Project CONN-CEPT Science Units

Astronomy: Sun, Moon, and Stars (K-2)
The World of Matter (1)
Living Things: Changes, Stages and Cycles (2-3)
Eurekas and Ecosystems
Light: A Rainbow of Explorations (4-5)
Sound's Story: H-Ear the Pitch (4-5)
Structure and Function: What's Their Junction (6)
Weather: The Never-ending Story (6)
Cells: The Story of Life (7)
Reactions and Interactions (7-8)

Project CONN-CEPT Social Studies Units

Time, Change, and Continuity in History (K)
Local Government (3)
What Makes a Region? An Investigation of the Northeast (4)
Goods, Services, Resources, Scarcity and Systems: An Exploration of State Economics (4-5)
Concepts and Tools of the Geographer (6)
With Liberty and Justice for All: A Study of the U.S. Constitution (6-8)

Units in Preparation

Junior Economist: People, Resources and Trade (1-2)
A Habitat is a Home for Plants and Animals: Needs, Resources, Adaptation and Systems (1-2)
May the Force Be with You: Forces, Motion and Simple Machines (2-3)
Geology: Rocks, Soil, Cycles and Systems (3)
Peopling of the Americas (4-5)
Going to the Source: Using Primary Resources in United States History (6-8)
Exploring the World's Oceans: Chemistry, Geology and Biology (7)
Reactions and Interactions: Chemical Reactions (7-8)

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A Shared Story

The exhibit hall was huge, and publishers' banners, suspended from the ceiling, waved back and forth in the air conditioned room. Hundreds of conference participants filled the aisles. Vendors of curriculum materials, eager to share their colorful and glossy wares with passing teachers and administrators, stood at the edge of their displays offering warm smiles, prizes, and publishers' catalogues.

Charlene and Andrew had carefully planned their tour through the aisles and divided up so that they could see all the materials. They looked forward to their time in the vendor area because they needed curriculum materials in social studies and science for their upper elementary and middle school students. They hoped they would find something good. They wanted coherent, comprehensive units that addressed their state and national standards, had good assessments, required students to think their way through content, provided teachers with teaching strategies, and some guidance regarding how to differentiate the curriculum for students with varied learning needs.

They looked at many cleverly designed curriculum packages and kits. Most materials were collections of episodic learning activities. Some contained coherent learning activities for students, but did not teach to the critical concepts and principles embedded in state and national standards. Other materials, claiming to be comprehensive, did not contain aligned pre- and post-assessments, user-friendly teacher information, suggestions for teaching, or techniques for differentiating. Several kits attended to concepts and principles, but none was comprehensive enough to address all the standards for a particular grade level. At least two kits would be required to cover the prerequisite standards. Worse, the cost for the two kits would not include the price for the consumables that would have to be purchased each year to keep the kits adequately stocked. They could hardly pay for the cost of one kit!

Charlene and Andrew met at the back of the hall and compared notes. They were disappointed because they realized that the high-quality, standards-based curriculum materials they wanted were not in the racks. Now what? Were there other vendors? If so, who were they and how could they be contacted? If there were no vendors with the materials they needed, could they write the needed curriculum themselves? Who could help them? Did the district have money to pay stipends for curriculum development? How could they possibly write all the curricula that was required to address the state assessments?

We dedicate this curriculum unit, as well as others written under this Javits grant, to all the teachers who have had experiences like Charlene and Andrew. We hope the unit presented here will meet the needs of educators who live in real classrooms, contend with real time constraints, prepare students adequately for high-stakes assessments, seek high-quality curriculum materials, and strive to meet the varied learning needs of all their students.

Deborah E. Burns
Jeanne H. Purcell

PREFACE

In 2002, the Connecticut State Department of Education was awarded a Javits grant from the U.S. Department of Education called Project CONN-CEPT. The major focus of grant activities was the creation of standards-based curriculum units, K-8, in science and social studies. These rigorous curriculum units have been created for all students because every child must have access to the highest quality curriculum. At the same time, the units also have a particular focus on the needs of advanced learners—those who know more, learn more rapidly, think more deeply, or who are more innovative in a particular area of study. It was our goal to embed learning opportunities for advanced learners that were tightly aligned with the concepts and principles that guided the unit.

The Parallel Curriculum Model

This standards-based curriculum unit has been designed using the *Parallel Curriculum Model* (PCM) (Tomlinson, Kaplan, Renzulli, Purcell, Leppien, & Burns, 2002). The *Parallel Curriculum Model* is a set of four interrelated designs that can be used singly, or in combination, to create or revise existing curriculum units, lessons, or tasks. Each of the four parallels offers a unique approach for organizing content, teaching, and learning that is closely aligned to the special purpose of each parallel. The four parallels include: the Core Curriculum Parallel, the Curriculum of Practice, the Curriculum of Connections, and the Curriculum of Identity.

The *Core Curriculum* addresses the core concepts, principles, and skills of a discipline. It is designed to help students understand essential, discipline-based content through the use of representative topics, inductive teaching, and analytic learning activities. The *Curriculum of Connections* builds upon the Core Curriculum. It is a plan that includes a set of guidelines and procedures to help curriculum developers connect overarching concepts, principles, and skills within and across disciplines, time periods, cultures, places, and/or events. This parallel is designed to help students understand overarching concepts, such as change, conflict, cause and effect, and patterns, as they relate to new content and content areas. The *Curriculum of Practice* is a plan that includes a set of guidelines and procedures to help students understand, use, generalize, and transfer essential knowledge, understandings, and skills in a field to authentic questions, practices, and problems. This parallel is designed to help students function with increasing skill and competency as a researcher, creator, producer, problem solver, or practitioner in a field. The *Curriculum of Identity* is a plan that includes a set of guidelines and procedures to assist students in reflecting upon the relationship between the skills and ideas in a discipline and their own lives, personal growth, and development. This parallel is designed to help students explore and participate in a discipline or field as it relates to their own interests, goals, and strengths, both now and in the future.

The *Parallel Curriculum Model* also contains a new concept called Ascending Intellectual Demand (AID). Ascending Intellectual Demand offers practitioners a way to think about a discipline and each student's steady, progressive movement from novice to expert within that discipline. As students are ready, teachers ask students for increasing levels of cognition, affect, and application. As such, AID is a framework teachers use to increase the challenge level for students by asking them to behave and act in expert-like ways. (Tomlinson, Kaplan, Purcell, Leppien, Burns, & Strickland, 2006).

This unit has been designed using the Core Curriculum parallel. Core Curriculum addresses the essential concepts, principles, generalizations, and skills of a subject area. It is designed to help students understand essential, discipline-based content through the use of representative topics, inductive teaching, and analytic learning activities. Although the majority of lessons in this unit have been designed using the Core Curriculum parallel, it also contains several lessons that provide students with opportunities to explore other parallels that are closely connected to the subject matter.

Our Invitation...

We invite you to peruse and implement this curriculum unit. We believe the use of this unit will be enhanced to the extent that you:

- **Study PCM**. Read the original book, as well as other companion volumes, including *The Parallel Curriculum in the Classroom: Units for Application Across the Content Areas, K-12 and The Parallel Curriculum in the Classroom: Essays for Application Across the Content Areas, K-12*. By studying the model in depth, teachers and administrators will have a clear sense of its goals and purposes.
- **Join us on our continuing journey to refine these curriculum units.** We know better than to suggest that these units are scripts for total success in the classroom. They are, at best, our most thoughtful thinking to date. They are solid evidence that we need to persevere. In small collaborative and reflective teams of practitioners, we invite you to field test these units and make your own refinements.
- **Raise questions about curriculum materials.** Provocative, compelling and pioneering questions about the quality of curriculum material—and their incumbent learning opportunities—are absolutely essential. Persistent and thoughtful questioning will lead us to the development of strenuous learning opportunities that will contribute to our students' life-long success in the 21st century.
- **Compare the units with material developed using other curriculum models.** Through such comparisons, we are better able to make decisions about the use of the model and its related curriculum materials for addressing the unique needs of diverse learners.
- **Examine PCM as one bridge between general and gifted education.** We believe that the rigorousness of PCM has much to offer *all* students, not just those who may be already know, do, or understand at very different levels of sophistication.

ACKNOWLEDGEMENTS

We would like to thank our mentors, Carol Tomlinson and Carolyn Callahan. They have been our constant supporters and guides as we moved into uncharted territory related to curriculum development and differentiation.

Over the years we have been guided by the wise counsel of our curriculum writers: Cheryll Adams, Renee Alister, Karen Berk, Fie Budzinsky, Meagan Bulger, Yvette Cain, Lori Cipollini, Leslie Chislett, Megan Coffey, Edie Doherty, Claire Farley, Kurt Haste, Carla Hill, MaryAnn Iadarolla, Caitlin Johnson, Megan Lamontagne, Donna Leake, Lisa Malina, Kay Rasmussen, Martha Rouleau, Cindy Strickland, Mary Grace Stewart, Kim Turret, Ann Marie Wintenberg, and Karen Zaleski. They have worked tirelessly on their curriculum units and provided us with many insights into the curriculum writing process. Although we had a road map at the outset of the writing process, our writers helped us to craft new roads when the old ones no longer worked. We thank them for their integrity, care, innovativeness, and encouragement.

We thank all of the people who featured into the field testing process. These people include teachers in Cheshire, Hartford and Portland Public Schools. We especially want to thank the following building administrators who supported our work: Tory Niles and John Laverty from Hartford; Linda Cahill and Deborah Granier from Portland; and Steve Proffitt, Diane DiPietro, Sharon Weirsman, Russ Hinkley, Beverly Scully, and Mary Karas from Cheshire. The insights from teachers and administrators helped to make our curriculum units stronger and more practical.

Kim Allen, from Project LEARN, provided us with assistance and support in all of our endeavors and made sure that we stayed the course in solid financial standing. Nancy Wight and Gail Heigel, from Cheshire Public Schools, spent untold hours formatting, typing, duplicating, collating, and distributing the experimental units and ordering the numerous student materials and teacher resources that supplement these lessons. They are the masters of due diligence and attention to detail. We also wish to thank Eileen Williams and Patricia Johnson, from the State Department of Education, for formatting, typing, and preparing the pre-assessments and post assessments for the units. They worked tirelessly for many hours after work and on weekends to meet our deadlines and never lost their smiles.

We thank Cheshire Public Schools and the Connecticut State Department of Education for allowing us to take on this tremendous task and allowing us the hours within day (and night) to accomplish all that was required.

Our families and friends deserve special recognition because they offered unwavering support and encouragement. We recognize they made personal sacrifices, and we hope that we have grown as a result.

Most of all, we would like to thank Judy Walsh on whose shoulders these units truly stand. With the greatest of care and unparalleled thoughtfulness and consideration, Judy has edited each manuscript, worked collaboratively with each author to refine each lesson, written lessons when it was necessary, and provided a sense of humor and her wisdom as a teacher. She is selfless and seeks only to advance each author and the project. In every way, she has been our "North Star" on the project.

Format for the Project CONN-CEPT Curriculum Units

Each Project CONN-CEPT curriculum unit is formatted in the same way and contains four components: an overview, the lessons, a content map, and a comprehensive list of resources required in the unit. The *overview* is a chart that includes the lesson principles, concepts and skills, the time allocation, the standards that are explicitly addressed within each lesson, and a brief description of each lesson. The overview provides potential users with a "snap-shot" of the unit, related standards, and classroom activities.

The *lessons* follow the overview and vary in number depending upon the content area and grade level of the unit. Each lesson is comprehensive and addresses 10 curriculum components: content, assessments, introductory and debriefing activities, teaching strategies, learning activities, grouping strategies, products, resources, extensions, and differentiation activities. For the most part, each lesson provides specific information about each of these components. An aligned pre- and post-assessment is included for the entire unit, and aligned formative assessments are provided at critical junctures in the unit. Additionally, each lesson contains all the required black-line masters and materials.

Many lessons contain two features that are unique to Project CONN-CEPT materials: opportunities for Ascending Intellectual Demands (AID) and talent-spotting activities. Ascending Intellectual Demand is a term used to describe learning opportunities that require students to work at increasing levels of discipline-specific expertise (Tomlinson et al). They are appropriate for any student who demonstrates advanced ability or expertise in a discipline. The AID opportunities are labeled using the acronym AID. Additionally, many lessons contain searchlight opportunities. Searchlight opportunities are rich moments during a lesson for teachers to observe students and note those who appear to have heightened interest in the topic under investigation. To support these students' emerging interests, extension ideas are provided.

A *content map* comes after the lessons. Like the overview, the content chart is a snap-shot of the important knowledge in a unit: the major and minor principles, concepts, skills, themes and guiding questions. Teachers who want in-depth information about the knowledge contained in the unit will find this chart useful.

A comprehensive list of *resource materials* concludes each unit. Although the required materials are also listed at the beginning of each lesson, the comprehensive listing provides teachers with a one-page summary of all the materials and it facilitates planning.

Introduction to Eurekas and Ecosystems - Grade 4

Eurekas and Ecosystems is a unit that provides students with opportunities to deepen their understandings about ecosystems by exploring its ecological science concepts and discovering facts and connections that students never realized existed, hence the title, "Eurekas and Ecosystems."

This unit on ecosystems has been designed using the Core Curriculum parallel. Core Curriculum addresses the core concepts, principles, generalizations, and skills of a subject area. It is designed to help students understand essential, discipline-based content through the use of representative topics, inductive teaching, and analytic learning activities. Although the majority of lessons in this unit have been designed using the Core Curriculum parallel, it also provides grade four students with opportunities to explore the methodology of the practicing professional (Curriculum of Practice).

The unit contains 14 lessons that are outlined in the chart below. The first column contains the lesson number and the name of the parallel(s) that the lesson addresses. The second column contains a series of numbers. The numbers reflect the national standards—culled from *National Science Education Standards* (National Research Council, 1996) and *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993)—that are addressed in each lesson and that are listed and numbered below. For brevity's sake, only one or two standards are listed in each row of the chart and represent the major focus of individual sessions. However, the lessons have been designed to build upon each other, and each session builds iteratively upon many of the standards. Connecticut's standards are also referenced here and are cited in the same column.

Column three contains the principles that guide the lesson. The principles—which state relationships among essential concepts—reflect what we want students to know and be able to do upon completing the lessons. They are derived from the standards, reflect both declarative and procedural knowledge, and illustrate the careful attention that has been given to "teasing apart" the complexity of ideas contained within standard statements.

Column four includes a brief description of the lesson. It provides an overview of some of the teaching and learning activities that are designed to occur within the classroom.

National Standards

Life Science

1. Organisms have basic needs. Organisms can survive only in environments in which their needs can be met. The world has many different environments, and distinct environments support the life of different types of organisms. (*National Science Education Standard*s, K-4)
2. Each plant or animal has different structures that serve different functions in growth, survival, and reproduction. (NSES*, K-4)
3. All animals depend on plants. (NSES, K-4)
4. An organism's patterns of behavior are related to that organism's environment, including the kinds and numbers of other organisms present, the availability of food and resources, and the physical characteristics of the environment. (NSES, K-4)
5. Plants and some microorganisms are producers—they make their own food. All animals, including humans, are consumers that obtain food from eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. (NSES, 5-8)
6. All organisms cause changes in the environment in which they live. Some of the changes are detrimental to the respective environment; others are beneficial. (NSES, K-4)

Science in Personal and Social Perspective

7. Some environmental changes occur slowly (drought Lesson 4), and others occur rapidly (oil spill Lesson 5). (NSES, K-4)

Interdependence of Life

8. Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful. (*Benchmarks for Science Literacy***, 3-5)

Science as Inquiry

9. Scientists use different kinds of investigations depending on the question they are trying to answer. Types of investigations include describing objects, events and organisms; classifying them; and doing fair test (experimenting). (NSES, Science as Inquiry, K-4)
10. Scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge). Good explanations are based on evidence from investigations. (NSES, Science as Inquiry, K-4)

* National Research Council. (1996). *National science education standards.* Washington, DC: National Academy Press.

** American Association for the Advancement of Science. (1993). *Project 2061: Benchmarks for science literacy.* New York: Oxford University Press.

Connecticut Related Content Standards
Grades 3-5

I Scientific Inquiry (Expected Performances – B INQ. 1, B INQ. 2, B INQ. 3, B INQ. 4)
Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.

Scientific Literacy (Expected Performances – B INQ. 5, B INQ. 6, B INQ. 8)
Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science.

Scientific Numeracy (Expected Performances – B INQ. 9, B INQ. 10)
Mathematics provides useful tools for the description, analysis and presentation of scientific data and ideas.

Grade 4

3.2 Matter and Energy in Ecosystems (Expected Performances – B 3, B 4)
How do matter and energy flow through ecosystems?
Organisms can survive and reproduce only in environments that meet their basic needs.
• Plants and animals have features that help them live in different environments.

4.2 Matter and Energy in Ecosystems (Expected Performances – B 10, B 11)
How do matter and energy flow through ecosystems?
All organisms depend on the living and non-living features of the environment for survival.
• When the environment changes, some organisms survive and reproduce and others die or move to new locations.

American Association for the Advancement of Science. (1993). *Project 2061: Benchmarks for science literacy*.

Lesson	Standards	Lesson Principles	Lesson Description
1 (CORE) 50 minutes			This lesson includes a pre-assessment that samples the content in this unit: ecosystems, the interdependence of organisms, food chains, adaptations, and the skills involved with scientific inquiry.
2 (CORE) 45 minutes		• Living and non-living things interact with one another in various ways. • Ecosystems have living and non-living things. • Organisms have dependent and interdependent relationships that enhance survival.	Students begin the unit in a large group discussion about the concept of an ecosystem by using their classroom as a model.
3 (CORE) 45 minutes	1,4, 6, 7, 8, 9, 10 CT Standards: 3.2 (Expected Performances – B3, B4) 4.2 (Expected Performances – B 10)	• Real-world ecosystems can be modeled and studied. • Ecosystems have living and non-living things. • Living and non-living things interact with one another in various ways. • Environmental changes occur for various reasons and at varying rates.	Students build a mini-pond in a jar in order to make observations over 2 ½ weeks to learn about the interactions in different ecosystems and how they change over time.
4 CORE) 50 minutes plus 1 to 1 1/2 weeks of observations	1,4, 6, 7, 8, 9, 10 CT Standard: 3.2 (Expected Performances – B3, B4) 4.2 (Expected Performances – B 10, B 11)	• Models are used to study the various aspects of nature • Living and non-living things interact with one another in various ways. • Organisms have dependent and interdependent relationships that enhance survival. • Real-world ponds can be modeled and studied. • Ecosystems can change because of changes in environmental conditions. • Environmental changes occur for various reasons and at varying rates.	Students build another mini-pond in a jar and let it dry out in an effort to simulate a natural environmental change, such as drought and its impact on an ecosystem. They make observations over 1 ½ weeks to learn about how an ecosystem can be changed as a result of natural causes.

EUREKAS AND ECOSYSTEMS

Lesson	Standards	Lesson Principles	Lesson Description
5 (CORE/AID) 50 minutes	1,4, 6, 7, 8, 9, 10 CT Standard: 3.2 (Expected Performances – B 3, B 4) 4.2 (Expected Performances – B 11)	• Models are used to study the various aspects of nature. • Living and non-living things interact with one another in various ways. • Organisms have dependent and interdependent relationships that enhance survival. • Ecosystems can change because of human impact.	The NSES indicates that students in grades K-4 understand that pollution is a change in the environment that can influence the health, survival, or activities of organisms, including humans. Students in this lesson will engage in an activity that explores what happens to sea birds when their habitat is polluted by oil.
6 (CORE/AID) 45 minutes	3,6 CT Standard: 4.2 (Expected Performances – B 10)	• Some scientific models have limitations that may restrict our understanding of scientific phenomenon. • Organisms need a source of energy, such as food, to live and grow. • Organisms can be grouped based on the method by which they obtain food.	In the first part of this lesson, students engage in a whole group discussion about the limitations of their model ecosystems. They will also discuss how the needs of organisms—living within an ecosystem—necessitate interdependence.
7-8 (CORE/AID) 1 hour, 30 minutes	3, 5, 6 CT Standard: 4.2 (Expected Performances – B 10, B 11)	• Ecosystems have producers, consumers and decomposers. • Ecosystems have food chains. • Organisms can be grouped based on the method by which they obtain food.	This lesson will help students deepen their understanding of interdependence through a study of food chains. Students will identify food chains in various ecosystems and explore what might happen if an organism is removed from a food chain.

Lesson	Standards	Lesson Principles	Lesson Description
9-10 (PRACTICE/ AID) 1 hour, 30 minutes	3, 5 CT Standards: I (Expected Performances – B INQ. 1, 2, 3, 4, 5 6, 8, 9, 10) 4.2 (Expected Performances – B 11)	• Organisms have dependent and interdependent relationships that enhance survival. • Ecosystems have food chains.	In this two-session simulation, students assume the role of scientists as they investigate: (1) what an owl eats through a dissection and analysis of owl pellets, and (2) what an owl's role is in a food chain. Additionally, they will weigh evidence and draw conclusions related to the data in the simulation.
11 (CORE) 45 minutes	1 CT Standard: 4.2 (Expected Performances – B 10)	• The diversity among ecosystems supports a wide variety of life forms on earth. • Ecosystems have similarities and differences.	Students will compare pictures of various real-world ecosystems to identify similarities and differences among them. Through large group discussion and questioning, students will develop an appreciation for the spectrum of diverse habitats on earth.
12 (CORE) 45 minutes	1 CT Standard: 4.2 (Expected Performances – B 10)	• Organisms have preferred habitats in which to live. • Some of an organism's features help it survive. • Features that help an organism survive are called adaptations.	By playing a game that has been adapted from Project WET, called "Water Addresses," students will explore the relationship between animal adaptations and the habitats in which they live.
14 (CORE) 50 minutes		All principles in the unit.	Post assessment

Reference

American Association for the Advancement of Science. (1993). *Project 2061: Benchmarks for science literacy*. New York: Oxford University Press.

Connecticut State Department of Education. (2004). *Core science curriculum framework*. Hartford, CT: Connecticut State Department of Education.

National Research Council. (1996). *National science education standards*. Washington, DC: National Academy Press.

Tomlinson, C. A., Kaplan, S. N., Renzulli, J. S., Purcell, J., Leppien, J., & Burns, D. (2002). *The parallel curriculum: A design to develop high potential and challenge high-ability learners*. Thousand Oaks, CA: Corwin Press.

CONTENTS

Preface	Page I
Acknowledgements	Page III
Format	Page V
Introductions to Eurekas and Ecosystems Grade 4	Page VI
Lesson 1, Module 1: Ecosystems and Scientific Inquiry Time Allocation: 50 minutes	Page 1
Lesson 2, Module 1: Ecosystems and Scientific Inquiry Time Allocation: 45 minutes	Page 11
Lesson 3, Module 1: Ecosystems and Scientific Inquiry Time Allocation: 45 minutes	Page 17
Lesson 4, Module 1: Ecosystems and Scientific Inquiry Time Allocation: 50 minutes plus 1 to 1 1/2 weeks of observation	Page 35
Lesson 5, Module 1: Ecosystems and Scientific Inquiry Time Allocation: 50 minutes	Page 47
Lesson 6, Module 2: Food Chains Time Allocation: 45 minutes	Page 61
Lesson 7 & 8, Module 2: Food Chains Time Allocation: 1 hour, 30 minutes	Page 69
Lesson 9, Module 2: Food Chains Time Allocation: 45 minutes	Page 87

CONTENTS

Lesson 10, Module 2: Food Chains Page 97
Time Allocation: 45 minutes

Lesson 11, Module 3: Adaptations Page 103
Time Allocation: 45 minutes

Lesson 12, Module 3: Adaptations Page 113
Time Allocation: 45 minutes

Lesson 13, Module 3: Adaptations Page 123
Time Allocation: 45 minutes

Lesson 14, Module 3: Adaptations Page 133
Post Assessment: 50 minutes

Curriculum Map Page 144

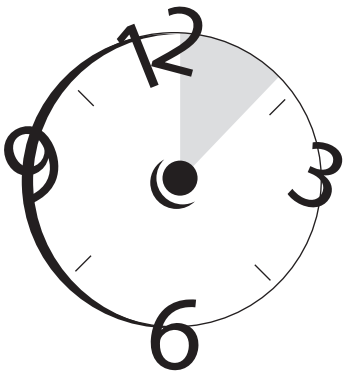
Materials and Resources Page 152

Ecosystems and Scientific Inquiry

Core

Time Allocation: 50 minutes

Required Materials and Resources on Page 152



Lesson Overview

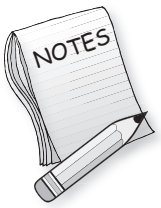
Students in this lesson answer questions that will serve as the pre-assessment of their understandings regarding the nature of ecosystems. In addition, students have the opportunity to brainstorm a list of topics/questions about ecosystems that they would like answered during this unit.

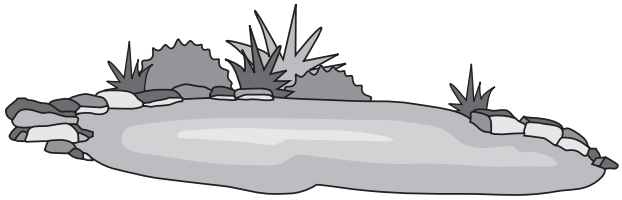
Guiding Questions

- What is an ecosystem?
- Why are some organisms living successfully in certain places and not in others?
- Why should you care about the smallest snail, an endangered quail and the quality of air?
- In what ways do people affect ecosystems?

BIG IDEA

What is an Ecosystem?





Content Goals

Universal Themes

- The natural world is composed of systems, which are organized groups of related objects that together form a whole.
- Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena.
- Form and function are complementary aspects of objects, organisms and systems in the natural world. Form and function are interdependent.

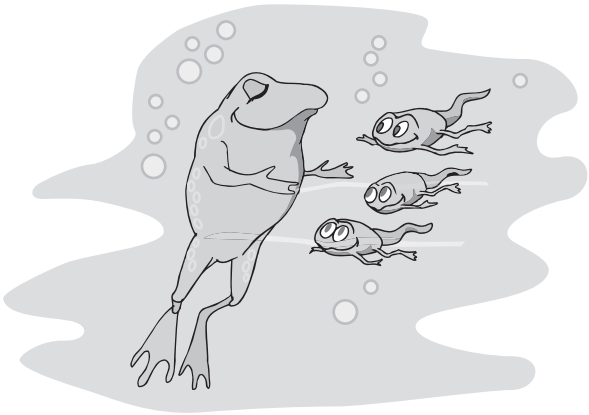
Principles and Generalizations

This list of principles includes much of the content that will be discussed in the unit. They are listed here because this lesson is the pre-assessment, and it requires students to have knowledge about many of the relationships expressed below.

- Ecosystems have living and non-living things.
- Organisms must have their needs met in order to grow and live.
- Living things depend on other living and non-living things to meet their needs.
- Organisms have dependent and interdependent relationships that enhance survival.
- Ecosystems contain producers, consumers and decomposers.
- Producers, consumers and decomposers perform different functions in an ecosystem.
- Ponds are ecosystems.
- Organisms can be grouped based according to the method by which they obtain food.
- Most animals are ultimately dependent on plants for their food.
- Some animals eat plants.
- Some animals eat only animals.
- Some animals eat both plants and animals.
- Decomposers have an important role in ecosystems.
- Decomposers cause dead organisms to decay.
- Many microorganisms are decomposers and are beneficial.
- Ecosystems contain food chains.
- In order to meet their needs, some organisms live at the expense of others.
- Most ecosystems have multiple food chains.

Concepts

- Ecosystems
- Organisms
- Microorganism
- Animals
- Plants
- Interdependence
- Survival
- Environment of non-living things
- Producer
- Consumer
- Decomposer
- Pond ecosystem
- Food chain
- Form and function



Teacher Information

N/A

Skills

- Identify characteristics
- Analyze
- Compare and contrast
- Draw conclusions

Materials and Resources

1. Poster of a pond ecosystem that students will study in the unit (find one at Google Images by putting in "pond ecosystem.")
2. A flip chart and markers

Preparation Activities

1. Hang the picture of the ecosystem in the front of the room so that all students can see it and have access to it for a closer view, if desired.
2. Be prepared to examine the pre-assessments closely when students are finished. Acting like a qualitative researcher, separate the students' pre-assessments into piles according to the most critical difference that you uncover. Differences might include, for example, prior knowledge or stylistic differences. Make sure to note these differences and be prepared to modify the upcoming lessons accordingly. Many extension opportunities are provided, as are alternative lessons requiring more cognitive challenge for students. Notes are also provided that will assist teachers in providing more feedback or scaffolding to students who need more support.

Introductory Activities

N/A

Pre-Assessment

Have students use the picture to complete the pre-assessment activity.

Teaching and Learning Activities (40 minutes)

1. Hand out the pre-assessment questions.

2. Tell students to answer the questions to the best of their knowledge and reassure them that this activity is not a test.

3. Explain the purpose of pre-assessment is for the teacher to have information related to what their students know or do not know so that instructional activities can be designed that are appropriate for their specific learning needs.

Products and Assignments

Pre-assessment results

Extension Activities

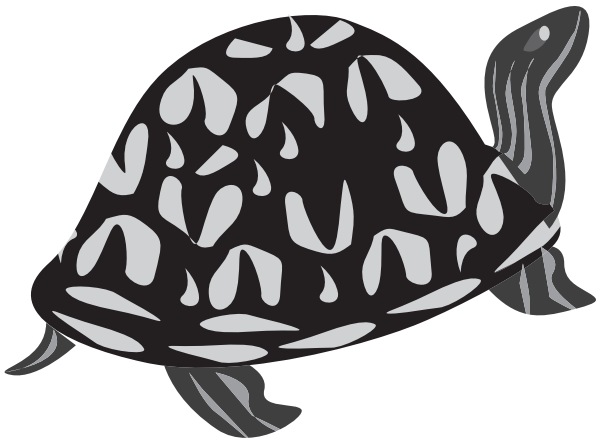
N/A

Post Assessment

N/A

Debriefing and Reflection Opportunities (10 minutes)

Reconvene students when they have completed the pre-assessment. Invite students to share questions they have related to ecosystems that they would like answered during the unit. Value all responses and write them on the flip chart. When students have shared their questions, post the flip chart paper (s) in a visible place in the classroom. Add to the list as new questions arise. Throughout the unit, make a point to weave in opportunities to answer students' questions.



Name_____ **Date**_____

Ecosystem Pre-assessment

1. Why is this area called an ecosystem?

2. Identify three organisms that live in this ecosystem.

3. Use three of the organisms from question #2 and describe what they do to help other organism(s) in their surroundings.
   Organism 1

   Organism 2

   Organism 3

4. What is one example of a producer, consumer and decomposer in this ecosystem picture? (If you cannot actually see them in the picture, you can indicate where they would be found in the picture).

   Producer

   Consumer

   Decomposer

5. What is the main difference between producers and consumers?

6. How do decomposers help this ecosystem?

EUREKAS AND ECOSYSTEMS

Name_____ **Date**_____

7. Describe an interaction between a living and non-living thing in this ecosystem.

8. If all the lily pads in the pond were removed, would this make much of a difference in this ecosystem? Explain why or why not.

9. Examine the food chain below:

   Plants ➔ mouse ➔ cat ➔ wolf

   Why do you think it is called a "food chain" and not a "food string" or "food line" or some other term?

10. Why should you care about the smallest snail, an endangered quail and the quality of air?

Name_____ **Date**_____

Possible Answers to the Ecosystem Pre-Assessment

1. **Why is this area called an ecosystem?**

   It has living and non-living things that are interacting.

2. **Identify three organisms that live in this ecosystem.**

   plants
   insects
   fish

3. **Use three of the organisms from question #2 and describe what they do to help other organism(s) in their surroundings.**

   Organism 1

   Plants supply oxygen for the fish.

   Organism 2

   Insects pollinate flowers.

   Organism 3

   Fish can be bottom feeders and help with getting rid of decay.

4. **What is one example of a producer, consumer and decomposer in this ecosystem picture? (If you cannot actually see them in the picture, you can indicate where they would be found in the picture).**

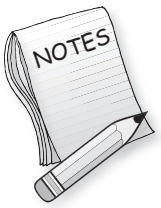
   Producer: plants

   Consumer: fish

   Decomposer: bacteria

5. **What is the main difference between producers and consumers?**

   Producers make their own food and consumers do not.



6. How do decomposers help this ecosystem?

They help break down organic material (e.g., dead organisms)

7. Describe an interaction between a living and non-living thing in this ecosystem.

A frog uses a rock to sit on to get out of the water. The frog could be warming itself or resting. Certain bacteria live in the soil to obtain nutrients and to be protected.

8. If all the lily pads in the pond were removed, would this make much of a difference in this ecosystem? Explain why or why not.

Lily pads are used by organisms to live under. It would upset the ecosystem. In addition, they are plants and produce oxygen so perhaps the amount of oxygen in the water would decrease and that may affect the organisms that live in the water and filter oxygen out of it for respiration purposes.

9. Examine the food chain below:

Plants ➔ mouse ➔ cat ➔ wolf

Why do you think it is called a "food chain" and not a "food string" or "food line" or some other term?

It is called a chain because each organism is like a link, a separate and important piece of the whole thing. A string is the same no matter where you cut it and it does not matter to one part of the string that the other part was separated from it. A chain implies something that has parts and that can be broken at specific sites.

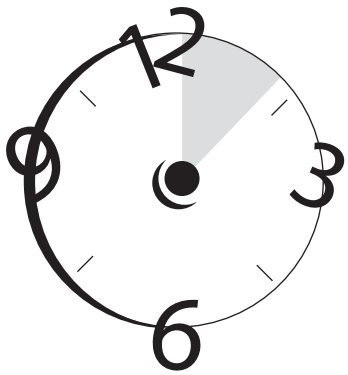
10. Why should you care about the smallest snail, an endangered quail or the quality of air?

All organisms are parts of food chains and each has an important role to play. Therefore, each is important and should be preserved. The quality of air is part of an ecosystem (non-living part) and it affects the organisms that breathe it. If it is polluted, it may cause harm to the ecosystem's inhabitants.

Ecosystems and Scientific Inquiry

Core

Time Allocation: 45 minutes
Required Materials and Resources on Page 152



Lesson Overview

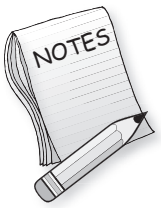
In this lesson, students will be introduced to the concept of an ecosystem by using their classroom as a model. Additionally, students will come to understand an important principle about scientific models: Although the "classroom ecosystem" has fundamental similarities to real-world ecosystems (e.g., living and non-living things interacting), it and the other model ecosystems that students will explore have shortcomings that limit their application to real-world ecosystems. Students will realize that these model ecosystems do not meet all of the needs of the organisms involved and, therefore, are not the same as real-world ecosystems.

Guiding Questions

- How is our classroom like an ecosystem?

BIG IDEA

Classroom Environment



Content Goals

Universal Themes

- The natural world is composed of systems, which are organized groups of related objects that together form a whole.
- Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena.

Principles and Generalizations

- Living and non-living things interact with one another in various ways.
- Ecosystems have living and non-living things.
- Organisms have dependent and interdependent relationships that enhance survival.

Concepts

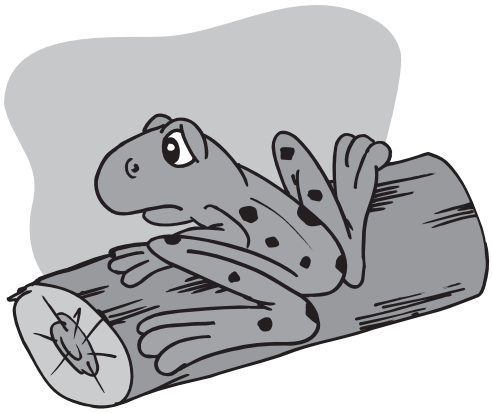
- Model
- Ecosystem
- Living and non-living things
- Organisms
- Interdependence
- Features/characteristics (adaptations)

Teacher Information

An ecosystem is all living and non-livings things that interact in a certain area.

Skills

- Observe
- Identify characteristics
- Compare and contrast
- Analyze
- Identify relationships
- Categorize



Materials and Resources

Dictionary

Preparation Activities

1. Put three columns on the board or on butcher paper labeled "Non-living things," "Living Things" and "Relationships between Living and Non-living Things."
2. Make copies of the Ecosystems Homework Assignment
3. (Optional) If you think that your students have not had much exposure to natural ecosystems, you may want to bring in a small ecosystem (e.g., terrarium, log and dirt with some small creatures in the soil or under the log) so that the classroom example will not be so abstract for the students.

Introductory Activities (5 minutes)

- Select a student to look up and read the definition of an ecosystem from a dictionary. Webster's defines ecosystem as "the complex of a community and its environment functioning as an ecological unit in nature."
- In a whole group discussion, invite students to talk about the concepts contained in the definition: ecosystem, community, environment, and nature. Eventually and through questioning, help students to understand that an ecosystem is the interaction of all the living and non-living things within a certain area. Help students to understand that an ecosystem can be as small as a puddle or as large as a forest or desert.

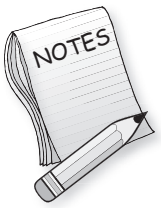
Pre-assessment

N/A

Teaching and Learning Activities (35 minutes)

1. Invite students into the lesson by posing a statement: Our classroom is an ecosystem. Ask students to agree or disagree with the statement and to provide justification for their answer.

2. **SEARCHLIGHT:** Move from group to group and listen to the pairs of students. Make a mental note of the conversations, seeking out students who already have advanced-level knowledge and those who might require more support throughout the unit. Write down the names of students who might benefit from the extension and AID opportunities that are provided throughout the unit and a list of students who may require more scaffolding because they are less familiar with the content and skills.



3. Once students have concluded that the classroom has some characteristics of real-world ecosystems, tell students that they will be using the "classroom ecosystem" as a model to further discuss the concept of an ecosystem.

4. Provide the same pairs of students with paper, pencil and erasers.

5. Instruct the students to put the same three column headers on their papers that are on the board or easel.

6. Have students examine the classroom and place as many things as they can in the classroom in one of the two columns: living things and non-living things.

7. Have students share items from their lists and place them on the board in front of the room. As the lists grow, ask students to share only the items that are different than what is on the board already. Hopefully students will see some mold, fungi, lichen or other small organisms that might later be identified as decomposers.

8. Ask students to describe the relationship between some of the items in each of the living and non-living columns. For instance, they might say that "students read books" or "students talk with other students" or "students follow the teacher's directions" or "students use a pencil sharpener." Write these under the "Relationships" column.

9. Discuss the idea that the living and non-living things in an environment interact.

10. Discuss the idea of interdependence by asking if students need the teacher. Do teachers need students? Do students need desks? Do students need each other?

11. Emphasize that ecosystems develop because of organisms' needs.

12. Ask students if they have any features or characteristics that help them be successful in this "ecosystem." (You can use the word "adaptation" but vocabulary is not the focus of the lesson. It is the idea that certain features present survival advantages for organisms). Students might mention the ability to hear or see the board (structural) or they might mention the ability to make friends or the willingness to share (behavioral) all of which add to their chances of being successful students. The features, adaptations, help them to function in the "classroom ecosystem."

13. Tell students they will be learning about many different ecosystems throughout the unit and that they will discover the similarities that all ecosystems have and some of the differences.

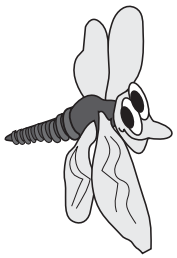
14. Assign homework and distribute the Ecosystems Homework Assignment.

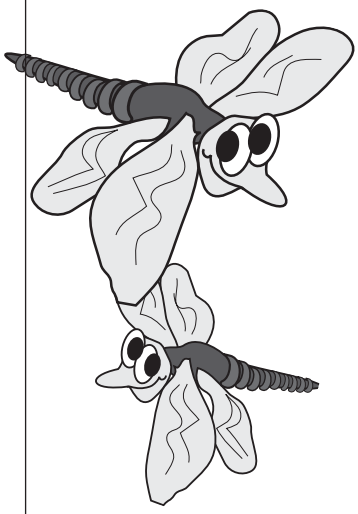
Products and Assignments

Explain to students that for homework they are to write their own definition of an ecosystem and to give an example other than those discussed in class that day. In the example they give, they must explain why their chosen ecosystem fits their definition.

Extension Activities

N/A





Post Assessment

N/A

Debriefing and Reflection Opportunities (5 minutes)

Share with students that they will be learning about many different ecosystems throughout the unit and that they will discover the similarities that all ecosystems have and some of the differences. Emphasize that all ecosystems have living and non-living components that interact with one another.

Name_____ **Date**_____

Ecosystems Homework Assignment

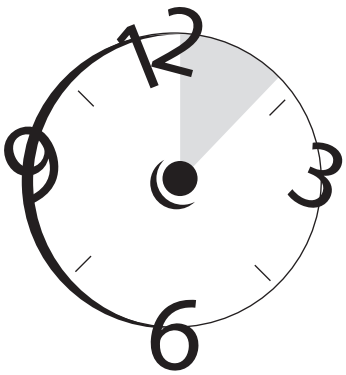
1. Write your OWN definition of an ecosystem below:

2. Give an example of an ecosystem other than those discussed in class today. Then EXPLAIN why your chosen ecosystem fits your definition.

Ecosystems and Scientific Inquiry

Core

Time Allocation: 45 minutes
Required Materials and Resources on Page 152



Lesson Overview

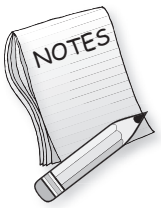
In this lesson students will begin the process of studying ecosystems directly by building a "mini-pond in a jar." Students will make and document observations of the interactions of organisms with each other and with the non-living components within this model ecosystem. They will discover the ways that living things depend on each other and on the non-living things in the environment. While working with mini-ecosystems, students may observe several stages in the life cycle of plants and animals, although the topic of life cycles is not a primary focus of this lesson. Students will compare and contrast food and environmental needs of the organisms used in the mini-pond in a jar.

Guiding Questions

- How do models help us better understand the real world?
- How is a "mini-pond in a jar" similar to a real-world pond ecosystem?

BIG IDEA

Mini-pond Model Ecosystem



Content Goals

Universal Themes

- Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena.
- The natural world is composed of systems, which are organized groups of related objects that together form a whole.

Principles and Generalizations

- Real-world ecosystems can be modeled and studied.
- Ecosystems have living and non-living things.
- Living and non-living things interact with one another in various ways.
- Environmental changes occur for various reasons and at varying rates.

Concepts

- Model
- Ecosystem
- Organism
- Interdependence
- Survival
- Interaction
- Pond
- Plant
- Animal
- Producer
- Consumer

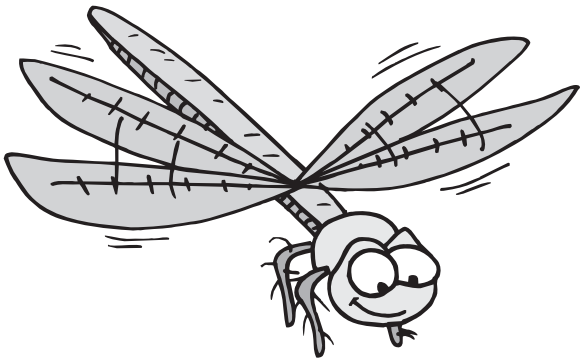
Teacher Information

- The pond insects may include the following:
- Smeller giant water bug
- Backswimmer
- Water boatman
- Mosquito wrigglers (larvae)
- Caddis worm - larvae pulling worm
- Diving beetles
- Water fleas (Daphnia and Cyclops)
- Scuds (small shrimp-like animals with curved backs and many legs)

- Pictures of all these insects can be found on sites like http://42explore.com/pond.htm
- The author received written permission from Dr. J. Abbott to use the information and images from his websites.
- The U. S. Fish and Wildlife Services has a National Image Library with public domain images for download. It is a wonderful resource for images of the various organisms studied in this unit. http://images.fws.gov

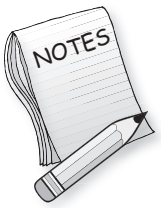
Skills

- Plan
- Organize
- Predict
- Make observations
- Collect data
- Identify relationships
- Develop explanations



Materials and Resources

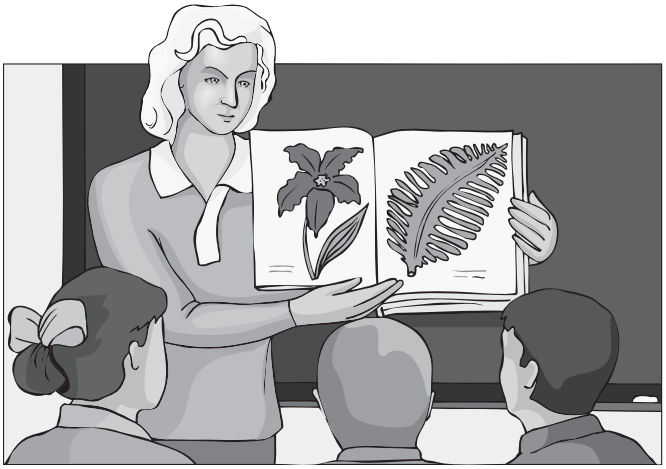
1. Order living organisms 20 days ahead of the time if you intend to purchase rather than collect pond life.
2. Four gallons of pond water (Bottled spring water or tap water can be used. However, it must be left out at room temperature for several days to ensure that chemicals, such as chlorine that is used in the treatment of local water supplies, have had time to escape.)
3. Try to collect one or two pond snails for each of student, as they help keep the water clean by eating the dead plant and animal materials and the tiny bits of green algae.
4. One small pail
5. One kitchen strainer
6. Two turkey basters for transfer purposes
7. Two pairs of tweezers for transfer purposes
8. Fine screening (enough to cover each of the jar tops)
9. Tape to secure the screening
10. Pond plants (1 or 2 sprigs of elodea or 10 – 15 duckweed plants per student).



Elodea or duckweed plants can be collected from a local pond or ordered through a supply house like Carolina Biological (1-800-334-5551) at 2700 York Road, Burlington, North Carolina 27215. Their website is: http://www.carolina.com

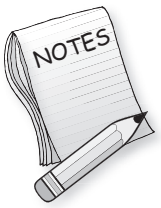
11. If the pond life is collected, a one gallon jar (pickle jar) into which to place the pond life is needed.
12. Plastic Baggies and small plastic containers with holes punched in the lids can be used in the field to collect plants and animals, respectively.
13. (Optional) Shallow pan (glass or enamel preferred for improved pond-life visibility)
14. Quart jars (1 for each student) - Canning jars or old mayonnaise-type jars can be used. Students can bring one in from home to reduce teacher preparation time.
15. Ruler (1 per student)
16. Newspapers to cover desktops/tables
17. Small plastic/paper cups to be used to carry pond silt/sand, water and organisms to desks (1 per student)
18. Hand lens (1 per student)
19. Paper bags (1 per student group)
20. Markers or small strips of tape or small labels to be used to identify each student's jar
21. A field guide to aquatic insects and/or pond life or books can be used to identify pond life such as: Amos, W. (1967). *The life of the pond*. New York: McGraw-Hill Book. This is an excellent resource book because of its photography, and the extent to which it describes pond life. It includes an appendix, "How to Learn More about a Pond," in which the construction of various sampling devices is described. In addition, it has a section for students who want to keep a pond ecosystem at home as well as a section on "What a Fish Sees" (science of light is included) and a section on "Exploring the Microscopic Pond World" if students have access to microscopes. Two other helpful books are:

    Parker, S. (1988). *Eyewitness books: Pond and river*. New York: Alfred A. Knopf.
    Gorvett, J. (1970). *The life in ponds*. New York: American Heritage Press.



Preparation Activities

1. Collect four gallons of pond water.
2. Obtain a small pail of pond silt/sand from the bottom of the pond.
3. Gather or order some small pond plants, insects, and snails and put them in a gallon jar. (Note: Aquatic insects that live on the surface of the water such as water striders should not be transported in water since they may drown. Put them in a container with damp aquatic plants only. Make sure the container has holes punched in the lid.)
4. Copy the Instructions for Building a Mini-pond in a Jar worksheets.
5. Copy the Mini-pond in a Jar Observations worksheets.
6. Copy the How Good Were Your Observations on Mini-pond Life? worksheets.
7. On the day of the lesson, put the organisms in a shallow pan, preferably glass or enamel so the organisms can be seen better.
8. If glass is used, place plain white paper underneath the glass pan if that is to be used to improve the visibility of the pond life.
9. On the day of the lesson, set out the equipment on a table "buffet style."
10. Organize the supplies so that students can file past them on both sides.
11. Use folded tabletop signs made of construction paper or index cards to label each item so that students know what it is and how much of it they should take.
12. Note that possible organisms the students will find and observe are found listed on the Teacher Reference Guide: Mini-pond in a Jar Observations below along with some of their respective characteristics.



Introductory Activities (5 minutes)

- Collect homework assignments and ask one or two students to summarize what was explained in the last discussion about the classroom as an ecosystem. Hopefully, students will recall the classroom contained living and non-living things that interacted with one another.
- Invite volunteer students to read their ecosystem definitions, describe the ecosystems they identified and why they meet the definition of an ecosystem.
- Ask other students to react to the definitions, examples and justifications provided by the volunteer students.
- Listen to students' thinking, making sure to pose questions if students offer incorrect ecosystems. Probe with students until they have a common, accurate grasp of the word *ecosystem*.
- **SEARCHLIGHT:** Make mental notes of students who demonstrate advanced-level thinking about ecosystems, as well as those who may be below-grade level. Make plans to attend to these student differences throughout the unit by capitalizing on extensions and AID opportunities and providing more frequent feedback to students who require more support.
- Explain to students that today they will now begin the process of studying ecosystems directly by building a mini-pond in a jar.
- Tell them that over the next two weeks, they will make and document observations of the interactions of organisms with each other and with the non-living components of the ecosystem. Tell them to use their senses, EXCEPT TASTE when making observations.
- Like scientists, they will discover the ways that living things depend on each other and on the non-living things in the environment.
- Distribute and review Instructions for Building a Mini-pond in a Jar to each group.
- Distribute and review Mini-pond in a Jar Observations worksheets.
- Distribute and review How Good Were Your Observations on Mini-pond Life? worksheets.

Pre-assessment

N/A

Teaching and Learning Activities (35 minutes)

1. Have students build their mini-pond and place them in a well-lighted area but not in the direct sun.

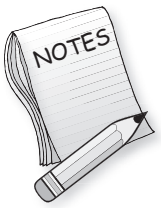
2. Explain to students how they will make observations of their mini-ponds each day and record observations in the Mini-pond in a Jar Observation Sheet which follows. To accommodate weekend time, share with students that they will have to add two days per week to their total count number. The reason is that the mini-pond evolves during weekends. To create an accurate picture of the entire study period, they must include all of the days in their count.

3. After students have completed building their ponds, ask them, "Do you think we will have to feed our organisms? If they say "Yes," then ask them about the type of food they think is needed. Use Socratic questioning to help them understand that animals eat plants and that plants make their own food through a process called photosynthesis. (The complete explanation is not appropriate for this age student. However, the uniqueness of plants with regard to their ability to make their own food should be emphasized. Using the correct vocabulary is important, but the students should not be asked to memorize the term or attempt to explain the process at this time.)

4. Over time students should observe various changes that will be recorded in their observation sheets. Tell them they will be turning in the How Good Were Your Observations on Mini-pond Life? sheets on the 12th day of observations.

Products and Assignments

- Students' Mini-pond in a Jar Observations sheets
- Students' How Good Were Your Observations on Mini-pond Life? sheets



Extension Activities

1. A comprehensive, affordable resource is the book *The Life of the Pond*, referenced above. Although not a recent publication, it has a remarkable collection of photographs and information on pond life. Its breadth and depth of information regarding pond life is exceptionally large (232-page book). It is excellent for the extension activities that follow.
2. Here are some questions that you might pose for students who show an interest in this topic, have questions about the mini-pond activity, or demonstrate advanced-level knowledge. Students might read on their own, summarize their new learning in a conversation with you, create a poster, or express themselves in any other format of their choosing.
   - How do you build your own organisms-collection devices?
   - How do you build a homemade pond?
   - How can I keep pond animals healthy at home?
   - What do microorganisms in ponds look like?
   - What do fish see when they look out of the pond at you?

Post Assessment

Ecosystem definitions and examples

Debriefing and Reflection Opportunities (5 minutes)

1. After students have completed building their ponds, ask them, "Do you think we will have to feed our organisms? If they say "Yes," then ask them about the type of food they think is needed. Depending on how they respond, use Socratic questioning to lead them to understand that these animals eat plants and that plants make their own food. Plants are producers as they are able to capture the sun's energy and use it with other ingredients to live and grow. The animals that eat or "consume" these plants are appropriately called consumers.
2. Invite student reflection about the following question: In what ways are the mini-ponds a model? Why do scientists use models?

Instructions for Building a Mini-pond in a Jar

1. Get pieces of newspaper and cover your work area to protect it from spills and dirt.
2. Get a pint jar, marker or label, and a ruler. Label your jar with your initials.
3. Place 1-2 cm of pond silt/sand in the bottom of the jar. Carry the pond silt/sand in a small cup to your work area.
4. Plant one pond plant in the jar. Carry the pond plant back to your work area in the small cup.
5. Add enough pond water to fill the jar ¾ full.
6. Add a snail, if available, and a few pond insects. Carry the animals back to your work area in the small cup. MAKE SURE THE WATER HAS CLEARED BEFORE ADDING POND INSECTS.
7. Cover the jar with screening secured by tape.
8. Get a hand lens and use it to view the organisms. They will become more visible as the silt settles.
9. At the end of class, place your jar in a relatively cool place (away from the direct sun and away from the radiator).
10. Do not shake the jar, as that will disturb the organisms in your "mini-pond."
11. Make sure you add additional pond water every few days to keep the water level in the jar approximately the same (not tap water as it contains chemicals that make it safe for us to drink but they are not good for pond organisms). Remember to add the water gently so that the silt and the organisms are disturbed as little as possible.
12. (Optional) Put a long stick in the jar for dragonfly, damselfly and caddisfly nymphs (immature form) to climb out of the water and change into their adult forms.

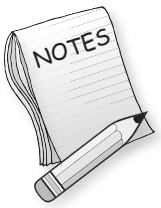
Name_____ **Date**_____

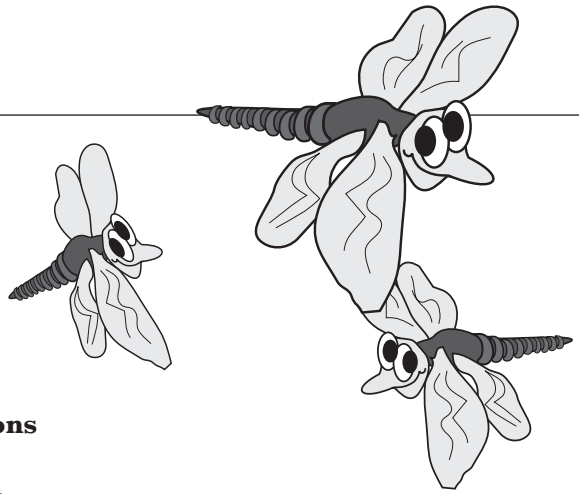
Mini-pond in a Jar Observations

Draw pictures below of all the animals in your jar. If you can identify the kind of organism from the insect books, Internet sites, etc. that are available, write down the name of the organism underneath the picture.

Name_____ **Date**_____

	Animal Observations (Use your senses except for taste)	**Plant Observations (Use your senses except for taste)**	**Interactions (living-living and living–non-living)**
Day #			
Day #			
Day #			
Day #			





Teacher's Reference Guide:
Mini-pond in a Jar Observations

Students might see the following:

1. Spring tails – no wings; no tail appendages; tiny; hops on the surface
2. Whirligig beetle (small very active at surface) - uses its hind legs as oars to propel itself; it has a bubble of air at the tip of its abdomen. The beetle also stores oxygen under its hard wing covers; has flat plates that function like the feathers of birds in that they overlap to form a solid paddle and then on the recovery stroke they open up like Venetian blinds and offer little resistance to water.
3. Diving beetle – large; uses its hind legs to swim (3rd pair much larger) as oars to propel itself; has bristles that stand out on the propelling strokes and collapse and lie close to the leg on the recovery stroke; carries a bubble or "physical gill" as compared to a biological or living gill with it.
4. Water strider – sucking mouth parts
5. Water scorpion
6. Water boatman – uses air between its wings and body so efficiently that it seldom comes to the surface.
7. Giant water bug – (up to 3 inches)
8. Backswimmer (less than ½ inch; swims on its back) – uses its hind legs as oars; carries a bubble or "physical gill" as compared to a biological or living gill with it.
9. Caddisfly nymphs (larvae have two hooks on the last segment)
10. Damselfly nymphs – 3 tail-like appendages; 3 pairs of legs
11. Mayfly nymph – 3 tail-like appendages; 3 pairs of legs; plate-like gills attached to the sides of their abdomens
12. Dragonfly – 3 tail-like appendages are inconspicuous; has fatter body, 3 pairs of legs. Can be seen as larvae crawling on the bottom; swims by a form of jet propulsion by drawing water into its rectal gill chamber, then violently expelling it, thus propelling itself forward.
13. Mosquito larvae (wrigglers) – hang just below the water surface and have posterior breathing tubes
14. Midge larvae – bright red body; moves by curling its body into a tight circle and then snapping it straight; primarily a drifter.
15. Phantom midge larvae – transparent body (silvery air sacs)

16. Water mite – 4 pairs of legs
17. Fisher spider – 4 pairs of legs
18. Leech – smooth body with no suckers; swims like a fish in wave-like ripples, undulating up and down.
19. Bristle worm – body with bristles and no suckers

Name_____ **Date**_____

How Good Were Your Observations on Mini-pond Life?

1. How do the pond animals get around?

2. What did you see animals eating? Sketch a picture, or name the animal if you can, next to the description of what it eats below:

3. Do any animals stay in one place? If you see one that mainly stays in one place, sketch a picture or name the animal if you can next to the description of what it eats below:

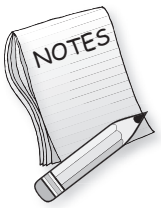
4. Do you see any animals that have bubbles around them or on them? If you did, draw the animal below:

Name_____ **Date**_____

5. Did you see any plants with bubbles on them? If you did see one, draw a picture of what it looked like below:

6. Do any of the animals stay below the surface? Would they have to have gills? If so, can you see the gills? Sketch pictures, or name the animals if you can.

7. Put a paper bag over the jar for one night. Remove it the next day. Do you see any differences in the organisms or their locations? If so, what differences did you see?



Answers for the Lab Activity, How Good Were Your Observations on Mini-pond Life?

1. **How do the pond animals get around?**

   Swim, crawl, wiggle from side-to-side and glide across water surface

2. **What did you see animals eating? Sketch a picture, or name the animal if you can, next to the description of what it eats below:**

   Eating plants, eating scum off the bottom of the jar (e.g., assuming you had a snail in the pond), eating scum off the side of the jar

3. **Do any animals stay in one place? If you see one that mainly stays in one place, sketch a picture or name the animal if you can next to the description of what it eats below:**

   Snail, wrigglers (mosquito larvae) that hang down from the surface of the water or from plant material

4. **Do you see any animals that have bubbles around them or on them? If you did, draw the animal below:**

   I saw a bubble attached to a water diving beetle (also some spiders have bubbles attached as well).

5. **Did you see any plants with bubbles on them? If you did see one, draw a picture of what it looked like below:**

   Some green algae produce bubbles of air that will appear on the algae on the water surface

6. **Do any of the animals stay below the surface? Would they have to have gills? If so, can you see the gills? Sketch pictures, or name the animals if you can.**

   Some animals that stay below the surface are snails, mosquito larvae, nymphs and tadpoles.

   Not all would have gills and they would come to the surface to breathe air.
   Tadpoles and snails have gills for breathing.

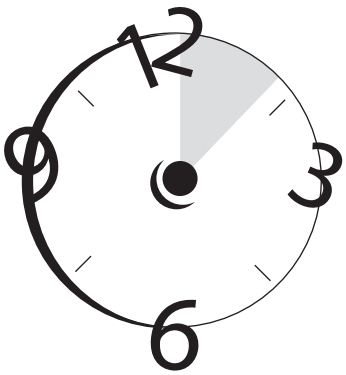
7. **Put a paper bag over the jar for one night. Remove it the next day. Do you see any differences in the organisms or their locations? If so, what differences did you see?**

   Snails may move up the jar and more of the animals may be found near the water surface.

Ecosystems and Scientific Inquiry

Core

Time Allocation: 50 minutes plus
1 to 11/2 weeks of observations
Required Materials and Resources on Page 152



Lesson Overview

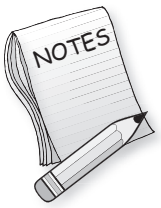
Students in this lesson will study a model of the process of succession. This activity will demonstrate that ecosystems can change from one type to another, as a result of changing environmental conditions.

Guiding Questions

- Do models help us better understand the real world?
- Can ecosystems change over time?

BIG IDEA

Change in an Ecosystem



Content Goals

Universal Themes

- Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena
- The natural world is composed of systems, which are organized groups of related objects that together form a whole.
- Properties of some objects and processes are characterized by constancy, while properties of others are characterized by change

Principles and Generalizations

- Models are used to study the various aspects of nature.
- Living and non-living things interact with one another in various ways.
- Organisms have dependent and interdependent relationships that enhance survival.
- Real-world ponds can be modeled and studied.
- Ecosystems can change because of changes in environmental conditions.
- Environmental changes occur for various reasons and at varying rates.

Concepts

- Model
- Ecosystem
- Organism
- Interdependence
- Interaction
- Pond
- Plant
- Stressful environmental conditions
- Change
- Succession

Teacher Information

- A characteristic of ecosystems is that they do change in response to changing environmental conditions. Succession is a term used to describe the ever-changing environment and the gradual process by which one ecosystem is replaced by another.
- While there is water in the jar, the seeds should germinate and then rot.

- As the water evaporates from the "mini-pond in a jar" down to the soil, the aquatic plant will die, thus modeling what would happen to plants in a pond if a long-term drought occurred.
- The birdseeds will find the environment suitable for successful growth after the water completely evaporates. A fan can be used to hasten the evaporation process.
- Sunflower seeds, which grow large, can be added to represent forest trees.

Skills

- Predict
- Justify thinking
- Make observations
- Collect data
- Compare and contrast
- Analyze
- Identify relationships
- Develop explanations
- Draw conclusions

Materials and Resources

1. (Optional) Fan
2. Pint or quart jar (1 per student group)
3. Newspaper (enough to cover a table for each student group)
4. Water (1 per student group)
5. Soil (enough to fill the jar 1/3 full)
6. Aquatic plant (1 per student group)
7. Some birdseed with sunflower seed included. If this cannot be found, just mix some sunflower seeds with regular birdseed. The seed should grow well near a window. If your classroom has no windows, substitute a grow-light

8. Pictures of ecosystems undergoing change or succession (e.g., pictures of a normal desert, one after atomic bomb testing, one with creosote bushes, one with annuals and the last with plants, such as wild buckwheat and foxtail chess). Pictures can be found on the Internet by using the Google Search engine and clicking on "Images" and typing in the name of the image desired. Mt. St. Helen can be a source of pictures, as it has undergone succession in two ways, areas where the traditional pioneer plants, such as alpine lupine emerged and in the other areas in which succession has not been traditional, as the first plants have been alder trees.
9. Resources for students to use in their exploration of the types of stresses that can affect ecosystems in the real world.
10. The Internet sites www.scilinks.org or www.google.com can be used. Enter the topic "succession" to find information associated with this concept.

Preparation Activities

1. Make up several "mini-pond in a jar" systems four days ahead of time, without animals, that will be used for this "stress lab."
2. Instructions for building the mini-pond-in-a-jars
   - Get pieces of newspaper and cover your work area to protect it from spills and dirt.
   - Obtain two or three pint jars.
   - Place 1-2 cm of pond silt/sand in the bottom of the jar.
   - Plant a few sunflower and regular bird seeds in the soil. The sunflower seeds will grow larger and could represent the "trees" in the evolving "mini-forest" ecosystem.
   - Place one pond plant in the jar.
   - Add enough pond water to fill the jar 1/4 full. Do not shake the jar.
   - Position these two or three mini-pond-in-a-jars in sunlight or under a grow light.
   - After the water has evaporated, if all of the bird seeds have rotted, place a few new ones in the soil. Tell students this would be similar to seeds that are transported via the wind and dropped on the soil from above.

Introductory Activities (15 minutes)

- Ask students, "Do you think it is possible for one type of ecosystem to change into another type?" If they do not think that it is possible, ask

them "What would happen to a local pond area if there was a drought that lasted several years?"

- Show students the two or three mini-pond-in-a-jar systems that you made and that will be manipulated to mimic changing environmental conditions in order to study the effect of stress on ecosystems.
- Tell students that you have NOT added additional pond water to keep the level in the jar approximately the same as it was when you first made them. The water should almost be evaporated.
- Ask students if the lack of water or "drought" will cause any stress to the "mini-pond" ecosystem. Students should recognize that the ecosystem will undergo stress as a result of water deprivation, and this stress will result in changes.
- Distribute the Mini-pond Ecosystem under Stress Observations sheet to each student and tell them they will be using it to record daily observations for a week or so.
- Distribute the handout, An Ecosystem under Stress Questions.
- Tell students to answer questions #1 and #2 on the An Ecosystem under Stress Questions. They will be predicting and justifying their predictions with some logical thinking, as to why they believe their predictions will be correct.
- Collect students' predictions and read some of them out loud.
- Have students discuss any predictions that are different from one another and provide opportunity for students to support or disagree with the various predictions.
- Tell students that scientists often meet in forums to share their research plans as well as results and during these times they can be challenged by other scientists. This sort of behavior is characteristic of scientific thinking.
- Discuss what is meant by the statement "Scientists display skepticism."
- At the end of the activity, approximately one week, have students answer the remaining questions on the An Ecosystem under Stress Questions handout.

Pre-assessment

N/A

Teaching and Learning Activities (30 minutes)

1. As the activity progresses and changes occur, discuss with students the concept of ecological stress and succession.

2. Introduce the term "succession." Tell students it is used to describe the process whereby an ecosystem and its associated organisms change as a result of a change in the environmental conditions.

3. Show your pictures of ecosystems that have been changed by various stressful conditions. For example, use a picture of an area being destroyed by an atomic bomb (nuclear testing site in a desert area) in which all of the plants are destroyed, soil disturbed, etc. Discuss with students the possible succession process for that area (e.g., rock, lichens, and bushes like the creosote would first grow and would be followed by some spring annuals like the desert pincushion or perhaps the succession would be to start with rocks followed by lichens and mosses, small herbs and shrubs, jack pine, spruce and aspen, and lastly the climax community of balsam fir, birch and white spruce).

4. Discuss other types of stresses that an ecosystem can incur, such as earthquake, forest fire, deforestation by man, flood, fire, hurricane, tornado, air pollution, disease, glacier retreats, droughts, water pollution.

5. At the completion of the activity, have the students talk about what they have learned about how environments can change.

Products and Assignments

- Students' Mini-pond Ecosystem under Stress Observations sheets
- Students' An Ecosystem under Stress Questions sheets

Extension Activities

N/A

Post Assessment

N/A

Debriefing and Reflection Opportunities (5 minutes)

At the end of the activity (approximately 1 to 1 1/2 weeks) discuss with students how ecosystems, including both the living and non-living components can change over time. Use the pictures of various ecosystems in various states of the succession process. Discuss the concept of succession, using the observations on the stressed mini-pond ecosystem, as well as pictures of real-world environments that have undergone succession.

Name_____ **Date**_____

Mini-pond Ecosystem under Stress Observations

		Soil	Bird Seeds	Aquatic plant	Water
Day #	Color				
	Other observations				
Day #	Color				
	Other observations				
Day #	Color				
	Other observations				
Day #	Color				
	Other observations				

		Soil	Bird Seeds	Aquatic plant	Water
Day #	Color				
	Other observations				
Day #	Color				
	Other observations				
Day #	Color				
	Other observations				
Day #	Color				
	Other observations				
Day #	Color				
	Other observations				

Name_____ **Date**_____

An Ecosystem under Stress Questions

1. What are your predictions for how the mini-pond ecosystem will be affected by the simulated drought?

2. Why do you believe your predictions will be correct?

3. What ecosystem does the mini-pond ecosystem resemble at the end of the study?

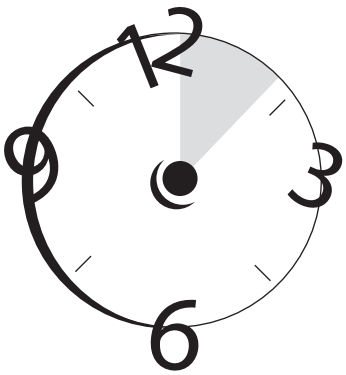
4. a) Identify another ecosystem and give an example of a stressful event.

   b) Describe what the process of succession might be for this "stressed ecosystem." What would it look like right after the stress occurred and what would be some of the stages in succession it would undergo as it approached the "climax stage" (the most developed stage of the ecosystem)? Use the resources provided to explore the effect of stress on a particular ecosystem.

Ecosystems and Scientific Inquiry

Core/AID

Time Allocation: 50 minutes
Required Materials and Resources on Page 152



Lesson Overview

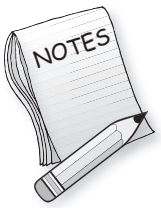
The NSES indicates that students in grades K-4 understand that pollution is a change in the environment that can influence the health, survival, or activities of organisms, including humans. Students in this lesson will engage in an activity that explores what happens to sea birds and when their habitat is polluted by oil.

Guiding Questions

- Do models help us better understand the real world?
- What is the impact of oil spills on bird habitats?

BIG IDEA

Pollution and its Effects



Content Goals

Universal Themes

- Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena
- The natural world is composed of systems, which are organized groups of related objects that together form a whole.
- Properties of some objects and processes are characterized by constancy, while properties of others are characterized by change

Principles and Generalizations

- Models are used to study the various aspects of nature.
- Living and non-living things interact with one another in various ways.
- Organisms have dependent and interdependent relationships that enhance survival.
- Ecosystems can change because of human impact.

Concepts

- Model
- Ecosystem
- Organism
- Interdependence
- Stressful environmental conditions
- Change

Teacher Information

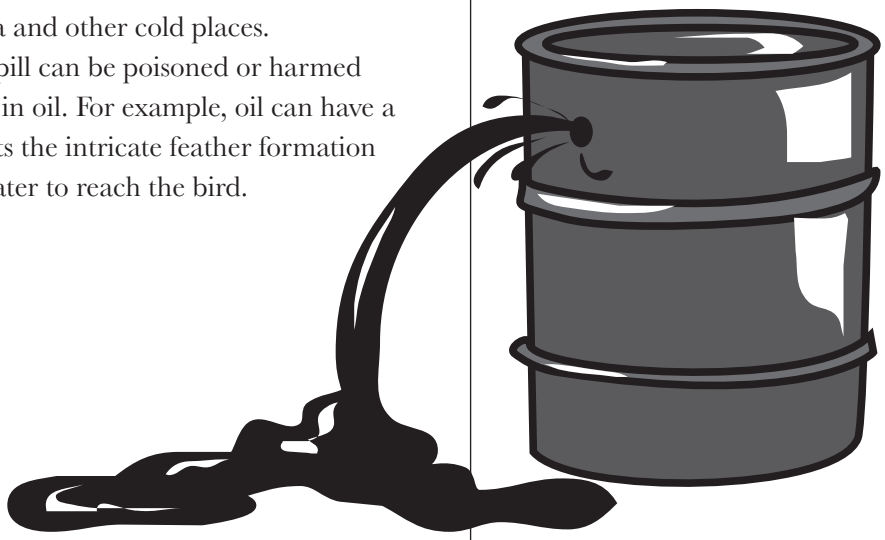
- A characteristic of ecosystems is that they do change in response to changing environmental conditions.
- The United States is the largest per-capita consumer of oil in the world. While it is important to understand the causes of oil spills and their effects on the environment, students should also know that the reason we run the risk of oil spills is because our highly technological society relies heavily on oil-based products.
- Students might not be aware of the many ways we use oil, besides fueling our vehicles and heating our homes. We also use it to lubricate machinery, to make asphalt for paving our roads, and to make plastics, medicines, ink,

fertilizers, pesticides, and paints. Because we use huge quantities of oil, it must be stored and transported in large volumes.

- Spills can be caused during storage or transport by people making mistakes or being careless; deliberate acts of war, terrorism, vandalism, or illegal dumping; equipment breaking down or leaking; or natural disasters such as hurricanes. Large oil spills like the Exxon Valdez spill depicted in the featured trade books make headlines, but most of the oil that pollutes aquatic environments each year comes from non-accidental sources such as drain disposal and road runoff.
- Birds are the only living creatures that have feathers. Of course feathers are important for flight, but feathers also help birds maintain their body temperature. Birds are warm-blooded; therefore, they need to keep warm, especially birds that feed in the water, such as sea birds and diving ducks. There are two main kinds of feathers-stiff contour feathers found on the body, wings, and tail and soft, fluffy down feathers found close to the body. Contour feathers have side branches called barbs that attach to the central shaft, the rachis. The barbs are woven together with smaller branches called barbules. This protection is tight enough to keep water off the bird's skin.
- Down feathers, like the down in a coat or comforter, are especially useful for warmth. Air is trapped between the feathers and acts as an insulator to keep the bird's body heat in and cold air out. This insulation is one reason that certain birds can live in Antarctica and other cold places.
- Animals in an area affected by an oil spill can be poisoned or harmed by the physical results of being coated in oil. For example, oil can have a dramatic effect on feathers. Oil disrupts the intricate feather formation that waterproofs birds, causing cold water to reach the bird.

Skills

- Make observations
- Compare and contrast
- Analyze
- Identify relationships
- Develop explanations



Materials and Resources

1. The activity "Tarred and Feathered" was adapted from *Science and Children* Volume 42 Number 6, March 2005, pages 57 and 58.
2. Trade books with information related to oil spills such as the following:

§ Rand, Gloria. (1994). *Prince William*. Henry Holt.
Synopsis: In Alaska's Prince William Sound, a young girl named Denny finds an oil-coated baby seal on a polluted beach. She rushes the pup to a makeshift rescue center set up to help wildlife affected by the Exxon Valdez oil spill. As Denny follows the seal's recovery over the next 10 weeks, she learns about the intense volunteer efforts to clean up the harbor and rehabilitate oiled animals.

§ Berger, Melvin. (1994). *Oil Spill!* HarperTrophy.
Synopsis: Focusing on the 1989 Exxon Valdez oil spill, the simple text and colorful illustrations of this Let's-Read-and-Find-Out science book describe why oil spills occur and how they are cleaned up. Oil Spill! provides information about actual clean-up techniques such as containment booms, skimmers, oil-absorbing pads, burning, chemical dispersants, hot-water sprays, and oil-eating bacteria. A section at the end suggests ways to prevent oil spills.

3. An article that explains how oil spills are cleaned up in real life from the same issue of *Science and Children*
4. Sanitized bird feathers that can be purchased from a craft store or a science supply house (2 per student group)
5. Hand lens (1 per student group)
6. Newspaper (enough to cover a table for each student group)
7. Bowl of water (1 per student group)
8. Bowl of cooking oil (1 per student group)
9. Disposable plastic bowl (1 per student group)
10. Large detergent bottle (1)
11. Small plastic cup (1 per student to hold detergent)

Preparation Activities

1. Gather and lay out materials for the lab activity.
2. Copy the lab activity, "Tarred and Feathered."
3. Print out for yourself the answers to "Tarred and Feathered."
4. Copy the extension activity, "How Are Oil Spills Treated?"

Introductory Activities (5 minutes)

- Ask students how often they think an oil spill occurs (they occur somewhere in the world almost every day of the year).
- Discuss what they think they know about the consequences.
- Ask students, "What happens to birds when they are drenched in oil as a result of an oil spill?"
- Let students share their ideas. Tell students they will explore a possible impact of an oil spill during the next activity.

Pre-assessment

N/A

Teaching and Learning Activities (40 minutes)

1. As the activity progresses, talk with groups about environmental impact as a result of human activity.

2. At the completion of the activity, have the students talk about what they have learned about the effect of oil spills on birds.

3. Distribute the article, "How Are Oil Spills Treated?" to students who are interested in the topic (AID).

Products and Assignments

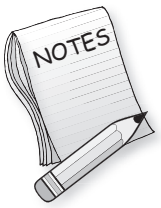
- Students' homework assignment is to answer questions from the Tarred and Feathered activity.

Extension Activities (AID)

1. Those students who are especially interested in oil spills and their effects can read the article, "How Are Oil Spills Treated?"
2. Students can share their understandings with other classmates on the following day.

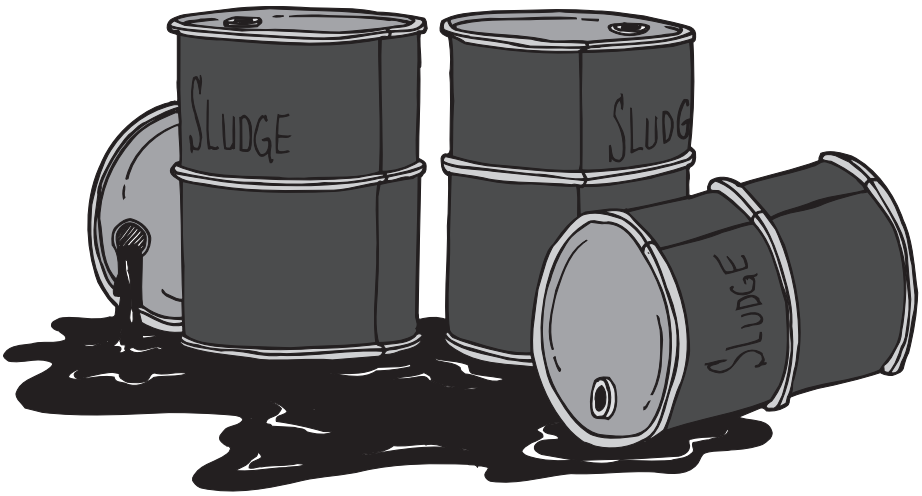
Post Assessment

N/A



Debriefing and Reflection Opportunities (5 minutes)

1. At the end of the activity discuss with students how ecosystems, especially the organisms that inhabit those ecosystems can be adversely affected by man's activities.
2. Ask them how they think other sea animals are harmed besides birds with questions like, "How do oil spills harm fish, shrimp, and crabs?" (Oil gets into their bodies and poisons them.) "How do oil spills harm sea mammals?" (They swallow oil and breathe poisonous fumes. The oil also coats their bodies.)



Name_____ **Date**_____

Tarred and Feathered

Birds' unique feathers put them at special risk after an oil spill. People often clean birds with soap after an oil spill. In this activity, you will compare feathers and see if cleaning an oiled feather with soap is effective. To obtain a detailed image of a bird's feather and its parts, go to the following website: http://z.about.com/d/birds/1/0/y/2/feather-parts-lg.jpg or go to http://www.google.com and click "images" and put in "parts of feather."

Instructions:

1. Cover the working areas with several layers of newspaper.
2. Divide a piece of paper into four boxes and label the sections #1-dry feather, #2-wet feather, #3-oily feather, and #4-oily feather cleaned with detergent.
3. Observe the clean, dry feather with a hand lens and make a detailed drawing in section #1. Save this feather for later observations.
4. Place the other feather in the bowl of water and observe.
5. Dry the feather and make a detailed drawing in section #2.
6. Move the feather back and forth through the bowl of oil and then place it in the empty disposable bowl. Find out if the feather behaves the same way in water as it did before being coated with oil.
7. After making observations, dry the feather and draw a detailed picture in section #3.
8. Clean the oily feather using a small amount of dish detergent and place the feather in a bowl of water and observe it.
9. Again, dry the feather and make a detailed sketch in section #4. Compare the cleaned feather with the dry one.

Name_____ **Date**_____

Questions:

1. How did the feather change after it had been dipped in oil?

2. How did the feather behave in water after it had been dipped in oil?

3. How did the feather behave in water after it had been "cleaned"?

4. How did the feathers you drew in sections #3 and #4 look different from the feather you drew in sections #1 and #2?

5. How do you think this change in the feathers would affect a bird's normal activities, such as swimming or flying?

6. Do you think detergent is the best way to solve the problem of removing oil from a bird's feathers?

7. Could the oil affect the birds in any other ways? What do you think happens to birds that swallow some of the oil or eat oil-coated foods?

Answers to Tarred and Feathered

Questions:

1. **How did the feather change after it had been dipped in oil?**

   It got soggy, clumpy and heavier.

2. **How did the feather behave in water after it had been dipped in oil?**

   It did not float.

3. **How did the feather behave in water after it had been "cleaned"?**

   It floated again.

4. **How did the feathers you drew in sections #3 and #4 look different from the feather you drew in sections #1 and #2?**

   Student drawings need to be examined.

5. **How do you think this change in the feathers would affect a bird's normal activities, such as swimming or flying?**

   The bird would not be able to swim or fly as easily.

6. **Do you think detergent is the best way to solve the problem of removing oil from a bird's feathers?**

   It probably works best but the process is very time consuming. Also handling the birds so much may injure them. Maybe they could be wrapped in a material that absorbs the oil before detergent is put on them.

7. **Could the oil affect the birds in any other ways? What do you think happens to birds that swallow some of the oil or eat oil-coated foods?**

   The oil may be poisonous to certain birds. I think if the birds swallow or eat oil-coated foods they would die because the oil would poison them.

How Are Oil Spills Treated?

No two oil spills are the same. Logistically, oil spills are a nightmare because they are unanticipated and uncontrolled events. Oil spills present a threat to wildlife and coastal resources, concerning everyone from local residents to state environmental agencies and the federal government.

Thousands of people may be involved in a significant spill and the response needs to be quick. Personnel and equipment arrives from all over the United States. Helicopter overflights are conducted, command posts are set up, and boats are launched. But then what happens? The goal of spill response is to control the spill, contain the spilled oil, and clean up spilled oil in the environment to enhance natural recovery.

It is important to point out that different oils spilled in different environments will require different treatments. Lighter oils, like gasoline and diesel, are more volatile and toxic, but evaporate and disperse quickly. Heavier oils, like crude, are less toxic but more persistent.

First Things First

The goal of the initial clean-up response is to secure the source and contain the spill. If the spill is from a ship collision, the oil in the inflicted tank can be diverted to other tanks, stopping the spill. Securing pipeline leaks can be more difficult. Pipelines, specially equipped pipes designed for the transportation of natural gas, hazardous liquids (including crude oil and other petroleum products), and other materials, can be hundreds of meters deep in the ocean and have millions of liters of oil stored inside. To help contain a spill, floating barricades called boom are brought in to help block off or capture spilled oil.

At the same time, responders are interested in where the oil may go on the water surface. Computer models called trajectories have been developed that consider the oil type, tides, currents, and weather to predict where the oil will travel. Using the trajectories and maps of environmentally sensitive areas, booming strategies can be designed.

Boom can be used in various ways. It can be placed around the source to contain the spill and keep it from spreading. Boom can keep oil from entering an area, for example, spreading boom across an inlet so a marsh is protected. It can also be used to divert and catch oil in open areas.

Cleaning Up

Once collected, oil is frequently recovered mechanically by vacuum trucks or by skimming devices that catch oil floating on the surface of the water. There are also ships equipped with skimmers that gather the oil off the surface and store it. Oil can also be absorbed. Frequently oil is simply picked up with sorbant: pads that resemble large paper towels. There is also sorbant boom (boom made of floating absorbent material) that can be strung out along containment boom or in other areas to capture oil. Another sorbant-type material is snare or pom-poms. Snare consists of groups of material clusters resembling cheerleaders' pom-poms that hold onto oil droplets. These can be strung out to catch oil in the same way sorbant boom may be used. Hoses can be used to flush water through or over areas to help push oil into the sorbant booms or skimmers to increase the collection.

Oil is also shoveled, scooped and raked into bags and removed from the site. Debris such as sticks, leaves, and trash are frequently oiled and must be removed. Sometimes oiled grasses are cut. If a sand beach is oiled, the sand is usually removed by shovels or heavy equipment and replaced. Depending on the amount of debris and the state where the spill occurred, oil debris may be moved to a landfill, reused in road construction, or incinerated.

Alternative Responses

Sometimes physical removal isn't enough. Certain spills may be treated more effectively by applying chemical dispersants. Issues and consequences need to be weighed about what possible worst-case spill scenarios may bring.

For instance, if there are many birds that could be oiled or a heavily used beach is in jeopardy, then chemical dispersants may be the best solution. They can be sprayed from a low-flying plane (only 20 to 35 m above the water) or by boat. Aerial application is the most common, though dispersants are seldom used, maybe once every two to three years.

The Environmental Protection Agency (EPA) has a list of approved dispersants and special considerations are taken into account before they are deployed. Similar to dish soap in a greasy sink, dispersants break up the oil and help it disperse more quickly throughout the water column. This is good news to birds and beaches, but may be bad news to larval fish and plankton. They can only be used on lighter, fresher oils and are best if used in deep water (water more than 10 m deep) where dispersion can take place.

Believe it or not, some oil spills are torched! In-situ burning is sometimes conducted when oil becomes heavily trapped in marsh grasses and must be removed. Sensitive marsh soils and plants cannot handle the constant degradation by clean-up crews that occurs during a normal cleanup, so the oil and grasses are burned, allowing for new, young grasses to develop oil free.

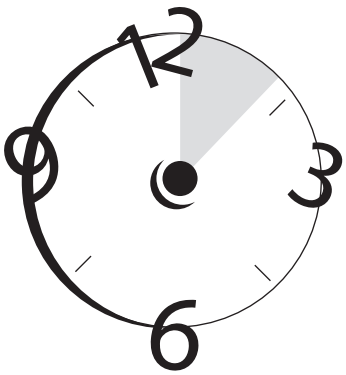
Bioremediation can also be used to clean up spilled oil. In this case, bacteria or fungi are applied to the spill site to help aid the decomposition of oil. This technique is not very common.

Sometimes it's best just to let the environment fix itself. If the spill is not severe enough to warrant insitu burning or cutting marsh grasses, "passive recovery" may be best. In this case the spill area is carefully surrounded with sorbant booms and the natural tidal flow and wind shifts help the boom gather what oil can be collected. The goal is always to do no more harm to the environment than the oil itself has done. The remaining oil degrades over time and the marsh restores itself naturally.

Food Chains

Core/AID

Time Allocation: 45 minutes
Required Materials and Resources on Page 152



Lesson Overview

In the first part of this lesson, students will engage in a discussion about the limitations of their model ecosystems. They will come to realize, for instance, that the classroom "ecosystem" was incomplete because it did not address the needs of all its organisms (e.g., food and water for the students and teacher). Students will discuss the other model ecosystems used thus far and examine whether or not the needs of organisms could be met without human intervention.

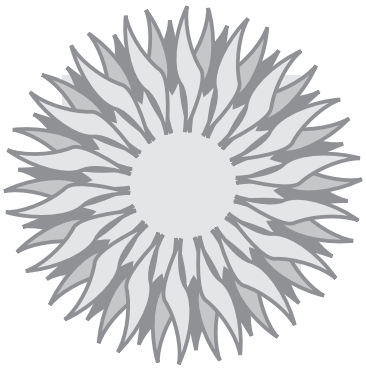
Students will also discuss how the needs of organisms—living within an ecosystem—necessitate interdependence. In this lesson a cheeseburger is used to represent a food source. A discussion of its components serves to introduce students to the concept of a food chain. One of the basic needs is food. Students will see and create examples of food chains and be introduced to the roles of organisms in ecosystems as they relate to obtaining energy to grow and live.

Guiding Questions

- What are some of the limitations of using models in efforts to understand ecosystems?
- What are the basic needs of organisms?
- What are food chains?
- How does the interaction of organisms help them meet their needs?

BIG IDEA

Food Chains



Content Goals

Universal Themes

- The natural world is composed of systems, which are organized groups of related objects that together form a whole.
- Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena.
- Properties of some objects and processes are characterized by constancy, while properties of others are characterized by change.

Principles and Generalizations

- Some scientific models have limitations that may restrict our understanding of scientific phenomenon.
- Organisms need a source of energy, such as food, to live and grow.
- Organisms can be grouped based on the method by which they obtain food.

Concepts

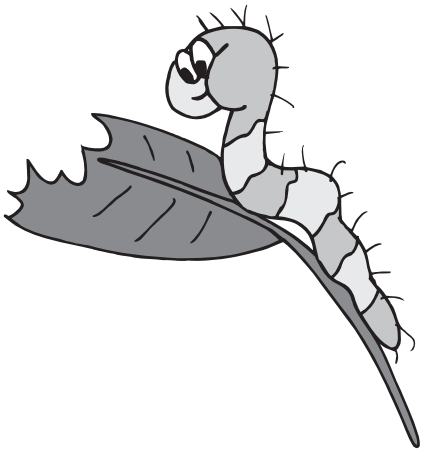
- Ecosystem
- Organism
- Interdependence
- Survival
- Animal
- Plant
- Prey
- Producer
- Consumer
- Carnivore
- Herbivore
- Omnivore
- Food chain

Teacher Information

- Plants need sunlight in order to grow. As a result of a complicated process, they can make their own food. When teaching this age group the national standards make it clear that it is not necessary to teach the concept of photosynthesis, the process whereby plants capture the sunlight's energy

and use it to transform carbon dioxide into sugars. They just need to know that plants are producers of food and that ultimately all other animals depend on the existence of plants for their survival.

- A food chain is the transfer of food from one level to another beginning with producers.



Skills

- Describe characteristics
- Identify characteristics
- Compare and contrast
- Analyze
- Identify relationships
- Categorize

Materials and Resources

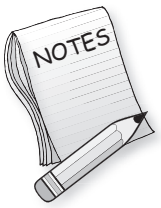
1. Clump of grass
2. Picture of a "Big Mac," "Whopper" or some other comparable fast food cheeseburger. Images like these can be obtained from the Internet using Google search engine. Click on the word "Images" and type "Big Mac" in the Search bar.

Preparation Activities

1. Get a clump of grass
2. Print out the picture of a cheeseburger and put tape on it so it can be attached to the board.

Introductory Activities (15 minutes)

- Have students make and record observations of their mini-ponds.
- When the students are finished with their observations, reconvene them as a large group.
- Engage students in a discussion. Ask them if they think the "classroom ecosystem" discussed three days ago is actually a healthy, stable, complete ecosystem, meaning it could survive for a long period of time without any other living or non-living things. Use Socratic questioning to move the discussion along. Eventually the answer should be "no," as the organisms in the "classroom ecosystem" (students and teacher) cannot have all their



needs met as there is no source of food or water, two of the basic needs of all organisms.

- In a similar way, ask students whether they think the mini-ponds are good models of ecosystems. Have students identify the strengths and weakness of these models. For example, the pond has no source of water (rain) unless the students add water. Because weather conditions do not vary in our classroom, students had to make sure that they placed their model ecosystems in the "right" environment.
- Brainstorm with students what the basic needs are of most all animals: food, water, air, and shelter. Students will probably mention the sun and not mention shelter. They may mention reproduction and the elimination of wastes. However, you should tell them that the emphasis in this unit of study will include the food, water and the shelter needs of organisms.
- The idea is to get students to realize that the classroom ecosystem is not stable or in balance because not all the needs of the organisms, students and teacher, can be met. There is no source of food or water.
- Remind students the classroom and mini-pond ecosystems are just models to introduce some aspects of ecosystems. They are used because they are convenient and students can relate to them easily. However, because these models have limitations; real-world ecosystems will be explored later on in this unit as well.

Pre-assessment

N/A

Teaching and Learning Activities (25 minutes)

1. Transition into the next phase of this lesson by sharing with students that an ecosystem must supply a source of energy for its organisms to live and grow. For instance, if the classroom ecosystem had an endless supply of food, such as cheeseburgers, the organisms would have a better chance of surviving in this ecosystem.

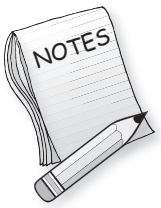
2. Invite students to silently think about all of the "parts" that make up a fully loaded cheeseburger (i.e., bun, cheese, lettuce, tomato, onions, pickles, ketchup and mustard).

3. Ask the following questions:
   - Where did the meat patty come from (a cow)?
   - What did the cow need to grow (food and water)?
   - What kind of food did the cow eat (grass)?
   - What did the grass need to grow? (source of energy, sunlight)
   - Illustrate this general flow on the front board.

   Human (eats meat patty ➔ cow ➔ grass ➔ sunlight (water, nutrients can be discussed, but are not the focus at this point)

4. Direct student attention to the list of answers on the board. In a think-pair-share, ask students to discuss the following: What inferences might they draw? What intrigues them? What puzzles them?

5. The ultimate goal is to have students recognize that organisms are members of food chains. They are to identify what an organism eats or depends upon what other organisms in a food chain.



6. Invite students to expand out each component of their cheeseburger in a manner similar to the meat patty diagram you just drew. The expanded list might look something like this:

cheese (human eats)	bun (human eats)	lettuce (human eats)
cow	wheat	sunlight
grass	sunlight	
sunlight		

7. Explain that the students have constructed a food chain for each cheeseburger ingredient. A food chain shows the transfer of energy from the sun to plants to animals.

8. Invite students to think about what all of these food chains have in common (sunlight is the primary food energy source).

9. Explain that food chains are found throughout nature. They help us to better understand what living things need to survive and grow.

10. Hold up the clump of grass. Explain that sheep eat grass like this in order to survive. Write out the following food chain on to the front board:

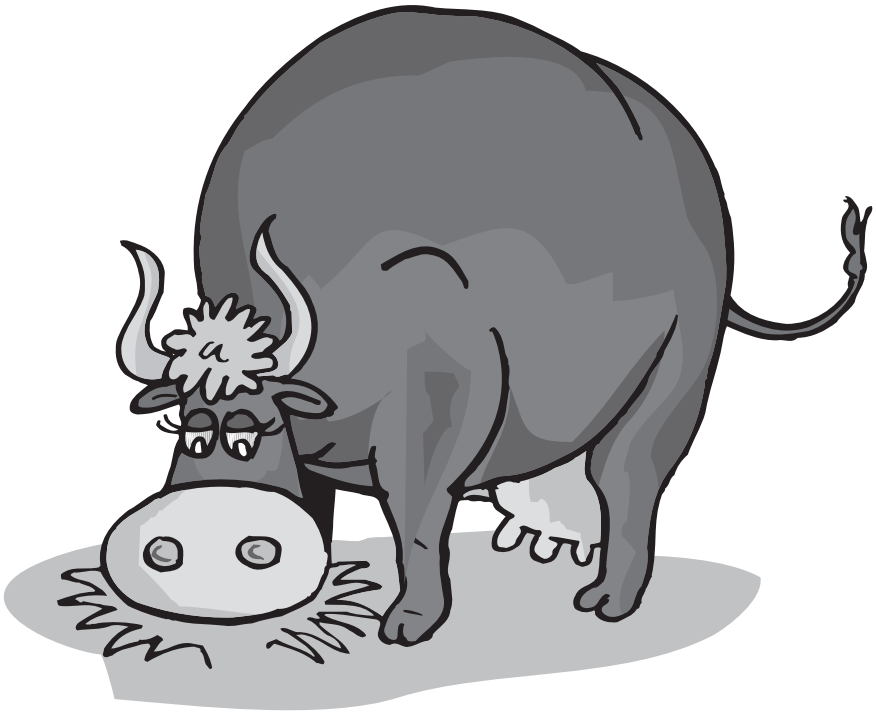
    Grass ➔ Sheep

11. Next, ask students what animal(s) might eat a sheep (humans, lion, or wolf). Add humans to the top of your food chain diagram.

12. Finally, ask where the grass gets its energy (sunlight).

13. Add sunlight to the bottom of the food chain diagram.

14. Draw arrows connecting sunlight with the organisms in your food chain. Explain that the grass, which is eaten by the sheep, which is consumed by humans, uses energy from the sun.
    Sunlight ➔ Grass ➔ Sheep ➔ Human
    or another food chain could be:
    Sunlight ➔ Grass ➔ Sheep ➔ Wolf



15. Explain that in a food chain, plants are called producers because they produce food. Also, explain that consumers are organisms that eat the food producers.

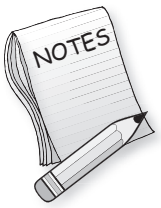
16. Introduce the terms: *predator*, *prey*, *carnivore*, *herbivore* and *omnivore*, again not for memorization purposes but so that when you use them in discussion, students will eventually be able to use them as well.

17. Emphasize the difference between a producer's and a consumer's role. Do not go into depth about *how* plants make their own food.

18. Assign homework.

Products and Assignments

Share with students that their homework will require that they think like scientists who study food chains. They are to sequence the following organisms in a food chain and to label each as a producer or a consumer: hawk, grass seed, mouse, snake, and sunlight.



Extension Activities (AID)

(AID) These activities are for students who have demonstrated a particular interest in this topic or who have demonstrated that they learn the material more quickly than their peers.

1. Have students go in pairs and use a digital camera to take a picture of organisms making up a food chain.
2. Print the pictures of the food chains and have students label the organisms, describe what eats what and identify their role in the food chain. This information can be typed or handwritten and placed below the picture.
3. Students can make mobiles using the pictures and the information, or they can also choose to post the pictures and descriptions in an area (hallway) where parents, other teachers and students can see the students' real-world understandings of food chains. Entitle the display area something like:

"*Food Chains, Food Chains Everywhere-*
in the Water, Dirt and Air!"

Post Assessment

- Homework assignment
- Digital pictures

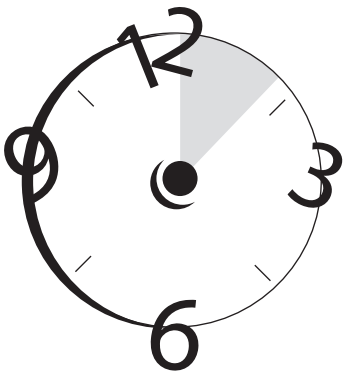
Debriefing and Reflection Opportunities (5 minutes)

Engage students in a brief, whole group discussion about why it is important to study food chains that are found throughout nature. Use questioning, if necessary, to guide students to important understandings including, but not limited to: food chains help us to better understand what living things need to survive and grow; studying food chains reveals the important role of the sun as a source of energy; and plants are producers for many other organisms.

Food Chains

Core/AID

Time Allocation: 1 hour and 30 minutes
Required Materials and Resources on Page 152



Lesson Overview

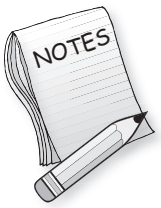
Through the use of purposefully selected pictures and open-ended questions, students will come to understand how the needs of organisms necessitate interdependence. Students will identify different food chains that exist in various ecosystems, as well as the effect of the removal of an organism from the food chain.

Guiding Questions

- How does the interaction of organisms help them to meet their needs?
- What are food chains and what are the roles of organisms in them?
- What happens if food chains are broken?

BIG IDEA

Food Chains and Ecosystems



Content Goals

Universal Theme

- The natural world is composed of systems, which are organized groups of related objects that together form a whole.

Principles and Generalizations

- Ecosystems have producers, consumers and decomposers.
- Organisms can be grouped based on the method by which they obtain food.
- Ecosystems have food chains.

Concepts

- Ecosystem
- Organism
- Microorganism
- Bacteria
- Interdependence
- Survival
- Producer
- Consumer
- Decomposer
- Predator
- Prey
- Phytoplankton
- Zooplankton
- Compost
- Decay
- Food chain

Teacher Information

- Phytoplankton are free-floating, tiny plants such as diatoms and green algae.
- Zooplankton are free-floating, tiny animal such as rotifers and copepods.

Food Chains

Skills

- Describe characteristics
- Identify characteristics
- Compare and contrast
- Analyze
- Identify relationships
- Categorize

Materials and Resources

1. Zooplankton and phytoplankton pictures can be obtained on the Internet by going to http://www.google.com, clicking on Images and entering the words "phytoplankton" or "zooplankton" in the search bar.
2. Pictures of microorganisms, such as bacteria and mold that assist in the decay process are needed. They can be found on the Internet or in books. An excellent book to show "critters" involved with the decay process is *Compost Critters* (1993) by Bianca Lavies. This can be purchased on the Web at http://www.amazon.com.
3. The U. S. Fish and Wildlife Services at http://images.fws.gov has a National Image Library with public domain images for download. It is a wonderful resource for images of the various organisms studied in this unit.

Preparation Activities

1. Collect or create pictures of environments that show organisms that are part of specific food chains.
2. Print picture(s) of plankton.
3. Print picture(s) of denitrifying bacteria.
4. Make copies of the Food Chain Homework Assignment.

Introductory Activities (10 minutes)

- Collect homework assignments.
- Invite students to reflect on their mini-ponds and the hamburger that was discussed previously. Pose the following question: What have you learned so far about ecosystems? Acknowledge all student responses. If students do not verbalize that ecosystems consist of living and non-living organisms that are interdependent, use Socratic questioning to move students toward this understanding.

- **SEARCHLIGHT:** Using your background knowledge about your students and any clues from the conversation above, assess the content knowledge of your students with respect to the upcoming lesson about food chains. If you believe you have students with a great deal of prior knowledge about this topic, refer them to the AID activities provided at the conclusion of this lesson.
- Share with students that in today's lesson, they will be exploring in more detail food chains, which show the interdependence of organisms.
- Have a student or two share their homework drawings of the food chain: The correct sequence for the homework assignment is:

Sunlight ➔	Grass seed➔	mouse➔	snake➔	hawk
	Producer	Consumer	Consumer	Consumer

- Discuss the roles of each organism in the food chain using the terms *producer, consumer, carnivore, herbivore, predator* and *prey*.
- Ask students to discuss the following question: What might happen if the grass seed disappeared from the area. (The mice would either have to find a new food source, or become extinct. This in turn would affect the number of snakes and ultimately the survival of the hawks that depend on those snakes.)
- Explain that scientists call this dependence of one species on another species *interdependence*.

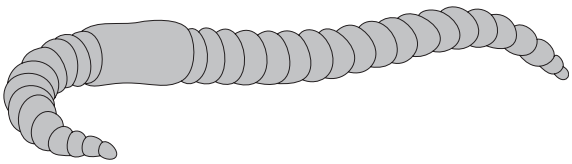
Pre-assessment

N/A

Teaching and Learning Activities (70 minutes)

1. Arrange students in small groups. Show students pictures/drawings of environments that have organisms in them that demonstrate food chains. Pictures can be found in textbooks or on the Internet by going to http://www.google.com and clicking on the word "Images" and then entering the words "food chain" into the search box.

2. For example, one picture may include plants, caterpillars or other plant-eating insects, birds and hawks. Provide student groups with the opportunity



to describe the source of food for each organism in the picture and identify each organism's role in the food chain.

3. Reconvene the whole group. Discuss with students the following terms: *producer, consumer, predator* and *prey, carnivore,* etc. The terms are not for memorization purposes but to enable them to identify the role and therefore the importance of the organism to the overall health of the ecosystem.

4. Show a second picture that might be of an ocean environment that shows phytoplankton, zooplankton, and small fish that feed on the plankton and larger fish, such as sharks, that prey on smaller fish. Again, ask students in their small groups to describe the source of food for each organism in the picture and identify each organism's role in the food chain.

5. As a large group, discuss how each organism is a source of food for the next group, thus creating a sequence, or chain called a food chain.

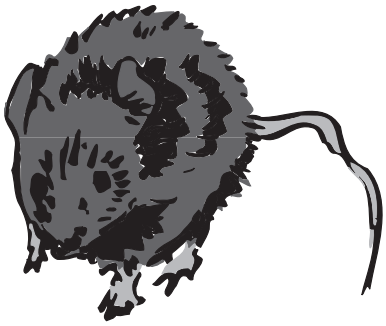
6. Using one of the pictures, select one member of the food chain. As students in their small groups to discuss what would happen if a member of the chain were eliminated.

7. Reconvene the group. Select a second picture and identify a species to remove. Discuss the removal of other organisms until you are confident students understand the importance of each organism to the stability of the whole food chain. Specifically, without the benefits of this interdependence, organisms would not survive.

8. Pose the following question to the whole group: What happens when some organisms in these food chains die? Do dead organisms just accumulate in an ecosystem?

9. Using Socratic questioning, lead students through a discussion of the concept of "decay" and how microorganisms assist in this process.

10. Introduce the term *decomposer*, again not for the purpose of memorization, but from the point of view that all healthy ecosystems have decomposers. Ask students what the word *decomposer* means to them.



11. Show them pictures of the sow bug, mold, worms and mites (*Compost Critters* is a great source for pictures). Discuss what a compost pile is and how these organisms feed on our garbage, and the idea that one organism's trash is another organism's treasures!

12. Share with students that these organisms are much bigger than the "invisible," truly microscopic bacteria.

13. Show them a picture of denitrifying bacteria. Guide students to an understanding that decomposers work on ecosystems visibly and invisibly.

14. Distribute the homework assignment, Food Chain Homework Assignment.

Products and Assignments

- Explain the homework assignment. Each student is to find or create a picture that represents a food chain. They are to indicate whether the organism is a producer, first-level, second-level consumer or decomposer, etc. and who eats whom.

Extension Activities

(Assign advanced students to either of these AID activities based upon their interest.)

1. AID – Language Arts and Science Terminology
   - In addition to adding to students' science vocabulary and understanding, the etymology of words in science is explored. Students should begin to understand that English words have origins in other languages. If students had a better understanding of the prefixes, roots and suffixes of words, they could use this information to predict what other words mean.
   - Tell students that the sequence of "what eats what" in a food chain is referred to as having "trophic levels."
     - Have students describe the origin of the word and explain its connection to food chains. (Trophos is from the Greek meaning nourishment.)
     - Have them identify and count the number of trophic levels for another set of organisms in a food chain.
     - Have students describe the origin of the word *plankton* and

explain its connection to characteristics of plankton. (Plankton is derived from the Greek word "plankton" meaning drifting).

- Have students describe the origin of the word *consumers* and explain its connection to the characteristics of consumers. (Consumer is derived from the French word "sumere," which means to "take up".).
- Have students describe the origin of the word, *producers* and explain the connection to characteristics of producers. (Produce comes from the French "pro" –meaning forward and "ducere" – meaning to lead; thus the idea of producing to mean to "lead forward.") The connection is more difficult to see. It is the idea of producers as leading the way for all other organisms, as all organisms are ultimately dependent upon them. Explain this to students who cannot make the connection on their own. Have students describe origin of the prefix "phyto" and explain its connection to characteristics of plankton. (Phyto is derived from the Greek prefix phyto, meaning plant.)
- Have students describe origin of the word *predator.* (Predator is from the Latin word, praedari, meaning to prey upon.)
- Have students describe origin of the word *herbivore*. (Herbivore is from the Latin word, herba, meaning grass.)
- Have students describe origin of the word *carnivore*. (Carnivore is from the Latin word, carn, meaning flesh.)
- Have students describe origin of the word *omnivore*. (Omnivore is from the Latin word, omnis, meaning all.)

2. (AID) Food Chains in the Antarctic Waters
   - Students who have a special interest in nature and, in particular, animals, might want to investigate the life forms in the hostile environment of the South Pole. On the web site www.globalclassroom.org/antarct7/.html there is information (descriptions of Antarctic organisms, food sources, behaviors) and related activities regarding the organisms of the Antarctic waters developed by Kim Kovich, as part of the Globalclassroom's Project Explore program. Below is an edited version of some of the information and activities on this site.

Antarctic Waters: Who Lives There?

Almost all of the life found in Antarctica is located in the waters surrounding the continent. Antarctic waters support a large expanse of floating, speck-sized plants called phytoplankton. Phytoplankton are the producers for the whole Antarctic community. In the green waters surrounding Antarctica tiny crustaceans (krill) and fish devour the plankton by the billions. These are then caught and eaten by larger fish and squids. Penguins, winged birds, seals, and whales will eat these, in turn. Here is a closer look at some of these animals and what they eat:

PLANKTON– Phytoplankton are speck-sized plants that are the major producers of the Antarctic. Zooplankton are microscopic animals, who along with the phytoplankton, make up a group of animals called plankton. Algae are very small plants found free-floating in the Antarctic waters. Plankton and algae are the base for the Antarctic food pyramid.

KRILL– Krill are small (1 cm to 15 cm) red, shrimp-like creatures. They look like a crayfish without the front claws. They provide a food source for most of the other life forms. Sometimes they are found in groups called swarms.

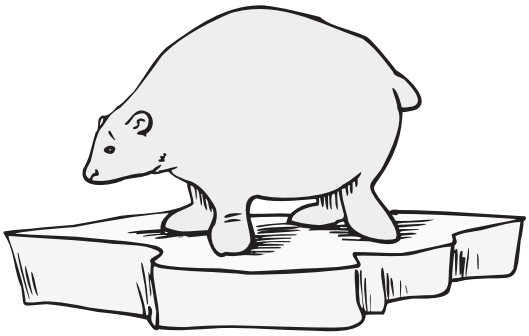
FISH– There are about 100 species of fish found in the waters off Antarctica. The very small fish may feed on the plankton and algae. The others feed on krill and on each other.

SQUID– There are many species (30-40) found in Antarctic waters. Sometimes they are found in groups called shoals. They are a food source for many larger animals. They feed on small fish and krill.

PENGUINS– They are flightless birds and have "wings" adapted to be effective paddles for swimming. Emperor penguins are the only large animals to inhabit the Antarctic mainland during winter. They have no predators on land and feed on fish and krill. Leopard seals and killer whales prey on penguins. Six types of penguins are found in Antarctica including the Emperor and Adelie.

SEABIRDS– There are a large variety of birds that visit the Antarctic region. The Skua is a scavenger, feeding on eggs and young penguins and wounded or dead animals. Many of the seabirds also feed on fish, squid, and krill.

Food Chains



SEALS– The seals along with whales are the most significant food consumers.

LEOPARD SEAL– The leopard seal is preyed upon by the killer whale. It feeds on penguins, young crabeater seals, seals, fish, squid and krill.

CRABEATER SEAL– The crabeater seal is preyed upon by killer whales, and young leopard seals. It feeds on krill, not crabs and has unusual teeth that are effective strainers. It is the most abundant seal in the world.

WEDDELL SEAL– It feeds mostly on cod and silverfish. It is preyed upon by killer whales and when young, leopard seals. It is at times killed by man because it's found close to many of the Antarctic bases (killed to feed sled dogs). It is a very deep diver and can stay submerged for up to an hour and a half.

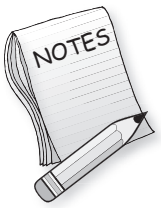
WHALES– Along with seals, whales are the most significant food consumers. Their importance as consumers has declined as a result of a reduction in their population due to hunting.

BLUE WHALE– This is the largest animal found on earth. It feeds on krill, which it strains through its baleen. Its only natural predator is the killer whale. Man has killed so many that it has brought it close to extinction.

SPERM WHALE– This is a toothed whale. It feeds on fish and squid and is occasionally preyed upon by the killer whale. It is a deep diver, using echolocation to find prey in dark deep waters.

KILLER WHALE– It is the top carnivore of the Antarctic and travels in packs or family groups called pods. It feeds on seals, penguins, fish and occasionally other whales.

LIFE ON LAND– The only plant life found on Antarctica is sparse growth of mosses, lichens, fungi and fresh-water algae. Plant life survives on exposed patches of ground during the summer. Bacteria and fungi are the main decomposers. The largest group of animals is the insects (mites and ticks).



Who Eats Whom? How Does It Work?

The sun is the source of energy for all life. Only green plants can "capture" this energy. Plants store this energy in the food they make during photosynthesis. Green plants are called producers because they produce their own food. Consumers are organisms that eat or consume other organisms. Animals, non-green plants, and many microorganisms are consumers and either directly or indirectly need green plants for their food. Predators are examples of consumers who catch and eat other animals. The animal that is caught and eaten is the prey. Decomposers use the wastes and remains of producers and consumers for food. They break down the wastes of living organisms and the remains of organisms. In the process of decomposition, the broken-down materials are returned to the soil where they are recycled and used again. Decay bacteria and fungi are examples of decomposers.

Some animals eat plants. Some animals eat other animals that have eaten plants. Thus, food and energy passes from plants to animals to other animals. This food relationship is like a series of chain links. By itself, each link is not useful. Put the links together, and you have a chain. Living things are related to each other by what they eat, and this relationship is called a food chain. There are special names for each link in a food chain. The plants are the producers. The plant-eating animals are called first level consumers; animals that eat the plant-eating animals are called second level consumers; and the last animals in the chain are the decomposers or scavengers. Scavengers are organisms that can eat plants, animals, or the remains of other organisms.

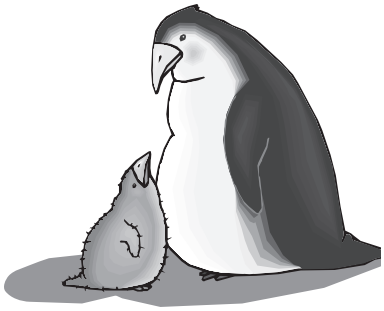
There are three classifications of animals: herbivores, carnivores, and omnivores. Herbivores are animals that feed on plants. Carnivores, also called meat eaters, are animals that eat other animals. Omnivores are animals that eat both plants and animals. One point that was mentioned before should be repeated. A food chain is really an energy chain. Energy from the sun is captured by the producers and passed on to the consumers. Through these chains, living things can access the energy they need to live. The following are some examples of food chains:

Food Chains

- Sun, grass, cow, human, mosquito.
- Sun, grass, mouse, snake, hawk.
- Sun, seeds, rat, cat, flea.
- Sun, corn, chicken, human.
- Sun, seed, insect, turtle, raccoon, mountain lion.
- Sun, leaves, deer, wolf, vulture, mite.
- Sun, algae, shrimp, small fish, tuna, human.

There are usually more producers in a food chain than other organisms. As you move to the next level, the number of organisms decreases. For example, a grass field feeds thousands of plant-eating insects. These insects feed a few hundred sparrows. Finally, the sparrows feed only a few hawks. Food chains are often shown as food pyramids. A pyramid shows how energy is transferred from one population to another. Food represents stored energy, and storage begins at the level of the producers. The stored energy is the energy that remains after the producers have used what they need for them to grow and reproduce. The first level consumers eat the producers. The consumers receive only the energy that remains stored by the producers. This is only a small part of the energy received by the producers from the sun so they need to eat many producers. Next, the second level consumer eats the first level consumer. The second level consumer receives the remaining energy stored in the first level consumer.

An ecosystem may have many food chains. Most animals in a food chain eat a variety of foods. An animal in one chain often eats animals from other chains. As a result, food chains overlap in this network.



Who Eats Whom? Activity:

Part One

You will be able to identify organisms found in the Antarctic as producers, primary consumers, secondary consumers, and scavengers. This will allow you to become aware of the roles these organisms play in the Antarctic community.

Procedure:

1. Make a list of Antarctic organisms described above.
2. Create a spreadsheet data table with the name of each organism under the column that best describes how that organism gets its food.

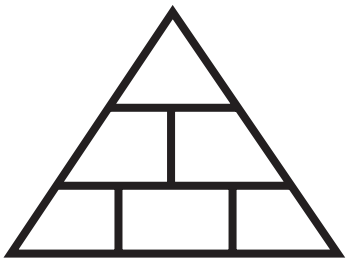
Data Table:

Primary
Secondary Producer
Primary Consumer
Secondary Consumer
Scavenger/Decomposer

Questions:

1. Of the four columns, which one do the others depend upon most? Why?
2. Of the four columns, which one do the others depend upon least? Why?
3. What is one way that organisms in a community depend on each other?

Food Chains



Part Two:
Antarctic Food Chains

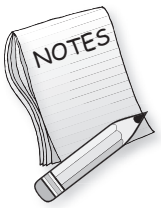
Procedure:

1. Take the organisms from Part One and put them into food chains. This will allow you to become familiar with the Antarctic food chains. Look at the data table in Part One. From this table make up as many different food chains as possible. Set up your food chain diagrams to look like the following example:

Producers	➔ primary consumer	➔ secondary consumer	➔ scavenger
Seeds	➔ rat	➔ cat	➔ flea

Questions:

1. What patterns do you see in the food chains?
2. Which organisms do you think are the most abundant if all the food chains you made actually occurred in the Antarctic? (Remember the food pyramids.)



Part Three:

Antarctic Food Chain Game

You will be able to put the organisms found in the Antarctic into food chains. By linking them, you will become more aware of what food chains are and how they work.

Materials:

30 index cards, pencil or pen, Internet, magazines, or reference books (*National Geographic* would work well).

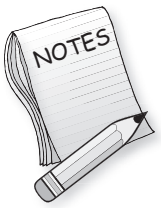
Procedure:

1. Get 30 index cards to represent fifteen different organisms that are found in the Antarctic community (all fifteen Antarctic organisms can be found in the concept invention activity portion of this module). You will need two cards per organism.
2. To make a card you need a picture of the organism. The picture of the organisms may be drawn or cut out and then attached to the top of the card.
3. Below the picture you need to make two columns. Label one column "eats" and another "eaten by." Fill in the columns with the appropriate organisms. There should be at least one to four organisms in each column. If the organism at the top of the card is a plant, write "makes its own food" under "eats." Make cards for the organisms listed in the "eats" and "eaten by" columns. Remember to make two cards for each organism.
4. Now you are ready to play the food chain game. Two to six players may play. Shuffle the cards. Deal five cards to each player. Place the rest of the cards face down on the table.
5. The player on the dealer's left selects a card from his/her hand, which serves as the base for the food chain. The second player selects a card from his/her hand and builds to the left or right of the base card. A card representing an organism eaten by the organism on the base card is placed to the left. A card representing an organism that eats the organisms on the base card is placed to the right.

6. If a player cannot place a card down, the player must draw from the deck until a card can be played. If no cards are left on the table, the player must pass. Play continues until a food chain is completed. The winner is the player with no cards remaining or the fewest cards remaining when the food chain is completed.
7. Before you play again, list the organisms in the data table that made up your food chain. Play the game several times to build up several food chains.

Questions:

1. Which organisms in your card deck are herbivores?
2. Which organisms in your card deck are carnivores?
3. Which organisms in your card are omnivores or scavengers?
4. What are some of the predator/prey relationships?
5. What is being passed from one organism to another in the food chain?

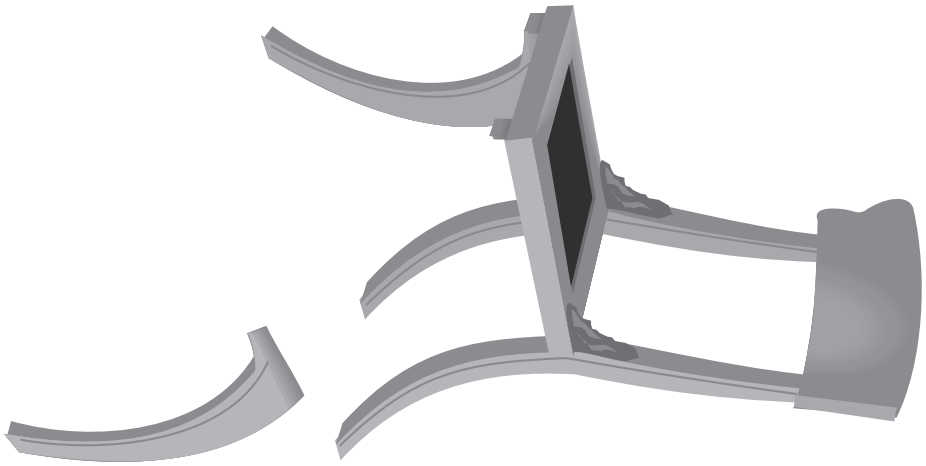


Post Assessment

N/A

Debriefing and Reflection Opportunities (10 minutes)

Select another picture. In a whole group discussion, ask students to discuss what would happen if a member of the chain were eliminated, thus reemphasizing the importance of each organism to an ecosystem's stability. Provide students with the opportunity to look back across all examples and draw out the commonalities regarding the interdependence of organisms in an ecosystem.



Food Chains

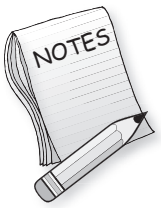
Food Chain Homework Assignment

1. Please read the following information, as it will help you complete the assignment accurately:

   The sun is the source of energy for all life. Only green plants can "capture" this energy. Plants store this energy in the food they make during photosynthesis. Green plants are called producers because they produce their own food. Consumers are organisms that eat or consume other organisms. Animals, non-green plants, and many microorganisms are consumers and either directly or indirectly need green plants for their food. Predators are examples of consumers who catch and eat other animals. The animal that is caught and eaten is the prey. Decomposers use the wastes and remains of producers and consumers for food. They break down the wastes of living organisms and the remains of organisms. In the process of decomposition, the broken-down materials are returned to the soil where they are recycled and used again. Decay bacteria and fungi are examples of decomposers.

   Some animals eat plants; some eat other animals that have eaten plants. Thus, food and energy passes from plants to animals to other animals. This food relationship is like a series of chain links. By itself, each link is not useful. Put the links together and you have a chain. Living things are related to each other by what they eat and this relationship is called a food chain. There are special names for each link in a food chain. The plants are the producers. The plant-eating animals are called first level consumers; animals that eat the plant-eating animals are called second level consumers; and the last animals in the chain are the decomposers or scavengers. Scavengers are organisms that can eat plants, animals, or the remains of other organisms.

   There are three classifications of animals: herbivores, carnivores, and omnivores. Herbivores are animals that feed on plants. Carnivores, also called meat eaters, are animals that eat other animals. Omnivores are animals that eat both plants and animals. One point that was mentioned before should be repeated. A food chain is really an energy chain. Energy from the sun is captured by the producers and passed on to the



consumers. Through these chains, living things can access the energy they need to live. The following are some examples of food chains (a) sun, grass, cow, human, mosquito and (b) sun, leaves, deer, wolf, vulture, mite.

There are usually more producers in a food chain than other organisms. As you move to the next level, the number of organisms decreases. For example, a grass field feeds thousands of plant-eating insects. These insects feed a few hundred sparrows. Finally, the sparrows feed only a few hawks. An ecosystem may have many food chains. Most animals in a food chain eat a variety of foods. An animal in one chain often eats animals from other chains. As a result, food chains overlap in this network and form a food web.

The first-level consumers eat the producers. The second-level consumers eat first-level consumers and so on (see the marsh grass example below).

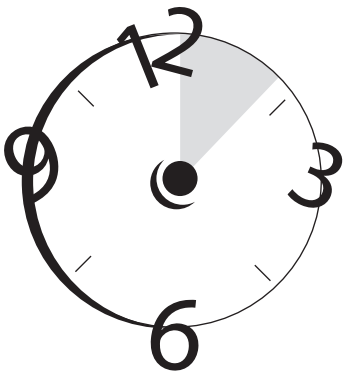
2. Your task is to find or create a picture, by cutting or pasting pictures from a magazine or drawing pictures that represents a food chain. You are to identify the organisms as a producer, first-level, second-level consumer or decomposer, etc., and show the chain so I can see who eats whom. For example, the food chain that was discussed in class would look like the following:

marsh grass ➔	grasshopper ➔	sparrow ➔	owl
producer	1st level consumer	2nd level consumer	3rd level c

Food Chains

Practice/AID

Time Allocation: 45 minutes
Required Materials and Resources on Page 152



Lesson Overview

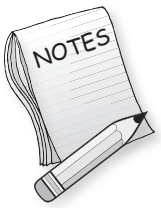
Students in this lesson will assume the role of scientists as they investigate what an owl eats through a dissection and analysis of owl pellets. This activity allows them to do some scientific exploration, document and share findings and draw conclusions about what an owl eats and its significance in a food chain. The students will realize that the owl, like all animals, is dependent on other living things for its survival.

Guiding Questions

- How can exploring what an owl eats tell us about food chains?
- How does the interaction of organisms help them meet their needs?
- How does merging and sharing data help in scientific investigations?

BIG IDEA

Barn Owl Food Chain



Content Goals

Universal Theme

- The natural world is composed of systems, which are organized groups of related objects that together form a whole.

Principles and Generalizations

- Organisms have dependent and interdependent relationships that enhance survival.
- Ecosystems have food chains.

Concepts

- Ecosystem
- Organism
- Interdependence
- Consumer
- Carnivore
- Predator
- Prey
- Food chain
- Population

Teacher Information

- Barn owls are expert hunters with specially designed eyes, ears, wings, pointed talons and hooked beaks to help catch prey. Owls consume three or four animals a night and these structural features assist them in consuming their prey whole. They cannot digest the bones, fur and feathers, so they become clumped in a special area inside the owl called the gizzard. This material is compacted and forms an owl pellet. Once formed, the pellet moves up from the gizzard to the proventiculus, where it remains for up to 10 hours before being regurgitated. Owls cannot eat while a fully formed pellet is present, blocking the digestive track. When an owl is ready to produce a pellet, it usually closes its eyes, gets a funny look on its face, does not want to fly and when the pellet is ready to come out, the beak is opened and the pellet simply drops out. Other birds of

prey, such as hawks, also produce pellets but the owl's digestive juices are less acidic than those of other birds of prey, so there is more material to form a pellet.

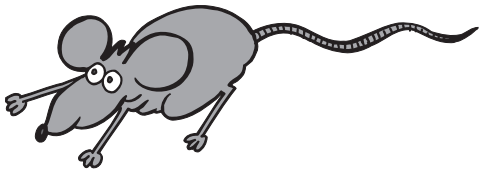
- Although the strict definition of population as it relates to ecology is a group of interbreeding organisms, it is not necessary to introduce the idea of species at this time. A population can be introduced as a group of the same kind of organisms like the owl population, chicken population, mice population, and even the rodent populations.

Skills

- Dissect
- Observe
- Describe
- Collect data
- Organize data
- Analyze data
- Compare and contrast
- Identify patterns
- Develop explanations
- Draw conclusions
- Communicate findings
- Measure

Materials and Resources

1. One owl pellet per group - Owl pellets can be bought from supply houses like Carolina Biological at (1-800-334-5551) 2700 York Road, Burlington, North Carolina 27215 or Nasco Science (1-800-558-9595) 901 Jamesville Ave. Fort Atkinson, Wisconsin. Owl pellets cost around $2.00 each. The website for Carolina Biological is: http://www.carolina.com
2. If one goes into that website further, the identification guides, bone sorting charts, bird, mole, rat skeleton charts needed for this activity can be downloaded for free from: http://www.carolina.com/owls/guide/birdskeleton.pdf
3. *Science Stuff* also supplies Barn Owl Pellet Activity Guides for $2.50 each. This guide comes with instructions, bone sorting chart and bird and vole skeleton layouts and the materials can be found at http://www.sciencestuff.com.



4. The Green Valley School has a web site, http://gvol.org/pellets.shtml that has pictures of a 4th grade class dissecting owl pellets. A *Microsoft PowerPoint* slide show of students' activities during these lessons could be created and shared with parents or other community members to show how enthusiastic students are when they have opportunities to engage in scientific inquiry.
5. One probe per student
6. One pair of tweezers per group
7. One paper plate per group
8. One paper towel
9. One bottle of glue/glue stick per group
10. One magnifying lens
11. Bone sorting and skeleton charts
12. Identification guides
13. One metric ruler per group
14. Four scales for massing pellets

Preparation Activities

Copy the Owl Outrage scenario, Bone Identification Chart, Skull Identification Chart, Bird Skeleton Chart, Mole Skeleton Chart, Rat Skeleton Chart, all of which can be obtained from the Carolina biological web site) and any other charts (mice, shrew or vole skeleton charts) or identification guides you have for the analysis of owl pellets.

Introductory Activities (10 minutes)

- Have students make and record their observations of the mini-pond ecosystem.
- Collect homework assignments.
- Invite a student or two to share their homework in which they were asked to find pictures that represent food chains.
- Have students identify the chain levels, what eats what, and what organisms are the producers and consumers.
- Use these examples of different food chains to emphasize how living things are interdependent on one another.
- Listen carefully to diagnose any misunderstandings. Use Socratic questioning to lead students to accurate understandings.

Pre-assessment
N/A

Teaching and Learning Activities (30 minutes)

1. Tell students that they will now have the opportunity to conduct a scientific exploration.

2. Hand out and review the Owl Outrage lab investigation scenario.

3. Introduce the term *population* and use it throughout the activity, not as a term to be memorized, but rather as a term that can be helpful when having conversations about the same kind of organism.

4. Have students collect their materials, including the charts and guides.

5. Remind them to put the bones that they find on the paper plate.

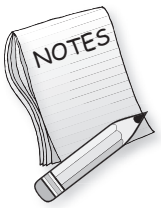
6. Remind them that they must answer the questions included in the lab investigations as they go along.

7. Tell students that they will finish the lab investigation tomorrow and that they will share their results, as all scientists do, to see if any conclusions can be drawn as to what owls really eat and whether they are causing the problem of which they have been accused.

Products and Assignments
N/A

Extension Activities
(AID) For students in need of greater intellectual challenge: Invite advanced students to use a computer to create their bar graphs in *Microsoft Excel*.

Post Assessment
N/A



Debriefing and Reflection Opportunities (5 minutes)

Gather the class together and using think-pair-share, ask groups what they think their investigation of the owl pellets will tell us about food chains.

Name_____ **Date**_____

Is the Outrage over the Owl Population Justified?

Your Task:

You are a wildlife biologist. A group of farmers have come to you asking for advice. The owl population in the area has increased significantly in the past two years. Many of the farmers believe that the owls are killing the chickens, especially the young chicks for food. They want payment given (bounty) to encourage people to kill owls and reduce their population. Another group of farmers believes the owls are not hurting the chicken population and that, in fact, the owls are benefiting farmers, as they are keeping the mice, rats, and voles (rodents) under control as a result of preying on them. This group of farmers says that they see fewer of these rodents in their grain storage bins, which means these animals are not depleting the grain supply. They want the state wildlife service to import even more owls to ensure that the rodent populations will be kept under control. Based on the fact that you are an expert in wildlife biology, you know you can collect and analyze owl pellets. The evidence from this investigation might resolve this controversy. You tell the farmers that you will be doing some exploration into the owl's diet by conducting some lab investigations, and that you will present your results to them the following week.

The Lab Investigation:

1. You and another wildlife biologist colleague of yours make the following list of necessary materials to conduct this investigation:

   Owl pellet
   Probe for dissections
   Pair of tweezers
   Paper towels
   Paper plate
   Glue stick
   Hand lens
   Metric ruler
   Scale
   Bond identification charts
   Skull identification charts
   Skeleton charts (bird, rat, mice, shrew, mole and vole)

2. Before you begin your dissection of the owl pellet, describe what it looks like.

   A. Use a metric ruler to measure the pellet's length _____ cm

   B. Use a metric ruler to measure the pellet's width _____ cm

   C. Mass the pellet _____ grams

   D. What color is the pellet? _____

   E. What texture is the pellet? _____

Name_____ **Date**_____

3. As you dissect the owl pellet, separate the bones from the fur and place all the bones on the paper plate. Use the bone sorting charts and the identification guides to help you categorize the bones.

4. Once the bones are identified, as to type, WASH YOUR HANDS.

5. Glue the bones to the skeleton charts, if they are available.

6. How many skulls did you find? _____

7. What kind(s) of skull(s) did you find? _____

_____

8. How many other bones did you find? _____

9. List the different types of bones you found (e.g., skull, scapula, femur, tibia, rib, pelvic, jaw).

10. List below the class findings for types and numbers of skulls and bones:

Name_____ **Date**_____

11. Based on the class findings, what can you conclude about the population of prey in the area where these owls must have fed?

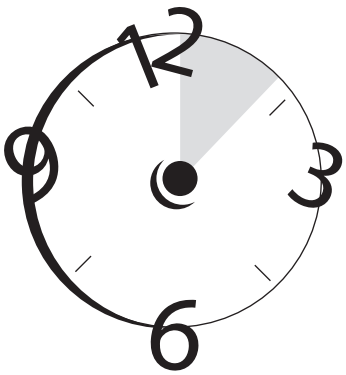
12. Write down the advice you will be giving the farmers' groups at their next scheduled meeting

13. Create a bar graph that shows the numbers and types of bones so that the farmers will have a visual picture of your data. Be sure the graph has a title, both axes labeled and a key (legend).

Food Chains

Practice/AID

Time Allocation: 45 minutes
Required Materials and Resources on Page 152



Lesson Overview

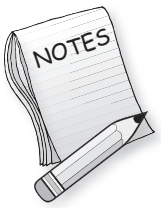
Students in this lesson will continue their investigation of organisms involved in an owl's food chain. As they work to examine and piece the owl-pellet bones together, they will be introduced to some anatomical information. They will have an opportunity to discuss the bones of small vertebrates and relate them to some of their own bones. They will also have the opportunity to share and merge their data, as scientists do, and adjust their small-group conclusions, if necessary, as a result of having access to a larger database of information.

Guiding Questions

- How does the interaction of organisms help them meet their needs?
- How does merging and sharing data help in scientific investigations?

BIG IDEA

Owl Pellet Food Chain



Content Goals

Universal Theme

- The natural world is composed of systems, which are organized groups of related objects that together form a whole.

Principles and Generalizations

- Organisms have dependent and interdependent relationships that enhance survival.
- Ecosystems have food chains.

Concepts

- Ecosystem
- Organism
- Interdependence
- Producer
- Consumer
- Predator
- Prey
- Food chain

Teacher Information

N/A

Skills

- Dissect
- Observe
- Describe
- Collect data
- Organize data
- Analyze data
- Compare and contrast
- Identify patterns
- Develop explanations
- Draw conclusions
- Communicate findings

Materials and Resources
N/A

Preparation Activities
Put the following headings on the board:
Rat, mice, vole, shrew, mole and bird skulls

Introductory Activities (5 minutes)

1. Have students make and record their observations of the mini-pond and terrarium ecosystems.
2. Remind students they should be completing the answers to the questions to the How Good Were Your Observations on Mini-pond Life? sheets.

Pre-assessment
N/A

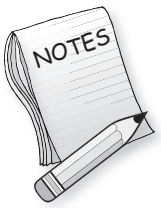
Teaching and Learning Activities (35 minutes)

1. When all the dissections are completed, invite students come to the front board and put the number of skulls they found in each of the appropriate columns.

2. Ask students what were other types of bones they found. (They might have found vertebras, scapulas, ribs, tibias, fibulas, humeri, femurs, jaw and pelvic bones).

3. In a think-pair-share activity, invite students to discuss the data on the board. How many rat, mice, vole, shrew, mole and bird skulls did the class find? Is there any one animal that was found most in the owl's pellet? If there was, what might be a reason why one animal was dominant in the owl's diet?

4. Reconvene students into a large group. Ask pairs to share their thinking. Acknowledge all student responses and, at the same time, use questioning to keep them directed toward the scientific conclusions that should emerge from the owl pellet data. Talk about which group of farmers was correct regarding the prey that owls eat.



5. **SEARCHLIGHT:** Listen to students' thinking, noting students who demonstrate careful observation, scientific thinking, interest in the nature of scientific investigations, or enthusiasm for this particular topic. Invite them to complete the AID activities at the conclusion of this lesson.

6. Assign homework. Students will draw a food chain for the organisms they discovered were part of the owl's diet.

Products and Assignments

- Completed student Owl Outrage lab investigation
- Owl food chain

Extension Activities (AID)

1. The *Carolina Biological* site http://www.carolina.com also has a Barn Owl online database that allows students to compare the contents of their pellets with those of other Barn Owl pellets from all over the United States.
   - Students needing additional challenge can enter their research information online and thus share it with the other owl pellet investigators around the county.
   - They can then take the data they find on the online and put it into an Excel spreadsheet with their classroom data. They could make two bar graphs and present these to other class members showing the similarities and differences in findings between the classroom research data and the data from around the country.
2. Students can extend this activity by being asked to use this food chain as the basis of a food web. They could look up the other food sources for the organisms on which the owl feeds. For instance, if they discover that an owl eats a songbird, then they would investigate what songbirds feed on (worms, caterpillar and insect larvae) and build a food web.

Post Assessment

N/A

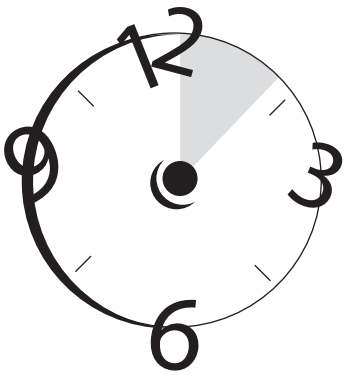
Debriefing and Reflection Opportunities (5 minutes)

Emphasize the ideas: (1) that an owl is part of a food chain and, (2) that its prey, mice, moles etc., have their own food sources. These organisms can be parts of other food chains, thus creating a food web, a new term that they will be talking about in more depth shortly. Solicit questions that may still be puzzling students. Tell them their homework will be to describe a food chain in which the owl is a part.

Adaptations

Core

Time Allocation: 45 minutes
Required Materials and Resources on Page 152



Lesson Overview

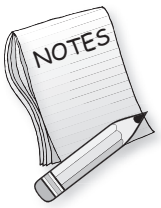
In this lesson, students will compare pictures of various ecosystems to identify similarities and differences between them. The lesson reinforces the idea that although ecosystems have many similarities, each also has unique characteristics that support the tremendous diversity of life. Students will understand that without the broad spectrum of habitats associated with many types of ecosystems, life forms would be more vulnerable to changes in environmental conditions.

Guiding Questions

- How are ecosystems alike and how are they different?
- Why is the diversity of ecosystems and their respective habitats so critical to life on earth?

BIG IDEA

Similarities and Differences in Various Ecosystems



Content Goals

Universal Themes

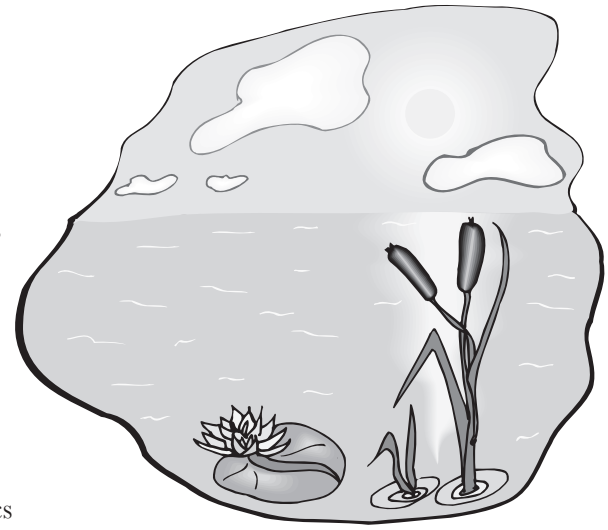
- The natural world is composed of systems, which are organized groups of related objects that together form a whole.
- Properties of some objects and processes are characterized by constancy, while properties of others are characterized by change.

Principles and Generalizations

- Ecosystems have similarities and differences.
- The diversity among ecosystems supports a wide variety of life forms on earth.

Concepts

- Ecosystem
- Environment of non-living things
- Organism
- Interdependence
- Producer
- Consumer
- Decomposer
- Food chain
- Diversity of organisms
- Change



Teacher Information

N/A

Skills

- Describe characteristics
- Identify characteristics
- Compare and contrast
- Analyze
- Identify relationships
- Categorize
- Justify answers

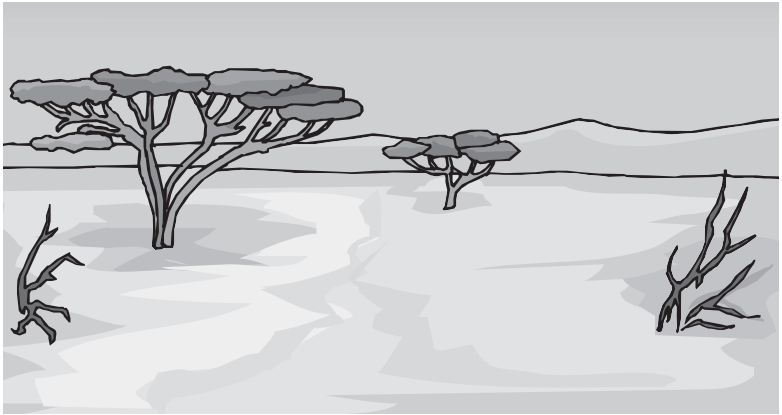
Materials and Resources

1. Index cards (12 -16)
2. Transparency/overhead projector or butcher block paper and easel
3. At the time of this writing, three, free 22" by 32" wildlife posters were available at the following address:

   Nongame Wildlife Fund
   Box 30028, Dept. D.
   Lansing, MI 48909

   These feature pictures of Michigan coastal dunes, forests and wetland. They are in color, and each has 50 or so organisms labeled in a small diagram below the poster. The back of the poster is filled with descriptions about the ecosystem and its inhabitants.
4. The Bureau of Land Management offers five, low-cost publications, which appeared in *Science and Children* magazines. Each consists of a pamphlet and a color poster that describes the different ecosystem. They were: "Some Like It Hot" (Sonoran Desert of Arizona), "The Big Empty" (Great Basin Desert of Nevada), "Welcome to the Underground" (cave ecosystems), "High Wide and Windswept" (Colorado Plateau), "The High Plains" (prairie ecosystems). The contact address is:

   Mr. Derrick Baldwin
   Bureau of Land Management
   Heritage Education Program
   P.O. Box 758
   Dolores, CO 81323
   (970) 882-4811
   The cost of each pamphlet/poster is $1.50.
5. The Bureau of Land Management also has a website that has a link to "Teacher resources" and then "Ecosystems." The web address is www.blm.gov/education
6. Use some or all of the following Internet sites if needed:



- Stream ecosystem construction directions
  http://www.augusta.k12.wi.us/HS/dept/sci/stream.html
- Classroom ecosystems – four cell kit
  http://www.oceanarks.org/education/clm/lessons
- Ecosystems
  http://www.scienceteacherstuff.com/ecosystem.html
- Rain forest
  http://curry.edschool.virginia.edu/class/edis/590s4/Snead/Helpful_Web_Sites.html
  http://curry.edschool.virginia.edu/class/edis/590s4/Snead/RAIN_F~1_htm
  http://curry.edschool.virginia.edu/class/edis/590s4/Snead/Resources.htm
  http://www.theteachersguide.com/Habitats.html#Rain
- Deserts
  http://www.theteachersguide.com/Habitats.html#Deserts
- Wetlands
  http://www.theteachersguide.com/Habitats.html#Wetlands
- Coral Reefs
  http://www.theteachersguide.com/Habitats.html#Coral

7. The US Fish and Wildlife Services at http://images.fws.gov has a National Image Library with public domain images for download. It is a wonderful resource for images of the various organisms studied in this unit.

Adaptations

Preparation Activities

1. Hang pictures of various ecosystems around the room.
2. Type ecosystem name tags for each system using two cards per system– one with the word, "Ecosystem" and the other identifying the actual type of ecosystem, such as desert. Place the ecosystem card under each picture and save the identification cards for the end of the activity at which time students will place these tags under the pictures.
3. Have transparencies or butcher block paper and easel available for the taking of notes on the ecosystems based on students' experiences with these ecosystems.

Introductory Activities (10 minutes)

- Place two columns on the board labeled, Similarities and Differences.
- Hand out the table entitled Table for Comparing Nature's Ecosystems.

Pre-assessment

N/A

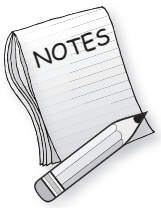
Teaching and Learning Activities (30 minutes)

1. Have students take one ecosystem identification label and place it under the appropriate picture.

2. As the label is placed under the appropriate ecosystem, ask students if any of them have been to the ecosystem, (e.g., a forest) and if so, to share one thing they remember most about that ecosystem.

3. Make a list of students' memories on transparencies or butcher-block paper for that ecosystem. Record the students' information regarding the ecosystem, including the living and non-living things associated with each of the ecosystems pictured.

4. Repeat this procedure for each of the ecosystems pictured or as many as is necessary to ensure that: (1) students have had enough opportunities to share their experiences with the different ecosystems, and (2) you have enough ecosystems displayed so that students will be able to compare and contrast them with ease.

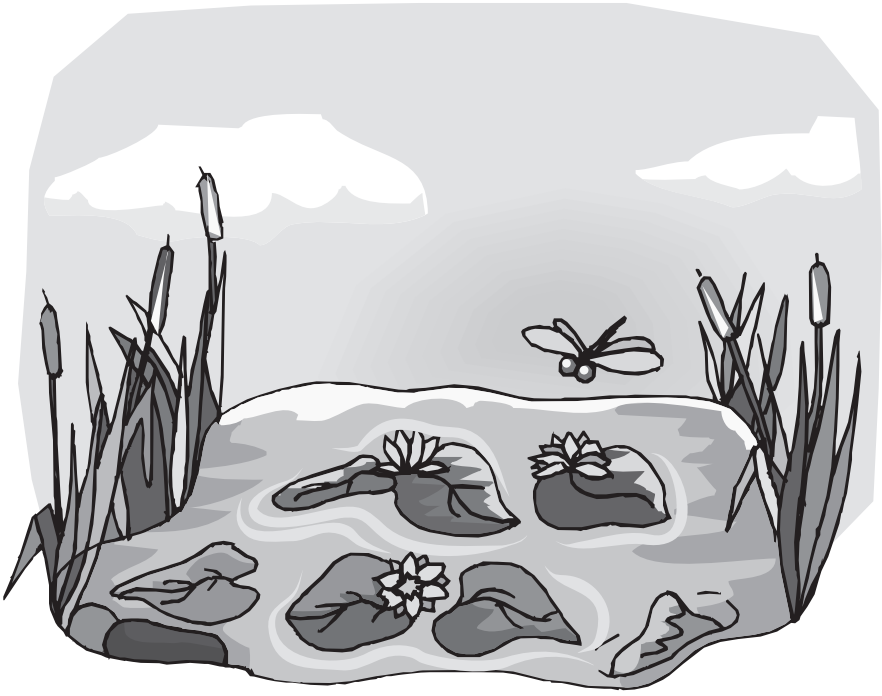


5. *Note to the Teacher:* Save these flip charts for the last wrap-up lesson. The baseline information gathered from students in this lesson will provide a visual foundation upon which students will be able build at the conclusion of the unit.

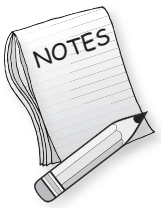
6. Engage students in a large group brainstorming session. The object is to list as many similarities and differences in the ecosystems that are displayed.

7. Invite students to fill out the table at the same time as you are filling out the columns on the board. Students may generate different responses than those listed on the chart below.

8. For instance, the columns may look like—or be very different from—the following:



Similarities of Nature's Ecosystems	Differences among Nature's Ecosystems
1. Ecosystems contain living things.	1. Many of the living things in different ecosystems are different.
2. Ecosystems contain non-living things, such as water and air.	2. Many of the non-living things in varied ecosystems are different.
3. Ecosystems have interactions between the living and non-living things.	3. Different ecosystems have unique interactions.
4. Organisms are dependent on living and non-living things.	4. Organisms are dependent on different living things and non-living things in different ecosystems
5. Ecosystems are stable until acted upon by some outside change.	5. Ecosystems are affected differently by different environmental changes (e.g., little rain would hurt a pond ecosystem, but not a desert)
6. Ecosystems use sunlight for plants to grow and live.	6. Ecosystems have different food chains
7. Ecosystems have food chains.	7. Ecosystems have different food webs.
8. Ecosystems have food webs.	8. Ecosystems have different producers, consumers and decomposers.
9. Ecosystems have animals, plants and decomposers like bacteria.	9. Ecosystems have unique places for organisms to be.
10. Ecosystems have producers, consumers and decomposers.	10. Ecosystems have varying environmental average temperatures
11. Ecosystems have habitats.	11. Ecosystems change over time at different rates.
12. Ecosystems change over time.	12. Ecosystems vary in their fragility.
13. All ecosystems are important to maintaining the diversity of life.	13. Ecosystems vary in size and complexity.



9. Ask students the following question: What is familiar in the first column? The commonalties serve to remind students of some of the unit's broader concepts and principles (e.g., Because of the interdependence of organisms within an ecosystem, when any one part is disturbed, there will be consequences that can be detrimental or often unpredictable. Ecosystems are everywhere).

10. Ask students the following: What is critical about the differences in the second column? Acknowledge all answers. The second column emphasizes the uniqueness of different ecosystems that support the wide diversity of life.

11. Ask a final question: Why is it important to preserve all the varied ecosystems? Without them, we would not have the richness of life on earth.

Products and Assignments

- Documentation (transparencies, butcher-block paper) of students' knowledge regarding ecosystems with which they have had personal experiences
- Students' Table for Comparing Nature's Ecosystems

Extension Activities

N/A

Post Assessment

N/A

Debriefing and Reflection Opportunities (5 minutes)

Emphasize that all ecosystems have living and non-living things and that the interdependent nature of organisms with each other and with their surroundings is a critical aspect of healthy ecosystems.

Name_____ **Date**_____

Table for Comparing Nature's Ecosystems

Similarities of Nature's Ecosystems	Differences among Nature's Ecosystems
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8
9.	9.

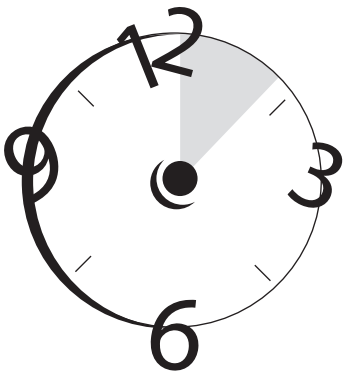
EUREKAS AND ECOSYSTEMS

Similarities of Nature's Ecosystems	Differences among Nature's Ecosystems
10.	10.
11.	11.

Adaptations

Core

Time Allocation: 45 minutes
Required Materials and Resources on Page 152



Lesson Overview

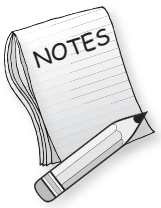
Students will explore the concept of habitats by discussing the various ones they have observed thus far in the unit. In addition, they will investigate other habitats to understand the wide range of habitats that exist on earth to shelter all of earth's organisms. They will also explore how adaptations allow organisms to live in such varying habitats.

Guiding Questions

- What are habitats and where can we find them?
- What is benefit of having such a large range of habitats?

BIG IDEA

Habitats



Content Goals

Universal Theme

- The natural world is composed of systems, which are organized groups of related objects that together form a whole.

Principles and Generalizations

- Ecosystems have a variety of habitats to accommodate the diversity of organisms.
- Safe habitats are critical to the survival and reproduction of organisms.

Concepts

- Interdependence
- Survival
- Diversity
- Habitat
- Shelter as a basic need
- Environmental factors

Teacher Information

- Habitat is the normal environment in which an organism lives.

Skills

- Recognize attributes
- Identify relationships
- Compare and contrast

Materials and Resources

1. Materials such as books, websites, and publications from organizations showing the large variety of habitats that exist should be collected. For instance The National Audubon Society publishes *Audubon Adventures*. One publication, "A Hole is a Home: Animal Abodes" is in newspaper format and could be used as a resource for this lesson. More information on *Audubon Adventures* can be found by calling the ordering department at 1-800-340-6546. The web site is : http://www.audubon.org
2. Other sites for students to use in their exploration of habitats are:
   - https://www.sitesalive.com/ol/tg/private/oltgHabitats.pdf
   - https//www.coast-nopp.org/
   - http://www.rbs.org/msti/lesson2.w4.html
   - http://www.wildlifehabitats.com
   - http://www.passporttoknowledge.com/students.html

Preparation Activities

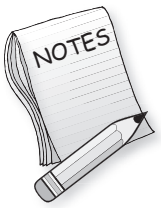
Copy the Hunt for the Inhabitants of a Host of Habitats for students.

Introductory Activities (5 minutes)

- Arrange students in small groups or pairs.
- Ask students to define what a habitat is. Combine their thoughts into a common definition that students enter into their notebooks.

Pre-assessment

N/A



Teaching and Learning Activities (35 minutes)

1. Brainstorm with students all the different habitats or homes they have observed or discussed throughout the unit. List the first few as follows: salt marsh snails (cordgrass) salt marsh clams (mud bottom) and water (elodea, duckweed). (Note: They are also listed on the Hunt for the Inhabitants of a Host of Habitat activity sheet below.)

2. Document student responses. Students should be able to add such habitats as soil (worms), in logs (beetles and termites), on a log (lichen), under a log (ant colony), nest (bird), dying tree (woodpecker), grass (grasshopper), and in a web (spider).

3. Hand out the activity sheet, Hunt for the Inhabitants of a Host of Habitats.

4. Invite students to identify at least one organism that lives in each of the habitats on the sheet.

5. Tell students to add organisms to the habitats just brainstormed.

6. Remind students to use the resources available, including each other, to collect this information.

7. When students are finished the "hunt," have them share their findings with each other.

8. Ask students: Why they think there is such a large range in types of habitats? Invite and support discussion.

9. Using Socratic questioning, help students uncover the principle: Ecosystems have a wide variety of habitats in order to support the earth's diverse organisms.

10. Review with students the importance of habitats in terms of their providing shelter and protection for organisms. Emphasize that safe habitats are critical to the survival and reproduction of organisms.

11. Close the lesson with a question: "Do you think it would be easy for the organisms you have researched in this Hunt for the Inhabitants of a Host of Habitats activity to switch homes with each other?" (This question serves to introduce the concept of adaptation in organisms that will be explored on the following day.)

Products and Assignments

Students' Hunt for the Inhabitants of a Host of Habitats sheets

Extension Activities

N/A

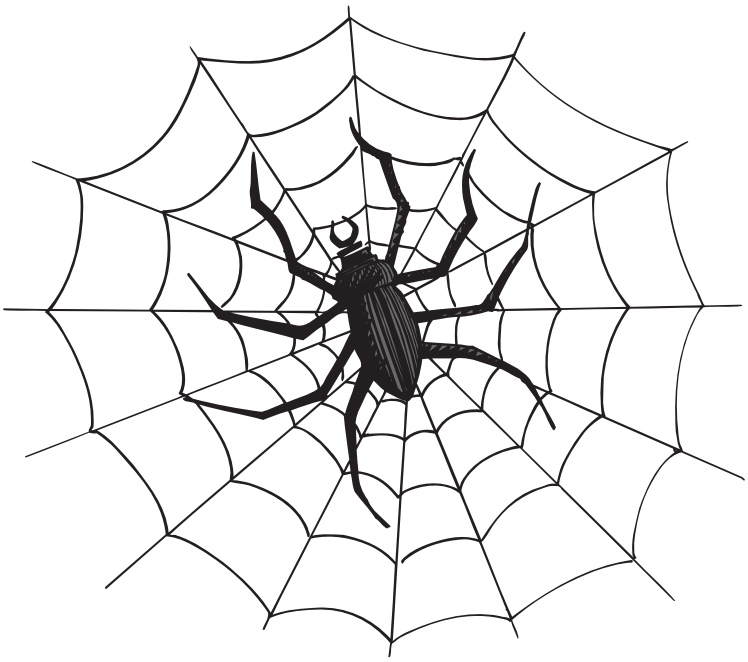
Post Assessment

N/A

Debriefing and Reflection Opportunities (5 minutes)

Ask students to summarize the key points they have learned about habitats:

- Living things must have their needs met in order to survive.
- Ecosystems have a variety of habitats to accommodate the diversity of organisms.
- Safe habitats are critical to the survival and reproduction of organisms.



Name_____ **Date**_____

Hunt for the Inhabitants of a Host of Habitats

1. Pond water – elodea, duckweed

2. Marsh cordgrass – salt marsh snails

3. Pond mud bottom – clams

4. On top of log (surface) –

5. Underneath log bark –

6. Underneath a log –

7. Inside a log –

8. Dying tree –

9. Dead tree top –

10. Live treetop –

11. Dead tree branches in water –

12. Tree limb –

13. Cave –

14. Rock piles and rock outcroppings –

15. Fresh water marsh grass –

16. Under a rock –

17. Salt water marsh –

18. Cacti –

19. Tunnels in the sand –

20. Underground burrow open at both ends –

21. Underground tunnel –

Name_____ **Date**_____

Hunt for the Inhabitants of a Host of Habitats

1. Pond water – elodea, duckweed

2. Marsh cordgrass – salt marsh snail

3. Pond mud bottom – clams

4. On top of log (surface) - lichen

5. Underneath log bark – beetle

6. Underneath a log – ant

7. Inside a log – termite

8. Dying tree – woodpecker, elf owls, brown bat, wren

9. Dead treetop – osprey, eagle, gray squirrel (winter)

10. Live treetop – gray squirrel

11. Dead tree branches in the water (lodge) – beaver

12. Tree limb – hummingbird, robin

13. Cave – bat, mountain lion, bobcat, bear

14. Rock piles and rock outcroppings – rat snake, timber rattlesnake, copperhead

15. Fresh water marsh grass – duck, red-winged blackbird, lily pad, yellow-headed blackbird

16. Under a rock – slug, millipede, beetle

17. Salt water marsh – heron, egret

18. Cacti – owl, wren

19. Tunnels in the sand – ghost crab

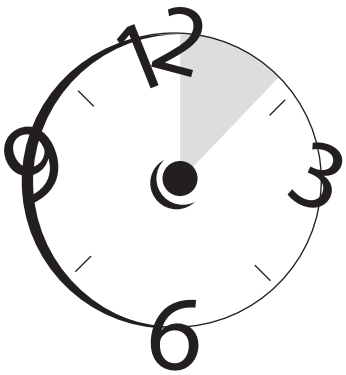
20. Underground burrow open at both ends – woodchuck, mole, burrowing owl, mice

21. Underground tunnel – gopher tortoise, snake, frog, prairie dog, badger, ferret

Adaptations

Core

Time Allocation: 45 minutes
Required Materials and Resources on Page 152



Lesson Overview

Students further explore the concepts of habitats and adaptations by playing a game that has been adapted from *Project WET*, called the "Water Addresses." By playing the game, students will have the opportunity see that organisms must be well adapted to their habitat if they are to survive. Students will be introduced to the relationship between the animal adaptations and the habitats in which they live. The lesson will start with the question, "Do you think it would be easy for the organisms you have researched in this "Hunt for Habitats" activity to switch homes with each other?" This question stems from the previous lesson.

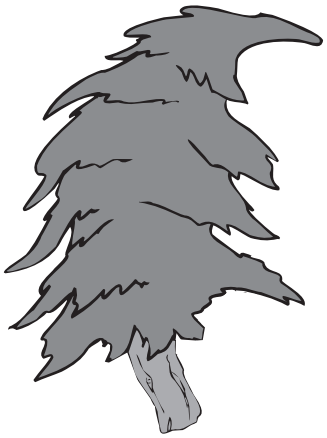
Guiding Questions

- How do animals' varying features help them to survive?

BIG IDEA

Organisms' Adaptions

EUREKAS AND ECOSYSTEMS



Content Goals

Universal Themes

- The natural world is composed of systems, which are organized groups of related objects that together form a whole.
- Form and function are complementary aspects of objects, organisms and systems in the natural world. Form and function are interdependent.

Principles and Generalizations

- Organisms have preferred habitats in which to live.
- Some of an organism's features help it survive.
- Features that help an organism survive are called adaptations.

Concepts

- Interdependence
- Survival
- Diversity
- Habitat
- Shelter as a basic need
- Adaptation
- Form and function

Teacher Information

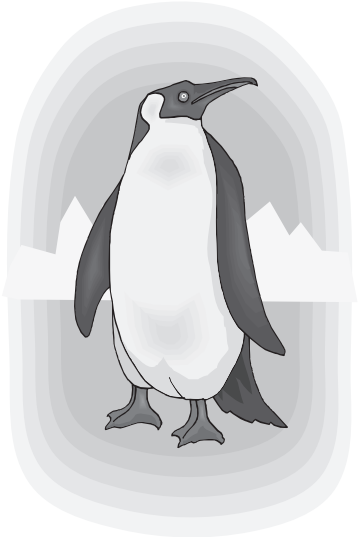
Adaptations are any change or adjustment that helps an organism to live and reproduce in its environment.

Skills

- Recognize attributes
- Identify relationships
- Compare and contrast

Materials and Resources

The game was adapted from the *Project WET Curriculum and Activity Guide* published in 1995 by the Waterhouse and Western Regional Environmental Education Council.



Preparation Activities

1. Make a copy of the "Water Address" cards for each of the groups playing the game.
2. Put the scoring system on the board.

Introductory Activities (5 minutes)

- Ask the question posed at the end of the previous day's lesson: "Do you think it would be easy for the organisms you researched in the "Hunt for the Inhabitants of a Host of Habitats" activity to switch homes with each other?"
- Realize that most students will recognize that animals would have difficulty surviving in environments that are very different from their own (adapted for).
- Engage students in a brief discussion about animal adaptations. What are some examples of animal adaptations? Why did animals develop that particular adaptation?
- Share with students that they will be exploring animal adaptations during this lesson. They will be exploring playing a game called "Water Addresses."

Pre-assessment

N/A

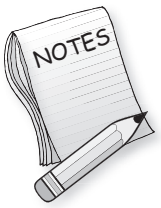
Teaching and Learning Activities (35 minutes)

1. Break the students up into groups of three.

2. Hand out a set of cards to each group. *Instruct the students that they are not to look at these cards before the game starts*.

3. Explain that each card lists four adaptations to water of a certain animal or plant. Based on these clues, students will try and guess the name of the animal or plant and the habitat in which the animal is found.

4. Select one member from each group to be the initial reader. He or she reads the clues one at a time in any order until someone in the group guesses the organism and its habitat correctly.



5. Tell students that some of the clues make the answer more obvious than others and that they are to use this fact to their advantage by trying to figure out which clue is the least obvious, thus reducing the chance for the other competitors to receive many points.

6. Select someone from each group to record the scores during the entire game.

7. Tell students that after the first round the student who guessed the organism correctly becomes the reader for the next round of play.

8. Tell students about the scoring process. The student who correctly names the organism and its water address receives points based on the number of clues that had to be read.
   One clue read = 4 points
   Two clues read = 3 points
   Three clues read = 2 points
   All 4 clues read = 1 point

9. Tell students that at the conclusion of each round all the clues must be read. If one student guesses the answer after just one clue, then the remaining clues are read by the "reader" to the group, so that students are aware of the variety of adaptations a specific organism has.

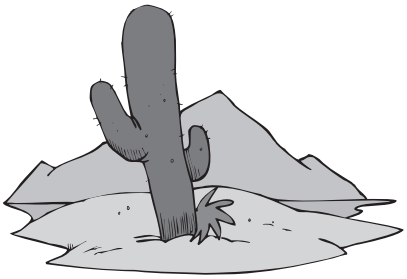
Products and Assignments
N/A

Extension Activities
N/A

Post Assessment
N/A

Debriefing and Reflection Opportunities (5 minutes)

1. Once again, engage students in a discussion about animal adaptations. Ask: How do adaptations enable organisms to live in their respective environments?
2. Have students summarize some of the water-related adaptations, including those that help organisms swim and breathe in water, as well as those that assist in the removal of water and the prevention of loss of water.



Water Address Cards

- My leaves have a wax-like coating that limits water loss through evaporation.
- I have tiny, needlelike leaves that contain very little moisture to freeze in winter.
- Pointy, thin leaves and sturdy, flexible branches keep snow from weighing me down.
- My buds contain a chemical and are covered with a protective layer to keep them from freezing.

Answer: Pine tree – found in northern forests, cold and /or dry areas

- I live in water but can survive out of water for many hours because my limestone doors can close, keeping me from drying.
- When submerged, I reach out and wave my legs to pull nutrient-filled water into my mouth.
- When first born, I move about in the water. When I am older, I stay in one place. I use a special adhesive to glue myself to a rock, a boat, or a whale.
- I create my own limestone house from materials that I filter from the water.

Answer: Barnacles – live at the edge of the ocean

- I can be found on still water.
- I have six wax-coated feet.
- I stand with legs splayed to distribute my weight, so I will not break through the water's surface.
- I appear to glide across the water's surface.

Answer: Water strider – lives in ponds and quiet streams

- My feet are webbed and used for steering.
- I wear a matted feather coat that keeps out wind and water.
- Blubber helps keep my body heat inside.
- I have wings that I use for flippers.

Answer: Penguin – lives in Antarctic

Water Address Cards

- I am able to drink great volumes of water and store it in the fat cells of my body.
- I sweat and urinate rarely, and do not pant or breather rapidly (to reduce evaporation)
- I can travel without drinking water 10 times longer than a human can.
- Fat stored in my hump is broken down for energy and in the process, water, which I can use, is released.

Answer: Camel – lives in the desert

- Where I live, I swim constantly to stay in one place.
- I lay my eggs in ditches and cover them with sand.
- I am smooth and slippery, with fins and a large tail.
- I breathe using gills, which take oxygen from water.

Answer: Trout – lives in fast-flowing water.

- I have dense, oily fur, webbed hind feet and ears and nostrils that close underwater.
- I sink green branches into my pond to retrieve during the winter.
- I use my wide tail as a paddle.
- I build a home in water with sticks, and it has an underwater entrance.

Answer: Beaver – lives in streams, ponds or rivers

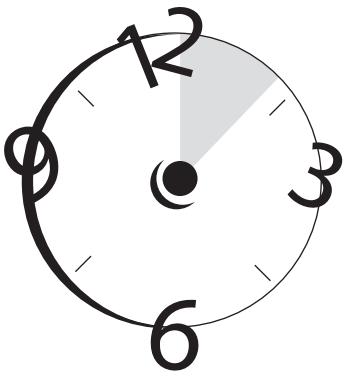
- My accordion-like stems expand to hold great volumes of water.
- My root system is widespread and shallow for absorbing water.
- My thick skin limits evaporation, reducing water loss.
- I have a spiny skin to prevent other organisms from trying to get my stored water.

Answer: Cactus – lives in the desert

Adaptations

Core

Time Allocation: 50 minutes
Required Materials and Resources on Page 152



Lesson Overview

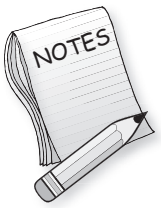
Students in this lesson answer post assessment questions that should reflect their current understandings regarding the nature of ecosystems.

Guiding Questions

- What is an ecosystem?
- Why are some organisms living successfully in certain places and not in others?
- Why should you care about the smallest snail, an endangered quail and the quality of air?
- In what ways do people affect ecosystems?

BIG IDEA

Ecosystems Sustain Life



Content Goals

Universal Themes

- The natural world is composed of systems, which are organized groups of related objects that together form a whole.
- Form and function are complementary aspects of objects, organisms and systems in the natural world. Form and function are interdependent.
- Properties of some objects and processes are characterized by constancy, while properties of others are characterized by change.

Principles and Generalizations

- Ecosystems have living and non-living things.
- Organisms must have their needs met in order to grow and live.
- Living things depend on other living and non-living things to meet their needs.
- Organisms have dependent and interdependent relationships that enhance survival.
- Ecosystems contain producers, consumers and decomposers.
- Producers, consumers and decomposers perform different functions in an ecosystem.
- Ponds are ecosystems.
- Organisms can be grouped based according to the method by which they obtain food.
- Most animals are ultimately dependent on plants for their food.
- Some organisms live at the expense of others.
- Some animals eat plants.
- Some animals eat only animals.
- Some animals eat both plants and animals.
- Decomposers have an important role in ecosystems.
- Decomposers cause dead organisms to decay.
- Many microorganisms are decomposers and are beneficial.
- Ecosystems contain food chains.
- In order to meet their needs, some organisms live at the expense of others.
- Most ecosystems have multiple food chains.

Adaptations

Concepts

- Ecosystem
- Environment of non-living things
- Organisms
- Microorganism
- Animals
- Plants
- Interdependence
- Survival
- Producer
- Consumer
- Decomposer
- Pond ecosystem
- Food chain
- Form and function

Teacher Information

N/A

Skills

- Identify characteristics
- Analyze
- Compare and contrast
- Draw conclusions

Materials and Resources

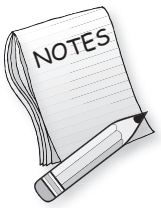
Poster of an ecosystem that students have not studied in the unit

Preparation Activities

Hang an ecosystem picture that has not been studied (it's ok if students have seen it) in the front of the room so that all students can see it and have access to it for a closer view, if desired.

Introductory Activities (5 minutes)

Hand out the post assessment questions and fully explain how you want students to proceed with the questions.



Pre-assessment
N/A

Teaching and Learning Activities (45 minutes)

1. Tell students to answer the questions to the best of their knowledge and reassure them that this activity is not a test.

2. Explain the purpose of post assessment is for the teacher to have information related to what their students know or do not know so that instructional activities can be improved for future students.

Products and Assignments
Completed post assessments

Extension Activities
N/A

Post Assessment
Completed post assessment questions

Debriefing and Reflection Opportunities
N/A

Name_____ **Date**_____

Ecosystem Post Assessment

1. Why is this area called an ecosystem?

2. Identify three organisms that live in this ecosystem.

3. Use three of the organisms from question #2 and describe what they do to help other organism(s) in their surroundings.
   Organism 1

   Organism 2

   Organism 3

4. What is one example of a producer, consumer and decomposer in this ecosystem picture? (If you cannot actually see them in the picture, you can indicate where they would be found in the picture).

   Producer

   Consumer

   Decomposer

5. What is the main difference between producers and consumers?

Name_____ **Date**_____

6. How do decomposers help an ecosystem?

7. Describe an interaction between a living and non-living thing in this ecosystem.

8. If all the lily pads in the pond were removed, would this make much of a difference in a pond ecosystem? Explain why or why not.

9. Examine the food chain below:

   Plants ➔ mouse ➔ cat ➔ wolf

   Why do you think it is called a "food chain" and not a "food string" or "food line" or some other term?

10. What were some of the limitations of the "classroom ecosystem" and "mini-ecosystem" you built (e.g., pond-in-a-jar). Why are these models not as good as the real-world ecosystems (e.g., ponds, lakes, swamps)?

11. Why should you care about the smallest snail, an endangered quail or the quality of air?

Name_____ **Date**_____

Possible Answers to the Ecosystem Post Assessment

1. **Why is this area called an ecosystem?**

   It has living and non-living things that are interacting.

2. **Identify three organisms that live in this ecosystem.**

   plants
   insects
   fish

3. **Use three of the organisms from question #2 and describe what they do to help other organism(s) in their surroundings.**
   Organism 1

   Plants supply oxygen for the fish.

   Organism 2

   Insects pollinate flowers.

   Organism 3

   Fish can be bottom feeders and help with getting rid of decay.

4. **What is one example of a producer, consumer and decomposer in this ecosystem picture? (If you cannot actually see them in the picture, you can indicate where they would be found in the picture).**

   Producer: plants
   Consumer: fish
   Decomposer: bacteria

5. **What is the main difference between producers and consumers?**

   Producers make their own food and consumers do not.

6. **How do decomposers help this ecosystem?**

   They help break down organic material (e.g., dead organisms)

7. **Describe an interaction between a living and non-living thing in this ecosystem.**

   A frog uses a rock to sit on to get out of the water. The frog could be warming itself or resting. Certain bacteria live in the soil to obtain nutrients and to be protected.

8. **If all the lily pads in the pond were removed, would this make much of a difference in this ecosystem? Explain why or why not.**

   Lily pads are used by organisms to live under. It would upset the ecosystem. In addition, they are plants and produce oxygen so perhaps the amount of oxygen in the water would decrease and that may affect the organisms that live in the water and filter oxygen out of it for respiration purposes.

9. **Examine the food chain below:**

   Plants ➔ mouse ➔ cat ➔ wolf

   Why do you think it is called a "food chain" and not a "food string" or "food line" or some other term?

   It is called a chain because each organism is like a link, a separate and important piece of the whole thing. A string is the same no matter where you cut it, and it does not matter to one part of the string that the other part was separated from it. A chain implies something that has parts and that can be broken at specific sites.

10. **What were some of the limitations of the "classroom ecosystem" and "mini-ecosystem" you built (e.g., pond-in-a-jar). Why are these models not as good as the real-world ecosystems (e.g., ponds, lakes, swamps)?**

    The classroom ecosystem and mini-pond ecosystem were limited by the fact that over a period of time they could not survive. The classroom did not have food for the students. Although they were protected by the building, they had no source of water unless the teacher went and found it. The mini-pond would dry up unless water was added.

11. **Why should you care about the smallest snail, an endangered quail or the quality of air?**

    All organisms are parts of food chains and each has an important role to play. Therefore, each is important and should be preserved. The quality of air is part of an ecosystem (non-living part) and it affects the organisms that breathe it. If it is polluted, it may cause harm.

Author: Fie Budzinsky
Curriculum Map: Eurekas and Ecosystems
Grade Level: 4-5

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
1. Pre-assessment	CORE 50 minutes	• Ecosystems have living and non-living things. • Organisms must have their needs met in order to grow and live. • Living things depend on other living and non-living things to meet their needs. • Organisms have dependent and interdependent relationships that enhance survival. • Ecosystems contain producers, consumers and decomposers. • Producers, consumers and decomposers perform different functions in an ecosystem. • Ponds are ecosystems. • Organisms can be grouped based on the general type of food, meat or plants they eat. • Most animals are ultimately dependent on plants for their food. • Some animals eat plants. • Some animals eat only animals. • Some animals eat both plants and animals. • Decomposers have an important role in ecosystems.	• Ecosystems • Organisms • Microorganism • Animals • Plants • Interdependence • Survival • Environment of non-living things • Producer • Consumer • Decomposer • Pond ecosystem • Food chain • Form and function	• Identify characteristics • Analyze • Compare and contrast • Draw conclusions	• The natural world is composed of systems, which are organized groups of related objects that together form a whole. • Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena. • Form and function are complementary aspects of objects, organisms, and systems in the natural world. Form and function are interdependent.	• What is an ecosystem? • Why are some organisms living successfully in certain places and not in others? • Why should you care about the smallest snail, an endangered quail or the quality of air? • In what ways do people affect ecosystems?

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
	• Decomposers cause dead organisms to decay. • Many microorganisms are decomposers and are beneficial. • Ecosystems contain food chains. • In order to meet their needs, some organisms live at the expense of others. • Most ecosystems have multiple food chains.					
2. Living and non-living things interact with one another in various ways.	CORE 45 minutes	• Ecosystems have living and non-living things. • Organisms have dependent and interdependent relationships that enhance survival.	• Model • Ecosystem • Living and non-living things • Organism • Interdependence • Features/ characteristics (adaptations)	• Observe • Identify characteristics • Compare and contrast • Analyze • Identify relationships • Categorize	• The natural world is composed of systems, which are organized groups of related objects that together form a whole. • Science involves making hypotheses, theories, and conceptual models to represent, explain and predict phenomenon.	• How is our classroom like an ecosystem?

Major Principles And Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
3. Real-world ecosystems can be modeled and studied.	CORE 45 minutes	• Ecosystems have living and non-living things. • Living and non-living things interact with one another in various ways. • Environmental changes occur for various reasons and at varying rates.	• Model • Ecosystem • Organism • Interdependence • Survival • Interaction • Pond • Animal • Plant • Producer • Consumer	• Plan • Organize • Predict • Make observations • Collect data • Identify relationships • Develop explanations	• Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena. • The natural world is composed of systems, which are organized groups of related objects that together form a whole.	• Do models help us better understand the real world? • How is a "mini-pond-in-a-jar" similar to a real-world pond ecosystem?
4. Models are used to study the various aspects of nature.	CORE 50 minutes + 1 to 1 and a half weeks of observation	• Living and non-living things interact with one another in various ways. • Organisms have dependent and independent relationships that enhance survival. • Real-world ponds can be modeled and studied. • Ecosystems can change because of changes in environmental conditions. • Environmental changes occur for various reasons and at varying rates.	• Model • Ecosystem • Organism • Interdependence • Interaction • Pond • Plant • Stressful environmental conditions • Change • Succession	• Predict • Justify thinking • Make observations • Collect data • Compare and contrast • Analyze • Identify relationships • Develop explanations • Draw conclusions	• Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena. • The natural world is composed of systems, which are organized groups of related objects that together form a whole. • Properties of some objects and processes are characterized by constancy, while properties of others are characterized by change.	• Do models help us better understand the real world? • Can ecosystems change over time?

Major Principles And Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
5. Models are used to study the various aspects of nature.	CORE/AID 50 minutes	• Living and non-living things interact with one another in various ways. • Organisms have dependent and interdependent relationships that enhance survival. • Ecosystems can change because of human contact.	• Model • Ecosystem • Organism • Interdependence • Stressful environmental conditions • Change	• Make observations • Compare and contrast • Analyze • Identify relationships • Develop explanations	• Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena. • The natural world is composed of systems, which are organized groups of related objects that together form a whole. • Properties of some objects and processes are characterized by constancy, while properties of others are characterized by change.	• Do models help us better understand the real world? • What is the impact of oil spills on bird habitats?
6. Some scientific models have limitations that may restrict our understanding of scientific phenomena.	CORE/AID 45 minutes	• Organisms need a source of energy, such as food, to live and grow. • Organisms can be grouped based on the method by which they obtain food.	• Ecosystem • Organism • Interdependence • Survival • Animal • Plant • Prey • Producer • Consumer • Carnivore • Herbivore • Omnivore • Food chain	• Describe characteristics • Identify characteristics • Compare and contrast • Analyze • Identify relationships • Categorize	• The natural world is composed of systems, which are organized groups of related objects that together form a whole. • Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena. • Properties of some objects and processes are characterized by constancy, while properties of others are characterized by change.	• What are some of the limitations of using models in efforts to understand ecosystems? • What are the basic needs of organisms? • What are food chains? • How does the interaction of organisms help them meet their needs?

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
7 & 8. Organisms can be grouped on the method by which they obtain food.	CORE/AID One hour and 30 minutes	• Ecosystems have producers, consumers and decomposers. • Ecosystems have food chains.	• Ecosystem • Organism • Microorganism • Bacteria • Interdependence • Survival • Producer • Consumer • Decomposer • Predator • Prey • Phytoplankton • Zooplankton • Compost • Decay • Food chain	• Describe characteristics • Identify characteristics • Compare and contrast • Analyze • Identify relationships • Categorize	• The natural world is composed of systems, which are organized groups of related objects that together form a whole.	• How does the interaction of organisms help them meet their needs? • What are food chains and what are the roles of organisms in them? • What happens if food chains are broken?
9. Organisms have dependent and interdependent relationships that enhance survival.	PRACTICE/ AID 45 minutes	• Ecosystems have food chains.	• Ecosystem • Organism • Interdependence • Consumer • Carnivore • Predator • Prey • Food chain • Population	• Dissect • Observe • Describe • Collect data • Organize data • Analyze data • Compare and contrast • Identify patterns • Develop explanations • Draw conclusions • Communicate findings • Measure	• The natural world is composed of systems, which are organized groups of related objects that together form a whole.	• How can exploring what an owl eats tell us about food chains? • How does the interaction of organisms help them meet their needs? • How does merging and sharing data help in scientific investigations?

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
10. Organisms have dependent and interdependent relationships that enhance survival.	PRACTICE/ AID 45 minutes	• Ecosystems have food chains.	• Ecosystem • Organism • Interdependence • Producer • Consumer • Predator • Prey • Food chain	• Dissect • Observe • Describe • Collect data • Analyze data • Compare and contrast • Identify patterns • Develop explanations • Draw conclusions • Communicate findings	• The natural world is composed of systems, which are organized groups of related objects that together form a whole.	• How does the interaction of organisms help them meet their needs? • How does merging and sharing data help in scientific investigations?
11. Ecosystems have similarities and differences.	CORE 45 minutes	• The diversity among ecosystems supports a wide variety of life forms on earth.	• Ecosystem • Environment of non-living things • Organism • Interdependence • Producer • Consumer • Decomposer • Food chain • Diversity of organisms • Change	• Describe characteristics • Identify characteristics • Compare and contrast • Analyze • Categorize • Justify answers	• The natural world is composed of systems, which are organized groups of related objects that together form a whole. • Properties of some objects and processes are characterized by constancy, while properties of others are characterized by change.	• How are ecosystems alike and how are they different? • Why is the diversity of ecosystems and their respective habitats so critical to life on earth?

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
12. Ecosystems have a variety of habitats to accommodate the diversity of organisms.	CORE 45 minutes	• Safe habitats are critical to the survival and reproduction of organisms.	• Interdependence • Survival • Diversity • Habitat • Shelter as a basic need • Environmental factors	• Recognize attributes • Identify relationships • Compare and contrast	• The natural world is composed of systems, which are organized groups of related objects that together form a whole.	• What are habitats and where can we find them? • What is the benefit of having such a large range of habitats?
13. Organisms have preferred habitats in which to live.	CORE 45 minutes	• Some of an organism's features help it survive. • Features that help an organism survive are called adaptations.	• Interdependence • Survival • Diversity • Habitat • Shelter as a basic need • Adaptation • Form and function	• Recognize attributes • Identify relationships • Compare and contrast	• The natural world is composed of systems, which are organized groups of related objects that together form a whole. • Form and function are complementary aspects of objects, organisms and systems in the natural world. Form and function are interdependent.	• How do animals' varying features help them to survive?

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
14. Post Assessment	CORE 50 minutes	• Ecosystems have living and non-living things. • Organisms must have their needs met in order to grow and live. • Living things depend on other living and non-living things to meet their needs. • Organisms have dependent and interdependent relationships that enhance survival. • Ecosystems contain producers, consumers and decomposers. • Producers, consumers and decomposers perform different functions in an ecosystem. • Ponds are ecosystems. • Organisms can be grouped based according to the method by which they obtain food. • Most animals are ultimately dependent on plants for their food. • Some animals eat plants. • Some animals eat only animals. • Some animals eat both plants and animals. • Decomposers have an important role in ecosystems. • Decomposers cause dead organisms to decay. • Many microorganisms are decomposers and are beneficial. • Ecosystems contain food chains. • In order to meet their needs, some organisms live at the expense of others. • Most ecosystems have multiple food chains.	• Ecosystem • Environment of non-living things • Pond ecosystem • Organisms • Microorganism • Animals • Plants • Interdependence • Survival • Producer • Consumer • Decomposer • Pond ecosystem • Food chain • Form and function	• Identify characteristics • Analyze • Compare and contrast • Draw conclusions	• The natural world is composed of systems, which are organized groups of related objects that together form a whole. • Form and function are complementary aspects of objects, organisms and systems in the natural world. Form and function are interdependent. • Properties of some objects and processes are characterized by constancy, while properties of others are characterized by change.	• What is an ecosystem? • Why are some organisms living successfully in certain places and not in others? • Why should you care about the smallest snail, an endangered quail or the quality of air? • In what ways do people affect ecosystems?

“Materials Resource List”

Lesson	Primary Materials	Books	Additional Materials (Supplied by Teacher)
1	Chart paper, markers, picture of pond ecosystem, 3-ring notebook for each student		Ask students to bring an empty pint sized or quart sized wide mouth jar for Lesson 3 two weeks prior to starting unit.
2			Dictionary
3	Fine screening for jar tops, heavy tape, pond plants, snails, paper bags, rulers, plastic cups, hand lens, and plastic baggies for each student, markers or small labels to identify each student's jar Turkey baster, kitchen strainer, gallon container, tweezers, and a number of small plastic containers for teacher	Pond reference book	Wide mouth pint or quart jar (a mayonnaise jar, applesauce jar or canning jar) for each student, four gallons of pond water (Bottled or tap water can be used, but it must be left at room temperature for several days to insure that chemicals have had time to escape). One small pail, and a shallow pan, newspapers to cover desktops/tables.
4	Several pint or quart jars, water, soil, aquatic plants, some birdseed with sunflower seed included, pictures of ecosystems undergoing change or succession. The internet sites http://www.scilinks.org or http://www.google.com can be used. Enter the topic "succession" to find information associated with this concept.		Newspapers to cover tables, fan, Internet access
5	Sanitized bird feathers (2 per student group), hand lens (1 per student group), bowl of water (1 per student group), disposable plastic bowl (1 per student group), 1 large bottle of detergent, small plastic cup (1 per student to hold detergent).	"Tarred and feathered." (2005, March). *Science and Children*, 57-58.	Newspapers to cover tables
6	Picture of a "Big Mac" (Use Google search engine, click on images, then put "Big Mac" in search bar.)		Clump of grass
7/8	3 posters or pictures of food chains, picture of plankton, denitrifying bacteria (Use Google Images or the U.S. Fish and Wildlife Services website http://images.fws.gov).		
9	1 owl pellet per group, 1 large paper clip that has been unbent to act as a probe per student, 2 large paper clips that can act as tweezers per student, 1 paper plate per group, 1 glue stick per group, one magnifying glass, bone sorting charts and skeleton charts, identification guide, 1 metric ruler per group, 4 scales for massing pellets.		Roll of paper towels
10	N/A		
11	Index cards (12-16), chart paper, posters of various ecosystems (save one for last lesson)		Overhead projector
12	N/A		Internet access
13	N/A		
14	Poster of a pond ecosystem that students have not studied in this unit		