

Fostering Outdoor Observation Skills



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A Project of the Association of Fish and Wildlife Agencies'
North American Conservation Education Strategy

Developed by the Pacific Education Institute

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Preparing Children for Outdoor Science and Recreation



Developed By
Pacific Education Institute
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Co-Executive Directors



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Association of Fish and
Wildlife Agencies'
North American
Conservation Education
Strategy



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Restoration Program

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Preface

 Experiences from Coyote Guide engage students in an area of learning that may be the oldest of all the cognitive disciplines. The closest name modern academia offers is “field ecology.” It might also be called “nature literacy”: an ability to read the “Book of Nature” fluently.

Nature literacy is more than the intellectual knowledge of place or the names of flowers and birds detached from a meaningful context. It encourages students to use all their senses in the field to understand the interdependent web of life. Nature literacy awakens habits of perception (sensory awareness) and cultivates a rich vocabulary of search images (knowledge of place). Through these, our students connect to the natural world in a meaningful way.

State fish and wildlife agencies have invested in Conservation Education for youth and for the past 30 years, bringing resources and opportunities to formal and informal education programs. Conservation Educators from state fish and wildlife agencies, encouraged by their agency directors through the Association of Fish and Wildlife Agencies (AFWA), worked through the first decade of the 21st Century to develop resources educators need to prepare learners to be successful in field studies, stewardship and recreation in the natural world.

In order to prepare students for field studies, the AFWA Conservation Educators designed a series of guidelines to be used with school science programs, and to add value to environmental education programs. These guidelines are designed for teachers to provide K-12 students “real world” experiences in fish and wildlife related Science, Technology, Engineering and Math (STEM) studies. They are also designed to assist educators in meeting The Next Generation Science Standards that bring to the forefront contemporary sciences and their scientific methodologies.

The first publication, Field Investigations, describes the three major scientific methodologies used by field biologists from natural resource agencies. Outdoor observation is foundational for the field methodologies: descriptive, comparative and correlative scientific inquiry. Traditionally, outdoor observation skills are not included in science education. However, educators now recognize that 21st Century learning must include the ability to observe and undertake inquiry through multiple science and social science disciplines. As a result, the guidelines for Fostering Outdoor Observation Skills are designed to prepare students of primary school age to develop their outdoor observation skills through demonstrations and practice in real world situations. The Pacific Education Institute honors the experience of fish and wildlife agencies by providing Fostering Outdoor Observation Skills guidelines for teachers to connect children with nature, engaging their senses, their emotions and their cognitive capacity.

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(AFWA) North American Conservation Education Strategy
AFWA North American Conservation Education Committees

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(* participating on K-12 and Working Group Committees)

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The Pacific Education Institute and the Association of Fish and Wildlife Agencies are indebted to the national environmental education organizations of Project WILD, Project Learning Tree and Project WET for paving the way for K-12 environmental science education. The AFWA/PEI environmental science process materials would not be possible without the leadership of these organizations to bring meaningful learning experiences to students.

Photo Credits: Eastern screech owl by Terry L. Sobel, Great-horned owl, courtesy of NatureMapping, Western screech owl by Tim Avery, and ant mound photo courtesy of Katholieke Universiteit Leuven, Laboratory of Entomology photo gallery



Acknowledgments, *continued.*

Fostering Outdoor Observation Skills is a culmination of the work of many experts and practitioners, both in the fish and wildlife professions and the formal and non-formal education professions. Thank you to all who participated in developing Fostering Outdoor Observation Skills.

Teachers at the Waterville and Cle Elum-Roslyn school districts have worked with the Washington Department of Fish and Wildlife (WDFW) and The NatureMapping Program for the past fifteen years to hone the guidelines to develop outdoor observation skills, building on national and state science education standards for field science inquiry. For this work we thank Diane Peterson, fourth grade teacher, and Cathi Nelson, Principal, at Waterville School District, and Trish Griswold, eighth grade science teacher, and Mark Flatau, Superintendent, at the Cle Elum-Roslyn School District.

These guidelines also grew out of the Coyote's Guide to Connecting with Nature (Young, Haas and McCowan, 2009) to bring field observation "core routines" to formal education. The Coyote's Guide to Connecting with Nature (Young et. al. 2009) is a result of the Wilderness Awareness School's 25 years of experience mentoring students in "primary" awareness and connection to nature to the formal school system

Visionaries at the Washington Department of Fish and Wildlife, including Michael O'Malley, Watchable Wildlife Program Manager, Rocky Beach, Wildlife Diversity Program Manager, and John Pierce, Chief Scientist, Wildlife Program, enabled these guidelines to evolve. A key partner is Dr. Chris Grue, Unit Leader of the Cooperative Fish and Wildlife Unit at the College of the Environment, University of Washington.

The Board of Directors of the Pacific Education Institute, consisting of leaders in the formal education sector and natural resource agencies and organizations, recognized the need to provide guidelines for field studies. Their support was essential to making Fostering Outdoor Observation Skills a reality.

The lion's share of the credit goes to Karen Dvornich, National NatureMapping Director, who developed the NatureMapping guidelines for Awakening Inquiry in order to prepare citizens of all ages to conduct meaningful science for the benefit of sustaining biodiversity in their local communities. Karen collaborated on Awakening Inquiry with Diane Peterson, a 25 year veteran teacher, and Ken Clarkson, Director of the Nature Awareness Department of the Riekes Center for Human Enhancement and a former US fish and Wildlife Service refuge biologist.

The NatureMapping Program, a leader in rigorous citizen science, provided AFWA with a set of methods designed to develop "essential" outdoor observation skills in young learners; Fostering Outdoor Observation Skills provides an abbreviated approach to Awakening Inquiry. For a complete approach, educators are directed to the NatureMapping Program's Awakening Inquiry (Dvornich, Peterson and Clarkson, 2010) complete with a CD providing educators with materials and resources.

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Executive Director, Pacific Education Institute*



How to Use Fostering Outdoor Observation Skills



Fostering Outdoor Observation Skills prepares young learners from kindergarten to eighth grade to complete a data report form of fish, wildlife and habitat they observe in the environment. Data they collect may be contributed through a citizen science program to a professional scientist who can use the data to inform research.

Fostering Outdoor Observation Skills also prepares learners for successful outdoor recreation that requires them to observe fish, wildlife and their landscape, for example: wildlife watching, geocaching, fishing and hunting.

The lessons and activities in Fostering Outdoor Observation Skills are intended to be used with Project WILD, Project Learning Tree and Project WET lessons that engage students in outdoor observation skills (See Appendix for activities).

Outdoor observation skills are developed through continued practice. Like reading the written word, students need to continuously practice and apply outdoor observation skills to become proficient at interpreting their environment. In particular, the skills of developing a search image for wildlife (Unit 1 and Unit 4A), using our human senses alone and with technology (Unit 4B), and estimating sizes (Unit 3A) and numbers of wildlife (Unit 3B) take continued daily and weekly practice over months to reach proficiency. Educators can adapt their curriculum experiences to provide daily opportunities to develop these senses both inside and outside the classroom. Educators will find the animal senses exercises particularly important to expand a student's personal observation ability through regularly practicing the routines of: Owl Eyes, Deer Ears, Raccoon Touch, Dog Nose and Fox Walk in every new setting.

Fostering Outdoor Observation Skills describes grade level benchmarks for each lesson from grades K-8, and provides a rubric for student assessment. These benchmarks are age appropriate guided by the Next Generation Science Standards (2011) and AFWA's K-12 Scope and Sequence. The observation, reporting and data analysis skills developed in each of the units is summarized in the Table: Skills Required to Complete a Data Collection Form.



Tips and Techniques

What does the mean?

The text associated with the  is adapted from *Coyote's Guide to Connecting with Nature* (Young, Haas, & McCowan, 2009), which can be used as a companion to these lessons.

Other Resources to develop Outdoor Observation Skills:

The lessons provided in the Fostering Outdoor Observation Skills units were created using the strength of science and technology from the NatureMapping Program and the development of a traditional connection with nature emphasized in *Coyote's Guide to Connecting with Nature* (Young et. al. 2009). The NatureMapping Program's book *Awakening Inquiry* goes several steps further; incorporating Habits of Mind, creating enthusiasm games, providing practice ideas, and extending the observations to plants. Awakening Inquiry also explores native traditions to connect with nature, and provides a bridge for students to apply their learning through scientific inquiry. Awakening Inquiry provides a CD with tools and resources for each unit in Fostering Outdoor Observation Skills for educators.

Resource Websites:

These guidelines can be used in conjunction with the NatureMapping information on the George Lucas Education Foundation's Edutopia website (<http://www.edutopia.org/naturemapping-introduction>). Other resources can also be found on the NatureMapping Foundation website (www.naturemappingfoundation.org).



Project WILD, Project Learning Tree and Project WET

The following table lists the *Project WILD*, *Project Learning Tree* and *Project WET* activities that educators can use to help students prepare for or practice the skills described in each lesson. Activities with an asterisk (*) directly teach to the lesson in *Fostering Outdoor Observation Skills*.

| Project WILD (Animal) | Project Learning Tree (Plant/Habitat) | Project WET (Habitat) |
|--|--|-----------------------------|
| Unit One: Science Notebook | | |
| Lesson 1: Living Animal/Plant/Habitat Forms | | |
| Aquatic WILD | The Shape of things Pre K-3 | Adventures in Density |
| Marsh Munchers K- | Picture this Pre K-5 | Macroinvertebrate Mayhem |
| Lesson 2: Using a Sit Spot | | |
| Wild Words 5-8 | Planet Diversity 4-6 | |
| Ants on a Twig -58 | Adopt a Tree | |
| *Learning to Look, Looking to See Pre-K,K-4 | The Fallen Log 4-8 | |
| Aquatic WILD | Bursting Buds K-6 | |
| Mermaids & Manatees | | |
| The Glass Menagerie 9-12 | | |
| Lesson 3: Using a Science Notebook | | |
| Color Crazy K-4 | Poet-Tree 3-8 | Water Log K-12 |
| Spider Web Geometry 5-8 | Peppermint Beetle | H2Olympics 4-7 |
| What's That Habitat? K-4 | Charting Diversity 4-8 | Hangin' Together 5-8 |
| *Drawing on Nature 5-8 | Trees as Habitats | Is There Water on Zork? 5-8 |
| Wildlife Research 9-12 | Pollution Search | Life in the Fast lane 5-8 |
| Aquatic WILD | How Plants Grow | Rainy Day Hike 4-8 |
| Water Canaries 5-8 | Sunlight and Shades of Green 3-8 | Water Log K-12 |
| Water Plant Art K-4 | Watch On Wetlands 7-8 | |
| Micro Odyssey 5-8 | Trees in Trouble 1-8 | |
| Eat and Glow 7-10 | Field, Forest, and Stream 1-3, 4-8 | |
| Edge of Home 5-8 | Nature's Recyclers 1-6 | |
| Lesson 4: Story of the Day | | |
| World Travelers 5-8 | | |



**Project WILD
(Animal)**

**Project Learning Tree
(Plant/Habitat)**

**Project WET
(Habitat)**

Unit Three A: Take Measurements and Estimate Size

Lesson 2: Estimate the Size of an Animal at a Distance

How Big is Your Tree 4-8

Lesson 3: Identification by Tracks

*Tracks! 5-8

Unit Three B: Estimate the Numbers of Animals in a Group

Lesson 1: Introduction to Group Estimates

Dropping in on Deer 9-12

Every Drop Counts 4-8

Unit Four A: Focusing on an Animal

Lesson 1: Focusing on an Animal

Grasshopper Gravity K-4

Interview a Spider 5-8

Adaptation Artistry

Mover Over Rover 5-6

Every Tree for Itself K-8

Web of Life 4-8

Looking at Leaves K-4

Name That Tree 2-8

Picture This K-5

Macroinvertebrate Mayhem 4-8

Lesson 2: Developing a Search Image (Where and When to Look)

*Wildlife is Everywhere K-4

*Urban Nature Search 5-8

*Habitrekking 3-4

*Microtrek Treasure Hunt 5-8

Surprise Terrarium K-4

Animal Poetry 5-8

Rain Reasons 6-8

*Schoolyard Safari Pre K-5

Are Vacant Lots Vacant 4-8

Field, Forest, and Stream 4-8

Bursting Buds K-6

How Big Is Your Tree 4-8

Signs of Fall K-6

*Planet Diversity 4-6

*The Shape of Things K-3

Signs of Fall K-5

*Trees as Habitats K-2, 3-8

Birds and Worms K-6

Trees in Trouble 1-8, 4-8

Salt Marsh Players 4-6

Water Address 4-8

A House of Seasons K-3



| Project WILD (Animal) | Project Learning Tree (Plant/Habitat) | Project WET (Habitat) |
|---|--|-------------------------------|
| Unit Four B: Use Your Senses | | |
| Lesson 1: Using Your Senses | | |
| Environmental Barometer | Get in Touch with Trees PreK-6 | Stream Sense k-6 |
| Thicket Game Pre-K, K-4 | Peppermint Beetle PreK-6 | |
| Seeing is Believing! K-4 | Sounds Around Pre K-8 | |
| Quick Frozen Critters 5-8 | Tree Lifecycle 3-6 | |
| Aquatic WILD | Nothing Succeeds Like Succession 3-6 | |
| Sockeye Scents | Looking at Leaves K-4 | |
| Lesson 3: Who Are You Listening To? | | |
| Bird Song Survey 9-12 | | Where Are The Frogs? 5-8 |
| Unit Four C: Wanted Poster – What are unique traits of different animals (or plants) | | |
| Habittracks | Adopt a Tree Prek-2, 3-8 | Salt Marsh Players 4-6 |
| Who Fits Here? | Environmental Exchange Box K-8 | Water Address 4-8 |
| Aquatic WILD | Habitat Pen Pals | Water: Read All About It 7-12 |
| Blue Ribbon Niche 5-8 | | |
| Fashion a Fish K-4 | | |
| Aquatic Times 5-8 | | |
| Kelp Help 5-8 | | |
| Unit Five: Read and Use Maps | | |
| Lesson 2: What is a Map? | | |
| | | Color Me A Watershed |
| Unit Six: Use Data to Answer Questions | | |
| Lesson 1: Building a Graph on Paper | | |
| Graphanimal Pre-K, K-4 | Pass the Plants, Please k-8 | |



The NatureMapping Program has established a universal data collection form, which requires basic data that can be used by any scientist. Throughout this guide students will be adding data to a typical data collection form. This form shows the units that guide students to complete each section of the data collection form.

Data Collection Form: For Field Investigation Science Inquiry

Unit 1: Begin field studies in the outdoors by having students record observations in a Science notebook; through extended time and practice in natural areas students record qualitative and sensory data, that is then transferred to the data collection form.

Data Collection Form

| Observer's Name | | | | City/Country/State | | | |
|---|-----------------------------------|--|--|--|---|--|----------------------|
| Date | Time | Temp | Species Name Description | How Observed? (saw, heard, tracks, etc.) | | Latitude | Longitude |
| Unit 2 | Unit 2 | Unit 2 | Units 3A, 4A | Units 3A, 4B | Unit 5 | Unit 3B | Unit 3B |
| Lesson 2: Lesson 1: Telling time Want a date? | Use a thermometer | Unit 3A: Take Measurements & Estimate Size | Lesson 1: As Big as What? Lesson 2: Estimate Size of Animal at a Distance Unit 4A: Lesson 1: Focusing on an Animal Lesson | Lesson 1: Identification by Tracks Unit 4B: Use Your Senses Lesson 1: Using Your Senses Lesson 2: How to Listen Lesson 3: Who are you listening to? Lesson 2: Develop a Search Image | Unit 5: Read & Use Maps Lesson 1: Cardinal Directions Lesson 2: What is a Map? Lesson 3: Creating Our Own Maps Lesson 4: Using a GPS Unit | Unit 3B: Estimate of Numbers of Animals in a Group Lesson 1: Introduction to Group Estimates Lesson 2: The Grid System | Is this an estimate? |
| Standard MM/DD/YYYY | Military time (From 0000 to 2300) | F or C | What do You See? Provide species common name if possible. Use field guide or best guess. Describe as many features as possible. Keep a record in science notebooks for future ID. Field Notes: Sketch & describe field marks on head, body & tail. For mammals, birds, amphibians and reptiles; observe color, size, behavior, habitat, body covering | | | | |

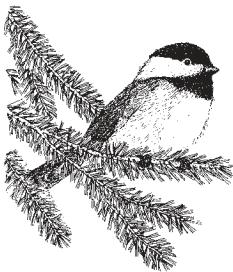


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Unit One: Science Notebook

How do students record qualitative, quantitative, and sensory data?

Objectives

Learn how to take good field notes in a science notebook.

Use all the senses to make observations.

Use a science notebook to practice writing about experiences at a Sit Spot.

Transfer notes from a science notebook to the data collection form.

Materials

Science notebooks

Data collection form

Leaves, seashells, flowers, or other objects for demonstration

Grid paper

Pens and pencils

Colored pencils

Pictures of the American robin and porcupine

Unit Summary

RECOMMENDED FOR EARLY ELEMENTARY STUDENTS (GRADES K-3)

In this unit, students will begin to record thoughts, observations, and measurements in their science notebooks. They will then transfer this information to the data collection form.

Four “Core Routines” will be introduced as lessons in this unit:

Lesson 1: Animal Forms

This lesson introduces “controlled fun” and creates enthusiasm among your students while introducing them to the use of their senses.

Lesson 2: Using a Sit Spot

A Sit Spot is as much a frame of mind as it is a physical place. The idea is to quiet your mind while pointing your senses outward.

Lesson 3: Using a Science Notebook

A scientist’s notebook goes by many names: nature journal, field notebook, or science notebook. Field researchers use such notebooks to record all sorts of information related to what they observe and measure. The information can be comparative or numeric, or consist of sensory observations (things you see, hear, feel, etc.) in the field.

Lesson 4: Story of the Day

After spending time in nature, tell the story of your day. Tell your story orally to others and by writing or drawing in a science notebook.

Activities such as writing in a science notebook and making observations at a Sit-Spot location will become “routine” in all of the units that follow.

| Nature Observation Form | | | |
|--------------------------|------------------|----------|-----------------------------|
| Location: Oak Tree Patch | | | |
| Time | Animal Observed | How many | Comments |
| 5:00 AM | American Robin | 1 | red breast, white belly |
| 5:15 AM | Chickadee | 1 | black cap, white belly |
| 5:30 AM | Blue Jay | 2 | blue feathers, white belly |
| 5:45 AM | Sparrow | 1 | small, brown feathers |
| 6:00 AM | Bird's Songbird | 1 | yellow feathers |
| 6:15 AM | Rock Screech Owl | 1 | white feathers, black spots |
| 6:30 AM | Robins | 2 | red breast, white belly |
| 6:45 AM | Woodpecker | 1 | black feathers, white belly |
| 7:00 AM | Porcupine | 1 | quills, white belly |
| 7:15 AM | Red-tail Hawk | 1 | large wings, white belly |
| 7:30 AM | Chickadee | 3 | black cap, white belly |
| 7:45 AM | Blue jay | 2 | blue feathers, white belly |
| 8:00 AM | Rock Screech Owl | 1 | white feathers, black spots |
| 8:15 AM | Robins | 2 | red breast, white belly |
| 8:30 AM | Woodpecker | 1 | black feathers, white belly |
| 8:45 AM | Porcupine | 1 | quills, white belly |
| 9:00 AM | Chickadee | 1 | black cap, white belly |
| 9:15 AM | Blue jay | 1 | blue feathers, white belly |
| 9:30 AM | Rock Screech Owl | 1 | white feathers, black spots |
| 9:45 AM | Robins | 2 | red breast, white belly |
| 10:00 AM | Woodpecker | 1 | black feathers, white belly |
| 10:15 AM | Porcupine | 1 | quills, white belly |
| 10:30 AM | Chickadee | 1 | black cap, white belly |
| 10:45 AM | Blue jay | 1 | blue feathers, white belly |
| 11:00 AM | Rock Screech Owl | 1 | white feathers, black spots |
| 11:15 AM | Robins | 2 | red breast, white belly |
| 11:30 AM | Woodpecker | 1 | black feathers, white belly |
| 11:45 AM | Porcupine | 1 | quills, white belly |
| 12:00 PM | Chickadee | 1 | black cap, white belly |
| 12:15 PM | Blue jay | 1 | blue feathers, white belly |
| 12:30 PM | Rock Screech Owl | 1 | white feathers, black spots |
| 12:45 PM | Robins | 2 | red breast, white belly |
| 1:00 PM | Woodpecker | 1 | black feathers, white belly |
| 1:15 PM | Porcupine | 1 | quills, white belly |
| 1:30 PM | Chickadee | 1 | black cap, white belly |
| 1:45 PM | Blue jay | 1 | blue feathers, white belly |
| 2:00 PM | Rock Screech Owl | 1 | white feathers, black spots |
| 2:15 PM | Robins | 2 | red breast, white belly |
| 2:30 PM | Woodpecker | 1 | black feathers, white belly |
| 2:45 PM | Porcupine | 1 | quills, white belly |
| 3:00 PM | Chickadee | 1 | black cap, white belly |
| 3:15 PM | Blue jay | 1 | blue feathers, white belly |
| 3:30 PM | Rock Screech Owl | 1 | white feathers, black spots |
| 3:45 PM | Robins | 2 | red breast, white belly |
| 4:00 PM | Woodpecker | 1 | black feathers, white belly |
| 4:15 PM | Porcupine | 1 | quills, white belly |
| 4:30 PM | Chickadee | 1 | black cap, white belly |
| 4:45 PM | Blue jay | 1 | blue feathers, white belly |
| 5:00 PM | Rock Screech Owl | 1 | white feathers, black spots |
| 5:15 PM | Robins | 2 | red breast, white belly |
| 5:30 PM | Woodpecker | 1 | black feathers, white belly |
| 5:45 PM | Porcupine | 1 | quills, white belly |
| 6:00 PM | Chickadee | 1 | black cap, white belly |
| 6:15 PM | Blue jay | 1 | blue feathers, white belly |
| 6:30 PM | Rock Screech Owl | 1 | white feathers, black spots |
| 6:45 PM | Robins | 2 | red breast, white belly |
| 7:00 PM | Woodpecker | 1 | black feathers, white belly |
| 7:15 PM | Porcupine | 1 | quills, white belly |
| 7:30 PM | Chickadee | 1 | black cap, white belly |
| 7:45 PM | Blue jay | 1 | blue feathers, white belly |
| 8:00 PM | Rock Screech Owl | 1 | white feathers, black spots |
| 8:15 PM | Robins | 2 | red breast, white belly |
| 8:30 PM | Woodpecker | 1 | black feathers, white belly |
| 8:45 PM | Porcupine | 1 | quills, white belly |
| 9:00 PM | Chickadee | 1 | black cap, white belly |
| 9:15 PM | Blue jay | 1 | blue feathers, white belly |
| 9:30 PM | Rock Screech Owl | 1 | white feathers, black spots |
| 9:45 PM | Robins | 2 | red breast, white belly |
| 10:00 PM | Woodpecker | 1 | black feathers, white belly |
| 10:15 PM | Porcupine | 1 | quills, white belly |
| 10:30 PM | Chickadee | 1 | black cap, white belly |
| 10:45 PM | Blue jay | 1 | blue feathers, white belly |
| 11:00 PM | Rock Screech Owl | 1 | white feathers, black spots |
| 11:15 PM | Robins | 2 | red breast, white belly |
| 11:30 PM | Woodpecker | 1 | black feathers, white belly |
| 11:45 PM | Porcupine | 1 | quills, white belly |

| Nature Observation Form | | | |
|-------------------------|------------------|----------|-----------------------------|
| Location: Forest Edge | | | |
| Time | Animal Observed | How many | Comments |
| 5:00 AM | Chickadee | 3 | black cap, white belly |
| 5:15 AM | Blue Jay | 2 | blue feathers, white belly |
| 5:30 AM | Rock Screech Owl | 1 | white feathers, black spots |
| 5:45 AM | Robins | 1 | red breast, white belly |
| 6:00 AM | Woodpecker | 1 | black feathers, white belly |
| 6:15 AM | Porcupine | 1 | quills, white belly |
| 6:30 AM | Chickadee | 1 | black cap, white belly |
| 6:45 AM | Blue Jay | 1 | blue feathers, white belly |
| 7:00 AM | Rock Screech Owl | 1 | white feathers, black spots |
| 7:15 AM | Robins | 2 | red breast, white belly |
| 7:30 AM | Woodpecker | 1 | black feathers, white belly |
| 7:45 AM | Porcupine | 1 | quills, white belly |
| 8:00 AM | Chickadee | 1 | black cap, white belly |
| 8:15 AM | Blue Jay | 1 | blue feathers, white belly |
| 8:30 AM | Rock Screech Owl | 1 | white feathers, black spots |
| 8:45 AM | Robins | 2 | red breast, white belly |
| 9:00 AM | Woodpecker | 1 | black feathers, white belly |
| 9:15 AM | Porcupine | 1 | quills, white belly |
| 9:30 AM | Chickadee | 1 | black cap, white belly |
| 9:45 AM | Blue Jay | 1 | blue feathers, white belly |
| 10:00 AM | Rock Screech Owl | 1 | white feathers, black spots |
| 10:15 AM | Robins | 2 | red breast, white belly |
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Lesson 1: Animal Forms

RECOMMENDED FOR EARLY ELEMENTARY STUDENTS (GRADES K-3)

Pre-Lesson Preparation

Walk around the school grounds and identify where you will take the students to practice their animal-form exercises. These exercises will move them toward their “Sit Spots” (see Lesson 2), so make sure the “end” point of the exercises is large enough to allow all the students to sit apart from each other for a few minutes of silence.



Whole Group Exercise

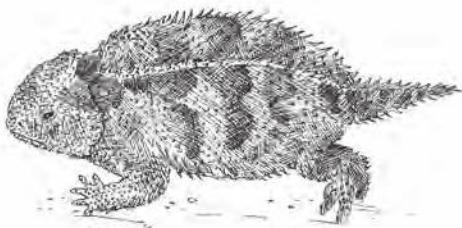
1. Take students outdoors.
2. Model with words and actions the movement of each of the animals listed in the *Animal Forms* section below. Begin by describing the actions without naming the animal, then let students see the type of movements each animal makes. Imitating these movements will give students an invaluable guide to understanding how animals walk at different speeds (e.g. gait patterns).
3. Have the class practice each animal form, then guide the students to the “end” point: their Sit Spots (see Lesson 2).
4. Explain to the students that they are to sit quietly with their eyes closed. They should:
 - a. Listen to what is around them.
 - b. Feel the wind or sun on their faces and note the direction from which it is coming.
 - c. Try to detect any smells.
5. As they sit, remind them to listen, feel, and smell for a period of two minutes before they open their eyes.
6. Discuss with the class what they experienced.
7. Return to the classroom using the same or different animal forms.

Animal Forms

Raccoon Form. As it walks, a raccoon first moves both legs on one side of its body, then the other side. Racoons are curious and look around as they move. They may sniff something that looks interesting, pick up a rock or seed, roll it around, drop it, and continue.

Ask students to get on their hands and knees and move from one spot to another, investigating the path they take. Older students should look around to understand how the landscape looks from the point of view of a raccoon (student’s knee level) and create a mental map of where a raccoon would go to remain undetected.





Deer Form. Deer are always alert, twisting their heads, turning their ears, and looking around to make sure a predator isn't sneaking up on them. They react quickly; if one of their group begins to move, they all do. They may begin to walk slowly, but if frightened, they will run, bounding high, landing lightly, and bounding high again.

Ask students to gather together in a group, each student looking in a different direction. They should pretend that whatever comes by (car, student, etc.) is a predator. Students will begin to walk away, then run and jump; but make sure they go in the same direction, which should be towards the area designated for their Sit Spots.

Have older students work in pairs and divide the class into two teams. Each member of the team will watch his/her partner walk, run, and then take one or two jumps. Students should note the distances they covered by means of the three modes of locomotion. They should think about how the tracks of a deer change as it moves from a walk, to a run, to a jump.

Cougar or Bobcat Form. Cougars and bobcats are predators, and they sneak up on their prey. They move very slowly, close to the ground, with one foot moving at a time.

Ask students to get on their hands and knees. They should try to get as close to the ground as possible while very slowly moving one leg and arm at a time, as though trying to sneak up on their prey (the teacher). Draw the students towards the area you've designated for their Sit Spots.

Older students should try to "direct register": As the students move their hands forward, they must put their knees where their hands were. They should notice how their "tracks" are almost along a single line and look like the prints of two feet instead of four. This information is important when tracking a cougar or bobcat, or even a house cat.

Other Animal Forms. Lizards have to lift themselves off the ground to run...using their muscles alone. This is the equivalent of getting ready to do a push up and moving forward at the same time. Frogs and rabbits lean on their front legs, then bring their back legs in front and spring out to land on their front legs again. Birds (such as a chicken or ostrich) run using their wings to steer themselves. Spiders and insects have multiple legs; to imitate them, pairs of students must work together to move all the legs at the proper time.

In each of the examples above, students imagine gait patterns as they crawl, run, and jump. Field biologists often get down on their hands and knees to "mimic" the tracks they see to help identify the animal and understand what it was doing at that particular moment in time.

NOTE TO TEACHERS: CHOOSE ANIMAL FORMS BASED ON THE WILDLIFE THAT EXISTS IN LOCAL HABITATS.



Lesson 2: Using a Sit Spot

RECOMMENDED FOR ALL ELEMENTARY STUDENTS (GRADES K-6)



What is a Sit Spot?

A Sit Spot is a site selected by each student where he/she can sit for 20 minutes (rain, shine, or snow) and make observations. Using pictures and words, the students record in their science notebooks what they see, hear, smell, and feel. The Sit Spot should be located outside (or at a place that has a view of the outside) and be in an area that you can visit regularly, rain or shine.

Grade Level Benchmarks

| | |
|------------|--|
| Grades K-1 | Students sit in a semi-circle around a common object, such as a tree, and draw what they see as you model the drawing activity on a large chart. |
| 2 | Students sit in a circle, with backs to each other. For 10 minutes, they draw and write what they see. |
| 3+ | Students use formal Sit Spots focused on observations (determined by you); they visit these spots once per season to experience the changes. |

Pre-Lesson Preparation

Depending on the age and ability of the students, it may take a lot of practice to make Sit Spots worthwhile. The level of expectation you set and the behavior you model during these experiences will determine your students' success in the field when you are not there to supervise.

Once you have identified a suitable area, inform students that they will be going out to find a Sit Spot on the school grounds.

Next, discuss with students this generic list of hazards and the precautions everyone should take. Know your school regulations for taking students on field trips.

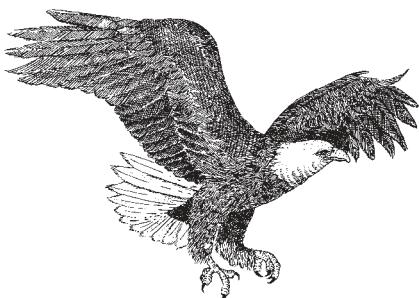


Examples of Hazards

- **Bees, yellow jackets, and wasps:** *Walk lightly around ground nests and keep your ear tuned for a “bzzz” sound.*
- **Venomous snakes and spiders:** *Carry a stick; go out early in the day. Be careful where you put your feet and hands—especially in dark places.*
- **Ticks:** *Check each other. Where on your body will they likely be?*
- **Poison ivy and poison oak:** *Look at plants before touching.*
- **Dead-falls from limbs:** *Look up; don’t sit under a dead tree branch.*

Creating Enthusiasm

To select their Sit Spots, students can play one or both of the following games:



Eagle-Eye Game. Close your eyes and pretend to be an eagle soaring over this area. The eagle needs a place to land that is its own special place. Go find a place to land.

Cat-Walking Game. Walk as if you were a cat. Slip along quietly in the shadows on the edge of cover. Walk a few steps and then stand still to sense danger. Turn your eyes and whiskers left, right, behind, and up. Use your “body radar” to feel which way to go next. Walk a few more steps, then again stop, look, listen, and adjust your course. Keep walking with cat-like awareness until the perfect spot attracts you, and you settle in.

Whole Group Exercise

Establishing Sit-Spot Expectations

Spend time in class explaining what a Sit Spot looks like and sounds like. Model the behavior you expect to see during this activity and have students practice. Make sure your expectations are clear to all students and that students know the boundaries of the area where they will sit.

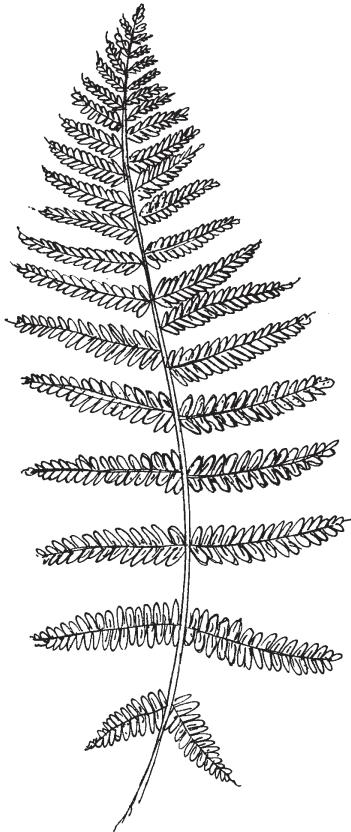
Remind the class that they already practiced a short version of a Sit-Spot activity when they did animal forms. Each student should:

- Choose a spot that he/she finds comfortable.
- Sit far enough away from other students that they can’t talk to each other.
- Sit in the same spot each time they go out.
- Be quiet. Note: Students will fidget the first or second time out until they become comfortable “being quiet.”
- Contact you only in an emergency.
- Return quickly and quietly to his/her starting point when you give the signal. Note: It’s fun to call the students back to you with a nature-sound signal, such as a crow’s caw or a coyote’s howl.



Lesson 3: Using a Science Notebook

RECOMMENDED FOR ALL ELEMENTARY STUDENTS (GRADES K-6)



Writing in a science notebook involves keeping a regular record, in drawings and in words, of your experiences outdoors. Note: Students in grades 3+ should glue their data collection forms into their science notebooks, because they will refer to the forms as they work through the units.

| Grade Level Benchmarks | |
|------------------------|---|
| Grades K-1 | <p>You bring in something for the students to look at—a bug or a plant. The students:</p> <ul style="list-style-type: none">• Draw, write, and discuss what they see.• Write a simple heading in their science notebooks, including date and time (which may be marked on a clock face).• Transfer what they see to the data collection form. <p>You elicit answers that have to do with all of the senses; students add to what they have written.</p> |
| 2 | <p>Working with you, students:</p> <ul style="list-style-type: none">• Use a common heading, including date, time, weather, and location.• Draw and write what they see inside the classroom (e.g., stuffed bird, picture, puppet, or live animal).• Use their senses to gain information about objects.• Ask questions about objects.• Use rulers to measure objects.• Transfer what they see to the data collection form. |
| 3+ | <p>Working more independently, students:</p> <ul style="list-style-type: none">• Use a common heading, including date, time, weather, and location.• Draw and write what they see inside the classroom (e.g., stuffed bird, picture, puppet, or live animal).• Use their senses to gain information about objects.• Ask questions about objects.• Use rulers to measure objects.• Use information in their science notebooks to write assignments.• Transfer the data from their science notebooks to the data collection form. |

Pre-Lesson Preparation

1. Create a large wall chart with columns on which students will record their sensory observations. In addition, prepare different scents in vials.
2. Teach students the importance of using a science notebook correctly: They should record the date, time, weather, and location every time they use their science notebooks. Work on student's note-taking abilities and show them samples of science notebooks or field journals (either personal or published).



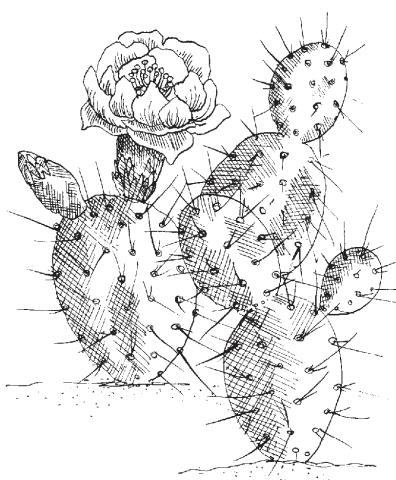
3. Elicit good habits by asking questions and instructing students to make comprehensive recordings while in the field, including feelings associated with what they see, hear, touch, or smell. In the beginning, students will need to be guided carefully. Their tendency will be to write sketchy, incomplete notes and to finish too quickly. This is a building process and will require a lot of modeling and practice.
4. Encourage students to look at their environment with a questioning eye: Ask questions such as “I wonder what would happen if...?” and “I wonder if...?” Have students keep a list of “I wonder” questions in their science notebooks.
5. Tell students: “When we are outdoors, we need to take careful notes about what we see. Later, we will use this information to fill out a data collection form.”

Whole Group Exercise

Accessing Prior Knowledge and Making Connections with Sketching

1. Show an example of a field science notebook and describe the components such a notebook should contain, including a consistent heading for every entry.
 - a. Day, date, time, weather, and location
 - b. Scientific drawings
2. Demonstrate the process of recording observations in a science notebook by looking closely at something to sketch, such as a leaf.
3. Try to focus students’ attention on what they *see*, rather than on the task of “drawing a leaf.”
4. Examine part of the edge of the leaf and talk about what it looks like; then draw that part.
5. The thinking behind this is:
 - a. “Oh, I see this line right here is jagged with little points at the end.”
 - b. “Oh, I see this vein getting wider as it goes up.”
 - c. The branches form a “V.”

For further references, see the resource section (Appendix A).



Frequency is very important for a Sit Spot exercise.

Do this activity frequently and formally. If it is impossible to go outside, at least stop and look out of the window for a few minutes of silence and make observations.

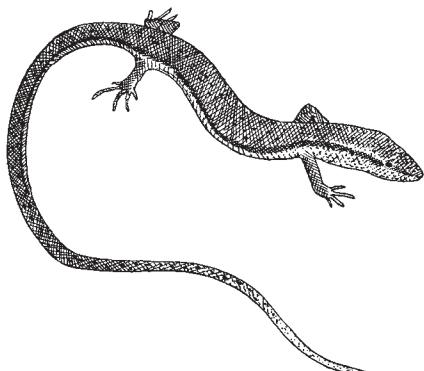
Going Outside. Make sure each student has a pencil and his/her science notebook. After the students have gone outside several times, you will want to add colored pencils, and possibly a ruler or other tools, to the Sit Spot materials. A zippered pencil bag works to hold all the tools.

1. Begin with a clean page and add the heading information: day, date, time, weather, and location.
2. Review what the students should record in their science notebooks.
3. It will help in the beginning for students to have a specific task to accomplish at their Sit Spots. Here are suggestions for specific Sit Spot focuses:
 - Describe what the weather is doing.
 - Spot a bird and describe (in drawings and/or words and phrases) what the bird is doing.
 - Write down “who, what, when, where, and why” about a plant at your Sit Spot.
 - Draw three plants at your Sit Spot in detail and write about them
 - Find something that interests you. Draw and label it.
 - First, write about what something looks like close-up. Next, write about what’s going on behind it. Finally, write how you feel about this thing you’ve just witnessed. 
 - Draw everything you see between the school building and the end of the football field.
 - Write three “I wonder” questions about your Sit Spot.
 - Go back to the same Sit Spot several times and record different data each time. For example, observe insects the first time, observe animals the second time, and so on. Alternatively, try to do a more accurate drawing of the plants you sketched on a previous visit.



Lesson 4: Story of the Day

RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE



1. Gather students (with their science notebooks in hand) around a flip-chart.
2. Make a sketch on the flip-chart of the area where the Sit Spots are located. Include landmarks the students can identify.
3. Take turns sharing things seen or heard, while adding words or symbols to the map.
4. Save this map for additional information from future Sit Spot activities.
5. Use different colors to record information that was gathered on different days, so that students can begin to see patterns.

Raising the Bar with Mind's Eye Imagining (Core Routine). When students are comfortable with the basic Sit Spot expectations, you may wish to try a Mind's Eye experience. This builds students' brain/memory and awareness skills; it ensures that students are aware and using their senses while at their Sit Spots, instead of sitting with their heads down, buried in their science notebooks. Mind's Eye is reinforced in Unit 3.

To begin, send students to their Sit Spots without their science notebooks. After you call an end to the Sit Spot activity, hand out students' science notebooks. Tell students to record their observations before they leave the field or have them wait till they have returned to the classroom. Alternatively, ask each student to return to the classroom and write about his/her experience at the Sit Spot and do a sketch from memory.

Other Mind's Eye Imagining Exercises:

- Give students 10 minutes to read through a field guide. Tell them to close their books and begin recording in their science notebooks. Alternatively, read a description from a field guide and ask students to write from memory in their science notebooks.
- Have students record (sketch, measure, draw, color, and label) their observations of objects brought back from their Sit Spots.
- Before students leave their Sit Spots, prompt them to go through all of their senses. Once back in the classroom, they should record these sensory observations in their science notebooks.



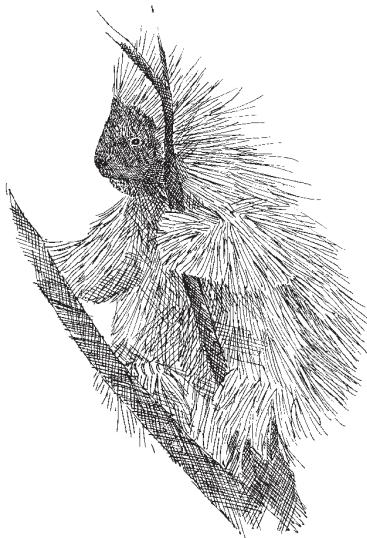


Transferring Information from a Science Notebook to a Typical Data Collection Form

1. Give each student a data collection form (Student Page, page 12).
2. Explain that the data collection form is the way we transfer, in a consistent fashion, the scientific data from our science notebooks.
3. Show students pictures of an American robin and a porcupine.
4. On the data collection form, students will:
 - a. Write the name and grade of the observer.
 - Grades K-2, write teacher's name and grade.
 - Grades 3+, each student will write his/her name.
 - b. In the correct columns, write the animal's name, the word "saw," and the number of animals the observer saw.
 - c. Explain to the students that they will learn in later units how to fill in the rest of the data collection form.
 - The data collection form will be the basis for the graphs created in Unit 6.
 - d. Teachers may ask older students to record their Sit Spot data as a separate exercise.

| Data Collection Form | | | | | | | | |
|------------------------------------|------|------|--------------------------|--|----------|-----------|-----------------------|----------------------|
| Observer's Name <u>Sally Smith</u> | | | | City/County/State <u>Waterville, Douglas, WA</u> | | | | |
| Date | Time | Temp | Species Name Description | How Observed? (saw, heard, tracks, etc.) | Latitude | Longitude | How many did you see? | Is this an estimate? |
| | | | American robin | saw | | | 1 | |
| | | | porcupine | saw | | | 1 | |
| | | | Western screech owl | saw | | | 1 | |
| | | | | | | | | |
| | | | | | | | | |





Practical: Grades 3+

Shown a picture of an animal, students will independently fill in “name,” “how observed,” and “how many” on a new data collection form that they will hand in.

Formative Assessment

- Students’ science notebooks should be handed in on a regular basis to give teachers insight into student-thinking and to guide instruction.
- Science notebooks reveal what students do and don’t understand, what misconceptions they have, and which organizational skills they are using; thus, science notebooks provide a formative assessment.
- Rather than writing on the pages of a student’s science notebook, teachers may respond to entries by writing on small sticky notes.

| Student Assessment | |
|--------------------|--|
| Exceeds benchmark | <p>In the student’s science notebook, the:</p> <ul style="list-style-type: none"> • Heading (time, date, weather, location) for each Sit Spot is complete. • Assignments are completed for each Sit Spot. • Entries include specific descriptive words, including measurable sizes. • Entries include clear observations. • Drawings are labeled in detail. <p>The student has correctly filled in three columns on the data collection form.</p> |
| Meets benchmark | <p>In the student’s science notebook, the:</p> <ul style="list-style-type: none"> • Heading is complete. • Drawings are partially labeled. • Assignments are completed most of the time. • Entries include descriptive words and accurate sizes. • Entries include clear observations. <p>The student has correctly filled in three columns on the data collection form.</p> |
| Below benchmark | <p>In the student’s science notebook, the:</p> <ul style="list-style-type: none"> • Heading is incomplete. • Drawings are not labeled. • Assignments are incomplete. • Entries include unclear descriptive words, such as big, small, cool, and so forth. • Entries include some observations. <p>The student has made one or more mistakes on the data collection form.</p> |



Student Page

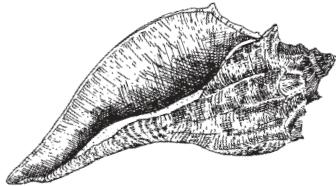
Data Collection Form

Observer's Name _____

City/County/State _____

Unit Two: Measure Time and Date

What are the different ways to record the time and date?



Objectives:

Understand the difference between digital and analog clocks.

Learn how to record time using standard and military notation.

Understand the different date formats, including NatureMapping's standard: MM/DD/YYYY.

Materials

Science notebooks

Data collection form, p. 12

Partially completed time and date data collection forms

Analog and digital clocks or watches

Calendars

Grid paper

Pens and pencils

Color pencils

Unit Summary

Scientists record times, dates, and temperatures to keep track of events and to analyze patterns or changes in data. You can start molding your students into young scientists by teaching them the basics of telling time and formatting dates.

In this unit, students will discover that there are different ways to record time. Primary students will record time by drawing on a diagram of a clock face and/or by writing down the time that they read on a digital clock. Intermediate students (and above) will record time using military time.

Unit Two includes the following two lessons:

Lesson 1: Telling Time

RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE

Because some students may know only how to tell the time using digital clocks, this unit ensures that they also learn how time is displayed on the circular face of a traditional analog clock. Converting standard time to military time is emphasized because it is easy to forget the A.M. or P.M. when recording time.

Lesson 2: Want a Date?

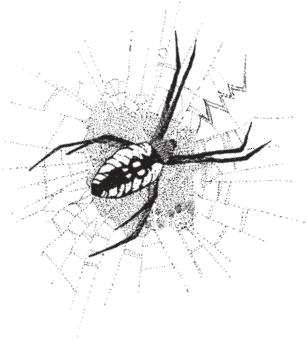
RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE

For those who live during the middle of a century, the need to remember the four-digit year may not seem as great as for those who have experienced the beginning of a new century. Because the NatureMapping Program has collected historical data that goes back to the 1800's, recording a date properly—including the four-digit year—is especially important.



Lesson 1: Telling Time

RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE



Telling time is more than reading a clock; it gives you a picture of what you are doing at a specific time. This lesson focuses on teaching students to convert from analog to military time and to link activities to a 24-hour period.

| Grade Level Benchmark | |
|-----------------------|--|
| Grades K-2 | Each student records time on a clock face (drawn by you) by adding the hands. The teacher may record the time in numbers and ask students to copy it into their science notebooks. |
| Grade 3 | Students draw a clock and record the digital time. |
| Grades 4+ | Students record time using military time, which always includes 4 digits. Students record elapsed time using digital or analog clocks. |

Getting Started

1. Explain the difference between analog and digital time using different watches or clocks as examples.
2. During the explanation of the clocks, divide two diagrams of clock faces into four sections. Label one A.M. and one P.M. Discuss with students the periods of the day: At 12 midnight, it is dark and we are sleeping. At 3 A.M., we are still asleep. It is getting light outside at 6 A.M. At 9 A.M. we are up and about our day. Twelve noon is when the sun is overhead, and now we denote time as P.M. (*post meridiem*, “after mid-day”). Three P.M. is in the afternoon. It begins to get dark at 6 P.M., and by 9 P.M., we are heading for bed.
3. Students will glue copies of the clocks into their science notebooks for reference.
4. Explain military time and standard-to-military time conversions.
 - a. Military time is based on a twenty-four hour clock that begins at 12 A.M. (0000) and goes to 11 P.M. (2300). It does not have annotations for A.M. or P.M.
 - b. Times are written in four-number increments that indicate the hour, followed by the minute.
 - c. Add twelve to the times from 1 P.M. to 11 P.M., and add zeros to complete the four-number format. For example, 1 P.M. is 1300 and 6 P.M. is 1800.

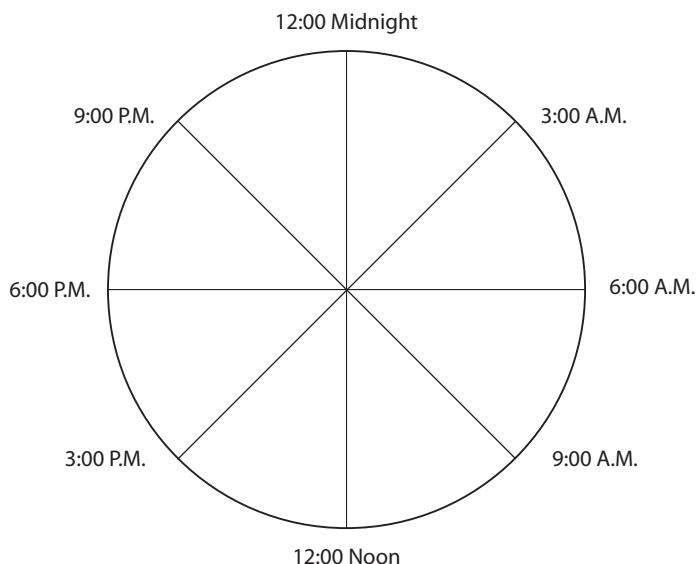
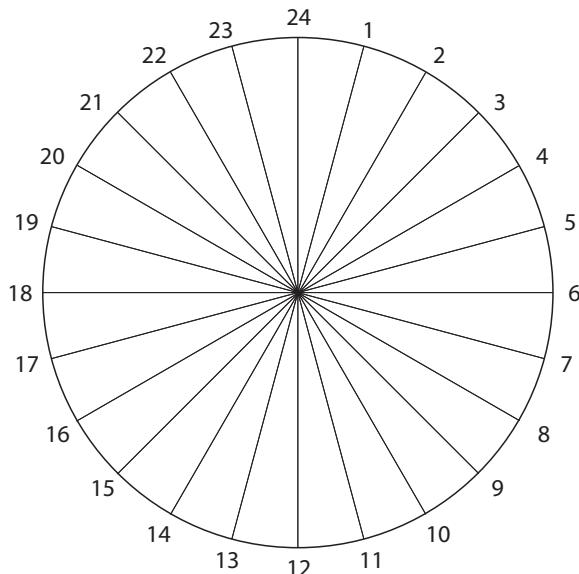


| Military/Standard Conversion | | |
|-------------------------------|---|--|
| Time | Conversion Method | Example |
| 1 P.M. through midnight | Add 12 to the time and then add two zeros to the end of the number. | $6\text{ P.M.} + 12 = 18$, add two zeros = 1800 |
| 1300 through 2400 | Remove the two zeros at the end of the number and subtract 12. | Remove two zeros from 1800 = 18 $- 12 = 6\text{ P.M.}$ |

- Ask students to speculate about why military time is universal across the globe and to share their strategies for converting from military time to standard time, or vice versa.
- Ask students to use these newly learned strategies to convert (from standard notation to military notation) different times that you say aloud.

Whole Group Exercise

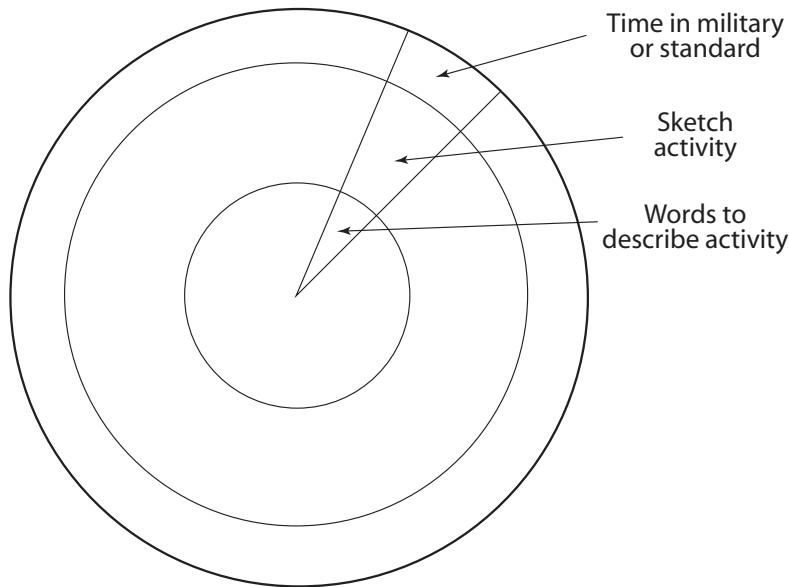
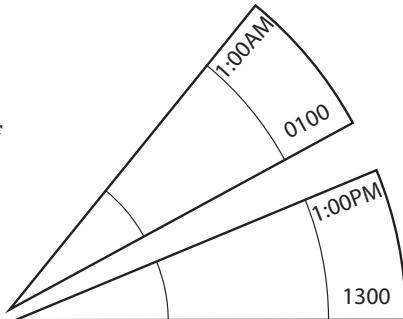
- Make a large clock, using the example below, and hang it on the wall.
- Discuss the activities that students are doing during each time segment and write these activities on the clock. (Examples: wake up, go to school, lunch, recess, etc.)
- Help the students to convert the times to military time and write the results on the clock.



Student Practice: Creating a 24-hour Clock

Make copies of the segments of a twenty-four hour clock. Cut up about 24 slips of paper with an activity on each slip.

1. Distribute the 24 “pie slices” of time.
(Depending on the age group, hand out a pie slice to each student or to each pair of students.)
2. The students should:
 - a. Write the standard time next to the military time on their pie pieces.
 - b. Sketch what they would be doing at that time.
 - c. Write two words to explain that activity.
3. When all pie pieces are complete, the pieces should be put together into a complete 24-hour circle. This will serve as a reference for the students when they need to record military time.



Extension. Once students choose the animals or plants they will “adopt” in Unit 4, the 24-hour clock drawing can be repeated as a day in the life of each student’s adopted animal or plant.



| Data Collection Form | | | | | | | | |
|------------------------------------|------|------|--------------------------|--|----------|-----------|-----------------------|----------------------|
| Observer's Name <u>Sally Smith</u> | | | | City/County/State <u>Waterville, Douglas, WA</u> | | | | |
| Date | Time | Temp | Species Name Description | How Observed? (saw, heard, tracks, etc.) | Latitude | Longitude | How many did you see? | Is this an estimate? |
| 05/06/2009 | 0700 | 60 F | American robin | saw | | | 1 | |
| " | 1630 | 70 F | porcupine | saw | | | 1 | |
| 05/23/2009 | 0900 | 55 F | Western screech owl | saw | | | 1 | |
| | | | | | | | | |
| | | | | | | | | |

Understanding Elapsed Time

Students' concept of elapsed time can be developed by such activities as keeping track of the time it takes for a butterfly's chrysalis to develop or for eggs to hatch. These activities are directly related to the activities the teacher brings into the classroom to study living creatures.

Practical

Students should be able to refer to the clocks in their science notebooks.

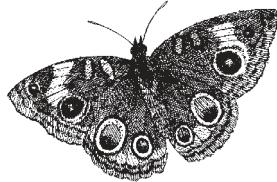
1. Hand each student a data collection form on which is recorded 10 animals that were seen or heard
2. Announce the time. For example, "Horny toad 1 was seen at 8:00 in the morning; please record the time."
3. Save the forms and use them to record date and temperature.

| Student Assessment | |
|--------------------|--|
| Exceeds benchmark | 10 times out of 10, the student recorded the time accurately when the time was presented orally. |
| Meets benchmark | 9 times out of 10, the student recorded the time accurately when the time was presented orally. |
| Below benchmark | 8 times out of 10 (or less), the student recorded the time accurately when the time was presented orally. The student needs more practice. |



Lesson 2: Want a Date?

RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE



The International Organization for Standardization (ISO 8601) says that the correct calendar date format is written as YYYY-MM-DD. However, date formats vary by organization and reflect individual preferences. In this lesson, the students will learn several ways to record a date, including the format used by professional biologists.

| Grade Level Benchmarks | |
|------------------------|--|
| Grade K | Students practice using a calendar and write an activity on their calendars every day. |
| Grades 1-2 | You fill in the month and year on the data forms; the students fill in today's date. |
| Grades 3-4 | Each student writes a list of months by him/herself. |
| Grade 5+ | Each student writes the date by him/herself. |

Whole Group Exercise

1. Show the data collection form and explain: "We have learned how to record time. Next, we will learn how to record the date. What are the parts of the date?"
2. Ask the students to think of all the ways to write today's date. (Depending on their ages, they may suggest between two and five different ways to write a date.)

The following list, while not exhaustive, provides examples that you can share with your students or refer to when adding ideas to the students' list:

| | | |
|-----------------|---------------|---------------------------|
| 8/29/2008 | August-2008 | Thursday, August 29, 2008 |
| August 29, 2008 | 8/29 | 8/29/08 6:00 PM |
| 8/29/08 | 8/29/08 18:00 | 08/29/08 |
| A | 29 Aug | A-08 |
| 29-Aug-08 | 29-Aug-2008 | Aug-08 |

3. Explain that, today, the students will learn a special format that scientists use to record the date when they collect data: x/xx/yyyy (or month/day/year). On the students' list, circle the protocol date format.

Note: Government includes observations dating back to the 1900s. It needs to know if the date is 1908 or 2008.

4. Post a list of the names of the months, and number the months so that students can refer to them (January is 1, February is 2, etc.). You can either give students copies of this list or ask them to write their own lists in their science notebooks.



| Data Collection Form | | | | | | | | |
|------------------------------------|------|------|--------------------------|--|----------|-----------|-----------------------|----------------------|
| Observer's Name <u>Sally Smith</u> | | | | City/County/State <u>Waterville, Douglas, WA</u> | | | | |
| Date | Time | Temp | Species Name Description | How Observed? (saw, heard, tracks, etc.) | Latitude | Longitude | How many did you see? | Is this an estimate? |
| 05/06/2009 | 0700 | 60 F | American robin | saw | | | 1 | |
| " | 1630 | 70 F | porcupine | saw | | | 1 | |
| 05/23/2009 | 0900 | 55 F | Western screech owl | saw | | | 1 | |
| | | | | | | | | |
| | | | | | | | | |

| Student Assessment | |
|--------------------|---|
| Exceeds benchmark | 10 times out of 10, the student recorded the date accurately when the date was presented orally. |
| Meets benchmark | 9 times out of 10, the student recorded the date accurately when the date was presented orally. |
| Below benchmark | 8 times out of 10 (or less), the student recorded the date accurately when the date was presented orally. The student needs more practice |

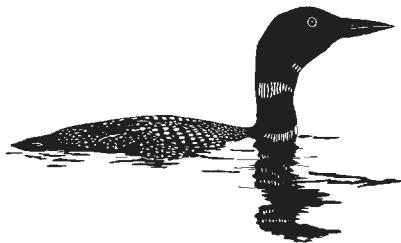
Practical

1. Hand students the same data collection form used to record time from Unit 2, Lesson 1 on which is recorded 10 animals that were seen or heard.
2. For each observation announce a date. For example, "American robin was seen on May 6, 2009; please record a date."
3. Use the forms to record the approximate temperature in Fahrenheit degrees (F) at time of observation using a thermometer or other technologies (e.g. web-based weather site).



Unit Three A: Take Measurements and Estimate Size

How can we use actual and estimated size to identify an animal?



Objectives

Learn to use field guides.

Use Mind's Eye Imagining to develop a mental picture of the animal.

Measure an animal's size using fingers, hands, and arms.

Measure an animal's size and tracks using rulers (standard and metric), measuring tapes, and calipers.

Learn how to estimate the size of an animal based on the observer's proximity to the animal.

Add additional information to the data collection form.

Unit Summary

A major part of keeping a science notebook involves drawing and labeling objects. If the object is a plant or a young animal, it will be growing during the year. This means students must pay as much attention to recording the size of the object as they pay to recording the date and time they observed it.

Observing fish, wildlife, and insects is an inexact science. A scientist who observes a flowering bush full of bees or a flock of ducks suddenly taking flight from a pond will find it difficult to count the exact numbers of individuals. It can be just as difficult to measure size: Most of the time, the animal or insect is moving. Therefore, field researchers often estimate numbers and size.

This unit is divided into three lessons that teach students how to use field guides as references and how to take good measurements. Field guides offer a compilation of the knowledge acquired by many people over a long period of time. Such guides provide comprehensive—but condensed—information about different animal and plant species.

Lesson 1: As Big as What?

RECOMMENDED FOR ALL ELEMENTARY (K-6)

The first lesson introduces techniques to measure size. Imagine that your students run into the classroom saying “We just saw this huge bird!” How big is “huge”? This lesson uses field guides to find measurements of animals and then helps students relate to those measurements using their fingers, hands, and arms.

Lesson 2: Estimate the Size of an Animal at a Distance

RECOMMENDED FOR ALL ELEMENTARY (K-6)

An animal that is far away looks small, even if it is large. Through outdoor activities and perspective drawing, this lesson teaches techniques that help students estimate the size of an object at a distance.



Materials

- Science notebooks
- Data collection form
- Completed owl and skunk data collection forms
- List of Common Species Found in Most Urban Areas (Appendix D)
- Field guides or animal fact sheets for different taxonomic groups
- Photos of owls
- Skunk tracks (Appendix D)
- Tracking Data Collection form, Student Page, p. 35
- Pet measurement homework assignment (Appendix D)
- Digital camera
- Wooden or metal stakes
- Computer and graphics software (such as Adobe PhotoShop)
- Grid paper
- Pens and pencils

Lesson 3: Identification by Tracks

RECOMMENDED FOR ALL ELEMENTARY (K-6)

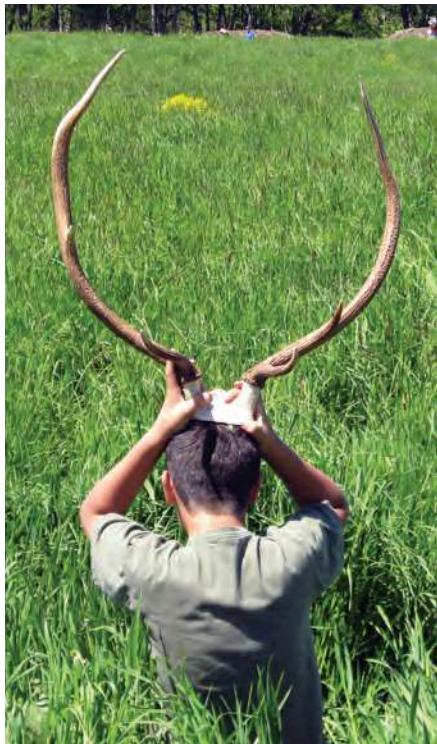
What better way to learn how to use different measuring devices than to read tracks left by animals? Taking measurements allows students to estimate the size of the animal and determine what the animal was doing. Tracking opens a new world for students to investigate, and they will want to use their measuring tools.

Throughout these lessons, students should be encouraged to close their eyes and picture the animal or group of animals (Mind's Eye Imagining). Tell students, "When you close your eyes, try to remember the details of the animal. When you open your eyes, you will notice details you didn't notice before; the picture in your mind's eye will become clearer and more vivid."



Lesson 1: As Big as What?

RECOMMENDED FOR ALL ELEMENTARY (K-6)



| Grade Level Benchmarks | |
|------------------------|---|
| Grades K-2 | <p>Students use their fingers, hands, height, and arms to estimate the size of a bird or small mammal.</p> <p>Students record their estimates in their science notebooks using words, numbers, and pictures.</p> <p>Students know where to look in their field guides to find the owls.</p> |
| Grades 3-4 | <p>Students consult their field guides to locate measurements for an animal selected from the List of Common Species Found in Most Urban Areas.</p> <p>Students compare the size of two or more animals based on information from a field guide.</p> <p>Students record information about size in their science notebooks using words, numbers, and pictures and showing correlation of size to finger, hand, height, or arm.</p> |
| Grades 5+ | <p>Students compare measurement information from a field guide to identify an unknown animal by relating it to an animal of similar size.</p> <p>Students record measurement information in a science notebook using words, numbers, and pictures and relating size to finger, hand, height, or arm.</p> |

Pre-Lesson Preparation

Field guides are usually organized in a taxonomic order, which means that similar species are grouped together. For example, sea birds, ducks, gulls, birds of prey, and woodpeckers are grouped together. Likewise, turtles, tortoises, lizards, and snakes are grouped together. Use the indexes of the field guides to find the species that are listed on the List of Common Species Found in Most Urban Areas.

Field Guides as Magic

Because field guides offer so much information (in small print and adult language), we need to make them fun, approachable, and accessible. We don't use them as textbooks, but rather as magical books that hold innumerable secrets. We want students to explore them with wide eyes and a playful attitude.

“Kids just love this!”

—Diane Petersen



Whole Group Exercise

Accessing Prior Knowledge and Making Connections to Size

Students should use the protocols they learned in Unit 2 to fill in the date and time on their data collection forms.

I. Introduction. Begin the exercise by asking, “If you saw an animal, what clues would you use to identify it?” Then:

1. Show pictures of the great horned owl, the western screech owl, and the eastern screech owl. Ask the students, “How are these owls the same and how are they different?”



Great-horned owl



Western screech owl



Eastern screech owl

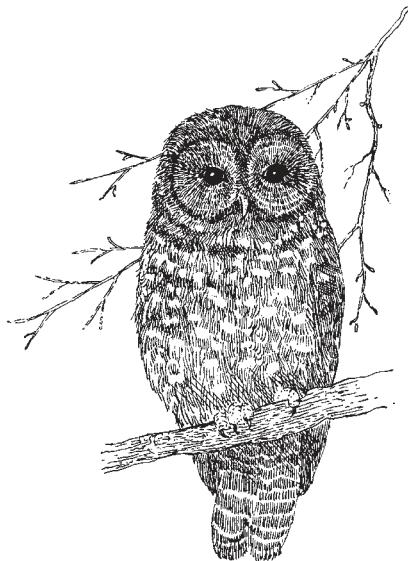
2. Explain that the pictures in a field guide make it appear that all of the birds are of equal size, so you can't judge the relative difference in sizes until you look up the measurements for each bird.

II. Looking through the Eyes of an Owl. Owls hunt at night. Sitting silently on high branches, they stare into the night with wide-angle vision, seeing everything at once and listening intently with their ears offset to catch the slightest of sounds. When something moves—such as a mouse in the leaf litter—an owl will turn its head suddenly to focus in on the source of the movement. An owl's eyes have to be large in order to capture all the available light, but they are so big that the eyeballs are literally stuck in their eye sockets. (Note: In response to a frequently asked question...they can't turn their heads completely around; only about 300 degrees.)

Owl Eyes. (Students learn to use and depend upon peripheral vision.) Tell the students to:

1. Get into two lines facing away from each other.
2. Open your arms until you can't see your fingers.
3. Wiggle your fingers and bring your arms in until you can see wiggling fingers, then drop your arms to your sides.
4. Without turning your head, name something in front of you, something you see on the right side of the room, and something you see on the left side of the room.





Eagle Eyes. Next, students pretend to be an eagle that can see far away:

1. Bend the fingers of both hands and put them together like a set of binoculars.
2. Bring your hands up to your eyes. Without turning your head, can you see the same things you saw as an owl?
3. Eagles hunt during the day, but owls hunt at night. Why do owls need to find animals at night?

Allow the students to spend time looking at all of the owls in the field guide. Next, ask them to find the eagles and to notice where on the eagles' heads the eagles' eyes are placed. They should compare this eye-placement to that of the owls.

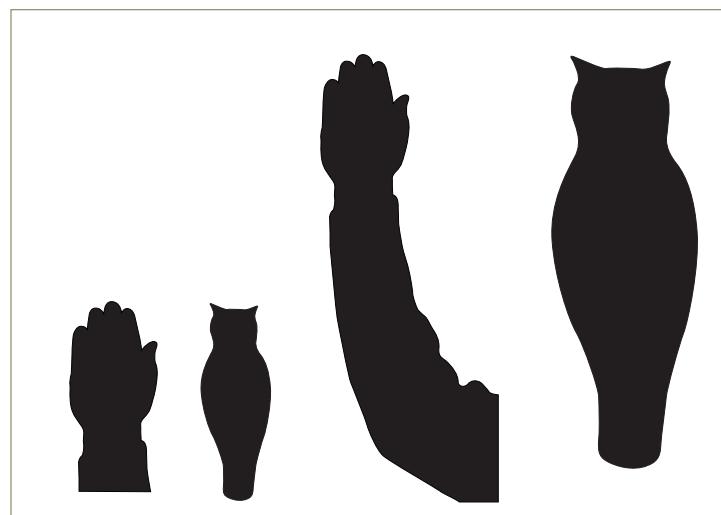
Students will notice other differences and similarities. By flipping through the field guide's pages, they will develop a search image for more than just the three owls in this lesson. By immersing themselves in the field guides, they unconsciously develop a file cabinet of images.

III. Estimating Size.

Explain how you can estimate the size of an animal without using a measuring tool.

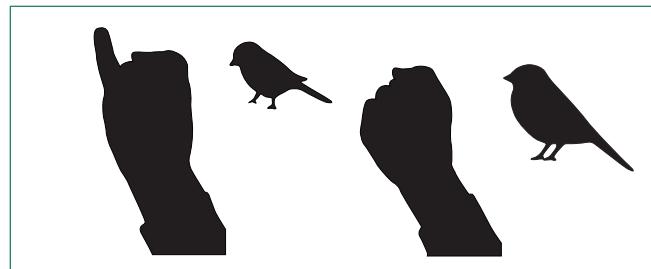
Look up the great horned owl, the western screech owl, and the eastern screech owl:

1. Read the measurements. Ask: "What part of your body is about the same size?"
2. If students have problems, use your hand and arm to show the difference between the western or eastern screech owl (*which is the size of your hand*) and the great horned owl (*which is the size of your arm from the elbow to the tips of your fingers*).
3. Students will draw the owl and hand/arm shapes and label them in their science notebooks.



For Further Practice: Look up a Black-capped chickadee and a House sparrow. Ask: “What part of your body is about the same size?” (*Answer:* A little finger for the chickadee and a fist for a House sparrow.)

1. Allow time for students to look at the field guides and find other chickadee and sparrow species.
2. Students will write in their science notebooks about how they would know a Black-capped chickadee or a House sparrow if they saw or heard one.
3. Students will draw the shape and size (to scale) of a Black-capped chickadee and a House sparrow.



Practical: Grades 3+

Students are given the names of two animals, such as hummingbird and deer, and are asked to find them in a field guide by using the index. Each student must then:

- Locate the size measurements for the animals.
- Record the measurements in his/her science notebook.
- Explain (in writing or a sketch) the size of each animal in relation to the student’s body: finger, hand, and height. E.g., hummingbird = size of the student’s finger; deer = the student’s height. (Fawns would be same height as younger students, and does and bucks the same height as older students.)

As time allows, students may use the field guide to find additional information and add sketches of the animals to their science notebooks. For example, they could sketch a deer with a stick-figure person beside it to show that they understand the comparative size. They would then add the measurements.

Sit Spot Reminder. As you and your students continue to visit Sit Spots regularly, encourage the students to list “I wonder . . .” questions that include size-relationship queries. If the size reference is too vague, use the books listed in the reference section to develop students’ awareness of accuracy when thinking about size.



| Student Assessment | |
|--------------------|---|
| Exceeds benchmark | <p>The student uses the index of a field guide to locate information about a specific animal.</p> <p>The student uses his/her science notebook to write about and draw the animals.</p> <p>The student draws his/her fingers, arms, hands, or body next to the animal.</p> <p>The student's science notebook includes size measurements, and the numbers are copied accurately from a field guide.</p> <p>The student's drawings of the shapes of the animals are correct.</p> <p>The student's data collection form is complete.</p> |
| Meets benchmark | <p>The student uses the index of a field guide to locate information about a specific animal.</p> <p>The student uses his/her science notebook to write about and draw animals.</p> <p>The student's science notebook includes size measurements that were copied accurately from a field guide.</p> <p>The student's drawings of the shapes of the animals are generally correct.</p> <p>The student's data collection form is complete.</p> |
| Below benchmark | <p>The student's science notebook includes minimal writing or drawing. Measurements are missing or incomplete.</p> <p>The shape of the animal is missing or incomplete.</p> <p>The student's data collection form is incomplete.</p> |



Lesson 2: Estimate the Size of an Animal at a Distance

RECOMMENDED FOR ALL ELEMENTARY (K-6)

The distance between the students and the animal they observe will make a difference when students calculate the size of the animal. In this lesson, students will practice estimating the size of the same animal at multiple distances. Students will also begin to develop the ability to imagine the size of an animal in relation to its surroundings.

| Grade Level Benchmarks | |
|------------------------|--|
| Grades K-2 | Students state that animals appear larger as they get closer to them. |
| Grades 3-4 | Students adjust the size of animals in their drawings to show the distance from the viewer (e.g., themselves). |
| Grades 5+ | Students use perspective drawing to show the correct size of animals. |

Pre-Lesson Preparation

Review your students' science notebooks to spot-check for misconceptions or missing information. (This will help reveal the material that you may need to re-teach or review.)

- Locate an area of open space on your school grounds. This space should be at least 100 feet wide.
- Prepare three life-size pictures of the same animal (e.g., an owl).
- Practice using the “C” method of measuring (see below).
- Get your camera ready; be sure you have good batteries.

Whole Group Exercise

I. Using the “C” Technique to Measure Size. Teach the students to “measure” height by closing one eye and holding up the thumb and index finger to form a “C” with the left hand, or a backwards “C” with the right hand. Make the object to be measured fit into the distance between the fingers.

1. Choose three students who are of similar height. Make sure students realize that they are the same height.
2. Go outside or into a large area. Have students use the “C” technique to measure the height of the three students at 10 feet away. Ask students to describe how big the “C” is in centimeters or inches.
3. Keeping their fingers steady, students will draw the size of the “C” in their science notebooks.
4. Ask students to pay attention to the size of the bushes, trees, poles,



Tip for Teachers:

It is helpful to track the discussion on chart paper.

Encourage students to frame their questions with

"I wonder . . .?"

You could keep a master list of

"I wonder . . .?"

questions during the year.

Recording the initials of the students who ask the questions gives students ownership of the process.

fences, and so on in the landscape. Students will add the landscape to the drawings in their science notebooks.

5. Make sure everyone comes to an agreement about size before you continue.
6. Move one student back about 50 feet. Students will again use the "C" technique to estimate the student's height. Discuss the differences between 10 and 50 feet.
7. Students should draw the next "C" on another page in their science notebooks.
8. Position the third student about 100 feet away. The students measure again and discuss the results.
9. Take a digital picture that includes all three students. You will use this photo later in this unit.

Practice Outdoors

1. Prepare three wooden stakes, each with an identical life-sized picture of an animal attached.
2. Put one into the ground at a distance of 10 feet, the next at 50 feet, and the third at 100 feet from where the students will be standing. (Take a digital picture to use later in this unit.)
3. Have students make observations and predictions about the size of the three animals and write them in their science notebooks.
4. Use the "C" measuring technique to gather data. Pull up the sticks and put them side by side to show the students that all are the same size.



Common Terms

Vanishing point: In perspective drawing, the point at which receding axes converge.

Perspective: Any graphic system used to create the illusion of three-dimensional images or spatial relationships on a two-dimensional surface.

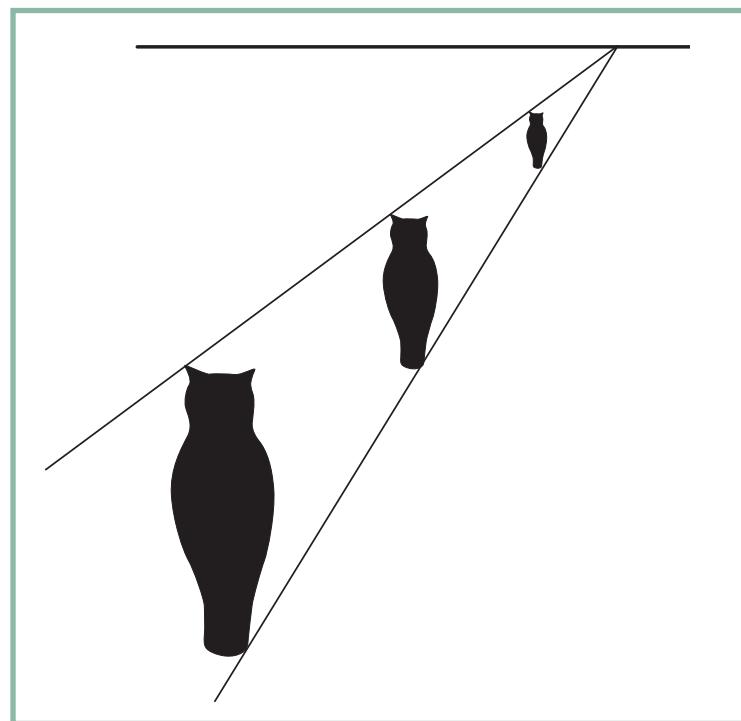
Horizon line: The line in a perspective drawing where the sky meets the ground. A drawing of the inside of a room has an eye-level horizon line.

Practice Perspective Drawing

1. Explain the basic concepts of perspective drawing, describing how one can represent objects at a distance by making them smaller and closer together.
2. Explain the meaning of the terms “vanishing point” and ‘horizon line.’ (See the list of common terms.)
3. Put the photos you took earlier (of the three students and the life-size pictures of the animals) on a screen and use a drawing tool on the computer to draw lines to the vanishing point.
4. Demonstrate on the computer how to draw using one-point linear perspective.
 - a. Draw the horizon-line above the image of the students.
 - b. Create a dot on the horizon-line to indicate the vanishing point.
 - c. Draw lines from the head and from the feet extending from the student to the vanishing point.

Practical

Students look at an animal and use the “C” technique to measure the animal. They transfer the “C” to their papers and draw the animal. Then, they draw the horizon-line and vanishing-point perspective lines and add sketches of the animal to show how it would appear at two other distances.



| Student Assessment | |
|--------------------|---|
| Exceeds benchmark | <p>Grades K-2 When shown a picture of an animal at two different distances, the student recognizes (5 times out of 10) that the smaller animal was farther away.</p> <p>Grades 3-4 The student uses perspective to draw pictures of the same animal at different distances (= three different sizes).</p> <p>Grades 5+ The student uses vanishing-point lines to draw an animal at different distances (= three different sizes).</p> |
| Meets benchmark | <p>Grades K-2 When shown a picture of an animal at two different distances, the student recognizes (4 times out of 5) that the smaller animal was farther away.</p> <p>Grades 3-4 The student uses perspective to draw a picture of the same animal at different distances (= two different sizes).</p> <p>Grades 5+ The student uses vanishing-point lines to draw an animal at different distances (= two different sizes).</p> |
| Below benchmark | <p>Grades K-2 When shown a picture of an animal at two different distances, the student recognizes (2 times out of 5) that the smaller animal was farther away.</p> <p>Grades 3-4 The student's drawings of the animal at different distances are not significantly different.</p> <p>Grades 5+ The student does not align the vanishing-point lines to the animal; the animal's sizes are not significantly different.</p> |



Lesson 3: Identification by Tracks

RECOMMENDED FOR ALL ELEMENTARY (K-6)



People who read animal tracks are called trackers. They “read” the story of what the animal was doing during the day.

Students will become trackers as they measure the tracks of the striped skunk. Using the “Track Data Collection” form and the “Pet Measurements” form and instructions, they will measure the length and width of an animal’s front and rear paws, its step, and the width of its trail (the width of the body of the animal). Mind’s Eye Imagining helps students use evidence drawn from an animal’s tracks to estimate the size of the animal and interpret what it was doing.

| Grade Level Benchmarks | |
|------------------------|---|
| Grade 2 | <p>Students:</p> <ul style="list-style-type: none"> Measure their steps with a ruler by marking the endpoint and sliding the ruler. Know if their classmates were walking or running. Identify the tracks of their tallest classmates based on the length of the steps and the size of the tracks. |
| Grades 3-4 | <p>Students:</p> <ul style="list-style-type: none"> Use appropriate measuring devices and measurements taken from a field guide to make a life-size representation of an animal. Examine a skunk’s tracks and explain what the skunk was doing and how they know. Use tracks to determine the length and width of the skunk’s body. |
| Grades 5+ | <p>Students:</p> <ul style="list-style-type: none"> Use different sized grids to draw an animal to scale. Use rulers (marked in inches and centimeters) and other tools, such as measuring tapes and calipers, to measure tracks. Examine a skunk’s tracks and explain what the skunk was doing and how they know. Use tracks to determine the length, width, and height of the skunk’s body. |
| Grade 7 | <p>Students:</p> <ul style="list-style-type: none"> Convert measurements between standard and metric. Examine a skunk’s tracks and explain what the skunk was doing and how they know. Use tracks to determine the length, width, and height of the skunk’s body. |



Creating Enthusiasm

Ask the students where in town they have seen tracks in concrete. A visit or even a discussion of these would lead to inquiry questions and predictions about the origin and story of the tracks.

Reading a Track. Did you know that you can tell from a track which way an animal was looking when it was standing still? Ask students to get down on their hands and knees and look left. What arm are they putting the most pressure on? Would the arm with the most pressure leave a deeper track in the mud or snow than the other arm?



Whole Group Exercise: Tracking * All student documents in Lessons 3 are found in Appendix D

1. Ask the class, "Do all animals walk the same way?" Discuss how some animals first move the legs on one side of their bodies, then the legs on the other side (skunks, bears, raccoons). Others move opposite legs (dogs, cats), and others jump moving first their front legs and then their back legs (river otters, rabbits).
2. Ask the class if they know the difference between cat and dog tracks.
Answer: Dogs leave claw marks; cats don't.
3. Ask the class if the length of an animal's nails can reveal the size of the animal. Note: You can point out that a student with long fingernails is not necessarily any larger than other students with shorter nails.
4. Pass out the Tracking Data Collection forms (Student page, page 109) and show the class the skunk tracks.
5. Give each student a copy of the life size skunk tracks and place the skunk tracks where the class can see them.
6. Using the tracks, discuss how skunks walk: Skunks move their front left and rear left legs at the same time. They have short legs, so their steps are not long, unless they are running. (Refer to the track patterns, page 105. Also see Diagonal, Bounder and Galloper walking patterns.)
7. Discuss how the size of the animal affects the length of its steps and the space between its front legs (trail width): The wider the animal, the more space between its legs.
8. Note that different animals have different track patterns: Pacer Walking Pattern, p. 105, Diagonal Walking Pattern, p. 106, Galloper Walking Pattern, p. 107 and Bounder Walking Pattern, 108.
9. Demonstrate how to measure the length and width of the skunk's front and rear feet; do not include the nails. (Refer to the skunk Track Pattern, page 105).

There are five “arts” of tracking:

Who, What, When, Where, and Why

WHO left this track?
(art of identification)

WHAT was it doing?
(art of interpretation)

WHEN was the track made?
(art of aging)

WHERE is it right now?
(art of trailing)

WHY does it do what it does?
(art of ecological understanding and prediction)

Small Group and Individual Practice: Knowledge Mastery

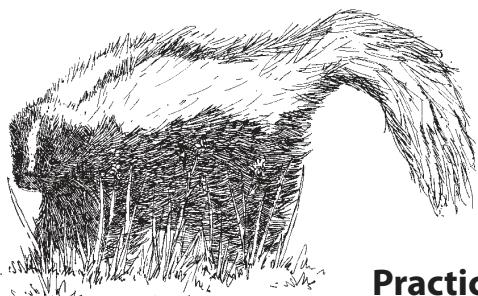
1. Divide the class into teams of 2-3 students to record the measurements of the skunk's tracks using rulers and measuring tapes.
2. Students should draw the front and rear tracks in their science notebooks, label the tracks as front and rear, and write the name of the animal.
3. Record the measurements on the Tracking Data Collection form. Make sure the students complete the form (e.g., team, name of animal, date).
4. Verify with each team the accuracy of their measurements, comparing their measurements to the table data (p. 106) for striped skunk.
5. Begin the discussion about variations of foot sizes.
 - Do all skunks have the same size paws? (Discuss differences between human babies, teenagers, and parents; then relate the differences to other animals.)
 - How can we tell the difference between two individuals? *Answer:* By measuring the length and width of one front and one rear paw.
 - What else can we measure to know if different skunks made the tracks? *Answer:* Step or trail width—the longer the step (at a walk), the larger the animal; the wider the trail width, the larger the animal.
 - Can you think of other clues that can help us to identify mammals? *Answer:* They leave scat, tracks, and scratches/rubs.

Extension: Each student uses the Pet Measurement handout to draw and measure the tracks of his/her dog or cat or a neighbor's pet (pg. 103-105).



Tracking Data Collection Form**Team and Your Name:** Team 1, Sally Smith**Date:** 05/06/2009

| Measurements | | | | | | |
|---------------|-------------|------------|-------------|------------|------|-------------|
| Species | Length | Length | Width | Width | Step | Trail Width |
| | Front Track | Rear Track | Front Track | Rear Track | | (Straddle) |
| striped skunk | 1.75"-2.25" | 1.75"-2" | 1"-1.25" | 1"-1.25" | 6.5 | 2.5"-4.5" |
| | | | | | | |
| | | | | | | |

**Practical**

Students work in pairs.

1. On a piece of 12 x18-inch paper, each student traces his or her partner's hand and foot and measures the width and length in inches and centimeters. The student records these measurements on the paper.
2. On a 3-foot piece of butcher paper, each student measures the length of his or her partner's steps by tracing the person's feet in a walking stance. (Each student gets a turn being measured and tracing footsteps.) Students should label measurements in the same way that they labeled the skunk tracks.
3. Select two pairs of students and send them to a spot where their classmates cannot see them. Two of the students should walk quickly across a 10-foot piece of butcher paper. Their shoes should be slightly wet so their outlines can be drawn on the paper. Once the outlines are drawn, lay the 10-foot sheets of paper on the floor. Ask the class to match the tracks to the students based on the size of the feet, the length of the steps, and who was going the fastest. The class must do this without taking measurements.



| Student Assessment | |
|--------------------|---|
| Exceeds benchmark | <p>The student recorded all measurements in both metric and standard notation; measurements are accurate within whatever range is appropriate for the grade level.</p> <p>The student's data collection form is complete.</p> <p>The student correctly matched four out of the four students to their tracks based on foot-size and length of steps.</p> <p>The student correctly matched two out of the four students to their tracks based on the size of the person.</p> |
| Meets benchmark | <p>The student chose one way of reporting measurements and has up to two mistakes (in measurements or labeling of numbers).</p> <p>The student's data collection form is complete.</p> <p>The student correctly matched one out of the four students to their tracks based on foot-size and length of steps.</p> <p>The student correctly matched two out of the four students based on the size of the person.</p> |
| Below benchmark | <p>The student chose one way of reporting measurements and has more than two mistakes (in measurement or labeling of numbers).</p> <p>The student's data collection form is incomplete.</p> <p>The student correctly matched one out of the four students to their steps based on foot-size and length of steps.</p> <p>The student didn't match any of the four students to their tracks based on the size of the person.</p> |



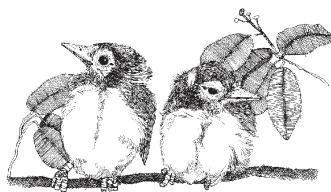
Sit-Spot Reminder. As your students continue to make routine visits to their Sit Spots, encourage them to focus on one small critter, such as an ant, a bird, a bee, or a spider, or on evidence of the critter, such as signs of scat, or of a spider's web, or of chewing on a plant leaf. What story do these signs tell?

Stay Still, and They'll Come to You. Getting to know animals' daily patterns is one of the most potent inspirations for Sit-Spot time. With enough attempts, such silent sitting will lead to first-hand experiences with animals. The stories of those experiences stay with people for a lifetime. Tracks, sounds, and traces of animals inspire our natural curiosity and encourage us to look ever more deeply into complex ecological relationships.



Unit Three B: Estimate the Numbers of Animals in a Group

How can we accurately use estimation to determine the number of animals in a group?



Objective

Estimate the number of individual animals in a large group by using the grid method.

Materials

Science notebooks
Students' data collection forms
Blank paper for class chart
Marbles or gum balls
Transparency
Pens and pencils

Unit Summary

Your class sees a flock of birds and, based on the size and shape of the birds, you decide they are rock doves (e.g., pigeons); but, how many birds did you and your students see before the flock disappeared from sight?

Estimation is a tool used to count large numbers of animals or objects. Grids are useful for counting objects that are stationary. Animals, however, are moving most of the time, so there are other techniques designed to count them quickly.

Unit 3B contains two lessons:

Lesson 1: Introduction to Group Estimates

RECOMMENDED FOR ALL ELEMENTARY (K-6)

Before your students can estimate the number of animals within a group, they need to try different ways to count the individuals. This lesson demonstrates techniques for counting in groups of five or ten.

Lesson 2: The Grid System

RECOMMENDED FOR ALL ELEMENTARY (K-6)

Lesson 2 teaches students how to use a grid system. Grids can be different shapes and sizes, but all of them help people estimate the number of creatures or objects in a large group, whether the group contains animals, insects, blood cells, cars in a parking lot, or trees in a forest.

The students will also learn to include estimates on their data collection forms.

| Grade Level Benchmarks (Lessons 1 and 2) | |
|--|---|
| Grades K-2 | Students group animals by tens. |
| 3-4 | Students group animals by fives and tens. They indicate when it is appropriate to count and when it is appropriate to estimate a group of animals. |
| 5+ | Students use a grid system to group animals. They indicate when it is appropriate to count and when it is appropriate to estimate a group of animals. |



Lesson 1: Introduction to Group Estimates

RECOMMENDED FOR ALL ELEMENTARY (K-6)



Pre-Lesson Preparation

Make copies of a close-up picture of an ant mound (Google image search). Also, create a large chart (with at least four columns) and mount it on the wall. Throughout the lesson, record data on this chart.

Refer to the data collection form (Appendix D, p. 111), and introduce the sections that relate to number and estimates. Explain that scientists need good estimates to determine the populations of different species across the country.

Whole Group Exercise

Explain that the close-up picture on the left is the area inside the yellow box of the picture on the right. You may want to display the pictures on a screen so students can see the ants more clearly.

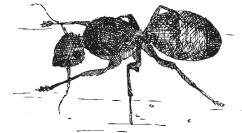
1. Ask the students the following questions. The students should record their answers/ideas in their science notebooks.
 - a. What do you see?
 - b. What questions do you have about these pictures?
 - c. How many ants do you think are in the close-up picture?
 - d. How did you decide?



2. Ask each student or pair of students to mark on the class chart their estimates of the number of ants. (You may wish to arrange these in numerical order so the class can find the median, mode, mean, and range of the answers.)

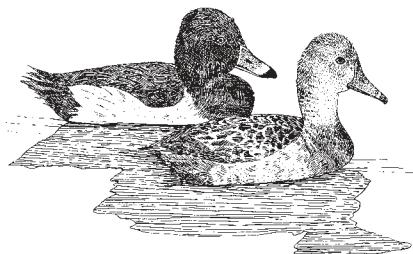


3. Record on the class chart the different methods the students came up with to determine the number of ants.
4. Pass out a copy of the close-up picture to each student or pair of students.
5. Ask them to choose one method and use it to make another estimate of how many ants are in the picture. (Some students will count by ones, some will circle groups of 5, 10, etc.) The students should record their estimates and their methods in their science notebooks.
6. When all have their estimates, record their new estimates on the group chart. (Again, record in numerical order and find mode, median, mean, and range.) Ask: “What do you notice about the two groups of estimates?” (Most likely, the numbers in the second group will be more similar and have a smaller range.)
7. Why would we not just count the ants? (The answer may seem obvious, but the question drives home the need for a process of estimation.)



Lesson 2: The Grid System

RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE



Whole Group Exercise

Still using the example of the ant mound, ask students to speculate: How would they determine the number of ants without counting all of them—for example, if they encountered an ant mound outdoors?

1. Display the photo (from Lesson 1) of the entire ant mound. Using the box drawn over the ant mound as your model, draw more boxes on the photo until you have created a grid covering the entire ant mound.
2. Ask students how they would use the grid to determine the number of ants.
 - a. Remind them that the hill is also on the other side of the tree.
 - b. Students can use calculators.
3. Explain to the students that scientists use a grid system to estimate large numbers of animals in nature: Count the number of animals in one box and multiply by the total number of boxes.

Additional Practice

You can also have students practice by applying the grid system to house finches and ducks (Find examples on the web using Google image search or access the NatureMapping Foundation's *Awakening Inquiry* CD Resources):

House Finches: As you show the picture of house finches in a tree, ask the students to imagine how easy it would be to count a group of birds in a tree if the birds didn't move.

1. Students will count the number of house finches in each of the squares and total them.
2. Explain that this is easy because the birds were sitting. If they were ready to fly away, you could quickly count just one square and multiply by four.
3. Students will have five seconds (longer for younger students) to count the number of finches in one box and multiply by four.

Ducks: Show older students the ducks in the water and ask them to estimate the total number of the ducks. Give them 20 seconds to come up with a total. Ask which students counted by fives or tens and whether their totals were that different.



Common Terms

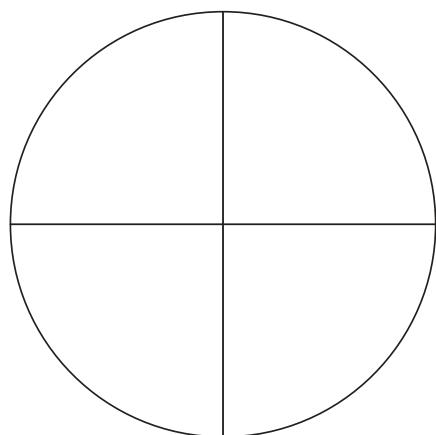
Grid system: a series of boxes or circles divided into equal areas.

Mean: the average of a set of numbers, determined by adding all the numbers in the set and dividing this sum by the number of numbers in the set; for example, the average of this set: 3, 6, 8, 11, 12, is 8.

Median: the “middle” of a set of numbers, determined by listing all the numbers in numerical order and identifying the middle value; for example, in this set: 3, 5, 9, 11, 12, the median is 9.

Mode: the number value that occurs most often in a set of numbers; for example, in this set: 7, 6, 7, 2, 2, 7, 3, the mode is 7.

Range: the difference between the lowest and highest numbers in a set of numbers.



Learning to Use an Imaginary Grid

Use the grid system to count marbles, gum balls, and other objects. Begin by using the attached circle grid, then challenge your students to imagine the grid in their heads without looking at it. Explain that scientists use an imaginary grid to recognize the number of animals traveling together in nature.

Ask students to practice using the imaginary grid on different objects, such as cookies on a cookie sheet or pens on a desk.

PRACTICAL (1)

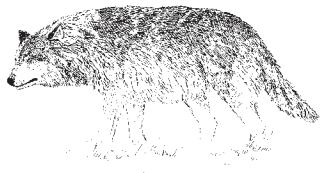
Go outside with science notebooks and pencils and ask students to *estimate* things like trees in the park, birds in a flock, plants in a flower bed, rocks in a pile, blades of grass in a square foot, leaves on a tree, and so on. Use whatever is on your school grounds. Occasionally, ask the students to consider something that should be *counted* (rather than estimated), such as the number of tulips in a clump or light poles on a block. For each item that you ask them to record, give them time to think; then, ask “In this case, should you have estimated or counted?” Students should answer in unison. If there is disagreement, have the students defend their positions.

If it is not practical to go outside, you could do this inside using marbles, pine cones, pieces of paper, blocks, pencils, or other items commonly found in classrooms.

Student Assessment

| | |
|-------------------|--|
| Exceeds benchmark | <p>The student chooses correctly whether to estimate or count a number of items.</p> <p>The student estimates to within 90% of the total.</p> <p>The student’s data collection form is complete.</p> |
| Meets benchmark | <p>The student chooses correctly whether to estimate or count a number of items.</p> <p>The student estimates to within 75% of the actual total.</p> <p>The student’s data collection form is complete.</p> |
| Below benchmark | <p>The student has trouble deciding whether to estimate or count a group of items.</p> <p>The student’s estimate is less than 75% of the actual total; the student needs more practice.</p> <p>The student’s data collection form is incomplete.</p> |





Unit Four A: Focusing on an Animal

What is it like to be an animal?

Objectives

Understand field guides

Learn about different animal (or plant) species

Materials

Science notebooks

Data collection form

Imaginary person materials:
backpack, clothing, water bottle, pencil holder

List of Common Species Found in Most Urban Areas (Appendix D)

List of animal species identification clues

Silhouettes of animals and/or birds (end of Unit 4A)

Field guides or animal fact sheets

Pictures of animals; pictures of scat (Google image search)

Feathers, pencil, and science notebook, chicken bone, dog collar, egg, lipstick, balloon, piece of fur, plaster cast of a track, dead moth, something stinky or fragrant

Masking tape

Grid paper

Pens and pencils

For studying plants: list of common plants and their uses; pictures of selected

Unit Summary

Your class has learned techniques to tell time, complete a science notebook, sit and observe, use field guides, and read tracks. Now it is time for each student to learn about one animal very well.

Spotting animals in nature can be a challenge (depending on the species and environment), so scientists seek to understand the behavior of the animals they research. Scientists and students who become familiar with the behavior of a particular type of animal are more successful at finding the animals in their natural habitats. As your students learn about and develop a greater appreciation of “their” animals, they will also share with their classmates the information they discover. You and your students will be able to increase your knowledge of local wildlife by the number of students in your class.

Unit 4 is divided into three subunits: In the first (4A), students are introduced to the use of field guides as a tool for identifying species. Students also participate in an activity in which each student chooses or “adopts” an animal. This animal will be the focus of the student’s studies. Unit 4B teaches students how to use their senses to mimic animals. Finally, in the third subunit (4C), each student creates a WANTED poster to share what he/she has learned about a particular animal. (**Note:** Students will use their science notebooks as the main reference for what they will put on the WANTED Posters.)

Two key lessons are presented in Unit 4A:

Lesson 1: Focusing on an Animal

RECOMMENDED FOR ALL ELEMENTARY (K-6)

There are lots of animals that fascinate students. When a student gets to know one animal very well, however, he/she develops an enduring relationship with that animal.

Lesson 2: Developing a Search Image (Where and When to Look)

RECOMMENDED FOR ALL ELEMENTARY (K-6)

Naturalists can walk outside and find an amazing number of species, no matter where they are. Why? Because they know where to look; they know what to listen for; and they have a mental list of the animals that are likely to live in that habitat. Lesson 2 focuses your students’ developing observation skills.

Note: Teachers who focus on plants rather than animals can adapt these lessons to explore plant species. Suggestions for adapting the lessons are included throughout the unit; you’ll also find some alternative activities and games at the end of the lessons or in the appendices.



Lesson 1: Focusing on an Animal

RECOMMENDED FOR ALL ELEMENTARY (K-6)



In this lesson, students begin learning about particular animals (or birds, or plants). This activity also creates opportunities for peer-to-peer mentoring: Students naturally learn from and teach each other about the creatures that they “adopt,” thereby building collective knowledge of locally important species. Simply hearing the names of so many local animals every day teaches a lot, but as individuals develop relationships with their particular creatures, they often share new information, adding to the group’s knowledge.

| Grade Level Benchmarks | |
|------------------------|---|
| Grades K | Group effort: Select one animal (or plant) for the entire class and record information on a group chart. |
| 1 | Students use a variety of resources to research the one animal (or plant); then, as the teacher demonstrates, each student records information in his/her science notebook. |
| 2 | Students work in small groups. Each group focuses on a different animal (or plant), but individual students are responsible for recording information. |
| 3-6 | Each student focuses on a different animal (or plant). |

Pre-Lesson Preparation

Gather models or pictures of animals, their skulls, their scat, or their eggs and lay them out on your “Nature Table.” This will attract much attention, and students will begin to bring in their own artifacts to add to the collection. The stories will flow and the excitement will build. (If you prefer to study plants, display models or pictures of plants, flowers, seeds, and roots.)

Make a master list of local animals (or plants):

- Lists can be made by asking students what they see around their homes.
- Use the generic List of Common Species Found in Most Urban Areas (Appendix D).
- You can generate your own list if you are familiar with the animals (or plants) of your bio-region and know what a student is likely to encounter in the field. You can have students choose from a list of one particular set of species (for example, a list of mammals, a list of birds, or a list of plants) or you can mix various animals, birds, and plants into one grand list.



Individual Practice: Knowledge Mastery of Field Guides

The following exercise allows students to practice identification through measurement. (This reinforces the previous unit.)

1. To begin, students use the information in field guides and on the internet to create a list of all the measurements related to their animals, such as length, height, and weight, size of scat, size of egg, length of stride, and size of paw. (For plants, the students should record measurements related to size, leaf type, size of flower, color and scent of flower, fruiting bodies—fruit, nuts, or seeds—and so on.)
2. To represent the height and length of the animals they are studying, students should use masking tape to make rectangles on the floor or on large paper. (The student should label each rectangle with the name of the animal whose dimensions it represents.)
 - a. If everyone in the class is using the same taxonomic group, follow this procedure:
 - i. Create the first rectangle to represent the animal with the largest dimensions.
 - ii. Overlay that rectangle with the rectangle representing the size of the second largest animal. Continue in this way until all animals are represented.
 - b. If many taxonomic groups are represented, you may wish to choose one measurement, such as length, to compare the animals. This could be done with string or ribbon of appropriate lengths.



Key Points

Ask your school's custodian about the proper tape to use on the floor. Depending on the floor's surface, some tape can be difficult to clean up. Duct tape is especially troublesome on slick surfaces. An inexpensive piece of outdoor grass carpeting works great for putting taped shapes on.

Extension (1):

1. Have students use a grid to draw their animals at different scales (for example, at 5x and 10x (or $\frac{1}{2}$ or 1/10) the size of the animal).
2. Using grid paper, calculate the area of the animal.

Extension (2):

Ask each student to make a three-column chart in his/her science notebook. The student should write his/her own name at the top of the left column; at the top of the right column, the student should write the name of the animal he or she "adopted;" in the middle column, the students will create a list of attributes (favorite food, hair color, favorite hiding place, height, weight, speed, etc). As they think about themselves and their animals, they add information to the left and right columns of the chart. They should quickly see the commonalities and differences between themselves and their animals (or plants).

Student Assessment

| | |
|-------------------|---|
| Exceeds benchmark | The student completes 5 out of 5 descriptions of the focus animal or plant. |
| Meets benchmark | The student completes 4 out of 5 descriptions of the focus animal or plant. |
| Below benchmark | The student completes 3 out of 5 descriptions of the focus animal or plant. |

| Jane | Attributes | Grey squirrel |
|----------------|-----------------------|---------------|
| peanut butter | Favorite food | acorns |
| brown | Hair color | grey |
| climbing trees | Favorite hiding place | tree tops |
| 4 foot | Height | |
| | Weight | |
| | Speed | |



Lesson 2: Developing a Search Image (Where and When to Look)

RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE



To find either people or animals, we need to look for the clues that they leave in the places where they spend their time.

| Grade Level Benchmarks | |
|------------------------|--|
| Grades K-1 | Group effort: The teacher works with the class to draw a map that includes signs and clues of the behaviors and activities of the animal whose name they chose at the beginning of Lesson 1. (If the students are focusing on plants, they should draw a habitat to depict where their plant would live.) |
| 2 | Students work in small groups. Each group draws a map that includes signs and clues of the behaviors and activities of the animals whose names they chose at the beginning of Lesson 1. (If the students are focusing on plants, they should work in small groups; each group draws a habitat that includes signs and clues that point to the group's plant.) |
| 3-8 | Each student draws a map that includes signs and clues of the behavior and activities of the animal whose name he/she chose at the beginning of Lesson 1. (If the students are focusing on plants, each student should draw a habitat that includes signs and clues that point to the particular plant he/she chose at the beginning of Lesson 1.) |

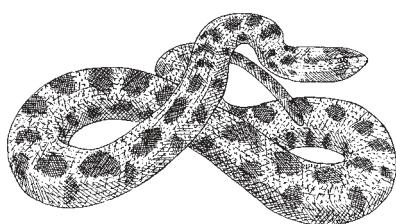
Pre-Lesson Preparation

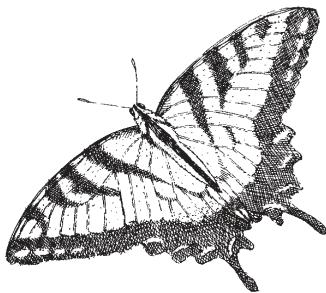
Leave objects belonging to an imaginary person around the classroom, such as a backpack, pencil holder, clothing, and water bottle.

Whole Group Exercise

This exercise is designed to help students build their observation skills. Begin by asking students to take out their data collection forms and to think about the section that asks *how* they have observed the animal (or plant). Brainstorm different ways to make observations, such as through sight and sound.

1. Ask students to form conclusions about the imaginary person based on what they can infer from the objects you distributed throughout the classroom. Is the person male or female? How old? What are the person's hobbies?
2. Extend the idea to other species. Explain the division of the animal kingdom into different classes, such as amphibians, mammals, birds, and reptiles. (In the case of plants, discuss the differences between trees, shrubs, forbs (herbs), and grasses.)
3. Show enlarged silhouettes of animals (owl, duck, squirrel, mole, and swallow) one at a time. Discuss their differences. Place the silhouettes around your room in logical places for the species (e.g. birds high on walls).





4. Discuss the habitats of each animal in relation to season, time of day, and temperature:
 - a. *Season.* During the winter, some species migrate to the south (e.g., swallows), some hibernate (e.g. bears), and some move below the freezing line in the ground (e.g. moles). Suggested questions:
 - i. What do bears do in the winter?
 - ii. What do rattlesnakes do in the winter?
 - iii. Are there animals that leave our area in the winter? Why?
 - iv. Are there animals that come to our area in the winter? Why?
 - b. *Time of Day.* There are certain times of day when some animals cannot be seen. Nocturnal species, such as owls, stay close to the tree trunk to blend in during the day. Diurnal species, such as ducks, move to safe areas in or close to the water at night. Crepuscular species are active at dawn and dusk, such as deer and cougars (predator and prey relationships). Suggested questions:
 - i. What animals come out at night? What are they called? Where do they go during the day?
 - ii. What animals are out during the day? What are they called?
 - iii. Has anyone heard of the word crepuscular? What animals can you think of that are active at dawn and dusk?
 - c. *Temperature.* Reptiles, because they are cold-blooded, need warm temperatures to eat and digest their food. Many insects, like butterflies, need warm temperatures before they can fly. Suggested questions:
 - i. What animals like to sit on rocks to warm up in the morning?
 - ii. Do butterflies fly when it is cold or warm?



Using all the senses helps the student to remember plants. People also remember best when, in addition to studying the plant in a book, they use the plant. For example, let students feel the soft cushion of mullein, also known as “settler’s toilet paper.”

Practical

Students choose from the following ideas to make their own map-cartoons:

- What would birds see while flying over the school?
- What adventures might a deer have at dawn?
- Where would you find the animal you chose to study?
- What route would you take to walk home?
- What is your “adopted” animal doing during the day?

If the class is focusing on plants, have each student draw his/her particular plant's habitat. The drawing should show what the plant looks like in each of the four seasons.

Student Assessment

| | |
|-------------------|---|
| Exceeds benchmark | The student's map-cartoon has 6 or more clues. (For plants: The student's drawing of the plant's habitat depicts more than the plant itself and includes all four seasons.) |
| Meets benchmark | The student's map-cartoon has 5 clues. (For plants: The student's drawing of the plant's habitat depicts the plant and includes all four seasons.) |
| Below benchmark | The student's map-cartoon has 4 clues. (For plants: The student's drawing of the plant's habitat depicts the plant, but one or more of the seasons is missing.) |

Common Terms

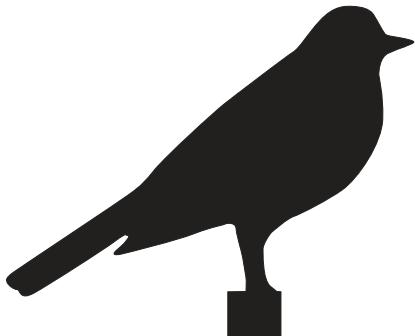
Species: A class of individuals having common attributes and designated by a common name.

Common name: The name that is generally used within a community to designate an animal species (e.g., gray wolf).

Morphology: The form and structure of an organism or any of its parts.



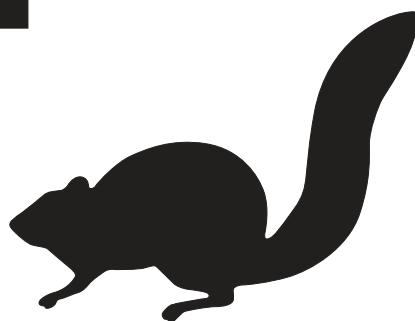
Silhouettes (To purchase life-size silhouettes, contact NatureMapping Foundation.)



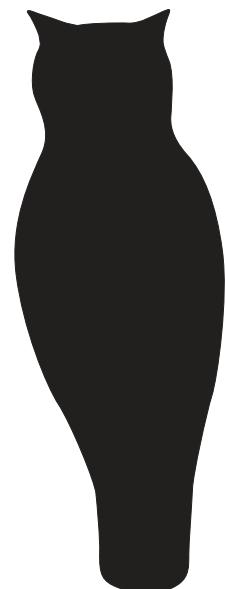
robin



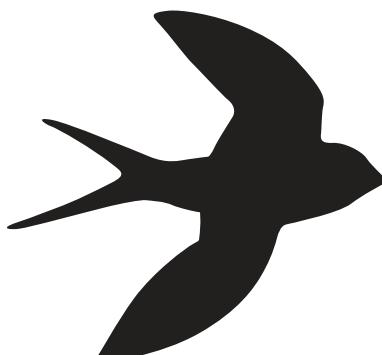
Northern flicker



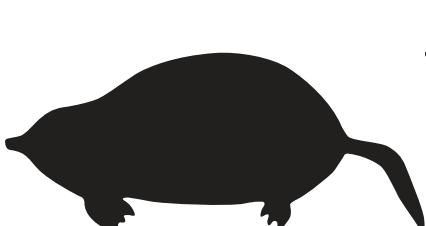
squirrel



Owl
Great-horned or screech



Barn swallow



mole



Mallard





Unit Four B: Use Your Senses

How do animals use their senses to survive?

Objectives

Learn about different animal (or plant) species

Build observation skills in the field

Use their senses (smell, touch, hearing, sight) and their perceptions of animals' movements to identify animals

(If studying plants, students use their senses and knowledge of plants to learn how to identify them.)

Materials

Science notebooks

Data collection form (p.111)

Bird drawings

Honey, burnt grease, cinnamon, nutmeg, rose, jasmine, gardenia, eucalyptus, pine, rosemary, thyme, lavender, or other earthy items (choose scents that are different than the scents used in Unit 1)

Feathers, pencil and science notebook, chicken bone, dog collar, egg, lipstick, balloon, piece of fur, plaster cast of a track, dead moth, something stinky or fragrant (if studying plants, substitute seeds, pine cones, a flower, vegetables, fruit, or herbs for some of the other items)

Grid paper

Pens and pencils

For studying plants: paint-color samples of different shades of green; four containers of soil

Unit Summary

Suppose that the animal a student has chosen to focus on is the California quail, a bird that spends much of its time on the ground in a large group of other quail. What are the quail's dominant senses? Sight? Hearing? How does it hide from its predators?

Scientists use their own senses to hone in on the clues that help them find and identify different species. In this unit, you will take concepts learned in the previous lessons to a deeper level by teaching students how to use their senses to understand what senses their "adopted" animals use to survive.

This unit introduces all the senses (except taste) in the following three lessons:

Lesson 1: Using Your Senses

RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE

Learning how to use their senses as animals do opens up a new world of experiences to your students.

Lesson 2: How to Listen

RECOMMENDED FOR GRADES 3-8

There are nuances in the tone and volume of a conversation that allow us to understand the emotional state of the person with whom we are conversing. Something similar occurs among animals. In this lesson, students begin the process of understanding what the different vocalizations of different birds and animals mean.

Lesson 3: Who Are You Listening To?

RECOMMENDED FOR GRADES 3-8

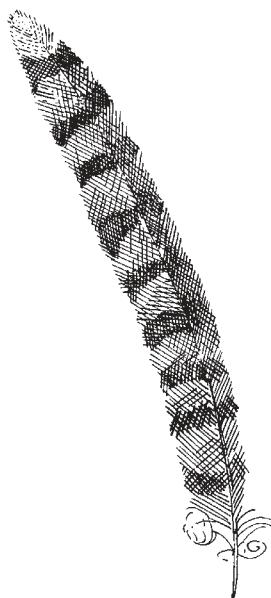
Now that your students have practiced using different senses and understand that animals communicate, they will begin to apply what they've learned as they study particular types of animals.

Note: Teachers who focus on plants rather than animals can adapt these lessons to explore plant species. Suggestions for adapting the lessons are included throughout the unit; you'll also find some alternative activities and games at the end of the lessons or in the appendices.



Lesson 1: Using Your Senses

RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE



In this lesson, students experience their different senses through outdoor exercises. They then apply these experiences as they think about their “adopted” animals and how those specific animals use each particular sense. (If the students are studying plants, they should think about how a person can use various senses to identify the plant. They should also consider how plants “sense” and respond to their environments.)

| Grade Level Benchmarks | |
|------------------------|---|
| Grades K-2 | Adjust benchmarks as appropriate to suit students' grade level. |
| 3-8 | <p>Each student researches:</p> <ul style="list-style-type: none">• The senses used by his/her chosen animal.• The clues the student would use to find the animal in the wild. <p>If studying plants, each student researches:</p> <ul style="list-style-type: none">• How his/her chosen plant “senses” and responds to its environment.• The clues the student would use to find the plant in the wild. |

Pre-Lesson Preparation

Place ten animal-clues and people-clues along the perimeter of your classroom or along a walkway outside of the school. (*Clues:* Feathers, pencil and science notebook, chicken bone, dog collar, egg, lipstick, balloon, piece of fur, plaster cast of a track, dead moth, something stinky or fragrant; if studying plants, substitute seeds, pine cones, a flower, vegetables, fruit, or herbs for some of the other items.) Place them so that they are not obvious, but not hidden. If you decide to do this activity outside, place the clues along a walkway that has a beginning and end point.

Whole Group Exercise: Clues

Discuss how animals can leave clues, such as feathers, scat, or tracks.

1. Feathers

- a. If lots of feathers are found on the ground, one of the first things to do is to look up to see if there is a tree branch above the feathers. If there is a branch, the bird might have been killed by a hawk, which plucked the feathers before eating its prey. If there isn't a branch, then the bird may have been killed by a mammal, such as a coyote or cat. Suggested questions:
 - i. Who found a feather on the ground?
 - ii. Where do you think it came from? Most birds shed (molt) their old feathers gradually throughout the year.
 - iii. Who found a lot of feathers together on the ground?
 - iv. What might be the reason for that?



2. Scat and Tracks

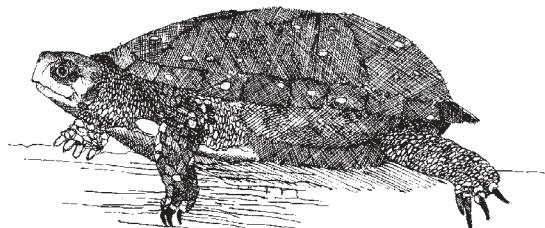
- a. **Scat:** Mammals are hard to see, but they leave a sign that everyone can read...scat. Cougars will leave scrape marks around their scat, which resembles a large tootsie roll. Coyote scat is twisted like a rope with a lot of fur showing. Coyotes like to leave the scat in the middle of trails. The scat of reptiles and birds can be identified by the bright white end (the urea). Suggested questions:
 - i. What is scat? What are the other names for scat? (Feces, poop, crap, doo, etc.)
 - ii. Describe some of the scat you are familiar with and tell how you know what animal it came from, such as your pet dog, cat, or bird.
- b. **Tracks:** Discuss where tracks would be found. For example, would a cougar walk out in the open looking for deer, or along the edge of the forest where it can hide? Suggested questions:
 - i. Where would you look for tracks: in the street or in the dirt?
 - ii. What can you learn from the tracks that you find? (The direction the animal was going, whether it was running or walking, whether there was more than one animal.)

Information. If you find a single feather and it has a color or marking that is unique to a particular bird (such as a tail feather from a northern flicker), then you can record your observation on the data collection form.

Individual Practice: Knowledge Mastery

Inform students that there are animal-clues (or plant-clues) and people-clues hidden in the area. The students must walk slowly and quietly as they look for these clues.

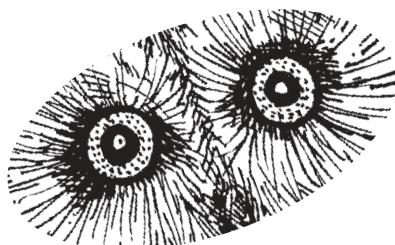
- Younger students walk in single file. They should count what they see without pointing the objects out to their classmates.
- Older students do the same, but then afterwards write down what they saw.
- The students in the class all walk back together, collect the items, and discuss what the clues tell them.



Whole Group Exercise: Animal Senses

Animals use their senses to survive in nature. The class will learn how to use some of their senses to become more observant.

Owl Eyes. Students learn to use and depend upon peripheral vision. (This exercise repeats and expands the exercise in Unit 3A.) Tell the students to:



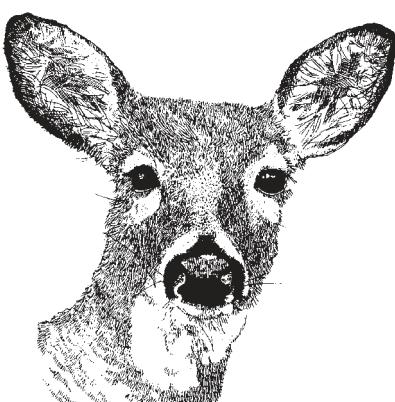
1. Get into two lines facing each other.
2. Open your arms until you can't see your fingers.
3. Wiggle your fingers and bring your arms in until you can see wiggling fingers, then drop your arms to your sides.
4. Pretend your eyes are glued in their sockets...like the eyes of an owl.
5. Beginning at the end of each line, describe what the person on your right is doing, without turning your head or moving your eyes. (Students can be putting their hands on their heads, or on their hips, or lifting a leg.)

Students write in their science notebooks about whether or not the eyes of the animals they chose to study are like the eyes of an owl. (If your class is studying plants, have the students consider how their own sense of sight helps them identify plants.)

Deer Ears. A deer's ears move forward and backwards so they can hear better.

1. The students pair up. One student stands behind the other student; they should be an arm's length apart.
2. The student in the back quietly snaps his/her fingers or whispers to the student in the front. (The student in front should barely be able to hear the sound.)
3. Repeat 2, but this time, the students in the front simulate a deer's ears by cupping their hands over their ears, with their palms facing backwards.
4. Go outside. Ask students to listen; they should close their eyes and focus on listening. Next, ask students to use their hands to simulate a deer's ears and continue to listen for two minutes.
5. Students should write down in their science notebooks the sounds that they heard; they should also discuss as a class what everyone heard.

Students write in their science notebooks about whether or not the ears of the animals they chose to study are like the ears of a deer.





Raccoon Touch. Students come to realize that their fingers, like those of a raccoon, are very sensitive and can identify objects.

1. Depending on the size of the group, get the class into one or two circles, facing each other and shoulders touching.
2. Tell them to put their hands behind their backs.
3. Put the first of three objects in a student's hands. (Examples: fern frond, sea shell, leaf, tangerine). When the student figures out what it is, he/she passes the object to the student on his/her left.
4. Put the second object in the first student's hand.
5. Put the third object in the first student's hand.
6. When all the students have finished, show the objects to the class and begin a discussion about what they felt and how they knew what the object was.

Students write in their science notebooks about whether or not the animals they chose to study have a sense of touch like that of a raccoon. (If your students are focusing on plants, they should write in their notebooks about how the plants they have chosen have distinct parts and that certain parts of a given plant feel different than other parts.)

Dog Nose. Students learn to use their noses (sense of smell) more effectively. (Remind students that they did a shorter version of this exercise in Unit 1, but that they will be using different scents this time.)

1. Find at least five different scents: honey, cinnamon, nutmeg, rosemary, thyme, lavender, burnt grease, or other herb/earthy scents. (If your class is studying plants, you may want to use scents such as rose, jasmine, gardenia, eucalyptus, or pine).
2. Put a couple of drops on (or rub over) cotton balls. You should use several cotton balls for each scent.
3. Put same-scented cotton balls into a plastic baggie.
4. Ask students to sniff the air around them: What does it smell like?
5. Hand each student a different cotton ball.
6. Each student needs to find the other students with the same smell on their cotton balls.
7. When the groups are formed, the students will describe what they smelled and try to identify the scent.

Students write in their science notebooks about whether or not the animals they chose to study have a sense of smell like that of a dog. (If your students are focusing on plants, they should write in their notebooks about whether or not their chosen plants have a distinctive scent.)



Fox Walk. Students walk like a fox: low to the ground and very quietly. There are two situations for which “fox-walking” is very useful:

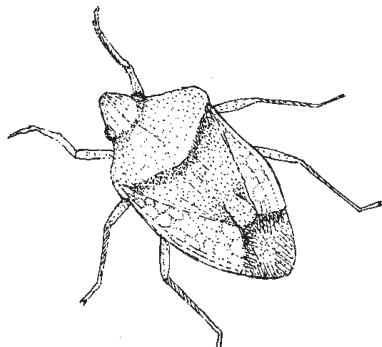
1. *Descending a Slope.* If you are on a steep slope, walk sideways down the slope: bend your knees, put first your toe, then the side of the foot, down on an angle into the slope; reach down with the arm that is closest to the slope so that you can grab the ground.
2. *Walking quietly.* Bend your knees, put your toe out first to feel if you are going to step on something that will make a noise (like a twig), and then put all of your weight on the front leg.

Sneaking Activity

1. Select two people (or you) to be the “Listener.”
2. Remaining students form teams of three to four. Position teams about 20 feet from the “Listener,” who stands facing away from the teams. Tell the teams to practice walking like a fox. They should try to sneak up on the “Listener.”
3. Listeners raise their hands when they hear a sound and say loudly (without turning around) what they heard.
4. Foxes should stop when they see the hand raised and wait to hear what the Listener has to say.
5. Foxes begin sneaking closer.
6. Listeners will now turn around when they hear a sound and thus catch the foxes.
7. Optional: You can put a marker on the ground where the foxes were detected to record which were the quietest of the foxes.
8. When a fox is caught, he/she must sit by the Listeners and, using their hands to simulate the ears of a deer, try to detect the rest of the foxes as they try to sneak up.

Students write in their science notebooks about whether or not the animals they chose to study walk like a fox.





Individual Practice: Knowledge Mastery (Sit Spot)

Have students divide a page in their science notebooks into four sections and label each section with a “sense” (*see, hear, touch, smell*). Students should focus on each of the senses as they sit in their Sit Spots. When time is called, they will write/draw each of their experiences in their science notebooks. The students will then return to the classroom and discuss their experiences.

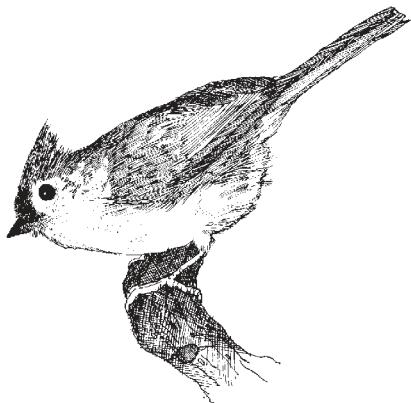
1. Expand the discussion to include the animals the students “adopted.” For example:
 - a. *Stink bug*. Apply “Owl Eyes.” Do stink bugs have the same eyes as humans?
 - b. *Cougar or a house mouse*. Apply “Raccoon Touch.” Cats and mice “feel” with their fur and whiskers. Do humans feel with their skin or hair?
 - c. *Bear*. Apply “Dog Nose.” A bear’s eyesight isn’t good, but a bear’s nose makes up for the difference. When one sense isn’t strong, then another will be. What happens when people become blind? Do they hear better? Does their “Raccoon Touch” increase so they can read Braille?
2. Students add newly acquired understandings to their science notebooks.

| Student Assessment | |
|--------------------|---|
| Exceeds benchmark | Student's science notebook contains notes on: <ul style="list-style-type: none"> • The 5 senses explored in the “Animal Senses” exercises (Owl Eyes, Deer Ears, Raccoon Touch, Dog Nose, and Fox Walk) • The 4 senses explored at his/her Sit Spot. |
| Meets benchmark | Student's science notebook contains notes on: <ul style="list-style-type: none"> • 4 of 5 senses explored in the “Animal Senses” exercises (Owl Eyes, Deer Ears, Raccoon Touch, Dog Nose, and Fox Walk). • 3 of 4 senses explored at his/her Sit Spot. |
| Below benchmark | Student's science notebook contains notes on: <ul style="list-style-type: none"> • 3 of 5 senses explored in the “Animal Senses” exercises (Owl Eyes, Deer Ears, Raccoon Touch, Dog Nose, and Fox Walk) • 2 of 4 senses explored at his/her Sit Spot. |



Lesson 2: How to Listen

RECOMMENDED FOR GRADES 3-8



You know how you can talk to your best friends on the phone and tell by how their voices sound that they feel upset? Many animals also use different vocalizations to express themselves. Birds have five different “voices.” The first four indicate normal non-life threatening situations, ranging from relaxed to extremely stressed. The last voice marks a break into fear and panic. Birds’ vocalizations are divided as follows:

- Babies begging for food
- Territorial songs/calls by males
- Courting
- Members of a flock checking in with each other
- Alarm calls

Whole Group Exercise

Birds. Learning how to listen is simple when students learn that animal sounds have meaning. The “Five Voices of the Birds” is a good way to start. (You can find a detailed description of vocalizations for the birds in *Coyote’s Guide to Connecting with Nature*.)

Teams of students make up skits (as if in an “improvisational theatre”) to act out the vocalizations of birds. Assign two or three actors or actresses to each “voice.” Give the teams of students a little time to invent two skits: the first in “Bird Language,” the second in “Human Translation.”

- *An Example of Begging:* One student sits down as if in a nest, flaps his/her wings and calls “feed me, feed me.” (Human Translation: two students sit talking together (as adults) and one student, the child, constantly interrupts his/her “mother” by asking for a candy bar.)
- *An Example of Territorial Calls:* Two males stand face-to-face and pretend they are getting ready to fight to protect their territories. Neither one actually wants to fight because they can get hurt. (If an animal is hurt, it can’t hunt.)
- *An Example of Members of a Flock:* A group of kids plays basketball; each kid urges the one who has the ball to throw it to him/her. (Bird Language: Each member of the flock would be saying “Here is food. Is it okay to eat? Is anyone watching for a cat?”) **Note:** Think about *Snow White and the Seven Dwarfs*: The Dwarfs always kept in touch by whistling and singing.

Follow up each skit with a discussion of the voice portrayed in the skit. During the discussions, students will often want to tell when they’ve seen or heard this voice/behavior before. Let the stories flow and the whole group will internalize and learn much more than you planned.

Mammals. Mammals vocalize, but they also communicate in other ways.



Write each of the following sentences on a slip of paper:

1. Rabbits thump their feet or scream when alarmed.
2. Skunks squeak or spray oil from their musk glands into a predator's face.
3. Coyotes, wolves, bobcats, cougars, and foxes "mark" their territories with urine or scat.
4. When angry, coyotes and wolves lay their ears down and snarl.
5. When angry, bobcats and cougars lay their ears down and swipe their tails back and forth.
6. Bats use different frequencies of sound to echolocate (bounce sounds off their prey) their food.

Divide the class into six groups; give each group a sentence and challenge them to develop a short skit showing what the sentence says. The rest of the class will try to identify the animals and activity involved.

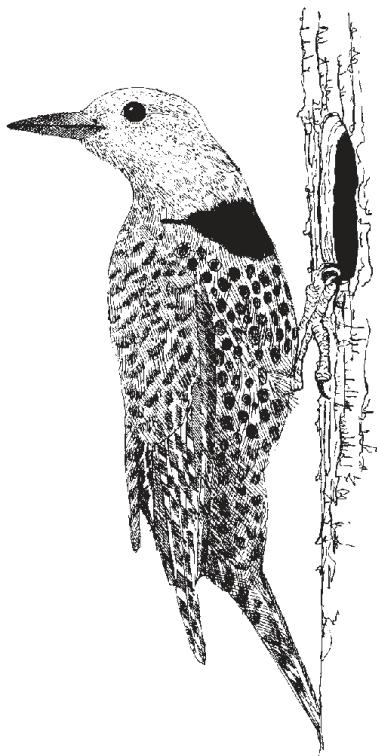


Students may grow frustrated because they can't identify a particular bird's vocalizations. Their abilities will grow with time and practice. You can start them watching one extremely common bird, such as the American robin, until they can distinguish song from alarm. As they begin to understand the nuances of companion calling, begging, and male aggression, rest assured that they have also begun to internalize the auditory and visual cues of identification.



Lesson 3: Who are You Listening To?

RECOMMENDED FOR GRADES 3-8



Whole Group Exercise:

If appropriate for your group, go outside, sit quietly, and listen for birds. Quietly discuss which vocalization you may be hearing. (It may take up to 20 minutes for birds to start “talking” after humans arrive, so move to the listening spot very quietly.) This exercise may be part of your regular activities at the students’ Sit Spots.

Individual Practice: Knowledge Mastery of Bird Vocalizations

Enlarge drawings of the following birds, cut them up into separate puzzle pieces (the younger the student, the bigger the pieces), and write the vocalization on the back of each piece:

- Great-horned owl (*who, who*)
- Killdeer (*kill deer, kill deer*)
- American robin (*jeep, jeep*)
- Black-capped chickadee (*chick a dee dee dee dee*)
- Northern flicker (*wick a wick a wick a wick*)

Give each student a puzzle piece and tell them to walk around the room making the vocalization. They should try to find another student making the same vocalization. When the students have found each other, they will put the puzzle pieces together and identify the bird.

Next, each student will select a bird and draw it in his/her science notebook. The student should also write the name of the bird, the bird’s vocalizations, and at least two characteristics that will help the student identify the bird. (See examples, p. 59)

Follow the sequence of activities in the chart below to work the students up to the highest level they can attain:

| Grade Level Benchmarks | |
|------------------------|--|
| Grades K-1 | Students work in a group to learn the sounds and put together the bird puzzle. |
| 2 | Students select puzzle pieces and move around the classroom saying the bird calls until they find the other students who are saying the same calls. |
| 3-5 | Cut strips of paper and on one side write the vocalization of a bird and on the other side a clue about the animal. Make 5 strips per bird. <ul style="list-style-type: none">• Students say the bird calls until they find the other students saying the same calls.• Students use field guides to find the identity of the bird based on clues. |



Common Terms

Habitat: The area or environment in which an organism or ecological community normally lives or occurs

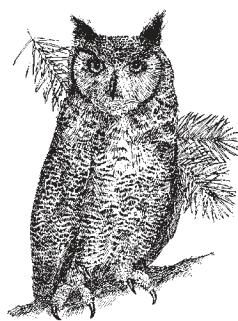
Nocturnal: Active at night

Diurnal: Active during the day

Crepuscular: Active at dawn and dusk

Migrate: To pass periodically from one region or climate to another

Hibernate: To spend the winter in close quarters in a dormant condition



Clues: *Great-horned owl*

1. I have feathers that look like pointed ears.
2. I eat rats.
3. I eat skunks.
4. I'm found throughout the United States.
5. I'm big: about 22 inches long.

Clues: *Killdeer*

1. My vocalization is also my name.
2. I pretend to have a broken wing if a predator comes too close to my nest.
3. I have a black ring around my neck.
4. I like to lay my eggs in gravel.
5. I'm good at running.

Grade Level Benchmarks

6-8

- Students sit with eyes closed and listen to recordings of bird sounds (from the Internet).
- Students draw the bird sounds as musical notes in their science notebooks.

Student Assessment

Exceeds benchmark

Student's data collection form is complete.
Student's puzzle is complete.
Student can properly mimic two animals from the puzzle activity.
Student has drawn his/her animal in his/her science notebook and labeled the drawing with the animal's common name, two characteristics, and vocalization.

Meets benchmark

Student's data collection form is complete.
Student's puzzle is complete.
Student can mimic his/her puzzle-animal's vocalization.
Student has drawn his/her animal and labeled the drawing with the animal's name and two characteristics.

Below benchmark

Student's data collection form is incomplete.
Student's puzzle is complete.
Student incorrectly vocalizes his/her puzzle-animal.
The drawing in the student's science notebook is incomplete.

Bird Clues for Puzzle Pieces

Clues: *American robin*

1. I have a red breast.
2. My eggs are light blue.
3. My babies have black specks on their breasts.
4. I love worms.
5. I have a white ring around my eye.

Clues: *Winter wren*

1. I have a stubby tail.
2. I'm mostly brown.
3. I stay in the bushes.
4. You usually see me by myself.
5. I can be found along stream banks.

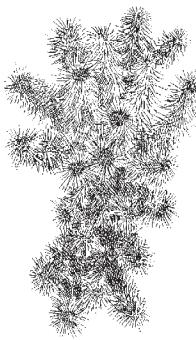
Clues: *Black-capped chickadee*

1. My cousin is chestnut-color.
2. I'm found almost everywhere in the United States.
3. I will hang upside-down at the suet feeders.
4. I have a black eye-stripe.
5. I like to hang around with others like me.

Clue: *Northern flicker*

1. I'm a woodpecker.
2. I have orange feathers.
3. I love ants.
4. I wear black proudly on my chest.
5. I have red cheeks if I'm a male.





Unit Four C: WANTED Poster

What are unique traits of different animals (or plants)?

Unit Summary

Animals may be known for their beauty, vocalizations, or ferociousness, or they may be considered pests. Plants can have many different uses, and what may be a weed to one person can be a source of food to another. Previously in Unit 4, students “adopted” particular animals (or plants) and began to learn more about them. The students also explored the world of animal senses (or used their own senses to learn more about plants). In Unit 4C, students can put all the pieces together and show what they have learned. To do this, each student will develop a “WANTED poster.” Some students may want to create an APPRECIATED FOR... rather than a WANTED poster and write about what they have come to appreciate about the animal(s) or plant(s) they have gotten to know.

Unit 4C presents the following two lessons:

Objective

Create an animal (or plant)
WANTED poster

Materials

Science notebooks
Field guides or animal fact sheets
Pictures of animals (or plants), pictures of scat
Grid paper
Pens and pencils

Lesson 1: What to Focus On

RECOMMENDED FOR GRADES 3-8

Students need to know what parts will make a complete WANTED or APPRECIATED FOR poster. The parts include size, senses, tracks, drawings, and cool facts that students want to share with others.

Lesson 2: Make the WANTED Poster

RECOMMENDED FOR GRADES 3-8

This lesson outlines the process for making a poster. It provides a template, but still allows for artistic freedom.

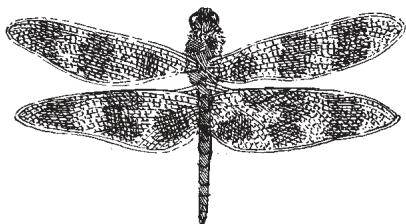
Story of the Day.

Invite kids to tell stories about their home pets (with emphasis on the tendencies of the pet’s breed).



Lesson 1: What to Focus On

RECOMMENDED FOR GRADES 3-8



Pre-Lesson Preparation

To get students thinking about animals (or plants) in terms of their unique qualities, you can begin by asking students to consider the traits of all sorts of animals (or plants) in all kinds of habitats. There are some great books about animal behavior (such as the ZooBooks or Encyclopedia of Mammals) that feature the most interesting traits of various types of animals. Have students look at such books or watch episodes of Planet Earth to find cool facts! Students will have fun with this activity.

Getting Started

After students have looked at the unique qualities of animals (or plants) in other parts of the world, each student should begin thinking about the unique qualities of the animal or plant he/she adopted.

Students will make an accurate drawing of their animals or plants. The pictures produced in this lesson can be used on the WANTED posters if students do not wish or are not capable of doing their own freehand illustrations.

Individual Practice: What Do They Look Like?

1. Make black-and-white copies of pictures of all of the students' adopted animals (or plants).
2. Students color in the copies while looking at a picture in a field guide.
3. Stress that students should pay attention to:
 - a. Markings (in the case of animals, the color of fur or feathers, eyes, legs; in the case of plants, the color of the plant and flowers).
 - b. Shape (in the case of animals, the head shape, body shape, shape of beak, length of legs and tail; in the case of plants, the leaf shape, plant shape, leaf structure on stalk, and flower shape).
4. Advanced or older students should color pictures of their animals in winter and breeding plumage and should color two pictures to represent the differences between males and females. (If students are focusing on plants, advanced or older students should color pictures of their plants in each of the four seasons and color two pictures to represent the differences between males and females.)



Whole Group Exercise: What is Their Size?

1. Hang a chart on the wall that lists the size of each person's animal or plant.
2. Think about the size of the completed WANTED poster and help students decide which animals (or plants) need to be drawn life-sized, which need to be enlarged, and which need to be scaled-down.
3. Use grid papers with different sizes of grids to help students draw to the appropriate scale. **Note:** This is an excellent opportunity to reinforce ideas of scale: 5:1, 10:1, etc.

Individual Practice: Draw and Label

Students in Kindergarten through 4th grade will work together on their drawings. Completed drawings may be cut out and glued to a background.

1. Label the parts of the animal (or plant).
2. Draw in pencil and then go over the pencil-lines with a permanent marker.
3. Use colored pencils or paint to add color.
4. To show details, such as the head of an insect or the stamen of a flower:
 - a. Project the drawing on the wall
 - b. Tape paper to the wall.
 - c. Trace the enlarged section on the paper.



Lesson 2: Make the WANTED Poster

RECOMMENDED FOR GRADES 3-8



Students will create WANTED posters for their adopted animals or plants.

| Grade Level Benchmarks | |
|------------------------|---|
| Grades K-2 | Adjust benchmarks as appropriate to suit students' grade level. |
| 3-8 | Each student makes a WANTED poster for his/her own animal or plant. |

Pre-Lesson Preparation

Cut white paper into appropriate sizes for each part of the poster. (Students will draw and write on the white papers, and then glue the finished pieces on the background. This way, one mistake will not ruin the entire poster; the students can easily re-do individual pieces and end up with a professional-looking product.)

Whole Group Exercise: WANTED Poster

Creating a Model. Find out what the class already knows about a WANTED poster. Choose an imaginary character that is well-known to everyone (i.e. from a cartoon or comic book) and work together to create a WANTED poster for that character. This poster will serve as the model for the posters that you want the students to create for their animals (or plants).

Steps for Creating the Poster:

1. Share the rubric (end of lesson) and demonstrate how they will use the materials to create the finished product.
2. Show a completed WANTED poster.
3. Use 12 x 18 or 18 x 24 colored construction paper for the background.
4. In order to make the WANTED poster interesting and relevant, encourage students to include personal experiences (their own or their classmates').
5. Before they begin writing, students should be given time to interview each other in small groups. They should record in their science notebooks information and observations that are relevant to their animals (or plants).



| Wanted for Preying on Mice | |
|--|---------------------------------|
| Great-horned owl Alias: <i>scientific name</i> | |
| (student's illustration goes here) | Physical Description |
| Signs (tracks, feathers, eggs, scat) | Sounds (or other cool facts) |

Template for Animal Wanted Poster

If you are able to use Microsoft PowerPoint™ to make the poster, show the students how to open the program and choose Page Setup; then, set the slide-size to “Custom” and enter the size/ measurements you require (be sure the size can be supported by your printer). Create the boxes for the posters, add the words, and import scanned drawings or use Microsoft Paint™ to do a drawing.

What Students Must Include on Their WANTED Posters:

1. Animal’s (or plant’s) common and scientific names. The scientific name is italicized with the first word (genus) capitalized and the second (species) in lowercase, for example: *Felis concolor* (animal), *Typha latifolia* (plant).
2. Pencil drawing of the animal. The drawing can be life-sized or drawn to scale and should be colored accurately using colored pencils. (If the students are focusing on plants, they should draw the entire plant, including its flower, fruit, seed, and leaf.)



| Wanted for Surviving in the Wild | |
|---|--|
| common cattail Alias: <i>scientific name</i> | |
| (student's illustration goes here) | Scents or other cool facts (peel and eat the stalk, bake the tuber) |
| Pieces and parts (stalk, tuber, cattail seed heads, seeds) | Physical Description |

Template for Plant Wanted Poster

3. Text and/or a drawing that tells where you would find the animal (or plant). This should include location and a description of the animal's (or plant's) habitat (focus on habitats in your city/state).
4. Sounds or smells the animal might make. (If the student's are focusing on plants, they should describe smells.)
5. Drawing of the animal's track, feather, and/or scat.
6. Physical description of the animal (or plant): size, color, and characteristic markings. Students should be discouraged from quoting text verbatim from the internet. Students can read the text and then (in their own words and using what they've written in their science notebooks) describe the animal (or plant). What they write should convey their own interpretations of what their animals or plants look like. For example, "...red and black isn't for camouflage, but to tell predators that 'I'm poisonous; stay away.'"
7. Why is the animal (or plant) WANTED (e.g., is the animal a predator, prey, or invasive species; is the plant good to eat, medicinal, or an invasive species)?



Alternate or Challenge Activity:

Students make their own “Field Guide Frenzy.” To learn more, review the online activity and the Student’s Guide link on the *NatureMapping* website (See Resources).

1. Cover the student’s animal’s (or plant’s) picture with five shapes of equal size (e.g., blocks, rectangles) using heavy paper or printed PowerPoint™ slides.
2. Students write five clues.
3. Clues are read, one at a time. After each clue is read, a shape is removed to reveal more of the animal (or plant).

Student Assessment

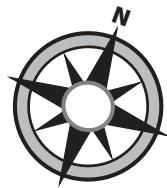
Print one rubric for each student. Circle the appropriate box for each criterion. The grade is based on total points (18-20 points = Exceeds benchmark; 15-17 points = Meets benchmark; 15 or fewer points = Below benchmark) or general “best fit.”

Wanted Poster Rubric

Name _____

| | Exceeds benchmark | Meets benchmark | Below benchmark |
|------------------------------|--|--|---|
| Information | All facts are accurate. | Most facts are accurate | More than two mistakes of fact. |
| Scientific language | Students use specific descriptive language. | Language is mostly specific. | Language is vague. |
| Illustration | Illustration is to scale or life size; colored accurately with colored pencils. | Illustration meets 2 of the 3 expectations. | Illustration meets 1 of the 3 expectations. |
| Complete | Each section is included. | One section incomplete. | One section missing. |
| Overall visual appeal | Poster is visually appealing, including neat writing, drawing, no tape or glue showing, edges glued tight. | Mostly visually appealing | Somewhat messy, loose edges or tape showing. |
| Conventions | Spelling, punctuation, and capitals are correct. | Spelling, punctuation, and capitals mostly correct | More than 3 mistakes in spelling punctuation, or capitals |





Unit Five: Read and Use Maps

How do we know where we are?

OBJECTIVES

Understand cardinal directions
Practice using maps
Learn how to use a compass
Use a GPS unit and understand latitude/longitude coordinates

Materials

Data collection form
Field guides or animal fact sheets
Compass
Compass wheel
Compass instructions *
Different maps (state, city, local)
Science notebooks
A 4-foot-square piece of colored paper
Note cards with N, S, E, W, NW, NE, SW, and SE written on them
Globe
GPS unit
How to use a GPS *
Tape measure—100”
Popsicle sticks
Pens and pencils

* Available at:

NatureMappingFoundation.org
website

Unit Summary

Explorers and current-day scientists record their locations on maps. The NatureMapping Program asks the public not only to “tell us what you see (plants, animals), but also where you see it (location).” There are multiple ways to describe a location with geographic precision. This unit will help you to teach your students both basic directional skills and some of the more complex directional skills so they can navigate nature and the greater biosphere. The unit starts with basic directions and mapping techniques, then moves on to using GPS units to take latitude and longitude coordinates. It ends by teaching students how to map their school’s grounds.

Unit 5 contains the following four lessons:

Lesson 1: Cardinal Directions

RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE

If you ask students where north is, most will raise their hands over their heads: They always see it at the top of a globe or map. This lesson shows patterns of direction (sunrise and sunset).

Lesson 2: What is a Map?

RECOMMENDED FOR UPPER ELEMENTARY (4-8) AND ABOVE

There are different maps for different uses. In this lesson, students will explore a variety of maps

Lesson 3: Creating Our Own Maps

RECOMMENDED FOR UPPER ELEMENTARY (4-8) AND ABOVE

What better way is there to learn about directions and maps than to map your own schoolyard? The precision of the map will depend upon the grade level of the students.

Lesson 4: Using a GPS Unit to Record Locations Around the Schoolyard

RECOMMENDED FOR UPPER ELEMENTARY (4-8) AND ABOVE

Older students use GPS to find latitude and longitude, which they transfer to grid paper in order to make a scaled model of their schoolyard.



Creating Enthusiasm

Talbott's Game ("Alright Folks, Close Your Eyes"). Once students have closed their eyes, ask them to answer the following (or similar) questions:

- Who is sitting next to you on your right?
- The person across from you wears what color of shoes?
- What direction are the clouds moving?
- Where is the sun right now?
- Looking from where we are right now, where will the sun rise?
- Were there any birds in the tree we just passed?
- What flowers are blooming right now?
- Where is north? *Ask the students to keep their arms pointing north and open their eyes. When they see arms pointing in every direction, they quickly realize how disoriented they are as a whole.*

Be sure to ask questions that at least a few people will get right. Try to vary your questions to emphasize different skills. Try to include questions that address all of the senses.

Local rescue agencies provide a list of 10 items everyone should take when they go on a car trip, hike, or field trip. The top two items on the list are a map and a compass. Neither needs a battery, cell tower, or model-specific instructions.



Lesson 1: Cardinal Directions

RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE

Lesson 1: Cardinal Directions

RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE

As students look at their data collection forms, they should notice that information about locations is still missing. In this lesson, students will begin to learn how to find their location by first learning cardinal directions.

| Grade Level Benchmarks | |
|------------------------|--|
| Grades K-1 | |
| | Students know where the sun is in the morning and which way is north. Students remember directions by using an acronym: ESWN: Eat Soggy Wheaties Now (or others that the kids make up). |
| 2 | Students draw a house and make symbols to label the rooms (for example, symbols for kitchen, bathroom, and so on). They make a key for reading the symbols and put in a compass rose. |
| 3+ | Students add the directions that come between E, S, W, N. |

Whole Group Exercise: Compass Wheel

Go outside and sit in a circle in an open spot. Show students the compass wheel.

1. Ask:
 - a. Where does the sun come up?
 - b. Where does the sun go down?
 - c. What direction is the sun?
 - d. Which way is north?
 - e. What is the direction between north and east? (Repeat for the other directions.)
2. Use an object, such as a branch, to point north. Explain the other cardinal directions.
3. Ask students to use materials in the area to mark the other directions.
4. Explain what a compass is and how it functions.
5. Use a compass to test the accuracy of the students' placement of objects to mark directions (see step 3 above).
6. Say the different directions out loud and ask students to point to where the direction is on a compass wheel or on a makeshift wheel outside. You can also hand out cards with directions for students to place on the wheel. (Ask older students to determine more precise directions, such northwest or southeast.)



Story of the Day

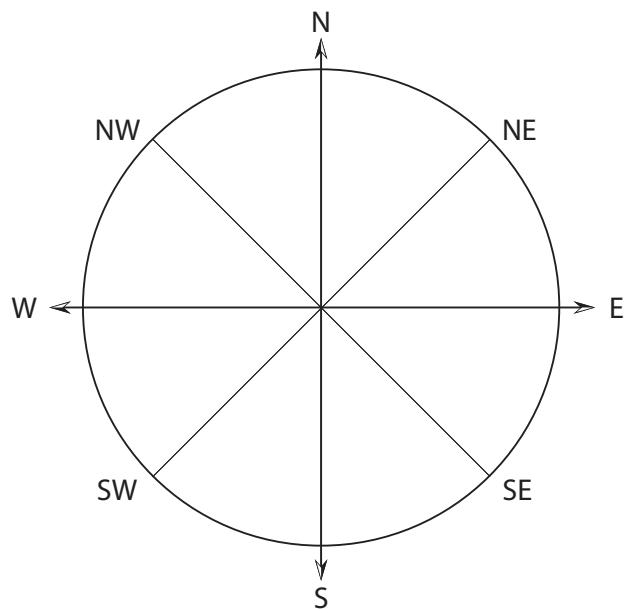
Draw a collective map on the whiteboard. The map should show where your class went and what they saw. First, draw the sun, then identify the directions of north, south, east, and west. Fill in the big landmarks, the walking trail, and anything else that caught the students' attention.

7. Go inside the classroom and ask students to find north and other directions in the classroom.
8. Ask the students to make direction markers and post them on the walls of the classroom in the correct location. Use the compass to double-check the location. (Further instructions on the use of a compass can be found on the NatureMapping Foundation's *Awakening Inquiry* CD.)

Practical

Test your students' understanding of directions and mapping by taking them outside and asking them to point or position cards in the directions you say aloud (such as east, west, or southeast).

| Student Assessment | |
|--------------------|---|
| Exceeds benchmark | The student points or places cards in the correct direction eight out of eight times. (N, S, E, W, NW, NE, SE SW) |
| Meets benchmark | The student points or places cards in the correct direction four out of four times. (N, S, E, W) |
| Below benchmark | The student points or places cards in the correct direction fewer than four out of four times. |



Compass Wheel or Compass Rose



Lesson 2: What is a Map?

RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE

Maps—Science Notebooks— Sit Spot

Maps are another variation on recording information in a science notebook. Students will draw maps in their science notebooks with themselves at the center and notable trees, hills, waterways, and paths to show the orientation. On this map, they can make notes about compelling events that happened as they sat and watched or wandered.

Students will choose the appropriate map for a given situation.

Grade Level Benchmarks

| | |
|------------|---|
| Grades K-2 | Students recognize maps of their classroom, school, and city. |
| 3+ | Students recognize topographic and state road maps. |

Individual Practice: Maps

Lay out different maps (topographic map, city map, state road map, map of the mall, etc.)

1. Have students look at the maps and tell all the different kinds of information that can be obtained from the map. Students should make a list of their answers; have them work first in small groups and then come together to share their answers with the whole group.
2. Bring students to a central location. Put four different maps in front of the class.
3. Ask students to list the types of information they can get from a map, such as directions, landmarks, and building projects.
4. Ask students to work together to determine which map would be the best one to use to find their way in the following scenarios:
 - a. Primary Scenarios:
 - i. If you were standing by the teacher's desk, which direction would you go to reach the front door? *Answer: Choose the classroom map, mark the route on the map, and use directional words.*
 - ii. If you are in the library and need to go to the lunchroom, which path would you take? *Answer: Choose the school map, mark the route on the map, and use directional words.*
 - iii. When you leave school, which direction would you go to get to the nearest park? *Answer: Use the city map, mark the route on the map, and use directional words.*
 - b. Intermediate:
 - i. How do you explain to a foreign dignitary where your city is and how to drive to your school after he/she lands at the airport? *Answer: Use the road map of the state/city.*
 - ii. How do you drive or walk from your house to the downtown library? *Answer: Use the city map.*
 - iii. Is my house at a different elevation than the school? *Answer: Use the topographic map.*
 - iv. What other countries are at my latitude? *Answer: Use a world map.*



5. You and your students make up other scenarios and challenge each other. As you discuss each scenario, use the directional words to describe movement.

| Student Assessment | |
|--------------------------|---|
| Exceeds benchmark | The student explains 4 out of the 4 scenarios with the correct directional words. |
| Meets benchmark | The student explains 3 out of the 4 scenarios with the correct directional words. |
| Below benchmark | The student explains 2 out of the 4 scenarios with the correct directional words. |

Transferring Information from a Science Notebook to the Typical Data Collection Form

Students will add city, county, and state to the form.

| Data Collection Form | | | | | | | | |
|------------------------------------|------|------|--------------------------|--|----------|-----------|-----------------------|----------------------|
| Observer's Name <u>Sally Smith</u> | | | | City/County/State <u>Waterville, Douglas, WA</u> | | | | |
| Date | Time | Temp | Species Name Description | How Observed? (saw, heard, tracks, etc.) | Latitude | Longitude | How many did you see? | Is this an estimate? |
| 05/06/2009 | 0700 | 60 F | American robin | saw | | | 1 | |
| " | 1630 | 70 F | porcupine | saw | | | 1 | |
| 05/23/2009 | 0900 | 55 F | Western screech owl | saw | | | 1 | |
| | | | | | | | | |

Practical

Write a scenario for four different maps that are laid out in one area. Students will select the appropriate map and explain each scenario with correct directional words.



Lesson 3: Creating Your Own Maps

RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE

The next two lessons build towards using GPS units to map latitude and longitude. This lesson engages students by having them map their own schoolyard. Lesson 4 introduces GPS units and gets students to pinpoint exact locations on their schoolyard map.

| Grade Level Benchmarks | |
|------------------------|--|
| Grades K -1 | The teacher directs and guides every addition to the map; the teacher makes the symbols and directs students to place the symbols on the map. |
| 2 | The teacher works with the students to create a map of the schoolyard that includes several major buildings; the teacher helps the students to add detailed objects in the correct places. |
| 3+ | The students map the schoolyard and use GPS locations to verify locations as they learn to use latitude and longitude. |

Pre-Lesson Preparation

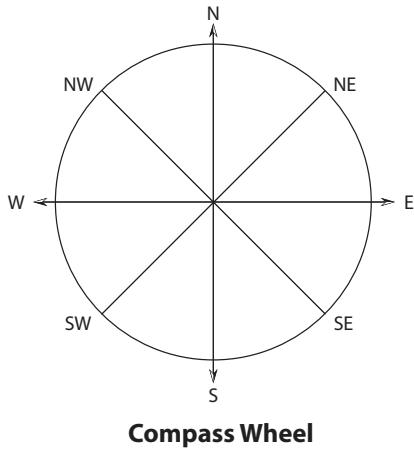
Create a rough diagram of your classroom/schoolyard on a 4-foot-square piece of colored paper. You will add landmarks and points of interest later.

Whole Group Exercise

(Students in grades K-2 work in the classroom; students in grades 3+ work in the schoolyard.)

1. Show the students your diagram of the classroom/schoolyard and discuss the orientation:
 - a. Which way is north in our classroom or our schoolyard?
 - b. What kinds of things could we add to the map that would make it easy for new students to find their way around our classroom or schoolyard?
 - c. Make a list.
2. Take a walk with the class around the classroom/schoolyard. Intermediate students should use field notebooks to sketch a rough map of the schoolyard, noting important landmarks and geography. Include the compass rose in the sketch. (Note: It helps to face north when sketching so as to get things in the right place.)
3. Brainstorm different elements the students would like to include on the map, such as flagpoles, swings, trees, baseball diamonds, or lights. Write these points of interest on note cards and give one to each student.
4. Each student will draw the object listed on his or her note card on small pieces of paper. They will add these to the schoolyard diagram.



**Compass Wheel**

- Ask students to attach each item to the diagram where they think it belongs. Use transparent tape so that students can move the objects around easily in the next lesson.

Students in grades K-2 should stop here.

Practical

Students are given four cards on which are written the names of items found in their classroom or schoolyard. Students will put the cards in the correct places on the map and make a compass rose.

Student Assessment

| | |
|-------------------|---|
| Exceeds benchmark | The student correctly places 4 out of the 4 items on the map and draws the compass rose on the map. |
| Meets benchmark | The student correctly places 3 out of the 4 items on the map and draws the compass rose on the map. |
| Below benchmark | The student correctly places 2 out of the 4 items on the map and draws the compass rose on the map |

CUSTOMIZATION TIP

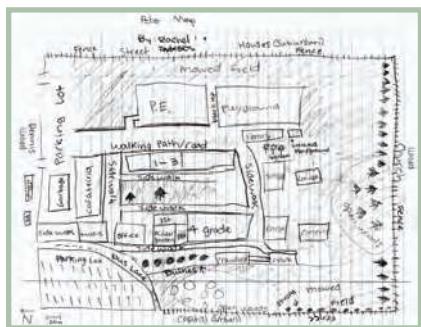
Is this lesson too simple or advanced for your students? Here are some ways to customize the lesson based on grade level:

- Grade K: Help students create and post objects on the map.
- Grade 1: Create symbols for students to place on the map.
- Grade 2: Give students more independence to make symbols and to use a map key.
- Grades 3-6: Encourage students to map the schoolyard using GPS locations as they learn latitude/longitude coordinates.
- Grades 7 and up: Challenge students to convert GPS and map locations from degrees and minutes to decimal degrees. Use grid paper to draw the school to scale.



Lesson 4: Using a GPS Unit to Record Locations Around the School Grounds

RECOMMENDED FOR UPPER ELEMENTARY (4-8) AND ABOVE



Older students use the GPS unit to get latitude and longitude, which they transfer to grid paper in order to make a scaled model of the schoolyard.

Grade Level Benchmarks

| | |
|------------------|---|
| Grades 4+ | Students use GPS locations to map the schoolyard. |
|------------------|---|

Pre-Lesson Preparation

Follow the *NatureMapping* lesson on how to use a GPS unit (on the NatureMapping Foundation's website and the *Awakening Inquiry* Guide) if you need more information. Tape together butcher paper to make a 3x5-foot sheet; you will use this sheet to make another schoolyard map.

Whole Group Exercise

1. Ask students how they can validate (confirm) the location of objects placed on the diagram in the previous lesson. Brainstorm possible answers.
2. Refer to the data collection form and point out the section on recording latitude and longitude.
3. Show the students a globe and explain to them the lines of latitude and longitude.
 - a. Lines of latitude run horizontally and provide locations in the north/south directions; north is depicted as a positive number and south as a negative number.
 - b. Lines of longitude run vertically and provide locations in the east/west directions.
 - c. Explain that each number reflects location in degrees, minutes, and seconds. For example, one reads $47^{\circ} 15' 25''$ as 47 degrees, 15 minutes, and 25 seconds.
 - d. You can write a coordinate in many different ways to express precisely a location on earth. For example, you can write $47^{\circ} 15' 25''$ in decimal degrees as 47.256944.
 - e. Each degree of latitude represents 69 miles, each minute 1.15 miles, and each second 0.02 miles.
 - f. Degrees of longitude vary in size, decreasing as one moves towards either of the poles.
4. Introduce a GPS unit.
5. Set the GPS to record decimal degrees.



6. Take the class outdoors so the GPS unit can acquire the satellite data.
7. Using the globe, show the students how the numbers of the GPS unit indicate how far north of the equator we are (latitude) and how far west of the Prime Meridian we are (longitude).
8. Pair students together and equip each pair with a GPS unit. Explain that one student will read the unit while the other records the readings in his or her science notebook.
9. Ask the students to walk the schoolyard from south to north, writing latitude numbers every 100', which is the approximate length of a second (e.g. degrees, minutes, seconds).
10. Repeat the step for writing longitude numbers from east to west.
11. Return to the classroom and ask students what they observed and if there was a number pattern.
12. Use a globe/map to review why the numbers increase and decrease.
13. Talk about satellites and show how they work. (Refer to the GPS notes on the NatureMapping Foundation's website and the *Awakening Inquiry Guide*.)

Recording Locations Around the School Grounds. Explain to students that when you put the latitude and longitude numbers together, that is considered an exact location, and they will use the GPS unit to test the precision of the objects they placed on their first schoolyard map.

1. Use the numbers they collected with the GPS unit to create a grid on a piece of butcher paper (3x5-feet), which will become their new schoolyard map.
2. Students will pair up and visit the locations of the items they originally put on the first schoolyard map.
3. Students record the latitude and longitude at each corner of the item recorded in their science notebooks. (Note: Hold the GPS right at the corner.)
4. Go back to classroom and discuss the numbers. Did some numbers not change when the students moved to another corner of their item? (Some won't change if the item is small.)
5. Students will write the latitude and longitude on the drawings representing their items and place them on the new map.
6. The entire class will read the locations and see if the objects are correctly placed on the map. If an object is not in the correct place, move it and then glue the object to the map.



Practical

Number ten popsicle sticks (from 1 to 10) and place them around the school grounds so that all students can see when they are close by one of the sticks. Give students a list of the latitude and longitude numbers. Using a GPS unit, each student (or team of students) will record the number of the popsicle stick with its matching latitude and longitude.

| Student Assessment (Grades 3+) | |
|---------------------------------------|------------------------------------|
| Exceeds benchmark | Student finds 10 out of 10 sticks. |
| Meets benchmark | Student finds 9 out of 10 sticks. |
| Below benchmark | Student finds 8 out of 10 sticks. |



Unit Six: Use Data to Answer Questions

How can data be used to answer questions?

Objectives

Understand how scientists and students can use data to answer questions

Learn how to transfer data from data collection forms to a spreadsheet

Use cognitive-thinking skills

Materials

Science notebooks

Field guides or animal fact sheets

Data collection form
(Appendix D, p. 111)

How to make a graph:
Instructions *

Pictures of graphs *

Graph 2 species cutouts

Graph paper

10 x 20-inch paper

Computer and spreadsheet software

Adhesive dots or stickers

Pens and pencils

* Available on the Nature Mapping Foundation's *Awakening Inquiry* CD

Oh no! Data Analysis...Can we skip this Unit?

The answer is no. Up to this point, you have had fun with your class learning different senses, animals, plants, and mapping. You are probably thinking, "How can DATA ANALYSIS be fun?"

Having awakened your students' sense of inquiry, you can show them how data—their data—can be used to help answer their questions and prove or disprove their theories. They will learn a very important lesson: As young as they are, they too can be scientists.

Every year, you can collect data with new students and compare it to the previous years' data. Comparisons and correlations may be reserved for high school mathematics, but they are a natural next step for data analyses in elementary school when the students are part of the data-collection process. — Karen Dvornich

Unit Summary

Scientists collect detailed information in order to quantify the results of their efforts. *NatureMapping* uses the data that students collect to help create a national biodiversity database. This database offers scientists a great tool to learn about the presence or absence of animals: Do the animals use a certain habitat or not? If they did, are they still there, and if not, why not? Questions about the movements and behavior of animals and the increase or decrease of a population can also be answered by using *NatureMapping* data.

Schools and scientists-in-the-making can also use the database to investigate their own questions: Do striped skunks live in our town? Do the barn swallows arrive at the same month every year? Are their numbers increasing or decreasing? Are there fewer young trees in a forest that English ivy has invaded? Finding answers to these questions begins by going outdoors and recording "what you see and where do you see it" in your science notebooks. This is descriptive field science that, when compiled into a database via the data collection form, allows students to then ask comparative and correlative questions. The potential questions are endless.

This final unit teaches students how to display their data by using manual and computer-generated graphs and highlights important mathematical and analytical skills.



Teacher Comments

“My knowledge has increased about actual environmental conditions. Now, maybe I can do something to help.”

“I can easily imagine how this data can be integrated in an elementary school curriculum. This is wonderful. I can easily see NatureMapping as a central unifying activity for the entire curriculum.”

Student Comments

“I want to thank you for letting us know that what we do is actually important to the state and that we really do matter.”

“When our teacher told us about this project, I was sure it would be another series of boring experiments. But I found that it was actually very exciting. I also felt like I was doing my community a big favor.”

“Thank you very much for showing me there is a bigger world out there just waiting to be explored.”

“I never knew that science was actually interesting.”

Lesson 1: Building a Graph on Paper

RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE

The *NatureMapping* Program needs data from schools and communities; the reasons are explained to reinforce the importance of being consistent when recording data. Students are the best critics of their classmates’ work and, without realizing it, are acting as “scientists” when they question the data on their forms and again when the data are displayed on their graphs.

Lesson 2: Using a Spreadsheet

RECOMMENDED FOR UPPER ELEMENTARY (4-8) AND ABOVE

Lesson 1 provides the students with an understanding of what their data should look like as part of a graph. The students will apply this understanding to perform a critical review of the same graphs created by the spreadsheet software.

Ideas for the Continuation and Integration of the Animal Study with Maps. We encourage you to connect the students’ data to the other subjects students are studying. Geography, math, writing, and technology are easy to integrate with science. Examples are provided.

Using These Data to Answer a Bigger Question. While this is the last unit, it is only the beginning of endless possibilities for further study. The online *NatureMapping* Activities are an extension of these units and help prepare students by giving them the tools to ask more questions and collect more data to answer bigger questions.

Common Terms

Descriptive investigation: Describing and/or quantifying parts of a natural system. Example: How many species did we see? How often did we see a specific species?

Comparative investigation: Collecting data on different populations/organisms or under different conditions (e.g., time of year, location) to make a comparison. Example: Is there a difference between the number of species seen in a park and the number seen in a forest?

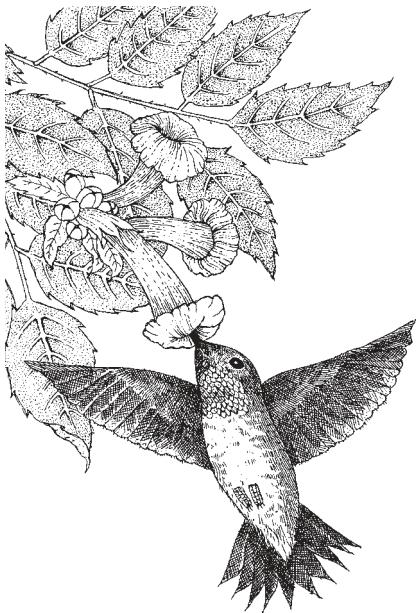
Correlative investigation: Measuring or observing two variables and searching for a relationship. Example: Is there a correlation between the weather and when snakes come out of hibernation?

Monitoring: Visiting a site more than once in a consistent fashion. For example, visiting a site at the same time of day, the same time of the year, or the same length of time to detect changes.



Lesson 1: Building a Graph on Paper

RECOMMENDED FOR ALL ELEMENTARY (K-6) AND ABOVE



Teach students the importance of recording data properly and explain how their data helps the scientists and organizations like the *NatureMapping* Program.

| Grade Level Benchmarks | |
|------------------------|---|
| Grades | |
| K-1 | Group effort: Students report from the class data sheet as the teacher leads and records on a chart or graph. Students are asked and answer questions about their data |
| 2 | The teacher leads students to make graphs by using data collection sheets. Students ask questions that can be answered by their data. |
| 3+ | Students make graphs from the data collection sheets and independently ask questions that can be answered by their data. |

Whole Group Exercise: Data Collection Form Review

Use the data collection form from the previous units as an example.

1. Engage students in the activity by asking:
 - a. Would we see different animals if we collected data at different times of the day? *Answer: Some animals are nocturnal (active at night); other animals search for food throughout their territory and may show up in certain areas only in the afternoons; insectivores will wait until the weather warms up enough for the insects to begin moving around.*
 - b. Would we see different animals if we collected data at different times of the year? *Answer: Some animals are migratory.*
 - c. Why are data important to scientists? *Answer: Collecting and analyzing data is the only way to get the answers to their questions*
 - d. Why is it important to collect data correctly? *Answer: If parts of the data collection are missing, the data can't be used.*
2. This chart highlights how one can record data in a table in an inconsistent way.

| Date | Species Name | How Observed |
|------------|--------------------|--------------|
| 11/16/09 | Anna's Hummingbird | Saw |
| 16-Nov-09 | Ana's Hummingbird | Sight |
| 11/16/2009 | Anna hummer | Saw it |





3. Ask students to explain what is wrong with the table:
 - a. The student wrote the data in three different formats. (The *NatureMapping* format is MM/DD/YYYY.)
 - b. The student listed “Anna’s hummingbird” as the species name in three different ways.
 - c. In the “How Observed” column, the student has used three different words or phrases to indicate that she saw the animal.
4. Discuss the pros and cons of using all caps versus upper and lower case when data are being entered. In this example, all caps were used.

| Date | Species Name | How Observed |
|------------|--------------------|--------------|
| 11/16/2009 | ANNA'S HUMMINGBIRD | SAW |
| 11/16/2009 | ANNA'S HUMMINGBIRD | SAW |
| 11/16/2009 | ANNA'S HUMMINGBIRD | SAW |

Thinking skills are important, so when the students can answer the above questions, they are ready for the information presented below. Remind students of why and how *NatureMapping* uses student-collected data to study animal movement, behavior, and preservation of the animals’ habitats.





Why is it important to submit data to organizations like the NatureMapping Program?

1. Scientists do not know where all the animals move from month to month and what type of habitats they use. Schools can help provide this information.
2. Students will report “presence or absence.” Presence means animals were seen at a certain place (location) and on a certain date. Scientists have made lists of the animals that they predict will be seen in certain habitats (for example, a forest or a city). If students do not see those animals in those habitats then, by default, they are reporting absence.
3. If a class collects data during different seasons, their data will tell scientists about animals’ movements from season to season.
4. Data submitted to NatureMapping are added to a statewide database that everyone can use to learn if the species are expanding their range, if they are becoming rare, or if they are responding to climate or habitat changes.

How NatureMapping data are used?

1. County and city planners use NatureMapping data to tell them where or where not to develop a new housing tract or mall.
2. The data are used on range maps (on the NatureMapping website) to show where species have been seen and places where we need data.
3. Students can help scientists learn more about local species and update species range maps.

How you can use your NatureMapping data?

Schools can inventory the biodiversity around their communities and monitor their species by collecting data for more than one year. When students analyze their data, they can evaluate how “their” species are doing and compare their data with that collected by other schools in similar habitats.





GRAPH 1:
Total Species by Family Groups

| Bird species | 8 |
|------------------------|---|
| American robin | |
| Western screech owl | |
| Great-horned owl | |
| House finch | |
| Killdeer | |
| Winter wren | |
| Black-capped chickadee | |
| Northern flicker | |
| Mammals species | 2 |
| Porcupine | |
| Striped skunk | |
| Insects species | 1 |
| Thatch mound ants | |
| Plants species | 5 |
| Ponderosa pine | |
| Dandelion | |
| Blueberry | |
| Prickly pear cactus | |
| Stinging nettles | |

Pre-Lesson Preparation

Prepare two sheets for two large paper graphs. One-inch graph paper works best. It should be about 10 x 20 inches in size. Hang the blank paper horizontally on a flat surface. Print the “Graph 2” Species List (p. 86). Make slips of paper and on each slip write the name of a species and a number representing the number of individuals a student observed. Make more than one slip for each species (with the same or different number), so that each student will get 2 to 3 species.

Graph 1: Total by Family Groups.

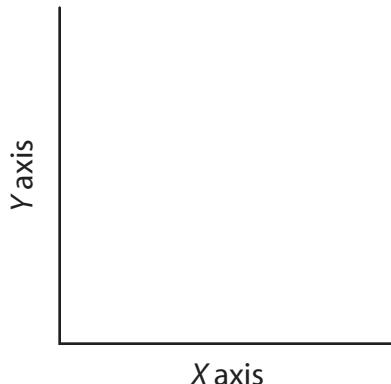
Explain to the class that they will be creating a chart of family groups. A family group is a combination of similar species, such as birds or mammals. This first chart/graph will illustrate what family group was seen the most. This will be based on, for example, how many different kinds of birds were seen of each family.

1. Students will use the data collection forms that they have been filling out as they worked through the other units. The information on the forms should be identical.
2. Pair students and ask them to check their partners' forms to ensure that their forms contain the same data.
3. Ask the students to name the birds they have reported on their data sheets. As they name a bird, record that name in the first column on the left side of the sheet. (Repeat for mammals, insects, and plants.)
4. Ask the students “How many different kinds of birds, etc. did we record? Put the total in a second column.

Create the Graph: Explain that the data have been grouped and are ready to create a graph. On another sheet of paper draw a horizontal (x-axis) and vertical (y axis) line.

1. Starting in the 3rd grade, here are the suggested questions:
 - a. What number goes at the bottom of the intersections of the x and y axis?
 - b. What scale should we use by looking at the biggest and smallest numbers?
 - c. What words do we need to put on the x and y axis?
 - d. What would be a good title for the x axis?
 - e. What would be a good title for the y axis?
 - f. What would be a good title for the graph?
2. Label the “x” axis “Family Groups”
3. Label the “y” axis “How Many” or “Quantity”

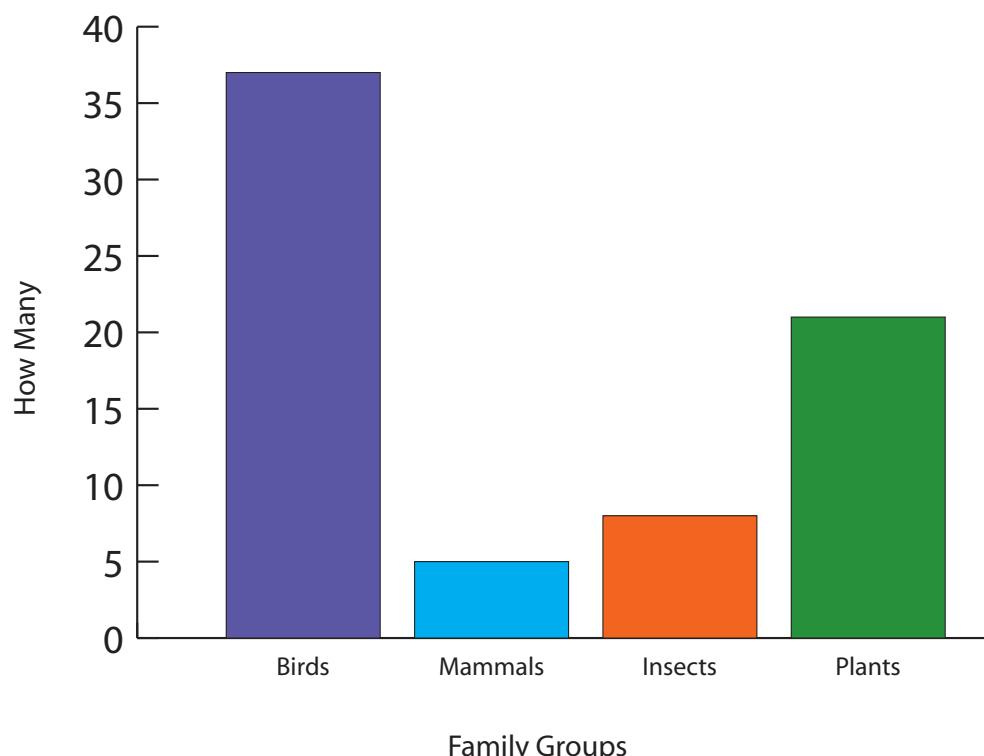


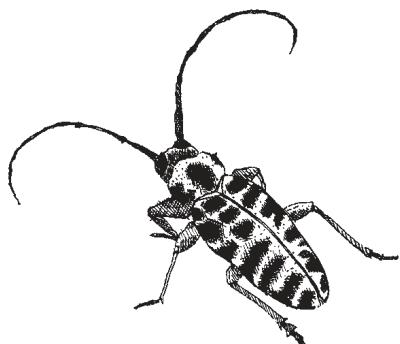


4. Give it a title; for example, “Biodiversity in Our Town” (the term biodiversity refers to the variety of species in nature).
5. Put a “0” at the bottom, then “1”, “2,” and so on (up to “10”) along the “y” axis (vertical).
6. List the taxonomic groups (e.g. birds, mammals) along the “x” axis (horizontal).
7. Draw a rectangle from the “x” axis to 8 on the “y” axis for birds.
8. Repeat for each family group.
9. Ask the students to think for a minute on their own and write down in their science notebooks one or two questions that can be answered by using this graph. Next, have students work in pairs: Ask them to share their questions with their partners. Each pair of students can then choose one question to share with the rest of the class to see if the class can answer it. Sample questions:
 - a. What species did we see the most?
 - b. Were there fewer insects because it was too cold?
 - c. Were there fewer insects because we didn’t spend as much time looking for them as we did for the birds?

Graph 1.

Biodiversity in our Town





Graph 2: Total Number of Individuals by Family Groups.

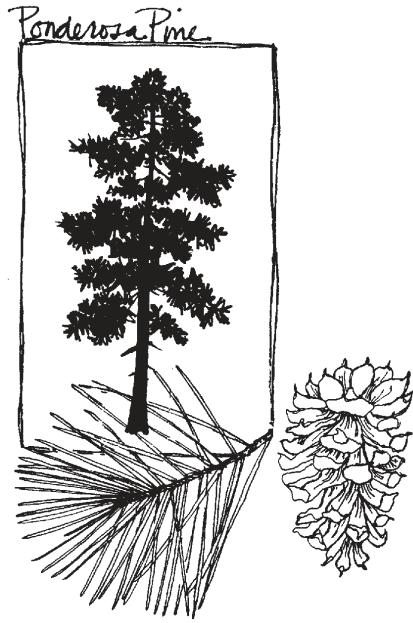
Explain to the class that they are going to make a similar chart/graph of family groups, but this time, they will graph the total number of individuals.

1. Copy the species' names onto the other piece of graph paper and add another column that has the number of individuals.
2. Hand out to each student 2 to 3 slips of paper on which the species' names and numbers are written. Do not give a student the same animal.
3. Students will pretend they went outside yesterday and wrote down the number of animals they saw at the same time on their slips of paper.
4. Ask "How many of you saw an American robin?" As each student reads the number of individuals they saw, add the number to the chart.
5. Suggested questions:
 - a. Do you think we could have seen the same robins when we went outside together? *Answer: Yes.*
 - b. What number best represents the number of individuals we saw as a class? *Answer: The highest number.*
6. Circle the highest number reported for each species.
7. Total the number of individuals and place the number under the total. (Note: Using the example above, total 6 robins, 5 rock doves, 1 owl, etc.)

Create the Stacked Bar Graph:

1. On another sheet of paper, draw a horizontal (x-axis) and vertical (y axis) line.
2. Put a "0" at the bottom, then "5", "10", "15," and so on (up to "40") along the "y" axis (vertical).
3. List the taxonomic groups (e.g. Birds, Mammals, etc.) along the "x" axis (horizontal).
4. This time, students will make a *stacked bar graph* that totals the number of individuals reported for each family group.
5. Using the example above, draw a box for the 6 American robins.
6. On top of that box, draw another box (with a different color) for the 5 rock doves.
7. Continue until the stacked-bar totals 37.
8. Repeat this process for the rest of the family groups.
9. Label the "x" axis "Family Groups."





10. Label the "y" axis "How Many" or "Quantity."
11. Change the title of the graph to "The Number of Individuals from our Science notebooks" or discuss with the class another title that best represents the graph.
12. Review the graphs as a class and check for accuracy. Ask:
 - a. Do the graphs make sense?
 - b. What do they tell us?
 - c. Does everything add up correctly?

GRAPH 2:
Species List with Total Number of Individuals by Family Groups

| Species | Number of individuals | Total |
|------------------------|-----------------------|-----------|
| Birds | | 37 |
| American robin | (6, 1, 2, 4) | 6 |
| Rock dove | (5, 1, 1, 5) | 5 |
| Great-horned owl | 1, 1, 1, 1 | 1 |
| House finch | (5, 4, 5, 5) | 5 |
| Killdeer | 6, 6, 6, 6 | 6 |
| Winter wren | (3, 1, 2, 3) | 3 |
| Black-capped chickadee | 5, 6, 7, 5 | 7 |
| Northern flicker | 4, 4, 4, 4 | 4 |
| Mammals | | 5 |
| Opossum | 1, 1, 1, 1 | 1 |
| Eastern gray squirrel | 3, 4, 3, 3 | 4 |
| Insects | | 8 |
| Bumblebees | 5, 5, 7, 8 | 8 |
| Plants | | 21 |
| Ponderosa pine | (10, 9, 10, 8) | 10 |
| Dandelion | 5, 5, 1, 3 | 5 |
| Blueberry | 3, 3, 2, 3 | 3 |
| Prickly pear cactus | (1, 1, 1, 1) | 1 |
| Stinging nettles | 2, 2, 2, 2 | 2 |



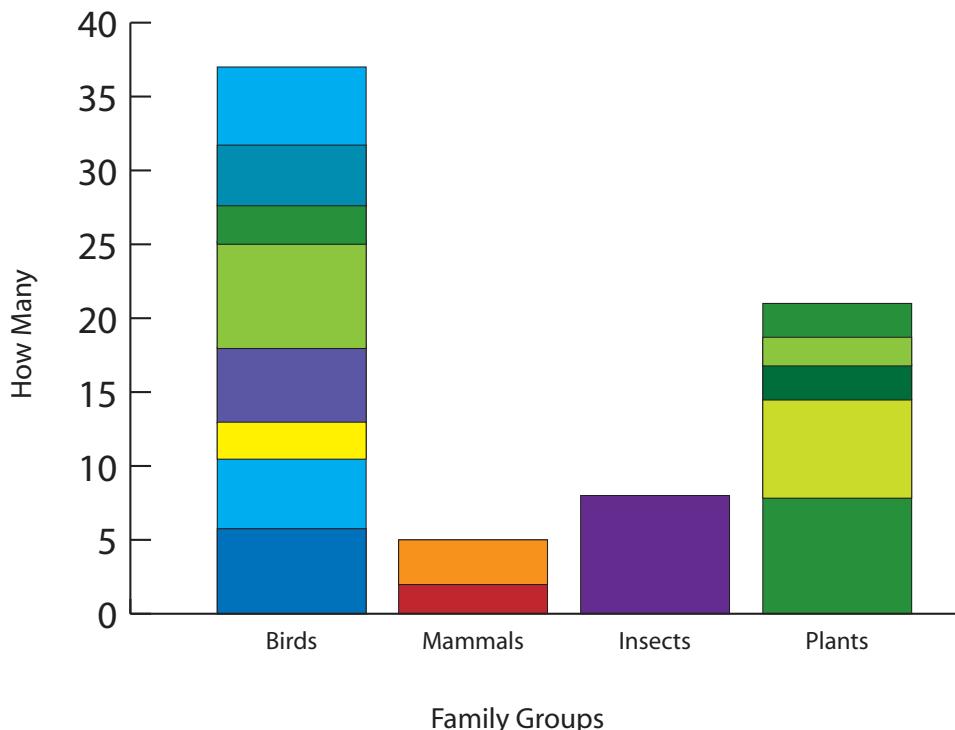
Individual Practice: Making and Evaluating Bar Graphs

Students will make and then evaluate bar graphs using the examples shown above. Each student should evaluate somebody else's graph.

1. Make copies of the following three questions and distribute them to each student:
 - a. Do the graphs make sense?
 - b. What do they tell us?
 - c. Does everything add up correctly?
2. Students will switch graphs and answer these questions.
3. Students should then write two questions that can be answered by the graph.
4. Students should write one thing that is good about the graph.

Graph 2.

Numbers of Individuals from our Science Notebooks



Extension. Add more information to this graph to increase its complexity, or create new graphs with additional information from the data collection form. Other graphs might include:

- Sight time.
- Sight date and season.
- Animal location.
- Animal habitat.
- Animal activity.

| Student Assessment | |
|--------------------|---|
| Exceeds benchmark | <p>The student's data collection sheet is filled out accurately so that the student can transfer data to the charts/graphs.</p> <p>The student:</p> <ul style="list-style-type: none">• Sorts data into different categories.• Counts and sums data (by the different categories) either by hand or by using a spreadsheet.• Writes two questions that can be answered by using the data; writes the answers. |
| Meets benchmark | <p>The student:</p> <ul style="list-style-type: none">• Makes occasional mistakes on the data sheet.• Sorts data into categories.• Counts data points in one category.• Writes one question that can be answered by using the data; writes the answer. |
| Below benchmark | <p>The student's data sheets contain many irregularities and mistakes.</p> <p>The student:</p> <ul style="list-style-type: none">• Has difficulty sorting and counting data points.• Has difficulty writing questions that can be answered with the data.• Needs more guided practice. |



Lesson 2: Using a Spreadsheet

RECOMMENDED FOR UPPER ELEMENTARY (4-8) AND ABOVE

Students will enter their data into spreadsheets, make the same bar graph as in Lesson 1 (*Total by Family Groups*), and create a pie chart.

Pre-Lesson Preparation

Each student will need a folder on the school's server (or on an individual computer) where he/she can save and retrieve his/her data throughout this lesson.

1. Teach a common way to name and save files. For example, use the student's ID number (or first initial and last name) and the date: Chjo-09202009 or CJohnson-09202009.
2. Write on a large piece of paper the names of the folders where the students will save their work; hang this piece of paper on the wall.



Whole Group Exercise Data Entry:

Using the example below, copy all the data from the data collection form into a computer spreadsheet, such as Excel™, for analyses. This can be done by the teacher, by students working in pairs, or by students working with a mentor from an upper grade level.

1. Show students how to widen columns and sum their data. If you need help, use the Excel™ spreadsheet on the NatureMapping Foundation's *Awakening Inquiry Guide* as a reference.
2. Follow the instructions below for Graph 1:

How to make a bar graph using Excel

| Species | | | |
|------------------------|---------------|-------------------|---------------------|
| Birds | Mammals | Insects | Plants |
| American robin | Poccupine | Thatch mound ants | Ponderosa pine |
| Western screech owl | Striped skunk | | Dandelion |
| Great-horned owl | | | Blueberry |
| House finch | | | Prickly pear cactus |
| Killdeer | | | Stinging nettles |
| Winter wren | | | |
| Black-capped chickadee | | | |
| Northern flicker | | | |

Family Groups

| | |
|---------|---|
| Birds | 8 |
| Mammals | 2 |
| Insects | 1 |
| Plants | 5 |

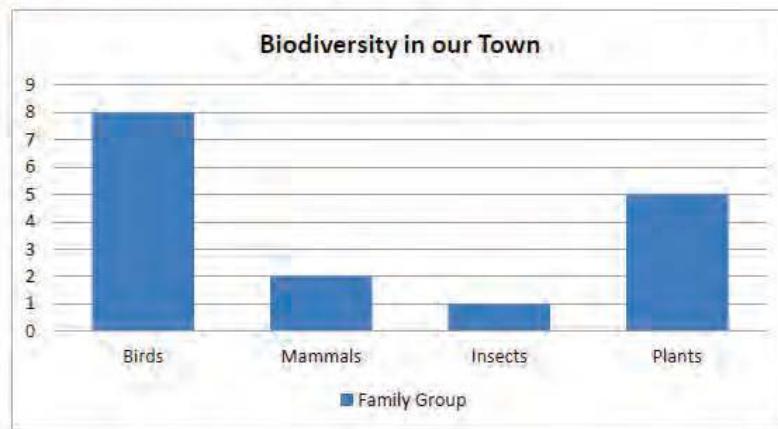
Instructions

List the species under the correct family grouping.

Total the number for species for each family.

Enter the family group names and total species in two columns.

Use the Chart Wizard to create a bar chart and labels



Pie Chart: Discuss the fact that there are other ways to explain the same information. For example, instead of a bar graph, students can use a pie chart.

1. Enter the name of each family group in Column A.
2. Write the total next to the family group in Column B.
3. Add the totals together to create the grand total.
4. To calculate the percentage: In cell C2, divide each family total (for example, in cell B2) by the grand total (in cell B10) and format the cell for *percentage*. The formula in Column C for “Birds” would look like this: =C2/\$C\$7 (if “8” was in C2 and “16” was in C7).
5. Check your work by following the instructions below to create a pie chart using the Excel Wizard.

The class spreadsheet (one spreadsheet with all of the data) would thus be ready to submit to the *NatureMapping* website if it contained real data from the students.

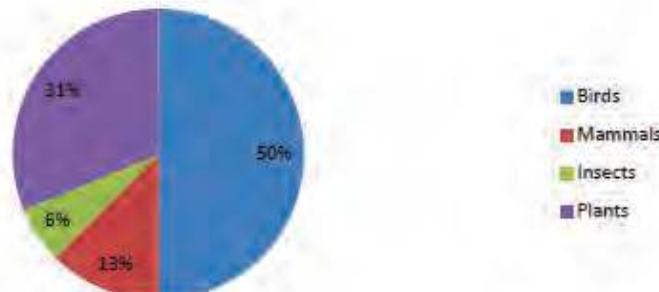
How to Make a Pie Chart using Excel

| | | |
|---------|----|------|
| Birds | 8 | 50% |
| Mammals | 2 | 13% |
| Insects | 1 | 6% |
| Plants | 5 | 31% |
| Total | 16 | 100% |

Instructions

Total the number of species by family groups using the same data in the bar graph.
Enter the family groups and total species by family in two columns.
Use the Chart wizard to create a pie chart and labels.

Species Seen by Family Groups



Individual Practice: Knowledge Mastery of Graphs

Students will graph by family group the number of species seen. To do this, they should use a bar graph and a pie chart.

| Student Assessment | |
|--------------------|--|
| Exceeds benchmark | <p>The student's data collection sheet is filled out accurately so that the student can transfer data to the charts/graphs.</p> <p>The student:</p> <ul style="list-style-type: none">Sorts data into different categories.Counts and sums data (by the different categories) either by hand or by using a spreadsheet.Writes two questions that can be answered by using the data; answers the questions. |
| Meets benchmark | <p>The student:</p> <ul style="list-style-type: none">Makes occasional mistakes on the data sheet.Sorts data into categories.Counts data points in one category.Writes one question that can be answered by using the data; answers the question. |
| Below benchmark | <p>The student's data sheets contain many irregularities and mistakes.</p> <p>The student:</p> <ul style="list-style-type: none">Has difficulty sorting and counting data points.Has difficulty writing questions that can be answered with the data.Needs more guided practice. |



Ideas for the Continuation and Integration of the

Animal Study with Maps. We encourage you to connect the data you collect to the other things you are studying. Geography, math, writing, and technology are easy to integrate with science. The geography of your area determines where animals and people live; data can be used to write “real” math problems (by either students or teacher); and students can write letters or articles from the viewpoint of a native species of your area. Students can also be challenged to use technology to share data and their conclusions on blogs or school websites. They can use a Microsoft Paint™ program to create projects that show their learning; or publish a field-guide page of a local species; or a make a PowerPoint™ presentation. Here are some specific ideas:

1. You or your students could put data points on a map of the area. Use a different color or symbol for each animal group. Help students analyze the information by asking “What can we learn from the map?” Then use a picture of the map on a poster or PowerPoint™ poster to explain your thinking to a wider audience.
2. What do these data tell you? Encourage and teach students to ask questions that can be answered by using these data. Work together to come up with some anchor questions that everyone can use, and then encourage lots of additional questions. Here are some examples:
 - a. Locate places that were missed in the sampling. Are there no critters there, or did we not look there?
 - b. Is there a lot of biodiversity or a little biodiversity?
 - c. What kinds of animals are seen most often? Heard most often? Recognized by signs most often? How many more of animal x are seen than animal y? Write other math problems that can be answered with the data.
 - d. Where are most animals seen? Why? What geographical features are in that area that encourage animals to live there? Use the map on a poster to explain your ideas.
 - e. Choose an animal from your data collection and have students make a picture using Paint™ to show the animal in its habitat.



Use the Data to Answer a Bigger Question.

1. Based on their data, how would geography determine where a student would want or be able to live? Argue for different choices, because they now have pros and cons (decision-making based on data). For example, if students wanted to see lots of water birds, then they would want to live by a lake or river.
2. Where do you think these animals live? Direct the questions to address the habitats the animals use. For example, owls need trees to roost (e.g. rest) and big trees with holes for their nests. They also need other habitats, such as open areas to hunt for their prey.
3. Develop a food web of the species to show how they are connected to each other, their habitats, their prey, and predators. If northern flickers are seen, then there must be trees and insects for the flickers to eat (especially ants). A northern flicker's territory is a $\frac{1}{4}$ mile radius. If there are only a few trees in town, would a lot of flickers live there, even if there are plenty of ants?
4. Become stewards of the environment, or “keep common animals common.” Select a few species and discuss what needs to be in place for the species to live in your town. Items to discuss are:
 - a. Bird feeders.
 - b. Landscaping (using native plants) to attract wildlife.
 - c. Eliminating pesticides if you want lots of insect-eating birds and bats, which are great insect-eaters and especially like mosquitoes. Research has shown that the higher the bird diversity in a community, the less outbreaks of mosquito-borne diseases that affect humans, such as West Nile Virus.
 - d. Maintaining greenbelts for animal protection and movement.
 - e. Keeping cats indoors, especially during baby bird season.
 - f. Creating rain gardens at school and around homes to collect rain water to reduce flooding and prevent toxins from flowing into the streams and ponds.

Use the *Field Investigation Guidelines*. As your students participate in the activities and lessons in this guide, they develop observation skills that are foundational and necessary for conducting scientific inquiry out of doors. For more direction on how to engage your students in field investigation, consult the *Field Investigation Guidelines*. (AFWA Conservation Education materials online)



APPENDIX A: Additional Resources

Introduction

Unit 1

Edutopia “New Day for Learning” (*NatureMapping*):

<http://www.edutopia.org/naturemapping-introduction>

<http://www.edutopia.org/naturemapping-lesson-field-journal>

Edwards, B. (1999). *The New Drawing on the Right Side of the Brain* (2nd ed.). New York: Tarcher/Putnam.

Klentschy, M. (2008). *Using Science Notebooks in Elementary Classrooms*. Arlington, VA: NSTA Press.

Leslie, C. Walker. (1995). *The Art of Field Sketching*. Dubuque, IA: Kendall/Hunt Publishing.

Leslie, C. Walker, & Roth, C. E. (2003). *Keeping a Nature Journal: Discover a Whole New Way of Seeing the World Around You* (2nd ed.). North Adams, MA: Storey Publishing.

My Name is America book series is available from Scholastic Inc. The series includes journals from different people in American history. (Publication details?)

NatureMapping Teacher’s Activities: Meeting Needs: Help student understand that an appropriate habitat will supply all an organism needs to survive:
http://naturemappingfoundation.org/natmap/education/protocols/9_meeting_needs.html

Name that Habitat: Students select a habitat in which their species can be found:
http://naturemappingfoundation.org/natmap/education/protocols/10_habitat.html

Habitat Association: Link wildlife with their habitats:
http://naturemappingfoundation.org/natmap/education/protocols/11_habitat_assoc.html
www.sciencenotebooks.org (to see examples of journals from different fields of science)



Unit 2

NatureMapping Teacher's Activities: Everything is connected:

Demonstrates the interdependence of living creature to each other and their environment:

http://naturemappingfoundation.org/natmap/education/protocols/1_connected.html

Unit 3A

Animal Fact Sheets: <http://naturemappingfoundation.org/natmap/facts.html>

Brown, T. Jr. (1986). *The Tracker*. New York: Berkley Books. (This book tells a very compelling story.)

Elbroch, M. (2001). *Mammal Tracks & Sign: A Guide to North American Species*. Mechanicsburg, PA: Stackpole Books. (This book gives very detailed information about animal tracks and sign.)

Elbroch, M., Marks, E., & Boretos, C. D. (2001). *Bird Tracks & Sign: A Guide to North American Species*. Mechanicsburg, PA: Stackpole Books. (This book gives very detailed information about bird tracks and sign.)

Hillman, B. (2007) *How Big is It?: A Big Book All About BIGness*. New York: Scholastic Reference.

NatureMapping Teacher's Activities: Animal Signs: An activity to help students develop observational skills recognizing common animal signs:

http://naturemappingfoundation.org/natmap/education/protocols/7_animal_signs.html

Field Guide Frenzy: Students will learn to use a variety of field guides to identify species and create their own species clues:

http://naturemappingfoundation.org/natmap/education/protocols/3_field_guide.html

Wells, R. E. (1993) *Is a Blue Whale the Biggest Thing There Is?* Morton Grove, IL: A. Whitman.

Wells, R. E. (1997) *What's Faster than a Speeding Cheetah?* Morton Grove, IL: A. Whitman.

Wells, R. E. (1995) *What's Smaller than a Pygmy Shrew?* Morton Grove, IL: A. Whitman.

Young, J., & Morgan, T. (2007). *Animal Tracking Basics*. Mechanicsburg, PA: Stackpole Books. (This book gives a rich picture of tracking.)

Unit 3B

NatureMapping Teacher's Activities: Name that Animal Part II:

An activity that allows students to practice using binoculars and observational skills to identify animals:

http://naturemappingfoundation.org/natmap/education/protocols/5_name_animal_2.html

Unit 4A: Animals

NatureMapping Teacher's Activities: Animal Signs: An activity

to help students develop observational skills and recognize common animal signs:

http://naturemappingfoundation.org/natmap/education/protocols/7_animal_signs.html

Unit 4A: Plants

NatureMapping Teacher's Activities: Habitats consist of specific species of plants. These activities extend learning about specific plants to the habitats in which they occur. Name that Habitat: Students select a habitat in which their species can be found:

http://naturemappingfoundation.org/natmap/education/protocols/10_habitat.html

Habitat Association: Link wildlife with their habitats:

http://naturemappingfoundation.org/natmap/education/protocols/11_habitat_assoc.html

Field Guide Frenzy: Students will learn to use a variety of field guides to identify species and create their own species clues – replace animals with plants: http://naturemappingfoundation.org/natmap/education/protocols/3_field_guide.html

Unit 4B

NatureMapping Teacher's Activities: Speaking Species Part I:

An activity to help students learn to identify species: http://naturemappingfoundation.org/natmap/education/protocols/2_species_1.html

Speaking Species Part II: An activity to help students identify animals common to their area: http://naturemappingfoundation.org/natmap/education/protocols/2_species_2.html

Animal Signs: An activity to help students develop observational skills recognizing common animal signs: http://naturemappingfoundation.org/natmap/education/protocols/7_animal_signs.html

Using Binoculars/Monoculars: Students learn about magnification, field of vision, and the use of binoculars and monoculars when observing wildlife: http://naturemappingfoundation.org/natmap/education/protocols/4_binoculars.html

Young, J. "Learning the language of Birds" and "Advanced Bird Language: Reading the Concentric Rings of Nature" (audio tapes or CDs by Jon Young offer story-filled explanations): <http://wildernessawareness.org>

Unit 5

Compass lessons by Kjetil Kjernsmo <http://www.learn-orienteering.org/old/lesson1.html>

NatureMapping Teacher's Activities: Introduction to Mapping Part I: An activity to help students learn about map elements and use them to find map locations: http://naturemappingfoundation.org/natmap/education/protocols/6_mapping_part1.html

Introduction to Mapping Part II: An activity to help students understand the idea of map scale and learn how to read topographic maps: http://naturemappingfoundation.org/natmap/education/protocols/6_mapping_part2.html

Using Maps: Where are You? An activity to help students learn how to locate the township, range, and section, latitude and longitude, or UTM of their homes and school: http://naturemappingfoundation.org/natmap/education/protocols/8_using_maps.html

Using Emerging Technologies to Collect and Analyze Data: An activity to (1) show students how to migrate from data collection forms and maps to NatureTracker data collection software and GPS units, (2) learn the concept of GIS, and (3) understand the basics of GIS: http://naturemappingfoundation.org/natmap/education/protocols/13_technology.html

Unit 6

NatureMapping Teacher's Activities: Data Collection Protocols: An activity to help students understand the structured process of collecting field data and the spreadsheet protocols: http://naturemappingfoundation.org/natmap/education/protocols/12_data_collection.html

Glossary of Common *NatureMapping* Terms

Edutopia "New Day for Learning" (*NatureMapping*):

<http://www.edutopia.org/naturemapping-vocabulary-terms-glossary.html>



APPENDIX B: Additional Resources for Field Science Inquiry

Additional Resources for Field Science Inquiry

American Forest Foundation. (2008). *Project Learning Tree: Pre K-8 Environmental Education Activity Guide*. Washington, DC: author.

Bell, R. (2008). *Teaching the Nature of Science through Process Skills: Activities for Grades 3-8*. Boston: Pearson Education.

Colburn, B. A. (2009). *Show Me a Picture, Tell Me a Story: An Introduction to Graphs for the Analysis of Ecological Data from Schoolyard Science Research Studies*. Harvard Forest, Petersham, MA: Harvard Forest Schoolyard Ecology Program.

Council for Environmental Education. (2008). *Project WILD: K-12 Curriculum & Activity Guide*. Houston, TX: author.

Field Investigation Models: www.nhplt.org/resources

McGlashan, P., Gasser, K., Dow, P., Hartney, D., & Heinemann, B. Rogers (2007). *Outdoor Inquiries: Taking Science Investigations Outside the Classroom*. Portsmouth, NH: Heinemann.

National Science Foundation. *Foundations, Vol. 2: An Introduction to Inquiry*: www.nsf.gov/pubs/2000/nsf99148

USDA Forest Service, “Natural Inquirer”: www.naturalinquirer.org

USDA Forest Service, “Investi-gator”: www.scienceinvestigator.org

YouthLearn.org. *Intro to Inquiry Learning*: www.youthlearn.org/learning/general-info/our-approach/intro-inquiry-learning/intro-inquiry-learning.



APPENDIX C: NatureMapping Foundation's *Awakening Inquiry* CD Contents

Unit 1

- American robin photo
- Porcupine photo
- Typical data collection form with Unit 1 data

Unit 2

- 24-hour clocks and segments
- Typical data collection form with time and date
- Compass rose
- Time activities examples
- Time wheel day and year examples of the Short-horned lizard
- Typical data collection form with temperature data
- Typical data collection form with Unit 2 time data

Unit 3A

- List of common species
- Owl photos (screech owl perching, screech owl in hand, great-horned owls)
- Skunk tracks and answers
- Typical data collection form with owls and skunk data
- Track data collection form
- Pet measurement homework assignment
- Vanishing point – Great-horned owl photo at 10-50-100 ft
- Vanishing point drawing

Unit 3B

- Ant mound photos (3)
- Typical data collection form with ant and bird data
- Photo birds in tree 4-square grid
- Photo birds in water 5-square grid
- Drawing of a marble grid
- Red-backed vole photo



Unit 4A & 4B (none for 4C)

- List of common species
- WANTED poster example
- Animal silhouettes (owl, duck, squirrel, mole, swallow)
- Silhouette notes and placement
- Typical data collection form with bird data
- Bird silhouettes - drawings

Unit 5A & 5B (none for 5C)

- Pictures of common plants
- Plant species and use list
- Typical data collection form with plant species data

Unit 6

- Compass wheel
- The first of three Compass instructions have been downloaded from a wonderful website by Kjetil Kjernsmo (see Appendix A - Resources for the url for his complete set of instructions.)
- GPS instructions
- Mapping the school photos of 4th graders
- Typical data collection form with latitude and longitude

Unit 7

- Manual Bar graph instructions
- Bar graph by family groups
- Spreadsheet Bar graph instructions
- Pie chart using a spreadsheet
- Same data different graphs – instructions
- Graph 2 – species list – cutouts
- Stacked bar graph



APPENDIX D: Unit 3 Lesson Materials

Pet Measurement Instructions

Track Length and Width

Place a piece of white paper on the ground. Place your pet on the paper so the animal is standing on it.

Have someone hold the pet and draw around the pet's left front and left rear paw. Take measurements from the drawing and write the measurements on the Track Sheet. (Student Pages My Cat's Tracks, My Dog's Tracks)

Draw what your pet's tracks would look like. (You can walk them in a few inches of snow, or let them get their feet wet and make them stand on a paper towel.)

Trail Width:

While your pet is standing still, measure the distance between the outside of the paws.

Step:

Option 1: Walk your pet outdoors in the snow. Draw a line across the tracks as shown in the diagram. Measure the distance between the two lines.

Option 2: While your pet is standing, measure the distance from the back of the left front paw to the toes of the left rear paw.



Student Page

My Cat's Tracks

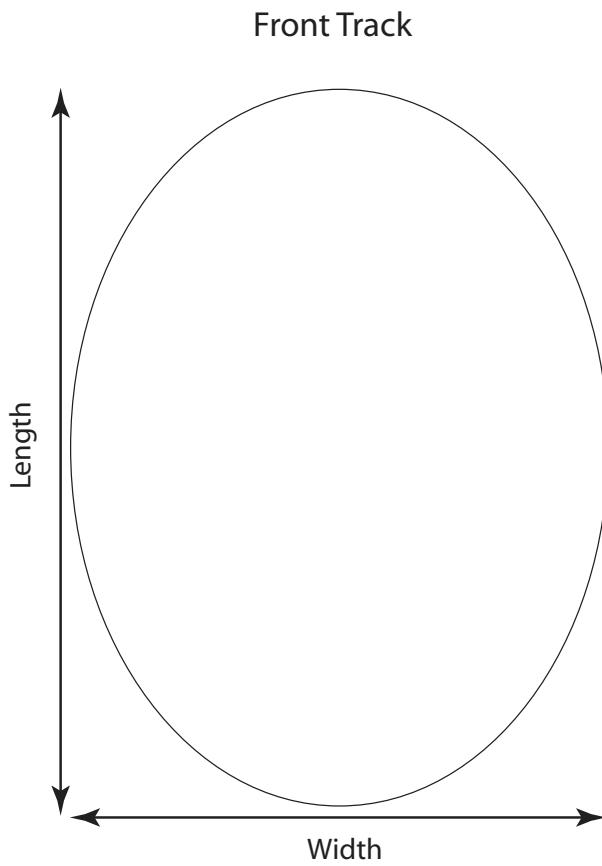
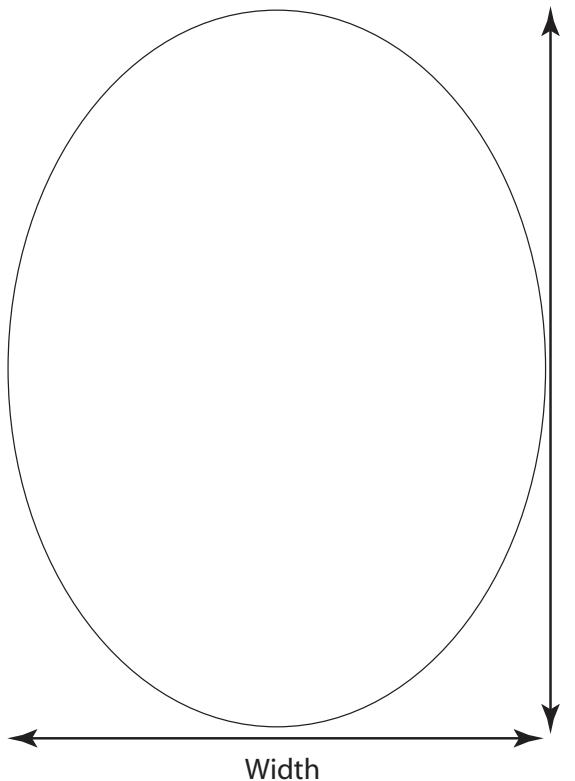
My name is :

My cat's name is:



Photo

Rear Track



Front Track

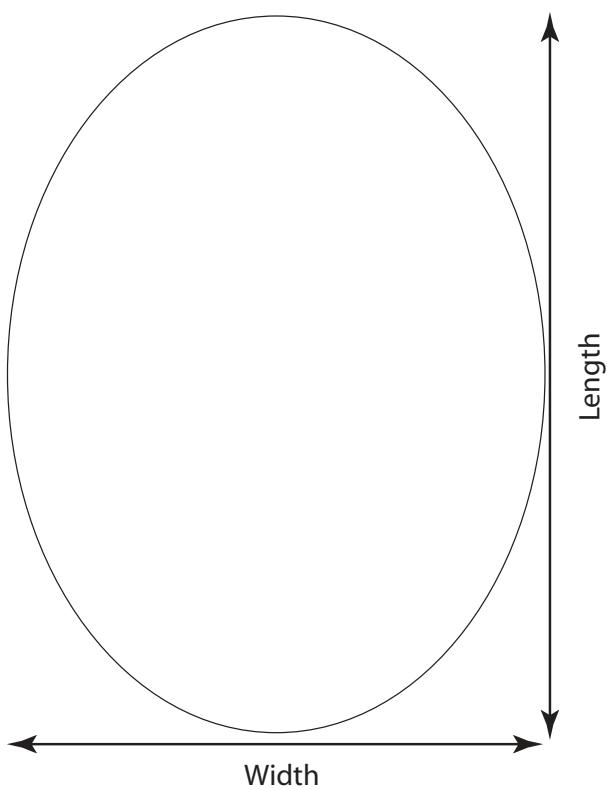
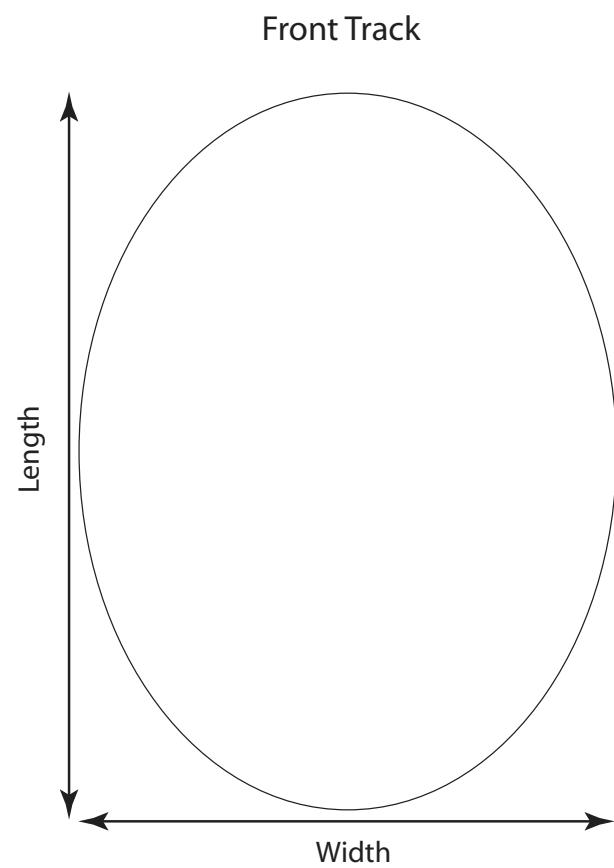
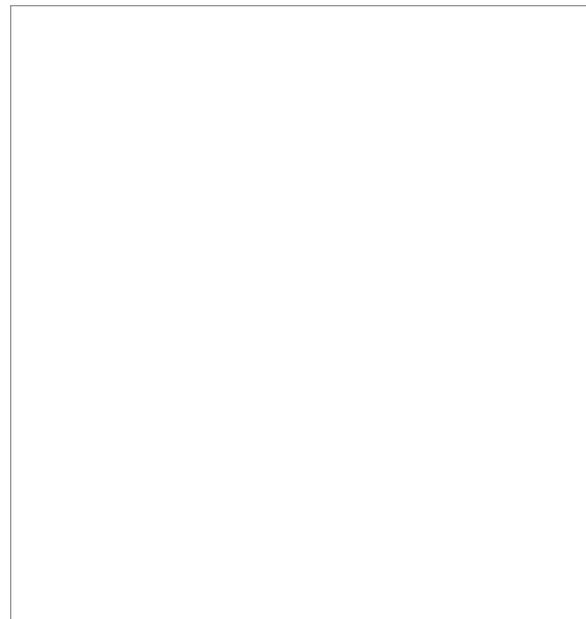


Student Page

My Dog's Tracks

My name is :

My dog's name is:

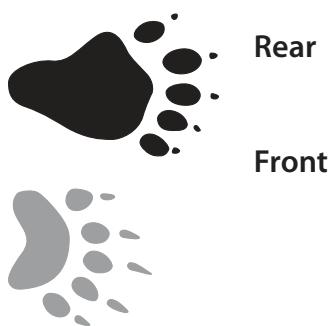


Track Patterns

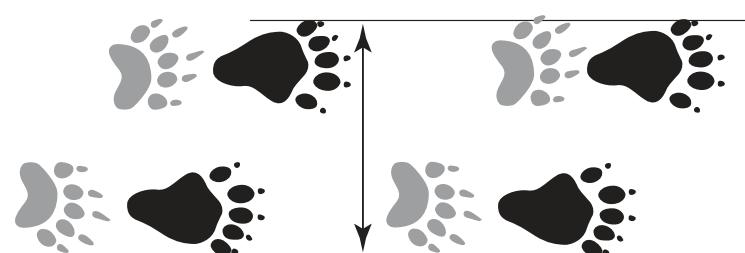
Pacer Walking Pattern - (moving in → this direction)



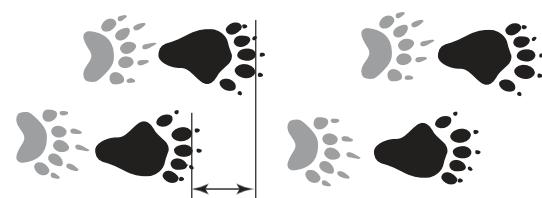
(Example of striped skunk tracks)



Trail Width



Step



| | Length | Length | Width | Width | Step | Trail Width |
|---------------|-------------|-------------|-------------|------------|---------|-------------|
| | Front Track | Rear Track | Front Track | Rear Track | | (Straddle) |
| Black bear | 5"-6.25 | 6"-7.75" | 3.75"-5.5" | 3.5"-5.5" | 17"-23" | 9.5"-14.5" |
| Raccoon | 2"-3" | 2.25"-3.75" | 1.75"-2.5" | 2.25"-2.5" | 8"-14" | 3.6"-6" |
| Striped skunk | 1.75"-2.25" | 1.75"-2" | 1"-1.25" | 1"-1.25" | 6.5 | 2.5"-4.5" |

Rear Track means the same as Hind Track

If the Front and Rear measurement range are the same in the table, an individual's rear track will be the smaller number in the range.

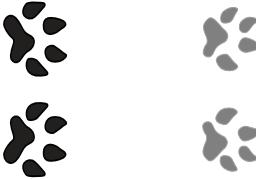
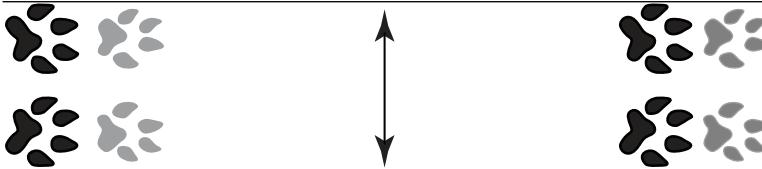
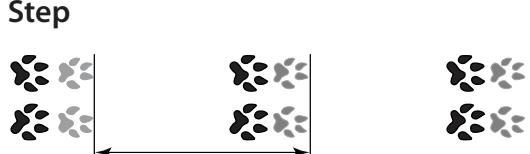


Skunk tracks - Actual size



| Track Patterns | | | | | | |
|--|--------------------|-------------------|--------------------|-------------------|-------------|-----------------------------------|
| Diagonal Walking Pattern - (moving in → this direction) | | | | | | |
| | | | | | | Rear (rear steps on front) |
| | | | | | | Front |
| <i>(Example of Canid tracks)</i> | | | | | | |
| Trail Width | | | Step | | | |
| | | | | | | |
| | Length | Length | Width | Width | Step | Trail Width |
| | Front Track | Rear Track | Front Track | Rear Track | | (Straddle) |
| Ungulates | | | | | | |
| Elk | 3.75"-4.75" | 3.75"-4.75" | 3.25"-4.75" | 3.25"-4.75" | 22"-42" | 7"-11" |
| Mule Deer | 1.25"-3.5" | 1.25"-3.5" | 1.25"-2.75" | 1.25"-2.75" | 18"-26" | 5"-8" |
| Canids (Dog) | | | | | | |
| Coyote | 2.5"-3.25" | 2.5"-2.75" | 1.75"-2.25" | 1.5"-2" | 17.5"-26" | 2.5"-5.5" |
| Red fox | 2.25"-2.75" | 1.75"-2.5" | 1.75"-2.5" | 1.5"-1.75" | 13"-18.75" | 2"-3.75" |
| Domestic dog | | | | | | |
| Felids (Cat) | | | | | | |
| Cougar | 3"-4.25 | 3"-4.25" | 3.25"-4.75" | 3.25"-4.75" | 20"-32" | 8"-11" |
| Bobcat | 1.75"-2.5" | 1.75"-2.5" | 1.5"-2.5" | 1.5"-2.5" | 11.5"-25" | 3"-5.25" |
| Domestic cat | 1"-1.75" | 1"-1.75" | 1"-1.75" | 1"-1.75" | 8"-14" | 2.25"-4.75" |
| Other | | | | | | |
| Porcupine | 2.25"-3.25" | 2.75"-3.75" | 1.25"-2" | 1.5"-2" | 6"-11" | 5"-9" |
| Beaver | 2.75"-3.75" | 5"-7" | 2.75"-3.5" | 3.25"-5.25" | 6"-10" | 6"-10.5" |
| Rear Track means the same as Hind Track | | | | | | |
| If the Front and Rear measurement range are the same in the table, an individual's rear track will be the smaller number in the range. | | | | | | |

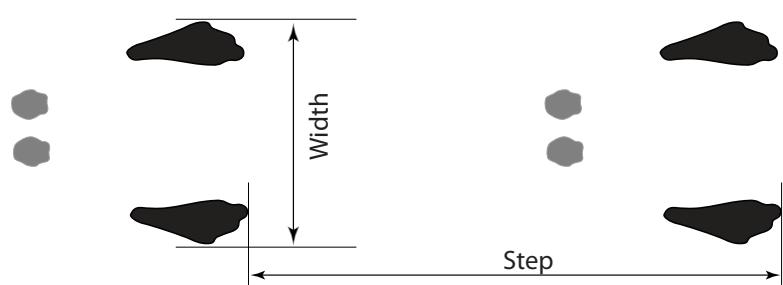


| Track Patterns | | | | | | |
|--|-------------|------------|-------------|--|----------|-------------|
| Bounder Walking Pattern - (moving in → this direction) | | | | | | |
|  <i>(Example of weasel tracks)</i> | | | |  Rear Front | | |
| Trail Width | | | | | | |
|  | | | |  Step Straddle | | |
| | Length | Length | Width | Width | Step | Trail Width |
| | Front Track | Rear Track | Front Track | Rear Track | | (Straddle) |
| Ermine | | | | | | 1"-2.25" |
| Long-tailed weasel | 1"-2" | 1"-2" | 1" | 1" | 9.5"-43" | 1.5"-3" |
| Douglas squirrel (gray squirrel) | | 1"-1.5" | | | | |
| Townsend's chipmunk | | 5/8"-7/8" | | | | 2.25"-3.25" |
| Rear Track means the same as Hind Track If the Front and Rear measurement range are the same in the table, an individual's rear track will be the smaller number in the range. | | | | | | |



Track Patterns

Galloper Walking Pattern - (moving in → this direction)



(Example of snowshoe hare tracks)

Rear

Front

| | Length | Length | Width | Width | Step | Trail Width |
|------------------------------------|-------------|------------|-------------|------------|---------|-------------|
| | Front Track | Rear Track | Front Track | Rear Track | | (Straddle) |
| Snowshoe hare | 2"-3" | 4"-6" | 1.5"-2" | 2"-3.5" | 10"-48" | 6"-8" |
| Mountain cottontail (Nuttall's) | 1"-1.5" | 3"-3.5" | 1"-1.5" | 1"-1.5" | 7"-36" | 4"-5" |

Rear Track means the same as Hind Track

If the Front and Rear measurement range are the same in the table, an individual's rear track will be the smaller number in the range.



Student Page

Team and Your Name:

Date:



APPENDIX E: Unit 4 Lesson Materials

List of Common Species Found in Most Urban Areas

Animal fact sheets available on the NatureMapping website

Birds

American crow
American robin
Barn swallow
Black-capped chickadee
California quail
Canada goose
Cardinal (east coast)
Common barn owl
Downy woodpecker
European starling
Great blue heron
Great horned owl
House sparrow
Killdeer
Mallard
Northern flicker
Red-tailed hawk
Rock dove (pigeon)
Winter wren

Mammals

Beaver
Cougar
Coyote
Eastern cottontail
Eastern gray squirrel
House mouse
Least chipmunk
Little brown bat
Mole
Muskrat
Raccoon
Red fox
River otter
Striped skunk
Virginia opossum
Water shrew
White-tailed deer

Invertebrates

Painted lady
Monarch butterfly
Western swallowtail
Lady bird beetle
Earthworm
Stink bug
Daddy long legs
Grasshopper
Mosquito

Reptiles

Gartersnake spp.
Painted turtle
Snapping turtle

Amphibians

Bullfrog
Chorus frog
Long-toed salamander
Tiger salamander
Western toad



APPENDIX F: Alignment of Fostering Outdoor Observation Skills with the Framework for K-12 Science Standards 2011

The Framework for K-12 Science Standards (National Research Council 2011) describes how science and engineering practices, cross-cutting concepts and disciplinary core ideas in science should be developed across grades K-12. The following table demonstrates how the guidelines for Fostering Outdoor Observation Skills integrates the framework's three dimensions with accompanying practices used by professionals and important for students to know and be able to do.

| 1. Scientific & Engineering Practices | | Fostering Outdoor Observation Skills Grades K-6 |
|---|--|--|
| 1. Asking questions (for science) & defining problems (for engineering) | | Questions for science: Lessons prepare students to ask questions: What lives where? What is the diversity of animals and plants at my place? |
| 2. Developing & using models | | Students use a template for field data collection used by field biologists. Map dependent data collection. Students draw models of animals etc. |
| 3. Planning & carrying out investigations | | Observational inquiry – techniques to observe and record each attribute on data collection report from. Learning how to measure wildlife (empirical data) |
| 4. Analyzing & interpreting data | | Data displayed in tables and graphs Learn to average to reduce error |
| 5. Using mathematics & computational thinking | | Use rulers and thermometers Analyze data – maximum, minimum, range and median |
| 6. Constructing explanations (for science) and designing solutions (for engineering). | | Explain observations on data collection form. |
| 7. Engaging in argument from evidence | | Use the evidence on data collection form to describe what lives in their place of interest |
| 8. Obtaining, evaluating, & communicating information | | Use journals to record ideas, thoughts, models in the form of diagrams. Produce reports on posters to communicate to others |
| 2. Crosscutting Concepts | | |
| 1. Patterns | | Students observe patterns to report living things in their area. |
| 2. Cause & Effect | | Develop observation skills to conduct investigations to identify variables and to measure them – observation is the first step to investigating cause & effect |



| | |
|---|--|
| 3. Scale, proportion, & quantity | Macro-scale – directly observable. Numbers and estimation of wildlife outdoors |
| 4. Systems & system models | Determining outdoors living and nonliving variables involved a natural setting embedded in a local system. |
| 5. Energy & matter: Flows, cycles, & conservation | Observing weather and recording temperature of the outdoor setting |
| 6. Structure & function | Students observe both structure and function of living things to explain behavior |
| 7. Stability & change | Intentionally left blank |

3. Disciplinary Core Ideas

| | |
|--|--|
| Physical Sciences | |
| PS1: Matter & its interactions | |
| PS2: Motion & stability: Forces & interactions | |
| PS3: Energy | |
| PS4: Waves & their applications in technologies for information transfer | |
| Life Sciences | Observe and record traits and behaviors of plants and animals in ecosystem |
| LS1: From molecules to organisms: Structures & processes | |
| LS2: Ecosystems: Interactions, energy, & dynamics | |
| LS2: Heredity: Inheritance & variation of traits | |
| LS4: Biological evolution: Unity & diversity | |
| Earth and Space Sciences | Observe weather and record temperature |
| ESS1: Earth's place in the universe | |
| ESS2: Earth's systems | |
| ESS3: Earth & human activity | |
| Engineering, Technology, & the Applications of Science | Use tools to observe and gather data on plants and animals |
| ETS1: Engineering design | |
| ETS2: Links among engineering, technology, science, & society | |

National Research Council. July 2011. A Framework for K-12 Science Standards: Practices, Crosscutting Concepts, and Core Ideas



Data Collection Form

Observer's Name _____

City/County/State _____

November 27

It's early. Like, birds-aren't-even-chirping-yet early.

But the way the grass crunches under my feet in this frost almost makes 7 a.m. bearable.

Using the GPS device to tell our group we're exactly 2,912 ft. above sea level definitely makes it worth it. We hike north with our instructor -

I announce our exact longitude and latitude - into deep forest. Signs are all around us. Signs, the instructor says, of cougars. We all laugh nervously.

Everyone works together.

We collect evidence - cougar evidence - that we'll use in our classroom labs over the next few weeks.

We're not only learning how cougars hunt and live and survive, but we're actually using math and science to figure it all out.

Best of all, my work could actually help make a difference for the cougars.