IMAGERS:

The Adventure of Echo the Bat

Teacher's Guide

Unit 3: Biodiversity

http://imagers.gsfc.nasa.gov

Teacher's Guide

Introduction to Teacher's Guide

Welcome to the IMAGERS Adventure of Echo the Bat Teacher's Guide! The Adventure of Echo the Bat is an interactive web site featuring an Interactive Adventure and Teacher's Guide, which combine to introduce students to remote sensing and biodiversity from a constructivist approach. The Teacher's Guide contains classroom activities and lesson plans that provide a structure to integrate the interactive adventure into the classroom. The activities introduce concepts basic to the understanding of remote sensing including understanding light and the introduction to the electromagnetic spectrum. The Adventure engages students in exploring concepts of remote sensing and biodiversity. After completing the Adventure, these concepts are reinforced back in the classroom with hands-on activities provided in the Teacher's Guide.

Participants begin with classroom activities from the Understanding Light unit. The activities allow students to explore the concepts of light. They continue investigating different electromagnetic energy with the IMAGERS Electromagnetic Spectrum web site. After introductory remote sensing activities, they start the interactive component of the IMAGERS site. A story of Echo the Bat sets the stage for the interactive adventure using a Landsat mosaic of Arizona as the interface. Students need to interpret satellite imagery to receive clues to Echo's location. As students find Echo, additional content about remote sensing and biodiversity is introduced. This web site provides teachers with a vehicle for introducing complex content that can be reinforced back in the classroom through the Remote Sensing and Biodiversity units

We created three thematic units targeted for grades 5-8: Understanding Light, Remote Sensing, and Biodiversity. Within each unit, you will find lesson plans, reproducible worksheets, visuals, and links to useful resources. The lesson plans are organized according to the 5-E constructivist model.

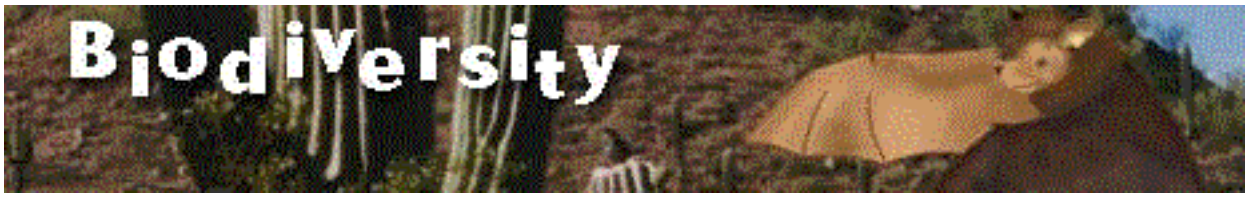
Engagement: capture attention, stimulate their thinking, assess their prior knowledge
Exploration: activity to introduce concept, an investigation
Explanation: discussion of concept, analysis of their exploration
Extension: apply concept to real world situation, expand their understanding
Evaluation: a short activity to assess students' understanding

Though IMAGERS is intended for grades 5-8, we encourage you to customize the activities to fit your class and curriculum. Depending on your students' prior knowledge, you may choose to expand or omit certain activities. See Appendix A for specific national and local standards covered in our lesson. We hope IMAGERS enables you to introduce new and exciting science concepts to your students through interactive multimedia and constructivist activities. Happy exploring!

Josephine To, SSAI, &
Ginger Butcher, SGT
http://imagers.gsfc.nasa.gov

IMAGERS: Unit III Biodiversity

Students begin this unit by identifying various habitats in Arizona and creating a food web in **Lesson 1.** As they continue the lesson, content on biodiversity is introduced. In Lesson 2, **Introducing NatureMapping**, students model the NatureMapping program to get a better understanding of how scientists study habitats.



LESSON 1: Introducing Habitats and Biodiversity

Students will:

- Identify habitats in Arizona.
- Define and illustrate a food web.
- Define and explain the importance of biodiversity in writing.

Materials Needed:

Plant and animal identification cards
available at http://imagers.gsfc.nasa.gov/fieldguide/index.html
String
Tape
Scissors

Engagement

Ask students to give their definition of "habitat." Bring them to this definition of a habitat. "A habitat is a place where a plant or animal naturally or normally lives and grows." Ask students to name some of the habitats they visited during the Adventure of Echo the Bat. Responses may include forests, Mogollon Rim, Grand Canyon, Tucson, Phoenix, desert area, etc. Ask them to predict the types of animals that live in Arizona's desert habitat. Tell them that today's activity will look at some of the plants and animals that live in Arizona's deserts.

Exploration

Tell students that their task is to illustrate how some plants and animals from Arizona's desert habitat are related to each other. Divide the students into small groups, depending on the availability of materials. Give each group a set of identification cards, string, tape, and a pair of scissors. Tell them to read the "clues" on the cards, then use the string to link the plants and animals together. When groups finish, have them present their web and describe how the plants and animals relate to each other.

Explanation

Ask students if they know what this web is called. Have students brainstorm names. Guide them to conclude that they created a food web. Ask them to give a definition of a food web. Explain that a food web is composed of many food chains. Give an example of a food chain from the food web, such as a prickly pear, an arid land honey ant, and a horned lizard.

Transition to discussing biodiversity by asking students what would happen if one part of the food web "disappeared." For example, what would happen if there were no more mesquite plants? Take a card out of the food web to illustrate this. Have students predict the outcome. Write their responses on the board. For example:

What if the ants disappeared?

Would there be less food for larger animals like lizards? Because lizards eat ants both as a source of food and a source of water, the disappearance of ants could possibly endanger the survival of lizards. The lizards are a source of food for Hawks, Road Runners and other predators. So the survival of lizards effects the survival of their predators.

What if the Harris' Hawk disappeared?

Since Hawks eat squirrels and snakes, would the population of squirrels and snakes increase? Would those animals consume more of the resources in that habitat (plants and smaller animals)? Would other animals become endangered because squirrels and snakes are eating all the food?

What if the Lesser Long-nosed bats disappeared?

Lesser Long-nosed bats are a major pollinator for saguaro cactus. They carry pollen on their noses from flower to flower. This pollinates the flowers so that fruit can form. The fruit is an essential food source for animals in the desert. The survival of animals who eat the saguaro fruit would be endangered if the bats disappeared. The fruit is the source of saguaro seeds. Saguaros are used as shelter for many animals including the cactus wren, the Gila woodpecker, the elf owl and more. So, if the Lesser long-nosed bats disappeared, the survival of animals who depend on the saguaro for food and shelter would be endangered.

Ask students how this would affect the habitat. Explain to students how the absence of biodiversity can hurt a habitat. Explain to students that if we do not take care of our habitats and keep them healthy, then it is hard for plants and animals to survive in this habitat because parts of the food web would be missing. If a part of the food web is missing, then the plants and animals that depend on it may die.

Extension

Ask students what would happen if owls, lizards, bats, and saguaro cacti disappeared from the Sonoran Desert? Would the habitat be more or less diverse? Explain the definition of diversity.

Introduce the term "biodiversity." Ask students to predict what this word means. Define the word by breaking it apart into "bio-" and "-diverse." They should conclude that "biodiversity" literally means biological diversity. Expand this definition to "a variety of living things in a habitat." Discuss with students why biodiversity is important in habitats. Lead them to the conclusion that biodiversity is an indication of a healthy environment. If a habitat has the necessary plants and animals for each to survive, then the habitat will survive.

Explain that biodiversity is important to habitats, including the one we live in. Ask students to go home and think about their habitat and determine whether it is biodiverse or not.

Evaluation

Have students write a paragraph on the habitat they live in and whether it has biodiversity or not.

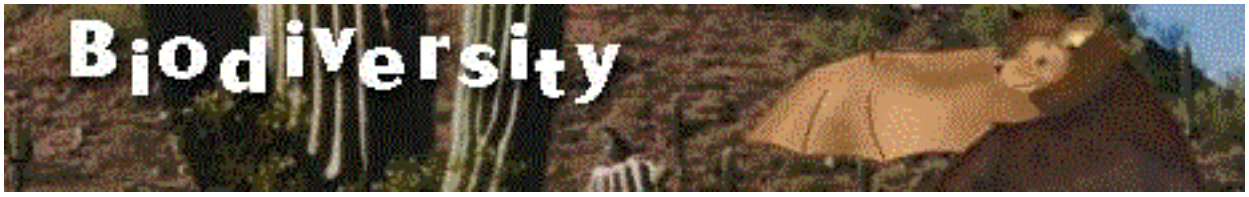
Tips for Teachers

- For shorter class periods, divide the cards into smaller groups so that students have enough time to create the web. Suggested groups:

  Group 1 - Centipede, Coyote, Creosote bush, Creosote Bush Grasshopper, Desert Hairy Scorpion, Elf Owl, Gila Woodpecker, Gambel's Quail, Long-nosed snake, Mesquite, Prickly Pear, Ringtail Cat, and Roadrunner

  Group 2 - Cactus Wren, Curve-billed Thrasher, Desert Tarantula, Gila Monster, Harris' Hawk, Harvester Ant, Jerusalem Cricket, Kit Fox, Lesser Long-nosed bat, Palo Verde Tree, Pyrrhuloxia, Rock Squirrel, Saguaro Cactus, and Teddy Bear Cholla

- Read a book to the class which illustrates describes the animals of the Sonoran Desert. See Biodiversity Resources list.



LESSON 2 - Introducing NatureMapping

Students will:

- To model the NatureMapping program.
- Learn about the NatureMapping program.

Materials Needed:

Worksheet 1 - What is NatureMapping?
Worksheet 1 - answer key
Worksheet 2 - Modeling NatureMapping
Worksheet 2 - answer key
Hidden Picture for Worksheet 2
Worksheet 3 - The NatureMapping Program

Engage

Begin by reviewing biodiversity with students. Ask them to predict how one could study habitats and its biodiversity. Write their predictions on the board. Explain that there is a program called NatureMapping that studies habitats and maintains biodiversity. Have students read Worksheet 1 to get a better understanding of the NatureMapping program.

Exploration

Tell students that one way to find out whether a habitat is healthy or not is by taking an inventory of the plants and animals in that area. If an area is biodiverse, then it is healthy. The next activity will model the NatureMapping program. Give students Worksheet 2 and the Hidden Picture Worksheet. Have students look for each type of animal and complete the chart on the worksheet.

Explanation

Ask students what information they learned from this hidden picture activity. Does this area have biodiversity? Have students predict how scientists might use this inventory, or collection of these inventories, over time and from many different locations in their study of the earth. Explain to students that this inventory allows scientists to study the biodiversity of an area. By studying the numbers of animals in a given habitat over a period of time, we may conclude that a small number of animals are thriving in that habitat. This may indicate an unbalance of the habitat and that its biodiversity is in danger. By protecting the biodiversity of an area, many species of plants and animals will benefit. Such studies may also lead to an advanced notice of a species becoming extinct. Have students continue this investigation by participating in the actual NatureMapping program. Use Worksheet 3.

Extension

Have students model the NatureMapping program by taking an animal inventory of the animals in their neighborhood. Choose a small area and observe the animals in this plot. Count the number of animals that show up.

Evaluation

Have students write a letter to a friend introducing the NatureMapping program. Include information about its purpose and role in our world.

Tips for Teachers

- See the Biodiversity Resource list for the NatureMapping Program web site.

NAME_____ **DATE**_____

What is NatureMapping?

Over the years, humans have impacted the planet earth by our large global populations and excessive use of our natural resources. As a result, species and their habitats have disappeared or dwindled. To ensure biodiversity, people have recently taken action by recycling, protecting wildlife habitats, setting up breeding programs for threatened or endangered animals, and much more.

NatureMapping is a program that was developed to identify and protect habitats, and to maintain biodiversity by keeping common animals common. Through NatureMapping, data is collected, by many members of a community, about the number of animals that live in different areas. Using this data, scientists can determine what animals are common and share the same habitats in an area. They can also see which places are more diverse, so that these areas can be protected by all of us taking better care of them.

Since 1993, Washington state students have been collecting data for this program. Now students around the country are being asked to help. Since habitats are constantly changing, it is important to have people involved locally. You and your school can participate in the NatureMapping program by collecting information about the habitats you live in.

1. How does NatureMapping help our environment?

_____

_____

_____

2. Why is it important for NatureMapping to happen?

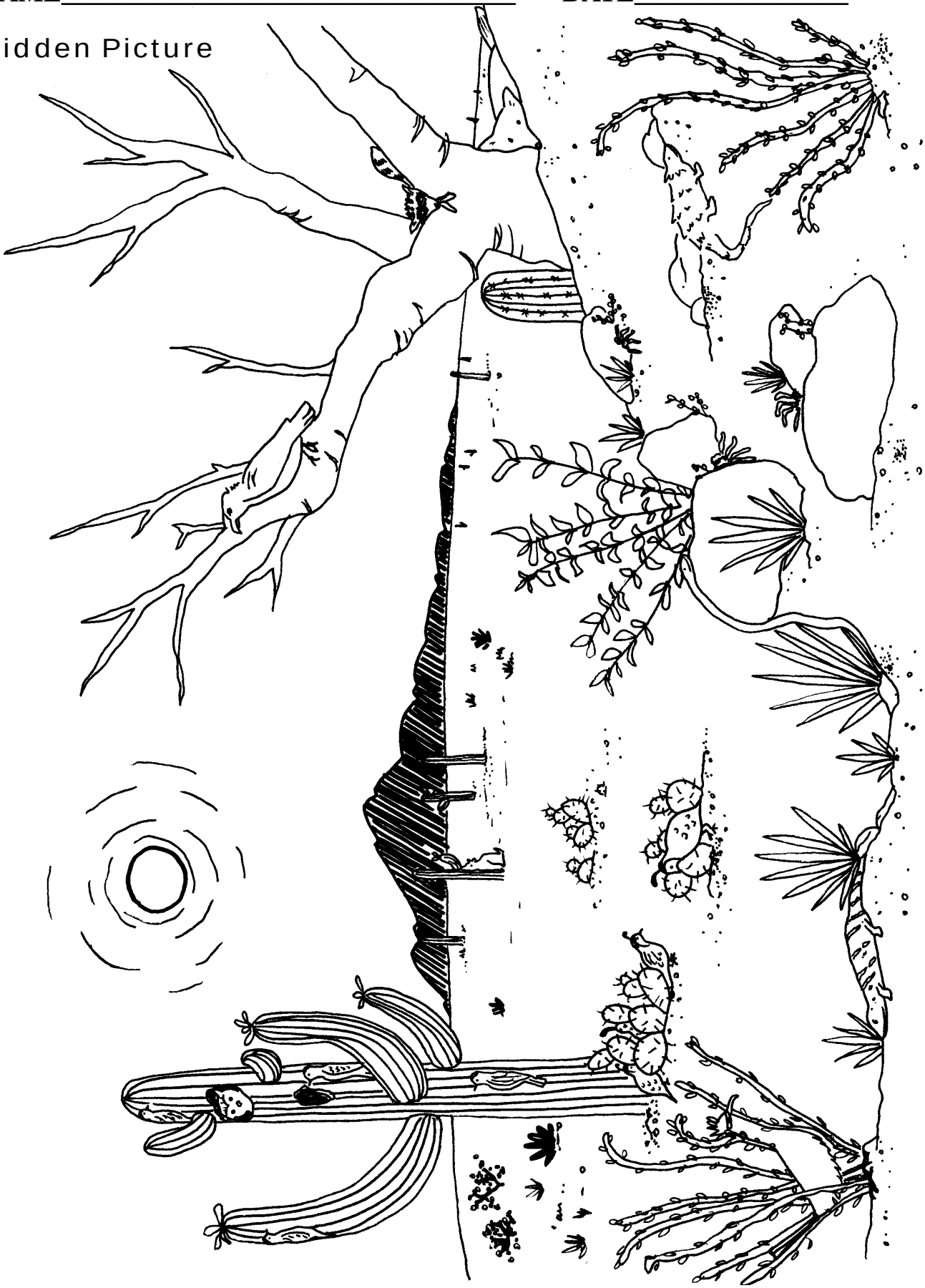
_____

_____

_____

NAME_____ **DATE**_____

Hidden Picture



NAME_____ **DATE**_____

Modeling NatureMapping

Part I - Using the Hidden Picture provided, complete the following chart. Find the animals listed below. Write down the location of each animal using the markers on the picture. Count how many animals of each type are present.

Location: Childs Valley near Childs Mountain, Sonoran Desert in Arizona
Latitude: 32º 30' N
Longitude: 113º W
Month: March
Year: 1990
Habitat: Desert

ANIMAL	**HOW MANY**
Coyote - *Canis latranus*	
Road Runner - *Geococcyx californianus*	
Gambel's Quail - *Laphortyx gambelii*	
Long-nosed Snake - *Rhinocheilus lecontei*	
Desert Tarantula - *Aponopelma chalcodes*	
Gila Monster - *Heloderma suspectrum*	
Elf Owl - *Micrathene whitneyi*	
Harris' Hawk - *Parabuteo unicinctus*	
Rig Tailed Cat - *Bassariscus astutus*	
Kit Fox - *Vulpes velox*	
Gila Wood Pecker - *Melanerpes uropygialis*	
Horned Lizard - *Phrynosoma solare*	

Conclusions:

1. What kind of information does this chart provide you?

_____

_____

_____

2. Does this area have biodiversity? How do you know?

_____

_____

_____

NAME_____ DATE_____

The NatureMapping Program

In this activity, students will make an inventory of the animals living in the ecosystems around their school.

Materials Needed:

- Maps - U.S. Geological Survey or topographic maps that show latitude & longitude
- Field Guides
- Binoculars and cameras
- Field notebooks and data collection form (Data collection forms may be printed from http://cerdev.hs.washington.edu/nm/wildlife/1form.html)

Directions:

1. Mark the area on the map and take a photocopy of the area. On the photocopy, write the topographic map name, city, county and state and your name. Use latitude and longitude to identify your area. You can access U.S. Geological Survey to find your latitude and longitude for most schools in the U.S. If you are still unsure, we can help identify the latitude and longitude when you send in a copy of the map with your data form.

2. Without disturbing the area, record the animals observed here.

3. Use the field guides to decide the species' common name. For example, there may be three Chickadees (Black-Capped, Mountain, or Chestnut-Backed) in your state and we need to know, to the best of your ability, which species you see. If you are not positive, put a '?' next to the animal's name.

4. Record the month and year and type of habitat (i.e. pond, football field, trees along the fence, etc.) on the form.

5. Listen for vocalizations of animals. Include this information on the form.

6. Record the number of each animal seen.

7. (Optional) Create a scrapbook of the wildlife and habitats around your school. If you are unsure of the identity of an animal, send us a picture and we will return it, with the identification of the species.

8. (Optional) Field notebooks comprise of notes and drawings, so students can report their entire experience during their fieldwork. Notebooks are journals and are important if a site will be monitored (visited on a regular basis, which could be daily, weekly, monthly, etc.) and for students to recall a trip made weeks or months before. Field Notebooks should not be mailed with the NatureMapping form.

Send the completed data chart to:

Karen M. Dvornich
University of Washington
Box 357980
Seattle, Washington USA 98195-7980

or email her at kgap@salmo.cqs.washington.edu

For more detailed information on the NatureMapping Program, visit the NatureMapping website at http://salmo.cqs.washington.edu/~wagap/nm

Biodiversity Resources

Web Sites

- *The NatureMapping Program* http://salmo.cqs.washington.edu:80/~wagap/nm/
- *Bat Conservation International* http://www.batcon.org/

Books

- Exploring Caves, U.S. Department of the Interior/ U.S. Geological Survey, 1997. Includes lesson plans on various science topics including Earth Science and Biology. Appropriate for grades K-3.
- Cactus Café: A Story of the Sonoran Desert by Kathleen Weidner Zoehfeld, Soundprints, 1997. Focuses on the Saguaro Cactus and its role in the desert. Includes descriptions of various animals and how they depend on the cactus for food and shelter.
- How Nature Works by David Burnie, Reader's Digest Association, 1991. A useful book for the junior high level detailing different aspects within phyla, with a small ecology section including food chains and habitats. Clear descriptions and colorful pictures, some experiments.
- BATS: Swift Shadows in the Twilight by Ann C. Cooper, Denver Museum of Natural History, 1994. A collection of activities about bats. Includes Native American legends about bats.
- Marcelo el Mucielago/ Marcelo the Bat by Laura Navarro, Bat Conservation International, Inc., 1997. A bat story written in both English and Spanish. Includes some interesting facts about bats.
- Creatures of the Desert World, National Geographic Society, 1987. A colorful, pop-up book with some text.
- The Three Little Javelinas by Susan Lowell, Reading Rainbow Book, 1992. A chronological story similar to The Three Little Pigs. Takes place in the Sonoran Desert.
- Stellaluna by Janell Cannon, Harcourt Brace & Company, 1993. A children's book with a heart-warming bat story. Teaches about bats and their habitat.
- Bat Jamboree by Kathi Appelt, First Scholastic printing, 1997. A colorful story filled with bats and other animals. Suitable for elementary grades.
- Zipping, Zapping, Zooming Bats by Ann Earle, Harper Collins Publishers, 1995. Includes interesting and fun facts about bats.
- Batbaby by Robert Quackenbush, Random House, 1997. A brief bat story . Includes colorful drawings and text.
- The Bat House Builder's Handbook by Merlin D. Tuttle and Donna L. Hensley, Bat Conserva-

tion International, Inc., 1993. Teaches how to build a bat house. Includes information on bats and bat conservation.

- Bats: Night Fliers by Betsy Maestro, Scholastic Inc., 1994. Includes descriptive detail and facts on bats. Teaches about the different types of bats.

Related Science Standards

AAAS Project 2061 Benchmarks

- **5D (6-8)** In all environments - freshwater, marine, forest, desert, grassland, mountain, and others - organisms with similar needs may compete with one another for resources, including food, space, water, air, and shelter. In any particular environment, the growth and survival of organisms depend on the physical conditions.
- **5D (6-8)** Two types of organisms may interact with one another in several ways. They may be in a producer/consumer, predator/prey, or parasite/host relationship. Or one organism may scavenge or decompose another. Relationships may be competitive or mutually beneficial. Some species have become so adapted to each other that neither could survive without the other.
- **12A (3-5)** Keep records of their investigations and observations and not change the records later.
- **12C (3-5)** Keep a notebook that describes observations made, carefully distinguishes actual observations from ideas and speculations about what was observed, and is understandable weeks or months later.

National Science Education Standards

Grades 5-8

- **Populations and Ecosystems** - A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.
- **Populations and Ecosystems** - Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some micro-organisms are producers — they make their own food. All animals, including humans, are consumers, which obtain food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem.
- **Populations, Resources, and Environments** - When an area becomes overpopulated, the environment will become degraded due to the increased use of resources.
- **Populations, Resources, and Environments** - Causes of environmental degradation and resource depletion vary from region to region from country to country.

Maryland School Performance Assessment Program Concept Indicators

Life/Earth Science

- **(4-5)** - Individuals and groups of organisms interact with each other and their environment.
- **(4-5) -** Humans depend on natural resources to meet needs and wants.
- **(6-8)** - Humans have a major impact on the living and non-living environment.
- **(6-8)** - Earth is changed over time by different natural and human forces.