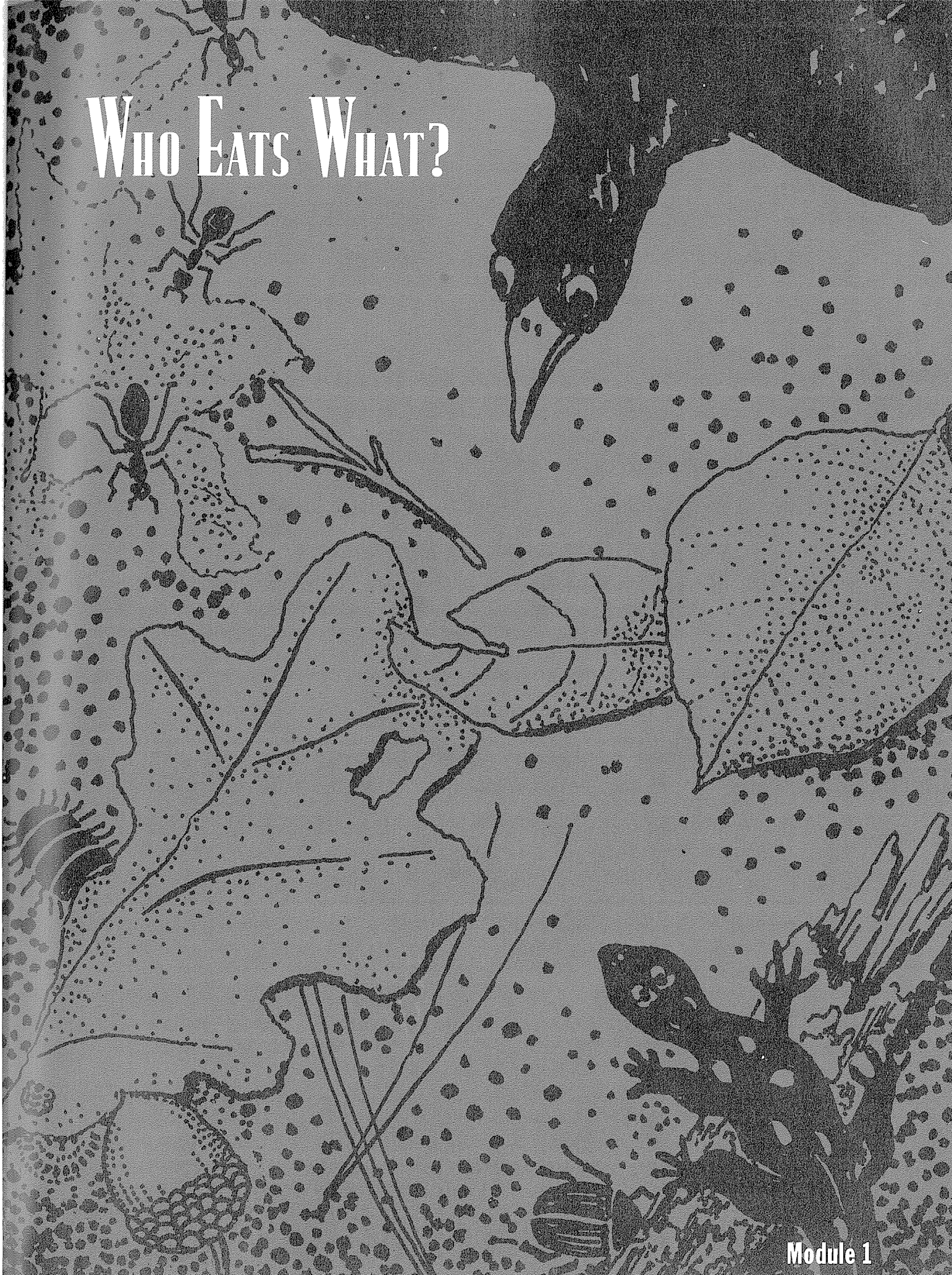


WHO EATS WHAT?



WHO EATS WHAT?



You are There

Imagine a full moon night in the desert, sunrise in a forest, or high noon in a field. You sit unnoticed, watching. Life pulses around you as animals forage for the food they need to survive.

We don't often witness feeding interactions in nature. They begin as sunlight strikes green leaves that convert solar energy to chemical energy, the sustenance of all life. An aphid sucks plant juices, a mouse nibbles grass seeds, a coyote kills a rabbit, a snake swallows a mouse. In each of these interchanges, nutrients and energy flow from one part of an ecosystem to another.

Humans are part of this interplay, also. Like all animals, we depend on the chemical energy that plants make during photosynthesis. Whether we eat fruit, vegetables, grains, dairy products, or meat, we consume energy whose source was sunlight.

Beyond our dietary link to other species through food chains, our daily actions also make us important players in how food relationships in ecosystems function. We have tremendous power to change landscapes or to introduce chemicals into food chains, which in turn affect animals and their food resources. As students get familiar with the ecological interactions within a local piece of land during this module, they become aware of the earth's life support system, and the impact they can have on it.

Overview of Students' Learning Experiences

Students' central challenge in this module is to determine the food web of a local site. They receive a request for this information from a school or community group, which establishes a real-world context for their studies. By investigating a familiar area, such as the schoolyard or a neighborhood park, students see their everyday environment as an ecosystem of which they are part.

As they tackle their challenge, students are at the center of their learning, solving problems, making decisions, and organizing their own work. After exploring outdoor study plots, students design investigations to answer their questions about animal feeding behaviors. Whereas in Modules 2 and 3 students learn and practice the disciplined procedures of controlled experiments, during this module they devise their own methods which may be more descriptive than experimental.

Once students find and interpret clues of feeding interactions, they are introduced to the language and frameworks ecologists use to organize this information. Fundamental ecological terms and concepts, such as *ecosystem*, *food chain*, *food web*, *food*, *nutrient*, and *energy*, take on meanings rooted in direct experience.

This module also develops students' communication and application skills through assessment activities. Students set up outdoor study stations to teach others about food web clues, and create an exhibition to share their findings. They also take on the role of professional ecologists by writing environmental impact statements to help people make land management decisions based on sound ecological knowledge.

Module 1 Overview Chart

WHO EATS WHAT?		
Mode	Lesson Title	Activities
<i>Activating Ideas</i>	1.1 A Research Request	Day 1: Students receive and discuss an invitation to investigate animals and their food resources on a local site. They talk about what they already know and how they could find out more.
<i>Investigating</i>	1.2 Preparing for Field Work	Days 2–3: Students become familiar with what animals and animal signs to look for outdoors, then practice field research skills and methods.
	1.3 Outdoor Research Excursion	Days 4–5: Students work in groups to investigate outdoor study plots for animals and clues to their food resources. The next day they process their findings.
	1.4 Feeding Habits Investigations	Days 6–10: Students hear a story about a scientist who studies animals and their food resources, then design and carry out indoor or outdoor studies to learn more about animals' feeding interactions.
	1.5 Outdoor Study Stations — Performance Assessment	Day 11: Students create stations at their outdoor site by making interpretive labels that teach others about signs of animals and what they eat.
<i>Processing for Understanding</i>	1.6 Making Food Chains	Days 12–13: Students make food chains for their study site organisms, and learn food chain terminology.
	1.7 Food for Thought	Days 14–15: Students sort items into food and non-food categories, then play a game to get enough food — nutrients and energy — to support six ecosystem organisms.
	1.8 Making Food Webs	Days 16–17: Students make food webs of their study site, propose an event that affects one population in the web, then trace how that change might affect other populations within the web.
<i>Applying and Assessing</i>	1.9 Environmental Impact Statements — Written Assessment	Day 18: Students judge a proposal for altering their study site by predicting how the change might affect the organisms that live there.
	1.10 Who Eats What Exhibition — Performance Assessment	Days 19–21: Students plan, prepare, and present an exhibition of their work to an audience.

Planning Ahead

CHOOSE A PROJECT FOCUS This module is designed to inspire and motivate students because it has relevance in the world beyond the classroom, and relies on them to become experts in ecology. Creating a real-world project requires finding a local community group or landowner who is genuinely interested in using information that students gather about the ecology of a local piece of land. This could be an environmental group, park commission, town committee, or the school board if you use the schoolyard as your study site.

Tell possible project sponsors that your goal is for students to learn how to study a piece of land to determine food web interactions. They might have additional goals, such as an inventory of the plants and animals on the site, that your students could help them fulfill. They might also be interested in making the project a long-term study of landscape changes by having new classes study the same site each school year.

In addition to inviting the project sponsor to present the study request in person (see Lesson 1.1), suggest that they write a letter to students. The letter could define the products that students produce during assessment activities described in Lessons 1.5, 1.9, and 1.10.

Dear Students,

The San Pedro Conservation Commission would like to know more about the property surrounding your schoolyard. We are particularly interested in what plants and animals are on the property, and how they interact. To help the school manage this property, we need to know what the animals living there eat, so that we can make sure their food sources don't disappear.

To increase people's enjoyment of the property, we would also appreciate it if you could create signs that point out animal signs and feeding interactions. Also, once you become experts about this piece of land, we'll ask your advice about any changes people want to make to it.

We hope that you will accept our request. Please let us know when you are ready to make a presentation of your findings.

Thank you, and good luck with the project!

Sincerely,



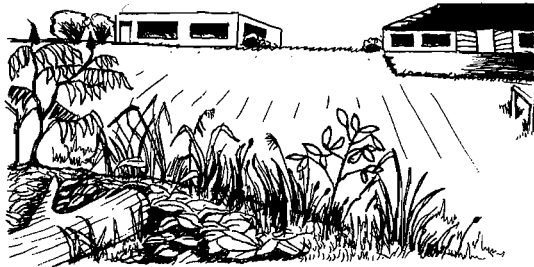
Michelle Rodriguez, Chairperson
San Pedro Conservation Commission

SCOPE OUT A STUDY SITE If at all possible, use your schoolyard as the study site. The advantages are:

- 1) it avoids the need for buses and long travel times;
- 2) it makes revisiting the site for follow-up observations feasible;
- 3) it helps students realize that nature is everywhere;
- 4) it helps students develop pride and stewardship for their everyday environment; and
- 5) it lets students focus on using new field research skills without being distracted by the need to get comfortable and familiar with a new environment.

After you read the criteria below, take a walk along the perimeter of your schoolyard to see if it's suitable. If it is not, visit other nearby sites to assess their conditions:

- ◆ **Natural Features.** Look for sites that have healthy plants, a layer of dead plant material on the ground, and non-compacted soil. These will be areas that are not constantly subjected to heavy disturbance by people, such as patches of unmown grass and weeds, a hedgerow of shrubs, a patch of undisturbed desert scrub, or a small patch of woods. If you teach in an urban setting, try to locate a small park within walking distance to use as your study site. Where there is a thriving plant community there will be animals seeking food, moisture, and cover. Sites where leaf litter, branches, and logs cover the ground will have microhabitats and food sources for small organisms that are the easiest animals for students to find and observe.



In general, the more mature the plant community you choose (i.e., the longer it's been left undisturbed), the more likely it will have an abundance of life forms to discover. Alternatively, choosing an area where there are small patches of different types of vegetation (e.g., weeds, shrubs, trees) will also provide enough variety to make your study interesting. Remember that your students will find twice as much as you do! For more specific information on possible study site habitats see the *Who Eats What* guide in the Appendix.

- ◆ **Size.** Select a site that:
 - 1) can comfortably accommodate your class;
 - 2) allows each group of 3–4 students to make a circular study plot with a 5-meter diameter (a technique for making circular plots is described in Lesson 1.2);
 - 3) has clear landmarks you can use to establish definite boundaries; and
 - 4) allows you to keep the entire group in sight.

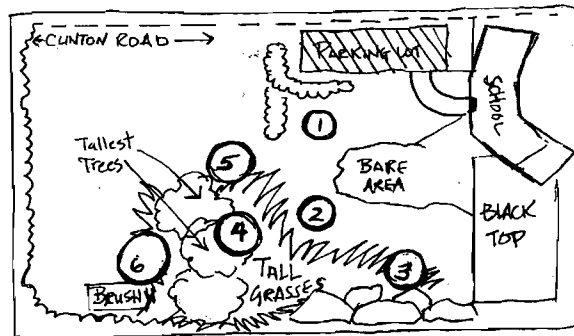
The exact size of the entire site and group plots can be flexible depending on the features of the area. If you choose a site that has small patches or rows of vegetation, such as along the perimeter of your playground, then the size and shape of each group's study area might be rectangular instead of circular. During your preliminary visit, decide where you will locate each student group so that you won't have to make those decisions with a class of energetic researchers at your side. If possible, mark each plot location (e.g., the center point of each circular plot) with flagging tape or ribbon.

- ◆ **Safety.** Avoid sites such as garbage-strewn vacant lots that have broken glass and other potentially hazardous refuse. If you'll be working on your schoolyard, try to enlist the help of the maintenance crew in picking up broken glass, nails, and other hazardous materials that might be in the far reaches of the property. If the site you choose has a pond or stream nearby, and especially if these aquatic environments have steep, sloping banks, either make sure you can enforce these areas as off-limits, or establish safety procedures for working near them.

Become familiar with drawings and information about poisonous plants and animals in your region. If you live in an area where ticks and Lyme disease are prevalent, familiarize yourself with precautions students can take to prevent tick bites and make sure parents know what actions to take if a tick is found on a child.

BRING BACK ARTIFACTS AND A MAP When scoping out the site, gather materials that will give students a preview of the area. You might want to take photographs or collect some natural artifacts, such as a pine cone, a leaf, fallen twigs, or a soil sample.

Also, you might want to make an outline of the study site to transfer to larger paper once back in the classroom. (In an optional activity, students add their plot maps to your master map in Lesson 1.3.) Orient a sheet of paper to the north and along its edges draw the landmarks (e.g., road, path, parking lot, tall tree, stream, school building) that designate the site boundaries. Next draw circles to indicate the study plots in their approximate relative locations. Finally, sketch and label any notable features, such as grassy or bare spots, large trees or rocks, brushy areas, fallen trees, or ditches.



MAKE ARRANGEMENTS WITH THE LANDOWNER If you are using land not owned by the school district, you might need to get permission to go off paths, turn over rocks and logs, dig in the soil, and collect leaf litter and organisms for classroom study.

If your site is a park or nature area, ask for guidance from park officials on how and what to collect to minimize impact. Take full advantage of the expertise of rangers or park naturalists in helping plan your trip. They might be able to co-lead or supplement the excursion, visit your class beforehand, or provide brochures to give students a preview of the site.

GET FAMILIAR WITH THE *WHO EATS WHAT* GUIDE The information in this guide (see the Appendix) will give you a good overview of different habitats and what you can expect to see in each, as well as specific information on animal signs and what different animals eat.

GATHER MATERIALS A list of materials used in this module is provided in the Appendix. The materials for Lesson 1.4 vary depending on which feeding habits investigations your students do. You might want to read over that lesson to anticipate what materials you'll need. If you decide to order live animals such as earthworms for the investigations, instead of using local organisms, order them in advance so they'll be there when you need them.

COLLECT RESOURCE BOOKS Enlist the help of your librarian in gathering books for a reference corner in your classroom or a reserve shelf in the library. Three types of books will be useful to have on hand throughout the module: 1) stories that describe common plants and animals; 2) science books written as succinct references; and 3) field guides to local plants and animals. See the following resource list for suggested titles. A list of organisms common in your region of the country would also be especially useful.

RESOURCE LIST

For Teachers

REFERENCES AND BACKGROUND READING

Animals in the Classroom

by D. Kramer (Addison-Wesley, 1989)

An indispensable reference on caring for critters in the classroom. Includes background information and detailed instructions on collecting, housing, and feeding over thirty organisms.

A Field Guide to Your Own Back Yard

by J. Mitchell (Norton, 1985)

- Arranged by seasons, this book helps the reader become familiar with the many plants and animals found in a suburban backyard habitat.

The Power Plant: Teacher's Guide to Photosynthesis

by K. Roth and C. Anderson (Michigan State University, 1987) [Order Occasional Paper 112, Michigan State University, 252 Erickson Hall, East Lansing, Michigan 48824, \$11.50]

An excellent collection of activities, readings, and worksheets that help students confront and change their misunderstandings about how plants get food.

The Urban Naturalist

by S. Garber (Wiley, 1987)

Each chapter features a different organism in this introduction to the wealth of animals and plants beyond urban doorsteps. Tells how to find wild creatures in the city, and includes fascinating facts about how they make a living.

The View from the Oak: The Private Worlds of Other Creatures

by H. and J. Kohl (Sierra Club, 1977)

Encourages observation and discovery of how environments are influenced by different animals. Portrays the human view as only one of many, and entices the reader to move away from familiar worlds in order to understand the experience of other animals. Lengthy, but thoughtful and interesting.

Wild Green Things in the City

by A. Dowden (Crowell, 1972)

This illustrated guide provides a multitude of natural history facts about weeds and wild plants found in the urban environment. Includes plant species lists for New York, Denver, and Los Angeles.

FIELD GUIDES

American Wildlife and Plants: A Guide to Wildlife Food Habits

by A. Martin, H. Zim and A. Nelson
(Dover, 1989)

What's in a bluebird's stomach? This book will tell you the answer, plus the food habits of over 300 other common species of American birds, mammals, reptiles, and amphibians. Entries for each animal include range maps, habitat descriptions, and foods (including percentages of different plants comprising the animal's diet).

The Audubon Society Field Guides

North American Insects and Spiders

by L. and M. Milne (Knopf, 1980)

Reptiles and Amphibians

by J. Behler (Knopf, 1979)

Birds of the Eastern U.S.

by J. Bull and J. Farrand, Jr. (Knopf, 1977)

Birds of the Western U.S.

by M. Udvardy (Knopf, 1977)

Mammals

by J. Whitaker (Knopf, 1980)

Easy-to-use guides with color photos of hundreds of species, referenced to family and species descriptions, habitat, range, food, and life cycle.

The Audubon Society Nature Guides

Deserts

by J. McMahon (Knopf, 1992)

Eastern Forests

by A. and M. Sutton (Knopf, 1993)

Grasslands

by L. Brown (Knopf, 1989)

Western Forests

by S. Whitney (Knopf, 1986)

Comprehensive guides that describe trees, shrubs, wildflowers, birds, mammals, insects, reptiles, and amphibians found in each habitat. Include color photographs of each animal species, plus a range map, description, typical sounds, habitat, range, and a few interesting facts.

The Field Guide to Wildlife Habitats of the Eastern United States

by J. Benyus (Fireside/Simon & Schuster, 1989)

The Field Guide to Wildlife Habitats of the Western United States

by J. Benyus (Fireside/Simon & Schuster, 1989)

A detailed look at twenty eastern or western U.S. habitats including nine different forest types. Each habitat section contains a list of typical plant species, a wildlife locator chart, and detailed natural histories of three organisms commonly found there.

A Guide to Animal Tracking and Behavior

by D. Stokes (Little, Brown, 1986)

Life-size illustrations of tracks and scats, plus over 200 drawings of animal signs provide references for becoming a wildlife tracker. Also includes chapters on individual animals with information on locomotion, food and feeding habits, family life, habitat, range, and typical signs.

For Students ■■■■■■■■■■■■■■■■■■

SCIENCE BOOKS

Beastly Neighbors: All About Wild Things in the City, or Why Earwigs Make Good Mothers

by M. Rights (Little, Brown, 1981)

Readers take a journey from a supermarket to a wastewater treatment plant, and make an expedition to an old board along the way. This book makes it clear that kids can study nature wherever they are, and includes many enticing and unusual activity ideas.

Being a Plant

by L. Pringle (Crowell, 1983)

Portrays the interrelationships among flowers, birds, insects, and other animals. Includes clear illustrations of plant structure, reproduction, and adaptation.

The City Kid's Field Guide

by E. Herberman (*Simon & Schuster, 1989*)

Based on the Nova television series, this book features color photographs that inspire kids to understand that cities are crammed with wildlife, and offers tips for finding and observing animals in the city.

Ecosystems and Food Chains

by F. Sabin (*Troll, 1985*)

A brief and simple book that explains the interdependence of plants, animals, and their environment. It emphasizes the effects of human actions on ecosystems.

Keeping Minibeasts

by B. Watts (*Franklin Watts, 1991*)

Uses close-up color photographs and very simple text to show how to find, house, feed, care for, and observe small creatures that are found in gardens, parks, and open spaces.

Looking at Insects

by D. Suzuki (*Warner, 1986*)

Sharing his fascination with the strange world of insects, the author includes illustrated chapters on common orders of insects and spiders, as well as easy activities and experiments.

Nature Detective: How to Solve Outdoor Mysteries

by E. Docekal (*Sterling, 1989*)

For kids who want to figure out what is living, eating, and sleeping right in their everyday environment. Provides sixteen "cases" and over 200 illustrated "clues" to nature mysteries that take young detectives from fields, to forests, ponds, and even into outer space.

A Night and Day in the Desert

by J. Dewey (*Little, Brown, 1991*)

Vivid images of many desert life forms, interactions, and cycles are presented through rich illustrations and clear descriptions of a flurry of daily and nightly activities.

One Small Square Backyard

by D. Silver (*W.H. Freeman, 1993*)

Highlights the exciting discoveries that are possible to make in plant and animal communities contained in a square foot of backyard. Includes a multitude of detailed illustrations and activities, and an in-depth look at life in the soil.

Secrets in the Meadow

by L. Hess (*Scribner's, 1986*)

Riveting black and white photographs come together with text to capture the fascinating story of the interdependent inhabitants of the meadow.

24 Hours in a Forest

by B. Watts (*Franklin Watts, 1990*)

An outstanding photographic study with informative text that reveals the changes that take place, from the microscopic to the largest life forms in a forest habitat.

Urban Roosts

by B. Bash (*Little, Brown, 1990*)

Examines the inventive places that pigeons, barn owls, nighthawks, and peregrine falcons make their homes in the heart of the city. Useful to encourage observation of wildlife in odd places such as traffic lights, tile roofs, and train trestles.

Wonders of the Desert

by L. Sabin (*Troll, 1982*)

Although written for the lower elementary level, this colorfully illustrated book is a good resource for learning about many of the animals of the American deserts, and their special adaptations to their habitat.

FIELD GUIDES

Animal Tracks

by G. Mason (*Linnet, 1988*)

A simple, well-organized tracking guide that provides an introduction to animals—their families, habitats, behaviors, and foods. Short, anecdotal descriptions of common North American animals accompany illustrations of animals and their footprints. Emphasizes the location of tracks as a clue to identifying animals.

The Audubon Society Pocket Guides

Familiar Insects and Spiders of North America

edited by J. Farrand, Jr. (*Knopf, 1988*)

Familiar Mammals of North America

edited by J. Farrand, Jr. (*Knopf, 1988*)

Familiar Birds of North America - Eastern

edited by A. Whitman (*Knopf, 1986*)

Familiar Birds of North America - Western

edited by A. Whitman (*Knopf, 1986*)

These compact guides are illustrated with color plates, and contain information on each of the familiar organisms, such as identification tips, habitat, range, and life cycle.

Crinkleroot's Guide to Knowing the Trees

by J. Arnosky (*Bradbury, 1992*)

On a walk through his forest, Crinkleroot introduces broadleaf and evergreen trees. Includes a three-page field guide to identifying trees by their leaves.

No Bones: A Key to Bugs and Slugs, Worms and Ticks, Spiders and Centipedes and Other Creepy Crawlies

by E. Shepherd (*Macmillan, 1988*)

A simple key leads to short, fascinating, and simply-written chapters on soil invertebrates. Also includes chapters on various flying and non-flying insects, and a comprehensive chapter on spiders with drawings of their different webs.

STORIES

All Upon a Sidewalk

by J. George (*Dutton, 1974*)

This book presents an ant's eye view of ecology. The story of *Lasius flavus*, a yellow ant who has an important mission to perform for her queen. We follow her adventures as she searches the sidewalk for the "wondrous treasure."

The Cactus Hotel

by B. Guiberson (*Holt, 1991*)

This story dramatizes the life cycle of the saguaro cactus and its role as a haven for desert animals. Also highlights the beneficial interactions between plants and animals, such as a pack rat drinking water dripping off of a tree, while birds, bees, and bats drink nectar from the cactus flower.

The Day They Parachuted Cats on Borneo: A Drama of Ecology

by C. Pomerantz (*Young Scott Books/Addison-Wesley, 1971*)

Based on a true story of how Borneo was affected when sprayed with DDT to wipe out mosquito populations. This book explores the ecological reverberations for the entire food web, from cockroaches, rats, cats, and geckos, to the river and the farmer. The powerful, humorous text is recommended for reading aloud or performing as a play.

The Empty Lot

by D. Fife (*Sierra Club/Little, Brown, 1991*)

Is a vacant lot truly vacant? Vacant lot owner, Harry Hale wants to sell his lot, but when he takes a last look he is astonished to find that the lot is far from empty. From birds and their nests to frogs and dragonflies, the lot is full of living things in a variety of different habitats. He changes his "FOR SALE" sign to read "OCCUPIED LOT— EVERY SQUARE INCH IN USE."

Forest Log

by J. Newton (*Crowell, 1980*)

Beautifully illustrated in black and white, this story reveals the ecological interactions that occur when a huge Douglas fir tree falls. Although written for the lower elementary level, teachers in the Pacific Northwest might find it useful for older students as an introduction to the flora and fauna of that region.

Incident at Hawk's Hill

by A. Eckert (*Little, Brown, 1971*)

A gripping novel based on the true story of Ben, a young boy on the prairie who has a special gift for understanding animal behavior. An amazing relationship begins when Ben, lost in a prairie rainstorm, is taken in by a female badger who cares for him for over two months. The novel portrays prairie badger ecology, and is good for reading aloud.

Nicky the Nature Detective

by U. Svedberg (*R&S Books/Farrar, Straus & Giroux, 1988*)

Exploring changes in nature is Nicky's specialty, and her discoveries allow the reader to join her in carefully examining the structure of a nesting place, the tracks left in the snow, and a zillion other fascinating creatures and plants.

The Old Ladies Who Liked Cats

by C. Greene (*HarperCollins, 1991*)

What happened when the old ladies stopped letting their cats out at night? Based on Charles Darwin's story about clover and cats, this ecological tale highlights island ecology, particularly the interrelationships of plants and animals.

One Day in the Prairie

by J. George (*Crowell, 1986*)

Spend an interesting day on the prairie observing nature through the eyes of a boy, a buffalo, and a prairie dog. The book is full of the interactions of over thirty-five animals, and also conveys how the prairie

has changed and why. Other books in this series include *One Day in the Desert* and *One Day in the Woods*.

The Roadside

by D. Bellamy (*Clarkson N. Potter/Crown, 1988*)

A meticulously illustrated story about the construction of a six-lane highway in a wilderness area, and how this temporary devastation forces the resident animals into a struggle for existence. Although set in the English countryside, the general events are similar to those in the United States.

Secret Neighbors—Wildlife in a City Lot

by M. Adrian (*Hastings House, 1972*)

A dramatic story about the lives of urban animals. Chapters describe groups of animals that survive in old tires, under rocks, in garbage cans, and in alleys as the seasons and the lot change.

The Song in the Walnut Grove

by D. Kherdian (*Knopf, 1982*)

When a curious cricket meets up with a grasshopper, they learn about each other's day and nighttime habits in an herb garden. They come to appreciate their differences when the cricket saves the grasshopper's life. Combines accurate information on insect behavior with descriptions of how insects affect the ecology of Walnut Grove.

Wolf Island

by C. Godkin (*W.H. Freeman, 1989*)

Simple, direct language and vivid full-color drawings transport the reader to a beautiful island. The story traces how changes in the size of a wolf population affect the island's entire food web.