Wildlife Ecology

An Environmental Study Unit For 5th – 8th Graders

MUHLENBERG
COLLEGE

Environmental Education Outreach
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Wildlife Ecology Unit at a Glance

Overview:

This unit is about wildlife ecology, and the ways people use information gathered by wildlife ecologists. Students will learn why wildlife ecology is important and how data gathered by ecologists is used to understand and make decisions about the environment. They will develop research skills in a real-life context by going "out into the field" and making first-hand observations of wildlife habitat. They will use the information they have gathered in problem-solving activities.

At the beginning of the unit, students will be introduced to the forest community of the field trip location and will develop the background knowledge and skills necessary to carry out a field study at the site.

During the field trip, students will observe and record wildlife data. They will then analyze their data, making inferences about biodiversity found in the community under study.

Upon returning to school, students will learn about the role of food webs in wildlife ecology. They will make a presentation of a food web created from the data they gathered on the field trip.

At the end of the unit, students will explore how people can use information gathered through research and field study to address the impacts of human activity on a natural community. They will be presented with an action scenario involving the community they have studied, and will make inferences, based on their research, regarding the environmental impact of the proposed action.

Overall Goal:

A study of a local ecosystem will become the focal point for students to develop skills in investigation and presentation of information. These skills include making and recording observations in a systematic manner, and presenting information in a variety of ways including verbally, visually and through writing.

Specific Objectives:

- Students will define what ecologists do and why it is useful and important.

- Students will learn to make and record field observations of an ecosystem. They will present these observations in the form of a field study report, which will include written, verbal and visual depiction of their findings.

- Prior to the field study, students will learn various skills needed for the task. These include the ability to:
  - Recognize and identify plants found at the study site.
  - Recognize and identify signs of animal activity.
  - Depict information through a combination of writing and graphics.
  - Differentiate between an observation and an inference.

- Use information about the plants and animals present at the field study site to construct a forest community food web.

- Make inferences about what might happen to all populations of organisms living in a natural community if there

were changes to the population's numbers for one of the organisms.

- Students will use their understanding of the community food web to come up with a written answer to a problem involving the impacts of alterations to that ecosystem and the populations of plants and animals inhabiting it.

Lessons:

1. The Field Study Challenge - 50 minutes

a) Define *Ecology* and *Ecologist.*
b) Discuss the work of a wildlife ecologist.
c) Take a look at pictures of Graver Arboretum and make a list of what the class already knows about the site.
d) Discuss why studying wildlife interactions might be important.

2. Field Study Techniques - 50 minutes

a) Brainstorm observing skills and record them in journals.
b) Review format for recording observations.
c) Take a look at pictures of animal signs from the study site. Match animal signs to location, adaptation and behavior.
d) Discuss and demonstrate safe collecting and observing.
e) Practice making and recording observations using a natural object supplied by the teacher.
f) Discuss the difference between observations and inferences.

3. Field Trip to an Outdoor Study Site - 150 minutes

a) Review the purpose of the field trip, safety considerations, and general field study guidelines.
b) Go over collecting equipment and how to use it.
c) Show each group to its study plot location.
d) Instructor facilitated gathering of information.
e) Groups gather together and debrief.
f) Groups pool information.
g) Analyze the results.
h) Create a concept map of the study site ecosystem, (Optional in-class follow up activity).

4. Food Webs and Interdependence - 100 minutes

a) Review food chain and contrast it with a food web. Explain the importance of a food web.
b) Have student groups make food webs using field study observations.
c) Groups present their food webs to the whole class.
d) Introduce the concept of interdependence using examples and stories.
e) Students work with their groups to write "What If . . ." questions about their food webs.
f) Wrap up discussion of relevance of food webs.

5. **Writing an Environmental Impact Statement - 65 minutes**
   a) Discuss environmental change and environmental impact.
   b) Introduce the concept of an environmental impact statement.
   c) Introduce the environmental impact statement task.
   d) Students brainstorm in pairs to begin formulating ideas.
   e) Students write impact statement, following rubric.

Unit Assessment:

- Quizzes
- Field Journals
- Data Presentations
- Environmental Impact Essay

State Standards for ENVIRONMENT AND ECOLOGY Covered by the Unit:

Renewable and non-renewable resources - 4.2.7

- Explain how plants and animals may be classified as natural resources.
  - People study the ecological relationships among plants and animals because they are interested in managing them as resources.
  - People are affected in many ways by what happens to wildlife populations. Examples include hunters interested in game species, farmers and foresters interested in weed species and economically valuable species, public health officials interested in disease carrying species, and those who recreate with nature interested in animals and plants with which they enjoy interacting.

Environmental Health - 4.3.7

- Explain the complex, interactive relationships among members of an ecosystem.
  - A community is made up of all the populations of different species that live in the same place at the same time. A community is a subset of an ecosystem.
  - Community field study focuses on the lifecycles and interactions of the populations of living things within the ecosystem.

Integrated Pest Management - 4.5.7

- Identify different examples of pests and explain the beneficial or harmful effects of each.
  - Pest species may help some members of a food web by providing them with their habitat needs, or they may hinder the survival of other members of a food web by competing with them for food, or replacing their food source.

- Identify several locations where pests can be found and compare the effects the pests have on each location.
  - Predict the effects that pest species might have on the forest community food web identified at the field study site.

Ecosystems and Their Interactions – 4.6.7

- Explain the flows of energy and matter from organism to organism within an ecosystem.
  - Identify and explain the characteristics of biotic and abiotic.
  - Describe and explain the adaptations of plants and animals to their environment.
  - Explain energy flow through a food web.
  - Explain the importance of the predator/prey relationship and how it maintains the balances within ecosystems.
  - Identify the relationship of biotic and abiotic components and explain their interaction in an ecosystem.
  - Explain a change in an ecosystem that relates to humans.

- Explain a change in an ecosystem that relates to humans.

Threatened, Endangered and Extinct Species - 4.7.7

- Select an ecosystem and describe different plants and animals that live there.
  - Identify and record animal signs such as feeding, locomotion, calls and homes.

- Explain how one species may survive an environmental change while another may not.

- Explain natural or human actions in relation to the loss of species.

Humans and Environment - 4.8.7

- Explain how people use natural resources.

- Explain how human activities may affect local environments.

- Explain the importance of maintaining natural resources at the local level.

State Standards for SCIENCE AND TECHNOLOGY Covered by the Unit:

Technological Devices and Computers - 3.6.7

- Apply knowledge of different measurement systems to measure and record objects' properties.

Lesson 1 - The Field Study Challenge

Author: Laurie Rosenberg, Muhlenberg College
Grade Level: 5-8
Lesson Time: 50 minutes
Suggested Class Structure: Guided discussion with the whole class.
Subject Areas: Science

BACKGROUND

This is the first lesson in a unit designed to get students to think and organize information like **ecologists**. Ecologists are scientists who study the interactions among living things and their environment. Ecologists study both the living, (**biotic**), and non-living, (**abiotic**) parts of the environment. The abiotic components of the environment includes light, moisture, temperature, soil mineral components, water flow, weather patterns, the lay of the land, and manmade structures such as roads and buildings.

Since ecologists study the whole environment, they are often asked to give advice about how to protect it, or to predict how certain actions will affect it. In order to give such advice, ecologists must develop a knowledge base about the environment in question. They will gather data about all of the environmental components, both biotic and abiotic.

In this unit, students will take on the role of wildlife ecologists. Specifically, they will study and gather information about the wildlife found in a natural area at Graver Arboretum. They will gather information about the interactions between animals and plants, and between various animals.

GOAL

Students will be introduced to the field study topic and discuss why it is important. They will make inferences about biotic and abiotic components of the ecosystem to be studied at Graver.

VOCABULARY

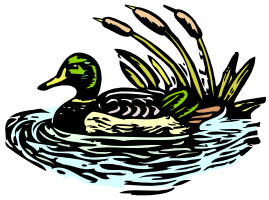
Abiotic – Referring to nonliving things in the environment, including soil, water, temperature, air, light, wind, and minerals.

Biotic – Referring to living things in the environment. This includes all forms of life, including plants, animals, fungus, bacteria, and other one-celled organisms.

Ecologist – Someone who studies the relationships between living things and their environments.

MATERIALS

--- Flip chart or poster board for recording KWL
--- Student journals – composition books or hand made writing booklets for each student. *(Copy masters for journals are in the Unit Appendix, beginning on page 53.)*
--- Downloaded PowerPoint pictures from Graver Web site, or borrowed slides from the college, (see page 9 for examples). An alternative copy master for an overhead transparency is located on page 12.



ADVANCE PREPARATION

- ✓ Purchase or make student journals. One of the easiest ways to provide field journals is to purchase small composition booklets for each student. Students or teachers can also assemble journals from office or lined paper with cardstock covers. *(Copy masters for journals are in the Unit Appendix, beginning on page 53.)*
- ✓ Arrange for AV equipment, (either computer and projector for PowerPoint, or slide projector for slides.)
- ✓ Download Graver PowerPoint from Web site or check out Graver slides from Muhlenberg.
- ✓ Gather flip charts and markers.

OBJECTIVES

The students shall:

1. Define what ecologists do and why it is useful and important.
2. Brainstorm what they already know about the topic, and develop a list of things they want to know/learn during the unit.

PROCEDURES – Outline and Narrative

1. Define *Ecology* and *Ecologist* - 10 min.

a) For this science unit, we will be studying ecology. Does anyone have ideas about what ecology is? Let's develop a definition.

b) Have student discuss this and/or brainstorm what they know about ecology. From the brainstormed list, develop a definition of the words ecology and ecologist. Make sure the definition of ecology includes reference to the interrelationships between the living and non-living parts of the environment. Students should write the definition in their journals.

c) Introduce the terms "biotic" and "abiotic" and tell the students you will be using those terms in further class work related to ecology. Students should write the definitions in their journals.

2. Explain the Work of a Wildlife Ecologist - 10 min.

a) We are going to be doing the work of ecologists, people who study ecology. The particular area of ecology we are going to focus on is the relationships among various types of wildlife found in our study site. For example: some animals eat other animals, some animals eat plants; this is an example of a feeding relationship. Can you think of other examples of how wildlife is related to or dependent on other wildlife in an ecosystem? Remember, plants and even tiny organisms are included in the term "wildlife."

b) Let's also think of some examples of how wildlife relates to the non-living part of the environment. Wildlife ecologists also study these relationships.

As we progress through this lesson, we will begin to think about how we can gather information about the relationships involving wildlife of our field study site.

3. **Take a Look at Pictures of Graver Arboretum and Make a List of What the Class Already Knows About the Site - 20 min.**

a) Let's take a look at some of the natural areas at Graver and see what we might already know about the area.

Note: There is a copy master for one picture of Graver in the Appendix for this lesson, on page 12. You may use this to create an overhead transparency. Another option is to use the PowerPoint slides available from Muhlenberg. (The PowerPoint may be downloaded from Muhlenberg's Web site or you may borrow a CD version from the college.) For your information, copies of those PowerPoint pictures are included on page 9 of this lesson.

Show the class the pictures and have them discuss what they might already know about the site by looking at the pictures. Have them record these observations in their journals. If possible, categorize the observations under "biotic" and "abiotic" features.

b) Pose the question of what wildlife the class might expect to find in the study site based on looking at the pictures. Make of list of these also.

c) Discuss where the students got these ideas, (books, TV, personal experience, etc.) Discuss the accuracy of these sources.

d) Make a list of questions or things the class wants to find out about the study site.

4. **Discuss Why Studying Wildlife Interactions Might Be Important - 10 min.**

a) Pose this question to the class—"Why is it important to know about wildlife ecology? Some examples might be for issues related to hunting, (becoming a better hunter, or making laws about hunting), to protect wildlife species, and to help people be good land stewards.

ASSESSMENT

- Quiz (See copy masters in the Lesson 1 Appendix, pp. 13-14).

RESOURCES

Books for the teacher:

Alden, P., et. al. 1999. *National Audubon Society Field Guide to the Mid-Atlantic States.* New York: Alfred A. Knopf.

Benyus, J. 1989 *The Field Guide to Wildlife Habitats of the Eastern United States*. New York: Fireside/Simon & Schuster.

Hogan, K. 1994. *Eco-Inquiry*. Dubuque, Iowa: Kendall/Hunt Publishing Company.

Kricher, J. and Morrison, G. 1988. *Eastern Forests*. New York: Houghton Mifflin Company.

Web sites: Since the Web is constantly changing, check Muhlenberg's Outreach Web site for updated listings. **http://www.muhlenberg.edu/cultural/graver/**

Web sites for the teacher:

U.S. Fish and Wildlife Service – *Ecosystem Conservation* **- http://ecosystems.fws.gov/**
This Web site gives an overview of how the FWS takes an ecosystem approach to managing wildlife.

Ecological Society of America – *Report on the Scientific Basis of Ecosystem Management* - **http://esa.sdsc.edu/ecmtext.htm**
This lengthy report from a professional group for ecologists provides detailed background on using ecology as a tool to make decisions about managing resources.

Green Teacher Magazine – *Planet Earth Pages: The Outdoor Classroom* - **http://www.greenteacher.com//articles/50planet.html** This website contains several ecology-related activities for various age groups. Back issues of *Green Teacher* can be obtained through www.greenteacher.com, e-mail: greentea@web.net, Phone: (416) 960-1244, Fax: (416) 925-3474, or by writing to *Green Teacher* at P.O. Box 1431, Lewiston, NY 14092.

U.S. EPA – *Mid-Atlantic Region Integrated Assessment* – **http://www.epa.gov/maia/index.html**
The Mid-Atlantic Integrated Assessment is a research, monitoring and assessment initiative. Its goal is to develop high-quality scientific information on the condition of the natural resources of the Mid-Atlantic region of the U.S., including the watersheds of the Delaware Bay.

The Pennsylvania Cooperative Fish and Wildlife Research Unit - http://pacfwru.cas.psu.edu/
This organization is a cooperative of various state and federal wildlife organizations, including the Pa. Game Commission, Fish and Boat Commission, and Penn State University. Part of their mission is to conduct research on wildlife species and publicize the findings.

Web sites for the students:

Environmental Protection Agency Student Center - http://www.epa.gov/students/ This website provides information on a variety of environmental topics.

PA ACADEMIC STANDARDS FOR ENVIRONMENT AND ECOLOGY COVERED BY THE LESSON

Know What Natural Resources Are - 4.2.7 A
- Explain how plants and animals may be classified as natural resources.

Ecosystems and Their Interactions - 4.6.7
- Explain the flows of energy and matter from organism to organism within an ecosystem.
- Identify and explain the characteristics of biotic and abiotic.
  - Demonstrate the dependency of living components in the ecosystem on the nonliving components.
  - Identify the relationship of abiotic and biotic components and explain their interaction in an ecosystem.

Slide 1
Second Pond

Slide 2
Trail Fork

Slide 3
Twin Pond

Slide 4
Wood's Edge

Lesson 1 Answer Key
The Field Study Challenge

1. c.

2. d.

3. A: water, air, & rocks

B: birds, trees, & small plants

4. (answers will vary)

5. d

6. (answers will vary)

7. (answers will vary based on ecosystem studied)

8. a

Lesson 1 – Appendix
The Field Study Challenge

Copy Masters for:

Picture of Graver Arboretum
Lesson 1 Quiz

Study Tables Located at Edge of Woods – Graver Arboretum

Lesson One Quiz: The Field Study Challenge

Name_____ Grade Level_____

Date_____ School_____

1. **Ecology is the study of:**
   a. Interactions between different organisms
   b. Interactions between organisms and their environment
   c. Both (a) and (b)
   d. None of the above

2. **An ecologist would most likely be found studying which one of the following?**
   a. How the human body fights disease
   b. How mice break open seeds with their teeth
   c. How cells divide
   d. How the number of mice in a field is related to the amount of seeds available for them to eat.

3. Put an "**A**" next to those things listed below from this picture that are **abiotic** and a "**B**" next to those that are **biotic**.

Birds _____ Water_____ Air_____

Trees_____ Small plants_____ Rocks_____

4. **Write a description of an interaction between two biotic things.**
   (Example: A caterpillar eats part of an oak leaf.)

5. **The work ecologists do is useful and important because:**

   a. Their studies help us to better understand the world around us
   b. The interactions they study help us to discover and sometimes solve environmental problems
   c. The interactions between living things and their environments can have powerful effects on people's lives
   d. All of the above

6. **List 3 biotic and 3 abiotic things from the ecosystem that you are studying:**

   Abiotic: Biotic:

   _____ _____

   _____ _____

   _____ _____

7. **Write a description of an interaction between on of the biotic and one of the abiotic things that you listed above.** (Example: Trees need sunlight to grow. Trees are biotic; sunlight is abiotic.)

8. **Which one of these is <u>not</u> an example of an interaction involving a predator and its prey?**

   a. A bird building a nest in a tree
   b. A raccoon chasing a crayfish along a stream bank
   c. A mole digging for grubs
   d. A fox trying to open the shell of a box turtle

Lesson 2 – Field Study Techniques

Author: Laurie Rosenberg, Muhlenberg College
Grade Level: 5-8
Lesson Time: 50 minutes + 15 min. optional extension
Suggested Class Structure: whole class and small collaborative group work
Subject Areas: Science, Language Arts

BACKGROUND

A community is made up of all the populations of different species that live in the same place at the same time. A community is a subset of an ecosystem. Our community field study of Graver will focus on the interactions between the populations of living things within in a forest community.

Scientists use the term **organism** to refer to an individual living thing. Students most often think of mammals and other **vertebrates** when they think of living things, but plants and all creatures big and small make up a natural community. This includes **invertebrates** such as insects, snails, spiders, worms, millipedes and even microscopic bacteria.

When studying organisms living and interacting in a community, it is not always easy to see them directly. Students will have to collect evidence that they are there. Finding animal signs takes careful **observation** and patience. As scientists make observations, they get ideas and think of questions about what something is, how it lives, what it is related to, how it survives, etc. The evidence scientists gather through observation helps them answer the questions and see if there is any support for their ideas.

An idea that is generated by looking at evidence can be called an **inference**. Scientists make inferences by looking at information gathered about the subject they are studying. The more evidence that supports their inference, the more likely it is to be accurate. Respected scientists gather a great deal of evidence and study a subject in detail over a long period of time before drawing a conclusion.

GOAL

Students will learn observation and field note taking skills, including recognizing animal signs and recording observations in a field journal.

OBJECTIVES

The students shall:

1. Recognize various animal signs that may be found in an outdoor study site.
2. Make inferences about animals' adaptations and relationships in a natural community based on observations of the animals' location, behavior and appearance.
3. Describe procedures for safely observing and collecting wildlife and plants. This includes safety to the humans doing the observing, and the wildlife being observed.
4. Make and record observation notes in a field journal according to the prescribed format.
5. Differentiate between an observation and an inference.

VOCABULARY

Inference – An idea that is generated by looking at evidence.

Invertebrates – Animals without backbones. Examples include insects, worms, spiders, crayfish, centipedes, millipedes, and sowbugs.

Observation – Information about one's environment gathered using the five senses.

Organism – A living thing. This term refers to all animals, plants, algae, bacteria, fungus and one-celled creatures.

Vertebrates – Animals with backbones. Examples include mammals, reptiles and amphibians, fish and birds.

MATERIALS

--- Pictures of animal signs
--- Journals for each student
--- Hand lenses for students, either one for each student or one for each small group
--- Clear plastic cups/baby food jars or other small containers such as bug boxes, etc.
--- Natural objects for student groups to observe

ADVANCE PREPARATION

✓ Find and gather a natural object for each student group to observe.
✓ Get animal signs pictures from Muhlenberg. The pictures can either be downloaded as a PowerPoint file from the Muhlenberg Web site, (www.muhlenberg.edu/cultural/graver/), or teachers can borrow slide or CD versions of the pictures from the college.

PROCEDURES - Outline and Narrative

1. Brainstorm observing skills and record them in the journals - 10 min.

(*Copy masters for student journals are in the Unit Appendix, beginning on p.53.*)

a) In order to prepare for going out in the field and doing a field study, today's lesson covers background on how to make and record observations, and how to recognize what our observations might tell us about the natural community we are studying.

b) Let's start by thinking about how we observe the natural world. Scientists need to be good observers. Let's list in our journals some characteristics of good observers.

Example

To Be a Careful Observer:

1. *Be still so you don't scare away the animals.*
2. *Look at something for a long time.*
3. *Keep checking on a place to notice how things change.*
4. *Look closely and see all the details.*
5. *Use all your senses.*

2. Review the format for recording observations in journals - 10 min.

a) The other thing we are going to do is practice recording our observations in a systematic way. That means we will all use the same format for recording things, so that we can look at each other's records and use them to make comparisons and create group reports. Scientists build new knowledge by

studying and comparing what others in their field are doing.

Having one format for doing things is an important part of the scientific process; it allows scientists all around the world to study each other's work and learn from each other's discoveries. This also allows scientists to collaborate on projects, even if they come from different countries. Since we will be working in small groups during our field study, using a uniform process for recording our findings will allow groups to share information and easily understand each other's findings.

b) The first thing we are going to do is prepare our field journals. (Show overhead of sample entry, or pass out handout with copy of sample entry. The sample entry is in Lesson 2 Appendix, p. 27.) Start by putting your name, the date and location in the top right corner of the journal. Divide the page into one column for observations, and one column for questions and ideas.

Example

	Name: Laurie Rosenberg Class: Life Science Date: September 10, 2001 Time: 1:30 p.m.
Observations The acorn is round, ¾" The top is light brown. The nut part is smooth and greenish-yellow. There is a crack on one side of the acorn. Brown dust is coming out of the crack	***Questions and Ideas*** What is inside the acorn? What kind of oak tree did this acorn come from? How many types of animals eat acorns?

3. Take a look at pictures of animal signs from the study site. *(PowerPoint outline begins on p.21.)* Match animal signs to location, adaptation and behavior - 15 min.

a) Now let's begin practicing our observation skills. We will use some pictures from Graver Arboretum to practice together as a group. As we look at each slide, let's ask ourselves some key questions to help guide our observations.

1. *Where is the animal or animal sign located?*
2. *What type of plants are in the area and how are the animals interacting with the plants?*
3. *How can we describe the animal's body (mouth, eyes, legs, body covering and shape)?*
4. *Are there any clues as to how the animal behaves?*

Record answers to these questions in the "Observations" column.

b) As we are making our observations, we may come up with ideas or questions about what kind of animal sign we are observing - is it a sign of an animal feeding, moving, getting shelter, getting water, escaping a predator? We may come up with questions about what animal could have made the sign. We may have more questions about the animal's life and behavior. Record these in the "Questions and Ideas" column.

4. Discuss and demonstrate safe collecting and observing - 10 min.

a) There are two more things to think about before we go into the field. Number one is safety, and number two is how to do our field study without damaging the environment we are studying at Graver. Let's start by brainstorming some of the things we need to be aware of to have a safe

and low-impact experience at the arboretum.

b) (Brainstorm a list with the class.) Make sure to include the following: *staying away from poison ivy, avoid stepping on plants and small animals, showing respect for all living things, minimizing damage to plants and animals while observing them.* Live plants should not be picked, and small animals should be carefully transferred to a small jar or bug box for observation and then released.

c) Students should also review how to dress properly—old clothes, sturdy, water-resistant shoes, raingear if needed, and insect repellent, hats, sunglasses, etc. if necessary.

d) Make a list of "Rules of the Road" for the class field study, and have students record them in their field journals.

e) Students can also practice using a hand lens to observe small objects and animals.

5. Discuss the difference between observations and inferences - 5 min.

a) As the group is sharing observations and ideas, bring out the difference between an observation, (something directly experienced with the senses), and an inference, (an idea about the meaning of the observation drawn from evidence, and/or prior knowledge.)

For example, a student might *observe* a small hole in an acorn, and *infer* that an animal made the hole as it burrowed into the acorn. If the student then opens up the acorn and observes a small worm burrowing inside they have found further evidence backing up their inference.

6. Practice making and recording observations using a natural object supplied by the teacher – (15 min. optional extension)

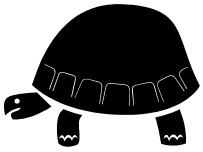
a) Now we are going to practice using our recording skills on a real natural object. Each group will receive an object and everyone in the group should help make observations and write them down in their journals. Also write down your group's questions and ideas. (Pass out objects to small groups of 2-4 students.)

b) When the groups are finished, have them share their findings, and turn in their journals for assessment.

c) A fun variation is to give each group an object that is only slightly different from all the others, (all acorns for example) and after they are finished observing them, mix the objects together and see if the group can find their specific object!

ASSESSMENT

- Quiz on animal signs, animal adaptations and roles, and differentiating between observation and inference.
- Sample observation writing assignment in journal.



RESOURCES

Books for the teacher:

Comstock, A. 1911. *Handbook of Nature Study*. Ithaca, New York: Cornell University Press.

Green Teacher Magazine, Summer 2000, Issue #62. (Learning Science through Patterns in Nature theme). Back issues of *Green Teacher* magazine can be obtained through www.greenteacher.com, e-mail: greentea@web.net, Phone: (416) 960-1244, Fax: (416) 925-3474, or by writing to *Green Teacher* at P.O. Box 1431, Lewiston, NY 14092.

Leslie, C.W. 2000. *Keeping a Nature Journal: Discover a Whole New Way of Seeing the World Around You.* North Adams, MA: Storey Communications, Inc.

Martin, A., Zim, H. & NelsonA. 1989. *American Wildlife and Plants: A Guide to Wildlife Food Habits.* New York: Dover.

McDougall, L. 1997. *The Complete Tracker: Tracks, Signs, and Habits of North American Wildlife*. New York: The Lyons Press.

Murie, O. 1954. *A Peterson Field Guide to Animal Tracks*. Boston: Houghton Mifflin.

Books for the students:

Brown, T. 1996. *The Tracker*. New York: Berkley Publishing Group.

Doolittle, B. 2001. *Reading the Wild*. Shelton, CT: The Greenwich Workshop Press.

Farrand, J., Jr. 1993. *National Audubon Society Pocket Guide: Familiar Animal Tracks of North America.* New York: Alfred A. Knopf.

Halfpenny, J., Ph.D. 2001. *Scats and Tracks of the Northeast: A Field Guide to the Signs of Seventy Wildlife Species*. Guilford, CT: Falcon Publishing Company.

Levine, L. and Mitchell, M. 2001. *Mammal Tracks: Life-Size Tracking Guide*. East Dummerston, VT: Heartwood Press.

Rezendes, P. 1992. *Tracking & the Art of Seeing: How to Read Animal Tracks & Signs*. Rochester, NY: Camden House Publishers.

Web sites: Since the Web is constantly changing, check Muhlenberg's Outreach Web site for updated listings. **http://www.muhlenberg.edu/cultural/graver/**

Web sites for the teacher:

American Museum of Natural History - *Online Field Journals*. (Field journals include: Birds, Insects, Butterflies, Leaves, Animal Tracks, Reptiles, Flowers and Spiders.)
http://www.amnh.org/nationalcenter/online_field_journal/fj/fj_menu.html

EduScapes - *The Topic: Animal Tracks*. Lamb, A and Johnson, L.
http://eduscapes.com/42explore/animaltracks.htm Websites on tracking, projects, and other resources.

Crinkleroot's Animal Tracking. York, J. http://www.scs.k12.tn.us/STT2000_wq/2-5/yorkl/default.htm
This is a WebQuest written for Jim Arnosky's story *Crinkleroot's Animal Tracking*.

Web sites for the students:

Beartracker's Animal Tracks Den. Cabrera, K. http://www.geocities.com/Yosemite/Rapid/7076/index.html
Provides a great deal of information on tracking, as well as resources and links to other tracking websites. *Note: This is an individual's website, and contains a section of Christian links.

Virtual Cub Scout Leader's Handbook - *Tracking and Stalking North American Wildlife* - http://www.geocities.com/Yosemite/9152/wildlife.html This is a cyber-guide for scouts, and includes tracking basics, safety, and information on various wildlife species.

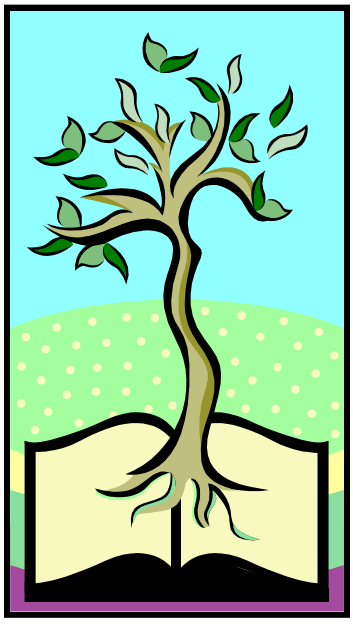
PA ACADEMIC STANDARDS FOR ENVIRONMENT AND ECOLOGY COVERED BY THE LESSON

Biodiversity - 4.3.7

- Explain the complex, interactive relationships among members of an ecosystem.
  - Identify the organisms found in an ecosystem. *(forest ecosystem)*
  - Identify how certain species are dependent on certain habitat conditions within a community. *(forest species interactions/ dependencies)*

Threatened, Endangered and Extinct Species - 4.7.7

- Select an ecosystem and describe different plants and animals that live there. *(forest ecosystem)*
  - *Identify and record animal signs in a forest such as feeding, locomotion, calls and homes.*
  - *Collect and record data related to observations of plant and animal life.*



Animal Signs PowerPoint Outline

Slide 1:

Picture on left – owl droppings on rhododendron leaves
Picture on right – collapsed owl pellet next to acorn pile. Bones from pellet are visible.

- This animal sign was found in the forest, at the base of a tree.
- The animal might use the tree as resting/feeding perch. This might indicate a bird of some type.
- Bones and fur found in pellet indicate animal is predator, eating small animals with fur.
- Chewed acorns indicate that the forest has many small animals feeding on nuts; they would provide food for the predator.
- Owls and hawks are two predator birds that live in forested areas. Due to the size of the collapsed pellet, this is probably a perch for a great-horned owl.

Slide 2

Great horned owl

- Great horned owls live and nest in the tops of trees, often nesting in large dead limbs or in "snags"—dead trees off of which the top has broken or fallen. Their brown mottled feathers are excellent camouflage, and the fluffy tufts of features on their head help them blend into the tree so they look like just another jagged broken branch.
- Owls have large eyes that let in a lot of light which allows them to see well at night. One of their main hunting strategies is to perch silently in a tree, watching and waiting for a prey animal to come along, at which point the owl swoops down and snatches them up. Special fringe on owls' wing feathers allow them to be virtually silent in flight.

Slide 3:

Top left: centipede
Top right: isopods
Bottom center: wooly bear caterpillar.

- These animals were found on the ground--the surfaces are different, perhaps indicating that the animals have different life habits.
- None of these animals have wings, so we can assume they live on the ground, at least at this stage of their life cycle. Another clue to their ground dwelling status is the presence of lots of legs for crawling along the ground.
- The isopods were found on a log with lots of holes in it. Perhaps these animals created the holes by chewing through the dead wood. They might also eat the wood.
- The isopods are camouflaged while the centipede and wooly bear are more noticeable. Perhaps the centipede dos not need as much protection from predators. The bristles on the wooly bear may make it unpalatable to predators.

Slide 4:

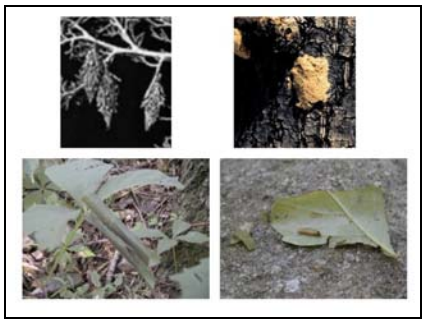
Various types of insect damage to leaves of plants growing in the understory of the forest.

- Insects and other animals that feed on plant leaves have characteristic ways of chewing on the leaves.
- Some tiny insects feed on plant tissue within the epidermis of the leaf. They are called leaf miners, because they create tunnels or "mines" within the leaf.
- Other insects, called leaf skeletonizers, eat the plant tissue between the veins, leaving behind a leaf skeleton.
- Other insects leave behind characteristic round holes, or jagged edges.

Slide 5

Top left – Oak apple gall
Top right – Spruce gall
Bottom left – Tent caterpillar
Bottom right – Bark beetle tunnel

- These animal signs are located on the leaves, branches and trunks of trees.
- The galls are abnormal swellings created by insects injecting the trees with chemicals from their bodies that cause abnormal growths. The insect larvae live and feed inside the galls. Gall making insects are very specific as to the type of plant they infest, and their galls have unique and characteristic shapes.
- Tent caterpillars create dense webs between tree branches, where they live and feed.
- Bark beetles chew tunnels through the layer of the tree just under the bark. When the bark falls away, the tunnels are exposed. Different types of beetles have different tunnel patterns.



Slide 6

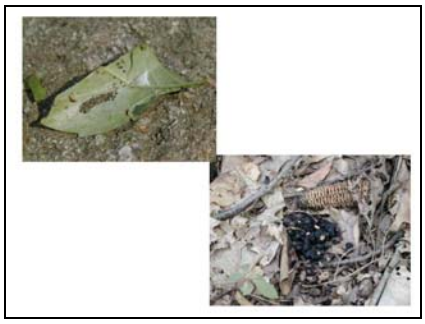
Top left – bagworm cocoon
Top right – gypsy moth egg case
Bottom left – leaf roller
Bottom right – leaf roller caterpillar

- On the leaves, branches and trunks of trees you can also spot cocoons and egg cases of insects.
- These egg masses and cocoons are often camouflaged to look like part of the tree.

Slide 7

Left – tunnel web
Top right – tunnel web spider
Bottom right – Argiope spider

- Tunnel webs are usually found on or near the ground.
- The web is not sticky, but if an insect lands on it, the spider darts out of its hiding place inside the tunnel to seize its prey.
- Each spider group has its own signature web style.
- The bright colors of the argiope spider mimic those of yellowjackets and other stinging insects, which confuses potential spider predators.



Slide 8

Top left – caterpillar droppings, (frass)
Bottom right – deer droppings, small type

- The study of animal droppings, (called "scat" by wildlife scientists), indicates a great deal about the animal. The size, shape and consistency of the droppings gives clues about the size of the animal, how its digestive system works, and what it eats.

Slide 9

Top left – raccoon
Bottom left – Whitetail deer
Top right – raccoon track
Bottom right – deer track

- Animal tracks offer clues to the lifestyle of the animal that left them behind. Hoofs, toes and foot padding can indicate the way the animal moves and looks for food.

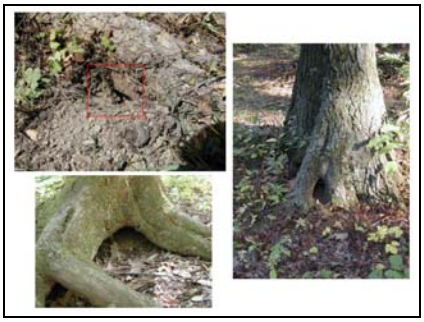
Slide 10

Top left – spruce cone stripped of seeds
Bottom left – hickory husk that has been gnawed
Top right – empty black walnut shell
Bottom right – pile of chewed acorns

- Squirrels, mice, and chipmunks all feed on seeds that they find on the ground, such as pinecones, acorns, walnuts and hickory nuts. All of these animals are rodents, which means that often the shells will show evidence of gnawing.
- Chipmunks and red squirrels hide their food in piles called a "cache," gray and fox squirrels bury many nuts scattered over a wide area. A large pile of nuts or seeds often indicated the presence of a red squirrel.
- Squirrels strip the bracts from evergreen cones to expose the small seeds located at the base. As a result of this practice they often leave behind piles of the stripped "cobs" of the cone.

Slide 11

Top – Grey Squirrel
Bottom – Chipmunk



Slide 12

Top left – hole in ground near tree rood
Bottom left – excavation at base of tree
Right – small hole at base of tree

- Very often students can find holes made by animals in or near trees. Often these holes have evidence nearby of the animal that made the holes, such as piles of seed shells or bits of chewed acorns.
- Dead and dying trees are a very important part of the forest ecosystem, and they provide shelter for many types of wildlife.
- Small animals that utilize ground nests and tunnels will usually have several entrances and exits in close proximity, in order to have multiple escape routes from predators.

Slide 13

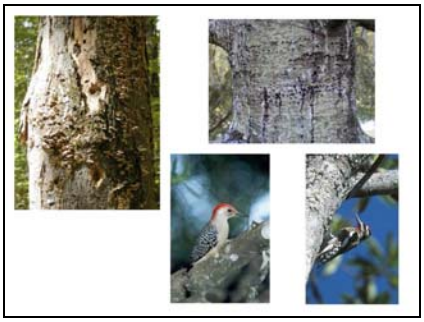
Top – Mole hole
Bottom – Mole

- Mole holes are frequently found in the forest grounds. These holes have a characteristic circle of excavated dirt around the entrance to the hole.
- Moles dig through the soil to locate their food, which consists of insects, worms and grubs.
- Moles eyes are small in comparison to their large pointed noses. The mole's nose is highly sensitive and helps them locate food.
- Another feature of a mole's anatomy are large flattened front paws adapted for digging in the soil.
- Moles have short, dark fur that allows them to slide quickly through their tunnels and blend in with their subterranean surroundings.

Slide 14

Top left – goldfinch nest
Bottom right – goldfinch

- Goldfinches nest in shrubby areas near open fields where they feed on seeds.
- The inside of a goldfinch's nest is lined with thistle down, (the fluff attached to thistle seeds). Besides being a neat, small rounded cup, down lining is one of the features that distinguishes a goldfinch nest.
- Thistle seeds are goldfinches' favorite plant food. Feeding on or near these prickly plants helps protect the birds from predators.
- The thick short beak of the goldfinch is adapted for cracking open tough outer husks of seeds.
- The bright yellow color of the male finch distracts predators away from nests during the breeding season. At other times of the year, the goldfinch's plumage changes to a duller olive color that blends in with the fall and winter foliage in their meadow habitat.



Slide 15

Top left – holes in tree left by unknown woodpeckers, (most likely downy or red bellied woodpeckers)
Bottom left – Downy woodpecker
Top right – holes in tree left by Yellow-bellied sapsucker
Bottom right – Yellow-bellied sapsucker

- These woodpecker signs are located on tree trunks. The yellow-bellied sapsucker has a distinctive habit of poking a line of holes in the bark of living trees. Sap pours out of these holes and the woodpecker feeds on the sap and the insects that gather around the sap.
- Besides having a chisel shaped beak, woodpeckers have gray, brown and white mottled feathers that helps them blend in to the branches and tree bark of their treetop habitat.
- Woodpeckers also have stiff tail feathers that help them balance against the tree trunks while drilling and poking around for an insect meal.

Slide 16

The entrance to crayfish burrows along the banks of a small stream
Inset – crayfish

- Holes and mud piles along the banks of streams or ponds often indicate the presence of crayfish. Crayfish hide and nest in these holes, and pile towers of mud around the entrance. Crayfish homes look like collapsing sand castles, hence their nickname "crayfish castles."
- Anyone who has ever tried to catch a crayfish knows you have to get them from the back, to avoid getting nabbed by the pincers in the front. One strategy crayfish have for survival is to back up into their holes, thus protected their rear while fending off predators from the front with their claws.

Lesson 2 Answer Key
Field Study Techniques

1. (answers will vary)

2. example: flippers for swimming, thick skin and fat layer for warmth, etc.

3. c.

4. (answers will vary)

5. (answers will vary)

6. c.

7. b.

8. (answers will vary)

9. (answers will vary)

Lesson 2 – Appendix
Field Study Techniques

Copy Masters for:

Sample Journal Entry
Lesson 2 Quiz

Observations

Examples

To Be a Careful Observer

1. Be still so you don't scare away the animals.
2. Look at something for a long time.
3. Keep checking on a place to notice how things change.
4. Look closely and see all the details.
5. Use all your senses.

Name: Laurie Rosenberg
Class: Life Science
Date: September 10, 2001
Time: 1:30 p.m.

Observations	Questions and Ideas
~ The acorn is round, ¾" ~ The top is light brown ~ The nut part is smooth and greenish-yellow ~ There is a crack on one side of the acorn nut ~ Brown dust is coming out of the crack	~ What is inside the acorn? ~ What kind of oak tree did this acorn come from? ~ I wonder how many types of animals eat acorns?

Lesson Two Quiz: Field Study Techniques

Name_____ Grade Level_____

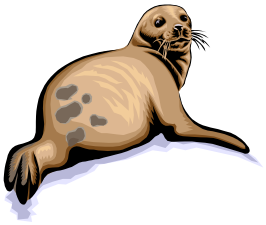
Date_____ School_____

1. List below four animal signs that you can observe in nature:

_____ _____

_____ _____

2. Describe one thing about this animal that makes it well adapted for swimming in cool water.



_____

_____

3. Which of the five senses should you NEVER use when trying to identify a plant you find?

(a) smell

(b) sight

(c) taste

(d) touch

4. List two observations/signs that might lead you to believe a bird is living in a tree.

_____

_____

5. List two signs that you could observe after this tiger left which would lead you to believe he had been at this place.

1. _____

_____

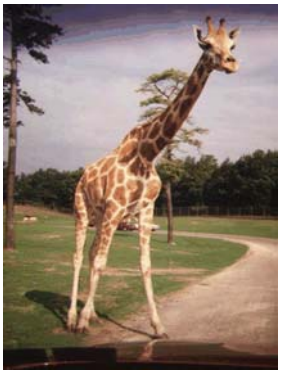
2. _____

_____

6. **You see a lot of deer and wolf tracks in the same area and you decide that a wolf must have been trying to catch a deer for dinner. You have:**
   (a) Made only two observations
   (b) made only two inferences
   (c) made an observation and then an inference from that observation
   (d) none of the above

7. **An inference is:**
   (a) information about one's environment gathered using the five senses
   (b) an idea that is generated by looking at evidence
   (c) an observation
   (d) none of the above

8. **Examine the giraffe pictures below, and write at least 5 *observations*.**



Observations:_____

_____

_____

_____

_____

_____

9. Pretend you are observing actual giraffes in their habitat. Explain one thing that you would do to be a *careful observer.*

_____

_____

Lesson 3 – Outdoor Field Study

Author: Laurie Rosenberg, Muhlenberg College
Grade Level: 5-8
Lesson Time: 150 minutes + 30 min. optional extension back at school
Suggested Class Structure: Small group investigation and whole class compilation of data and discussion of results.
Subject Areas: Science

BACKGROUND

To prepare for this field trip, students should have completed lessons 1 and 2 in the wildlife ecology unit. They should be familiar with making observations of wildlife signs in the field and know how to record them in a systematic manner. They should be able to identify poison ivy and understand safe and low impact methods of collecting and observing natural specimens. Students should also know basic categories of living organisms—plants, animals and fungus.

Several general plant categories include: **conifers**, **broad-leaved trees**, shrubs, moss, **lichens**, and **herbs**. Some common types of invertebrate animals include spiders, mites, worms, snails, centipedes, isopods, and millipedes. Perhaps the largest group of animals that can be observed in the field study site include members of the insect class. **Galls** are common signs of insect activity.

Other living things that will be encountered on the grounds include birds such as crows, blue jays, cardinals, woodpeckers, nuthatches, chickadees, and sparrows; mammals such as deer, raccoons, squirrels and chipmunks; amphibians and reptiles such as garter snakes, green and wood frogs, and various salamanders. Students will also encounter molds and mushrooms.

GOAL

Student teams will visit a designated study site and collect evidence of what animals live there, what they eat, and record any other interactions between the animals and environment that they observe.

OBJECTIVES

The students shall:

1. Work cooperatively in small groups, observe, identify and record wildlife observations including plants and signs of animal activity in a field study plot.
2. Compile individual group data sets into a large class data set, and create categories for organizing the information.
3. Analyze class wildlife observation data to make inferences about the biodiversity found in the field study area, including how biotic and abiotic factors influence biodiversity.
4. Make inferences as to why some animals are more commonly observed in the field study site than others.
5. Work together as a class to create a concept map of the ecosystem of the field study site.

VOCABULARY

Broad-leaved Trees – Trees and shrubs with broad, flat, usually deciduous leaves.

Conifers – Trees and shrubs with small, needle or scale shaped leaves, having cones as seed-bearing structures, and usually being evergreen.

Galls – Unusually shaped growths on plant parts such as leaves, stems, and twigs. Galls are caused by chemical secretions from

insects. The insects usually inject these chemicals into plant tissue to cause the gall to form, and then lay eggs in the swellings that result. Often, the insect larvae live within the galls.

Herbs – In a scientific context, plants that do not have woody stems are called herbs or described as being ***herbaceous***.

Lichens – These unique living organisms consist of an interdependent relationship between a fungus and algae. The fungus provides a surface upon which the algae grows, and the algae provides energy for the fungus by carrying out photosynthesis. Lichens are often the first living things to colonize bare rock, and can often be found on tree bark.

MATERIALS

Supplied by college:

--- White dishpans
--- Forceps
--- White spoons
--- Field guides
--- Bug boxes
--- Hand lenses
--- Soil screens
--- Easel
--- Small bug nets
--- Flip chart
--- Big markers for chart
--- Whistle
--- Storage shed

Required for classes, (teachers bring):

--- Field journals
--- Nametags for each student

Optional for classes, (teachers or students bring):

--- Cameras

ADVANCE PREPARATION

- ✓ Complete lessons 1 and 2 in the wildlife ecology unit.
- ✓ Make or buy nametags for all students. Students should be wearing nametags on the day of the field trip.
- ✓ Bring journals along on field trip. See page 53 for journal copy masters.
- ✓ Make sure students know to dress properly for all kinds of weather they may encounter on the day of the trip. The weather will seem colder out in the open with wind chill or in the shade at the arboretum than the students might be used to in an urban area.

PROCEDURES – Outline and Narrative

1. Review Purpose of the Field Trip, Safety Considerations, and General Field Study Guidelines - 10 min.

a) Have students review their goals out loud.

b) Review what poison ivy looks like, and other general safety and conservation guidelines.

c) Introduce the signal that will tell student groups that they have ten minutes left before they must finish their data collection, (one whistle blast), and the signal for closing and returning to the central gathering area, (two whistle blasts.) Point out the area where they are to gather when they are finished with their field study.

2. Go Over Collecting Equipment and How to Use It - 10 min.

a) Show all the equipment they will be using and briefly review how to use it.

3. Show Each Group to Its Study Plot Location - 15 min.

a) Point out the study sites and their boundaries.

b) Remind students to look at all levels, and to take detailed notes.

4. Facilitate Gathering of Information - 45 min.

a) Here are some facilitation tips:
   i) Invite students to show you what they've found.
   ii) Ask students questions about their findings.
   iii) Set the tone for focused fieldwork right away.
   iv) Give students who are uncomfortable in the outdoors some individual attention in the form of encouragement.
   v) Find some small critter or natural feature to show groups of students.
   vi) If one group finds something particularly interesting, share their finding with the other groups.
   vii) Help groups to see subtle details they might be overlooking.
   viii) Encourage students to record other interesting things such as prominent topographical features of their plots and other non-living components. If students know for sure the names of the plants and animals they are observing, they can record them.
   ix) Ask focusing questions such as:

1. Do some plants show more evidence of being eaten than others?
2. Why would insects prefer to eat certain types of plants, or certain parts of plants?
3. How big do you think the animal was that made that sign?
4. Did more than one type of animal feed on this plant? How can we tell?
5. What animal made that sign?
6. Is this a recent or old sign? How can you tell?
7. Was the sign made by one animal or more than one? How can you tell?
8. What was the animal doing that made that sign? Was it a food gathering activity? If not, what other aspect of survival does the sign tell us about? (shelter, getting water, reproduction, hiding from predators, etc.)
9. Can you guess what an animal eats by where you found it?
10. What behaviors can you observe that help the animal get food?
11. What do the animal's mouthparts look like? (straw, needle, scraper, knife, sponge, chisel, etc.) Can you tell what the animal eats from looking at its mouthparts?
12. Is there anything about this animal that would help it escape from a predator and thereby avoid becoming food?
13. Is there evidence that human animals have been here? Can we find any evidence of what they were doing or eating?

5. Gather Groups Together to Debrief - 15 min.

a) Give the small groups a few moments to go over their notes and make sure they have completed them and that they understand everything they have written.

b) Have the students select one group member as their reporter for the next activity. Ask the groups to pick one or two of their most interesting findings and share them, one at a time, with the whole group. Discuss what these findings might indicate about interactions in the study site. If they saw less or more than they expected, discuss why.

6. Pool Information - 30 min.

a) Decide how to categorize information. Suggested categories include: plants, insects, other invertebrates, other animal categories, animal signs, non-living things, shelter, etc.

b) Create a large chart for groups to write their findings on. Either the teacher or a student can record the results on this chart.

c) Select a new recorder for each group to do the reporting. Recorders should read off their findings and note the plot number where each item was found.

d) As group recorders read off their findings, the students can debate under which category the items should be recorded. They may expand or refine their categories as the process evolves. Students can record the number of each item they found as well as the specific name of the plant or animal if they know it.

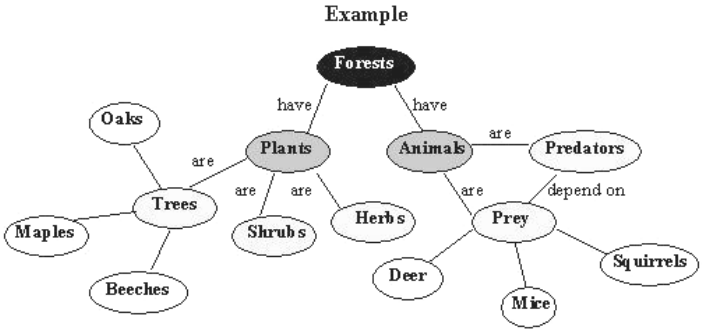
7. Analyze results - 20 min.

a) Ask students to look at the class' findings and answer the following questions:
   i) Which plots have the highest biodiversity? (A lot of different kinds of living things)
   ii) Which plots have the lowest biodiversity? (Only one or two kinds of living things)
   iii) Do the physical conditions of the site with high biodiversity differ from the plots with low biodiversity?
   iv) What organisms were found in many plots, (were common in the overall study area)?
   v) Why do you think some animals are more common than others?
   vi) Does how common something is have anything to do with what it eats? What is the relationship?
   vii) How well were you able to figure out animal signs in your study plot--what clues did you use? What are you unsure about?
   viii) Where within each plot did you find the most evidence of feeding activity? (ground level, herb layer, shrub layer, tree tops)
   ix) Have people had a high, medium or low impact on the site?
   x) Is our study site an ecosystem? Why or why not?

8. Create a Concept Map of the Study Site Ecosystem *(optional, 30 min.)*

a) Introduce concept mapping to the students by showing them a simple concept map. A copy master for this

example is in the Appendix of this lesson, on page 37.



b) The words next to the connecting lines describe the relationship between the circled words. For example, in the concept map above, the word plants is related to the words trees, herb and shrubs because they are all found in a forest.

c) Ask students to use what they have learned about the interrelationships of living things to brainstorm a list of words that describe relationships between the living things in the forest ecosystem that they have just surveyed. Here are some examples:

Need	Make
Become	Use
Cause	Have
Some are	Like
Include	Take up

d) It is often helpful to post these words somewhere for students to see while they are making concept maps.

e) Ask the student groups to take a look at the data for the whole class' findings, and create a concept map that organizes this information visually. Give each group a sheet of newsprint and large crayons to use to draw the final version of their concept map.

f) When the groups are finished, have them share their concept maps with the whole class. Differences in the way groups organized the information can be brought up and discussed.

ASSESSMENT

- Field study journal notes.
- Class data report.
- Answers to questions.

RESOURCES

Books for the teacher:

Behler, J.L. and King, F.W. 1979. *National Audubon Society: Field Guide to Reptiles and Amphibians.* New York: Alfred A. Knopf.

Council for Environmental Education (CEE). 2000. *Project WILD K-12 Curriculum & Activity Guide.* "Urban Nature Search" pp.70-72. Houston, Texas: CEE.

Green Teacher Magazine, Summer 1999, Issue #59. (Integrated Learning theme.) Back issues of *Green Teacher* magazine can be obtained through www.greenteacher.com, e-mail: greentea@web.net, Phone: (416)

960-1244, Fax: (416) 925-3474, or by writing to *Green Teacher* at P.O. Box 1431, Lewiston, NY 14092.

Green Teacher Magazine, Spring/Summer 1998, Issue #55 (Environmental Monitoring theme).

Griggs, J.L. 1997. *An American Bird Conservancy's Field Guide: All the Birds of North America.* New York: HarperPerennial.

Peterson, R.T. and McKenny, M. 1968. *The Peterson Field Guide Series: A Field Guide to Wildflowers*. Boston: Houghton Mifflin.

Books for the students:

Behler, J.L. 1988. *National Audubon Society Pocket Guide: Familiar Reptiles and Amphibians of North America.* New York: Alfred A. Knopf.

Farrand, J.Jr. 1988. *National Audubon Society Pocket Guide: Insects and Spiders.* New York: Alfred A. Knopf.

George , J.C. 1995. *One Day in the Woods*. New York: HarperTrophy.

Griggs, J.L. 1998. *An American Bird Conservancy Compact Guide: All the Backyard Birds (East).* New York: Harper Perennial.

Peterson, R.T. 1986. *Peterson First Guides: Wildflowers*. New York: Houghton Mifflin.

Web sites: Since the Web is constantly changing, check Muhlenberg's Outreach Web site for updated listings. **http://www.muhlenberg.edu/cultural/graver/**

Web sites for the teacher:

Neartica- *Eastern Deciduous Forest.* **http://www.nearctica.com/biomes/edf/index.htm**
This is a great resource for Eastern deciduous forests, including information about plants, animals, soils, and much more. *Note: this site contains several banner advertisements.

PA ACADEMIC STANDARDS FOR ENVIRONMENT AND ECOLOGY

Ecosystems and Their Interactions - 4.6.7

- Explain the interaction of the biotic and abiotic components of an ecosystem.

Threatened, Endangered and Extinct Species - 4.7.7

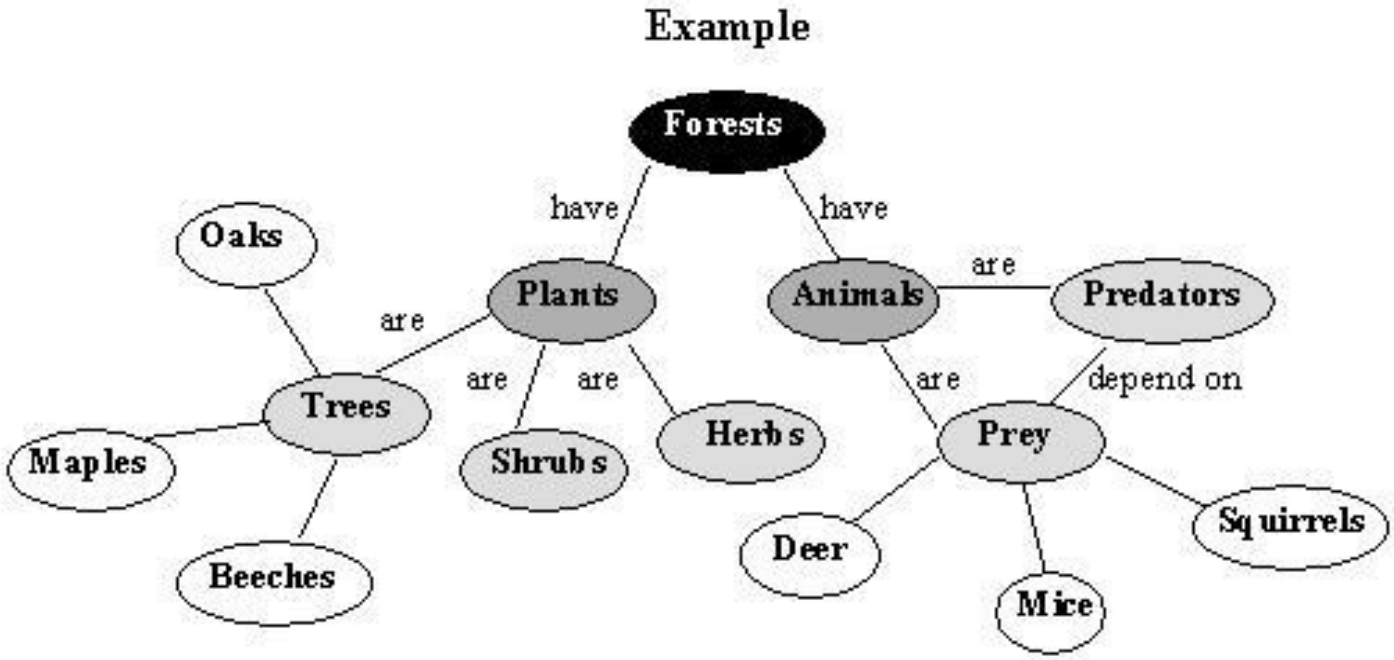
- Describe diversity of plants and animals in an ecosystem.

Lesson 3 – Appendix
Outdoor Field study

Copy Masters for:

Concept Map

Concept Map


Example
Forests
have
have
Oaks
Plants
Animals
are
Predators
are
are
are
depend on
Trees
Herbs
Prey
Maples
Shrubs
Squirrels
Deer
Beeches
Mice

Lesson 4 - Food Webs

Author: Laurie Rosenberg, Muhlenberg College
Grade Level: 5-8
Lesson Time: 100 minutes (one 45min. session, one 55 min. session)
Suggested Class Structure: whole class and small collaborative group work
Subject Areas: Science, Language Arts

BACKGROUND

The concept of a food chain illustrates how the sun's energy is used by plants to make food, and then the energy is passed on to animals that eat plants, and in turn passed on to animals that eat other animals. An individual food chain may have a sequence like this: sun –> mountain ash tree –> cedar waxwing –> sharp shinned hawk. In this example the energy from the sun is converted to sugars and proteins allowing the mountain ash to survive and grow. When the cedar waxwing eats the mountain ash berries some of that energy is passed on to it, and when the sharp shinned hawk nabs and eats the cedar waxwing in order to survive, it receives some of that energy.

The concept of energy transfer is also the foundation of food webs, but they illustrate the complexity of interaction between populations of living things in a natural community as they carry on their lives and thus utilize the energy and matter available to them. In contrast to a food chain, a food web shows the interconnections and interdependencies of all members of a community.

To understand the difference, let's take a look at the food chain above. There are many trees in the forest competing for sunlight besides the mountain ash, and cedar waxwings may feed on any number of different berries, some from trees and some from shrubs. Sharp shinned hawks eat other types of small birds, and may in turn be caught and eaten by cooper's hawks. Raccoons or snakes may prey upon the eggs and young of all these bird species. Raccoons eat berries too, and thus pose a double threat to the hawks, not only eating their prey and their young, but also by competing with their prey for food. On the other hand, raccoons and birds spread the seeds of the mountain ash in their droppings.

The reason these connections are important is because changes that directly affect one species in a community often have far reaching often unexpected effects on other species. And because of the complexity of food webs, it is sometimes difficult to gauge what the outcomes of any give action will be. Ecologists are constantly discovering new interactions.

GOAL

Students will use the data they collected on their field trip to Graver to create a food web for the natural community they studied. They will practice ecological thinking by predicting what might happen if there were changes in the population numbers for one of the organisms in their web.

OBJECTIVES

The students shall:

1. Use information about plant and animal species present in a natural community to construct a food web.

2. Discuss and read about how changes that happen to one population in a natural community might affect other populations in the community.
3. Make inferences about what would happen to all populations of organisms living in a natural community if there were changes to the population numbers for one of the organisms.

VOCABULARY

Population – Organisms of one species living in the same place at the same time.

Community – All the populations of different species that live in the same place at the same time.

Food Web – A series of overlapping food chains.

MATERIALS

--- Pictures of food web either as slide or overhead transparency
--- Students need their study plot data collected during their field trip to Graver.
--- Large sheets of butcher paper or flip chart paper for each student group.
--- Crayons or markers for each student group.
--- Field guides.

ADVANCE PREPARATION

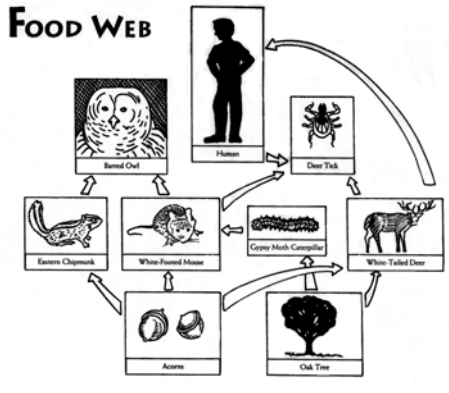
✓ Run off copy of food web to make overhead transparency or set up projector to show food web slide.
✓ Prepare large sheet of paper and markers for each student group.
✓ Make field guides available in classroom for student research.

PROCEDURES – Outline and Narrative

1. Review Food Chain and Contrast with Food Web. Explain Importance of Food Web - 10 min.

a) Ask students if they know what a food chain is. Draw or write out a simple example of a food chain on the board.

b) Show slide or overhead of a food web. Discuss differences between a food chain and a food web. *(Food chains do not take into account all the feeding relationships in a natural community).* Tell students that food webs are important to ecologists because they help them figure out how changes in the population of one type of living thing in a community might affect the populations of other living things in the community.



c) Ask students why people might be interested in the food web depicted in the example. (*People use oak trees for lumber, they get sick from diseases carried by deer ticks, and gypsy moth caterpillars are a pest species that can cause the death of trees in the forest.)*

d) Explain to the students that if ecologists can figure out what makes the populations of these organisms grow or shrink, they can help people make decisions about how to manage the forest resource. That's why they will be studying food webs and learning to think like ecologists.

2. Have Students Make Food Webs Using Field Study Observation Data - 20 min.

a) Have students go back into their field study groups and make a food web using their research findings from their field trip to Graver. They should start the webs with plants and animals they saw in their study plot. Pass out materials, (paper and markers) to each group.

b) Students will have to decide how to organize their food webs. Food webs are often organized like food chains, with the producers, *(plants)* at the bottom, the herbivores, *(plant eaters)* in the middle, and the omnivores and carnivores at the top. One technique is to choose one organism and work upwards and downwards to form a web around it.

c) Students can use data gathered from other groups' study sites and background information about the plants and animals to make inferences about additional plants and animals that could complete their web. It is best to make the connections between what eats what with pencil first, and then darken the marks once they are sure everything is organized correctly.

3. Students Groups Present Their Food Webs to the Whole Class - 15 min.

a) Have each student group show their work and explain how their food web is organized to the class. Discuss similarities and differences between the webs.

End of session 1.

4. Introduce the Concept of Interdependence Using Examples and Stories - 20 min.

a) Tell the students that the next step to understanding the importance of a food web is to think of a "What if . . ." sequence of events. Show the overhead food web example again and ask the students to predict what would happen if one year all the oak trees in the forest produced a huge crop of acorns. Put plus signs or minus signs on the overhead next to organisms that students predict will increase or decrease in the first year after acorn production increases.

b) Next talk about what would happen the following year. If acorn-eaters increase the first year because they have more acorns to eat, there might be a corresponding increase in the population of owls that eat mice. And there might be fewer gypsy moths because there would be more mice to eat them. Encourage students to think about how a change could affect organisms on both ends of the arrows,

to emphasize that effects ripple through a food web in all directions. For example, an increase in mice might lead to an increase in owls, but once there are more predators, then the population of mice might decline again.

c) A lot of questions and complications will arise in discussing how a change in one population could affect an entire food web, which are exactly the kind of issues that make food web scientists' work challenging. You might want to read the essay to your class, "Thinking Like a Mountain" by Aldo Leopold. In this essay, the pioneer ecologist Leopold contemplates the effect on an entire mountain ecosystem when the wolf predators are removed from the community.

d) Two other stories that deal with food webs are *The Day They Parachuted Cats on Borneo*, and *Wolf Island*. Both these stories are dramatic depictions of real life food webs that were altered in some way with unexpected results.

5. Students Work with Groups to Write "What If . . ." Questions About their Food Webs - 20 min.

a) Have students go back into their study groups and write a "What if..." question for their food web.

b) Next have the student groups write what they think the answer to their "What if…" question is, but write it on a separate piece of paper. They can then exchange their food web questions, (but not the answers), with another group. Have the other group write their answers.

c) After the groups have written their answers, have them compare notes with the group that originally made the prediction. Have them discuss differences and try to come to consensus if there are different opinions. Students may differ on their predictions, and this is a good way to discover new questions they want to answer about the interactions between organisms in an ecosystem.

6. Discussion of the Relevance of Food Webs - 15 min.

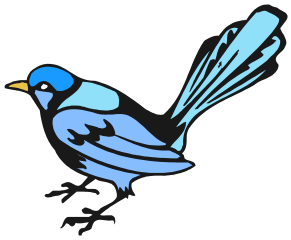
a) Ask the students to think of some investigations they could do to figure out if their food web predictions are correct.

b) Ask the students if there are any organisms on their food webs that people might want to control. For example, people like to control plants and animals that they consider to be pests, and encourage those that they can use to make their own lives better or more enjoyable. What effects does this behavior have on ecosystems?

ASSESSMENT

- The assessment for this lesson is the writing assignment for the closing lesson of the unit.

- Another assessment might be to ask the students to write the answers to this question, "What are the different ways a change in one population can ripple



through a food web?

RESOURCES

Books for the teacher:

Green Teacher Magazine, Summer 1997, Issue #52, pp.26-30. (Great Lakes Food Web play.) *Green Teacher* magazine can be obtained through www.greenteacher.com, e-mail greentea@web.net, Phone: (416) 960-1244, Fax: (416) 925-3474, or by writing to *Green Teacher* at P.O. Box 1431, Lewiston, NY 14092.

Leopold, A. 1991. *A Sand County Almanac*. New York: Ballantine Books.

Books for the students:

George, J.C. 1992. *Who Really Killed Cock Robin? An Ecological Mystery*. New York. HarperCollins Juvenile Books.

Godkin, C. 1989. *Wolf Island.* New York: W.H. Freeman and Company.

Pomerantz, C. 1971. *The Day They Parachuted Cats on Borneo.* Reading, MA: Young Scott Books.

PA ACADEMIC STANDARDS FOR ENVIRONMENT AND ECOLOGY

Know What Natural Resources Are - 4.2.7 A

- Explain how plants and animals may be classified as natural resources.

Explain Biological Diversity - 4.3.7 C

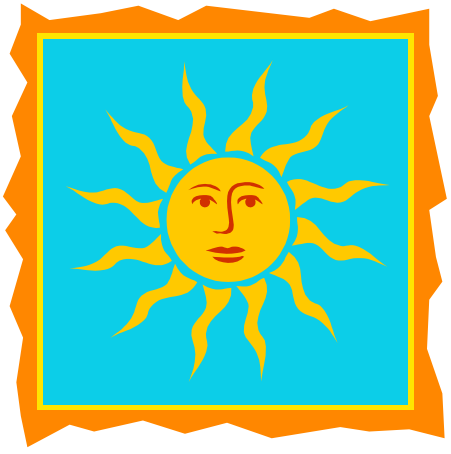
- Explain the complex, interactive relationships among members of an ecosystem.

Explain Benefits and Harmful Effects of Pests - 4.5.7 A

- Identify different examples of pests and explain the beneficial or harmful effects of each.

Ecosystems and Their Interactions - 4.6.7 A

- Explain energy flow through a food web.
- Explain the importance of the predator/prey relationship and how it maintains the balances within ecosystems.
- Understand limiting factors and predict their effects on an organism.

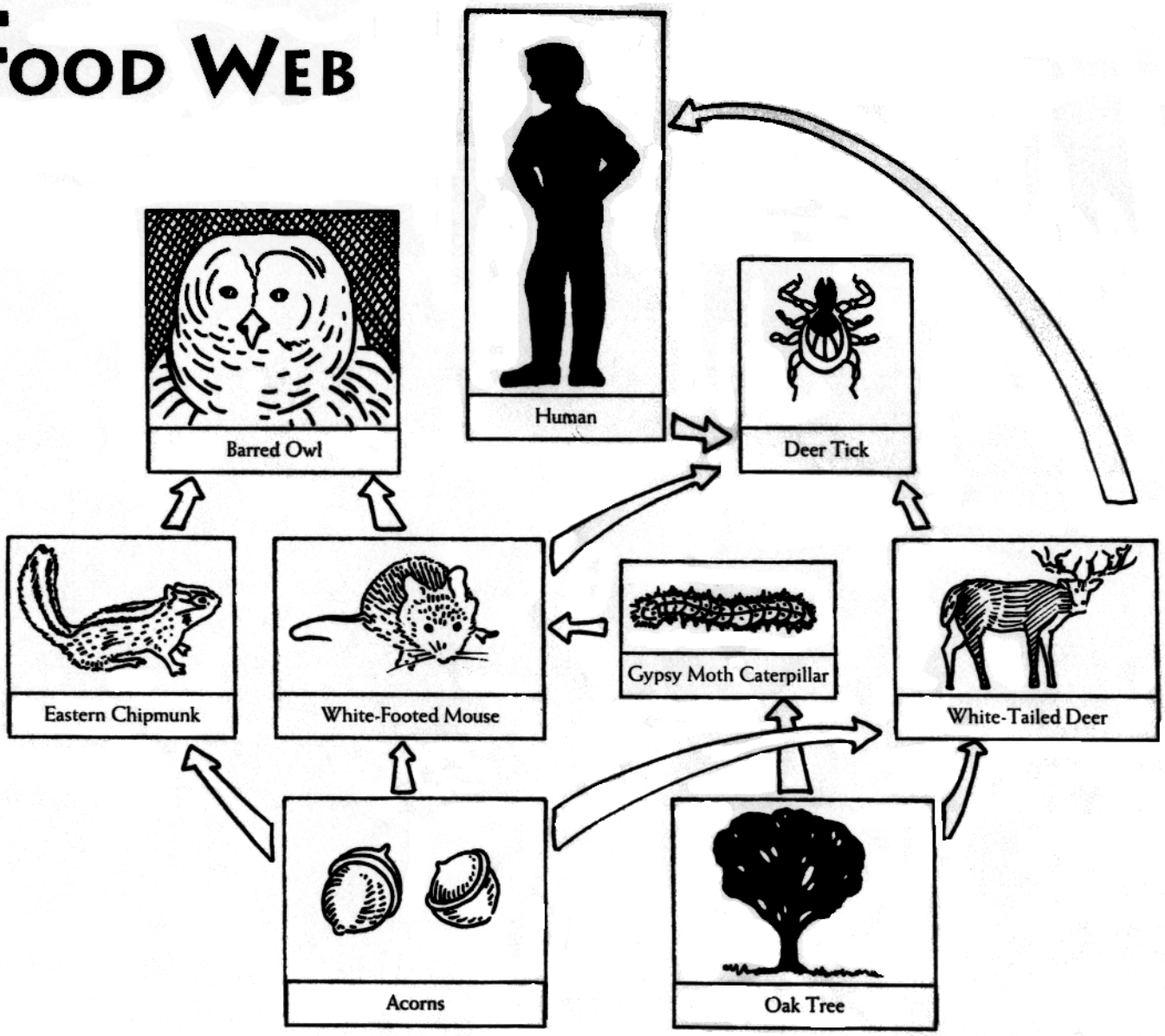


Lesson 4 – Appendix
Food Webs

Copy Masters for:

Food Web Diagram

Food Web


Human
Barred Owl
Deer Tick
Eastern Chipmunk
White-Footed Mouse
Gypsy Moth Caterpillar
White-Tailed Deer
Acorns
Oak Tree

Lesson 5 - Writing an Environmental Impact Statement

Author: Laurie Rosenberg, Muhlenberg College
Grade Level: 5-8
Lesson Time: 65 minutes
Suggested Class Structure: whole class and small groups
Subject Areas: Science, Language Arts

BACKGROUND

The process of assessing the impact of a given action on the environment is called an environmental impact statement (EIS). The practice of creating impact statements became common in the 1970's with the passage of the endangered species act and other environmental legislations that affected land use decisions. EIS were seen as tools to assist citizens, businesses and government officials in making sound decisions based on a rational assessment of the costs and benefits of proposed actions.

A typical EIS begins with a description of the ecosystem to be affected, and includes a description of historical, cultural and environmental resources on the site. Vegetative land cover, habitat information, wildlife species, soil types, topography and water drainage patterns are typically included. An attempt is made to bring together as much relevant objective information as possible.

The findings in an EIS are sometimes up for debate, and controversies can arise over the relevancy or accuracy of certain data.

GOAL

Students will write predictions of how a proposed change to their study site would affect the organisms that live there.

OBJECTIVES

Students shall:

1. Give examples of manmade causes of change to an environment.
2. Write an assessment of the impact of a study site alteration.

VOCABULARY

Environmental Impact Statement – a scientific report describing environmental conditions in a certain site, and predicting how proposed changes will affect the ecosystem of the site.

MATERIALS

--- Copies of impact statement scenario for each class member
--- Copies of impact statement letterhead

ADVANCE PREPARATION

--- Run off copies of handout.

PROCEDURES – Outline and Narrative

1. Discuss Environmental Change and Environmental Impact - 10 min.

a) One of the things we discussed, that is important about knowing how different animals interact with plants, other animals, and the non-living environment to survive, is being able to predict how their survival will be affected if the place where they live is changed. Having this kind of information can help humans make

informed decisions about land use. Let's start by thinking of some things that people could do that would change the environment of our study site.

b) Brainstorm a list of activities that would have an impact on the environment of the study site. Examples include lumbering, building a housing development, clearing for agriculture, creating manmade structures, planting different plants, building trails and roads, hunting and trapping animals on the site, etc.

2. Introduce the Concept of an Environmental Impact Statement - 5 min.

a) Ask if anyone has heard of an environmental impact statement. After students share their ideas, state that many laws require that scientists make such a report before a landowner can make changes on certain pieces of land. An example is landowners who have endangered species of wetlands on their property. They need to do an environmental impact statement before they can build or make changes to the way in which their property is used.

The job of the scientist is to survey the living and non-living features of the site and predict how the proposed changes will affect these things. The purpose of these reports is not necessarily to stop all uses, but to help people shape their plans so that damage to the ecosystem is minimized.

b) Tell the students that they will be writing an environmental impact statement.

3. Introduce the Environmental Impact Statement Task - 10 min.

a) Read over the scenario and task. (See Appendix, page 49).

b) Discuss criteria for evaluating the writing assignment. (See sample rubric in Appendix, page 49.)

c) Review resources available—notes, reference books, group summary.

4. Students Brainstorm in Pairs to Begin Formulating Ideas - 10 min.

a) Give students time to share ideas in pairs. This time is to allow for idea exchange and to jog their memory. Help students by listening and making sure they are using the writing assignment as a chance to demonstrate their understanding of animal and plant interactions.

Students will copy their final statement onto the handout. See Appendix for copy masters.

5. Student Writing - 30 min.

a) Have students work individually or in pairs to complete the final version of the impact statement. When they are finished, students may take turns reading their statements, or they may be posted on bulletin boards in the classroom, or included in portfolios.

ASSESSMENT

- Student writing assignments.

RESOURCES

Books for the teacher:

Green Teacher, December 1995/January 1996, Issue #45. (Ecological Footprint theme). Back issues of *Green Teacher* can be obtained through www.greenteacher.com, e-mail: greentea@web.net, Phone: (416) 960-1244, Fax: (416) 925-3474, or by writing to *Green Teacher* at P.O. Box 1431, Lewiston, NY 14092.

Web sites: Since the Web is constantly changing, check Muhlenberg's Outreach Web site for updated listings. **http://www.muhlenberg.edu/cultural/graver/**

Web sites for the teacher:

Utah State Office of Education- *Earth's Biological Systems* - **http://www.wested.org/werc/earthsystems/biology/lpbiology.html**. Click on "Evaluate Ecosystems" for a lesson on environmental inventory.

EPA Office of Federal Activities- **http://es.epa.gov/oeca/ofa/**. Environmental impact statements are listed on this site when they are published, and other resources are available such on how to file an EIS.

PA ACADEMIC STANDARDS FOR ENVIRONMENT AND ECOLOGY

Environmental Health - 4.3.7

- Explain the complex, interactive relationships among members of an ecosystem.
- Identify the organisms found in an ecosystem.
- Identify how certain species are dependent on certain habitat conditions within a community.

Threatened, Endangered and Extinct Species - 4.7.7

- Select an ecosystem and describe different plants and animals that live there.

Humans and Environment - 4.8.7

- Explain how human activities and natural events have affected ecosystems.

Lesson 5 – Appendix
Writing an Environmental Impact Statement

Copy Masters for:

Environmental Impact Statement Scenario
Letter Template
Wildlife Ecology Unit: Vocabulary Review

Environmental Impact Statement Scenario

A new business called the *Clean Up Crew Two* has made a special offer to the owner of Graver Arboretum. After its parent company, *Clean Up Crew*, picks up any trash on the site, *Clean Up Crew Two* will clear away all the dead leaves, branches, logs, and all other dead material on the ground. *Clean Up Crew Two* will also remove any dead branches from living plants, and any dead plants that are still standing.

They claim that their work will make the site a neater, cleaner, and safer place for people to enjoy. Their first visit will be free, after that the landowner will pay a discount price for a cleanup every six months.

Your Challenge

Write an Environmental Impact Statement in the form of a letter to Muhlenberg College, the owners of Graver Arboretum. Say what you predict would happen to the things that live on the site if they accept the offer. Mention organisms that could lose their food or shelter, die outright, or increase. Give examples of how each thing that is affected will also affect other living things in the environment.

Rubric

Content:

1. **Mentions organisms that would die or lose their food source**.

High Quality	Meets the Objectives	Falls Short	Not Done
3 points	2 points	1 point	0

2. **Mentions organisms that could increase.**

High Quality	Meets the Objectives	Falls Short	Not Done
3 points	2 points	1 point	0

3. **Gives examples of how each thing that is affected will also affect some other living thing.**

High Quality	Meets the Objectives	Falls Short	Not Done
3 points	2 points	1 point	0

Presentation:

4. **Presents a clear and detailed argument. Gives evidence to back up inferences.**

High Quality	Meets the Objectives	Falls Short	Not Done
3 points	2 points	1 point	0

5. **Presents work that is neat, legible, and without significant errors in spelling or grammar.**

High Quality	Meets the Objectives	Falls Short	Not Done
3 points	2 points	1 point	0

Total points

15-11 points : High Quality
10-6 points: Meets Objectives
5 points or lower: Falls Short

Date: _____

Dear Sirs,

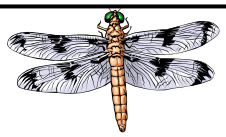
According to my research, the proposed highway will have the following effects on the ecosystem of the study site . . .

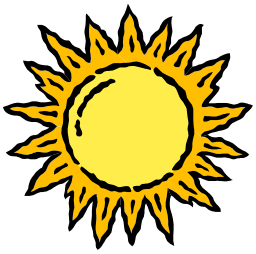
Sincerely, _____

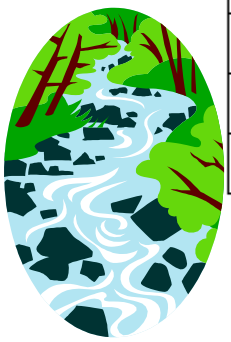
Wildlife Ecology Unit: *Vocabulary Review*

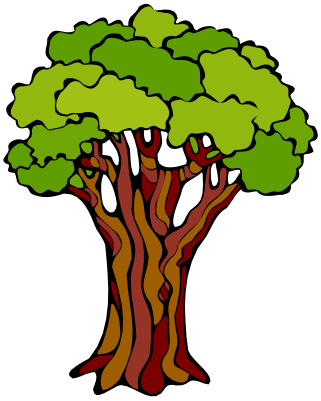
Name:_____ Class:_____

Date:_____ School:_____









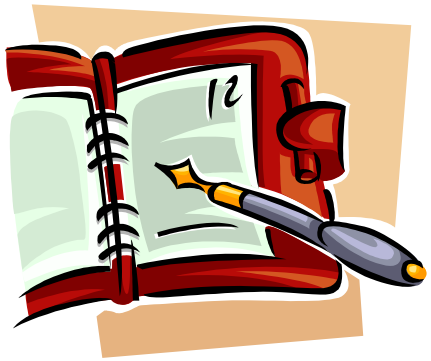
Across

5. Living things in the environment
7. Animals without backbones
10. Someone who studies the relationships between living things and their environments
11. An association of interacting populations

Down

1. The combination of all the feeding relationships that exist in an ecosystem
2. A group within a single species in which the individuals can freely interbreed
3. Information about one's environment gathered using the five senses
4. Nonliving things in the environment
6. A living thing such as a plant or animal
8. Animals with backbones
9. An idea that is generated by looking at evidence

Unit Appendix
Wildlife Ecology Journal Pages



Copy Masters:
Cover & back page
Pages 16, 1
Pages 2, 15
Pages 14, 3
Pages 4, 13
Pages 12, 5
Pages 6, 11
Pages 10,7
Pages 8, 9

**Note: The journal front and back cover page should be copied separately as a single-sided page. Cardstock is recommended but not required. The remaining journal copy masters should be stacked all facing in the same direction and photocopied front to back.*

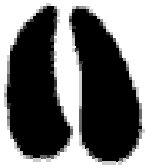
DRAFT

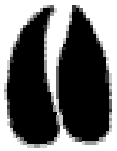
Wildlife Ecology Journal

Name: _____

School: _____

Grade: _____ Year: _____





What Makes a Good Field Observation?

Observations

Reminders – Look for and describe:

- Animals
  - The animal's body shape
  - The animal's behavior
- Plants that animals have been eating
- Other animal signs
- The locations of things
- Other signs of animals interacting with each other and with plants

Questions and Ideas

Reminders- Write ideas and questions about:

- What animals made the signs?
- What do different animals eat?
- What other interactions are taking place between the plants and animals? (Shelter, nests, hiding, getting water, etc.)
- About what do I want to know more?

Name: _____

Class: _____

Date: _____

Time: _____

Brainstorm: What is *ecology*?

Write a definition of ecology.

Ecology is _____

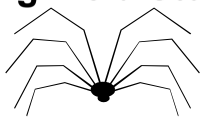
Ecology Terms:

Biotic _____

Abiotic _____

Write some examples of how wildlife depends on other wildlife in an ecosystem. *Remember, plants and even tiny, microscopic organisms are included in the term "wildlife."*

Analyzing Field Study Data



5. **Does how common something is have anything to do with what it eats? What is the relationship?**

6. **How well were you able to figure out animal signs in your study plot, what clues did you use? What are you unsure about?**

7. **Where within each plot did you find the most evidence of feeding activity? (ground level, herb layer, shrub layer, tree tops)**

8. **Have people had a high, medium or low impact on the site?**

9. **Is our study site an ecosystem? Why or why not?**

Analyzing Field Study Data

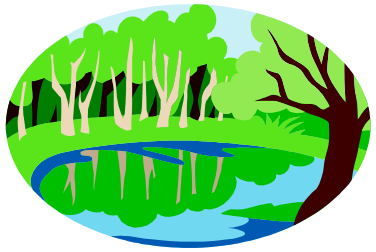
1. **Which plots have the highest biodiversity? (A lot of different kinds of living things)**

2. **Which plots have the lowest biodiversity? (Only one or two kinds of living things)**

3. **Do the physical conditions of the site with high biodiversity differ from the plots with low biodiversity? How?**

4. **What organisms were found in many plots, (were common in the study area)?**

5. **Why do you think some animals are more common than others?**



Name: _____

Class: _____

Date: _____

Time: _____

What do we already KNOW about our field study site:

_____

_____

_____

_____

List the *biotic* parts of the field study site:

List the *abiotic* parts of the field study site:

What kind of wildlife might we find at our field study site?

What do we WANT TO KNOW about our field study site?

Name: _____

Class: _____

Date: _____

Time: _____

Brainstorm: To be a careful observer, you should . . .

_____

_____

_____

_____

_____

_____

Observations

1.

2.

3.

And more . . .

Name: _____

Class: _____

Date: _____

Time: _____

Questions and Inferences

1.

2.

3.

And more . . . .

Name: _____

Class: _____

Date: _____

Time: _____

Observations

Name: _____

Class: _____

Date: _____

Time: _____

Questions and Inferences

Name: _____

Class: _____

Date: _____

Time: _____

Observations

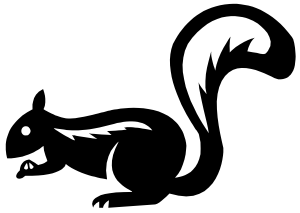
Name: _____

Class: _____

Date: _____

Time: _____

Questions and Inferences



Name: _____

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Observations

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Questions and Inferences

Name: _____

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Date: _____

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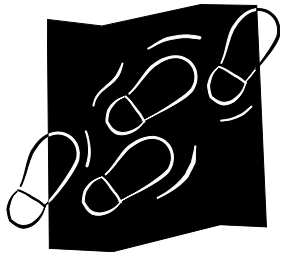
Observations



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Questions and Inferences