of the activity.
3. Dig your hand into your cup of beans and “capture” a medium-sized handful of “animals”. Carefully count the “captured” beans and record this information on your data sheet. Now, “mark” the captured beans by replacing them with the same number of beans of a different color (or mark them with a marker)—these now become your marked animals. Set aside the original beans that you have replaced.
4. Put this marked group back into the cup and thoroughly mix up the beans by pouring your beans back and forth between two cups. It is important that the beans get thoroughly mixed.
5. Now it is time to do a series of recaptures. Dig your hand back into the cup to grab a medium-sized handful of beans. First, count the total number of beans in your recapture and then make a count of all the ones out of that recapture that were marked from your first capture. Record both of these pieces of data onto your data sheet. Then put all of these beans back into the cup. Repeat this procedure nine more times recording all your data onto your data sheet.
6. Once you have finished ten recaptures, find the average number of beans for the recaptures and then the average number marked in the recaptures.
7. Put these two averages along with the number in the first sample count into the formula on the data sheet. Calculate the scientific estimate of the population of beans in the cup.
8. Now dump the beans out of the cup and carefully count every bean to determine the actual number in the cup.
9. Determine the percent error between your scientific estimate and the actual count.

Use the percent error formula on your data collection sheet to calculate the percent error. An error rate of less than five percent would indicate that your scientific estimate is a reliable indicator of the actual total population. An error rate of more than ten percent is an indication that your scientific estimate is flawed.

# DATA ANALYSIS

Part 1: Visual estimate of the number of beans in the cup: \_\_\_\_\_

Part 2: Number of beans in your first capture all of which you marked: \_\_\_\_\_

Part 3: Fill in the following chart with your recapture data and then add up the two columns and divide by 10 to get the average.

Data Recording Sheet

	# animals	
Original Capture		
	# animals	# marked
Recapture 1		
Recapture 2		
Recapture 3		
Recapture 4		
Recapture 5		
Recapture 6		
Recapture 7		
Recapture 8		
Recapture 9		
Recapture 10		
	Total/10 = average	Total/10= average
	###	###

**Part 4:** Calculate your scientific estimate using the following formula:

$$\left( \frac{\text{Number of beans in your first capture}}{\text{Average number of marked beans from recapture samples}} \right) = \text{Scientific Estimate}$$

Example:  $\frac{86}{\left(\frac{22}{88}\right)} = \frac{86}{.25} = 344$

$$\left( \frac{\text{_____}}{\text{_____}} \right) = \text{_____}$$

**Part 5:** Count the actual number of beans in the cup: \_\_\_\_\_

**Part 6:** Determine the percent error of your scientific estimate using the following formula:

$$\frac{\text{Scientific estimate} - \text{actual number}}{\text{Actual Number}} = \% \text{ Error}$$

$$\frac{\text{_____} - \text{_____}}{\text{_____}} = \text{_____} \% \text{ Error}$$

**Part 7:** Determine the percent error of your visual estimate using the following formula:

$$\frac{\text{Visual estimate} - \text{actual number}}{\text{Actual Number}} = \% \text{ Error}$$

$$\frac{\text{_____} - \text{_____}}{\text{_____}} = \text{_____} \% \text{ Error}$$

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## Evaluation

- Which is more accurate, your visual estimate or your scientific estimate? Why do you think this is so?
- Identify two reasons why ecologists would want to use a scientific technique of determining ecosystem populations as opposed to doing an actual count of all the animals in an area.
- In what situations might ecologists choose to do an actual count of every individual in a population (census) rather than use the capture-mark-recapture method. (What are some of the behaviors and characteristics of animals that make it difficult for scientists to get an accurate count of their populations in the wild?)
- How does the time interval between the first capture and the subsequent recaptures affect the reliability of the capture-mark-recapture method? What are the advantages and disadvantages of increasing or decreasing that time interval?
- In the field, how can the time of the year affect the results of a population study?
- In using the capture-mark-recapture method, why would it be important for scientists to be familiar with the territorial range and migratory behavior of the species being studied?
- How does the lifespan of the animal being studied affect how quickly scientists do a recapture after the initial capture?
- What advantage does the capture-mark-recapture technique have over simple sampling and extrapolation? For example, a scientist may want to know what the gopher population is for a 100,000 square foot habitat. She sections off a 1,000 square foot area and carefully counts all the gophers in this small area and then multiplies the results by 100, thus extrapolating to the entire area under study.  
  
Explain to her why she might want to use the capture-mark-recapture instead.
- In using the capture-mark-recapture technique, why is it important to take an average of several recaptures rather than doing just a single recapture?

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## Extensions

Refer to p. 181 *Mark/Recapture Tag Game*.

In the United States, the federal government requires that human populations be determined through the use of a census in which every person is supposed to be counted instead of using an estimating technique such as capture-mark-recapture. What would the advantages and disadvantages be for using some sort of sampling technique to ascertain human populations instead of attempting to count every individual?



### Additional Resources

#### Online

Alaska Department of Fish and Game  
[www.adfg.alaska.gov](http://www.adfg.alaska.gov)





TARGET  
GRADES  
6–8

DURATION  
2–3  
Sessions

GROUP SIZE  
4 Groups  
of Students



## LESSON 3

# Graphic Populations

### LESSON OVERVIEW

Students compare graphs for several wildlife populations and determine trends and actions or external factors that may have caused the declines.

**SUBJECTS** Science, math, language arts

**SKILLS** Analysis, communication, graph, inference, prediction, synthesis

**SETTING** Indoors

**TERMS TO KNOW** Conservation, extinction, graph, population decline, population recovery, stable population, carrying capacity, percent, error

### STATE STANDARDS

Language Arts: Speaking and Listening  
SL.6.1b; SL.6.1c; SL.6.1.d; SL.7.1.b;  
SL.7.1.c; SL.7.1.d; S.L.8.1b;  
S.L. 8.1c; SL.8.1.d

Math: Functions  
8.F.2, 8.F.4, 8.F.5.

### NGSS

MS-LS2-1, MS-LS2-2, MS-ESS3-4

### MATERIALS

- wildlife population fact cards for the Western Arctic Caribou Herd, The Fortymile Caribou Herd, Unit 20 D Moose, and the Peregrine Falcon fact card. Enough copies for each student and group
- graphing paper and/ or graphing software

### GUIDING QUESTIONS



What do we mean when we say trend in a population?  
Why is understanding how populations change over time important?  
Why is historical population data important?

### OBJECTIVES

- Students will compare population trends.
- Students will determine factors that may cause population declines or increases.
- Students will discover ways that human actions have contributed to the population changes.





## ALASKA WILDLIFE CURRICULA COMPLIMENTARY ACTIVITIES

- *How Many Bears Can Live in this Forest?* (Section 2, Lesson 5)
- *Oh Moose!* (Alaska's Ecology)

## Supporting Information



See **Insights**

*Biodiversity and Populations—Alaska's Dynamic Wildlife  
When Populations Decline—Losing Biodiversity* (Insight 7)  
*Wildlife Conservation is Up to Us!* (Insight 8)



each group's wildlife population fact sheet. Ask the groups to make a list of the factors that affected the population trends for their animals. Have students select a spokesperson from each group to share the graphs and explain to the class what scientists need to know about population changes for management.

For example, scientists would need to know

- whether the populations being counted represented the entire species or if other populations still survived after some populations dropped to zero.
- the life history, where young are born and raised, and any migratory movements.
- how it is changing by looking at recruitment (births) and mortality (death) rates to predict how this population will change in the future.
- why the mortality may be high. Is it a constant factor or just a bad year or just a bad weather year, with flooding, deep snow or other events?

This information then can let them know if the population needs protection for a certain amount of time or if the population can handle some hunting, or if it can handle liberal hunting so the animals don't exceed their carrying capacity. Have each group make a list of human actions that may have contributed to population declines and a list of human actions that may have helped reverse population declines. If the population has increased, list what human actions may have contributed to the increase and determine if the increase is healthy or cause for concern.

# WILDLIFE POPULATION FACT SHEET

## Delta Junction Moose

The moose population in Unit 20D near Delta Junction has gone through many changes over the past few decades. Several severe winters in the mid-1960s and early 1970s killed many moose throughout this unit and other portions of Interior Alaska. It also set the stage for predation and hunting to compound and aggravate already widespread population declines. Through hunting restrictions and some predator control, the moose population rebounded and began to increase.



### Flying Biologists

Because moose live in the forest, it is too expensive and logistically impossible to count all moose in a certain area. Instead, biologists must estimate the number of moose using the scientific method of estimating numbers based on samples.

In a typical moose survey, a game management area is broken up into survey units measuring  $2.5 \times 2.5$  miles square. Biologists fly over these units briefly prior to the survey to determine if each unit is a high or low-density moose area based on the habitat.

Then a certain number of sample units (the more the better) are randomly chosen from the high density and low density area for intensive observation. When conditions are just right, pilots and observers take to the air to look for moose. These conditions include:

- Adequate snow—enough frost or snow so moose are visible
- Adequate light—days get shorter and shorter in the winter
- Antlered bulls—no surveys after December 5 so most bulls have antlers
- Wind—less than 30 mph and not turbulent
- Temperature—higher than  $-30^{\circ}\text{F}$

Pilots with observers fly back and forth in the selected units looking for any moose. When they see moose, they circle them to determine the age and sex of the animals and record the data.

### Graphing Challenge

Let's look at the population estimates for the Southern portion of Unit 20D over the years. Graph the population and then think about what could have happened to cause the moose numbers to level out. (Hint) Notice that the moose surveys were conducted every year in the later years. Biologists were keeping a close eye on the population for a reason. What could the Department of Fish and Game do in order to stop the population growth? And why would they?

#### Population Estimates of the Southern portion of Unit 20D

1995:	2,522
1998:	3,360
2000:	3,932
2001:	3,435
2003:	5,493
2005:	5,553
2006:	7,243
2008:	5,006
2009:	4,633
2010:	4,574
2011:	4,134
2012:	4,450

# WHAT HAPPENED

## Delta Junction Moose

As moose populations recovered during the mid-1970s and early 1980s as a result of continued hunting restrictions, mild winters, and wolf control in adjacent Units, hunting opportunities were expanded in Unit 20D. The population continued to grow through the 90's. As the population grew, the density of moose became a concern. Biologists' noticed that moose were over-browsing much of their range, calf weights were lower than they should be, and there was reduced reproductive success for cow moose; all signs that the moose population was nutritionally stressed.

Antlerless moose hunting (targeting cows) began in fall 2006 in Unit 20D with a limited number of permits issued in response to a high-density population, moderate overwinter browse removal and moderately low twinning rates. The goals of the antlerless hunts were to stabilize population growth in the unit and to address concerns about range degradation, reduced nutritional conditions, and reduced reproductive success. Antlerless moose hunting in Unit 20D continued through fall 2009.

The moose density was reduced by the antlerless hunts. Three indicators of moose nutritional stress conditions—how much winter browse is removed, the proportion of females with twin calves, and late-winter calf weights—were evaluated in relation to lowering the moose density. The post-antlerless hunt evaluation of these three indices was compared to pre-hunt data and data collected during the hunts. The comparison detected a decrease in winter browse removal, an increase in twinning rate, and an increase in the average weight of 9-month-old calves.

For the most part there have been no antlerless hunts since the 2009 season.

Current, biologists are closely monitoring the three indicators of a nutritionally stressed moose population. If those indicators suggest that the moose population is getting to high then antlerless moose hunts will be implemented to stabilize the population.

### Why Cows?

Cow moose are targeted to reduce a large population because they have a more direct impact on the population than bulls do. You can significantly affect a moose population by the number of cows harvested, whereas this is not the case with bulls. Since cows are capable of adding to the population by birthing one to two calves each year, the harvest of cows affects the population more significantly than the taking of bulls.

# WILDLIFE POPULATION FACT SHEET

## Fortymile Caribou Herd

The Fortymile caribou herd is located in Interior Alaska. Their range includes portions of the upper Fortymile, Tanana, and Yukon River drainages in both Alaska and Yukon, Canada. Like other caribou herds in Alaska, the Fortymile Herd has gone through major population fluctuations over time.



During the 1920s, it was the largest herd in Alaska, possibly reaching over 500,000 caribou. For unknown reasons, the herd declined during the 1930s to an

estimated 10,000–20,000 caribou. The herd rebounded and by the 1950s had increased to an estimated 50,000 caribou, likely aided by a federal predator control program that began in 1947. Through the early 1960s, the herd fluctuated but remained around 50,000 animals.

Between the mid-1960s and mid-1970s the herd declined to about 7,500 animals; its lowest population level since the 1920s. This decline was due to a combination of high hunter harvests, severe winters, and wolf predation. During this decline, the herd also reduced its range size and changed its seasonal migration patterns. By the early 1970s, few Fortymile caribou moved into Yukon, Canada. Since the early 1970s, the herd's range has remained less than 25 percent of the range used during the 1920s.

### Counting Caribou

Unlike counting moose where we do a population estimate, the behavior of caribou allows us to perform a census—we count every animal in the herd.

During the hot summer, mosquitos, bot flies, and warble flies torment caribou. They try to escape by finding locations with fewer insects. This includes snowfields, coastlines and windswept ridgelines. When they bunch up, biologists fly over them and take photographs of the entire herd—that is usually in several large groups.

The photos are developed and the caribou counted using stereoscopes and a clicker. A photo census involves photographing and then counting every animal in the photos.

### Graphing Challenge

Using the Fortymile Caribou Census data listed below, graph the caribou population since 1986. What is the population doing? Can you observe any trends? What are possible reasons for trends in the caribou population? What concerns might wildlife managers have about an increasing population?

#### Population Estimates of the Upper Fortymile, Tanana, and Yukon River drainages

1986:	15,307
1987:	no count
1988:	19,975
1989:	no count
1990:	22,766
1991:	no count
1992:	21,844
1993:	no count
1994:	22,104
1995:	22,588
1996:	23,458
1997:	25,910
1998:	31,029
1999:	33,110
2000:	34,640
2001:	35,900
2002:	40,800
2003:	43,375
2004, 2005, 2006:	no count (estimated between 40–44,000)
2007:	43,837
2008:	44,673
2009:	46,510
2010:	51,675

# WHAT HAPPENED

## Fortymile Caribou Herd

The Fortymile caribou herd began increasing after 1976, likely in response to favorable weather conditions, reduced harvests, and a natural decline in wolf numbers. By 1990, the herd was estimated at 22,766 caribou.

During 1990–1995, the herd remained relatively stable at about 22,000 caribou when population growth stabilized due to high adult mortality, unusually low pregnancy rate in 1993, and low to moderate calf survival.

In combination with public wolf trapping, the Alaska Department of Fish and Game (ADF&G) conducted nonlethal wolf control during November 1997 to May of 2001 within the calving and summer range of the Fortymile herd. Wolf numbers were reduced by 78 percent and there remained only two sterilized alpha wolves in each of 15 pack territories.

During 1996–2002, the herd doubled in size due to elevated pregnancy rates and increased adult and calf survival.

The herd continued to grow up to the last successful census in 2010, when it was over 51,000 animals. Substantial numbers have also crossed the Yukon River into Canada for the first time in many years. If the herd is to grow further, then they must expand their range into former territory or there is a risk that they will damage their existing habitat. This could result in nutritional stress and a population decline. Biologists can only monitor the herd, wait, and see what happens.

Biologists will monitor the herd for signs of nutritional stress. One of the best indicators of nutritional stress (indicating that the animals are not getting enough good food) over time is the number of three-year-old cows that are giving birth. If the rate of three-year-old cows giving birth is less than 55 percent over a five-year average, it indicates that the herd is nutritionally stressed. Fall time calf weights are also measured. A declining trend in calf weights can also indicate nutritional stress on the herd.

The Management goal for the herd is to restore it to as much of its traditional range in Alaska and Yukon as possible, within sustainable levels, and without significantly compromising herd health and habitat condition. The current objectives of 50,000–100,000 caribou and harvest of 1,000–15,000 caribou were established by the Alaska Board of Game in 2000.

# WILDLIFE POPULATION FACT SHEET

## Arctic Peregrine Falcon

Falcons are swift crow-sized raptors with long, pointed wings and long tails. They capture their primarily avian prey in open country by virtue of superior speed, either in powered flight or in a characteristic dive called a stoop. A stooping falcon folds its wings and dives from a high perch or while flying overhead, and may exceed 200 miles per hour!

Falcons do not build nests, rather deposit eggs directly on a "scrape," or cleared space on ledges of rocky hillsides or mountain cliffs.

In the late 1960s, populations of the American peregrine falcon populations had declined throughout the United States and the bird was recommended for listing on the federal Endangered Species List. The Arctic peregrine falcon, the subspecies which breeds in Interior Alaska, declined by as much as 80 percent.



In 1970, the American and Arctic peregrine falcon subspecies were listed as endangered under the Endangered Species Conservation Act of 1969 (the law preceding the Endangered Species Act of 1973), reflecting their critical biological status.

Between 1968 and 1977, the number of pairs of peregrines that nested each year in the upper Yukon River changed very little yet female falcons were laying the same number of eggs that they did before the population declined.

### Counting Falcons

The peregrine Falcons that inhabit Interior AK nest primarily on cliffs along rivers. To count the birds, biologists generally float, or motor boat along a river until they find suitable habitat for the falcons (cliffs and rocky hillsides along the river). They stop in that area where they can look for birds and observe them through binoculars and spotting scopes. They may stay at each location for several hours to determine if there are birds nesting there. If there are birds present, they try to figure out how many adults and how many young are in the nest. They do this by looking through spotting scopes or by climbing up/or down the cliffs so they can visually inspect the nest.

### Graphing Challenge

Graph the population counts for the upper Yukon River peregrines. Can you imagine why the population dropped by 80% in the late 1960's and remained low for several years? Why didn't the population grow? What was the trend of the population after 1977? What could have caused the population to change again so dramatically from the 1970s to the present? What did the population do in the late 2000s? Can you speculate why?

#### Population Estimates of the Upper Yukon River

1966:	60
1968:	42
1970:	42
1973:	40
1975:	42
1977:	50
1980:	82
1984:	100
1988:	126
1990:	148
1991:	123
1993:	160
1995:	159
1997:	151
1999:	157.5
2001:	150
2003:	162
2005:	169
2007:	181
2009:	185.5
2011:	178.5

# WHAT HAPPENED

## Arctic Peregrine Falcon

Scientists learned that the cause of death of young birds was thin eggshells. When the adults sat on the eggs, they crushed them and they did not hatch. Scientists later learned that pesticides such as DDT (a persistent organochlorine), which were in widespread use since the 1940's, caused the thinning of eggshells. Adult peregrines (and other birds of prey) ingested DDT when they ate smaller birds that had fed on crops sprayed with DDT. The thin egg shells were not hatching and new young were not being recruited into the population.

In 1972, the United States (Environmental Protection Agency) banned the use of DDT and similar pesticides. It took time for the population to recover, however, because the pesticide is slow to break down in the environment to the point where it is no longer toxic to peregrines and other birds.

The Arctic Peregrine eventually recovered enough that in 1984 the birds status changed from endangered to the less critical category of threatened. Then, in October 1994, the Arctic Peregrine falcon had increased in numbers enough so that it was removed from the threatened and endangered species list. The populations of Arctic Peregrines is now healthy once again.

The recovery of the peregrine falcon is considered one of the most dramatic successes of the Endangered Species Act.

The population of arctic peregrines of the Upper Yukon River Drainages increased until about 2009 and it seems to have stabilized or declined slightly. The population probably stopped growing because the birds reached the carrying capacity of the area, meaning that there is no more suitable habitat available to support any more nesting birds. In fact, biologists believe that the population has dipped slightly in the past few years due to competition for available resources amongst the higher density of birds.

# WILDLIFE POPULATION FACT SHEET

## Western Arctic Caribou Herd

The Western Arctic Caribou Herd is a barren ground caribou herd that ranges throughout northwestern Alaska. This large herd ranges over a 140,000 square-miles or (363,000 km<sup>2</sup>) area. Approximately 40 communities and 13,000 people are located within the range of the herd. For the people of these communities the herd is a vital link to cultural traditions, as well as a food staple for many families. The caribou move seasonally over this large area, which has important implications on the ecology and subsistence patterns throughout the region, from harvest to nutrient cycling. The Western Arctic Herd is the largest caribou herd in Alaska and one of the largest in the world. This herd last peaked around 2003 when it reached 490,000 caribou. Since this time the herd has declined substantially and the last census, conducted in 2013, put the herd at approximately 235,000 caribou.



### Studying and Counting the Herd

In order to manage the herd, biologists must know the population size. A photocensus of the herd is currently conducted every two years. In a photocensus aerial photography is used to take pictures of the animals when they are bunched up during the summer. The photos are developed and each caribou in the multitude of photos is counted, one by one. Imagine counting 400,000 little specs on photograph after photograph!

Composition surveys are also conducted annually during the June calving period to determine how many calves are born and to delineate the calving area. Spring surveys are conducted the following spring to monitor calf survival through their first year of life. Fall surveys are also conducted biennially to monitor proportions of bulls, cows and calves in the herd. Adult mortality is estimated annually. Distribution and movements of this herd are monitored through radio telemetry data.

What trends do you notice in your graph? Based on history, what do you expect to happen to the herd population in the coming years? Can you develop any hypothesis why the caribou herd rose to such a high number and is now rapidly declining?

### Graphing Challenge

Caribou abundance in northwest Alaska has varied substantially over the past 150 years. Although biologists have only been able to count caribou herds during the last 45 years, we know from historical records of early explorers that caribou almost disappeared from large portions of this area by the mid-19th century.

Using the census data below, graph the Western Arctic Herd population over time.

### Population Estimates of the Northwestern Alaska

1970:	243,000
1976:	75,000
1978:	107,000
1980:	138,000
1982:	172,000
1986:	129,000
1988:	343,000
1990:	416,000
1993:	450,000
1996:	463,000
1999:	430,000
2003:	490,000
2007:	377,000
2009:	348,000
2011:	325,000
2013:	235,000

# WHAT HAPPENED

## Western Arctic Caribou Herd

Biologists first counted the Western Arctic Herd in 1970; at that time it numbered about 242,000 caribou. The herd declined rapidly from 1970 to 1976 when it numbered only about 75,000 caribou. From 1976 through 1990 this herd grew about 13% annually to reach a population size of 416,000 caribou. From 1990 to 2003 the herd grew only 1-3% annually and the herd peaked around 490,000 caribou. Since 2003 the WAH has declined and, as of 2013, numbered about 235,000 caribou.

Biologists that study the WAH and other caribou herds look at long-term trends in population data, weather patterns, numbers of predators, quality of food and habitat, along with disease and recruitment (births) and mortality (deaths). Currently biologists are noticing that female caribou are producing about as many calves as in the past but an increasing proportion of these calves are not surviving through their first winter. Also, a higher proportion of cows are dying than in the past. Based on historical data and anecdotal evidence from people living with this caribou herd for centuries, it has fluctuated widely and will likely continue to do so.

Caribou across the North are facing many changes. Climate change brings melting permafrost, expanding shrubs, decreasing lichen, increasing wildfires, and changes in temperature. Oil, gas, and mineral developments may bring roads, pipelines, power lines, people, construction, and possibly contaminants. The warming climate is also opening the arctic to an even greater expansion of resource exploration and development. Hunting pressure may influence this herd in both positive and negative ways, depending on how hunting pressure changes in response to fluctuations in the population cycle. Predators can also play a role, and depending on how their numbers increase and decrease, they can also impact the number of animals in a herd. All of these things and more will influence this herd in the future. Changes impacting caribou also impact people who value and use them. As long as there are caribou, people will have to be responsive to the normal highs and lows of the population cycles.

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## Evaluation

- Ask students the relationship between the number of births and the number of deaths in a population at the following points on a population graph:
  - a. Upward graph (number of births exceeds the number of deaths)
  - b. Straight line graph (number of births equals the number of deaths)
  - c. Downward graph (number of deaths exceeds the number of births)
- Students research wildlife management success stories in Alaska (Aleutian Canada geese, sea otters, mallards, bowhead whales, muskox, trumpeter swans, or arctic nesting geese) or elsewhere in the world. List the ways population declines were reversed.
- Each group interviews community members, elders, or experienced naturalists or hunters in their community to learn about how local populations have changed in their lifetime. What do they contribute the change to? What are their predictions for the future? What did their ancestors predict and is that prevalent today?

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## Extensions

- A. Computer graphing. Use a computer program that generates graphs based on population data or present graphs and conclusions to another class through a computer network.
- B. Research and write about other populations. Research and develop population story examples and "What Happened?" sheets for other Alaskan animals.
- C. Discuss wildlife news stories. Students bring in and discuss news articles on animal populations and how they are changing.
- D. Guest wildlife manager. Invite wildlife managers to the classroom to discuss population graphs. If the biologist is unable to come to class, ask for sample population graphs of animals in your area, or animals of particular interest to your students.
- E. Guest Native elder. Invite knowledgeable long-term residents and Native elders to describe changes in local wildlife populations that they have observed over their lifetime. Discuss possible human influences on the changes in local populations.
- F. Graph other animal populations. Obtain scientific data about local animal populations. Graph the data to see if they are declining, increasing, or stable. Predict actions wildlife managers might take after getting the data.



## Additional Resources

The Raptor Kit introduces students to the fascinating birds of prey that live in Alaska. Included are lesson plans and materials you will need to guide your students through such topics as adaptations and identification, habitat and migration, predators and prey and conservation and research. The kit contains materials suitable for students K-12 and covers science, math, language arts and art. Raptors of Alaska kits are available from:

Alaska Resources Library and Information Services in Anchorage (907) 272-7547  
Alaska Department of Fish and Game in Fairbanks (907) 459-7206

### Online

***Steller Sea Lions*** (Video- ADF&G)

***Interior Alaska Moose Management Predator Prey Relationships in Alaska—Video series*** <https://vimeo.com/45605405>

### Books

***California Condor*** (Silverstein)

***Endangered Animals: 140 Species in Full Color*** (Kest)

***The Peregrine Falcon—Endangered No More*** (Priebe)





TARGET  
GRADES  
7–9

DURATION  
1–2  
Sessions

GROUP SIZE  
Groups of  
6 Students



## LESSON 4

# Happy Hunting

### LESSON OVERVIEW

Students conduct two experiments to determine how search and handling of prey affects predator success.

**SUBJECTS** Science, math

**SKILLS** Inference, prediction, graphing, analysis, communication

**SETTING** Classroom

**TERMS TO KNOW** Predator, prey, limiting factor, search time, handling time, statistics, modeling, viable information

### STATE STANDARDS

Math: Statistics and Probability, making Inferences and Justifying Conclusions, Functions

6.SP.1, 7.SP.1, 7.SP.2, S-IC.4, 8.F.2, 8.F.4, 8.F.5.

Physical Education: Exhibit social behavior that respects self and others

8.E.1, 8.E. 2, 8. E.3, 12.E.2

### GUIDING QUESTIONS



How does hunting in a group affect the number of prey that predators can catch?

What limits how fast a predator can catch prey?

Why are predator/prey dynamics important?

### OBJECTIVES

- Students will conduct a series of experiments to determine how search, handling time, availability of prey and hunting as a pack can affect the hunting success of predators.
- Students may repeat trials and record results, which may be used as data by ADF&G biologists studying predator-prey dynamics.

### MATERIALS

A set for each group of 6 students

- 100 disks of 4 cm. sandpaper (may use a roll of pennies or poker chips)
- cardboard or poster board
- 2 to 3 blindfolds
- 6 fanny packs (or another pouch such as a gallon Ziploc on a string)
- graph paper or computer w/graphing software (Excel)





- **Mark and Recapture** (Section 2, Lesson 2)
- **The Muskox Returns to Alaska**
- **Graphic Populations** (Section 2, Lesson 3)

## Background

How does hunting in a group affect the number of prey a predator can catch? A successful predator is one that catches a lot of prey in a short amount of time. What limits how fast a predator can catch prey? For the most part, two factors are important. The first is the number of prey available. A predator has to search for prey and that takes time. If there is a lot of prey, the predator can find prey faster than if there are only a few. The number of prey available determines the amount of time the predator spends searching. This is called "search time".

The second factor is how long it takes to handle the prey once it is caught. For a bird catching a mosquito it shouldn't take too long. All it has to do is swallow once and it is ready to find another. But for a single wolf that has caught a caribou that is twice as big as she is, it might take her a few days to eat it. That "handling time" is time that she cannot spend hunting for other prey.

Discuss with your students why biologists would need this information. Why would it be useful for wildlife managers to know how many caribou a wolf pack can potentially kill relative to a single hunting wolf? When should wildlife managers intervene to ensure there are enough caribou for other uses (i.e. human hunting)?

# Happy Hunting



## Procedure

Ask your students if caribou, moose or other prey species appear to be plentiful around their community. Do they know if these species are stable, increasing or declining? Do they see prey species often? Do they hunt or have

family or friends who hunt? How is their hunting success? What affects their hunting success?

Wildlife populations fluctuate over time due to a number of conditions. Wildlife biologists study animals to understand why, and they are also interested in predator-prey dynamics and how that affects populations. In their studies, wildlife biologists look at habitat and at the condition of animals to see if they have enough food; they do studies to see if they are sick; they put collars on them to see where they go; and they also look at predation.



We are going to conduct an experiment to see what factors affect how fast a single predator (wolf) can kill prey (caribou). Then we are going to do another experiment to see what happens when predators hunt in a group, like a pack of wolves.

How do predators hunt? They search around and find something they can catch and they eat it. Wolves often eat large prey so it can take while to eat the prey.

How many caribou are out there? If there are a lot of prey, wolves should be able to catch more because caribou should be easier to find.

Search time is a factor, but handling time matters too. Wolves hunt in packs, so they get some help finding prey; other wolves know where to go or pick up a scent or spot prey the leader missed.

### Experiment 1

#### How does searching and handling affect hunting success?

Split the class into groups of six students. The groups will repeat each round of experiments twice. As a result, there will be enough trials to provide statistically viable information. Place different numbers of 4 cm disks of sandpaper on a 3' x 3' piece of cardboard (you can also substitute a towel or butcher paper) that is set on a table or floor (ie: playing field). The disks are the prey. You may substitute the sandpaper disks with other objects, such as pennies or poker chips.

## NOTES

Blank lined area for notes.

## Rules for the Experiments

### 1. Hunting Wolf

- Blindfolded (chin down, no peeking)
- One-handed—use only one hand or hunting
- One finger tapping (no sliding, no palms)
- A wolf may pick up two disks at once if they are stacked. If disks fall on the floor, they are lost and do not count.

### 2. Pups may only handle one disk at a time

### 3. Other adult wolves

- May direct (talk to) hunting wolf
- May take disks from hunting wolf and handle
- Cannot pick up disks



**Round 1:** Start with four disks haphazardly arranged on the playing field. Our predator is a blindfolded student wearing a fanny pack or other type of pouch, such as a Ziploc bag on a string. The predator hunts the disks by tapping one finger around the table trying to feel a disk. When the predator finds a disk it takes the disk and puts it in the fanny pack, closes the pack, and resumes hunting. The predator has 60 seconds to find disks and put them in the pack. The tapping is the search time and picking up the disk and putting it in the fanny pack is the handling time. We don't need to keep track of those times, simply count the number of disks the predator caught in 60 seconds.

Reset the board and repeat the experiment with one or two more predators from that class.

**Round 2:** Now place nine disks on the board and do it all over again. There is more prey now so the disks are easier to find, but it still takes the same amount of time to put each disk in the pack, one at a time.

This experiment is repeated with boards containing 16, 25, 49, 81, 100, disks. Then make a graph of the number of disks captured in each trial.

From the graph, we can see that search time limits the number of prey caught when there are few prey. The number of prey captured increases quickly when increasing the number of prey available, because they are easier to find. But, when there is a lot of prey available, and we add more prey, the predator can't catch them any faster. It is too busy eating (putting them in the fanny pack). Search time is the big factor when prey are scarce and handling time is the big factor when prey are plentiful.

This experiment was first done in 1959 by an insect biologist named C.S. Holling. From this experiment, he developed the equations that biologists use to understand how predator success affects predator-prey relationships. Hundreds of experiments and field studies have been done since then to refine his basic ideas. Exploration of this concept is ongoing, and the data your class collects from these experiments may be used by the Alaska Department of Fish and Game for scientific papers on the subject.

## Experiment 2

### How do additional pack members affect hunting success?

**Round 1: Young wolves** What happens when a predator does not hunt all by itself? What happens when predators hunt in groups, like a pack of wolves? In the first example, we simulated a wolf that killed a caribou that was twice her size and it took her a while to eat it. But if she had a bunch of youngsters with her, they would eat the caribou too and it would not take as long. We simulated the time it took her to eat it by making our wolf put the disk into a fanny pack. So let's give our wolf some help eating those caribou.

The set-up is the same but now we have a pack of six wolves. Three to five of these wolves are youngsters. They do not know how to hunt yet, but they sure know how to eat! The five young are not blindfolded, but they each wear fanny packs. When the blindfolded adult catches a disk, it just hands it to one of the others. They open their fanny packs, put the disk in, and close it up again. But the adult must put every sixth disk it catches in its own fanny pack, because it has to eat too.

At the end of 60 seconds, we tally the number of disks caught. Then add more prey to the habitat and repeat. Use the same number of disks for each trial as used in first experiment (4, 9, 16, 25, 49, 81, 100). Complete as many trials as time allows.

ADF&G biologists have developed computer simulations showing that the curve on the graph will be very similar until it starts to plateau at the top. In this experiment, the curve will go much higher before it levels out. We expect the result will be that the maximum kill rate is much higher when handling time is reduced. We can also see how many disks there are per wolf at the end of the trials and see how many disks have to be available to feed the wolves. And when some wolves will not get enough disks and have to leave the pack.

### Round 2: Additional adults help find and capture prey

This time we have a pack of wolves, but one of the wolves gets to help the blindfolded wolf in the following fashion: The helper wolf can tell the blindfolded wolf where to tap. For example, if the hunting wolf taps close to but misses a disk, the helper can say "left" or "back" or whatever helps. The helper can also direct the hunter to areas of the table that have a lot of disks. This simulates the condition where the other adults have information about where prey might be and also have experience that helps the hunter find prey.

Also, when the hunter finds a disk, the helper gets to pick it up and hand it to the youngsters. This simulates the condition where other adults actually help catch the prey once it is located. Again, both adults have to "eat" every 5th and 6th disks. And, again, we repeat this for the different prey availabilities.

The expected result is that the curve will go up steeper, that is, searching will be much more efficient, especially when a low number of prey are available. We should see a little increase in the maximum kill rate too.

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## Evaluation

- Generate a curve using data collected in your trials and submit it to the Department of Fish and Game.
- Contribute results of your trials to ADF&G. Please send to:  
Brenda Duty, Project WILD Coordinator  
Division of Wildlife Conservation  
333 Raspberry Rd.  
Anchorage, AK 99518  
Email: [brenda.duty@alaska.gov](mailto:brenda.duty@alaska.gov)
- Relate the data to your original question and hypothesis. Write a summary of what you found out and what you learned. How might this information be helpful for future management of this species?

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## Extensions

- A. Learn more about predator-prey relationships in various wildlife populations around the world. Look at historical data and discuss how the predator-prey relationship changes over time.
- B. Talk to local elders, hunters, trappers, and resources biologists to find out more information about local wildlife populations. What are they perspectives on this cycle?
- C. Play the **Mark and Recapture** tag game on p. 181.



### Additional Resources

#### Online

**Alaska Dept. of Fish & Game**

<http://www.adfg.alaska.gov>



TARGET  
GRADES  
5-8

DURATION  
20-45  
minutes

GROUP SIZE  
12 or  
more



## LESSON 5

# How Many Bears Can Live in this Forest?

### LESSON OVERVIEW

Students role-play bears as they forage for food to demonstrate the nutritional needs of bears and the concept of carrying capacity.

**SUBJECTS** Mathematics, physical education, science, social studies, habitat review

### SKILLS

**SETTING** Outdoors or Indoors

**TERMS TO KNOW** Carrying capacity, cover, habitat, limiting factors, omnivore, shelter

### STATE STANDARDS

Math: Ratios and Proportional Relationship

6.RP.1

Physical Education: Exhibit social behavior that respects self and others

5.E.1; 8.E.1; 8. E.3

### NGSS STANDARDS

MS-LS2-1; MS-LS2-4; MS-LS2-2;  
HS-LS2-1



### MATERIALS

- construction paper (2-3 sheets of each of six colors) or an equal amount of light poster board
- one black felt pen
- one envelope or small plastic bag for each student
- pencils
- scratch paper
- one blindfold

### GUIDING QUESTIONS



What is carrying capacity?  
How does habitat influence carrying capacity?  
How might humans influence carrying capacity?

### OBJECTIVES

- Students will be able to define carrying capacity.
- Students will describe the importance of carrying capacity for wildlife and people.





## ALASKA WILDLIFE CURRICULA COMPLIMENTARY ACTIVITIES

- ***Graphic Populations*** (Section 2, Lesson 3)
- ***Happy Hunting*** (Section 2, Lesson 4)
- ***Habitat Roulette***

## Background



See **Insights**

### ***Biodiversity and Populations:***

- ***Carrying Capacity***
- ***What's on a Bear's Menu*** Fact Sheets

## LESSON 5

# How Many Bears Can Live in this Forest?



## NOTES

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## Procedure

1. **Background Discussion:** Explain to students that they will be playing a game in which they pretend to be black bears to learn about the biological concepts of habitat, carrying capacity and limiting factors.

A. **Assess what students know about local bear populations:** Ask students which bear species are found in Alaska (black, brown or grizzly and polar bear). Ask students whether bear populations are healthy in Alaska (yes, overall; habitat is excellent and ecosystems are mostly intact though bears can be affected by habitat issues and human-bear conflicts).

B. **Discuss limiting factors that keep wildlife populations in check:** One way to introduce this section is to ask students about how many bears they think live in the area. Why aren't there millions of bears? Brainstorm limiting factors for populations such as food, water, shelter, cover, predators, and disease, for example. All wildlife populations, including stable or growing populations, have limiting factors.

C. **Explain the concept of carrying capacity:** Carrying capacity is defined as the number of plants or animals of a given species that an area of land or water can support. It is the largest population a unit of habitat can support on a year-round basis, or during the most critical period for the species.

D. **Discuss bear foraging behavior:** Ask students about how much time they think bears spend searching for food. Present and discuss the activity budget information (basically, how bears spend their time each day) from the *Anchorage Urban Bear Project*. Discuss the behavior variation among individual bears, and among bear populations. Explore the data in "What's on a bear's menu?"

### 2. Game Set-Up

A. Prepare the game pieces: Cut the paper or poster board into 2" x 2" or 2" x 3" pieces. For a classroom of 30 students, make 30 cards of each color as follows (for classes with 12-20 students, see the chart at the end of this activity).

- Orange for Roots (wild sweet pea): mark 30 pieces "R-2."
- Blue for Berries (cranberries, devil's club berries, blueberries, raspberries): Mark five pieces "B-26," mark 25 pieces "B-10."
- Yellow for Insects (worms, larvae, ants): Mark five pieces "I-11," mark 25 pieces "I-5."
- Red for Meat (mice, rodents, hare, birds, moose): Mark five pieces "M-14," mark 25 pieces "M-6."
- Green for Plants (leaves, grasses, herbs): Mark five pieces "P-22," mark 25 pieces "P-10."



- B. Prepare the "garbage" game pieces: In addition the natural food cards, cut up pink construction paper or poster board into the same 2" x 2" or 2" x 3" pieces to represent "garbage" or anthropogenic food (food provided by humans). For a classroom of 30 students, you will want approximately 10-15 pink garbage cards. Mark these cards "G-50."
- C. Scatter the game pieces: In a fairly large open area (about 50 feet x 50 feet), scatter the colored "food" pieces, including the pink "garbage" cards.
- D. Have other materials ready: To play the game, you will also need envelopes or small plastic bags (representing the bear stomachs), a blindfold and pencils/paper in case students need to work out the addition on paper.

### Game Instructions

- A. Explain the goal of the game: This game is based on bear research from the Kenai National Wildlife Refuge that indicates a mature black bear might typically eat about six pounds of food per day in a 10-day period. But for the purposes of the game, don't reveal that detail until after the game is played. Just tell the students that they will be bears waking from winter and that the goal of the game is to collect as much food as possible (the colored cards) until all the food is gone. They will be competing with other bears for food.
- B. Hand out one envelope or bag to each student. This will be their "stomach". Have students surround the playing area and find a spot for their envelope or bag at the starting line around the perimeter of the field or playing area.
- C. Give instructions: Have students stand over their envelopes on the starting line as you explain these instructions.
  - In this game, you are now black bears: You are all black bears, but just as in all populations, there is individual variation.
  - Select one student to be a young male bear that has not yet found his territory and got into a fight with a larger male bear: This young male hurt his leg in the fight before he could get away. This student must play the game and forage for food hopping on one leg.
  - Select another student to be another young bear that investigated a porcupine too closely and was blinded by the quills: This young bear must hunt for food blindfolded. Give this student a blindfold and have someone help put it on. This student will need to put their "stomach" in a place that will be easy to find by touch. Remind other students to watch out for the blind bear so no one gets injured.
  - Select another student to be a sow (mother bear) with two small cubs: This bear must collect twice as much food as the other bears.

- Tell the students their job is to collect as much food as they can: Do NOT tell the students what the colors, initials and number on the pieces of paper represent. Tell them only that the pieces of paper represent various kinds of bear food. Bears are omnivores. They gather a wide assortment of foods, so they should gather different colored squares.



- Walk, don't run, while foraging: Tell students they must walk into the "forest" as they look for food. When students find a colored square, they should pick it up (one at a time) and return it to their envelope or bag (stomach) before picking up another colored square. If they are caught violating this rule, remind them. If caught more than once, they may need to sit out of the rest of the game.
- Keep roughhousing to a minimum: Competitive nudging and gentle pushing over food resources is acceptable as long as it is under control. Remind students that if bears fight (which they rarely do), they can become injured and unable to gather sufficient food. Out of controlled competitiveness can be rewarded by a simulated injury, assigned by the teacher, or by removal of food to represent energy lost.
- Once all the colored squares are gathered: After all the cards are gone from the playing area, ask students to sit next to their "stomach" or return to the classroom and wait for instructions.

### Discuss the Game

- Total the pounds of food collected:** First, have each student add the numbers on each of the colored cards they collected. These represent the total number of pounds of food that she or he gathered (total of meat, insects, berries, plants, roots, etc). Have them write that number down on some scratch paper, or keep it in their head.
- Ask each student how much food they found:** Record each response on the chalkboard, or if you are short on time, ask students with totals of 60 or higher to raise their hands. These are the bears who gathered enough to "survive." If they did not collect 60 pounds, they did not survive.
- Ask the "blind," "crippled," and "sow with cubs" bears how much food they ate.** Did they survive? Remember that the sow with cubs had to gather twice as much food for her and her cubs, so she would have needed to collect 120 pounds. Discuss how being injured, or needing to care for young, makes life more challenging for a bear.
- Now discuss the colors on the cards and what those mean:** Ask the students to think about the foods they know bears eat. Now tell them the colors and letters on the cards represent different foods that bears rely on. See if they can guess which foods match the letters and colors. Help them if need be—R for roots, B for berries, I for insects, M for meat and P for plants.

E. **Now discuss the pink cards:** At this point, students will be asking and/or guessing about the pink “G” cards. If they don’t guess, explain that the pink G cards represent “garbage.”

Explain that if a ‘bear’ collects the G50 cards, they represent garbage. As opportunistic feeders, the bears (participants) do not know that garbage is not good for them. They just seek it out like any other food. Once they learn that they can get easy food from garbage they keep returning and become a human-food conditioned bear. Human food conditioned bears often become more aggressive around humans and cause problems. Bears (participants) who collected three or more garbage cards are told they were killed in defense of life and property (DLP) by a home owner, the Department of Fish and Game, or a police officer. This news is usually met with great disappointment by the students, who thought they collected enough food to make it through the winter, but learned they actually were shot in defense of life and property when they became aggressive while protecting ‘their new food source.’

#### Some questions for your students:



How many bears survived?

Was there enough food in the habitat to keep all the bears alive?

If not, how many bears did the habitat support?

How many were killed because they were conditioned to eating garbage?

#### A Little Math

Calculate a class total for all the pounds of food they gathered as bears. Divide the total by the 60 pounds needed by an individual bear in order to survive in a 10-day period. Considering the class results, how many bears could the habitat support? What percentage would have survived had the food been evenly divided? In each case, what percentage would not survive? What other limiting factors would influence the survival of individual bears and populations of bears in an area? If time is limited, you may choose to skip the class calculations but instead simply count how many bears survived and how many didn’t. What do students think would happen if more food became available in the habitat? Would more bears survive?

Students could also engage in a current events project to find newspaper articles on how bear encounters have been handled by neighborhoods, agencies and the state in general.

## Supplementary information to use with

# How Many Bears Can Live in This Forest?

Remember, black and brown bear diets vary greatly by region and season, so these figures are very generalized and based on late-summer estimates for Brown Bears in Alaska.

Admiralty Island Southeast	Alaska Range	Kenai National Wildlife Refuge	Kodiak Island
Weight: 600 lbs Range: 50 sq. mi. Lbs/day: 20  50% salmon 25% sedges 12% berries 3% salmonberries 2% currants 2% blueberries 5% devil's cub berries 3% skunk cabbage 2% horsetail 2% deer 2% voles 2% misc. intertidal carrion  <b>North Slope of the</b>	Weight: 350 pounds Range: 300-400 sq. mi. Lbs/day: 14  25% horsetail reeds 25% grass 25% bear cabbage 6% caribou 5% flowers 5% ground squirrels 3% voles 2% berries 4% roots, bees, eggs	Weight: 170 pounds Range: 165 sq. mi. Lbs/day: 6  36% fruits and berries 17.6% lowbush cranberry 7.2% devil's club 4.2% twisted stalk 7.0% misc. berries 34% animal matter 13.7% insects 10.7% moose 3.5% hares 2.6% birds 2.0% insect larvae 1.6% fish, small animals 28% green vegetation 13.6% horsetail 5.6% grass, sedge 4.4% clover 3.9% leaves, moss 2% other flowers	Weight: 600-1100 lbs Range: 20 sq. mi. Lbs/day: 20  54% salmon 3% ungulates 16% berries • salmonberries • elderberries 6% northern groundcone 3% graminoids 11% horsetails 7% forbes • cow parsnip • stinging nettle • lupine

### Bear Food Tokens for 12 or 20 Participants

These formulas can be used for smaller group sizes (12 or 20 participants).

Participants	<b>12</b>	Participants	<b>20</b>
Total Food	720	Total Food	960
Roots (orange)	15-2s	Roots (orange)	24-2s
Berries (blue)	2-26s, 13-10s	Berries (blue)	4-26s, 20-10s
Insects (yellow)	2-11s, 13-5s	Insects (yellow)	4-11s, 20-5s
Meat (red)	2-14s, 13-6s	Meat (red)	4-14s, 20-6s
Plants (green)	2-22s, 13-10s	Plants (green)	4-22s, 20-10s

## Evaluation

- **Changing variables:** Continue the discussion by asking students what they think might happen if more variables in the game were changed. What would happen if there had been more food cards? Would more bears have survived? Or what if there had been more or less students playing the game? What might have happened then? Complete the discussion by discussing the idea that a given area of black bear habitat can only support a limited number of bears. This is carrying capacity. Could the carrying capacity change? Under what conditions? If students are having a hard time grasping this, you can use the analogy of a gallon bucket. A gallon bucket is only able to contain one gallon of liquid and no more. That is its carrying capacity. What about your classroom? Let's say there are 25 students, one teacher, desk, tables and equipment. At present, there is room enough for all. It is reasonably comfortable and you can work and learn in the space. But what would happen if we brought in another group of 25 students. Or what would happen if there were fewer bears competing for the same amount of food? Would more bears survive? What would happen if there were even more bears?
- **Reality check:** Discuss how this is a simulation, or a game, and not reality. What would really happen to bears that did not get 60 pounds of food. Would they all starve? Or would they instead lose weight, or leave the area in search of food elsewhere? In an urban area, what do you think might happen if the berry crop, or an important fish run failed? Do you think bears might seek out human sources of food such as garbage, bird seed or other human foods? Discuss, too, what might happen to reproductive rates if food is scarce. Bears use a reproductive strategy known as delayed implantation where bears mate, but a pregnancy may not result if the female bear isn't well-nourished enough to support her cubs.
- **Conclusion:** Talk about the bucket, the classroom and bear habitat. What similarities and differences are there in carrying capacity? Conclude with a discussion that any piece of land can support only so many plants and/or animals. That is the land's carrying capacity. What human actions might result in a decreased carrying capacity? To what extent can individual people and societies exert a positive influence on the global environment?

## Extensions

**Math challenge:** Students record how many pounds of each of the five categories of food each gathered. Students convert these numbers into percentages of the total pounds gathered. Provide the students with the background information on the diets of bears across the state so they can compare their percentages. Students guess how healthy their bear would be. How do those bear's dietary requirements compare with those of humans for balance and nutrition?



### Additional Resources

#### Online

*Alaska Wildlife Notebook Series* [www.state.ak.us/adfg](http://www.state.ak.us/adfg)

*Living with Bears* [www.livingwithbears.com](http://www.livingwithbears.com)

#### Books

*Alaska's Bears* (Alaska Geographic)

#### Credit

Adapted from "How Many Bears Can Live in This Forest?" Project WILD K-12 Activity Guide, Council for Environmental Education, 1992.



TARGET  
GRADES  
6–8

DURATION  
**One class  
period**

GROUP SIZE  
**15–50  
Students**



## LESSON 6

# Muskox Maneuvers

### LESSON OVERVIEW

Students learn about predator–prey movements by simulating muskoxen (prey) and wolves (predator) in a physical activity. Students will recognize types of adaptations (physical and strategic) and limiting factors in a predator–prey relationship. The basic concept of this lesson can be applied or compared to other prey species and their adaptive strategies to minimize losses from predation.

**SUBJECTS** Science, outdoor learning, history, physical activity

**SKILLS** Movement, working together, modeling behavior

**SETTING** Outdoors or Indoors

**TERMS TO KNOW** Limiting factors, predators, prey, calves, bulls, cows, pups

### STATE STANDARDS

Language Arts: Speaking and Listening

SL.6.1b; SL.6.1c; SL.6.1.d;  
SL.7.1.b; SL.7.1.c; SL.7.1.d;  
S.L.8.1b; S.L. 8.1c; SL.8.1.d

Physical Education: Exhibit social behavior that respects self and others

5.E.1; 8.E.1; 8. E.3

### NGSS STANDARDS

Ecosystems, Interactions, Energy & Dynamics, Earth & Human Activity

MS-LS2-2; MS-LS2-4



### MATERIALS

- two different color of rag flags to use as tails (similar to what is used to play flag football)
- as many flags as there are wolves and calves

### GUIDING QUESTIONS



What strategies do different predators use to capture prey?

What strategies do different prey use to escape or evade predators?

What adaptations do certain predators and prey species make to live with one another?

### OBJECTIVES

- Students will explore the effectiveness of two adaptation strategies in predator–prey relationships.



## Supporting Information

**NOTE:** Although this activity does not illustrate all the complexities of predator and prey relationships, it does illustrate broad concepts.

The muskox (*Ovibos moschatus*) is a stocky, long-haired herbivore mammal with a slight shoulder hump and a very short tail. Like other herbivores, their eyes are on the side of their heads to give them a wider scope of vision. This helps them see predators coming. Inupiaq-speaking Eskimos call muskox "oomingmak", meaning "the animal with skin like a beard," a reference to the long guard hair that hangs nearly to the ground. Both male and female muskoxen have horns, but the horns of bulls are larger and heavier than those of cows. The coat consists of a long, coarse, outer layer, and a short, fine underhair. Muskoxen have cloven hooves, all four of which are the same size. Mature bulls are about 5 feet high at the shoulder and weigh 600-800 pounds. Cows are smaller, averaging approximately 4 feet in height and weighing 400-500 pounds. Single calves weighing 22-31 pounds are born between April and June to cows older than two years. Growth is rapid and the animals weigh 150-235 pounds as yearlings. These animals inhabit Arctic regions of Alaska, Greenland, and Canada where their long thick fur protects them from -50°F and high winds.

Winter herds may include up to 75 animals (both male and female). Smaller harem groups which form during the mating season contain anywhere from 5 to 15 females and sub-adults, with one dominant bull who prevents other adult bulls from entering the group.

Muskox adults vigorously defend their young. Males and females join in protecting the young from bears and wolves. Like elephants, muskox will protect their young by surrounding the babies and positioning in an inner circle; keeping their eyes on the predator. However, they will also create a line and or scatter as necessary to elude the predator, or at least create an advantage by their spacing. Researchers have found that even infant muskox that were reared by humans use these techniques to defend the herd instinctively. Muskox do charge people, dogs and other threats.

By the mid 1800's, the muskox population disappeared in Europe and Asia. Not until the 1920's had they disappeared from Alaska. In 1930, 34 muskoxen were captured in East Greenland and brought to Fairbanks. This group was then transferred to Nunivak Island, a large island in the Bering Sea. The muskoxen thrived there and, by 1968, the herd had grown to 750 animals. Muskox from the Nunivak herd were later translocated to establish new herds on the Seward Peninsula, on Cape Thompson and Nelson Islands, in the Arctic National Wildlife Refuge, and on Wrangel Island and the Taimyr Peninsula in Russia. By 2000, almost 4,000 muskoxen existed in Alaska. In recent years, the herds in the Arctic National Wildlife Refuge and adjoining areas have declined.

### Not Always Welcome Guests

Muskox sometimes ramble into the yards of unsuspecting parents and children in local villages. Muskox have destroyed property by rubbing up against posts or chewing wood, but they also defend themselves against barking dogs with their horns and hooves, actually charging the dogs. Muskox have a reputation as being gentle and non-threatening, but like any animal, they can be antagonized or provoked into action. Scientists still are not sure why muskox have begun to come into human settlements, but they do know that human/muskox interactions usually do not end well for the muskox.



# Muskox Maneuvers

**NOTE:** This activity is best done outdoors in an open, grassy area; however, it is possible to do the activity indoors—even in a room—if tables, chairs, and desks can be moved to create a large space in which students can freely move, including “tag-like” running.

**NOTE:** Use the following chart as an initial guide for dividing the class into groups. Educators can vary the proportions in later rounds to respond to what happens in the simulations.



1. Divide the class into four groups. (For example, a group of 33 students would break down into three wolves, six bulls, 12 cows, and 12 calves.) Each will have a distinctive role.
2. Give the wolves and calves the appropriate flag, and have each one wear the flag so it is hanging out of a back pocket or looped over a belt in the back. The flags need to be visible and easily removable.
3. Next, tell the students the following information: Muskox are herbivores (plant-eaters) and often graze peacefully in meadows or on the tundra. While grazing, they spread out. Calves typically do not stray too far from their mothers, but the animals do not always stay clustered—except when predators appear. As the activity begins, the students representing muskoxen are grazing peacefully and the wolves are out of sight of the herd.

### How it plays out:

4. Explain to students the role (behavior) each animal in the scenarios should exhibit.

The attack begins:

**Cows:** As soon as grazing begins, the cows should choose a lead cow to watch for predators. The cows should pick a signal that the lead cow will use to communicate to the rest of the herd that predators (wolves) are approaching. When the lead cow signals that predators are near, all the cows move closely together with their young in a straight line.

**Calves:** The calves depend totally upon the cows for protection. Each calf is to hold onto a cow with both hands on the cow’s waist, and follow only the cow’s lead. Calves cannot influence the cows’ movement.

**Bulls:** Once alerted about a predator, the bulls also gather with the cows to face the lone wolf. They, along with the cows, are active defenders as they keep the young between the adult muskox.



**Wolves:** Wolves begin the activity out of sight of the herd. They try to get as close as possible to the herd without being detected. Wolves typically work as a unit so they can attempt a strategy for surprising the herd in order to kill the calves for food. Begin by sending just one wolf out to attract the lead cow. The wolves are mobile, able to move at any time in any direction. They can use any maneuver (except pushing and shoving) to break the herd's defenses.

Allow both cows and bulls to reach for a wolf's flag. Cows still cannot use their hands or feet to block wolves. Permit bulls to move in either direction.

Soon the muskox realize there may be other wolves or sense the rest of the pack closing in around them.

The line of muskox bend to make a circle with the young and older (slower) animals to the center, cows and bulls create an outer ring. All eyes facing out, watching the circling wolves.

**Cows:** With the calves in the center of a circle, the cows stand with their backs to the calves,

facing outward to watch the wolves. The cows can move very little. Mostly, they stay firmly in one place, moving their upper bodies to block the wolves from reaching the calves. The cows cannot touch the wolves with their hands or feet.

**Calves:** Hang onto your mommas! The wolf wants to separate you from an adult where you'll be easier to catch!

**Bulls:** As the predators near, the bulls form a circle around the cows, which in turn are forming a circle around the calves. The bulls form as tight a circle as they can around the cows and calves, never any farther than one step in front of the circle of cows. The bulls can move, but only in a clockwise direction around the circle of cows. The bulls do have use of their hands. As the wolves attack the herd, the bulls try to "kill" them by pulling the flags out of their back pockets, or wherever the flag is attached. When a bull kills a wolf, the wolf moves off to the side, "dead" but able to watch the remainder of the activity.

**Wolves:** The wolves are mobile, able to move at any time in any direction. They can use any maneuver (except pushing and shoving) to break the herd's defenses. Their objective is to intimidate and confuse the herd into moving around to be able to get them to charge or stampede. This will create an opportunity to get to the young or the old animals in the center of the circle. Once a wolf kills a calf—by pulling the calf's flag out of its pocket— temporarily stop the game and move the calf's carcass to the side, where it, too, can watch the remainder of the activity.

A note about sound effects: Wolves can howl to communicate predetermined signals and to startle and confuse the muskoxen. The muskoxen can moo loudly.

**Review these muskox maneuvers:**

The muskox herd grazes quietly. The wolves are out of sight of the herd. The wolves move to attack the herd. When the lead cow spots wolves, the herd begins its defense. The muskoxen form a circle, with calves in the center, cows and bulls in an outer circle, also facing the wolves. Each should behave appropriately, as described above.

6. Remember that the activity can conclude in several ways. For example:
  - All the wolves could be killed.
  - All the calves could be killed.
  - The wolves could give up in frustration after a period of time with no success in killing a calf.
  - The wolves could kill one or more calves, and the activity would conclude because you know that the wolves are going to eat the calf (or calves) and the herd will move on.

In these scenarios, who goes on to be successful and who will die off?

7. Once the excitement and enthusiasm have peaked, sit down with the students to discuss what happened and what the activity represents in terms of animal adaptation and predator and prey relationships. Ask the students to describe and evaluate the predatory behavior of the wolves and the various defense behaviors of the muskoxen. What would happen if the wolves could not get into the herd? What would happen if the wolves always got into the herd?
8. Ask the students to brainstorm or research other examples of predator and prey relationships. Describe and evaluate the strategies of the predators and the prey in each example. How effective are these behavioral adaptations in enhancing the survivability of the species involved? What about the physical adaptations? If a wolf gets underfoot, a muskox will stomp them to death. Male muskox also have horns that extends across its entire head.



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## Evaluation

- Identify a different prey and predator relationship in Alaska. Describe how each is adapted to the other. How does the prey protect itself? How does the predator overcome this protection? Describe the overall effectiveness of each animal's adaptations.

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## Extensions

- A. A few students can research and report back to the class with more details about the life and times of muskoxen and wolves. Have them acquire additional information about their survival needs, habitat, and behaviors.
- B. Investigate predatory and defense behaviors of different species in different habitats. For example, selected species of plains/tundra, forest, desert, and ocean animals can be compared. How do other species that have a herding instinct adapt to ward off predators? (Caribou, elk, bison, elephants).

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## Aquatic Extensions

Many fish species also have effective adaptations that serve to protect them from predator species. Have one student be a predator and the rest of the students are prey. This time, the predator is a tuna, and the prey are herring in a school of fish. (Educators can pick their own example of predator and prey. Just pick a prey species that forms a school of fish.) Pantomime the school of fish moving through waters with the predator trying to catch at least one prey for food to survive. In a large open area, have the students move as the school of fish. Have three or four students inside the school of fish wear a bright-colored cloth or tie that the predator will try to remove in order to have successfully caught its prey. The school of fish must keep moving. See if the school of fish can successfully move the length of the open area at least once without any fish being caught by the predator. The predator may move in any direction and may stop and start moving at any time. The prey must move generally together and may not stop.



## Additional Resources

### Online

***Managing Predators and Prey in Alaska***, Alaska Department of Fish & Game

[www.adfg.alaska.gov/index.cfm?adfg=multimedia.main](http://www.adfg.alaska.gov/index.cfm?adfg=multimedia.main)

### Credit

Adapted from "*Muskox Maneuvers*" Project WILD K-12 Activity Guide, Council for Environmental Education, 1992.

# SECTION 3

## Sustaining Wildlife and Communities

### LESSON 1

Wildlife Uses Interview

### LESSON 2

Eye of the Beholder

### LESSON 3

Workers for Wildlife

### LESSON 4

Learning about Local Wildlife

### LESSON 5

Wrangling the Regulations

### LESSON 6

Exploring Wildlife Issues

### LESSON 7

I Propose

### LESSON 8

Can Do!

#### Introductions to Lessons 4–8

Lessons 4-8 are designed to lead students through a process that is very common in communities across the state when issues regarding development, fisheries and wildlife arise. Members of the community, who have a stake in the issue, often get involved and feel passionate about their side of the issue. Proposals are brought forward and decisions are made by various entities including school boards, city councils, and the Board of Game and Board of Fish.

In these lessons, students will become members of a community that is faced with a wildlife related issue. At the beginning of this section (Lesson 4, ***Learning about Local Wildlife***) students will learn about local wildlife and related conservation and or management issues with the species. Species can be selected from what students learned in Lesson 2 with the wildlife use interviews. In the Lesson 5, ***Wrangling the Regulations***, students will learn the reasons animals are regulated and what those regulations are. The following Lesson 6, ***Exploring Wildlife Issues***, students will write a letter stating their own personal opinion about the issue that will be researched. The letters will be turned in and then handed back to the students at the conclusion of the lessons. Students will decide if their personal opinion changed at all after all of the research. To remove some of the discomfort, students will be assigned a Point of View for these lessons. They will work in small groups to investigate the issue from the perspective they were assigned. In Lesson 7, ***I Propose***, groups will investigate possible solutions and write a proposal to the Board of Game stating the problem and solution and will role play a mock Board of Game meeting. Groups will have a chance to present their point of view to the Board which will then make a final decision on the issue. In the final Lesson 8, ***Can Do***, students will have a chance to work on a project in their community to improve wildlife habitat.





TARGET GRADES  
**6–12**

DURATION  
**2 Sessions**  
(out of class interviews)

GROUP SIZE  
**Individual**



## LESSON 1

# Wildlife Uses Interview

### LESSON OVERVIEW

Students conduct an interview. Students then report the results in the form of a letter, or podcast to the class.

**SUBJECTS** Science, language arts, social studies

**SKILLS** Analyzing results, interviewing, recording data, writing a letter, writing questions, predicting results

**SETTING** Community

**TERMS TO KNOW** Career, interview, survey, wildlife appreciation, cultural diversity



### MATERIALS

- writing paper
- poster paper
- video camera
- iPad, or voice memo feature on smart phone

### STATE STANDARDS

Language Arts: Speaking and Listening, Presentation, Comprehension and Collaboration

S.L.6.1.a; SL.6.1b; SL.6.1c; SL.6.1.d  
SL.7.1.a-d; SL.8.1.a-d; SL.6.3; SL.7.3  
SL.8.3; SL.6.4; SL.7.4; SL.8.4; SL.12.1.a;  
SL.12.1.b SL.12.1.c; SL.12.1.d; SL.10.4; SL.12.4

### NGSS STANDARDS

5-ESS3-1; MS-ESS3-4

### GUIDING QUESTIONS



Why is it important to understand the cultural diversity of Alaska and understand different values of wildlife?

What are some of the different ways subsistence can be defined?

### OBJECTIVES

- Students will discover and describe ways that Alaskans use and benefit from Alaska wildlife.
- Interviews conducted in this lesson can be used in the previous lesson *Eye of the Beholder* (Section 3, Lesson 2) to better understand different perspectives on the use and value of wildlife.



## Supporting Information

See *Insights*

- ***Wildlife Conservation Is Up to Us!***  
*Teacher's Guide for Dealing with Differing Viewpoints*  
North Slope Borough Department of Wildlife Management



### ALASKA WILDLIFE CURRICULA COMPLIMENTARY ACTIVITIES

- ***Eye of the Beholder*** (Section 3, Lesson 2)
- ***How Many Bears Can Live in this Forest?*** (Section 2, Lesson 5)
- Section 3



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## Evaluation

- Students write letters or make video reports to the people they interviewed explaining the class results (a class letter will work for younger children). If an elder is interviewed, brainstorm items to be shared or things to do for the elder to show thanks. A thank you letter to the interviewee is always appreciated.
- Students create a mural, write a story or essay titled “Wildlife in My Life.” The pieces should describe ways of using or enjoying wildlife in their community and explain why wildlife is important
- Give students five minutes to list the many ways that wildlife is used in their community.

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## Extensions

- A. List by time frame: Students make a list of ways that people in their community use or enjoy wildlife over time (a single day, a single year, and the lifetime of an individual).
- B. Invite guest speakers: Invite members of the community to come talk to your class about how they use or enjoy wildlife. Provide them with a list of the interview questions before they come so they can discuss topics that are relevant to the activity.
- C. Compile a wildlife use map. Include a local map as part of the interview form. Students ask the interviewees where they use or enjoy wildlife. Then, compile a local Wildlife Users’ Map, recording local place names. Discuss any threats to wildlife habitat in these areas. Use Google Earth to create the map. Drop pins or draw polygons around important use areas.
- D. Make rural-urban comparisons. Swap information with an urban or rural class to complement and compare to information gathered locally. Discuss how the similarities and differences might impact statewide decisions regarding wildlife?



## Additional Resources

### Online

**Alaska Board of Game** [www.adfg.alaska.gov/index.cfm?adfg=gameboard.main](http://www.adfg.alaska.gov/index.cfm?adfg=gameboard.main)

**Alaska Department of Fish and Game: Subsistence Division**  
[www.adfg.alaska.gov/index.cfm?adfg=subsistence.main](http://www.adfg.alaska.gov/index.cfm?adfg=subsistence.main)

**North Slope Borough Department of Wildlife Management**  
[www.north-slope.org/departments/wildlife-management](http://www.north-slope.org/departments/wildlife-management)

**Alaska Native Heritage Center** [www.alaskanative.net/](http://www.alaskanative.net/)

**Alaska Trappers Association** [www.alaskatrappers.org](http://www.alaskatrappers.org)

**Ducks Unlimited** [www.ducks.org/alaska](http://www.ducks.org/alaska)

**Wilderness Society** <http://wilderness.org/alaska>

**Environmental News Network** [www.enn.com](http://www.enn.com)

**Alaska Dispatch News** [www.adn.com](http://www.adn.com)

**Arctic Sounder** [www.thearcticsounder.com](http://www.thearcticsounder.com)

**Fairbanks Daily News-Miner** [www.newsminer.com](http://www.newsminer.com)

### Books

*Living with Wildlife in Anchorage: A Survey of Public Attitudes* (Whittaker)



TARGET  
GRADES  
6–12

DURATION  
1-2  
Sessions

GROUP SIZE  
1-6  
Students



## LESSON 2

# Eye of the Beholder

### LESSON OVERVIEW

Students use observation, discussion, and research to become aware of different attitudes toward wildlife and different types of relationships that people may have with wildlife.

**SUBJECTS** Science, language arts, visual arts, social studies

**SKILLS** Analysis, comparing and contrasting, communication, imagination, observation, presentation, reading

**SETTING** Indoors or outdoors

**TERMS TO KNOW** Analysis, relationship, complex, observations, Venn diagrams

### STATE STANDARDS

Language Arts: Speaking and Listening  
S.L.6.1.a; SL.6.1.b; SL.6.1.c; SL.6.1.d;  
SL.7.1.a-d; SL.8.1.a-d; SL.12.1.a-d

### NGSS STANDARDS

Ecosystems, Interactions, Energy & Dynamics, Earth & Human Activity  
MS-LS2-2; HS- LS2-8; MS- ESS3-4; HS- ESS3-1



### MATERIALS

- white board or poster paper
- a place where animals can be observed (ravens in the schoolyard, gulls at the beach, birds at a feeder, insects or fish on a field trip)
- Wildlife Perspective cards

### GUIDING QUESTIONS



How is wildlife management a complex mix of biological and social science?

Why is it important for wildlife managers to consider a variety of viewpoints?

What is a Venn diagram?

### OBJECTIVES

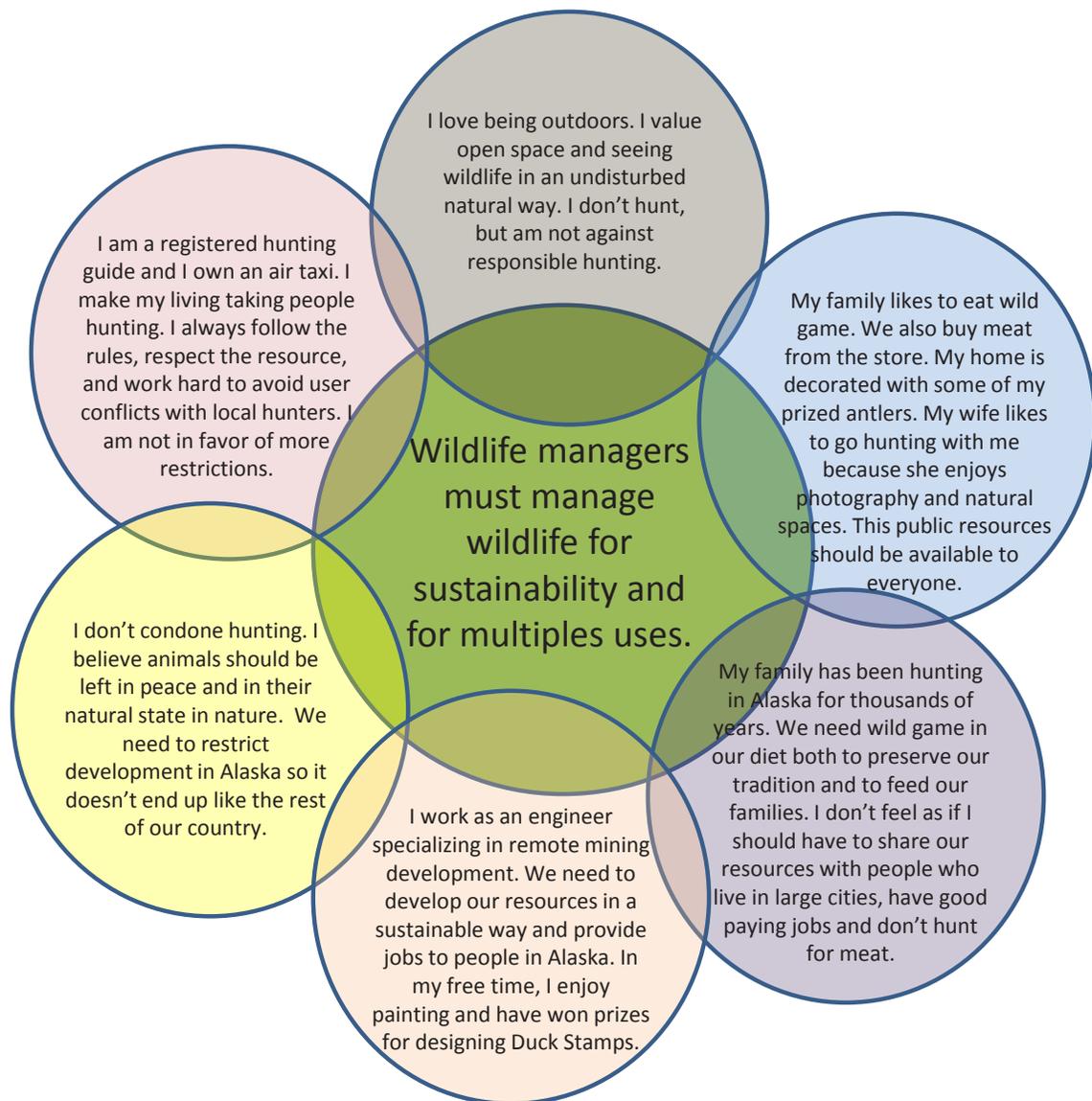
- Students will learn that management of species is complex and involves understanding that different groups of people have different value systems. These factors influence how management decisions are made.
- Students will observe an animal and express their observations employing a variety of viewpoints.
- Students will use Venn diagrams to help explain how complex wildlife value systems can be and how balancing these values are essential in wildlife management.





Example Table		
Positive	Negative	Indifferent

Example Venn Diagram- Wildlife Perspectives





# Wildlife Interview Worksheet

	YES	NO	
1. Do you eat wildlife?	<input type="checkbox"/>	<input type="checkbox"/>	What species? _____
Do you hunt?	<input type="checkbox"/>	<input type="checkbox"/>	What species? _____
Do you share your harvest?	<input type="checkbox"/>	<input type="checkbox"/>	
2. Do you wear fur clothing?	<input type="checkbox"/>	<input type="checkbox"/>	What kind? _____
3. Have you ever trapped?	<input type="checkbox"/>	<input type="checkbox"/>	What species? _____
For your own use?	<input type="checkbox"/>	<input type="checkbox"/>	
To sell?	<input type="checkbox"/>	<input type="checkbox"/>	
4. Does your job depend on wildlife?	<input type="checkbox"/>	<input type="checkbox"/>	How? _____
5. Have you ever photographed wildlife?	<input type="checkbox"/>	<input type="checkbox"/>	What species? _____
For your own use?	<input type="checkbox"/>	<input type="checkbox"/>	
To sell?	<input type="checkbox"/>	<input type="checkbox"/>	
6. Do you spend time with wildlife to have fun?	<input type="checkbox"/>	<input type="checkbox"/>	In what activities? _____
7. Do you use wildlife to create art?	<input type="checkbox"/>	<input type="checkbox"/>	What types of art? _____
For your own use?	<input type="checkbox"/>	<input type="checkbox"/>	
To sell?	<input type="checkbox"/>	<input type="checkbox"/>	

## Tally Poster for Results

	Food	Fur	Trapping	Job	Photo	Fun	Art
Yes							
No							
To Sell							
To Keep							

## Evaluation

- Have students construct Venn diagrams based on the perspectives represented in lists on the board. This can be done individually or in small group or collectively as a class.
- Students describe three viewpoints toward Alaska's wildlife and how managers have to take all views in to consideration when managing a population.

## Extensions

- A. Invite guest speakers. Bring in speakers with different points of view from the local community or nearby. (Examples include hunters, naturalists, trappers, photographers.) Ask your guests to describe their perspective on local animals and to share their observations with the class.
- B. Find local stories. Bring in a local traditional storyteller or learn a local story about wildlife and share it with the class. Work with bilingual/bicultural resource persons to develop other extensions featuring local cultural beliefs about wildlife.
- C. Multi-media viewpoints. Students photograph, videotape, or draw the animal they observed and write a set of captions from different points of view.
- D. Students read "Water Sky" by Jean Craighead George. Compare and discuss contrast the different points of view regarding the bowhead whale.
- E. Compare and contrast other wildlife knowledge. Research traditional and scientific information about other Alaskan species. Compare and contrast the information gathered.



## Additional Resources

### Online

**Alaska Native Heritage Center.** Links to Native groups. Select Education & Programs, then Cultures of Alaska for links. [www.alaskanative.net](http://www.alaskanative.net)

**ADF&G Species Profiles** [www.adfg.alaska.gov](http://www.adfg.alaska.gov)

**Alaska Science Forum** [www2.gi.alaska.edu/ScienceForum/](http://www2.gi.alaska.edu/ScienceForum/)

### Alaska Statewide Databases

Accessed through your local library website; <http://sled.alaska.edu/>

### Staff-written Alaska newspaper articles

**Alaska Dispatch News** [www.adn.com](http://www.adn.com)

**Fairbanks Daily News-Miner** [www.newsminer.com](http://www.newsminer.com)

**Alaska Fish and Wildlife News** [www.adfg.alaska.gov](http://www.adfg.alaska.gov)

### Videos

[http://video.nationalgeographic.com/video/wolves\\_gray\\_hunting](http://video.nationalgeographic.com/video/wolves_gray_hunting)

<https://www.youtube.com/watch?v=WKYotRZNiZ0>

ADFG Wolves of Alaska video <http://vimeo.com/54984209>

ADFG Pack Creek Bears video <http://vimeo.com/54984209>

### Books

*How Raven Brought Light to People* (Dixon)

*Raven: A Trickster Tale from the Pacific Northwest* (McDermott)

*Raven's Light* (Shetterly)

*Water Sky* (George)



TARGET  
GRADES  
6–12

DURATION  
5  
Sessions

GROUP SIZE  
Individual  
Whole class



## LESSON 3

# Workers for Wildlife

### LESSON OVERVIEW

Invite a wildlife biologist to give a presentation or have students watch a video or video clips found on the Internet on wildlife careers. Discuss wildlife careers in class. Students write questions to wildlife managers, and make a class portfolio about being a wildlife manager.

**SUBJECTS** Creative dramatics, language arts

**SKILLS** Letter-writing, vocabulary development, writing questions, writing nonfiction, biography

**SETTING** Indoors

**TERMS TO KNOW** Career, management, regulations, species, wildlife

### STATE STANDARDS

Language Arts: Speaking and Listening  
SL.6.2; SL.7.2

### NGSS STANDARDS

Earth and Human Activity  
5-ESS3-1



### MATERIALS

- poster paper
- paper for writing letters
- *Wildlife-Related Organizations and Careers* fact sheet
- video *Alaska's Wildlife: An inside Glimpse* by Alaska Department of Fish and Game

### GUIDING QUESTIONS



Who are the workers for wildlife?

How do socio-economic factors work into wildlife management?

### OBJECTIVES

- Students list and describe a variety of wildlife management occupations.
- Students will gather information and portray one wildlife management occupation.
- Students will understand the role that wildlife biologists and managers play and how their occupation is quite often more about managing people than animals.



### ALASKA WILDLIFE CURRICULA COMPLIMENTARY ACTIVITIES

- *Wildlife Conservation Is Up to Us!* (Insight 8)
- *Workers for Wildlife* (Section 3, Lesson 3)
- *Wildlife-Related Organizations and Careers* fact sheet



## LESSON 3

Workers for  
Wildlife

ADFG biologist Rick Merizon targets an unsuspecting ptarmigan with a net gun



## Procedure

1. As a class, brainstorm a list of jobs related to helping or working with wildlife. Help students consider a variety of jobs. Refer to Career Fact Sheet.
2. Show parts of the video, "Alaska's Wildlife: An Inside Glimpse," for examples of fieldwork that biologists do for research and management.
3. Brainstorm questions the students could ask a "worker for wildlife" about their occupation (What did they study in school? What do they do in their job?). Use the following worksheet "Wildlife Careers Interview" as an option.
4. Each student chooses a career and does an in-person or over the phone interview. Students could also write an email or a letter, asking their questions to someone in that occupation.



Biologists use helicopters to sight and collar moose



High school students team up with biologists to put radio-collars on caribou as they cross the Kobuk River at Onion Portage.

# Wildlife Careers Interview

Directions: Investigate a career related to wildlife. Contact an individual in a wildlife career and use this interview form. You may ask additional questions, or add other information that the person provides on the backside of the paper. Print neatly or type your final copy so others will be able to read it.

Career/Occupation Title: \_\_\_\_\_

1. What is the function or purpose of this job and how does it relate to wildlife?
2. How does a person in this occupation spend his/her time? What proportion is spent at a desk, in a lab, indoors, outdoors, traveling, in meetings, etc.?
3. In conducting this job, what skills are used? (writing, speaking, working with computers, numbers, measuring, physical labor, using specialized equipment)
4. What training is needed for this job? Academic or vocational? What types of classes are needed and what level of education is required?
5. Where is training available? Does this person recommend a particular school or program for training?
6. What employers might hire people in this occupation? Be specific.
7. What are the typical benefits of this occupation?  
Monetary: \$\_\_\_\_\_/ hour or \_\_\_\_\_/ year  
What are the personal rewards? (knowledge of doing something worthwhile, value to the community, to the future, chances for travel, security, prestige?)
8. Will there be a greater or lesser need for people in this occupation in the future? Specify where jobs are most likely to be available.
9. Will more training be needed in the future than is needed at present?
10. What are the best and worst parts of the job?

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## Evaluation

- Upon reviewing responses from professionals, portray various jobs using props that represents their work (for example, rain gear, cameras, binoculars, clipboards, computer maps and charts, etc.). The other students will guess the occupation.
- Students name and describe three jobs in Alaska that involve work with wildlife. Students list the type of training that is required for each job.

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## Extensions

- Turn research into Help Wanted posters:** Make “Help Wanted” posters for wildlife positions, including all the requirements of the person applying for the job. As a class, brainstorm a list of jobs related to helping or working with wildlife. Help students consider a variety of jobs. See *Fact Sheet*.
- Invite a guest speaker/interviewee.** Invite a wildlife manager or someone whose work relates to wildlife into class and interview them in person. Then make a class “biography” of that person’s occupation. Be sure to prepare the class and provide advance notice to the wildlife manager.
- Hold a natural resource job fair.** Combine this activity with career day activities or trips to other communities (see “Forest Careers” activity in Section 5 of Alaska’s Forests & Wildlife of the Alaska Wildlife Curriculum).
- Work a day in a wildlife-related job.** If you have students who are particularly interested, make arrangements for them to spend part of a day with someone in a wildlife field and report their experience to the class.



## Additional Resources

### Online

*Alaska’s Wildlife: An Inside Glimpse* (Video) (ADF&G)

*Bison and Marten* <http://vimeo.com/58911675>

*Moose and Black Bear* <http://vimeo.com/58923863>

*Caribou and Brown Bear* <http://vimeo.com/58923862>

*Sounds Wild: Malaspina Brown Bear Research* <http://vimeo.com/112115705>

*Connecting with Caribou* (Video) (ADF&G)

*Wolves of Alaska* (Video) (ADF&G) <http://vimeo.com/54984209>

*Genetics for Sustainability: Management of Bristol Bay Sockeye Salmon*  
<http://vimeo.com/110201354>

*A Visit to the Innoko Sheefish Project* <http://vimeo.com/43147238>

### Books

Sayre, April. *Put on Some Antlers and Walk Like a Moose*

Ricciuti, Edward R. *Wildlife Special Agent: Protecting Endangered Species*



TARGET  
GRADES  
**6-8**

DURATION  
**2**  
Sessions

GROUP SIZE  
**Whole**  
class



## LESSON 4

# Learning about Local Wildlife

### LESSON OVERVIEW

Students will research Alaska wildlife species and provide an oral presentation, using technology to create presentations, video or podcasts.

**SUBJECTS** Science, geography, language arts, technology

**SKILLS** Researching, writing, communication, oral presentations

**SETTING** Classroom, computer lab, and community

**TERMS TO KNOW** Scientific name, species, population, trend, range, predators, prey

### STATE STANDARDS

Language Arts: Comprehension and Collaboration, Presentation of Knowledge and Ideas

SL.6.2; SL.7.2; SL.6.3; SL.7.3;  
SL.8.3; SL.6.4; SL.7.4; SL.8.4;  
SL.6.5; SL.7.5; SL.8.5; SL.10.3;  
SL.12.3; SL.10.4; SL.12.4; SL.10.5; SL.12.5

### NGSS STANDARDS

Ecosystems, Interactions, Energy & Dynamics,  
Earth & Human Activity

MS-LS2-4; HS-LS2-2; HS-LS2-6



### MATERIALS

- access to research materials on the web, in the library, and in the community
- computers, projectors, or smart boards
- track casting materials, skulls and hides from loan collections, samples gathered from local community members.

### GUIDING QUESTIONS



What are the population trends and habitat requirements for different species in Alaska?

How do different people with different backgrounds view this species?

How might these different viewpoints influence management decisions?



## OBJECTIVES

- Students will host a **Wildlife Conservation Conversation** and invite parents, members of the school, and/or community. This conversation can include oral presentations, posters, movies, and photographs of local species.
- Students will provide the scientific, common and local name, life history, population and trend, range, predators and prey, and habitat requirement information for a specific species of Alaska wildlife.
- Students will present adaptation strategies, field sign and track information, local uses and stories relating to their chosen species.



## ALASKA WILDLIFE CURRICULA COMPLIMENTARY ACTIVITIES

- **Exploring Habitats and Biodiversity**
  - **Habitat is Where it's At!** (Section 1, Lesson 1)
  - **Schoolyard Biodiversity Investigation** (Section 1, Lesson 3)
- All lessons in Section 3

## Supporting Information

See **Insights**

- **Biodiversity and Populations—Alaska's Dynamic Wildlife**



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## Evaluation

- Students will demonstrate knowledge in each of the concept areas mentioned above relating to the species of their choice through their presentation.

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## Extensions

- A. Dramatize research for others. Students write stories about their chosen animal and perform these stories to younger students after practicing and critiquing them for their class. Stories can include traditional myth, personal experience, and information gathered in the above activity.
- B. Archive research for future users. Students can store computerized presentations on a school server, post them to the school web page, or add projects to external hard drives for future reference by other students and teachers.



## Additional Resources

### Online

**Alaska Department of Fish and Game Species Section**

[www.adfg.alaska.gov/index.cfm?adfg=species.main](http://www.adfg.alaska.gov/index.cfm?adfg=species.main)

**Alaska Department of Fish and Game Multi-media video library**

[www.adfg.alaska.gov/index.cfm?adfg=multimedia.main](http://www.adfg.alaska.gov/index.cfm?adfg=multimedia.main)

**Alaska Biological Science Center** <http://alaska.usgs.gov/>

**Alaska Natural Heritage Program** <http://aknhp.uaa.alaska.edu/>

**Alaska Statewide Databases** accessed through your local library website

<http://sled.alaska.edu/>

**Animal Diversity Web** <http://animaldiversity.org/>

**Animals of the Arctic National Geographic**

<http://animals.nationalgeographic.com/animals/photos/arctic-animals/>

### Books

***Alaska Wildlife Notebook Series*** (ADF&G)

***Alaska's Bears*** (Sherwonit)

***Alaska's Birds*** (Armstrong)

***Alaska's Fish*** (Armstrong)

***Alaska's Mammals*** (Smith)

***Encyclopedia of the Animal Kingdom*** (Kerrod)

***Facts on File Wildlife Atlas*** (Kerrod)

***Mammals of Alaska*** (Alaska Geographic)



TARGET GRADES  
6-12

DURATION  
2 Sessions

GROUP SIZE  
Whole class or small groups



## LESSON 5

# Wrangling the Regulations

### LESSON OVERVIEW

Students will learn the importance of regulations in wildlife management through a population building game and how to read and interpret wildlife hunting, trapping and fishing regulations through a scavenger hunt.

**Note to teachers:** Before beginning this lesson it would be helpful to familiarize yourself with the regulations. If you have questions contact an ADF&G employee to help or possibly visit your classroom.

**SUBJECTS** Science, geography, history, culture and society

**SKILLS** Critical thinking, understanding legal responsibilities for harvest of fish and wildlife

**SETTING** Indoors

**TERMS TO KNOW** Regulations, harvest, permits, licenses, seasons, bag limits, Board of Game, or Game Management Unit (GMU), statutes, tier II

### STATE STANDARDS

Language Arts: Speaking and Listening  
S.L.6.1.a; SL.6.1.b; SL.6.1.c; SL.6.1.d;  
SL.7.1.a-d; SL.8.1.a-d; SL.10.1.a; SL.10.1.b;  
SL.10.1.c; SL.10.1.d; SL.12.1.1-d

### NGSS STANDARDS

Ecosystems, Interactions, Energy & Dynamics, Earth & Human Activity  
MS- LS2-2; MS-ESS3-4; HS- LS2-1; HS- LS2-2; HS- LS2-7; MS-ESS3-3



### MATERIALS

- 500 pennies
- regulations books
- recent proposal (contact a local ADF&G office for this material)
- pencils or pens
- paper

### GUIDING QUESTIONS



What are hunting regulations?  
How does hunting regulation differ around the state? Between different land owners?  
Why are hunting, trapping, and fishing regulations important?  
Why are hunting regulations always changing?  
How do hunting regulations change?

### OBJECTIVES

- Students will understand how to read the hunting, trapping, and fishing regulations and why regulations are important in sustaining healthy wildlife populations. Students will learn how human populations impact wildlife populations and how regulating hunting is one tool wildlife managers use to manage wildlife resources.





## ALASKA WILDLIFE CURRICULA COMPLIMENTARY ACTIVITIES

- ***Wildlife Uses Interview*** (Section 3, Lesson 1)
- ***Eye of the Beholder*** (Section 3, Lesson 2)
- ***I Propose*** (Section 3, Lesson 7)
- ***Birds Now or Later***
- Wildlife fact cards on hunting regulations

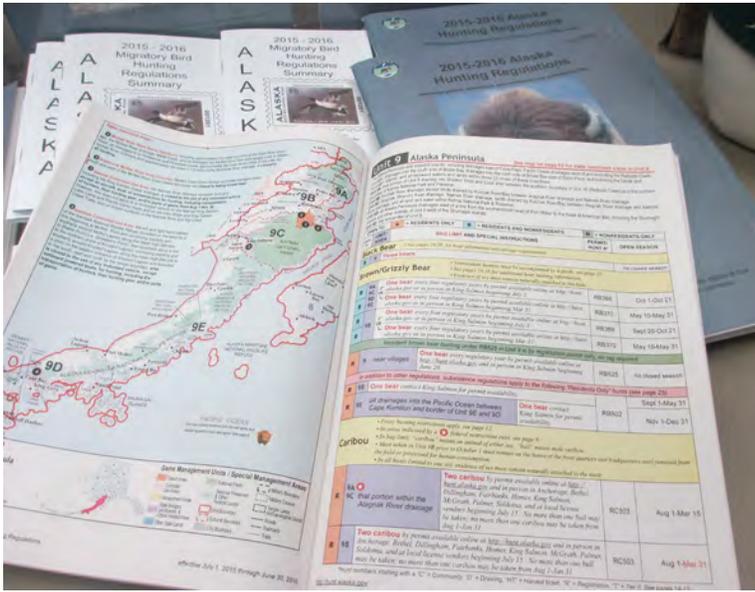
## Supporting Information



- Wildlife Fact Sheets: ***Checks & Balances, Tracking Wildlife Regulations, Hunting Regulation Vocabulary***



- Have the students record their data on a spreadsheet and graph their results. See the data sheet on the following page for an example.



### Discussion Questions

- Did you get more birds after 10 years by hunting heavily the first years or by waiting for the population to increase? What are the benefits of waiting to take animals for a few years? If one person takes all the birds now, will there be any for the future? If we take no birds now, we can all take many later. Discuss the concept of delayed gratification.
  - Did the population increase even with some hunting opportunity? How did too much hunting opportunity impact the population?
  - If there were no hunting, would the population increase beyond the limits of the habitat? (Natural predators, weather, habitat degradation would likely limit population numbers, see Section 2 in this curriculum).
- If you were a wildlife manager and wanted to increase the population, how might you do it? (Restore or improve habitat, transplants, predator reductions, limit hunting opportunities).
  - As human populations increase, what happens to hunting? What if there were no hunting regulations and everyone could hunt limitlessly?
  - How do you think traditional knowledge has been used to determine harvest levels?
  - How does the State of Alaska or federal government set hunting regulations?
  - How can you provide harvest opportunity and still keep the population stable?
  - Why is it important for wildlife managers to conduct surveys to understand where animal populations are and why do they need to do them frequently?

### Scavenger Hunt

Hike through the Regulations Book. Provide each student with a copy of the current hunting regulations book. You may also wish to use a trapping regulations or fishing regulations book. Then ask the students the following questions. Students can raise their hands and answer as a group or keep track of their answers on a sheet of paper: (30 min)

- Who can find the Game Management Unit (GMU) that includes your home? Raise your hand when you find the correct starting page.

2. Ok, now looking at the map for your GMU and list some names of other communities that are also included in that unit. Ask students if the name of a community outside their GMU is included. Answers will vary, but students should be able to use the map to identify if the neighboring community is part of their GMU.
3. Looking at the top of the first page of the GMU you are discussing, ask the students what the orange 'R', the blue "B" and the green 'N" indicate? R is resident hunters, B is both resident and non-resident, and N is non-resident hunters.
4. Below the resident/non-resident section there is a bar indicating 'bag limit', 'permit hunt', and 'open season'. Explain to students what we mean by 'bag limit' (number and/or sex of animals available for harvest), 'permit number or hunt number' (this number indicates what type of permit or ticket you need to get from your local ADF&G vendor or online), and last 'open season' refers to when that species is legally open for hunting. **You may also refer to the glossary or hunting definitions in INSIGHTS.**
5. Ask students what information is contained in the yellow bar across the page? Answers should indicate that species is listed in the yellow bar.
6. Now ask students if they can hunt black bears in their unit? If yes, why? If no, why not?
7. If students can legally hunt a black bear, what type of permit do they need? How many can they harvest? When is the season open?
8. Now ask them to tell you about a species that is a bit more complicated like moose, caribou or sheep? Who can hunt, what permit do they need, when is the season open? Are there any other special instructions?
9. Next ask students about wolverine hunting? Can they legally hunt a wolf or a wolverine? Now compare and contrast wolf or wolverine in the hunting regulations with those in the trapping regulations for your same unit. Did you notice any differences?
10. Ask students if they can hunt ptarmigan in your unit? Chances are they won't be able to find ptarmigan and they will tell you it is not in there. Now show students that the small game species are listed in the back of the hunting regulations. For small game, you find your species first and then look at the regulations for your GMU of interest below.
11. Now that the students are familiar with the regulations in their unit, hopefully you have captured their attention and the book doesn't seem so overwhelming. Now take them back to the front of the hunting regulations and look at all the other information included in the beginning. Things like who needs a license and what type, how to report, if you can buy, sell, or barter wildlife, a list of common wildlife violations, general hunting restricts on equipment, how to care for meat, and some helpful hints for identifying the difference between males, females, and young and old animals.

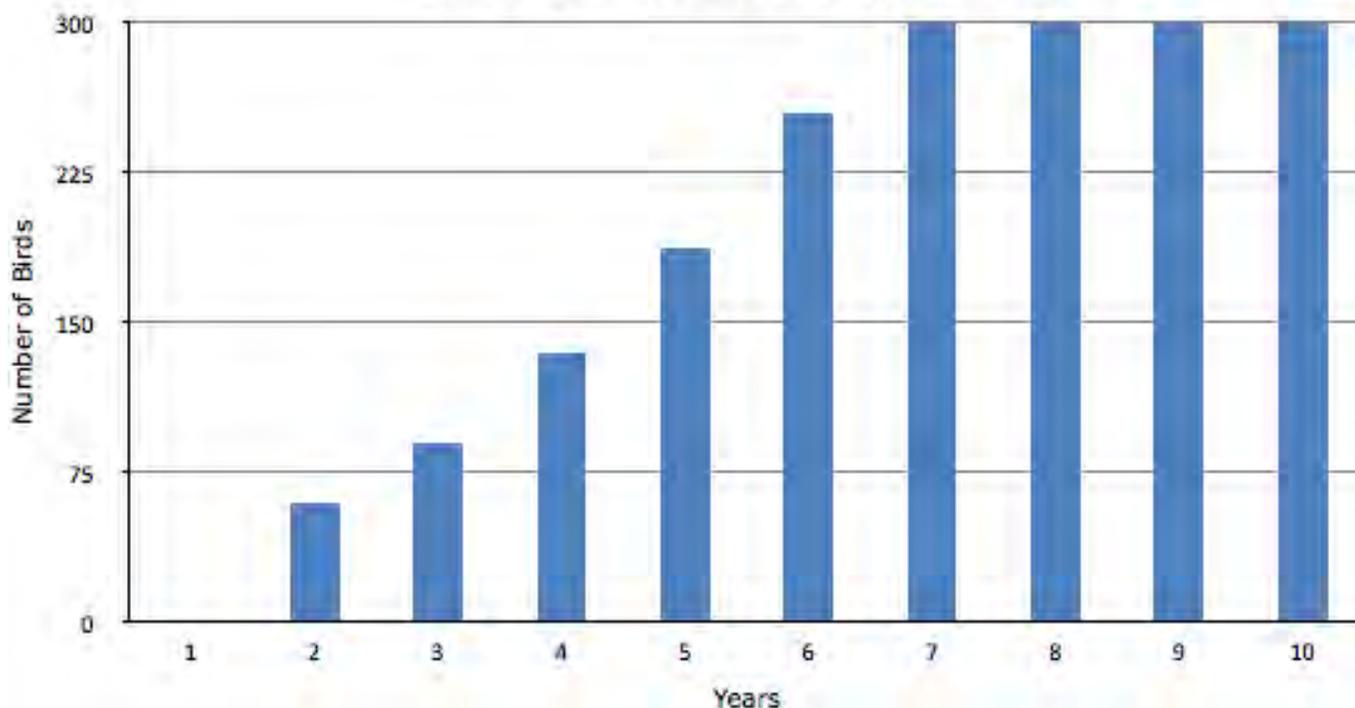
## Wrangling the Regulations

### Student Data Collection Sheet

Year	Starting Population	Number Harvested	Ending Population	Number Added (1 per breeding pair)	Ending Population	Harvest Restriction Type
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Year	Starting Population	Number Harvested	Ending Population	Number Added (1 per breeding pair)	Ending Population	Harvest Restriction Type
1	45	45	0	0	0	None
2	45	5	40	20	60	5 permits
3	60	0	60	30	90	No Harvest
4	90	0	90	45	135	No Harvest
5	135	10	125	62	187	10 permits
6	187	17	170	85	255	17 permits
7	255	55	200	100	300	55 permits
8	300	100	200	100	300	100 permits STABLE
9	300	100	200	100	300	100 permits STABLE
10	300	100	200	100	300	100 permits STABLE

Bird Population for 10 years



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## Evaluation

- Students must teach one other person how to read the regulations for their unit. Students can take the regulation book home, teach family members about their GMU or if it is possible and reasonable, have students partner with another class of students in their school. Students should work as partners and ask the other student the questions that were asked of them above.
- Students could make a poster or presentation summarizing regulations for main species hunted in their area.
- Students can present data and make graphs in Microsoft Excel or other spreadsheet programs showing changes in animal populations over time when different management techniques or types of harvest restrictions are used.

---

## Extensions

- A. Follow the same scenario above with different types of regulations (federal, trapping, fishing).
- B. Create different types of spreadsheets and graphs to represent populations, how they change with different influences including harvests, predation, changes in habitat, or disease. Make posters to represent bird population changes.



## Additional Resources

### Online

#### **Alaska Department of Fish & Game: Regulations & Species Management Reports**

[www.adfg.alaska.gov/index.cfm?adfg=regulations.main](http://www.adfg.alaska.gov/index.cfm?adfg=regulations.main)

[www.adfg.alaska.gov/index.cfm?adfg=librarypublications.wildlifemanagement](http://www.adfg.alaska.gov/index.cfm?adfg=librarypublications.wildlifemanagement)

#### **Federal Subsistence Management Program**

[www.doi.gov//subsistence/index.cfm](http://www.doi.gov//subsistence/index.cfm)

### Video

***Alaska's Wildlife: An Inside Glimpse*** Two short programs about 14 minutes each looking at wildlife and wildlife management and research in Alaska. This program looks at caribou and brown bears.

<http://www.adfg.alaska.gov/index.cfm?adfg=multimedia.embeddedvideo&videoID=58923862>

#### ***Alaska's Village Trappers***

<http://www.adfg.alaska.gov/index.cfm?adfg=multimedia.embeddedvideo&videoID=152503648>

### Publications

***Alaska Hunting Regulations***

***Alaska Trapping Regulations***

***Alaska Sport Fishing Regulations***

***Federal Hunting Regulations for Alaska***



TARGET GRADES  
6-12

DURATION  
4-6 Sessions

GROUP SIZE  
2-5 Students



## LESSON 6

# Exploring Wildlife Issues

### LESSON OVERVIEW

Students research a wildlife conservation issue and write “Letters to the Editor” that are supported with pertinent and accurate information. Students will explain the problem and potential solutions.

**SUBJECTS** Science, language arts, social studies

**SKILLS** Analysis, discussion, persuasive argument, role play, critical thinking, reading critically

**SETTING** Indoors

**TERMS TO KNOW** Facts, opinions, controversial, persuasive, government, agency, viewpoints

### STATE STANDARDS

Language Arts: Reading Informational Text, Reading Social Studies, Writing

SL.6.1.a; SL.6.1b; SL.6.1c; SL.6.1.d;

SL.7.1.a-d; SL.8.1.a-d; SW.6.2;

SL.7.2; SL.6.3; SL.7.3; SL.8.3; RI.6.7;

RI.6.8; RI.6.9; RI.7.8; RI.7.9; RI.8.8; RSS.8.7; RSS.8.8; W.6.1a;

W.6.1.b; W.6.1.c; W.6.1.d; W.6.1.e; W.7.1.a-e; W.8.1.a-e; W.6.4;

W.7.4; W.8.4; W.6.7; W.7.7; W.8.7; W.6.8; W.7.8; W.8.8

### NGSS STANDARDS

Ecosystems, Interactions, Energy & Dynamics, Earth & Human Activity

MS-LS2-4; MS-LS2-5; MS- ESS3-4



### MATERIALS

- newspaper articles related to a specific wildlife conservation issue
- access to websites, biologists, community groups, books, research papers, etc.
- paper
- pens
- computers

### GUIDING QUESTIONS



What is the difference between a fact and an opinion?

What do we mean by saying an issue is controversial?

How do we take both facts and opinions into consideration when looking at a controversial topic?



## OBJECTIVES

- Students will learn to read critically.
- Students will use the Internet and library to gather supporting facts and opinions on a wildlife conservation issue.
- Students will study a controversial issue related to wildlife conservation to learn that issues are often complex, requiring creative solutions.
- Students will clarify their opinions regarding an issue and support their opinions with factual information.



## ALASKA WILDLIFE CURRICULA COMPLIMENTARY ACTIVITIES

- *Eye of the Beholder* (Section 3, Lesson 2)

Research done in this section will be used in:

- *I Propose* (Section 3,; Lesson 7)
- *Can Do!* (Section 3, Lesson 8)

## Supporting Information

### Wildlife Conservation Is Up to Us! (Insight 8)

- *Tracking Wildlife Regulations*
- *Teacher's Guide for Dealing with Differing Viewpoints*



3. Pass out a perspective card to each student. Have students with similar cards get into a group.
4. Hand out a large piece of butcher paper to each group. Have each group read through the resources and prepare an outline of the problem from their group's point of view. Information listed must be supported by facts and information from the materials. Groups should list as many details about the issue as possible from their point of view on the butcher paper. Details should include; pros or cons, who will be impacted, financial ramifications, effects on wildlife, people and habitat.
5. Students use the group outline to write their own opinion pieces in the form of "Letters to the Editor." Keep all written materials available for students to refer to as they write. These letters can be used to help students write proposals to the Board of Game in the next section.
6. Have students from each group peer review and comment on the drafts of each other's letters. They should check for content and use of opinions substantiated by accurate information and facts. Also provide feedback regarding grammar, spelling, and sentence structure. Explain that a poorly written letter has less impact than a well-written letter.
7. Return letters to students for a final rewrite. When letters are completed, grade and return.
8. If students wish to submit their letters for publication, parental letters of permission are recommended.

## Evaluation

- Return the original one-page assignment from the first session and discuss how your opinion may or may not have changed.
- Students read their final letters to the class aloud. These letters should provide an opinion, supported by strong arguments and relevant factual information. They should be persuasive as well.
- Ask students how their opinions changed after studying the issue in detail.
- Lead a discussion on how their written work changed from the start of the project to the current time. What conclusions have the students drawn?



## Additional Resources

### Online

**Alaska Hunting Regulations** [www.adfg.alaska.gov/index.cfm?adfg=hunting.huntingregulations](http://www.adfg.alaska.gov/index.cfm?adfg=hunting.huntingregulations)

**Alaska Native Heritage Center** [www.alaskanative.net/](http://www.alaskanative.net/)

**Alaska Outdoor Council** [www.alaskaoutdoorcouncil.org/](http://www.alaskaoutdoorcouncil.org/)

**Alaska Science Forum** [www2.gi.alaska.edu/ScienceForum/](http://www2.gi.alaska.edu/ScienceForum/)

**Alaska Wildlife Alliance** [akwildlife.org/](http://akwildlife.org/)

**Office of Subsistence Management** [www.doi.gov//subsistence/index.cfm](http://www.doi.gov//subsistence/index.cfm)

### Books

***Guardians of Wildlife*** (Chandler)



TARGET GRADES  
6-8

DURATION  
3-4 Sessions

GROUP SIZE  
Whole class or small groups



## LESSON 7

# I Propose!

### LESSON OVERVIEW

Students study a wildlife management issue in depth, study the wildlife regulatory process, and present a mock (or real) proposal to the Alaska Board of Game.

**SUBJECTS** Science, government and citizenship, social studies, language arts

**SKILLS** Reading, writing, problem solving, and researching an issue

**SETTING** Indoors; community

**TERMS TO KNOW** Alaska Board of Game, Advisory Committees, permit, regulations, proposal, seasons, statutes, wildlife

### STATE STANDARDS

Language Arts: Reading Informational Text, Reading Social Studies, Writing,

S.L.6.1.a; SL.6.1b; SL.6.1c; SL.6.1.d;

SL.7.1.a-d; SL.8.1.a-d; SW.6.2; SL.7.2;

SL.6.3; SL.7.3; SL.8.3; RI.6.7; RI.6.8;

RI.6.9; RI.7.8; RI.7.9; RI.8.8; RSS.8.7; RSS.8.8; W.6.1a; W.6.1.b;

W.6.1.c; W.6.1.d; W.6.1.e; W.7.1.a-e; W.8.1.a-e; W.6.4; W.7.4; W.8.4;

W.6.7; W.7.7; W.8.7; W.6.8; W.7.8; W.8.8

### NGSS STANDARDS

Ecosystems, Interactions, Energy & Dynamics, Earth & Human Activity

MS-LS2-4; MS-LS2-5; MS- ESS3-4

### GUIDING QUESTIONS



Why do we need hunting, fishing and trapping regulations?

What is the role of the public in the regulatory process?

What is the role of the Alaska Board of Game in the regulatory process?

How are regulations proposed, changed or rejected?

### OBJECTIVES

- Students will explain how regulations are created through the Alaska Board of Game process.



### MATERIALS

- information provided on the Alaska Department of Fish and Game website (regarding regulations, Board of Game proposals, wildlife populations, and issues)
- paper
- pens
- smart board
- copies of Regulation Proposal Form





## ALASKA WILDLIFE CURRICULA COMPLIMENTARY ACTIVITIES

- ***Eye of the Beholder*** (Section 3, Lesson 2)
- ***Wrangling the Regulations*** (Section 3, Lesson 2)
- ***Can Do!*** (Section 3, Lesson 8)
- ***Birds Now or Later in Wetlands*** or ***Harvesting Wildlife in Alaska Wildlife*** Alaska Wildlife Curriculum, Wetlands and Wildlife Volume

## Supporting Information



***Wildlife Conservation Is Up to Us!*** fact sheets  
***Hunting Regulation Vocabulary*** fact sheets  
***Tracking Wildlife Regulations*** fact sheets  
***Check & Balances for Wildlife Regulations*** fact sheets  
***Teacher's Guide for Dealing with Differing Viewpoints***  
Understanding the Board of Game



3. Ask each group to draft one proposal. If there are distinctly different proposals, let the groups splinter into smaller groups. As with the actual Board of Game, there may be many approaches to a specific issue.



4. Students present their finished proposals to the class. If there are several proposals relating to one issue, clump these together and conduct a discussion when all have been presented.
5. As a class, discuss the strengths and weaknesses of each proposal, both in presentation and content.
6. To take this lesson one step further, take one proposal and conduct a 'Mock Board of Game' with students. Follow lesson plans below for an in depth evaluation component of this lesson.

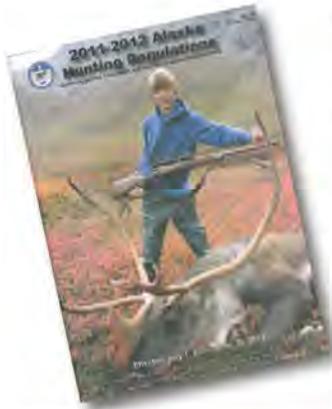
### Day Three

Conduct a 'Mock' Board of Game meeting. Designate a seven member Board of Game, a hunter, a biologist, and members of the public. Have one student present their proposal to the Board of Game, have students use either accept or reject the proposal based on evidence and proposal quality.

**Overview:** In this lesson students play different roles in a mock meeting. This exercise works best if the class is familiar with working in small groups. Previous experience with role play may be helpful but is not essential. This works best with between 12-20 students per class.

1. Choose a seven-member 'Board of Game'. Board of Game members are appointed by the governor and confirmed by the legislature (you as the teacher). Appoint one student as the chairman of the board who will run the meeting. Use the 'Chairman Instructions' handout at the end of this lesson to help the chairman with running this lesson. It is a good idea to choose students from diverse backgrounds and perspectives. The proposal passes with a majority vote of the seven member board.
2. Use the perspective cards from the Eye of the Beholder activity at the beginning of this section for the audience for the Board of Game and assign them to students. Teacher or students choose one student to present the proposal. This should be a student familiar with the proposal. You may need to give this student some time to write up his presentation or practice following the proposal sheet he already completed. Depending on the proposal it could come from a biologist or member of the public. The public will have an opportunity to comment on the proposal.
3. Choose one proposal to move forward as a class. It could be one that was used as the class example or one of the student's proposals that has generated the most interest.

4. Give students some time to familiarize themselves with their roles. Make it clear to students that they may not necessarily agree with the role they are assigned, but they are to uphold these perspectives for the sake of this lesson.
5. If the chairman feels comfortable with his role as leading this session, he can follow the attached instructions. If not, the teacher can prompt students on what happens next.
6. Before beginning go around the room, starting with the Board chairman have students introduce themselves and who they are or what they do for a living.
7. The board chairman will follow the attached instructions for asking for the 'presentation of the proposal', period of public testimony, and then for a call for voting.
8. **Note:** this is a condensed version of the multi-day approach for real Board of Game sessions, but will familiarize students with how proposals are made, approved or not, and then how regulations are made.



### Want to know more?

To find out more about Advisory Committees or how to submit a proposal, contact Board Support in your area:

#### Arctic Region:

442-1717

#### Interior Region:

459-7263

#### Southwest Region:

842-5142

#### South Central Region:

267-2354

#### Southeast Region:

465-4110

# Understanding the Board of Game

## Or...Do you know how hunting and trapping regulations are made?

It often comes as a surprise to many Alaskans to learn that the state's hunting and trapping regulations are NOT made by the Alaska Department of Fish and Game (ADF&G). This job falls to the Board of Game, a group of seven people appointed by the governor and approved by the legislature.

While the Board makes the final decisions, the process provides several ways in which all Alaska residents can participate. Here's how it works.

### The Board considers the needs of wildlife and Alaskans

The Board of Game receives written proposals, comments, and oral testimony from members of the public, local Fish and Game Advisory Committees, and ADF&G biologists. The Board then attempts to pass regulations that respond to people's concerns, while also considering the need for long-term conservation and sustainable use of wildlife. Board of Game meetings are open to the public and provide opportunity for public comment.

### The role of Advisory Committees

There are more than 80 Advisory Committees covering all areas of the state, each with up to 15 locally-elected members. Each committee listens to and discusses local concerns about hunting and trapping regulations and then submits proposed regulation changes to the Board of Game. The Advisory Committees also provide comments and recommendations to the Board on proposals that would impact the resources in their area. These same Advisory Committees interact with the Board of Fisheries in a similar manner.

### The role of ADF&G

ADF&G biologists share the results of wildlife surveys and other biological and habitat studies with both the Advisory Committees and the Board of Game. The biologists work closely with the advisory committees to develop proposals for Board consideration, and also submit independent ADF&G proposals to the Board.

### The role of the individual

Any individual may submit a proposal to the Board of Game for a change to the hunting or trapping regulations. The Board Support Coordinator for your region can assist you in writing a proposed change, and provide you a proposal form. You can also file a proposal online or find the form at: [www.boardofgame.adfg.alaska.gov](http://www.boardofgame.adfg.alaska.gov) You may also submit written comments to the Board on proposed changes, and sign up to present public testimony at a Board meeting. Contact your regional coordinator (see list at left) for details and meeting schedules, or visit [www.adfg.alaska.gov](http://www.adfg.alaska.gov)

### The value of working together

While the Board considers all proposals submitted by individuals, Advisory Committees, and ADF&G, a proposal that has first been reviewed and agreed upon by the above entities demonstrates to the Board that there is considerable support for the proposal.

# How regulations are made

## The Public



**People** can bring concerns to their local Advisory Committee, submit their own proposals directly to the Board of Game, and provide written comments and oral testimony to the Board.

## Local Advisory Committees



**Advisory Committees** discuss local wildlife observations and issues, seek information from ADF&G, and submit proposals about hunting regulations to the Board.

## ADF&G



**ADF&G** biologists provide information to the advisory committees, submit their own proposals to the Board of Game, and provide biological information about wildlife to the Board.

## Board of Game



**Board of Game** meetings are held 3 times a year. Proposals from each major region are typically considered once every two years. Meetings are generally held in the region whose proposals are being considered.

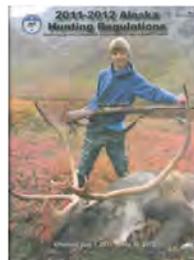
**Board of Game** meetings are open to the public, and everyone is encouraged to attend.

**Decisions are reached by a majority vote of the Board**

**The decisions are given legal review and made official by the Lt. Governor**

**Want to know more?**

[www.boardofgame.adfg.alaska.gov](http://www.boardofgame.adfg.alaska.gov)



The **Hunting and Trapping Regulations** are made available to the public by ADF&G, and are enforced by the Alaska Wildlife Troopers.



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## Evaluation

- Write a strong regulation proposal with scientific and accurate background information as an independent assignment.
  - Describe the process by which Alaska wildlife regulations are created and changed in essay form
- 

## Extensions

- Submit proposals to the Board.** If student-generated proposals are deemed feasible by the class AND if students have permission from their parents (and you from your administration), students submit their proposals to the Board of Game and follow them through the process.
- Attend meetings and take notes.** Attend Fish and Game Advisory Committee and/or Board of Game meetings. Students record meeting notes and their observations of people providing testimony as well as the committee/ board members. Back in class, students share their observations and discuss their views on the process.
- Civic lesson.** Introduce the concept of “checks and balances” in the democratic process. Using the “Checks & Balances for Wildlife Regulations” chart (from INSIGHTS), ask students to find places within the Board of Game process where checks and balances exist. Ask students to identify areas where they think the process is effective or problematic. Compare this public process to other public processes to further identify strengths and weaknesses.



## Additional Resources

### Online

**Alaska Board of Game** [www.adfg.alaska.gov/index.cfm?adfg=gameboard.main](http://www.adfg.alaska.gov/index.cfm?adfg=gameboard.main)

**Alaska Hunting Regulations** [www.adfg.alaska.gov/index.cfm?adfg=hunting.huntingregulations](http://www.adfg.alaska.gov/index.cfm?adfg=hunting.huntingregulations)

**Alaska Native Heritage Center** [www.alaskanative.net/](http://www.alaskanative.net/)

**Alaska Outdoor Council** [www.alaskaoutdoorcouncil.org/](http://www.alaskaoutdoorcouncil.org/)

**Alaska Science Forum** [www2.gi.alaska.edu/ScienceForum/](http://www2.gi.alaska.edu/ScienceForum/)

**Alaska Resource Library and Information Services ARLIS** [www.arlis.org/about/public/](http://www.arlis.org/about/public/)

**Alaska Wildlife Alliance** [akwildlife.org/](http://akwildlife.org/)

**Office of Subsistence Management** [www.doi.gov//subsistence/index.cfm](http://www.doi.gov//subsistence/index.cfm)

**Anchorage Dispatch News** [www.adn.com](http://www.adn.com)

**Fairbanks Daily News-Miner** [www.newsminer.com](http://www.newsminer.com)

### Books

Chandler, Gary. *Guardians of Wildlife*



TARGET  
GRADES  
6-8

DURATION  
**Three**  
**45-min.**  
**Sessions**

GROUP SIZE  
**Any**  
**size**



## LESSON 8

# Can Do!

### LESSON OVERVIEW

Students develop a community action project. Include a planning form to help with this activity.

**SUBJECTS** Social studies, language arts, science

**SKILLS** Analysis, application, description, discussion, evaluation, invention, listing, public speaking, problem-solving, group work, synthesis, writing

**SETTING** Indoors or Outdoors

**TERMS TO KNOW** Alternatives, authority, compromise, constructive, problem, realistic



### MATERIALS

- writing materials
- materials specific to chosen project. Have students generate a list of materials they will need and check with a teacher or community project leader before beginning.

### STATE STANDARDS

Language Arts: Speaking & Listening  
SL.6.4; SL.7.4; SL.8.4

### NGSS STANDARDS

Ecosystems, Interactions, Energy & Dynamics, Earth & Human Activity and Engineering Design  
MS-LS2-5; MS-ESS3-3; MS-ETS-1

### GUIDING QUESTIONS



- What are some local issues we have for helping wildlife?
- How can we help improve habitat for local wildlife?
- How do we begin, undergo, and complete a community project?

### OBJECTIVES

- Students will identify a problem involving wildlife on their own school grounds, community or region.
- Students will suggest and evaluate ways to solve or improve the situation.
- Students will undertake the project.
- Students will analyze and describe the process they used to solve the problem or improve the situation.





## ALASKA WILDLIFE CURRICULA COMPLIMENTARY ACTIVITIES

- All Sections

### Background



See **Insight**

- *Wildlife Conservation Is Up to Us!* (Insight 8)

# Can Do!



## NOTES

A large rectangular box with a thin orange border, containing ten horizontal lines for writing notes.



## Procedure

**NOTE:** Use your judgment to assist students in selecting a project that is realistic, constructive, and possible. If the project is unrealistic or the problems insurmountable, the students may get frustrated and develop an attitude of “can’t do.” Start small!

1. Introduce the definition of problem—a difficult situation to be improved, or an opportunity to make things better. Problems can’t always be “solved,” but situations can usually be improved.
2. Brainstorm problems on the school grounds that negatively impact wildlife. Consider heading outside to brainstorm so students can see problems they might like to address. If your school grounds are not suitable, consider other locations within the community. The following may give you some ideas; however student creativity with a local emphasis will engage students more in the project.
  - litter that poses a hazard to some kinds of wildlife;
  - wet areas that birds use for water but that has been recommended for paving to minimize dust and mud;
  - a proposed pesticide spraying that will not only kill the “pest” but perhaps affect other plants and animals;
  - removal of a tree or shrubs that currently help clean the air, produce oxygen, and provide food and shelter for varying kinds of wildlife.
  - bears getting into trash cans
  - invasive plants taking over an area
3. Look at the list with the students and help them identify problems that they can realistically handle. If students have difficulty deciding between projects, they might give short speeches on why they feel one project should be chosen and then take a vote. The list below are some possible project ideas. However encourage the students to think of their own ideas to benefit their school and community prior to consulting the list.
  - Plant native shrubs or trees in the schoolyard to provide food and shelter for birds and other animals. Do so with moose or a specific type of bird in mind to give students room for safe observations.
  - Set up and maintain bird feeders.
  - Build and place bird houses.
  - Develop a local advertising campaign how plastic litter hurts wildlife.
  - Organize or participate in a litter clean-up of your schoolyard or the local area.
  - Develop a set of class “rules” for field trips to a natural area. Consider the effects of student activities and how to avoid disturbing wildlife and their habitat.
  - Visit refuges or other areas where wildlife management programs are occurring. Arrange to talk with a wildlife

manager and ask questions during your visit. Work with the refuge staff to establish how the class can support the refuge.

- “Reduce-Reuse-Recycle” projects help wildlife by reducing the demand for materials whose production results in loss of wildlife habitat. Recycle newspapers, aluminum cans, or anything else that can be recycled in your community.
  - Set up a classroom recycling center for toys, paper, or other items that can be exchanged by students and reused.
  - Build a school compost box to demonstrate recycling of organic materials as an alternative to landfills or commercial fertilizers that could cause water pollution. (See “Create a Classroom Compost Box” activity in Alaska’s Ecology, Section 2; or contact the University of Alaska Cooperative Extension Service.)
  - Take a field trip to the grocery store to look for unnecessary packaging of items sold and write a letter to the company encouraging them to use less packaging.
  - Start a school garden, green space, or school yard habitat.
  - Wildflower Wise- Talk about the importance of preserving native species and begin a project to eradicate invasive.
  - Wildlife Safety messaging. Do you have an issue with wildlife on your school grounds? Bear, muskox, moose or fox perhaps? Develop a wildlife safety plan and teach younger kids.
  - Storm drain awareness or stenciling
  - Recycle projects
  - Promote clothes line usage
  - Plant trees
  - Make water filters
  - Grow local or native plants
  - Promote wild Alaska foods
  - Marine debris clean up
  - Special types of wildlife proof trash cans
4. After selecting the project, students work in small groups to generate ideas for solving or improving the problem. Each group should devise one plan that includes a written description and illustrations or sketches showing how it will work and how it can be accomplished. Project Planning Guide.
  5. Groups present their solution to the rest of the class. Other students may ask questions for clarification. Once all the plans have been presented, ask the students to select the plan that seems most constructive, realistic, helpful to wildlife, and apt to make a lasting contribution.
  6. Ask students to select an alternative plan in case the first is not acceptable to the school authorities.
  7. Students select representatives to present the proposal to the principal, other appropriate school authorities, and community members or organizations (consider janitors, other teachers, school board members, the community council, neighbors to the school).
  8. Students make an appointment to present their proposal.
  9. Hold a practice session in the classroom prior to the presentation.
  10. Delegates report to the class after their official presentation. Are there compromises to be made?
  11. After approval from all relevant authorities, the class proceeds with their project.

# Can Do! Project Planning Guide

1. What is the wildlife problem, issue, or need?
  
2. Who is your audience? (who will be using the area or who are you trying to convince to change?) You may have multiple audiences to consider.
  
3. What are the goals of this project? Specifically list out what you hope to accomplish.
  
4. List ways you plan to accomplish these goals?
  
5. Name some ways that you'd measure whether you've accomplished goals in the end.
  
6. Write a plan to do one or more of the items identified in #6 including a timeline with specific tasks to complete.

Product:

Audience	Date to begin work	Date work is to be completed	Goal	Student's Name

## B. Plan Project Deliverables

Project Title:

Project team names:

How much will this project cost? Who will pay for it? How will you get supplies.

Approval by teacher to begin project:

Evaluation: Write a report describing how the plan turned out, what you might do differently in the future, and what you would recommend for sustainability. Also be sure to include photographs, videos, or personal communications in your report.

Final project approved by teacher: Date: \_\_\_\_\_ Grade: \_\_\_\_\_

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## Evaluation

- Students analyze the results of their project. Did things work out as they wanted them to? Were there any surprises? How might they have been more effective?
- Students write reports on the progress and effectiveness of their project.
- Students present their project at a School Board, Advisory School Council or City Council meeting.

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## Extensions

- A. Students choose a wildlife-related issue in their community and follow the local advisory committee process, attending meetings, and following one-two proposals throughout the year. See ***I Propose*** (Section 3, Lesson 7).



## Additional Resources

### Online

***How genetics is used to reduce overharvest.*** Video about genetic studies of sockeye salmon in Bristol Bay. <http://vimeo.com/110201354>

Video about brown bear research in Yakutat. <http://vimeo.com/112115705>

### **Alaska Department of Fish and Game Citizen Science**

[www.adfg.alaska.gov/index.cfm?adfg=citizenscience.main](http://www.adfg.alaska.gov/index.cfm?adfg=citizenscience.main)

Video about **bat research** in SE AK <http://vimeo.com/89359691>

**UAF Cooperative Extension Composting** [www.uaf.edu/ces/ah/soils/](http://www.uaf.edu/ces/ah/soils/)

***Birdhouses for Alaska, Winter Bird-feeding in Alaska and Landscaping for Wildlife*** [www.adfg.alaska.gov/index.cfm?adfg=livingwithbirds.winterfeeding](http://www.adfg.alaska.gov/index.cfm?adfg=livingwithbirds.winterfeeding)

**EPA Wastes** [www.epa.gov/wastes](http://www.epa.gov/wastes)

### Books

EarthWorks Group. ***50 Simple Things Kids Can Do to Recycle*** ()

Lavies, Bianca. ***Compost Critters***

Lewis, Barbara A. ***Kid's Guide to Social Action***

Langone, John. ***Our Endangered Earth: What We Can Do to Save It***

Kalman, Bobbie. ***Reducing, Reusing and Recycling***

Pringle, Laurence. ***Taking Care of the Earth***

### Credit

Adapted from "Can Do!" Project Wild K-12 Activity Guide, Western Regional Environmental Education Council, Boulder, CO, 1992.

# INSIGHTS AND BACKGROUNDS

## INSIGHT 1

Habitat: Basis for Survival

## INSIGHT 2

Microhabitats and Biodiversity

## INSIGHT 3

What are Maps?

## INSIGHT 4

Location Ideas for Collection and Field Trip Site

## INSIGHT 5

Wildlife Populations

## INSIGHT 6

Population Explosions

## INSIGHT 7

When Populations Decline—Losing Biodiversity

## INSIGHT 8

Wildlife Conservation is Up to Us

## INSIGHT 9

Predator—Prey

## INSIGHT 10

Muskox Returns to Alaska

## INSIGHT 11

Wildlife at a Glance

## INSIGHT 12

Workers for Wildlife

## INSIGHT 13

Hunting and Regulations



## HABITAT: BASIS FOR SURVIVAL

To survive, all living things need food, water, shelter (or cover), and space presented in a suitable arrangement that fits their specific needs. These elements are habitat requirements or survival needs.

**FOOD:** We wouldn't live long if we only had branches to eat, but a moose would.

**WATER:** We require freshwater to drink, but a harbor seal lives all its life in saltwater.

**SHELTER/COVER:** We can build a house on a hilltop, but a salmon would die up there.

**SPACE:** Swans can nest, feed, and hide in a square mile of tundra, but would not survive in a square mile of city streets and buildings.

Insects, spiders, frogs, worms, as well as plants, fish, birds, and mammals can live only where the environment provides accessible necessities. Highways, houses and other barriers might interfere with a species access to these needs.

### Think about it!

- If you dropped a polar bear in Southeast Alaska—even though there is food, water, shelter, and space—it would struggle to survive. Southeast Alaska does not provide the right kind of food, water, shelter, and space for an arctic marine mammal! Can you think of why the Arctic Coastal Plain is a better habitat for a Polar Bear?

### Seasonal Variations

An animal's habitat requirements may be different at different seasons and times in its life. Some wildlife use multiple habitats, either daily, periodically or seasonally.

### Think about it!

- A female polar bear will den (shelter) from November through April to give birth to cubs. After the cubs are old enough to emerge from the den, she will not use a den again until the next time she is pregnant.
- A brown bear will dine hungrily on tender roots and sedges in spring when few other foods are available. When salmon swim into nearby streams from the ocean, the brown bear will walk past sedges to fish for the high protein salmon. In early fall, the bear will leave the salmon stream and gorge itself on berries.

### Habitat: Sizes and Places

Wildlife managers also study the 'home range' of different species. The home range is the area in which that animal usually confines its daily activities. That home range needs to be a habitat that sustains that animal. They might stay within that home range and never leave it, or move locally or migrate long distances in search of their habitat needs.

When asking why an animal is found on the south-facing slope of a mountain and not on north-facing slopes, it is also important to understand the influences of topography, soil, sunlight, temperature, wind, snow, and permafrost, or the ecology of the area. This is the study of the interactions between and among living things and their nonliving environment. These elements make up a habitat.

**Think about it!**

- Mosquitoes are infamous for their abundance in Alaska, but their habitat needs can be met in a small area. Both male and female mosquitoes sip plant nectar for food, but the female needs a blood meal from a warm-blooded animal to produce the eggs she will lay on the surface of any nearby water. Their 'range' can be quite small.
- Sandpipers that migrate to Alaska each summer need a shoreline for feeding and dry ground for nesting, but they also need their several thousand mile-long migratory flight path and the winter shore and land area to take care of their yearly habitat needs. They occupy more than one habitat and move to the appropriate habitat for their particular needs. Their range within each habitat can be large or small.

## Adaptations; Strategies for Survival

There are many ways in which living things are finely adapted to survive and thrive in their ecosystem. Over time, the physical characteristics of a species change and that species fills a niche seasonally or permanently. Lynx are suited for winter climates with heavily furred, wide paws that spread out their body weight across the snow, much like snowshoes prevent people from sinking in deep snow.

- The large claws of the brown bear aid in fishing and digging.
- Wolves splay out their feet when heading downhill, over ice, or mud for better balance and grip.
- Ptarmigan and hares change color with the season to help them blend with their surroundings.

Wildlife also adapt with behavioral strategies such as migration or hibernation. Birds migrate to find habitat that is best suited for nesting and raising young in spring and summer, and that may be different than the habitat that will support them through the winter. Wildlife will also migrate elevationally, moving from higher elevations in summer (like productive alpine meadows) to lower elevations in winter.

Understanding each animal's specific needs at different times of the year and where in nature those needs are met is the key to finding or seeing wildlife. The Alaska Ecology Cards available as part of this curriculum are handy references for habitat and food requirements of Alaska organisms from all five kingdoms (animals, plants, fungi, monerans, and protists).

## Biodiversity, Abundance and Distribution

Biodiversity (biological diversity) is a measure of the variety and number of different organisms and ecosystems—locally, regionally, and globally.

- Abundance is the number or population of a particular species within an ecosystem.
- Distribution is the natural geographic range where a species can be found.

A species is a group of organisms that are alike and that are able to breed and produce fertile offspring under natural conditions.

Biodiversity is a measurement of concern in the 21st century. All living things exist in biotic (living) communities—ecosystems—with a complex web of roles. Each species has adapted to fill specific niches (detritivores, producers, consumers, for example) Biodiversity allows ecosystems to respond with flexibility to damage or change.

### *Think about it!*

- The more numerous the detritivores are in an ecosystem, the better that job will continue to be done if one or more species are weakened or removed.
- If a forest is attacked by spruce bark-beetles, that forest will be radically changed if only one kind of tree—spruce—grew there.
- If the only wetland in town is removed, no wetland species can survive there and that will affect the entire food web for that region.

Biological diversity is an important measurement in understanding how human activities can influence the future of wildlife and our Earth.

## Biodiversity and Humans

**DIRECT** benefits from the multitude of living things that we use for food, shelter, clothing, medicines, and raw materials include the moose meat that stocks the freezer, the spruce trees that provide wood for homes, and the plants gathered for teas, soaps, or medicines. Because we are omnivores, we can survive on a variety of foods, even if one food type is removed. By maintaining biodiversity in an ecosystem we also conserve the possibility of discovering new uses for plants and animals, and discovering other important roles a species might play within an ecosystem.

**INDIRECT.** We also benefit indirectly from living things, or in ways we do not directly observe. Insects pollinate food crops, or control pest species in warmer climates where a majority of our fruits, vegetables, and grains are grown. Many Alaskans enjoy recreational activities that involve a variety of living things, such as bird watching, nature study, hunting, fishing, and gardening.

**INTRINSIC.** Some benefits are intangible because each type of living thing is a unique element of the world. While many people value other living things because of their utility, some people believe that all species have intrinsic value even if there is not an existing or potential known human use.

**EARLY WARNING SYSTEM.** Changes in the distribution and abundance of wildlife populations may indicate more widespread changes in environmental conditions. For example, changes in lichen species may show that levels of harmful air pollutants have increased in an area. These changes may be an “early warning” of environmental changes that could be affecting human health.

**ECO-SERVICES.** Example: Forests convert carbon dioxide, minerals, and sunlight into food for themselves and release oxygen that humans and animals breathe. They also help maintain the water cycle by returning water to the atmosphere by transpiration. Bacteria and fungi recycle minerals and energy on the forest floor as they break down dead things for their food and clean up the planet. Marshes and bogs filter out pollutants from the water passing through them and can prevent flooding by slowing rainwater runoff.

### Diversity Low, But Intact in Alaska

The roster of Alaska’s wildlife is small in comparison with the number of species in the world (see table “How many species ... a sampling”). Our state’s biodiversity is noteworthy because it is remarkably intact, primarily due to our low human population. Less than a handful of known species have gone extinct in historical times (see INSIGHTS Section 3). Relatively few Alaska species of plants, mammals, fish, birds and invertebrates are on the endangered or threatened species list: <[www.r7.fws.gov](http://www.r7.fws.gov)> or Endangered Species <[endangered.fws.gov](http://endangered.fws.gov)> (US Fish & Wildlife Service) and some species have been restored in recent years. (ex. eagles and wood bison)

Some of our species incorporate diversity in their survival. Black bears eat different foods throughout the spring, summer and fall. By eating what becomes available, their population does not react as severely to one change (loss of one prey species, for example) in their habitat. (See student activity “How Many Bears Can Live in this Forest?”)

### Alert for Changes in Biodiversity

Today, changes in biodiversity are attracting more attention from scientists and the public because the global rate of species extinction is rapidly increasing. People want scientists to keep track of changes in wildlife populations to alert us before a species is in danger and Earth’s biodiversity is diminished.

Appreciating the importance and value of all species is also the key to developing attitudes of respect, responsibility, stewardship, and action for the environment and wisely conserving our resources.

## MICROHABITATS AND BIODIVERSITY

If you look closely at the environment, you will notice that differences exist even on a small scale. Examples of these small “mini-environments,” called microhabitats, are a tree stump or a dead animal. Within each microhabitat, there are living things adapted to minute variations in conditions.

In a pond, for example, fish and many plants live below the surface of the water while the water strider and other insects are adapted for life on the surface. Some insects are even adapted for life on the underside of the surface of the water.

On land, some insects live inside the bark of a tree while others are found among the lichens on top of the bark. Some plants live on the tops of tussocks in the tundra while others thrive in the wetter troughs between the tussocks where they are finding all of the elements of a habitat needed for survival.

When scientists describe or measure the amount of biodiversity in a particular place, they do two things:

1. identify and count the number of different species (variability).
2. count the number of individuals of each species (abundance).

Scientists often compare small areas in order to draw conclusions or estimates about the biodiversity of a larger area.

Wildlife managers try to predict and monitor changes in species diversity after forest fires, beetle outbreaks, drought or floods, human development, or as one animal high on the food chain becomes more abundant or scarce.



**Questions that scientists try to answer include the following:**

1. How do changes in a plant community (forest, wetland, tundra, etc.) affect wildlife that depend on that community for some or all of their habitat needs?
2. Who eats who?
3. What other species may be impacted because of the web of connections of living things in an ecosystem?
4. How many individual animals might be affected if the habitat is lost?
5. How significant will the loss of individuals be to the continuance and abundance of the population?
6. Will elimination of one population or species from an area result in the loss of other populations or species?
7. What is the carrying capacity for a population? (How much habitat is needed to support a population?)
8. How can impacts to wildlife be balanced against human needs and desires that lead to land use changes?



## WHAT ARE MAPS

From Exploring Environmental Issues: Places We Live, Project Learning Tree

“It seems to me that one can think of mapmaking as a fundamental human activity, if not the fundamental human activity...Learning consists of looking at something new and beginning to see paths into it. You construct a map or series of maps, each one an approximation and probably wrong in details, but each one helping you to go further into the territory.”

- Tony Kallett, “Homo Cartigraphicus.”

What do photographs, interviews, essays, articles, books, movies, and maps all have in common? They can all be used to tell the story of a place. Maps are powerful tools that can display characteristics of a place at a moment in time, or they can reveal change over time. By comparing maps from different periods, we can unveil the history and stories of a place, as well as make predictions about the future.

### What are maps?

A map is a picture of a place, usually from directly above, with distances, directions, and scale accurately depicted. Maps are graphic representations that can be used to illustrate selected physical, scientific, cultural, or social aspects occurring on the Earth. Maps can visually represent information ranging from landforms and bodies of water to streets, buildings, and sewer systems. They can also represent abstract information such as population density, percentage of urbanization, or ethnic diversity. A map can be a simple line drawing on paper illustrating directions from one place to another or a computer-generated, three-dimensional color map depicting a region's topography.

Normally when we look at the world from ground level, we don't see much of it from one spot. If we were to stand on a sidewalk, for example, we might see several buildings, a strip of road, and a couple of green trees, but our view is generally quite limited. From above, however, places look

radically different. By looking at larger pieces of the world from above, we can see the relationship of one point to another—the orientation of the buildings to the rest of the block or of the block to the rest of the neighborhood or city. It gives us perspective of an area.

Analyzing such relationships is useful for determining the patterns formed by the placement of either physical or abstract features on the Earth's surface. Those arrangements can be explored, organized, and analyzed, thereby allowing investigators to generate hypotheses about the cause of such patterns.

For example, a map of an area's vegetation types could be used along with a map noting the movement of bears to create a correlation or relationship between bear movement and available food sources. Mapping a habitat for biodiversity is also a valuable tool for scientists, developers and municipal planners alike.

## LOCATION IDEAS FOR COLLECTION AND FIELD TRIP SITES

### **After break-up** (spring, summer, and fall):

- Ponds, streams, wetlands, intertidal areas
- Vegetated areas of your school grounds
- Forest with several successional stages in close proximity
- Aquarium - classroom or public facility
- Classroom terrarium
- Dig a hole under grass or other area with organic layer
- Garden or flowerbed
- Lawn
- Pile of leaves
- Decomposing tree stump, log, or snag
- Rock outcrop
- Top of a pingo or cottongrass tussock
- Wet trough of tundra polygons (permafrost areas)

### **After freeze-up or snowfall** (winter):

- Snow-free areas under large trees—in the leaf litter (wood frogs!)
- On and under tree bark (insects, lichens, moss)—yes, some insects live through the winter!
- Subnivean environment: Under the snow where snow is deep enough to insulate the area and keep temperatures above freezing (check for unfrozen plants or small animal tunnels)
- On the surface of the snow after a thaw
- Also ask local naturalists and Native elders in your community to help you find living things during different seasons of the year.

## WILDLIFE POPULATIONS

A population is all the individuals of a single species that live and multiply or raise their young in a specific area.

### Dynamics of Population Change

Maintenance of biodiversity means maintaining the populations of our diverse wildlife and their habitats. How does one measure when a species is in trouble? What are natural ups and downs population trends?

Animal populations change over time. Animals die because of predation, starvation, hunting, disease, accidents, extreme weather challenges, old age, and loss of habitat. Populations lose animals because they emigrate (move away), or gain from others immigrating into the area. They also gain in population when habitat is abundant and rich and predation is low.

### Bottom Line is Habitat

Ultimately, every population is shaped by the amount of available habitat (food, water, shelter, and space). Often, the key is the availability of one necessity that is in shortest supply.

- When drought dries small ponds (shelter), nesting and brood rearing sites for ducks are limited. The change results in fewer ducklings being born and even fewer young ducks surviving to fly south.
- A shortage of prey (food) such as lemmings in a tundra area may trigger an emigration of snowy owls that prey on the lemmings. This phenomenon occurs periodically on the Arctic Coastal Plain of Alaska. Between 1986 and 1991, biologists estimated that the snowy owl population varied from zero to approximately 4,000 owls in response to changing populations of lemmings.

The relationship between predator and prey species is important to understanding population dynamics of wildlife. Although predators are often the major factor limiting growth of a prey population, prey populations (as illustrated by the lemmings) can also limit the size of predator populations (the snowy owls) if the prey are the only source of food available.

### Humans Influence Habitat

Humans and our activities affect the dynamics of wildlife populations. Our actions can alter or wipe out habitat. Lawns and ball fields in Anchorage provide feeding areas for Canada geese which rarely nested in the city historically. The clearing of land to develop roads and the construction of buildings for homes and industry decreases available habitat for other wildlife. Timber harvests and mining can change or remove food and shelter and change the temperature or clarity of water.

## Carrying Capacity of Habitats

Every population has a maximum size it can reach before the species exceeds the available habitat. This maximum number is the carrying capacity of an area. It is a “ceiling” for the population.

**Population Explosions.** Numbers may briefly soar past the ceiling under favorable conditions (mild winters, abundant food) causing a population explosion. Inevitably, deaths drop numbers below the carrying capacity when individuals cannot find resources needed to survive.

**Population Crashes.** Populations of herbivores (plant-eating animals) such as deer and caribou may crash precipitously if they exceed carrying capacity. This is because they can damage or kill their plant food sources through heavy browsing or grazing. The heavily-browsed lichens and shrubs can take years to recover. Herbivore populations that have crashed are limited while their food supplies recover. In this situation, the animals actually reduce the carrying capacity of their habitat temporarily.

## Limiting Factors

Something that keeps a population of animals from increasing is called a limiting factor. For wildlife it could be a shortage of food, water, shelter, or space. Or it could be diseases, predation, climatic conditions, pollution, hunting, poaching, and accidents that affect either the number of births, the number of deaths, or both.

Limiting factors in a habitat affect its carrying capacity.

- For example, the availability of willow browse is a limiting factor for moose. More moose cows have twins (versus single calves) that survive their first winter in areas where willows are abundant.
- Another limiting factor for moose is snow depth. More moose die during a winter when deep snow covers willow shrubs for a long time.
- The depth of snow also affects the ability of moose to avoid predators. Thus, a winter with deep or long lasting snow will lower the carrying capacity of an area (and the moose population) compared to winters when the snow is shallower or less persistent.

A healthy wildlife population fluctuates from year to year as limiting factors and the carrying capacity of the habitat change. Some animal species have a wider range of tolerance – they eat a variety of food and can diversify when one food is in short supply, for example. The populations of these species tend to stabilize at a certain level, while other species’ populations fluctuate widely.

## Population Cycles

Certain species display cyclic patterns of growth and decline. Lynx and snowshoe hare populations in Alaska and elsewhere are a classic example of a predator/prey/plant cycle. (see following “Predator-Prey” Fact Sheet and the activity “Predator-Prey Predicament in Section 2). Among the larger mammals, moose and wolves also go through peaks and troughs of abundance, with each species’ population size dependent on the other.

## Tracking Wildlife Populations

One of the main jobs of wildlife managers in Alaska is to track the ups and downs of wildlife populations and to determine the causes. They do so because Alaska wildlife is managed

on the principle of sustaining human uses of wildlife into the future. Rises or drops can indicate a change in the health of a population, its habitat, and other members of its food chain.

**Helping Actions.** Serious population changes may call for human intervention – changes in harvest regulations, habitat protection, and/or habitat enhancement. Wildlife managers work to maintain healthy populations that permit a variety of human uses of wildlife.

**People Care.** Many Alaskans and visitors hunt, trap, photograph, or view our wildlife. People who depend on animals become concerned when populations change. Wildlife managers allow harvests of populations (hunting and trapping) when the predicted rate of reproduction is high enough to replace the animals harvested.

**Tailor Plan to Situation.** In Alaska, certain populations of geese are high (Canada geese in Anchorage) while other populations remain low (Emperor geese on the Yukon-Kuskokwim Delta). Management plans for these populations must be designed differently, for different results.

**Worrisome Lows and Highs.** Wildlife managers worry that small populations of wildlife may disappear. An isolated population of mountain goats on an island, for example, might decline as the result of overhunting and/or harsh winters, and die out. If populations are small or have declined to low numbers, people may need to make special efforts to help them increase or recover.

Wildlife managers are also concerned about large populations for the overall health of the population (avoiding crashes) and impacts on the health of the ecosystem and human health.

## How are Populations Counted?

Wildlife managers study populations of animals (rather than individual animals) to keep track of changes in animal abundance.

1. Wildlife biologists must determine population boundaries in order to know which animals are part of the same population before they can study how populations change. They also need to know the best time of year to see and count all the animals.
2. Then they need to count the animals within those boundaries, repeating their counts over years to **detect changes and trends**.

**Determining population boundaries.** The first question—which animals are part of the same population—involves finding out which animals live and raise their young in the same area year after year. This can be difficult because some Alaska wildlife species move over long distances and gather in groups only briefly. Biologists try to make accurate counts of all animals in a population, but they are not always able to do so.

Caribou for example: Herds may spread out over tens of thousands of square miles during winter. Where does one caribou population end and another begin? Fortunately for biologists, caribou herds gather into separate areas after calving. Biologists can census (count each animal) at this time of year.

**Counting the animals.** Not all wildlife species come together in groups at certain times of year. Many animals are hard to see during a survey. A moose in a dense stand of spruce trees may be impossible to spot even from an airplane. Because it is often difficult to census all animals in a wildlife population, biologists often choose a smaller area within the whole and count that portion of the population (a sample).

**From sample to whole.** From that sample, they estimate the size of the total population. They multiply the results by the number of same-size areas in the whole habitat. (For example, if they just counted one-tenth of the habitat, they multiply their census number by 10 to get an estimate of the entire population.) While this is a simplification of the process wildlife biologists use to determine population, it illustrates the general concept.

Many variances are included in an actual census, sometimes involving complex equations.

## POPULATION EXPLOSIONS

### Linear or Exponential Growth?

#### Example

If a population were to increase linearly, it would grow at a constant rate. For example, if your class size increased at the linear rate of two students per year, at the end of five years, there would be two times five, or 10 new students.

If the number of students in a classroom doubled every year, that would be an example of exponential growth. A class of 25 students doubled would have 50 students in the second year, 100 in the third, then 200, 400, and 800 in the sixth year. In ten years, the class would number 12,800. Exponential growth occurs at an increasing rate through time.

### Potential Rates

Most animal populations grow at an exponential rate because each female has the potential to give birth to more than one offspring in each generation. Thus, the number of females ultimately determines how fast the population can grow.

#### Example

Ptarmigan. A pair could nest and raise six chicks in one year. The next year, if half of the chicks were female and all survived, the three chicks and the original female would each raise six chicks, three of which would be female who would, in turn, each raise six chicks.

At the end of two years, assuming no deaths occurred, the original population of two would have grown to 32. After three years there would be 128, in five years there would be 2,048, and after nine years this imaginary ptarmigan population would have grown to include over a million birds.

### Actual Rates

The larger the population is, the faster it grows. The faster it grows, the larger the population becomes. Although all animal populations have the potential to grow at an exponential rate, the actual growth rate for each species varies

because each has a different pattern of births. The pattern or rate of births is influenced by:

1. time between generations
  2. length of gestation (pregnancy)
  3. number of young born each time a female gives birth
  4. age at which a female first gives birth
  5. average reproductive life of females.
- Female red-backed voles produce four to eight young up to six times each year and give birth to their first young at three to six weeks of age. In one year, one female red-backed vole can give birth to 24–48 young. That’s a lot of voles!
  - In contrast, humpback whales produce one calf every two years and begin breeding at 6 to 12 years old.

### Factor in Mortalities

In reality, animal populations do not grow as rapidly as their reproductive rate would predict because deaths occur. The size of a population at any point is a result of both births and deaths.

For example, a biologist surveys a moose population each winter. The change in the size of the population from one winter to the next is a result of both the number of calves that were born into the population and the number of adults and young that died.

## WHEN POPULATIONS DECLINE— LOSING BIODIVERSITY

About 65 million years ago, the North Slope of Alaska resounded with the thud of dinosaurs. About 15,000 years ago, woolly mammoths grazed beside glaciers. All those species are gone now.

**Life and Death in Change.** The world we live in is dynamic. Environmental change—with life and death consequences—can come from changes in the nonliving elements of our ecosystem (climate, floods, drought, fires, volcanic eruptions, earthquakes) and the living things (through competition, predation, disease, and actions of humans). Or the cause can be a combination of elements.

**Dinosaur Did it Without Us!** Change can lead to extinction of some of Earth's life forms. We know that many species have come and gone since the earliest fossil records dating to four billion years ago. Dinosaurs, the most famous example, disappeared about 65 million years ago, for reasons that are still under debate – but at least we know humans were not to blame!

**Humans Speed the Decline.** In more recent times, humans, armed with technological advances and an appetite for resources, have been speeding the decline of habitats and the extinction of species around the world. The Steller sea cow, a marine herbivore of the North Pacific related to the manatee, was first described by naturalist Georg Steller in 1741. Within 27 years of its discovery by Europeans it was hunted to extinction. When every member of a species is gone, it is extinct. When all the members of a species in a specific area are gone, it's called extirpation. Musk oxen and wood bison were extirpated from Alaska, then later reintroduced from small populations that survived elsewhere. Wolves were extirpated from the Lower 48 and then reintroduced.

**Looking for the Causes.** Sometimes it is a challenge to distinguish between human-caused and natural ecosystem changes such as in the current decline of species in Alaska's Bering Sea. Understanding how our actions have caused loss in biodiversity in the past will help us understand how to prevent future losses and reverse current declines.

### Alaska's Contributions to Diversity

The biological diversity of Alaska is unique because our ecosystems remain relatively healthy and intact, compared to many other parts of the world. Alaska's low human population, combined with vast tracts of undeveloped land, provide vital habitat to plants and animals that need open spaces free from human development.

**Big Responsibility.** For some animals, Alaska is the only habitat they use. Almost all Emperor geese, for example, breed on the Yukon-Kuskokwim Delta and winter in our Aleutian Island chain. For other animals, Alaska is crucial to their survival for migration stop-overs or spring nesting.

**Open Space Reservoir.** We serve as a stronghold for species no longer found, or in trouble, in the Lower 48 states including bears, wolves, salmon, and lynx. Recent efforts to reintroduce species to their former ranges in the Lower 48 have relied on individual animals from Alaska and Canada. For example, wildlife managers are capturing Alaska lynx for

reintroduction in Colorado. The success of these efforts depends on many factors; but without healthy populations in Alaska, reintroduction could not be possible.

## No Complacency Allowed

Although we can boast about many healthy populations of fish and wildlife in Alaska, we are also facing an increasing number of species in trouble. Declines in wild residents of the Bering Sea ecosystem in particular remind us that we cannot be complacent.

**Challenge to Monitor.** One of the main tasks of wildlife managers is to conduct population counts to help recognize declines. Our vast and remote landscape allows many of our species to thrive, but at the same time makes it more challenging and expensive to track population ups and downs with needed regularity.

**Healthy Record.** To date we have been able to turn around declines in peregrine falcons, geese, and sea otters. No Alaska species is known to have become extinct in the 20th century; and few have been lost since the large-scale extinctions that occurred at the end of the Pleistocene period 10,000 years ago.

[www.adfg.alaska.gov/index.cfm?adfg=specialstatus.extinct](http://www.adfg.alaska.gov/index.cfm?adfg=specialstatus.extinct)

## Laws Protect Wildlife

Some of the first wildlife laws in this nation were written to protect Alaska's resources. In the early 1900s, laws were passed to protect sea otters, fur seals, and migratory birds from overhunting.

**Endangered Species Act.** In 1973, Congress passed the Endangered Species Act to protect populations that are threatened or endangered. Teams of specialists from state and federal agencies and other organizations work together to reverse population declines, protect habitat, and reduce threats to survival. (See following "Endangered Alaska Species" Fact Sheet.)

[www.adfg.alaska.gov/index.cfm?adfg=specialstatus.fedendangered](http://www.adfg.alaska.gov/index.cfm?adfg=specialstatus.fedendangered)

**Aleutain Success Story.** Some previously declining wildlife populations are now recovering. The Aleutian Canada goose population dropped to 790 birds in 1975 and was one of the first animals in Alaska to be protected under Endangered Species status. Through extensive management efforts, the population rebounded to 7,000 in 1991, and the Aleutian Canada goose was moved from the endangered listing to threatened status. In 2001, with a population of 37,000, Aleutian Canada goose populations are stable and they were delisted from the threatened status.

Today the Aleutian goose population is stable at 25,000. Recovery measures included harvest management (changes in hunting levels), protection of winter resting habitat, and removal of non-native predators (introduced foxes) that preyed on nesting geese and their goslings.

Habitat loss as a result of human activities is now the leading cause of extinction of wildlife populations.

## Factors Behind Declines

Animals are more prone to population decline and extinction if they:

- Interfere in some way with human activities. At times, some animals kill livestock, eat or ruin crops, or feed on animals that humans eat. Animals may threaten our

safety or property. If wildlife interfere with human activities, they are often shot or poisoned.

- Are in high demand by humans. If a species has a high economic or other use value to people, it could become endangered or extinct unless its harvest is carefully regulated and enforced. For example, a substance from the Pacific yew tree has been a successful treatment for some forms of cancer and is now in high demand.
- Migrate. Animals that migrate usually depend on several different habitat areas, stopover places enroute, and connecting corridors or greenbelts. If habitat areas are destroyed along the migration route, their population may be more vulnerable.
- Are high on the food chain. These animals tend to be larger, with slower reproductive rates, and are more susceptible to over-harvest or habitat loss.
- Have very specific habitat requirements. Some animals have adapted to eating only one type of food or living in one type of area. They can become endangered if their food source or habitat area disappears.
- Are sensitive to pollution. Many animals have difficulty adapting to changes in their environment. For example, birds of prey are very sensitive to chemicals introduced into their environment, such as pesticides.
- Have a low number of offspring and long gestation periods. If populations of these species decline, they recover slowly and could become extinct if multiple factors affect them. Compare the offspring of a northern red-backed vole that has up to 48 young a year to that of a black bear that has two young every other year. If all offspring reproduce at the same rate, the sixth generation of 382,205,952 voles will be produced in six years, whereas the sixth generation of 11 black bears will be produced in 12 years.
- Are naturally rare. Some animals are rare throughout their range, and others have a very limited range. Small populations with limited distributions are particularly vulnerable to environmental changes, habitat destruction, or human-caused problems.

Adapted from National Wildlife Federation. *Endangered Species: Wild and Rare*, NatureScope, Washington DC, 1988.

For more information on the Endangered Species Act and the status of species, browse, [www.fws.gov/endangered](http://www.fws.gov/endangered) (US Fish & Wildlife Service).

## PREDATOR—PREY

Predators often limit the population growth of the animals they eat. Prey populations, in turn, limit the size of predator populations if they are the only source of food available. If the prey animals eat plants, then plants also can affect this relationship.

Alaska's best example of a predator-prey-plant relationship is the cycle of lynx and snowshoe hare populations.

Snowshoe hares prefer early successional stages of forests (see *Alaska's Forests & Wildlife*). They need branches of willow, birch, and aspen at heights they can reach. Hares reproduce "like rabbits!" and multiply rapidly.

As their population increases, they begin to destroy the plants they eat. In defense, gnawed willow and birch produce chemicals that either taste bad or affect the hare's ability to digest food. Without being able to eat their favorite foods and consuming all others, many hares starve. Others may become diseased. Their once-high population drops ("crashes") to a low level within two or three years.

Without the pressure of browsing hares, the vegetation recovers. But it takes three to five years before snowshoe hares will have enough food to increase again.

And what's happening to the lynx? Lynx are uniquely adapted to prey on snowshoe hares, their main food source. As hare numbers increase, more lynx kittens are born and survive. The lynx population will continue to rise until snowshoe hares crash.

The peak in the lynx population is usually a year behind the peak of snowshoe hares. Lynx can support themselves and their kittens on the still relatively abundant hares for an extra year or two, which adds to the hares' swift decline. Then, as hares become scarce, the lynx population crashes.

The cycle of population explosion and crash in this predator-prey-plant-food chain may take 8–14 years but is usually 9–11 years. This cyclic pattern, recorded for more than 200 years, occurs across most of northern North America with remarkable regularity.

### Carrying Capacity

Carrying capacity is the number of plants or animals of a given species that an area can support (the species having its survival needs met within the habitat). It is the largest population a unit of habitat can support on a year-round basis, or during the most critical period for the species.

Carrying capacity for many species constantly changes, both seasonally and from year to year. Yearly variations may be caused by natural disasters, changes in rainfall and temperature patterns, or human interventions. Many populations of living things fluctuate naturally around some level. Carrying capacity affects that level.

A population may be below carrying capacity, such as in the spring following a hard winter, or temporarily above it. The latter situation inevitably results in a decline of the population by deaths through disease, emigration, and/or lowered reproductive rate until it drops below carrying capacity.

Black bears provide a good example. Black bear habitat limits populations especially through the influences of shelter, food supply, and the social tolerances or territoriality of the animal.

- Shelter or cover is a prime limiting factor. Black bears need thick cover to hide from each other and brown bears. Adult bears run adolescent bears out of the area or occasionally kill them. These young bears must keep moving until they find an area vacated by the death of an adult. If they do not find an area for themselves, eventually they will die.
- When food supplies are reduced, competition becomes more intense. Some adult bears might temporarily move to seldom-used portions of their home ranges, sometimes many miles away. Most bears, however, must live on what food is available in their area. These individuals may become thin, occasionally starve, or in the case of young bears, be killed or forced from the area by more aggressive adults.

Through these “adjustments,” the total bear population remains within the carrying capacity of the habitat.

## WILDLIFE CONSERVATION IS UP TO US

We all come from differing points of view and cultural backgrounds (see accompanying Teacher’s Guide), but a majority of Alaskans agree healthy fish and wildlife populations are important to our quality of life now and in the future. Wild mammals, birds, and fish are integral to our state’s cultural and economic identity.

### A Variety of Perspectives

Alaskans have a long tradition of dependence on the natural world. Plants, fish and wildlife provided all that Alaska indigenous peoples needed to survive and define themselves spiritually and culturally.

### Respect for Wildlife Reaps Benefits

Traditional Native Alaskan beliefs and practices demonstrated respect for wildlife, including intolerance for waste.

- An Aleut hunter, for example, dressed in elegant clothes when hunting to please the spirits of the sea animals so necessary for survival.
- The Tlingit burned or returned all unneeded animal remains to the water so that animal spirits could report to their kind on the respectful treatment by humans. This would ensure the reproduction of future generations of animals.
- Athabaskans performed elaborate ceremonies of respect for animals, both those hunted and those respected because of their spiritual power.
- Inupiat hunters on the sea ice had a ritual to show respect for the seals that gave themselves to the hunter in a successful hunt. In that ritual, they gave them a drink of fresh water.
- The implements of Bering Sea Yup’ik peoples were designed to please to the animals. The Yup’ik believed that the spirit of a seal killed for food would remain in the animal’s bladder. The bladders of all animals harvested in a year were kept until the annual Bladder Festival. The animals’ spirits were treated as honored guests and then the bladders were thrown into the sea to ensure that more seals would return to the hunters.

### Wildlife Continues to Lure Newcomers

In historic times, waves of Russians, Europeans, and Americans came to Alaska in search of wealth from the land. They trapped furbearing animals for the international fur market and, as a result, established settlements, some which remain today. Others came to harvest whales and fish.

Wildlife and fish were Alaska’s first economy and they continue to be important mainstays today.

Alaska has become a destination for people who value a direct relationship with wildlife. Many who settled in Alaska have a heritage of hunting and fishing passed down through generations. They depend on local fish and wildlife for food and a connection to the natural world.

The beauty and mystique of Alaska’s wildlife and wildlands continues to draw people to Alaska. Today, more than ever before, wildlife viewing is an important part of Alaskan life. This “non-consumptive use” of wildlife is expected to increase, possibly impacting habitat.

### Conservation is Effective

Because of their commitment to wildlife, both Native and non-Native residents of Alaska are active in wildlife conservation efforts. These include the public process of the Alaska Board of Game, local and regional advisory committees, and hunting and conservation groups.

We have not always managed sustainably (refer to INSIGHTS Section 3, When Populations Decline). The muskox, extirpated from Alaska by 1865, is case in point. (See accompanying “Muskox Returns to Alaska” Fact Sheet). Their habitat, the coastal tundra ecosystem, was still intact. Conservation measures starting with the reintroduction of a small herd in 1930 succeeded in reestablishing the muskox as a viable member of Alaska’s tundra ecosystem.

### Managing Wildlife for Many Interests

Reintroduction of formerly abundant species is one tool to help wildlife recover. But many people agree it is wiser and less expensive to avoid the need for reintroduction by practicing conservation in the first place.

**Conservation:** Conservation is the use of natural resources in a way that assures their continuing availability for future generations; the wise and intelligent use or protection of natural resources.

**Wildlife Management:** This is the application of scientific knowledge and technical skills to protect, preserve, conserve, limit, enhance, or extend the value of wildlife and its habitat.

- Wildlife managers use a variety of techniques including regulating harvests, sustaining habitat, and changing habitat for selected species. Modern wildlife management blends the science of gathering data and reaching conclusions with the art of decision-making that occurs during political and legal processes.
- Social issues arise over concerns for equal access to wildlife. Wildlife is a natural resource owned in common, but people sometimes compete for its use or have different values, beliefs, and opinions about appropriate behavior of people toward wildlife. Social issues surround “tradeoff” decisions about whether to do something that will alter wildlife habitat or populations.
- Technology also plays a key role in many wildlife issues. The tools available to study wildlife are becoming increasingly sophisticated—from satellites to genetic markers. In Alaska, the accessibility of wildlife and their vulnerability to over-harvest has been altered by the technology of motorized vehicles, airplanes, and modern hunting weapons.

### Traditional Knowledge

Alaska Natives have lived with and relied upon wildlife for thousands of years. Generations have passed on information about habitat needs, population trends,

and interrelationships between species, migration patterns, and behavioral traits. Observational skills and memories regarding wildlife continue to be an important part of Native tradition.

In the past, wildlife managers looked only at data that could be quantified scientifically. They considered Native knowledge as “anecdotal.” Now traditional knowledge and western science are seen as complementary. Wildlife managers rely on local hunters for traditional ecological knowledge of the health, location, and local historical trends of animals.

Rural citizens and wildlife managers are creating working relationships on advisory boards and in co-management of species. Cooperative decisions are being made on regulations, methods of data collection, and methods of reporting harvest information. Successful management of geese on the Yukon-Kuskokwim Delta, walrus, bowhead whales, and the Western Arctic Caribou Herd Working Group are examples of the benefits of co-management.

For more information on wildlife managers, see following “Workers for Wildlife” Fact Sheet.

## The Public Has a Vital Role

In the United States, wildlife is a resource owned by the people and managed for their common use. In Alaska, the authors of the state constitution in 1959 mandated management of fish, wildlife, and other renewable resources on the principle of sustained yield (sustaining human uses into the future).

The Alaska Constitution calls for a participatory system of wildlife management with a Board of Fish and Board of Game. Board members are appointed by the Governor and confirmed by the state legislature. Once appointed, members gather information through a public process to set policies for regulations to be carried out by the Department of Fish and Game, Fish and Wildlife Protection, and the Department of Public Safety. (See following “Tracking Wildlife Regulations” Fact Sheet.)

## What Can You Do?

Alaskans feel passionately about wildlife and wild places. The future of Alaska’s wildlife depends on you. What can you do?

- Increase your knowledge of wildlife and the ecosystems that support all living things.
- Participate in public hearings
- Support Board members
- Participate on advisory committees
- Attend and speak at Board meetings
- Support wildlife research and management projects
- Act on behalf of wildlife and wild places
- Determine how your actions affect wildlife and act responsibly. (Consider how you develop the land where you live, what you buy as a consumer, what impact your food choices have on the environment, for example.)

We can continue to harvest fish and wildlife if we limit harvests to numbers each population can sustain. We can watch, photograph, and enjoy wildlife if we minimize

our impact to avoid disturbance of sensitive species at critical times and in crucial areas. And we can continue to develop Alaska, if we maintain adequate areas of wildlife habitat and limit and plan development to minimize habitat loss.

## Dealing with Differing Viewpoints

Controversy is pervasive, even valued, in a democratic society. Controversy occurs when a person's or group's ideas, conclusions, theories, or opinions are in opposition to those of another person or group.

The study of controversial subjects is essential to the education of all citizens in a free society. In preparation for contributing to a healthy society, students must learn to gather and examine evidence; differentiate opinion, fact, and inference; evaluate differing viewpoints with objectivity; and define and justify their personal points of view.

By stressing the use of facts to justify decisions, the importance of developing alternatives, and use of appropriate problem solving skills, teaching about controversial issues can impart real "survival skills" while bringing relevancy to the classroom.

What is controversial in one place and time may not be in another. In Alaska, wildlife-related topics are often controversial. As a state, our identity, tradition, heritage, and economy are linked to wildlife. Although most school curriculum is built around activities that present factual, non-controversial information, there are some topics and activities that are potentially controversial within Alaskan communities. Rather than avoiding these topics, we encourage you to use the following guidelines.

### Curriculum Selection & Lesson Preparation:

- Determine whether a specific issue is grade-level appropriate and relevant to the student.
- Choose issues that relate directly to the curriculum being studied and to the goals and objectives of this study.
- Determine whether enough factual information can be gathered on the various points of view related to an issue.
- Be clear about what alternative positions will be presented in dealing with a controversial issue.
- Decide on your own opinion/position on the topic so that you can recognize your own biases.
- Use community resources and expertise, making sure that you choose people and materials to present more than one side of an issue, while being sensitive to differing cultural values in your presentation and selection. Have students prepare questions for guest speakers.
- Design the unit to teach citizenship skills such as critical thinking, listening, decision making, and problem solving as well as loyalty to democratic principles.
- Use your community resources to adapt issues for local relevance, while presenting the "big picture" as well.
- Examine curriculum content and topics for cultural bias and include cultural sensitivity and respect for diversity.

**In the Classroom:**

- Develop a climate of trust, respect, and openness to free inquiry in the classroom as well as respect for the student’s right to privacy, right to hold opinions and perspectives, and value the strength of diversity in our society.
- Distinguish between fact and opinion when analyzing issues.
- Teach students to identify value-laden language that reveals biases in materials. Look for these biases with different perspectives, such as “timber harvest destroys wildlife habitat,” versus “timber harvest alters wildlife habitat.”
- Have students scrutinize their own values that determine their positions on an issue.
- Have students gather information from as diverse an array of sources as possible.
- Determine if facts were “left out” or slanted because of the bias of the presenter or the materials.
- Teach students to raise questions which clarify the important positions in a controversy rather than attacking positions with which they do not agree.
- Recognize stereotyping and avoid the polarization that results. People and groups should not be strictly categorized. Include multiple players in the same “role” in simulations. Have these players hold different opinions to break down stereotyping.
- Use additional information, community resources, and pointed questioning to assist students to view differences in values and opinions as positive and learn to disagree without degrading others. Emphasize that different points of view are not right or wrong.
- Include activities such as simulations, role-playing, creative writing, music, and dramatizations. This will encourage students to take positions temporarily on issues that are different from the ones they currently hold in order to clarify the basis for differences. Have students explain how people within a group or a role could hold different views.
- Use realistic simulations and role playing activities where compromise and tradeoff situations are likely.
- Ask students to evaluate the effects of decisions made on future actions and problems.
- Include effects on different populations and aesthetic, social, cultural and long-term economic costs and benefits in any cost/benefit analysis or identification of impacts.
- Be as politically and religiously neutral as possible on value sensitive issues and clearly delineate your own opinions when presenting them.
- Work on finding agreement on controversial issues by using techniques such as nominal group approach or finding common words (in differing viewpoints).
- When possible, let students choose the topic or issue to be studied.
- Provide opportunities for students to make decisions and engage in actions dealing with the issue.

**With the Community:**

- Anticipate the controversial issue in the curriculum and inform parents about how the issues will be treated before they are introduced. Invite them to attend lessons on these topics.
- Be clear about the community values held and be cautious when examining opposing ones.
- If criticized for including a controversial issue in your lessons, do not respond defensively or with anger. Discuss your goals and your methods with critics so they can appreciate your sensitivity to their concerns.
- Before teaching the unit, obtain the support of the school administrator.
- Teach about the “real world” with an emphasis on problem solving, critical thinking, and citizenship skills.

Text by the Alaska Department of Education with the Alaska Steering Committee for Project Learning Tree and the Alaska Resources Kit: Minerals, Teacher Advisory board.

Adapted from the Project WILD handout, “The Teacher’s Role in Dealing with Controversial Issues” by C.E. Knapp; the pamphlet, “Curriculum Guidelines,” by the National Council for the Social Studies; and a journal article in *Environmental Education & Information*, Vol. 3, #4, 1984, “The Handling of Controversy and Problem Solving in Environmental Education.” Reprinted here by permission from the Alaska Department of Education.

## MUSKOX RETURNS TO ALASKA

The muskox is a large, shaggy herbivore (plant eater). In Inupiaq it is called “oomingmak” or “itoomingmak” (the animal with skin like a beard).

### Natural History

The muskox (*Ovibos moschatus*) is a stocky, long-haired herbivore with a slight shoulder hump and a very short tail. Like other herbivores, their eyes are on the side of their heads to give them a wider scope of vision. This helps them see predators coming. Both male and female muskoxen have horns, but the horns of bulls are larger and heavier than those of cows. The coat consists of a long, coarse, outer layer, and a short, fine under hair. Muskoxen have cloven hooves, all four of which are the same size. Mature bulls are about 5 feet high at the shoulder and weigh 600-800 pounds. Cows are smaller, averaging approximately 4 feet in height and weighing 400-500 pounds. A single calf weighing 22-31 pounds is born between April and June to cows older than two years. Growth is rapid and the animals weigh 150-235 pounds as yearlings. These animals inhabit Arctic regions of Alaska, Greenland, and Canada where their long thick fur protects them from -50° F and high winds.

Winter herds may include up to 75 animals (both male and female). Smaller harem groups of five to 15 females and sub-adults form during the mating season, dominated by one bull that prevents other adult bulls from entering the group.

Muskox adults vigorously defend their young against predators, primarily bears and wolves. Like elephants, muskoxen protect their young by surrounding the babies; facing out and keeping their eyes on the predator. However, they will also create a line or scatter as necessary to elude the predator, or at least create an advantage by their spacing. Researchers have found that even infant muskox that were reared by humans use these techniques to defend the herd instinctively. Muskox charge people, dogs and other threats.

Muskoxen are not always welcome guests. Muskoxen sometimes ramble into the yards of unsuspecting parents and children in local villages. Muskox can destroy property by rubbing up against posts or chewing wood, but they also defend themselves against barking dogs with their horns and hooves, actually charging the dogs. Muskoxen have a reputation as being gentle and non-threatening, but like any animal, they can be antagonized or provoked into action. Scientists still are not sure why muskox have come into human settlements, but they do know that human/muskox interactions usually do not end well for the muskox.

Muskox do not have musk glands nor are they closely related to oxen. Muskoxen are ancient Ice Age animals related to sheep, goats.

By the mid 1800's, the muskox population disappeared in Europe and Asia. By the 1920s had they disappeared from Alaska. In 1930, 34 muskoxen were captured in East Greenland and brought to Fairbanks. This group was then transferred to Nunivak Island, a large island in the Bering Sea. The muskox thrived there and, by 1968, the herd had grown to 750 animals. Muskox from

the Nunivak herd were translocated to establish new herds on the Seward Peninsula, on Cape Thompson and Nelson Islands, in the Arctic National Wildlife Refuge, and on Wrangel Island and the Taimyr Peninsula in Russia. By 2000, the number of muskox in Alaska had grown to almost 4,000. In recent years, the herds in the Arctic National Wildlife Refuge and adjoining areas have declined.

**Nunivak Island:** Muskox were introduced to Nunivak Island in 1935-36 and the herd grew slowly until the late 1950s, then grew more rapidly. The first hunting season was in 1975, and the herd has since fluctuated between 400 and 750 animals. The management objective is to maintain a minimum population of 500 to 550 animals. About 84 muskoxen are harvested each year (five year average, 2001-2006).

**Nelson Island:** In 1967 and 1968, 23 muskoxen were moved from Nunivak Island to Nelson Island, about 20 miles away across Etolin Strait. The population grew quickly between 1968 and 1981. When the population reached the management goal of 200 to 250 animals in 1981, hunting was opened. Since the mid-1980s the population has fluctuated between a high of about 320 and a low of 123 animals. The current objective is a population of at least 250 animals. The 2004 population estimate was 318 animals, and the harvest was 38 animals. Muskox can immigrate and emigrate between the mainland and Nelson Island, complicating management and population assessments.

**Seward Peninsula and Nulato Hills (GMU 22 and Southwest 23):** In 1970, 36 muskoxen were reintroduced to the southern portion of the Seward Peninsula from the population on Nunivak Island. In 1981, an additional 35 muskox were introduced. Muskox have extended their range to suitable habitat throughout the Seward Peninsula and as far east as Ruby on the Yukon River, and northeast into GMU 23 (see the next section). A 2007 census count in Unit 22 indicated 2,688 muskoxen, an increase since 2005, when 2,387 were counted. The population has been increasing since 2000. The total harvest, including subsistence, registration and drawing hunts, for the 2007-08 season was 123 muskoxen.

**Western Brooks Range and Kotzebue Sound (GMU 23):** Animals in the Southwestern portion of GMU 23, between the Goodhope and Buckland rivers, are the product of the introductions mentioned in the preceding section, in 1970 and 1981. In 1970, 36 muskoxen were moved to Cape Thompson from the Nunivak herd, and 34 more were released there in 1977. From 1970 until 1998 the Cape Thompson population grew about eight percent a year, and since 1998, the population has probably been stable at about 350 animals.

**Central and Eastern Arctic Slope (GMU 26):** In 1969 and 1970, 51 muskox from Nunivak Island were released on Barter Island (near the village of Kaktovik, about 75 miles from the Canadian Border) and 13 were released at Kavik River on the eastern North Slope (about 100 miles west of Barter Island). Over time, muskox moved east into Canada and west to the Colville River in the eastern portion of GMU 26A. The population increased steadily and during the mid-1990s was estimated at 500 to 600 animals, with another 100 estimated in Canada. Beginning in 1999, calf production, yearling recruitment and number of adults declined substantially in the northeastern corner of the state (GMU 26C), and in 2003 only 29 animals were observed. The population further west (GMU 26B) seemed to be stable or slightly increasing between 1999 and 2003. The population in 2005 was estimated at about 300 muskoxen in Unit 26B and eastern Unit 26A. It appears that mortality is increasing, this could be due to increased predation by brown bears, drowning, and starvation due to weather, stranding on sea ice, and poor habitat. Emigration may also be a factor. It is likely that the combined population of GMU 26B and 26C is fewer than 250 animals.

## WILDLIFE AT A GLANCE

### What does “Wildlife” mean?

Wildlife refers to animals that are not tamed or domesticated. They do not depend on humans for survival. Humans, however, can affect their survival.

That’s the definition. But wildlife can represent much more in the mind and hearts of Alaskans. The chickadee that lands on a bird feeder, the trout that lands in a frying pan, the V formation of geese flying north in the spring, and the moose filling the freezer for the winter—all fall on a spectrum of appreciation for wildlife that connects us to living things of the land, no matter what our points of view.

The health of Alaska’s wildlife is directly linked to the quality of our lives.

### What are the survival needs of wildlife?

Wildlife (and all living things, including humans) have four very basic needs to survive: food, water, shelter (or cover) and space to roam in an easily reached place that’s right for them in a suitable arrangement. These are called habitat requirements.

An animal’s habitat must contain all four things in good quality and quantity. An animal’s habitat requirements may be different at different seasons and times in its life, however. Some wildlife use multiple habitats, either daily, periodically, or seasonally.

### What is “Biodiversity” and does it matter?

Biodiversity (biological diversity) is a measure of the variety and number of different living things and their habitats—locally, regionally, and globally.

Animals live in a community or ecosystem with their own roles to fulfill—producer, consumer, detritivore—to keep their habitat, and the encompassing ecosystem, healthy.

Biodiversity allows ecosystems to respond with flexibility to damage or change. The more diverse the ecosystem, the more options there are to respond to change—such as the decline of one prey species.

Biological diversity is an important measurement in understanding how human activities can influence the future of wildlife and our Earth.

### How is biodiversity measured?

When scientists describe or measure the amount of biodiversity in a particular place, they do two things:

They identify and count the number of different species.

They count the population—the number of individuals of each species in that area.

**Populations fluctuate normally, right?**

Animal populations change over time. Every population has a maximum size it can reach before the number of animals exceeds the available habitat. This maximum number is the carrying capacity of an area. It is a “ceiling” for the population.

Numbers may briefly soar past the ceiling under favorable conditions (mild winters, abundant food) causing a population explosion. Inevitably, deaths drop numbers below the carrying capacity when individuals cannot find resources needed to survive.

Something that keeps a population of animals from increasing is called a limiting factor. It could be a shortage of food, water, shelter, or space as well as disease, predation, climatic conditions, pollution, hunting, poaching, and accidents.

**If populations continue to decline?**

Because of the dinosaurs, everyone is familiar with the word extinct — gone forever. We also have a vocabulary for other levels of population decline.

**Endangered:** in danger of extinction in all or a major part of its habitat.

**Threatened:** at risk of becoming endangered.

**Extirpated:** no longer existing in an area of former abundance, but still existing elsewhere on Earth. (Example: muskox were extirpated from Alaska after 1865, but some remained in Greenland and Canada.)

**Reintroduced:** a species that has been moved by humans to a place where it originally occurred but has been absent. (Example: muskox were reintroduced to Alaska in 1930s)

**What are the alternatives?**

While people are the key to many problems facing wildlife, we are also the key to many of the solutions.

**Conservation:** the use of natural resources in a way that assures their continuing availability for future generations.

**Wildlife Management:** the application of scientific knowledge and technical skills to sustain the abundance and variety of wildlife and its habitat while providing for diverse use of wildlife.

Both are public participation processes in Alaska.

## WORKERS FOR WILDLIFE

People work with wildlife in a variety of jobs in Alaska. The Alaska Department of Fish and Game (ADF&G) is responsible for managing most of the wildlife and fish in Alaska while the U.S. Fish and Wildlife Service manages marine mammals and waterfowl.

Staffs of these agencies work as research biologists, management biologists, technicians, educators, naturalists, technology specialists, data engineers, administrative staff, and a variety of other support jobs.

**Rule-Making Boards.** ADF&G biologists gather information about wildlife populations and harvests. They use this information to make recommendations to the Board of Game and the Board of Fisheries about regulations that set seasons and bag limits for hunting and fishing.

**NOTE:** Any Alaskan citizen can propose new regulations or changes in existing regulations to the Board, which then votes on all the proposals received (see “Tracking Wildlife Regulations” Fact Sheet in this section).

**Migratory Birds.** Alaska is part of the Pacific Flyway Council. ADF&G and rural subsistence hunters make recommendations to the US Fish and Wildlife Service on migratory bird management. Waterfowl biologists work together with villagers to manage migratory birds that nest throughout Alaska.

**Nongame Species.** ADF&G biologists also gather information about wildlife habitat relationships and wildlife species that are not harvested—called nongame species. Staff members are also part of teams restoring threatened or endangered species. These biologists work in the Threatened, Endangered, Diversity Program at ADF&G.

**Many Partners.** ADF&G often works in cooperation with public, private, and governmental organizations including Native organizations, conservation and hunting groups, USDA Forest Service, National Park Service, National Marine Fisheries Service, and the Bureau of Land Management. Many of these organizations make decisions that affect wildlife on the lands they manage. ADF&G biologists provide information and recommendations to land managers to help them minimize negative impacts to wildlife and their habitat.

### Wildlife-related Organizations and Careers

- A. **Alaska Department of Fish and Game** Fisheries and wildlife research, management, and education. [www.adfg.alaska.gov](http://www.adfg.alaska.gov)

Also refer to “Workplace Alaska” on Alaska’s website for state jobs in biology. [www.doa.alaska.gov/dop/workplace/](http://www.doa.alaska.gov/dop/workplace/)

- B. **US Fish and Wildlife Service** Research and management of fish and wildlife, conservation education, nature interpretation. [www.fws.gov](http://www.fws.gov)

- C. **US Geological Survey—Alaska Science Center** Wildlife research on federal lands and in shared ecosystems: studies of fisheries, migratory birds, marine mammals, freshwater and wetlands. <http://alaska.usgs.gov/index.php>
- D. **National Park Service** Park planning and management, wildlife biology, ecology, law enforcement, recreation, education. [www.nps.gov](http://www.nps.gov)
- E. **USDA Forest Service** Planning and management, wildlife biology, hydrology, ecology, geology, recreation, fire management and control, personnel, budgeting. [www.fs.fed.us](http://www.fs.fed.us)
- F. **Bureau of Land Management** Land-use planning, wildlife biology, ecology, education, entomology, nature interpretation, personnel, fire management and control. [www.blm.gov](http://www.blm.gov)
- G. **Alaska Department of Natural Resources** Land-use planning, management, fire management and control. [www.dnr.alaska.gov](http://www.dnr.alaska.gov)
- H. **Native groups** Wildlife management, land-use planning, environmental education, natural resource law, lobbying. Contact groups in your area, the Alaska Native Knowledge Network's regional coordinators [www.ankn.uaf.edu](http://www.ankn.uaf.edu) or the Alaska Native Heritage Center. [www.alaskanative.net](http://www.alaskanative.net)
- I. **University of Alaska or other universities** Research and teaching in wildlife, fisheries, ecology, and management. Contact the Cooperative Extension Service. [www.uaf.edu/coop-ext](http://www.uaf.edu/coop-ext)
- J. **Conservation organizations** These groups use people with careers in biology, ecology, lobbying, natural resource law, conservation, resource education, natural history interpretation, marketing and fund-raising. Examples include:
- **Alaska Outdoor Council and Alaska Fish and Wildlife Conservation Fund** [www.alaskaoutdoorcouncil.org](http://www.alaskaoutdoorcouncil.org) Official state affiliate of the NRA.
  - **Alaska Trappers Association** [www.alaskatrappers.org](http://www.alaskatrappers.org)
  - **National Audubon Society** [www.audubon.org](http://www.audubon.org)
  - **National Wildlife Federation** [www.nwf.org](http://www.nwf.org)
  - **The Nature Conservancy** [www.tnc.org](http://www.tnc.org)
  - **The Wilderness Society** [www.wilderness.org](http://www.wilderness.org)
- K. **Tourist guiding companies** (“ecotourism” guides must be knowledgeable about wildlife) Alaska Wilderness Recreation and Tourism Association. [www.awrta.org](http://www.awrta.org)
- L. **Jobs in Natural Resources** [www.cyber-sierra.com/nrjobs/natres.html](http://www.cyber-sierra.com/nrjobs/natres.html) Job openings in the field of Natural Resources. Has links to many career offerings.
- M. **Occupational Handbook** [www.bls.gov/oco/](http://www.bls.gov/oco/) National source of career information.



## Tracking Wildlife Regulations

In Alaska, wildlife management relies heavily on hunting to maintain healthy and productive wildlife populations. The wildlife management regulations that control hunting are created through extensive public involvement. Tracking the process involves many residents.

- **Fish and Game Advisory Committees:** About 80 communities across have advisory committees with up to 15 elected members. Fish and Game Advisory Committees provide local forums to discuss fish and wildlife issues and make recommendations to the boards. There are approximately 80 community-based Fish and Game advisory committees. They meet prior to the 'Call for Proposals' deadline to develop proposals that address the board's agenda. Advisory committees meet after proposals are published to comment and provide opposing or supporting arguments.
- **Alaska Board of Game (and the Board of Fish):** The Governor appoints seven public members who then must be confirmed by the Alaska State Legislature. Meeting two or three times a year, the Board of Game sets hunting regulations. The board does not have time to consider every regulatory topic at each meeting. Instead, it deals with topics on a rotating basis. After setting the next meeting's agenda, the board issues a 'Call for Proposals' and sends it to various agencies, groups, and individuals. The announcement is also published in Alaska newspapers.

A Board of Game meeting will include biologists and other staff from the Division of Wildlife Conservation and Division of Subsistence; members of the general public; and often includes representatives from the Alaska Department of Law; the Alaska Department of Public Safety, Division of Fish and Wildlife Protection (Wildlife Troopers); a United States Fish and Wildlife (USFWS) liaison; and members of Advisory Committees.

## How to Make Proposals

Any individual or group in the state can propose a change to a hunting regulation:

1. Submit proposals using the Regulation Proposal Form (sample provided for student use—see activity "I Propose...!" in Section 3, Lesson 7).
2. Write proposals using clear, concise language.
3. If possible, include the Alaska Administrative Code number (for example, 5AAC 92.990. DEFINITIONS) for the regulation addressed or provide the general heading and page number (for example, "DEFINITIONS" page 18-19) in the current regulation book.
4. State the problem and the reasons why the regulation should change, and who will be affected.
5. Submit the proposal to the board before the deadline.

### Tracking the Proposals

After all proposals are reviewed, they are printed and sent out for public comment. Any individual or group in the state may attend board meetings to express their views and ideas about the proposals.

Before the board votes on a proposal, members must consider written comments, public testimony, and biological information such as wildlife population health and environmental changes, social factors including historic use patterns, and all pertinent court rulings.

### Next Step for Approval

After the board meeting adjourns, Alaska Department of Fish and Game staff draft the regulations to be entered into the Alaska Administrative Code. The Alaska Department of Law reviews these changes. If approved by the lawyers, the Lieutenant Governor signs the new regulations into law.

### For Use by the Public

The Alaska Department of Fish and Game creates summaries and “public” versions, written in plain English. These will become the “Alaska State Hunting Regulations” a publication available free to the public in print and on our website. Regulations are enforced by the Alaska Department of Public Safety’s Division of Wildlife Protection, or Wildlife Troopers.

**NOTE:** Waterfowl are managed under a different process of regulation because Alaskans share these migratory birds with other states and other nations. The U.S. Fish and Wildlife Service sets harvest guidelines and then works with state waterfowl representatives to set rules and state allocations. Alaska is in the Pacific Flyway.



## Mark Recapture Tag

Alaska Wildlife  
Curriculum, Wildlife for  
the Future

### Preparation and materials:

- 1 red clothespin for every 4 kids in class. Example: Use 6 clothes pins for 24 students. Write numbers on the clothespins. The numbers represent the tag # and should be large and bold.
- 20 yellow clothespins numbered 1–20 (make numbers large and bold)
- Data sheet: one per biologist on a clip board for each biologist and a pencil

### Round 1:

Assign 1–3 students (depending on the side of the class) to be “biologists” and the rest animals.

Give biologists the clothes pins. The biologist’s job is to capture and mark as many animals as they can until they are out of clothespins or the time is up. Biologists “capture” the animals by chasing them and tagging them with two hands. Once the animal is “captured,” the biologist attaches a red clothespin to animal’s clothing so it is visible and then lets it go. The animal rejoins the class and the biologist writes down the clothespin number and the sex of the animal under Round 1 on the data sheet. Once the data is written down, the biologist continues to chase and try to capture more animals until he or she is out of clothespins. Marked animals cannot be re-caught this round.

### Round 2:

The biologists now have yellow clothes pins and again try to “capture” as many animals as possible by attaching the yellow clothespin to the animal’s clothing. Once the animal is “captured,” the biologist attaches a yellow clothespin to animal’s clothing so it is visible and then lets it go. The animal rejoins the class and the biologist writes down the clothespin number and the sex of the animal. Once the data is written down, the biologist continues to chase and try to capture more animals until he or she is out of clothes pins. Marked animals **can** be re-caught this round.

### Data Analysis:

Once all of the clothespins are gone, have students return to their seats. Leave clothespins attached to their clothing. Animals with



red and yellow clothespins are the animals that were marked and recaptured. Draw the following data table on the board and fill it in as you go.

- Have students marked with **red** clothespins stand up. This is **M** (number marked in round 1). Have them sit down.
- Have students with **red OR yellow** clothespins stand up. This is **C** (total number captured in round 1 and 2). Have everyone sit down.
- Have students marked with **red AND yellow** stand up. This is **R** (total number marked in round 1 and recaptured in round 2).

Symbol in the equation	What the symbol stands for	Data from your experiment
<b>M</b>	<b>Marked</b> —The number of animals captured and marked during Round 1.	
<b>C</b>	<b>Captured</b> —The number of animals (both marked and unmarked) captured during the second visit to the site.	
<b>R</b>	<b>Recaptured</b> —The number of recaptured animals that were marked.	
<b>N</b>	<b>Number</b> —The estimated number of animals in the population.	

Once the table is complete, complete the equation to calculate the estimated number of animals in the population (N). Compare the actual size of the class to the estimated size obtained through the experiment. Were the results an overestimate or underestimate?

Calculate the Percent error—Percent error calculation can be used to determine how accurate your estimate of the animal population is. The percent error for your animal population estimate is calculated using the following equation:

### Round 3:

Many things can affect the accuracy of the mark-recapture technique. As a class discuss possible events or situations that could cause the percent error to increase or decrease. Play the game again adjusting the number of clothespins to represent various scenarios. Predict what will happen to the estimated population if you change the number of red or yellow clothespins, the amount of time biologists have to trap, predators interacting with the population etc.

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