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 about Ecosystems
Light: A Rainbow of Exploration (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, 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, 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.

PROJECT CONN-CEPT

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.

Structure and Function: What's Their Junction? Grade 6

This unit provides students with opportunities to deepen their understandings about ecosystems and their adaptations by exploring ecological science concepts and discovering facts and connections that students never realized existed. The unit 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 six students with opportunities to explore the methodology of the practicing professional (Curriculum of Practice), the opportunity to connect the material to another discipline (Curriculum of Connections), and the chance to reflect on themselves as emerging scientists (Curriculum of Identity).

The unit contains 26 lessons that are outlined in the chart below. The first column contains the lesson number and the name of the parallels(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* (BSL) (American Association for the Advancement of Science, 1993)–that are addressed in a 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 lesson. 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. All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment. (*National Science Education Standards*, 5-8)
2. Regulation of an organism's internal environment involves sensing the internal environment and changing physiological activities to keep conditions within the range required to survive. (NSES*, 5-8)
3. Behavior is one kind of response an organism can make to an internal or environmental stimulus. (NSES, 5-8)
4. An organism's behavior evolves through adaptation to its environment. (NSES, 5-8)
5. A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem. (NSES, 5-8)
6. Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some micro-organisms are producers—they make their own food. All animals, including humans, are consumers that obtain food from eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem. (NSES, 5-8)

Scientific Inquiry

7. Different kinds of questions suggest different kinds of scientific investigations. Some investigations involve observing and describing objects, organisms, or events; some involve collecting specimens; some involve experiments; some involve seeking more information; some involve discovery of new objects and phenomena; and some involve making models. (NSES, 5-8)
8. Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations. (NSES, 5-8)
9. Scientific explanations emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories. The scientific community accepts and uses such explanations until displaced by better scientific ones. When such displacement occurs, science advances. (NSES, 5-8)
10. Science advances through legitimate skepticism. Asking questions and querying other scientists' explanations is part of scientific inquiry. Scientists evaluate the explanations proposed by other scientists by examining evidence, comparing evidence, identifying faulty reasoning, pointing out statements that go beyond the evidence, and suggesting alternative explanations for the same observations. (NSES, 5-8)

Interdependence of Life

11. In all environments—freshwater, marine, forest, desert, grassland, mountain, and others—organisms with similar needs may compete with one another for resources, including food, space, water, air, and shelter. In any particular environment, the growth and survival of organisms depend on the physical conditions. (*Benchmarks for Science Literacy*, 6-8)

Models

12. Models are often used to think about processes that happen too slowly, too quickly, or on too small a scale to observe directly, or that are too vast to be changed deliberately, or that are potentially dangerous. (BSL**, 6-8)

Constancy and Change

13. Physical and biological systems tend to change until they become stable and then remain that way unless their surroundings change. (BSL, 6-8)

Systems

14. Thinking about things as systems means looking for how every part relates to others. The output from one part of a system (which can include material, energy, or information) can become the input to other parts. Such feedback can serve to control what goes on in the system as a whole. (BSL, 6-8)
15. Any system is usually connected to other systems, both internally and externally. Thus a system may be thought of as containing subsystems and as being a subsystem of a larger system. (BSL, 6-8)

* 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 6-8

I Scientific Inquiry (Expected Performances – C INQ. 1, C INQ. 2, C INQ. 3, C INQ., C INQ. 5)

Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.

Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.

Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.

Scientific Literacy (Expected Performances – C INQ. 8, C INQ. 9, C INQ. 10)

Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science.

Scientific literacy also includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.

6.2 Matter and Energy in Ecosystems (Expected Performances – C 4, C 5, C 6)

How do matter and energy flow through ecosystems?

An ecosystem is composed of all the populations that are living in a certain space and the physical factors with which they interact.

- Populations in ecosystems are affected by biotic factors, such as other populations, and abiotic factors, such as soil and water supply.
- Populations in ecosystems can be categorized as producers, consumers and decomposers of organic matter.

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 and webs, adaptations, and the skills involved with scientific inquiry.
2 (CORE) 45 minutes	5, 12, 14 CT Standards: I (Expected Performances – C INQ. 3, 5) 6.2 (Expected Performance – C 4)	• 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. • Most animals are ultimately dependent on plants for their food because animals are unable to make their own food.	Students build a simple terrarium in a plastic bottle in order to make observations over 2 $^{1}/_{2}$ weeks to learn about the interactions in an ecosystem and how it changes over time. The lesson also reinforces the idea that all ecosystems have living and non-living things that interact.
3 (CORE) 45 minutes	7 CT Standard: I (Expected Performances – C INQ. 5, 10)	• Scientists use tools to assist them in their scientific investigations. • Concept maps are visual representations of concepts and their relationships • Concept maps help us understand science topics.	Students continue to make observations and discuss their model ecosystems. In this lesson they are also introduced to concept maps as communication tools. Concept maps will be used in future lessons as graphic organizers and as an assessment tool to evaluate student knowledge.
4 (PRACTICE/ IDENTITY/AID) 45 minutes	7, 9 CT Standard: I (Expected Performances – C INQ. 5, 10)	• Scientists work by wondering, observing, describing, using data to explain phenomena, and sharing information. • Anybody can be a scientist.	In this lesson, students are invited to engage in a large group discussion about the work of scientists. They will realize that they, too, will work like scientists as they make observations and compare data about the ecosystems they have created.

Lesson	Standards	Lesson Principles	Lesson Description
5-6 (CORE/ AID) 1 hour, 20 minutes	5, 6, 15 CT Standards: 6.2 (Expected Performance - C 5)	• Ecosystems contain food chains. • Most ecosystems contain multiple food chains, thus forming food webs.	Students will further explore food chains through discussions and a kinesthetic activity. Specifically, they will come to understand that ecosystems support more than one kind of food chain and that organisms are part of multiple food chains, thus forming food webs.
7 (CORE/ AID) 45 minutes	7, 13, 15 CT Standard: 6.2 (Expected Performances- C5, C6)	• The availability of food sources determines the likelihood of an organism's survival in a food web. • Environments differ with respect to physical factors such as temperature, moisture, light and soil type (AID). • Environments differ with respect to biological factors, such as the kinds and numbers of organisms and availability of food (AID). • Environmental change can be brought about by natural or man-made causes (AID).	Students will engage in learning activities focused on a salt marsh ecosystem in order to deepen their understanding of food webs: a discussion and exploration and analysis of food web diagrams of the salt marsh ecosystem.
8 (CORE/AID) 45 minutes	6, 7, 13, 15 CT Standard: 6.2 (Expected Performances C5, C6)	• The availability of food sources determines the likelihood of an organism's survival in a food web.	Through participation in a kinesthetic activity that is based on their understanding of salt marsh organisms, students will come to understand the complexity and interdependence in a food web.
9 (CORE) 1 hour, 5 minutes	11, 12, 13, 14 CT Standards: I (Expected Performances – C INQ 1, 5, 8, 9, 10) 6.2 (Expected Performance - C 6)	• Ecosystems have similarities and differences. • Organisms have dependent and interdependent relationships that enhance survival. • Ecosystems can change over time.	Students will use the terrarium observations collected over the past 2 ½ weeks as well as their ideas about a mini-pond which they could have created. They will be able to envision this virtual mini-pond by visiting one on the Internet. From their thoughts and observations about the mini-pond and their terrarium they will be able to draw conclusions about the nature of ecosystems. During this process, students will be invited to identify, discuss or explain some of the major concepts and principles introduced thus far. Students will use the terrarium observations collected over the past 2 ½ weeks to draw conclusions about the nature of ecosystems. During this process, students will be invited to identify, discuss or explain some of the major concepts and principles introduced thus far.

Lesson	Standards	Lesson Principles	Lesson Description
10 (CORE) 45 minutes		• Organisms have dependent and interdependent relationships that enhance survival. • Ecosystems have producers, consumers and decomposers which have different functions in the ecosystem. • Environmental changes occur for various reasons and at varying rates and can affect the survival of organisms in an ecosystem.	This lesson includes an assessment of students' understanding of the terrarium as a mini-ecosystem as well as their understanding of food chains and food webs. The assessment invites students to construct a concept map of the terrarium ecosystem.
11 (CORE) 45 minutes	1, 2, 3, 4 CT Standard: I (Expected Performances – C INQ. 9, 10)	• Structural, physiological and behavioral adaptations affect the survival of organisms. • Features that help an organism survive are called adaptations	In this two-day simulation, students apply and deepen their knowledge about adaptations. They will create their own creature with adaptations that will enable it to hide in the schoolyard.
12/13 (CORE) 1 hour, 30 minutes	2, 3, 4 CT Standards: I (Expected Performances – C INQ. 3, 5, 9, 10) 6.2 (Expected Performance – C 5)	• Structural, physiological and behavioral adaptations affect the survival of organisms.	In this two-day simulation, students apply and deepen their knowledge about adaptations. They will create their own creature with adaptations that will enable it to hide in the schoolyard.
14 (CORE/AID) 45 minutes	1, 2, 3, 4 CT Standard: 6.2 (Expected Performances – C 5, C 6)	• Structural, physiological and behavioral adaptations affect the survival of organisms. • Some organisms can be detrimental to an ecosystem (AID).	In a kinesthetic activity, students explore how adaptations help organisms survive in a real world environment: a tidal salt marsh.

Lesson	Standards	Lesson Principles	Lesson Description
15 (CORE) 45 minutes	7, 11, 12 CT Standard: I (Expected Performances – C INQ. 1, 9, 10)	• Ecosystems have similarities and differences. • The diversity among ecosystems supports a wide variety of life forms on earth.	Students will use the mini-pond and terrarium observations collected over the past 2 ½ weeks to draw conclusions about the nature of ecosystems. During this process, students will be invited to identify, discuss or explain some of the major concepts and principles introduced thus far.
16-17 (CORE) 1 hour, 15 minutes	2, 3, 4, 8 CT Standard: I (Expected Performances – C INQ. 1, 2 , 5, 9,10) 6.2 (Expected Performance – C 5)	• Environmental factors affect the survival of organisms. • Structural, physiological and behavioral adaptations affect the survival of organisms.	In small groups, students are invited to research organisms of their choice to discover their respective habitats and adaptations.
18-19 (CORE CONNECTIONS) 1 hour, 30 minutes	1, 3, 4, 7 CT Standard: I (Expected Performances – C INQ. 1, 2,5, 9, 10) 6.2 (Expected Performance – C 5)	• Organisms have preferred places in which they live. • Structural, physiological and behavioral adaptations affect the survival of organisms.	Students will prepare a presentation—in a format of their choice—that focuses on their understanding of the connection between habitats and adaptations.

Lesson	Standards	Lesson Principles	Lesson Description
20-21 (CORE/ AID) 1 hour, 30 minutes	4, 10, 14 CT Standard: I (Expected Performance C INQ 1, 2, 5, 8, 9, 10) 6.2 (Expected Performance C5)	• Structural, physiological and behavioral adaptations affect the survival of organisms. • Environmental factors affect the survival of organisms	Students share their presentations. At the conclusion of each presentation, students are invited to ask clarifying and probing questions to deepen their understanding of the relationship among organisms, habitats, their respective adaptations, and the impact of changing environmental situations.
22, 23, 24 (CORE) 1 hour, 30 minutes		All principles from the unit.	Students create a class book that chronicles their "aha's" about ecosystems.
25 (CORE) 50 minutes		All principles from the unit.	Using a quotation by John Muir and their reflections from Lesson 18, students will reflect on the growth of their understandings about ecosystems.
26 (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.

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.

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Ecosystems and Scientific Inquiry

Core

Time Allocation: 50 minutes
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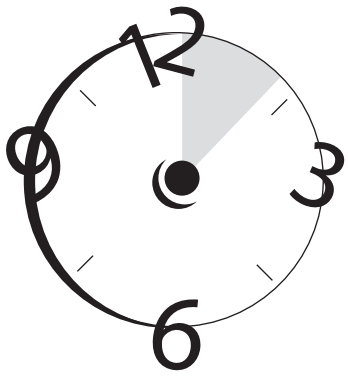


Lesson Overview

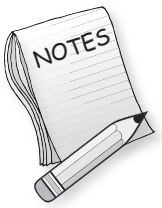
Students in this lesson answer questions that will serve as the pre-assessment of their understandings regarding the nature of ecosystems. In addition, students have the opportunity to brainstorm a list of topics/questions about ecosystems that they would like answered during this unit.

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 and how do organisms survive in it?



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 preassessment, 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.
- Adaptations are important for organisms to survive in their ecosystems.
- Structural, physiological and behavioral adaptations effect the survival of organisms.

- Ecosystems contain food chains.
- In order to meet their needs, some organisms live at the expense of others.
- Most ecosystems have multiple food chains.
- Organisms can be part of multiple food chains, thus forming food webs.

Concepts

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

Teacher Information

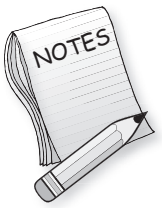
N/A

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
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

Students' 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.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

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

Name_____ **Date**_____

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?

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

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

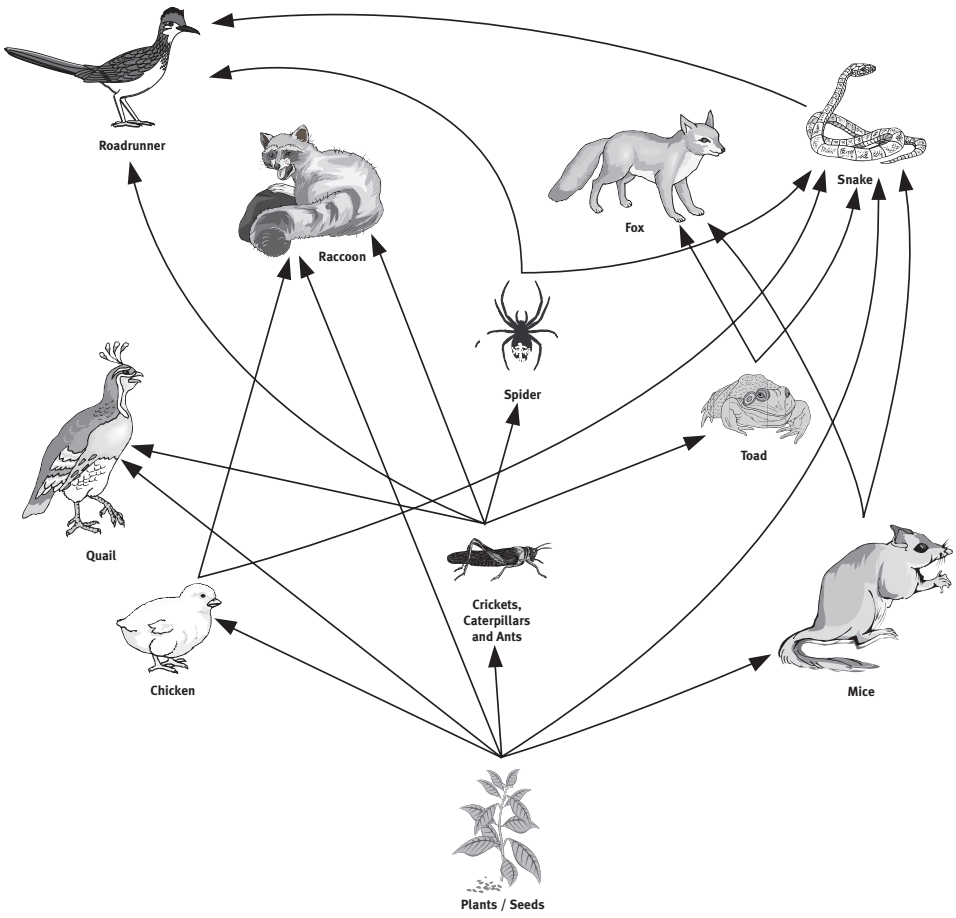
8. If all the lily pads in the pond were removed, would this make much of a difference in this ecosystem? Explain why or why not.

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. Examine the food web below and answer the following questions:



Name _____ **Date**_____

A. Pick out four organisms that are in one single, complete food chain that starts with the organisms that use sun to make food.

B. "Carne" means flesh. Carnivores eat meat. Which organisms are carnivores in your food chain?

C. Identify the organisms in the food web that eat both plants and animals.

D. What would happen to the food web if crickets, ants and caterpillars died out? List three consequences.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

11. Pretend you are part of a scientific study of a hummingbird that is an endangered species. It feeds on the nectar (sugar-like liquid) of only two types of plants on a small island off the coast of South America. You have found an unusual amount of dead hummingbirds in the area, so you decide to examine the stomach contents of these birds. Much to your surprise, you find remains of small insects. What do you think might have caused the hummingbird to eat insects?

12. Identify an adaptation for one of the organisms you listed in question #10 A above.

13. How does the adaptation identified in question #12 enable the organism to survive in its environment?

14. 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

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

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:**

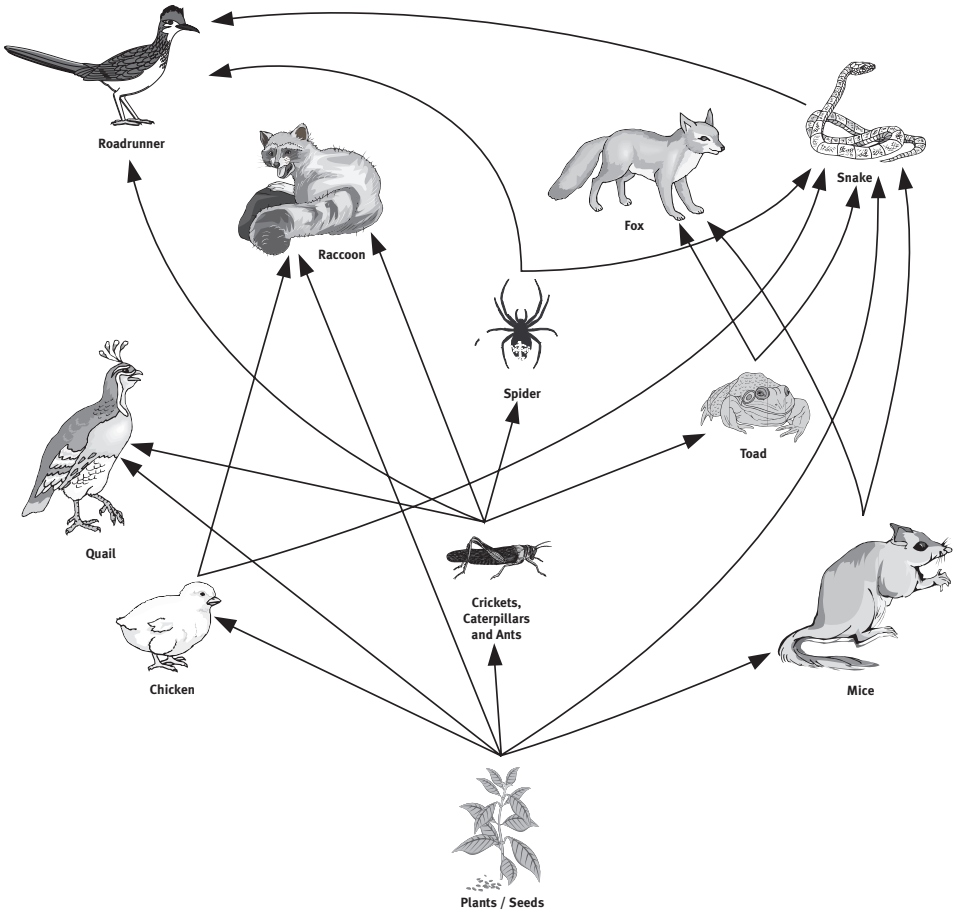
   Plants → *mouse* → *cat* → *wolf*

   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.

Name _____ **Date**_____

10. Examine the food web below and answer the following questions:



A. Pick out four organisms that are in one single, complete food chain that starts with the organisms that uses sun to make its food.

Plants/seeds/crickets/caterpillars/and ants -> toad -> fox

B. "Carne" means flesh. Carnivores eat meat. Which organisms are carnivores in your food web?

Toad, quail, spiders, roadrunner, raccoon, snake and fox

C. Identify the organisms in the food web that eat both plants and animals.

Snake

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

D. What would happen to the food web if crickets, ants and caterpillars died out? List three consequences.

Toads, quail and spiders would have nothing to eat.

11. Pretend you are part of a scientific study of a hummingbird that is an endangered species. It feeds on the nectar (sugar-like liquid) of only two types of plants on a small island off the coast of South America. You have found an unusual amount of dead hummingbirds in the area, so you decide to examine the stomach contents of these birds. Much to your surprise, you find remains of small insects. What do you think might have caused the hummingbird to eat insects?

The hummingbird could not find the nectar it normally feeds on and in desperation starting eating insects in order to survive.

12. Identify an adaptation for one of the organisms you listed in question #10 A above.

Toads have long quick tongues to catch insects.

13. How does the adaptation identified in question #12 enable the organism to survive in its environment?

Without a quick long tongue it may be harder for the toad to catch food and more of them may die.

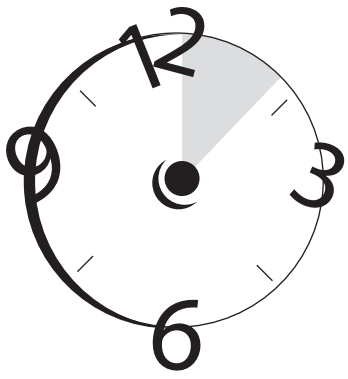
14. Why should you care about the smallest snail, an endangered quail or the quality of air?

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 206



Lesson Overview

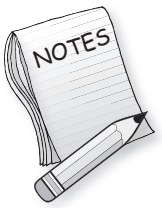
In this lesson students will study ecosystems by building a simple terrarium. This lesson reinforces the concept that model ecosystems can be beneficial in the study of real-world ecosystems. It also reinforces the idea that all ecosystems have living and non-living things that interact.

Guiding Questions

- Is a terrarium like an ecosystem? Why or why not?
- What kinds of interactions are seen in a terrarium?

BIG IDEA

Terrarium: Model Ecosystem



Content Goals

Universal Themes

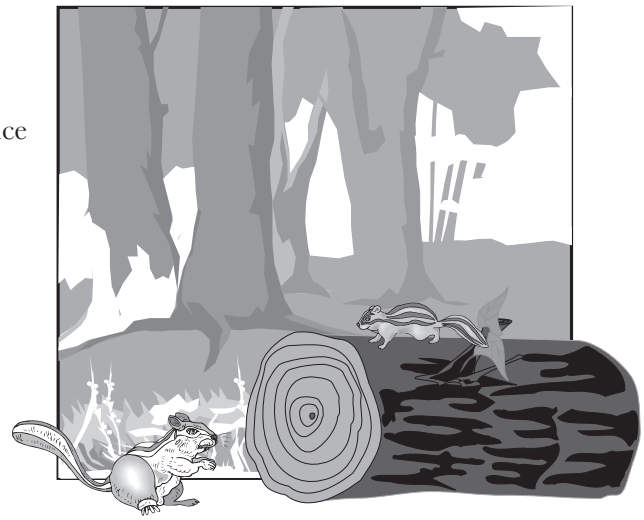
- The natural world is composed of systems, which are organized groups of related objects that together form a whole.
- Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena.

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.
- Most animals are ultimately dependent on plants for their food because animals are unable to make their own food.

Concepts

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



Teacher Information

N/A

Skills

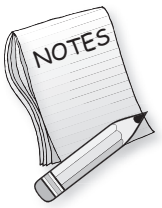
- Observe
- Compare and contrast
- Analyze
- Organize
- Measure (optional)

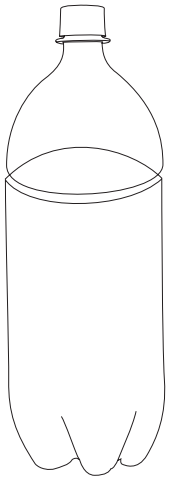
Materials and Resources

1. 2-liter soda bottles per terrarium (two per group)
2. Droppers for watering (one per group)
3. Newspaper to protect tables
4. Cleanup supplies
5. Index cards to use for labeling items at the distribution center
6. Wide rubber band for measuring heights on each terrarium bottle (one per group)
7. Regular rubber band for securing the screening material (one per group)
8. Permanent marker for measuring heights on each terrarium bottle (one per group)
9. Plastic cup (one group)
10. (Optional) Metric ruler (one per group) or have teacher or adult volunteer mark the bottles ahead of time.
11. Utility knife (for teacher or adult volunteer)
12. Cups (four 6-ounce plastic per group)
13. Gravel/aquarium rocks (one cup per group). Purchase about 15 Kg (30-pound bag) for the entire class.
14. Potting soil (1-2 cups per group)
15. Hand lens (one per group)
16. Heavy tape (one per group)
17. Leaf mulch or other materials that might contain small organisms (e.g. compost, chunks of moss with soil attached (collected by teacher or students)
18. Fiberglass screen [about 10 cm (4 inches) square per group]
19. Seeds (three, 30-ml paper cups, each containing 20-30 seeds per group of one kind such as Scott's quick growing grass, sprout, birdseed mixture, alfalfa, or mustard). **Note: If you plan to teach this unit in the fall, purchase the seeds during the previous spring.**
20. Spoon (one per group)
21. (Optional) Aquarium charcoal (one cup per group)
22. (Optional) Scissors (one per group)

Preparation Activities

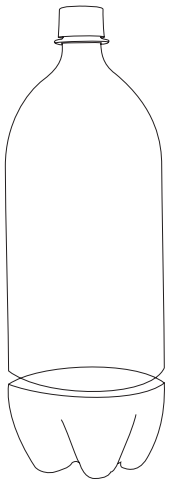
1. Two weeks prior to teaching this lesson, send home the letter requesting plastic soda bottles or post a notice in your newsletter.
2. Invite parents to come to class and assist students in the building of the terrariums. The extra hands will come in very handy.



3. Remove the label from the bottle by placing the soda bottle in hot water to soften the glue on the base of the bottle.
4. Wash the bottles, so the plastic is clear.
5. Make the cutting and assembly of the terrarium simpler by using a wide rubber band to mark heights for the cut lines.
6. Decide who will cut the bottles, you or the students. The advantage of letting the students cut the bottles is that they will be using measurement skills. You can make the initial cut and students can use scissors to easily finish the cutting.
7. Be sure the cap is on the bottles when the initial cuts are made.
8. The first bottle gets the spout cut off.
9. Place the rubber band 11-cm down from the top of the bottle.
10. Use a marker to draw a circle all the way around the bottle, running your marker along the rubber band.
11. Cut and identify the bottle as Bottle #1. See diagram below.
12. 

13. The second bottle gets the base cut off, leaving most of the bottle including the spout.
14. Place the rubber band again at the 24-cm mark down from the top of the bottle.
15. Use a marker to draw a circle all the way around the bottle, running your marker along the rubber band.

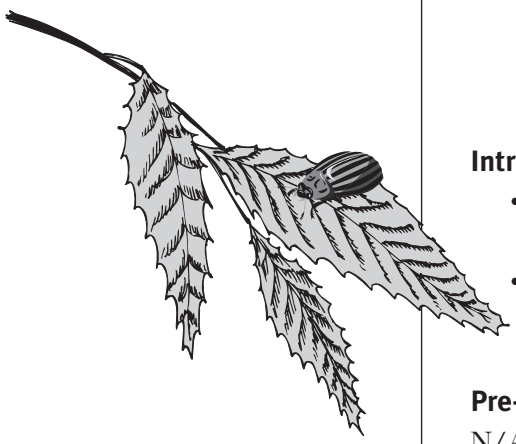
16. Cut and identify the bottle as Bottle #2.



<–Bottle #2

<–24-cm down

17. Save one of the two bottle caps for each terrarium system to place on Bottle #2.
18. Cut 10-cm squares of fiber screen (one for each group).
19. Purchase the kinds and quantities of seeds listed above realizing that each group will need five of each type of seed.
20. On the day of the lesson, set out the equipment on a table "buffet style."
21. Organize the supplies so that students can file past them on both sides.
22. 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.
23. Make copies of the **Instructions for Cutting the Bottles** (one for each group).
24. Make copies of the **Instructions for Building a Terrarium** (one for each group).
25. Make copies of the **Terrarium Observations** sheet (one for each student).
26. Make copies of the **Conclusions Regarding Terrarium Observations** sheet (one for each student).



Introductory Activities (5 minutes)

- Hand out **Instructions for Building, Maintaining and Observing a Terrarium and Terrarium Observations.**
- Discuss the origin of the word, *terrarium* (Terrarium is from the Latin word "terra" meaning earth).

Pre-assessment

N/A

Teaching and Learning Activities (35 minutes)

1. Help students build their terrariums, scaffolding as needed.

2. Explain to students that their terrarium is an ecosystem they will make observations about over the course of the next 2 ½ weeks.

3. Return to the terrariums. Share with students that they should see their seeds start to germinate in three-four days.

4. Have students place the terrariums in a well-lighted area.

5. Tell students that they will be observing their terrariums each day and recording observations in the **Terrarium Observations** worksheet below. Remind them about accommodating the weekends in their observations and to count the weekend days as explained in the earlier lesson.

6. At the conclusion of the observation period (about 2 ½ weeks) hand out the **Conclusions Regarding Observations** and **Analyses of the Terrarium** (see below for the **Possible Answers to the Observations and Analyses of the Terrarium**).

7. Remind students that they should start answering the questions on the **Conclusions Regarding Terrarium Observations** after the plastic wrap has been placed on the terrarium. This will take place on the 12th day of observations, during Lesson #9.

Products and Assignments

Students' terrariums

Extension Activities
N/A

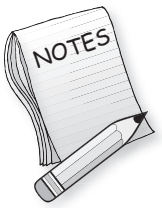
Post Assessment
N/A

Debriefing and Reflection Opportunities (5 minutes)
Gather students together and ask the following questions: Why is the terrarium like an ecosystem? Why will a model assist them in their study of ecosystems?

Instructions for Cutting the Bottles

1. Remove the labels from the bottles.
2. Make sure the bottles are clean.
3. Make sure the caps are on when the initial cuts are made in the bottles.
4. Bottle number 1 gets the spout cut off. Place rubber band 11 cm down from the top of the bottle.
5. Use a marker to draw a circle all the way around the bottle, running your marker along the rubber band.
6. Cut and identify the bottle as Bottle # 1 (the bottom part of the original bottle).
7. Bottle number 2 gets the base cut off, leaving most of the bottle including the spout.
8. Place the rubber band again at the 24 cm mark down from the top of the bottle.
9. Use a marker to draw a circle all the way around the bottle.
10. Cut and identify the bottle as Bottle #2.
11. Save one of the two bottle caps to place on Bottle #2.

Once Completed See **Instructions For Building, Maintaining and Observing a Terrarium.**

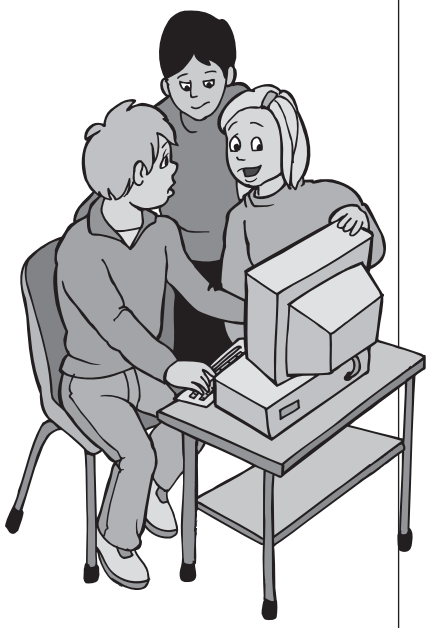


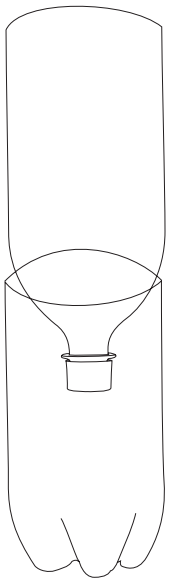
Instructions for Building, Maintaining and Observing a Terrarium

1. Get Bottle #1, Bottle #2, a bottle cap, screening, plastic cup, rubber band and a marker.
2. Place a piece of screen on the top of the spout of Bottle # 2 and secure it with a rubber band.
3. Gently screw the top on to Bottle #2 without ripping the screen.

   An alternative to steps 2&3 for using the screen is to tape the screen inside the bottle in case you find that the screen rips when you screw on the cap.

4. Invert Bottle #2 and stand its spout down on a plastic cup.
5. Have one partner balance the bottle over while the other student places a layer of gravel/rocks into the bottle (about one-two cups of materials). Try not to get the material on the sides of the terrarium.
6. If charcoal is available, sprinkle one teaspoon of charcoal over the rocks.
7. Add one-two cups of potting soil to the bottle.
8. Divide the surface of the terrarium into four areas using a pencil tip.
9. Place three-five alfalfa seeds or whatever seeds you chose to work with in one of the four areas, pressing them lightly into the soil, just below the surface.
10. With the marker label the outside of the bottle with the seed name, (e.g., alfalfa) in the area where the seeds were planted using a permanent marker.
11. Repeat Step #7 for the grass seeds, mustard seeds and dead leaf/compost combination material, respectively.
12. Remove the bottle cap and throw it away.
13. Invert Bottle #2, spout down, and place it into Bottle #1.





14. Get a cup of water and use a dropper to wet the soil thoroughly until water drips out the bottom.
15. Every time you water your terrarium, let it finish dripping into Bottle #1. Then empty Bottle #1 of any water and put it back under Bottle #2.
16. Using the Terrarium Observations sheet, write down the changes every day that happen in the terrarium. Remember to look for changes in the organisms and in the environment. For instance, the color of the rocks may change because of organisms growing on their surface; drops of water may collect in places that did not show them before; or the soil may change color over time.
17. Enter the number of the day in the column on the left. Remember after a weekend to add two days to your total number. For instance, if Friday was Day #3 of growth, then on Monday when you come back from the weekend, you will enter Day #6 because Day #4 and #5 were weekend days during which you could not make observations, but the terrarium was still undergoing changes.
18. Using eye dropper, water your terrarium once a week.
19. When you water once a week, remove the bottle cap from the terrarium and replace it after the water begins dripping through the screen.
20. Remember to record the number of droppers of water added.
21. After eight days of observations, place a piece of plastic wrap over the top of the terrarium.

Partner Name _____ **Date**_____

Terrarium Observations

		Soil	Alfalfa Seeds	Grass Seeds	Mustard Seeds	Mulch/ Compost	Water
Day #	Color						
	Other observations (e.g., organism moving)						
Day #	Color						
	Other observations						
Day #	Color						
	Other observations						
Day #	Color						
	Other observations						
Day #	Color						
	Other observations						
Day #	Color						
	Other observations						

Name _____ **Date**_____

Conclusions Regarding Observations and Analyses

1. What are the living components of the terrarium ecosystem?

2. What are the non-living components of the terrarium ecosystem?

3. A. What changes occurred after the plastic wrap was added to the bottle?

   B. What do you think was causing these changes?

   C. Does what you see remind you of a natural process that occurs on the earth? If so, describe.

4. Describe evidence you observed that organisms were dependent on other organisms.

5. Describe evidence you observed that organisms interact with non-living things in their environment.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

Possible Answers to the Observations and Analyses

1. **What are the living components of the terrarium ecosystem?**

   Insects, seeds, plants

2. **What are the non-living components of the terrarium ecosystem?**

   Water, soil, charcoal, twigs (were living), pebbles, leaves (were living)

3. **A. What changes occurred after the plastic wrap was added to the bottle?**

   Water collected inside the bottle

   B. What do you think was causing these changes?

   Water vapor (gas) produced by plants during photosynthesis cannot escape and it collects (condenses) on the plastic

   C. Does what you see remind you of a natural process that occurs on the earth? If so, describe.

   Condensation or raining occurs on earth after the water evaporates from its surface and forms clouds.

4. **Describe evidence you observed that organisms were dependent on other organisms.**

   I think organisms were in my terrarium and that they were dependent on one another. Plants give off oxygen for tiny insects or bacteria that may be living in the terrarium.

   OR

   Plants are producers and therefore provide food for some organisms in the terrarium.

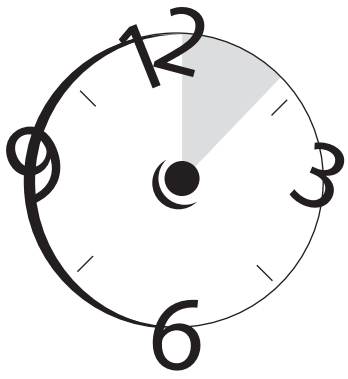
5. **Describe evidence you observed that organisms interact with non-living things in their environment.**

   Plants need water. Soil is needed to hold the plants of the roots and it also supplies nutrients.

Ecosystems and Scientific Inquiry

Core

Time Allocation: 45 minutes
Required Materials and Resources on Page 206



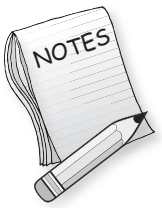
Lesson Overview

Students in this lesson will be introduced to concept maps as communication tools. They will be told about the various purposes of using concept maps and then go about building one around the topic of sports, thus sharing their current understandings about this common topic. Concept maps will be used in future lessons as an instructional teaching aid and as an assessment tool to evaluate student knowledge gained as a result of instruction.

Guiding Questions

- What are concept maps?
- How do concept maps help users to understand content?

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



Content Goals

Universal Theme

- Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena.

Principles and Generalizations

- Scientists use tools to assist them in their scientific investigations.
- Concept maps are visual representations of concepts and their relationships
- Concept maps can help us to understand science topics.

Concepts

- Scientific investigation
- Concept
- Concept map
- Relationship

Teacher Information

A concept map is a tool—a graphic organizer—that can demonstrate understandings regarding a specific topic. It can be used to assess students' prior knowledge during a brainstorming session. It can be used to share current understandings regarding a topic, and it can be used as a student assessment tool.

Skills

- Organize
- Sequence
- Identify missing information
- Identify relationships

Materials and Resources

1. Concept map entitled, **What Are The Different Types Of Sports?** (See the map on page 31)
2. Overhead projector

Preparation Activities

Make copies of the concept map, **What are the different types of sports?** (See the map on page 31).

Introductory Activities (5 minutes)

Have students observe and record their observations of the terrarium ecosystem. For the remainder of the 2 weeks of terrarium observations, it should be noted that these observations can occur at different times in the day so that a particular science class that might be short on time is not slowed down by these daily observations.

Pre-assessment

N/A

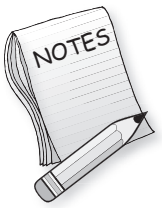
Teaching and Learning Activities (35 minutes)

1. Start the lesson by inviting students to think about the words "concept" and "map." They have probably heard and know both terms individually. But what might the two words mean when used together? Acknowledge all students' thinking. At the same time, move the conversation so that students come to understand that maps are tools that many professionals use, including geographers, architects, and scientists, to name a few. Concept maps are specific kinds of maps, graphic organizers that show concepts (ideas) and their relationships. They can be used by anyone who wants to understand how knowledge in a field or discipline is organized.

2. Building upon students' information about concept maps, share that they will be learning how to draw these maps. To begin, share that you will be working together to draw a concept map about a familiar topic: sports.

3. Using an overhead projector project draw the major concept, sports, in an oval to start the map.

4. Ask students what types of sports exist. Generate a list such as basketball, boating, swimming, ping-pong, skating, running, field hockey, volleyball, etc.



5. Continue by saying, "Sports can be played in two major places, on land and water. Draw in the next two ovals below the concept sports. Connect these concepts with the main concept using the words "are played in or on."

6. Get the students to break the water concept into two concepts, ice and liquid water, such as lakes or ponds.

7. Continue the process of generating the map by asking questions about the concepts and their relationships.

8. The completed concept map, "What are the different types of sports?" is for your reference. Students may generate other concepts that can be mapped differently. The map below is just a model. It can be handed out if necessary.

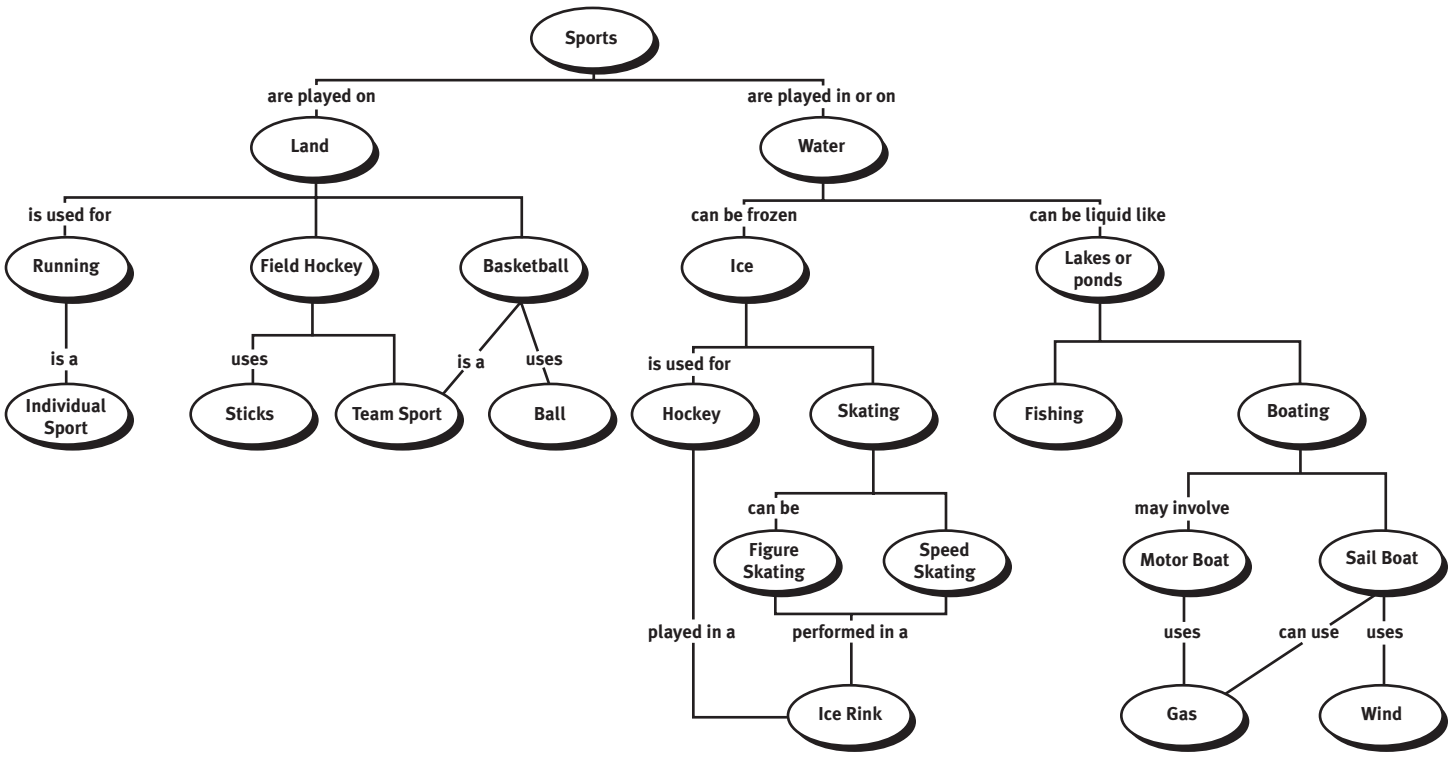
Products and Assignments
Students' concept maps

Extension Activities
N/A

Post Assessment
N/A

Debriefing and Reflection Opportunities (5 minutes)
Review, briefly, the two major parts of a concept map: concepts and links (relationships). Then, in a large group discussion, pose the following question and invite students' reflection: Why are concept maps valuable to all professionals, including scientists?

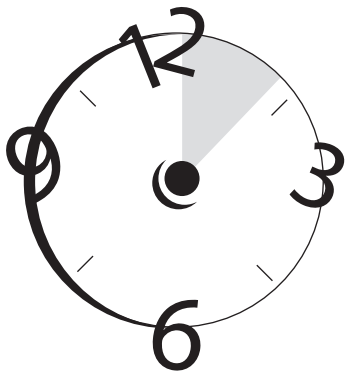
Concept Map for "What are the different types of sports?"



Ecosystems and Scientific Inquiry

Practice/Identity/AID

Time Allocation: 45 minutes
Required Materials and Resources on Page 206



Lesson Overview

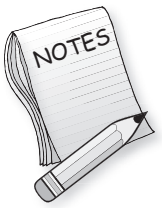
Students in this lesson will discuss the nature of scientific exploration emphasizing what scientists do. The purpose of the lesson is to have students understand that they too can engage in science, and that it is important to understand how scientists go about their work. A concept map, focused on how scientists do their work, is used as a graphic organizer for the discussion.

Guiding Questions

- What is the nature of scientific explorations?
- What do scientists do when they explore natural phenomena?

BIG IDEA

Scientists and Their Work



Content Goals

Universal Theme

Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena.

Principles and Generalizations

- Scientists work by wondering, observing, describing, using data to explain phenomena, and sharing information
- Anybody can be a scientist.

Concepts

- Science
- Scientist
- Scientific exploration
- Scientific question
- Curiosity
- Information
- Problems
- Questions
- Tools
- Experiments
- Data
- Teams of scientists
- Plans
- Discussions
- Individual opinions
- Conclusions
- Right
- Wrong
- Different

Teacher Information

Science is knowledge about the physical world obtained through methods that can be repeated and whose results can be verified.

Ecosystems and Scientific Inquiry

Skills

- Organize
- Sequence
- Identify missing information
- Identify relationships

Materials and Resources

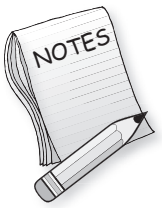
1. Concept map entitled, **What Is The Nature Of The Work Scientists Do?** (See the map on p. 40)
2. Overhead projector

Preparation Activities

1. Make copies for each student of the **List of Missing Concepts and Linking Phrases** (See the list on p. 39).
2. Make copies for each student of the partially filled concept map entitled **Student Work Copy** for **What Is The Nature Of The Work Scientists Do?** (See the map on p. 39)
3. Make copies for each student of the concept map entitled **What Is The Nature Of The Work Scientists Do?** (See the map on p. 40)

Introductory Activities (5 minutes)

- Have students observe and record their observations of the terrarium ecosystem.
- Share with students that they will be studying ecosystems in a way that is similar to scientific investigations.
- Provide a couple of minutes for students to discuss the following question: What is scientific investigation?
- **SEARCHLIGHT**: Listen carefully to student conversations. Note those students who are engaged with the question and/or exhibit an unusually deep understanding of scientific investigation. These students might benefit from the AID opportunity explained later in this lesson.
- Discuss with students the nature of scientific exploration. If it does not surface during the discussion, explain that science is knowledge about the physical world obtained through methods that can be repeated and that has results which can be verified.



- Mention that people who "do science" are usually called scientists. Point out, however, that everyone can do science. It does not necessarily have to be one's job. Students need to understand that they, too, can behave as scientists.

Pre-assessment

N/A

Teaching and Learning Activities (30 minutes)

1. Give students a copy of the partially filled out concept map, **What Is The Nature Of The Work Scientists Do?** with a list of missing concepts and linking phrases, **List of Missing Concepts and Linking Phrases**.

2. Review the concept list and tell students the purpose of the "linking phrases" is to describe the relationship between the linked concepts.

3. Using an overhead projector, show students the partially filled concept map.

4. Start at the top of the list discussing the first link between the concepts "scientists" and "problems" using the link "explore." Proceed through the chart asking students to help you fill in the blanks. Elaborate, whenever possible, on the nature of scientific exploration and the role scientists play in this process.

5. Hand out completed copies of the concept map, **What Is The Nature Of The Work Scientists Do?**

6. Share with students that the next day they will be asked to design a concept map that reveals their understandings of the definitions and relationships among the concepts associated with ecosystems.

Products and Assignments

Students' **Student Work Copy**

Extension Activities

(AID) Students who need a greater cognitive challenge can be asked to write a reflective essay in which they are asked to discuss the personal attributes they possess that would assist them if they chose to become scientists. Ask the students to think and write about some of the qualities that allow scientists to be successful: curiosity, persistence, skepticism, open-mindedness and keen observations skills. Ask them, "Do you possess some or many of these? If so, write about them and how you think they could help you to become a scientist."

Post Assessment

N/A

Debriefing and Reflection Opportunities (10 minutes)

At the end of the concept map activity have students summarize their understanding of what scientists do and how scientists conduct scientific explorations. In addition, have students orally describe some of the important attributes to have if one is to actually act like a scientist. Then pose the question, "Do you see yourself as a scientist? Encourage students to give specific reasons why they think they could or could not become a scientist.

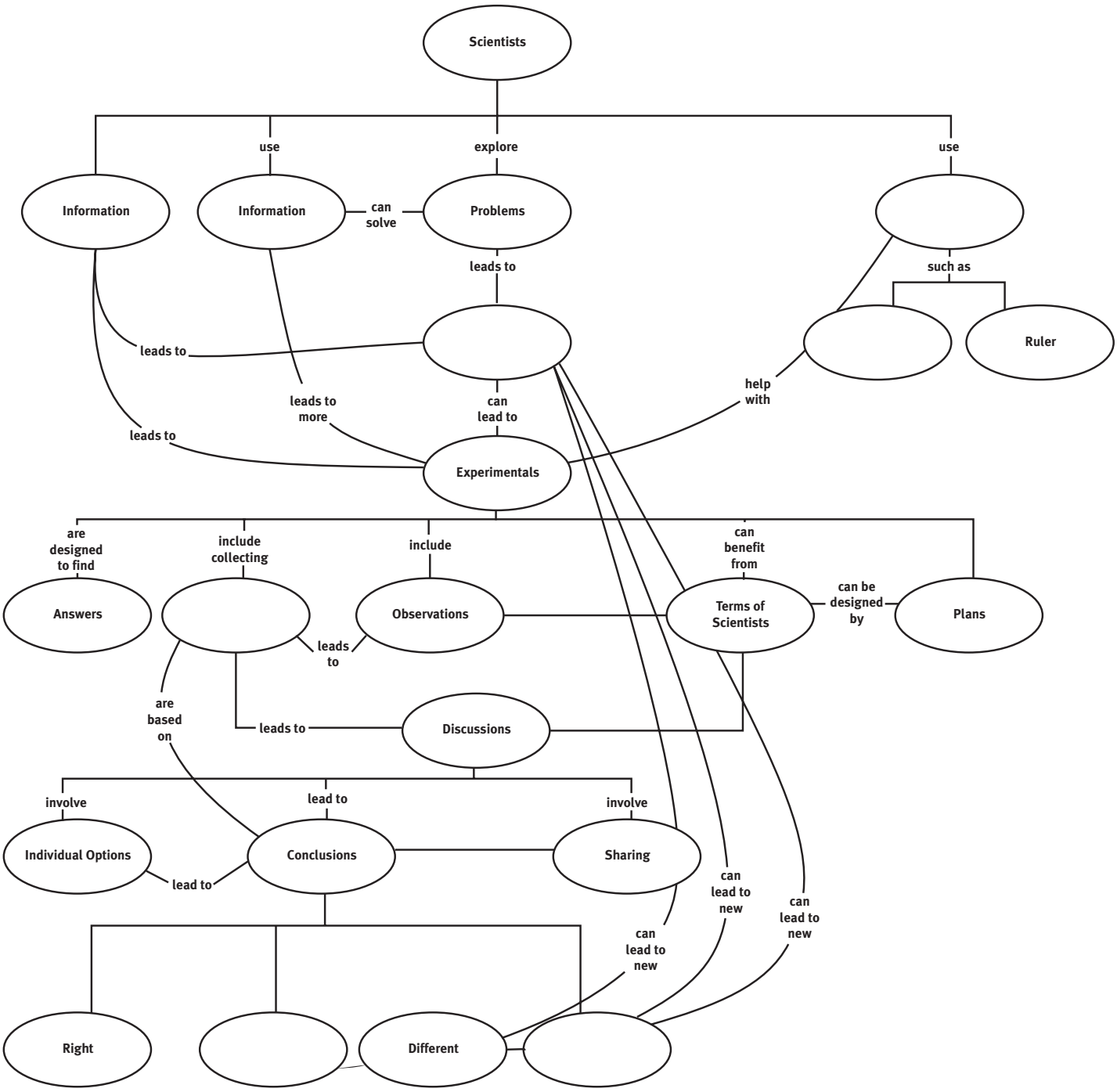
STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

List of Missing Concepts and Linking Phrases

Concepts	Linking Phrases
Magnifier	can improve
Data	use
Tools	can improve number and quality of
Questions	require
Wrong	can be
None	have

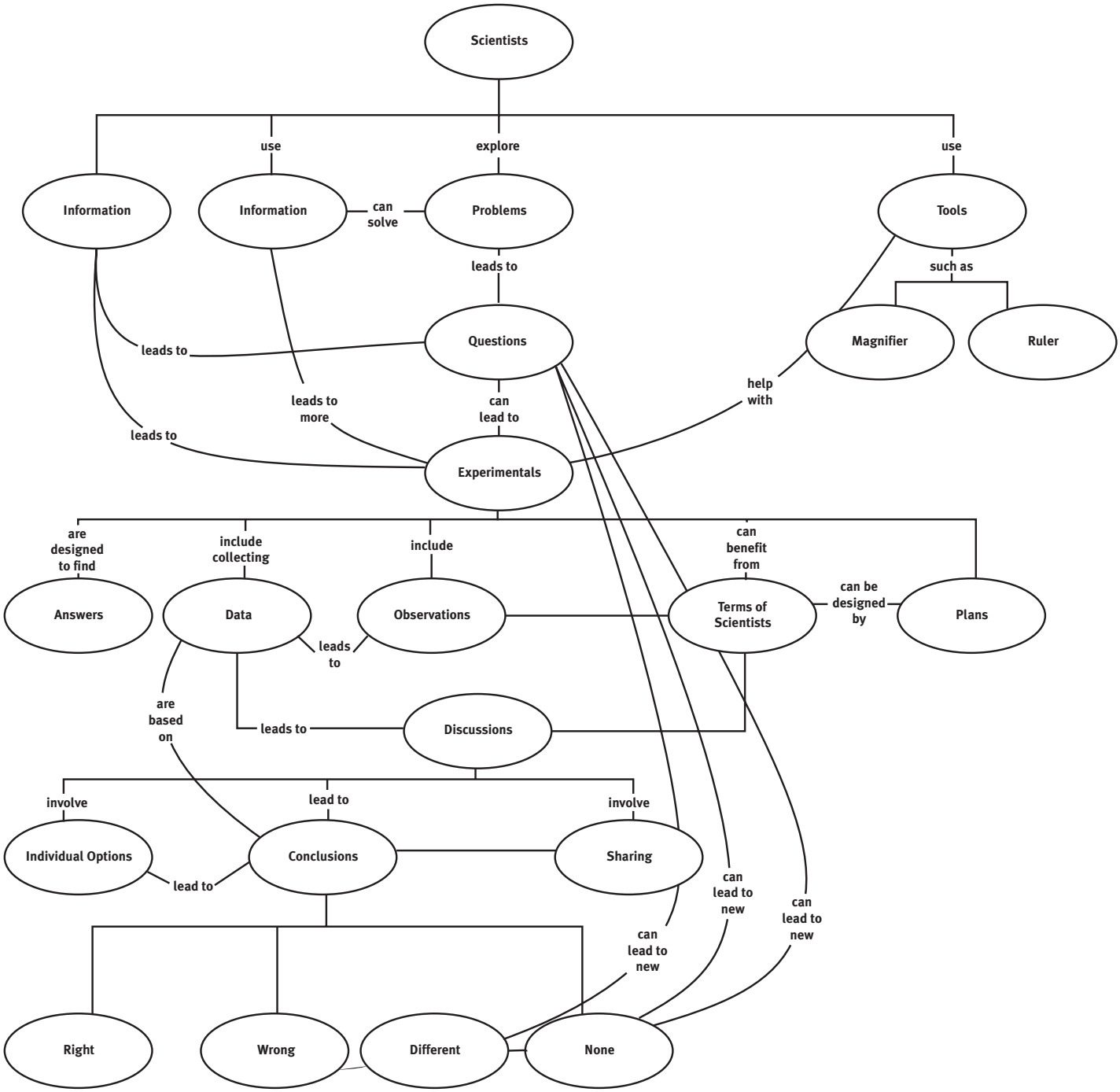
Student Work Copy

What is the Nature of the Work Scientist do?



Concept map related to what scientists do. This map review serves two purposes: (a) model what a completed concept map looks like and (b) reinforce the "identity parallel," as it relates to being a scientist.

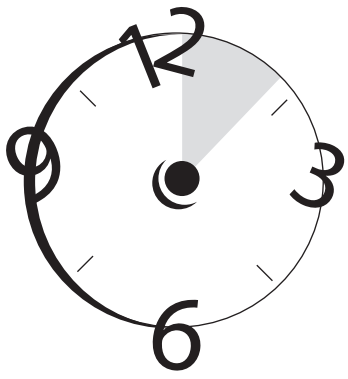
What is the Nature of the Work Scientist do?



Food Chains and Food Webs

Core/AID

Time Allocation: 1 hour 20 minutes
Required Materials and Resources on Page 206



Lesson Overview

In this lesson students will explore food chains. Specifically, students will come to understand that ecosystems have more than one kind of food chain and that organisms are part of multiple food chains, thus forming food webs. They will explore food webs through discussions, pictures and a kinesthetic activity. Some students will investigate food webs in deserts and explore the distinction between the term *biome* and the term *ecosystem* as it relates to the desert biome in particular.

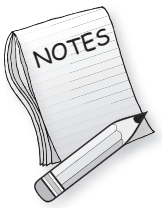
All students will change the terrarium mini-ecosystem conditions by making it a "closed system" from which the water cannot escape. In a future lesson students will determine whether this change stresses the ecosystem and ultimately affects its living things.

Guiding Questions

- How can models help us understand some of nature's processes?
- How does the interaction among organisms help them meet their needs?
- How do food webs help organisms survive?

BIG IDEA

Food Chains and Food Webs



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 contain food chains.
- Most ecosystems contain multiple food chains, thus forming food webs.

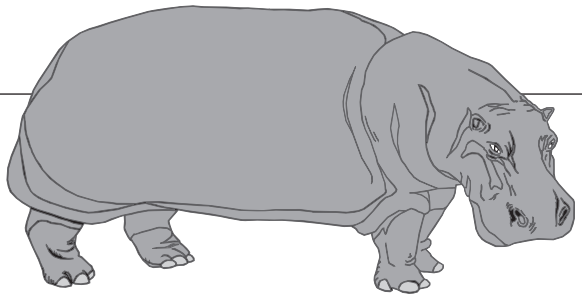
Concepts

- Model
- Ecosystem
- Organism
- Microorganism
- Interdependence
- Survival
- Producer
- Consumer
- Decomposer
- Carnivore
- Herbivore
- Omnivore
- Predator
- Prey
- Phytoplankton
- Zooplankton
- Food chain
- Food web
- Desert (AID)
- Biome (AID)

Teacher Information

This information was modified from the Internet websites:

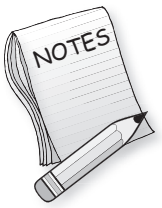
- http://www.greatestplaces.org/book_pages/okavango.htm
  http://nationalgeographic.com/
  (once at this site, type in "Okavango" in the search area)



Food Chains and Food Webs

The Okavango in northwestern Botswana is called the "the river which never finds the sea," because it disappears into a 6,000-square-mile maze of lagoons, channels, and islands. The river system annually brings more than two million tons of sand and silt into the Delta, yet less than three percent of the water emerges at the other end. The Okavango Delta is Africa's largest and most beautiful oasis. The River Okavango, which rises in the highlands of Angola, never reaches the sea; instead its mighty waters empty over the sands of the Kalahari. It is a natural refuge and giant water hole for the larger animals of the Kalahari. The water gives rise to many forms of life unexpected in a "desert": There are fish, crocodiles basking on the sands, and hippopotamuses and swamp antelopes feeding on the vegetation. As the Okavango leaves the humid highlands and enters the arid flatness of the Kalahari, it slows and drops its sediment load. Over time, some two million tons of sand and debris have been deposited over the Kalahari sands, creating the characteristic fan shape of the Delta. The Okavango offers an oasis of habitat for prolific plant and animal life. Inhabiting the waters of the Okavango are about 80 species of fish. The most abundant of these are the bream which are preserved from excessive predation by crocodiles feeding on the tiger fish that would prey on the bream. Hippos flatten paths through the papyrus on their nocturnal forays to graze, allowing easier access for the antelope to traverse across the swamps during their daytime migrations. Belts of forest fringe the swamps with tall trees giving shade to large herds of larger game. Beyond the forest fringe, the landscape forms an open savanna and in these drier areas the predator families accompany the greatest concentrations of game: lion, leopard, cheetah, hyena, and wild dog.

- A food web is a collection of food chains that indicates the interactions occurring among the producers and consumers within an ecosystem.
- A biome is a large biogeographical region characterized by distinctive vegetation and organisms associated with a particular physical environment maintained under the climatic condition of the region. Some of the major biomes are tundras, taigas, deserts and tropical rainforests. These areas are large-scale ecosystems created by major types of climates (AID).
- Desert creatures have special adaptive features that enable them to survive in the harsh desert conditions such as waxy coatings to prevent loss of water, thorns and spines to keep predators away, and body shapes that can expand rapidly when water becomes available. Some desert animals like the scorpion have exoskeletons to protect against water loss (AID).



- Desert plants have large networks of roots that lie near the surface and can capture rain when it falls and many do not have leaves at all to decrease opportunity for water loss. Instead they have chlorophyll in their stems. Some perennial plants store moisture in their underground bulbs or tubes. Some desert plants produce small hard seeds that may not sprout for up to 10 years if water is not available (AID).

Skills

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

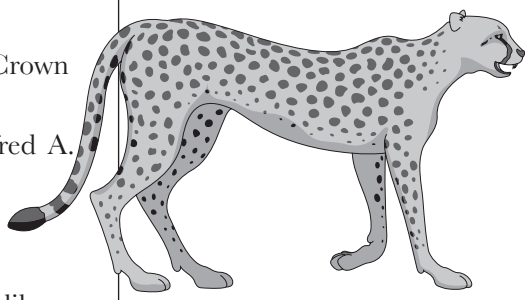
Materials and Resources

1. A wonderful resource for images of the various organisms studied in this unit is the US Fish and Wildlife Services a at http://images.fws.gov. It has a National Image Library with public domain images for download.
2. A label for each of the following:
    - Sunlight
    - Plants (papyrus)
    - Trees (Phoenix palm)
    - Hippopotamus (eats vegetation)
    - Lechwes (herbivores)
    - Okavango Delta Lechwes
    - Okavango Delta
    - Pangolin (eats termites)
    - Cheetah (carnivore)
    - Crocodile
    - Wild Dog
    - Termite

3. One ball of yarn
4. The http://www.nationalgeographic.com website has food chain activities on it. Click on the word "Okavango" at the top of the web page, and this will take users to a collection of food chain activities. The one used below was adapted from that site.
5. The http://www.greatestplaces.org website includes the Okavango Delta, which is a resource for students, as it includes the flora and fauna of the region and some film clips.
6. Map of the world that shows Africa and the country of Botswana.
7. Pushpins
8. Illustrations of simple food chains in which some of the organisms are common to each of the food chains. They can be created using Inspiration.
9. Examples of food webs which can be created using Inspiration (see "Common Food Web" below). This food web can be made into an overhead rather than having copies for each student.
10. (AID) Excellent resources for information and pictures of desert animals are the following books:

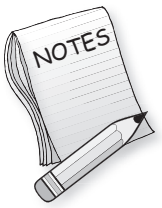
    Wiewandt, T. (1990). (*The hidden life of the desert.*) New York: Crown Publishers.

    Macquitty, M. (1994). *Eyewitness books desert*. New York: Alfred A. Knopf.



Preparation Activities

1. Have several pictures of food chains that come from ecosystems like a pond, woods, lake or river that can be used as a comparison to student pictures of similar ecosystems. The purpose of the comparisons is to show that ecosystems contain multiple food chains that overlap one another and produce food webs. Students must begin to realize that organisms often have multiple sources of food and thus are part of more than one food chain at a time.
2. Prepare labels (and pictures, if desired) for each of the organisms from the Okavango Delta that can be taped onto student volunteers for the Food Web.
3. Have a world map that will stay up in the room for the entire year and as each country comes up in science discussions throughout the year, place



a pushpin into the map to mark that particular area. By the end of the year students should see pins on most every continent, reinforcing the idea that science, its ideas, processes and components occur and can be found everywhere in the world.

4. Print a picture of a simple food web available to show students via an overhead, computer slide, web picture, handout, etc. (see **Common Food Web** on p. 49).
5. Make copies of a **Desert Food Web Drawing Instructions.**

Introductory Activities (5 minutes)

SEARCHLIGHT: Observe students in the discussions and activities in this lesson. Make a note about students who possess a great deal of prior knowledge about food chains and webs and/or who learn more quickly than their peers. Invite these students to complete the AID activities at the conclusion of this lesson.

- Have students observe and record their observations of the terrarium ecosystem (Day 5).
- Tell students to take a piece of plastic wrap and cover the terrarium. (Day 5)

Pre-assessment

N/A

Teaching and Learning Activities (55 minutes)

1. Transition into the lesson by sharing with students that there is a place called Okavango Delta in Botswana. It is an ecosystem that is probably different from the ones they discussed a moment ago (Day 5)

2. Show students where Botswana is. (Day 5)

3. Have a student go to the classroom map and put a pin on Botswana.

4. Share with students that some of the organisms that live in the Okavango Delta are plants like papyrus, trees like the Phoenix palm, animals like the crocodile, the cheetah, the hippopotamus, the lechwe (antelope), and the wild dog, and insects like the termite. List the organisms on the board and next to each list an example of what each one eats (Day 5):

Sunlight
Plants (papyrus) use sunlight – producers
Trees (palms) use sunlight – producers
Hippopotamuses eat plants
Lechwes eat plants
Crocodiles eat lechwes
Cheetahs eat lechwes
Crocodiles eat wild dogs
Pangolins eat termites
Termites eat trees
Wild dogs eat lechwes

5. Place pictures on student volunteers. Have them stand in a circle (Day 6).

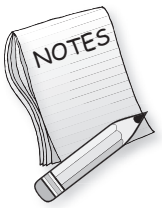
6. Begin with a ball of yarn and a student pretending to be the plants (grass). Have the student hold one end and toss the ball to a lechwes that eats grass, stating "grass" and the animal eating it. For example, "Grass is eaten by lechwes." Then that student might say, "Lechwes are eaten by crocodiles." and toss the ball to a student playing a crocodile, while still holding on to part of the yarn. Since the crocodile is the top of that food chain it reverses the order, tossing the yarn to an animal that it would eat such as a wild dog (Day 6).

7. Soon all of the students end up holding part of the yarn, illustrating both individual food chains and the interconnection of chains into a food web (Day 6).

8. Ask students, as a large group, to reflect on the "yarn story." What might the yarn tell us about food webs? What questions do you still have?

9. Hand out and discuss a picture of a food web (see the handout called **A Common Food Web** p. 49) (Day 6).

10. Discuss the "levels" in a food web, starting with the bottom level of producers and then moving up through the consumers (Day 6).



Products and Assignments

Desert Food Web Drawing assignment for the desert organisms (AID)

Extension Activities

(AID) These activities are for students who have a great deal of prior knowledge or who learn more quickly than their peers.

1. Tell these students they will be investigating another large-scale ecosystem, called a biome.
2. Hand out **Desert Food Web Drawing Instructions** to each student.
3. Have students explore food webs in a desert by going to a Internet site such as http://curriculum.calstatela.edu/courses/builders/lessons/less/biomes/desert/desert/html
4. Assign them the task of finding out how a "*biome,*" a term referred to at the above website, and an "*ecosystem*" are different.
5. Have them draw a food web for some of the desert organisms (see the **Desert Food Web Drawing Instructions** p. 51).
6. Although animal and plant adaptation is not the focus of this lesson, encourage students to read about the organisms they put into their food web and look for any special features that might assist these organisms in their efforts to live in desert environments.
7. Have them share their findings with classmates, ensuring that students have discovered some of the special adaptations desert creatures have that enable them to survive in such a hostile environment.

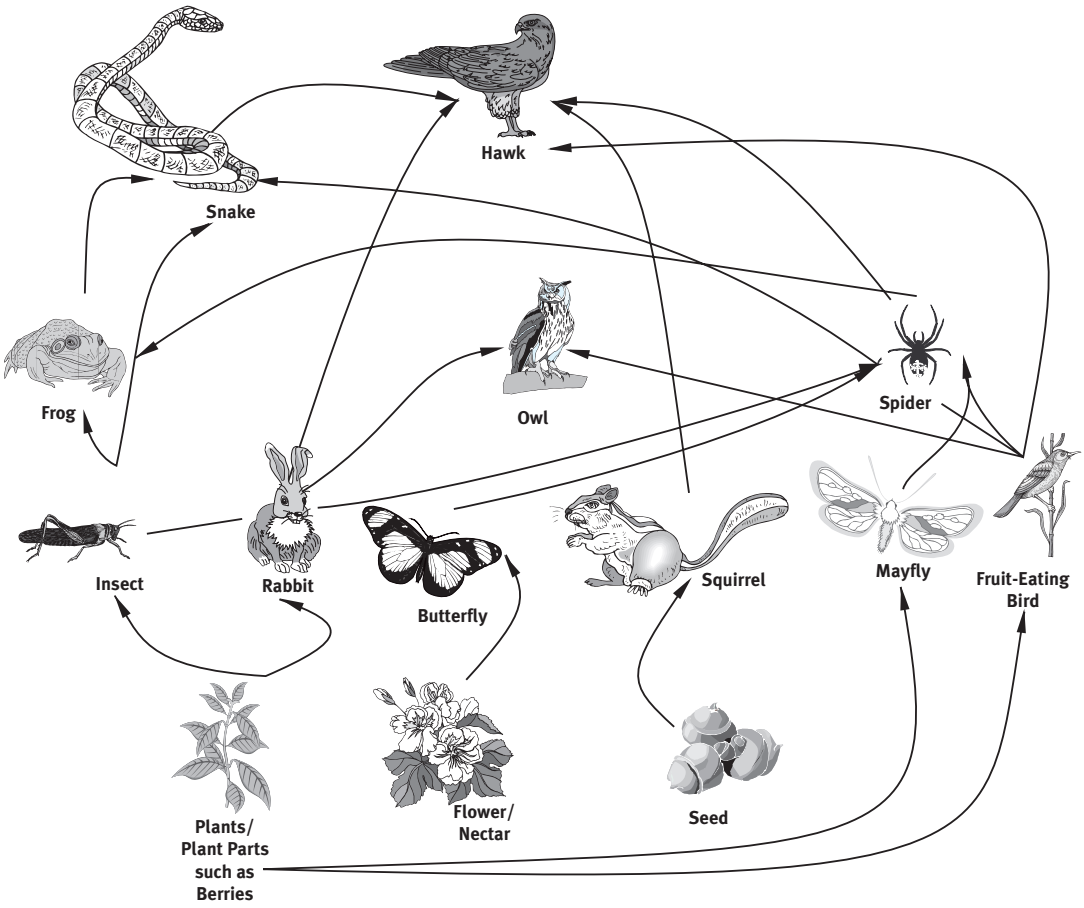
Post Assessment

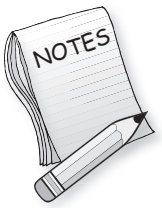
N/A

Debriefing and Reflection Opportunities (20 minutes)

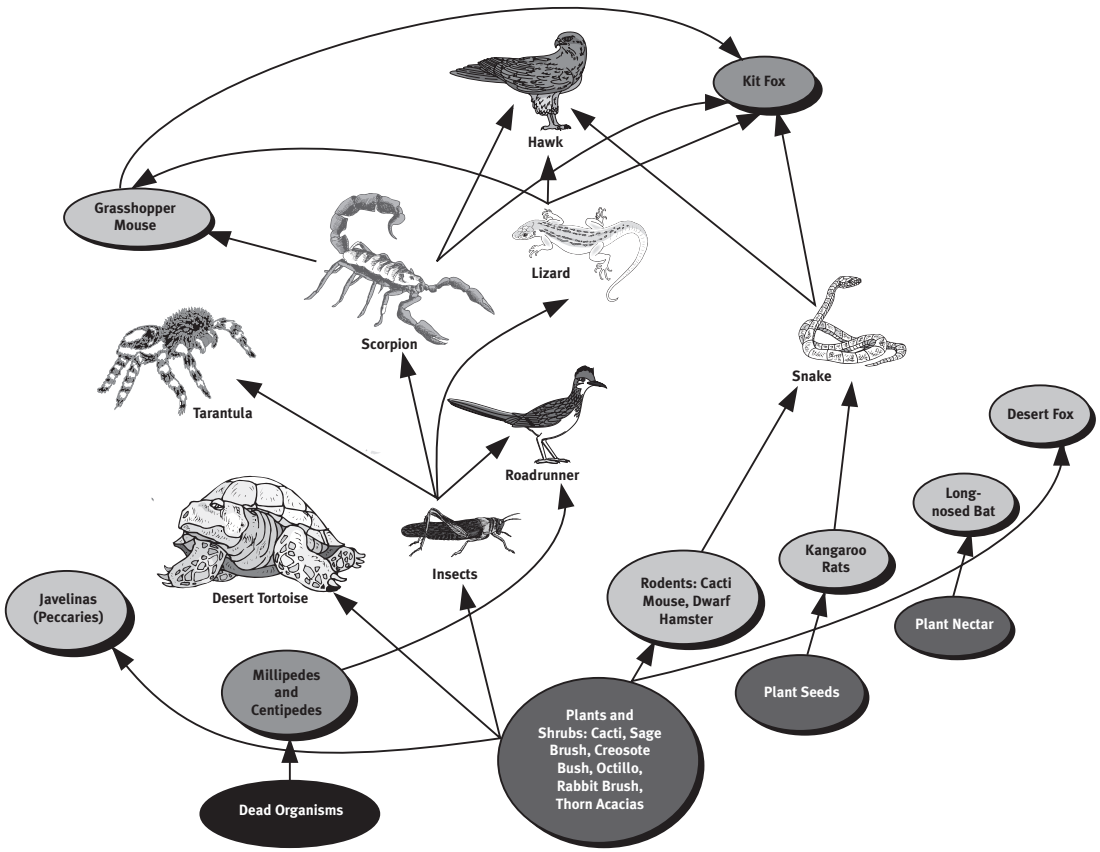
1. Hand out and discuss a picture of a food web (see the handout called **A Common Food Web** p. 49). Discuss the level starting with the bottom level of producers and then moving up through the consumers. Review its web-like appearance.
2. Engage students in a short discussion about food webs. What makes a web different from a food chain? Why might multiple food sources be important? Diagnose students' understanding of food chains, food webs, and the interdependence among living and non-living things in them. Re-teach as necessary.

A Common Food Web





A Food Web in the Desert Biome



Name _____ **Date**_____

Desert Food Web Drawing Instructions

1. Deserts are called biomes. Find out what a biome is and describe the main differences between a biome and an ecosystem below:

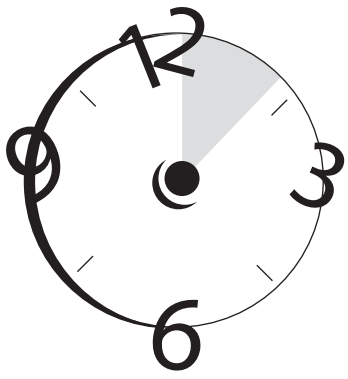
2. Investigate a desert food web using the Internet (http://curriculum.calstatela.edu/courses/builders/lessons/less/biomes/desert/desert.html) or other resources.

3. Draw a food web below for the organisms that you find in a desert. Label the organisms as producers or consumers and identify each as a herbivore, carnivore or omnivore.

Food Chains and Food Webs

Core/AID

Time Allocation: 45 minutes
Required Materials and Resources on Page 206



Lesson Overview

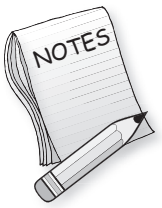
Students will engage in three learning activities focused on a salt marsh ecosystem in order to deepen their understanding of food webs: a discussion, exploration and analysis of food web diagrams, and a kinesthetic activity. They will be introduced to the idea that organisms have food preferences and that the availability of their dietary needs determines the extent of their survival.

Guiding Questions

- How does the interaction of organisms help them meet their needs?
- What are food webs, and how can they help organisms to survive?

BIG IDEA

Salt Marsh 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 (AID).

Principles and Generalizations

- The availability of food sources determines the likelihood of an organism's survival in a food web.
- Environments differ with respect to physical factors, such as temperature, moisture, light and soil type (AID).
- Environments differ with respect to biological factors, such as the kinds and numbers of organisms and availability of food (AID).
- Environmental change can be brought about by natural or man-made causes (AID).
- Many types of man-made environmental changes are detrimental to organisms (AID).

Concepts

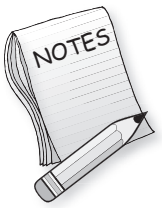
- Ecosystem
- Organism
- Microorganism
- Interdependence
- Producer
- Predator
- Prey
- Consumer
- Phytoplankton
- Zooplankton
- Food chain
- Food web
- Environmental stress (AID)
- Ecosystem balance (AID)

Food Chains and Food Webs

Teacher Information
N/A

Skills
- Identify characteristics
- Describe characteristics
- Compare and contrast
- Analyze
- Identify relationships
- Judge the accuracy of information

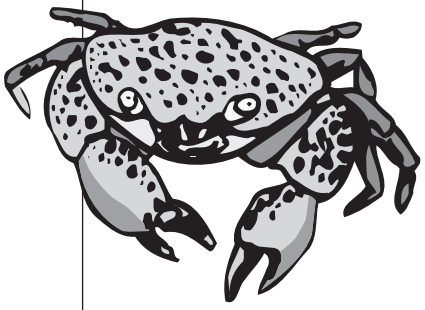
Materials and Resources
1. Resources for student to use in their exploration of salt marsh organisms (e.g., encyclopedias, library books and the Internet)
2. The US Fish and Wildlife Services at http://images.fws.gov has a National Image Library with public domain images for downloading. It is a wonderful resource for images of the various organisms studied in this unit.
3. Labels for each of the salt marsh organisms that will be used in the **Spinning a Food Web** game tomorrow (e.g., index-size cards with pictures on them, 8" by 11" pictures of the organisms printed from the Internet, oak tag with pictures glued on) as well as an identifier sign labeled "Dead Organisms" which is needed for the teacher
4. Oak tag/index cards and string or tape so that the organism identifiers can be attached or hung on each student for their participation in the building of the **Salt Marsh Food Web**
5. Internet sites that have some creative games that deal with the concept of food chains such as "The Tale of the Blue Crab" produced by the Smithsonian Environmental Research Center found on the following website: http://www.serc.si.edu/index.jsp. In search bar type "blue crab."
6. Copy of articles that describe environmental stresses, such as the over harvesting of blue crabs in a salt marsh, and the consequences of upsetting nature's balance such as "Without blue crabs, southern salt marshes wash away, study finds" found at the Brown University site at www.brown.edu/administration/news/2002003/02-005.html. Type in "blue crabs" (AID).



Preparation Activities

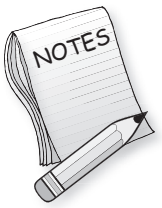
1. Collect resources from school and local libraries on salt marshes. Encyclopedias also can be useful.
2. Access Internet sites that contain pictures and descriptions of all the salt marsh organisms such as:
   - o "Field Guide to the Shores of Rhode Island Salt Marsh" www.uri.edu/artsci/bio/rishores/saltmrsh.html
   - o "Spartina Salt Marshes" in Long Island NY http://www.life.bio.sunysb.edu/marinebio/spartina.html
3. Find relevant sites by going to Google and entering, for example, "striped bass" + "eats." It will list many relevant sites, one of which is http://www.dnr.state.il.us/lands/education/exoticspecies/stripedbass.htm. From sites like this one, students can find out that striped bass eat fish and insects, and in fact almost anything that they can out swim. Other sites for the following animals can be used:
   - o Red-winged blackbird http://www.chariho.k12.ri.us/ric/phandley/bird.htm
   - o Blue crab http://www.blue-crab.org/lifecycle1.htm
4. Make organism identifiers for the following organisms which will be used in the Spinning a Food Web game:
   - o Dead organisms
   - o Phytoplankton (tiny plants like algae) – Producer
   - o Marsh hay (salt meadow hay) -Producer
   - o Zooplankton (tiny animals like copepods) – Consumer (eats phytoplankton)
   - o Clam (soft shelled) – Consumer (eats phytoplankton)
   - o Snail (salt marsh snail, marsh periwinkle) – Consumer (eats phytoplankton and bits of dead plants)
   - o Blue crab – Consumer (eats phytoplankton, dead plants and animals, fiddler crabs and clams)
   - o Fiddler crab – Consumer (eats phytoplankton and dead plants like marsh hay)
   - o Worm – (sea worm, also called clam worm) – Decomposer (eats dead fish and soft insides of clams that float in the water)
   - o Clapper rail (Marsh hen) – Consumer (eats fiddler crabs, worms, and snails)

- o Striped bass – Consumer (eats crabs, worms, clams, small fish, bottom plants, and insects)
- o Smelt – Consumer (eats zooplankton)
- o Snowy egret – Consumer (eats fish and fiddler and blue crabs)
- o Short-billed dowitcher – Consumer (eats clams, worms, insects, crabs, and seeds of marsh and aquatic plants)
- o Heron – Consumer (eats fish, insects, fiddler and blue crabs)
- o Herring gulls – Consumer (scavenger that eats adult birds, clams, insects and fiddler and blue crabs)
- o Diamondback terrapin – Consumer (eats snails, crabs, worms and fish)
- o Red-winged blackbirds – Consumer (eats marsh plants and insects)
- o Insects such as flies, grasshoppers – Consumer (eats dead organisms and plant seeds)



Introductory Activities (10 minutes)

- Have students observe and record their observations of the terrarium ecosystem.
- Remind students to answer the questions on the **Conclusions Regarding the Analyses and Observations of the Terrarium**. (This sheet is in Lesson 4.)
- Give students the complete list of salt marsh organisms. (See the **List of Salt Marsh Organisms** p. 60.)
- Share with students that they will be doing research, in pairs, on each organism in the salt march to determine its food source. Explain that the class will be "spinning a salt marsh food web" based on the results of their research.
- Assign an organism from the salt marsh ecosystem to each pair of students until every pair has an organism from this ecosystem. Have one pair of students research the producers (salt marsh hay and phytoplankton). Have another pair research all the crabs and another pair investigate the mollusks (clams and snails). This arrangement provides research organisms for 14 pairs. If there are fewer students, some students can do the research independently. The teacher will hold the sign, Dead Organisms, when the food web is created in the upcoming kinesthetic activity.



- Provide students a list of resources they can use (See the Preparation Activities above).
- Explain to the students who are assigned the topic of producers, to research which organisms from the list eat them. Inform the students assigned the topic of consumers to research which of their "class members" they can eat.
- Instruct the students who eat predominantly decomposing matter to identify what decomposed organisms from the salt-water marsh ecosystem they eat.
- Hand out the appropriate organism identifier (e.g., index card with safety pin, oak tag with string) to a student from the pair. If a pair of students is researching more than one organism, give the pair the second organism identifier including the string, tape or pin needed to attaching the identifier to the student who will play the "organism" in the (**Spin the Salt Marsh Food Web**) activity.

Food Chains and Food Webs

Pre-assessment
N/A

Teaching and Learning Activities (30 minutes)

1. Provide resources for students to use as they gather information. In addition, the resources should address the main role of each organism in a salt marsh community (producer, consumer or decomposer). Students can use an encyclopedia, Internet or library books.

2. Hand out the **Worksheet on a Food Web for a Salt Marsh Ecosystem.** Have students complete the worksheets with their research findings.

Products and Assignments
Worksheet for **Salt Marsh Ecosystems Food Web**

Extension Activities
(AID) There are many articles about the importance of balance in an ecosystem. Students needing more challenge can read one such as "Without blue crabs, southern salt marshes wash away, study finds" that was published by Brown University researchers in August 2002. The article describes the problems associated with over harvesting blue crabs and the colossal die-off of salt marshes that has resulted because of the increased periwinkle snail population. Invite these students to create bulleted lists of their findings about balance in an ecosystem. Students can then share these real-world stories with the other members of the class.

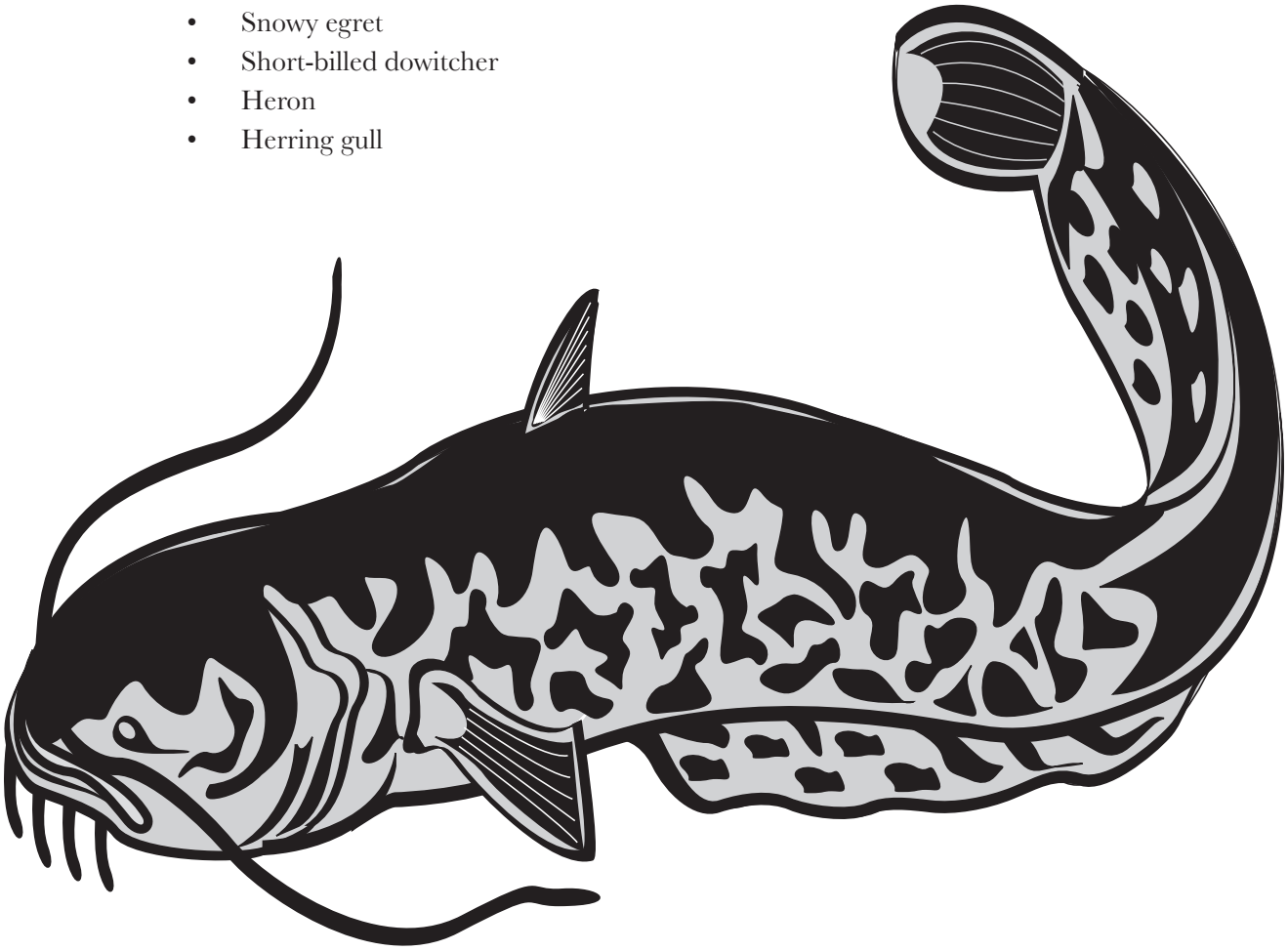
Post Assessment
N/A

Debriefing and Reflection Opportunities (5 minutes)
Invite students to share some of their findings regarding their salt marsh organisms. Using Socratic questioning, ensure that students understand that each ecosystem is a system, composed of interdependent parts. Each part depends upon another part for survival. Pose the following question: Why might it be advantageous to depend on more than one source of food, thus providing some transition for the next day's spinning a food web activity in which some of the food sources are removed from the web. Acknowledge students' responses and share that they will learn more about the answer to this question in the next lesson.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

List of Salt Marsh Organisms

- Dead organisms
- Marsh hay
- Phytoplankton (tiny plants like algae)
- Zooplankton (tiny animals like copepods)
- Clam (soft shelled)
- Snail (salt marsh snail, marsh periwinkle)
- Insects
- Blue crab
- Fiddler crab
- Worms
- Clapper rail (Marsh hen)
- Diamond-backed terrapin
- Striped bass
- Smelt
- Red-winged blackbird
- Snowy egret
- Short-billed dowitcher
- Heron
- Herring gull



Name _____ **Date**_____

Worksheet on Food Web for Organisms in a Salt Marsh Ecosystem

1. Name of your organism _____

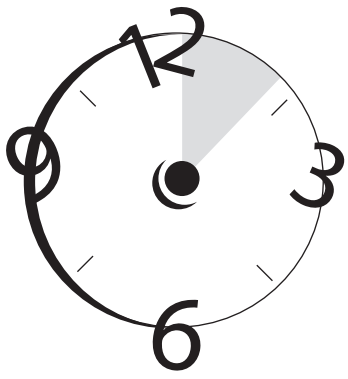
2. What role does it have in the ecosystem, producer, consumer or decomposer?

3. What does your organism eat or decompose? If you are a producer, which organisms from the list eat you?

Food Chains and Food Webs

Core/AID

Time Allocation: 45 minutes
Required Materials and Resources on 206



Session Overview

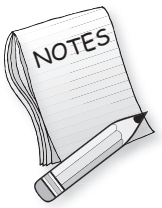
In this lesson, students will further explore food chains. Specifically, they will come to understand that ecosystems can have more than one kind of food chain and that organisms are part of multiple food chains, thus forming food webs. They will develop a model of the formation of a food web using a kinesthetic activity.

Guiding Questions

- How can models help us understand some of nature's processes?
- How does the interaction of organisms help them meet their needs?
- What are food webs and how can they help organisms to survive?

BIG IDEA

Food Web for a Salt Marsh



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 from a whole.
- Properties of some objects and processes can be characterized by constancy, while properties of others are characterized by change.

Principles and Generalizations

- The availability of food sources determines the likelihood of an organism's survival in a food web.

Concepts

- Ecosystem
- Organism
- Interdependence
- Producer
- Consumer
- Predator
- Prey
- Phytoplankton
- Zooplankton
- Food chain
- Food web

Teacher Information

N/A

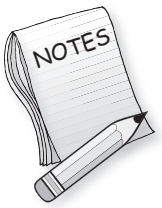
Skills

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

Food Chains and Food Webs

Materials and Resources

1. **Salt Marsh Food Web** concept map on page 72 which shows the links that should develop as the students produce the web in the **Spin the Salt Marsh Food Web** activity.
2. Organism identifiers which must be able to be attached or hung on each student so string or safety pins will also be necessary
3. Green-colored yarn/string cut into three-meter lengths. Each producer must have enough lengths to connect to its various consumers. The marsh hay needs three. The phytoplankton needs six.
4. Black-colored yarn/string cut into three-meter lengths. The teacher will need six lengths.
5. Brown-colored yarn/string cut into three-meter lengths. The first level of consumers, fiddler crab, worms, snails, clams, zooplankton and insects need six, four, two, three, one, and five, respectively.
6. Yellow-colored yarn/string three-meter lengths. The second level of consumers, blue crab, rail, dowitcher and smelt need four, one, two and four. The red-winged blackbird gets no string because its predators, raccoon, fox, and hawk, are not part of this organism's food web.
7. A useful websites include:
   http://www.nwi.fws.gov
8. (AID) The simple map of A Lake's Organisms on page 73 or
9. (AID) A poster which you can make of a lake showing the following organisms:
   - o Phytoplankton (algae, diatoms)
   - o Zooplankton
   - o Bloodworms
   - o Northern pike
   - o Yellow perch
   - o Catfish
   - o Muskrat
   - o Diving beetle
   - o Pond snail
   - o Green frog
   - o Painted turtle
   - o Blue-green teal duck



Preparation Activities

Clear about 4 x 4 meters in the center of the room so the students can build the food web.

Introductory Activities (5 minutes)

- Have students observe and record their observations of the terrarium ecosystem.
- Remind students to finish the **Conclusions Regarding the Terrarium Observations** sheets that were handed out in Lesson # 2 (see a copy on p. 70), as their last observations will be tomorrow and these sheets will be collected and discussed.
- Remind students that the objective for the day is to model a food web by "spinning" a salt marsh food web.
- Have member(s) of each pair of students attach the appropriate identifier tag/picture for their organism(s).

Pre-assessment

N/A

Teaching and Learning Activities (35 minutes)

1. Have all the producers come to the front of the room and give them each green colored string. (An Inspiration map of the salt marsh organisms is attached below, **Map of Food Web for Salt Marsh**. It illustrates each organism's trophic level as well as the organisms that feed on it. By the end of this activity, students should be connected via strings much the same way as the map on page 8. The arrows represent the strings used by the various "student organisms.")

2. The teacher stands next to the producers with a sign that says "Dead Organisms."

3. Have the organisms that only feed on the producers come to the front of the room (zooplankton) and grab one end of the green string from the producers and stand in front of them

4. Direct all the other students who eat the producers come up (i.e., snails, clams, insects, blue crab, fiddler crab, dowitcher, red-winged blackbird).

Food Chains and Food Webs

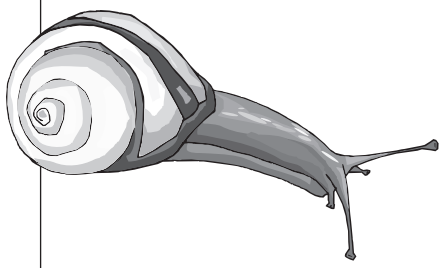
5. Ask which of these organisms that feed on phytoplankton also feed on dead organisms. (clams, snails and insects). Give clams and snails green string from the "Phytoplankton" and give the insects a green string from the "Marsh hay, and then have the teacher who represents "Dead Organisms" give the fiddler crab, clams, snails, and insects a black string.

6. Direct organisms that feed only on dead organisms to come up and grab a black string from the teacher (fiddler crab).

7. Ask if there are any other organisms in the audience that feed on dead organisms. (The blue crab should come forward and be given a black length of yarn.)

8. Ask: What else does the blue crab eat? Because the answer is fiddler crabs, clams, etc., it moves to a higher level in "front" of the second level. Each organism, fiddler, clam and phytoplankton that the blue crab also feeds on should give it a colored length of yarn, brown and green respectively.

9. Ask: What other organisms feed on the second level of organisms? The rail, dowitcher, smelt and red-winged blackbird should come forward and take a brown-colored yarn/string from the organisms on which they feed.



10. Ask: What organisms feed on the third level? The turtle, striped bass, snowy egret, herring gull and heron should come up. Have them get yellow lengths from all the organisms they eat and stand in their own row in front of the blue crab row or level.

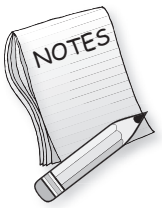
11. Have the turtle get brown strings from the fiddler crab, worm and snails.

12. Have the striped bass get a brown string from the worms.

13. Have the snowy egret get a brown string from the fiddler crab.

14. Have the dowitcher get a brown string from the worms, clams and insects.

15. Have the herring gull get a brown string from the clams and insects.

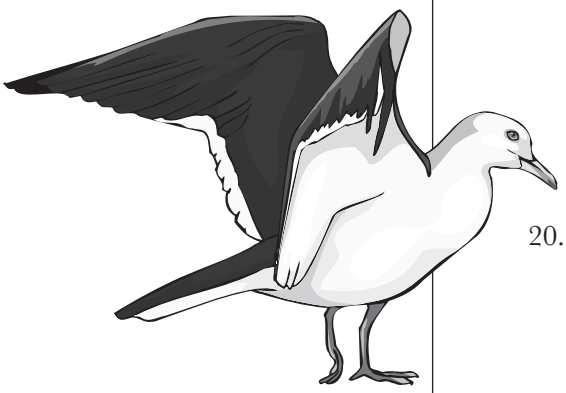


16. Have the heron get a brown string from the fiddler crab and insects.

17. Direct students to look around. Invite them to make observations about the class web. Acknowledge all responses. Guide a discussion with all students to ensure that they understand the levels and complexity of the web.

18. Begin to explore the effect of removing an organism from the food web by asking the phytoplankton to drop their strings and discuss what would be the consequences of having no plants. (Students began thinking about the consequences of removing organisms from a web at the conclusion of the previous lesson.) Students should discuss the fact that the organisms at the second level would not survive, even those like the worms that feed on dead organisms because decayed plant life is part of this and zooplankton, the other part, is dependent on phytoplankton. Once the second level is gone, the web is destroyed.

19. Instead of destroying the producers, the whole foundation of the web, share with students that you are about to make a less drastic change in the web. Ask them what would happen if just zooplankton were removed. They should discuss the fact that the smelt population, carnivores that eat zooplankton, would die out and the herring gull, heron and snowy egret that feed on smelt would have to compete more for the remaining food sources.



20. Invite students to consider: Which of those three might be at the greatest disadvantage. Students should see that the snowy egret has only two other source of food, fiddler and blue crabs, versus the heron and herring that have three other sources. The snowy egret, therefore, is at the greatest disadvantage.

21. Ask: Which organisms are carnivores, herbivores and omnivores? Ensure that students' conceptions of these terms are clear.

22. Elicit from students the names of the prey of the rail (fiddler crab, worms and snails).

Products and Assignments

Ecosystem Lake Food Web (AID)

Extension Activities (AID)

For students in need of greater challenge, offer this activity:
(AID) Lake food web

- Show students the small lake ecosystem food web (p. 73) showing many of the organisms that live in the lake .
- Give the printouts of the organisms to students.
- Have students research the organisms.
- Have students pin the labeled picture of the organism(s) assigned to them to a bulletin board.
- Start with the producers on the left and have students add direct consumers of producers, primary ones first etc, without worrying about terminology. Use string to connect organisms, showing which organism eats what, thus building a food web for the lake ecosystem.

Post Assessment

N/A

Debriefing and Reflection Opportunities (5 minutes)

1. In a think-pair-share, ask some questions. If there is little time, this activity can be done with the whole class. Why is it important for organisms to be part of a food web rather than just a food chain? Students should be able to discuss the advantage of being part of multiple food chains to help ensure the survival of an organism.
2. Why should we think twice before we clear marsh lands to construct housing developments? Students should realize that marshes are filled with producers that provide food for a whole ecosystem. Without the marsh grasses etc., a whole ecosystem is essentially destroyed.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name_____ **Date**_____

Conclusions Regarding Observations and Analyses of the Terrarium

1. What are the living components of the terrarium ecosystem?

2. What are the non-living components of the terrarium ecosystem?

3. A. What changes occurred after the plastic wrap was added to the bottle?

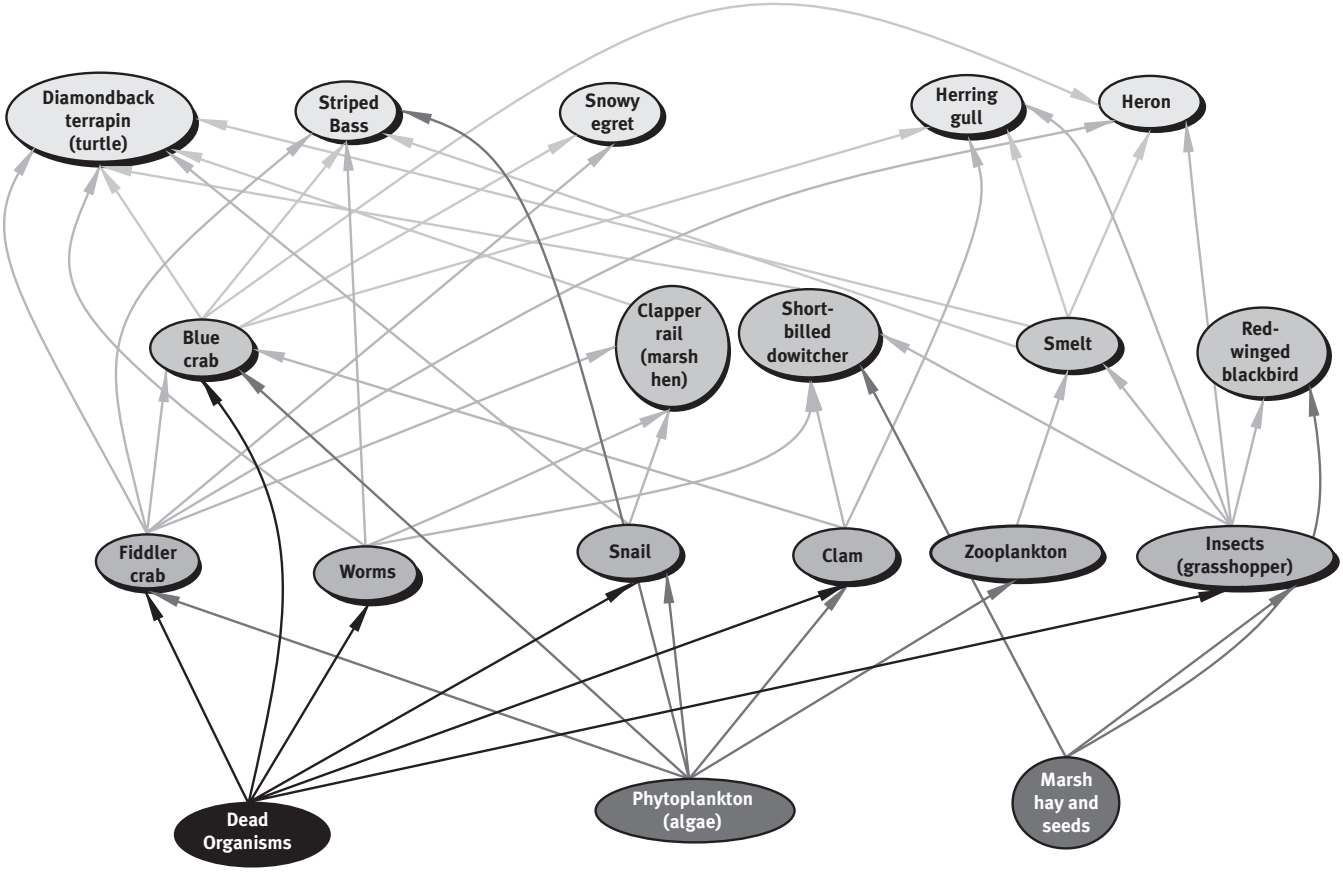
   B. What do you think was causing these changes?

   C. Does what you see remind you of a natural process that occurs on the earth?

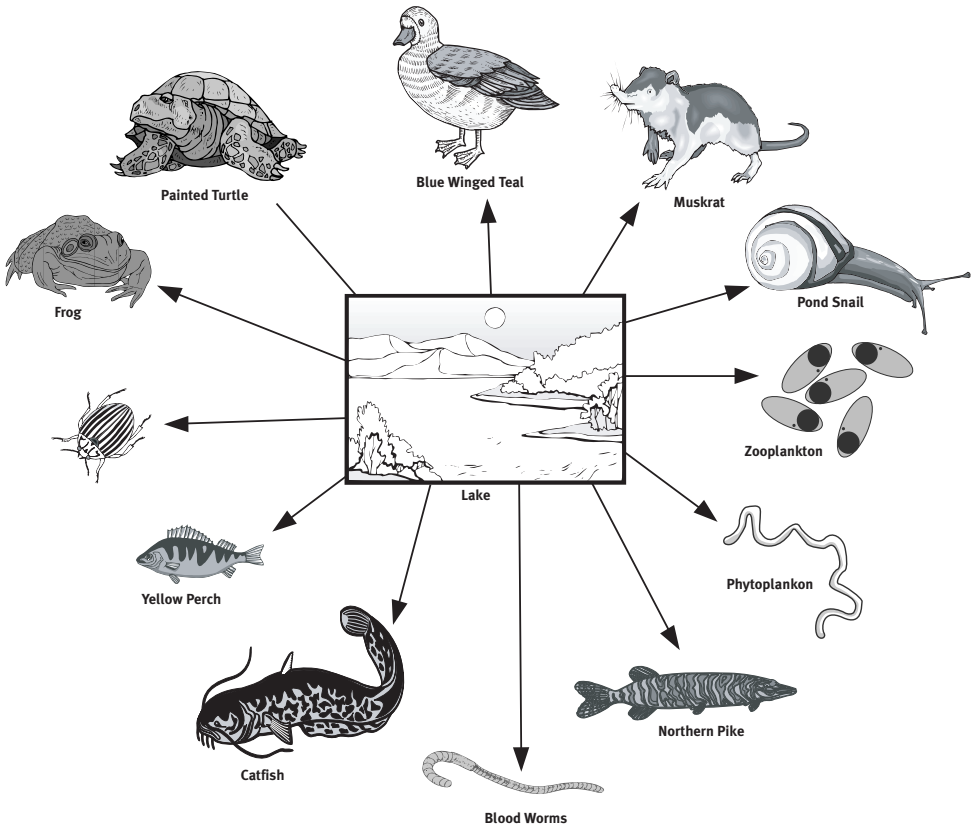
4. Describe evidence you observed that organisms were dependent on other organisms.

5. Describe evidence you observed that organisms interact with non-living things in their environment.

Salt Marsh Food Web



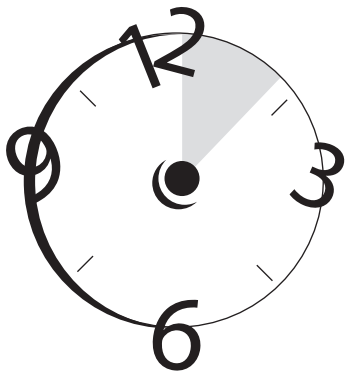
Extension Activity– Lake Ecosystem Food Web



Food Chains and Food Webs

Core

Time Allocation: 1 hour, 5 minutes
Required Materials and Resources on Page 206



Lesson Overview

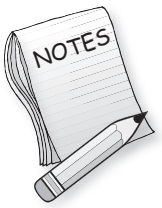
Students will explore the similarities and differences between model ecosystems and the models' real-world counterparts. They will use the terrarium observations collected over the past 2½ weeks to draw some conclusions about the nature of ecosystems. Students will also take a virtual dip in a pond by using a website on the Internet. This experience will enable students to review pond life. Using the terrarium observations as well as information from the virtual pond experience, students will be challenged to identify, discuss or explain some of the major concepts and principles of the unit introduced thus far. For instance, students should be able to verbalize that ecosystems have living and non-living components that interact; that organisms are interdependent, thus improving their chances of survival; that most animals are ultimately dependent on plants; and that although models are useful tools in the study of science, they have limitations that must be considered.

Guiding Questions

- What kinds of interdependence are seen in the pond and terrarium ecosystems?
- How can models help us understand some of nature's processes?
- How are the model ecosystems similar to each other?
- How are model ecosystems similar to and different from

BIG IDEA

Similarities and Differences in Real-World and Model Ecosystems



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

- Ecosystems have similarities and differences.
- Organisms have dependent and interdependent relationships that enhance survival.
- Ecosystems can change over time.

Concepts

- Model
- Ecosystem
- Organism
- Microorganism
- Interdependence
- Survival
- Producer
- Consumer
- Decomposer
- Predator
- Prey
- Food chain
- Food web
- Diversity of organisms
- Change

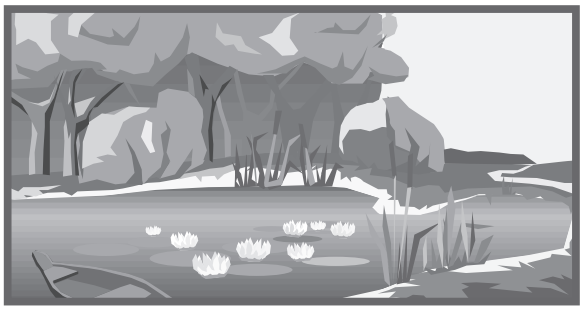
Teacher Information

N/A

Food Chains and Food Webs

Skills

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



Materials and Resources

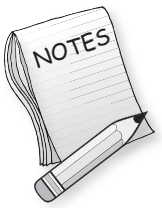
1. Picture(s) of ponds can be found in textbooks, library books, Google at www.google.com and The US Fish and Wildlife Services at http://images.fws.gov
2. Access to the Internet to visit a website http://42explore.com/pond.htm that features a virtual pond dip.

Preparation Activities

1. Hang a picture(s) of a pond ecosystem in the front of the room.
2. Depending upon the number of computers you have available, group students around computers to visit the website: http://42explore.com/pond.htm
3. Copy **Description of Virtual Mini-pond**, for students to use for note taking during the virtual pond dip.
4. Have butcher block paper and easel available for the taking of notes on the students' observations of the virtual pond and their terrariums.
5. Have another two sheets of butcher block paper available to record the similarities and the differences between a hypothetical mini-pond and terrarium model ecosystems and the similarities and the differences between a virtual mini-pond and the real-world pond ecosystems, respectively.

Introductory Activities (30 minutes)

- Explain to students that they will be building a virtual mini-pond. They should image a large glass jar filled with pond water with some pond silt or sand at the bottom, a couple of pond plants, and at least seven different creatures that they will meet in the virtual pond dip.



- Guide students through a quick preview of the virtual pond dip. Tell them that they will be asked to take notes on at least seven creatures that they will house in their virtual mini-pond.
- Now go through the virtual dip, visiting each at least 20 organisms. You will find that as you visit each of the pond creatures, there is information given about its size, life cycle, position in the food chain (what it eats, who eats it) and method of breathing. Remind students to take notes on the organisms that they are including in their virtual mini-pond.
- Ask students if they would have to feed the organisms if they had made a real mini-pond. 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.

- Allow time for each student to complete the worksheet on the virtual mini-pond.
- Collect the **Conclusions Regarding the Observations and Analyses of the Terrarium** sheets.
- Have students observe and record their last observations of the terrarium ecosystem.
- Have students put their terrarium observation sheets and their virtual mini-pond description sheets in front of them.
- Place two columns on the board/easel labeled **Virtual Mini-pond Descriptions** and **Terrarium Observations**.
- Ask students to share some of their observation from the past 2½ weeks of data collection on the terrarium.
- List these observations on the board under their respective columns.
- Engage students in a whole group discussion about the observations including those that were made after the plastic wrap was placed on the terrarium. Make sure students noted the condensation. Ask: Where did the condensation come from? Make sure they understand that it did not "rain" in the terrarium, so the water must have come from inside the container. A brief discussion of the role of plants in this process (photosynthesis) is all that is needed at this time. Students should realize that plants are the producers in the ecosystem and that as they make food, one of the by-products in that photosynthetic process is water, hence the condensation when the plastic wrap is put over the top of the terrarium.

- Compare the closed ecosystem to the open ecosystem (the virtual mini-pond). Ask: Which one is more like a real-world, land-based ecosystem? They should say the real-world, land-based systems are open and dependent upon rainfall. There is no recycling of water, as is the case in the closed terrarium.
- Place two more columns on the board/easel labeled, Similarities and Differences.

Pre-assessment

N/A

Teaching and Learning Activities (30 minutes)

1. Hand out the tables entitled **Student Table for Comparing the Virtual Mini-pond** and **Terrarium Ecosystems** and **Student Table for Comparing the Virtual Mini-pond and Real-world Ecosystems**.

2. Brainstorm with students the similarities and differences between the model ecosystems, virtual mini-pond and terrarium.

3. Instruct students to fill out the table at the same time as you are filling out the columns on the board.

4. The overall purpose of these activities is to flesh out the major similarities between all ecosystems and, in doing so, to probe students' understandings of the major concepts presented thus far in the unit.

5. For instance, the columns may look like the following upon completion of the brainstorming session:

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Similarities of Virtual Mini-Pond & Terrarium	Differences between Virtual Mini-Pond & Terrarium
1. Contain living things	1. Terrarium has no liquid water
2. Contain non-living things such as water, air and soil	2. They contain different organisms.
3. They have interactions between the living and non-living things.	3. Plants can live underwater in the pond and plants in the terrarium cannot.
4. Organisms are dependent on each other and on the non-living things in the ecosystems.	4. Mini-pond does not have leaves decaying.
5. They cannot survive without our help.	5. Pond has animals
6. They use sunlight for plants to grow and live.	6. The pond has no evidence of decay over time whereas the terrarium does.
7. They have a food chain.	7.The changes in the pond ecosystem are slower and less obvious than the changes in the terrarium.
8. They have producers and consumers.	
9. They have preferred places for organisms to live.	
10. They have no visible decomposers.	
11. They change over time	

6. When students provide a similarity like #1 above, ask them questions like "What type of living things?" "Is it a carnivore or herbivore?" "What is its role in the ecosystem?"

7. When #5 is brought up, be sure to discuss the idea that the virtual mini-pond and terrariums are models that aid in the study of ecosystems, but that they have certain limitations. Discuss the advantages and disadvantages of using these models. Advantages: convenient, easy to build and study. Disadvantages: lack of the diversity contained in real-world ecosystems, lack of the complexity of real-world ecosystems, lack of the full extent of interactions.

8. Repeat this activity but instead have students brainstorm the similarities and differences between the virtual mini-pond and real-world pond ecosystems. Again use the vocabulary associated with ecosystems as a tool to help students communicate and clarify their understandings of the nature of ecosystems. A student response might be: "It does not have all the organisms in it that a real pond has." Follow this by a discussion of what organisms are missing and how each would affect the other organisms in the pond. In other words, what roles do they play? What pond organisms depend on these organisms? If you wish using the same website, visit pond food chains. This page graphically demonstrates what happens in a food chain when one organism is eliminated. Another difference that a student may note is that real ponds are much deeper. Take this response and perhaps talk about the fact that the organisms in our virtual mini-pond would receive much more light than the organisms at the bottom of a real pond might receive. Link this to a discussion about plants' needs. Would they be found on the bottom of a deep pond? Near the shallow edges or surface? Instruct students to fill out the table at the same time as you are filling out the columns on the board. The finished columns may look something like this:

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Similarities of Mini-pond to Real Pond	Differences between Mini-pond & Real Pond
1. They contain living things.	1. Mini-pond is much smaller than a real pond.
2. They contain non-living things such as water, air and soil.	2. Mini-pond contains a greater number of living and non-living things.
3. They have interactions between the living and non-living things.	3. Mini-pond contains less of a variety (diversity) of living and non-living things.
4. They have living things that are dependent on other living things and on the non-living things in the ecosystems.	4. Mini-pond has interactions because there are fewer living and non-living things.
5. They cannot survive without our help.	5. Mini-pond cannot survive on its own. It is not stable.
6. They use sunlight for plants to grow and live.	6. Mini-pond has no weather affecting it.
7. They contain animals that eat plants.	7. Mini-pond has few food chains.
8. They have food chains.	8. Mini-pond has no webs.
9. They have producers and consumers.	9 Mini-pond has fewer places for organisms to live.
10. They have preferred places for organisms to be.	10. Mini-pond does not have visible composers.

Products and Assignments

- Students' **Conclusions Regarding the Terrarium Observations** sheets
- Students' **Descriptions of a Virtual Mini-pond** sheets
- Documentation (transparencies, butcher-block paper) of students' terrarium observations
- Students' tables of similarities and differences

Extension Activities

N/A

Post Assessment

N/A

Debriefing and Reflection Opportunities (5 minutes)

1. Reiterate to students how the virtual model mini-pond is helpful in understanding the activities and interactions of organisms in a real pond. Push students to understand that scientists use models to help them better understand nature because of convenience and expense, but that it is preferable to study all aspects of nature directly.
2. Ask students: What did they learn from the model ecosystems? They might say things like "They taught us that an ecosystem has to have living and non-living things to survive" or "Ecosystems contain organisms that interact with their environment and sometimes with each other" or "Organisms depend on each other."
3. Ask students: What were you not able to learn from the model ecosystems? They might say, "the virtual mini-pond did not show us how many different kinds of organisms are in a real pond" or "the virtual mini-pond had no fish so we could not learn what they need to survive in a pond" or "the mini-pond did not show us all the different places organisms can live in a real pond."
4. Recap some of the similarities and differences in experiences that students had regardless of ecosystem discussed. Emphasize that all ecosystems have living and non-living things and that concept of interdependence is a critical aspect of healthy ecosystems.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name_____ **Date**_____

Student Table for Comparing the Mini-pond and Terrarium Ecosystems

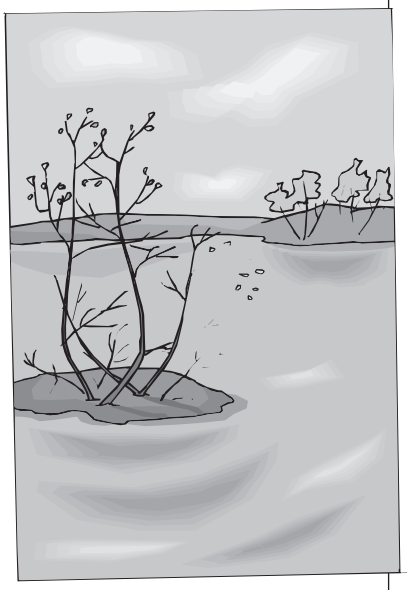
Similarities of Virtual Mini- Pond to Terrarium	Differences between Virtual Mini-Pond & Terrarium
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.
11.	11.

Name_____ **Date**_____

Student Table for Comparing the Model Mini-pond and Real-world Ecosystems

Similarities of Virtual Mini-Pond to Real Pond	Differences between Virtual Mini-Pond & Real Pond
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.
11.	11.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



Description of Virtual Mini-pond

Your virtual mini-pond is in a jar with sand or pond silt on the bottom. It is filled with pond water, has a few pond plants, and has seven organisms you have chosen from a virtual pond dip. For each organism, list its name and three facts about it (size, place on food chain, life cycle, breathing process, or any other fact that you found interesting in the virtual dip). Take good notes as the sheet will be your guide to some other activities in the lesson.

1.

2.

3.

4.

Food Chains and Food Webs

5.

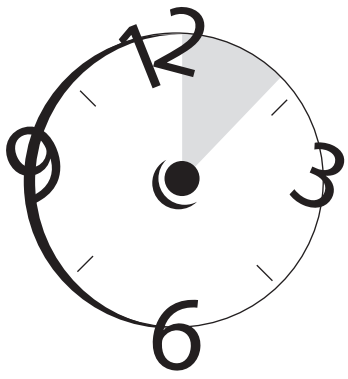
6.

7.

Food Chains and Food Webs

Core

Time Allocation: 45 minutes
Required Materials and Resources on Page 206



Lesson Overview

Students will be assessed on their understanding of the terrarium as a mini-ecosystem and their understanding of food chains and food webs.

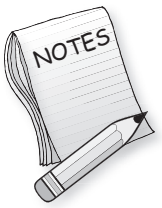
Guiding Questions

- Do you understand the basic components of ecosystems?
- Can you identify and describe the interdependence of organisms in the terrarium "mini-ecosystem"?
- Can you construct a food web and differentiate between producers, consumer, carnivores, herbivores and omnivores?

BIG IDEA

Constructing a Food Web

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



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

- Organisms have dependent and interdependent relationships that enhance survival.
- Ecosystems have producers, consumers and decomposers which have different functions in the ecosystem.
- Environmental changes occur for various reasons and at varying rates and can affect the survival of organisms in an ecosystem.

Concepts

- Ecosystem
- Environment of non-living things
- Organism
- Microorganism
- Interdependence
- Survival
- Producer
- Consumer
- Decomposer
- Food chain
- Environmental conditions
- Environmental change

Teacher Information

N/A

Food Chains and Food Webs

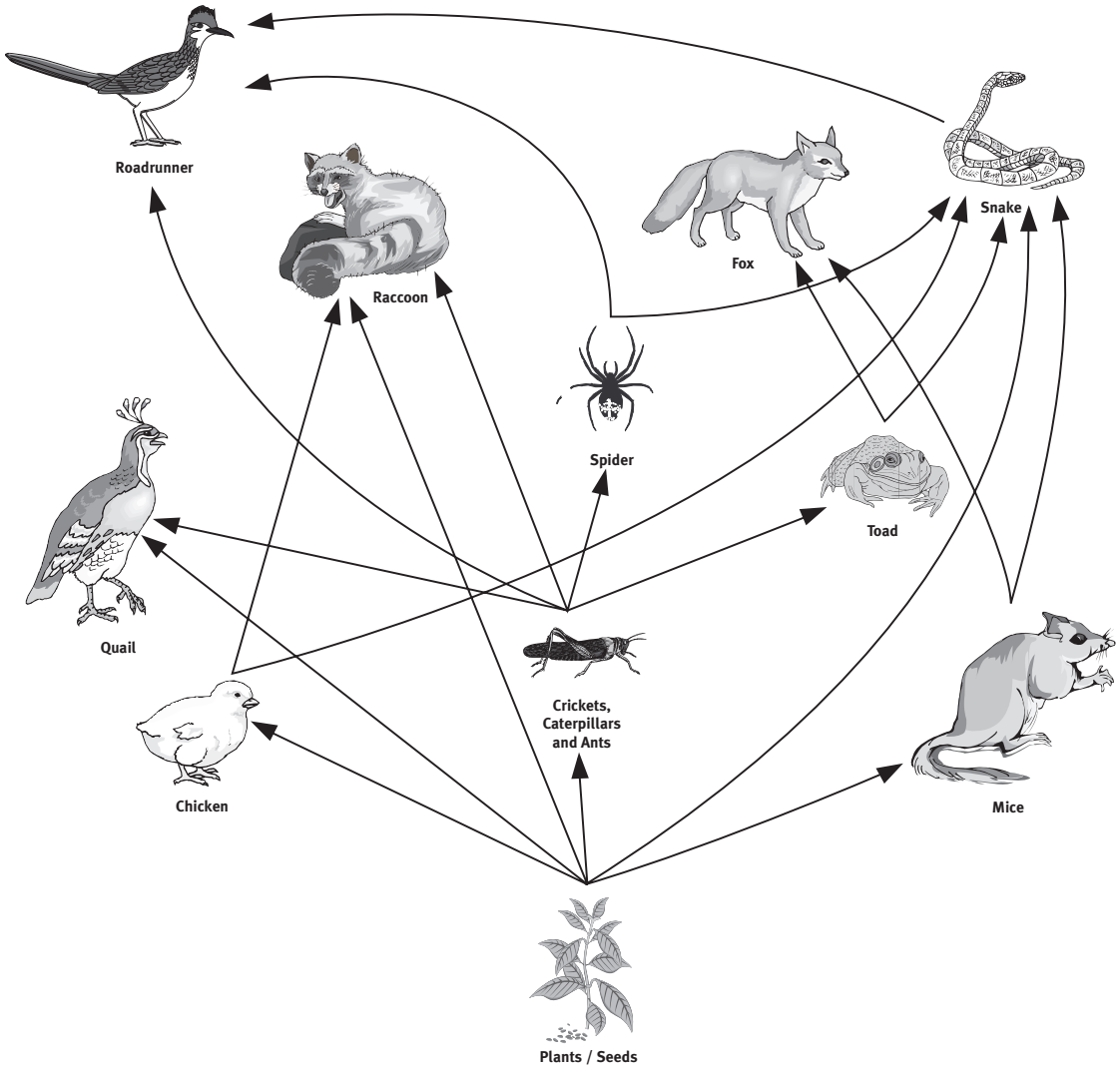
Skills

- Recognize attributes
- Organize
- Sequence
- Identify missing information
- Identify relationships

Materials and Resources

1. Students' **Terrarium Observations** sheets from Lesson 9
2. The **Concept Map Rubric** on pages 98 and 99 can be used to assess students' concept maps.
3. A sample concept map that a student might produce is seen on page 96. It is a more inclusive sample than one that most students will probably produce, as it contains 23 concepts and links. It is one of many approaches to building a representative map of the components of and relationships in a terrarium. What students should be able to include is the idea that ecosystems have both living and non-living components and that there are interactions between them. They should also be able to demonstrate that ecosystems change over time and that these changes are a result of the interactions between living and non-living things, a result of needs of living things.
4. Resources for students to use as they create their food webs for the take-home assessment assignment
5. A great resource for the Arctic ecosystem is the article "Incredible Shrinking Polar Bears" published in the February/March 2004 issue of *National Wildlife* magazine.
6. Copies of **Can You Weave a Wonderful Web**? for students – An example of a possible food web is presented below.

Possible Student Homework Assessment Results



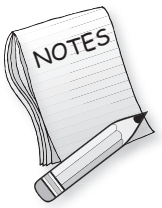
Food Chains and Food Webs

Preparation Activities

Make copies of the **Mini-ecosystem Assessment** (page 95) one for each student

Introductory Activities (5 minutes)

- Provide students with time to observe and record their observations of the terrarium. Tell them this will be the last formal observation, but encourage them to continue making observations on their own time and to share any significant happenings that they observe with their classmates as the year progresses.
- Hand out the **Mini-ecosystem Assessment** (page 95).
- Share with students they will use their **Terrarium Observations** sheet to assist them to develop a concept map that demonstrates their understanding of the components and relationships in their terrarium ecosystem.



Pre-assessment
N/A

Teaching and Learning Activities (40 minutes)

1. Explain to students how they should complete the assessment. Make sure to answer any student questions.

2. Hand out and review the instructions for the **Can You Weave a Wonderful Web?** take-home assignment.

3. Review the assignment with the students. Again, answer any questions they might have.

4. Tell students it will be due in two days.

Products and Assignments
Students' terrarium assessment results

Extension Activities
N/A

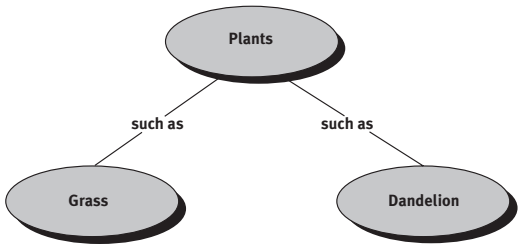
Post Assessment
N/A

Debriefing and Reflection Opportunities
N/A

Name _____ **Date**_____

Mini-ecosystem Assessment

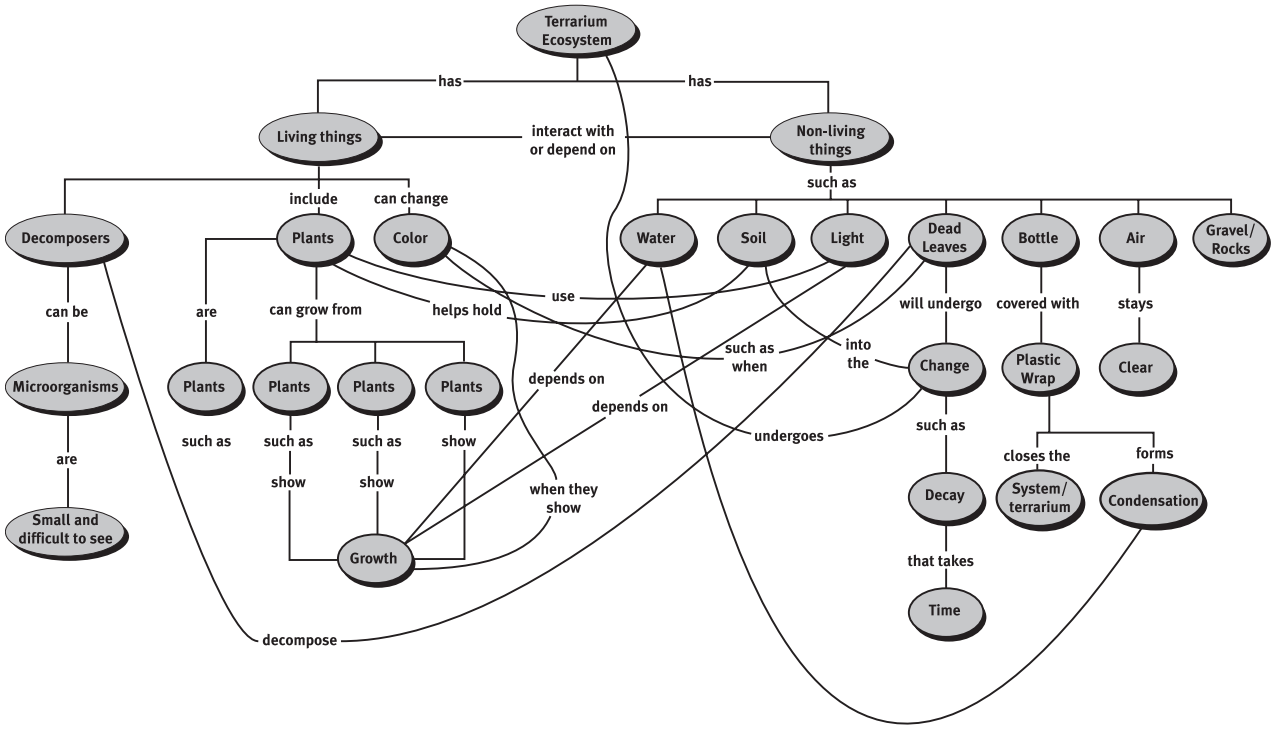
Use your Terrarium Observation sheet and draw a concept map that describes the components of your terrarium and the interactions that occur between those components. Your map must include at least 15 concepts (circles) filled in and at least 15 links that describe the relationships between the concepts that are linked. For instance the concepts of "plants," "grass," and "dandelions" could be linked by the words "such as" and look like the following:



Draw your map below

Terrarium Ecosystem

Example of a Concept Map for the Terrarium Ecosystem



Name _____ **Date**_____

Can You Weave A Wonderful Web?

Instructions:

1. Use the following 11 organisms listed below and draw a food web. Use an encyclopedia or other library resources to assist you in determining the food source relationships in your web.
2. Identify one carnivore, herbivore and omnivore.
3. Label one producer and one consumer.
4. Circle a single food chain within the food web you draw.

Food Web Organisms

- Plants/seeds
- Fox
- Baby chicks or chick eggs
- Spiders
- Snake
- Mice
- Raccoon
- Quail
- Toad
- Crickets/caterpillars/ants
- Roadrunner

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date** _____

Concept Map Rubric

Criteria	1	2	3	4	Your Score
Content – the Conceptual Objective	The concept map does not convey the logical relationships among the conceptual components.	The concept map has some illogical connections or unconnected symbols that obscure the relationships among conceptual components.	The concept map in general shows the logical relationships among most components but has some omissions.	The concept map captures all the logical relationships among all the conceptual components.	1 2 3 4
Content – Required concepts	The concept map contains less than 15 concepts and they poorly reflect the range of physical and biological components in the ecosystem.	The concept map contains less than 15 concepts. However, they demonstrate for the most part the range of physical and biological components in the ecosystem.	The concept map contains at least 15 concepts. However, they do not completely demonstrate the range of physical and biological components in the ecosystem.	The concept map contains at least 15 concepts and they demonstrate the complete range of physical and biological components in the ecosystem.	1 2 3 4
Content – Required links	The links are incomplete and do not always accurately describe the relationships among the conceptual components.	Some of the links are missing but most accurately describe the relationships among the conceptual components.	The links are complete and for the most part accurately describe the relationships among the conceptual components.	The links are complete and accurately describe the relationships among the conceptual components.	1 2 3 4

Name _____ **Date** _____

Criteria	1	2	3	4	Your Score
Overall Design – Appearance	The appearance of the concept map seems so overwhelming that the reader is likely to say, "Tell me what this is about."	The appearance of the concept map is cluttered, confusing and can discourage the reader from further study of the contents.	The appearance of the concept map is somewhat cluttered and requires some effort by the reader to grasp the subject and the meaning.	The appearance of the concept map is uncluttered and instantly conveys subject and meaning to the reader.	1 2 3 4

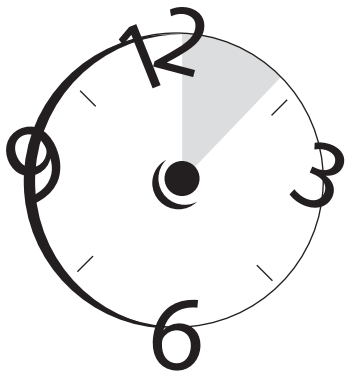
Name _____ **Date** _____

Criteria	1	2	3	4	Your Score
Symbol Size		Under use of the symbol size, shape, color, labels and position reduce the impact of the diagram on the reader.	Overuse of symbol size, shape, color, labels and position reduce the clarity of the diagram.	Thoughtful and sensible use of symbol size, shape, color, labels, and position to engage reader and convey meaning.	1 2 3 4

Adaptations

Core

Time Allocation: 45 minutes
Required Materials and Resources on Page 206



Lesson Overview

Students will discuss types of adaptations: structural, physiological and behavioral. The relationship between form and function will be explored as students identify, compare and contrast types of adaptations. Students will continue to investigate the relationship between habitats and adaptations. They will explore a range of diverse habitats and will discover the significant variety in adaptive structures and behaviors that exist in nature.

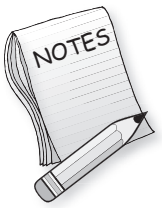
Guiding Question

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

BIG IDEA

Habitats and Adaptations

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



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

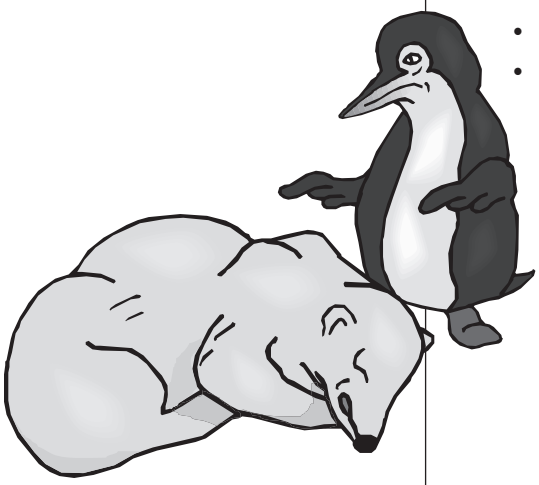
- Features that help an organism survive are called adaptations.
- Structural, physiological and behavioral adaptations affect the survival of organisms.

Concepts

- Survival
- Adaptation
- Form and function
- Structural adaptation
- Physiological adaptation
- Behavioral adaptation

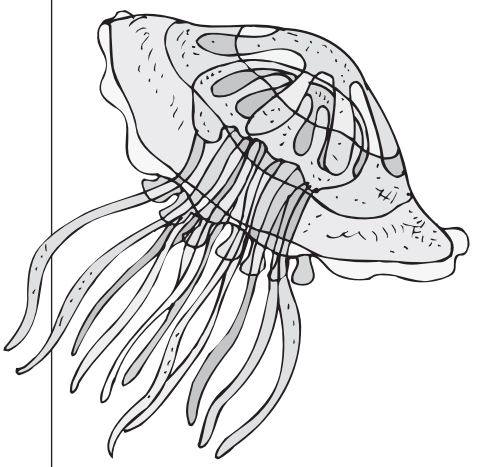
Teacher Information

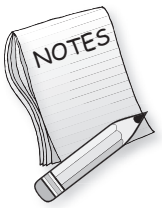
- There are three types of adaptations: structural, physiological and behavioral.
- Behavioral adaptations can be instinctive and learned.
- Examples of structural adaptations are as follows:
  - o Animals are colored in such a way as to camouflage them. For instance, toads' brown rough skin help them blend in with the ground, polar bears blend with the snow, tigers blend with tall grasses, scorpion fish blend in with the sea floor bottom, the living stone plant blends in with rocks, the hawkmoth caterpillar looks like a poisonous snake, and the goldfinch's yellow color helps protect it while it feeds on the seeds of the coriopsis yellow daisy.
  - o Leaves on pine trees like the spruce are thin, long and narrow, thus enabling the tree to withstand cold climates and harsh winds.



- o Some jellyfish have gas-filled areas similar to sails that assist them in floating.
- o Four-eyed butterfly fish fool predators with color. Its true eyes are camouflaged in black stripes on its head but it has two large false eye spots on its tail. The false eyes may confuse predators. Mistaking these for the true eyes, a hunter is likely to attack the eyespots and miss the fish's head, allowing the butterfly fish to escape capture.
- o Tropical plants have broad leaves to catch as much sun as possible, as they are found on the forest floor under the shade of much taller trees.
- o Birds have special structural adaptations to assist them in flight such as strong wings and light bones.
- o Birds have beaks that are especially adapted for obtaining the food they eat (e.g., the kingfisher has a dagger-shaped bill to spear fish).
- o Birds of prey have long, sharp talons to assist in the capture of prey.
- o Fish have gills that allow them to survive in water and still obtain the oxygen they need.
- o Nurse sharks "taste" along the ocean bottom with fleshy whiskers called barbels. When they detect a tasty crab or spiny lobster hidden in the coral, they open their mouths and suck their prey from its hiding place. They have flat teeth and powerful jaws for grinding and crushing shells.
- o Mayflies have flattened and streamlined bodies to withstand the strong currents in streams. Some Rhithrogena have an abnormally developed gill, which forms a sucker to allow them to cling onto smooth surfaces.
- o Catfish have flattened bellies that assist them to live on the bottom of lakes. They have eyes on the dorsal side (top) and ventral (bottom) suckers or friction pads to attach to smooth surfaces in currents.
- o Herons have wide toes that prevent them from sinking in the mud.
- o Cacti have thick waxy coverings that reduce the loss of water and long, shallow roots that absorb rainwater quickly.
- o Plants have thorns and irritating chemicals as protective structural adaptations.
- o Toads have poison glands that release a bad-tasting liquid so that animals that capture them will spit them out.

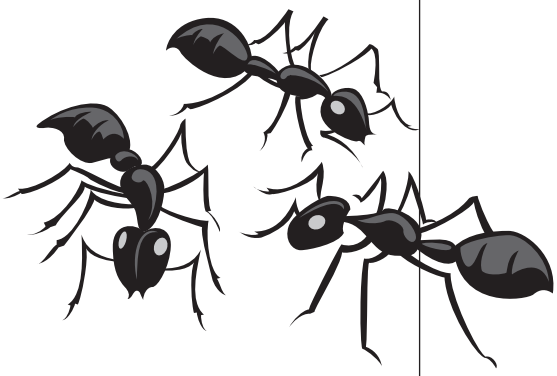
- Examples of physiological adaptations are:
  - o A chameleon that camouflages itself by quickly changing its color to blend in with the surrounding environment.
  - o Some animals can sweat or shiver.





- o Some plants can close up in drought conditions.
- o Some animals can produce light.
- o Seals can shut down the oxygen supply to their extremities.
- o The Venus flytrap and mimosa plant respond to stimuli and close in around their prey.
- o The Ptarmigan (a bird from Alaska and Canada) has feathers that change from brown speckled in the summer to white in the winter, temperature being the stimulus and the color change being the response

- Examples of behavioral adaptations are:
  - o Some beetles that live in deserts like the Namib in Africa stand on their heads at night to collect water.
  - o Toads puff up their bodies so they become too big for some snakes to swallow.
  - o Puffins fly in groups when they leave the nest to feed to better avoid predators. This behavioral adaptation is also seen when sea lions leave in groups to feed to more effectively avoid predation by sharks.
  - o A burrowing owl makes a hissing noise like a snake to scare away predators.
  - o Migration is an instinctive behavioral adaptation.
  - o The behavior of ants, the workers, drones, and queen vary and are instinctive.
  - o Certain birds like the killdeer and the plover pretend to be injured when they or their young are in danger.
  - o Birds building nests is an example of instinctive behavioral adaptations.
  - o Spiders spinning webs is instinctive behavior that enables these organisms to capture food.
  - o A covey of bobwhite quails roosts in tight circles at night for defense against predators and the cold.
  - o Portuguese man-of-war use stingers for protection.
  - o An example of learned behavioral adaptation is bears learning that there is food associated with the presence of humans.



Skills

- Recognize attributes
- Identify relationships
- Compare and contrast
- Judge the accuracy of information

Adaptations

Materials and Resources

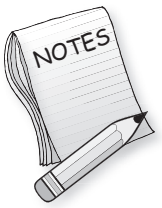
1. The book *You Won't Believe Your Eyes* written and published in 1987 by National Geographic Society contains beautiful pictures and plentiful information on the subject of camouflage and mimicry in the fourth chapter, "When Nature Fools the Eyes." This chapter's references to organisms from all over the world provide a starting point for research opportunities for those students who need additional challenge in the area of adaptations.
2. The site below has lesson plans on adaptations: http://www.sciencenetlinks.com.
3. The National Wildlife Federation at http://www.nwf.org has excellent information on ecosystems, such as the wetlands. Click on Kids Zone. Click on Cool Tours and then click again on Wetlands. This could be used to provide good information for your introduction to a camouflage as one type of adaptation.
4. (Optional) The video *Eyewitness Pond & River* combines good information with special effects that students will enjoy.
5. The following site offers information on adaptations of organisms to fast flowing waters: http://users.aber.ac.uk/mjll/page2.html
6. A general list of biology website references for both students and teachers is located at http://www.ncsu.edu/imse/1/ecology.htm.

Preparation Activities

- Make copies and hole-punch the **List of Adaptations**, one for each student.

Introductory Activities (15 minutes)

- Collect the students' **Can You Weave a Wonderful Web?** take-home assessment activity
- Invite students to think about the size, shape, and coverings of animal bodies. In a large group brainstorming session, ask students to list the animals whose bodies reveal clues about where they live.
  a) A water strider has wide pads for feet so it can lower the pressure (force per unit area) and "walk on water" by not breaking the water's surface tension.
  b) A beaver's sharp teeth for gnawing trees and its large flat, rudder-like tail indicate it must be associated with water that is near trees.
  c) Animals with oil "jackets" live in water (e.g., duck and otter).
  d) Animals with webbed feet often live in water environments.



e) A burrowing animal, like a mole, has front legs that are like paddles that help it shovel and "swim" through soil at very fast rates. Its fur can lie forward or backward allowing it to move easily in either direction.

f) A badger has large curled front claws that make it easy for it to dig through soil.

g) A pocket gopher has two major features that assist it in building its home. It has strong curved claws and curved front teeth, for chewing out its burrow, with flaps of skin to prevent the dirt from entering its mouth.

- In a think-pair-share, ask students to describe what they think are other examples of animal adaptations. List these on the board and add some of your own (see Factual Information on p. 2-3).
- Introduce the idea that adaptations can be categorized into three different kinds: structural, physiological and behavioral. Use the student-provided examples on the board or others you provide (See the Teacher Information section above) to distinguish between the three kinds of adaptations. Engage students in a discussion about the value of categorization. When we categorize, we are able to better understand our world.
- Talk about the sensory adaptations that animals have that are usually structural in nature.
  For example, snakes use their tongues for body scent and use heat receptors on the margins of the lips to detect prey. Flies taste with hairs around their mouths, moths have sensory hairs on feathery antennae to detect chemicals, and squid have large eyes that enhance their vision.

Pre-assessment

N/A

Teaching and Learning Activities (25 minutes)

1. Give students the handout, **List of Adaptations**.

2. Explain to students that they will be using their new knowledge to categorize a list of adaptations.

3. Tell students to put an "S" next to an adaptation that is structural, "P" next to an adaptation that is physiological and a "B" next to those that are behavioral in nature.

4. Circulate to check students' progress and answer questions they may have about the activity.

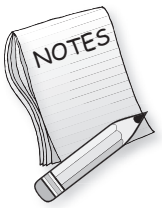
Products and Assignments
N/A

Extension Activities
N/A

Post Assessment
N/A

Debriefing and Reflection Opportunities (5 minutes)
Solicit questions that students may have related to the types of adaptations. Using Socratic questioning, guide students to see the differences among the three types of adaptations. Share with students that they will be finishing their list of adaptations in the next lesson.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



Name _____ **Date**_____

List of Adaptations

1. I live in water, but can survive out of water for many hours because my limestone doors can close, keeping me from drying.
2. When submerged, I reach out and wave my legs to pull nutrient-filled water into my mouth.
3. When first born, I move about in the water; when older I stay in one place. I use a special adhesive to glue myself to a rock, a boat, or a whale.
4. I create my own limestone house from materials that I filter from the water.
5. My leaves have a waxlike coating that limits water loss through evaporation.
6. I have tiny, needlelike leaves that contain very little moisture to freeze in winter.
7. Pointy, thin leaves and sturdy, flexible branches keep snow from weighing me down.
8. My buds contain a chemical and are covered with a protective layer to keep them from freezing.
9. My feet are webbed and used for steering.
10. I wear a matted feather coat that keeps out wind and water.
11. Blubber helps keep my body heat inside.
12. I have wings that I use for flippers.
13. My accordion-like stems expand to hold great volumes of water.
14. My root system is widespread and shallow for absorbing water.
15. My thick skin limits evaporation, reducing water loss.
16. I have a spiny skin to prevent other organisms from trying to get my stored water.
17. I am able to drink great volumes of water and store it in the fat cells of my body.
18. I sweat and urinate rarely, and do not pant or breather rapidly (to reduce evaporation)

19. Fat stored in my hump is broken down for energy and in the process, water, which I can use, is released

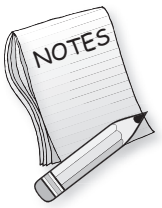
20. I swim constantly to stay in one place where I live.

21. I lay my eggs in ditches and cover them with sand.

22. I am smooth and slippery, with fins and a large tail.

23. I breathe using gills, which take oxygen from water.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



Name _____ **Date**_____

Answer Key for List of Adaptations

1. I live in water, but can survive out of water for many hours because my limestone doors can close, keeping me from drying. **P**

2. When submerged, I reach out and wave my legs to pull nutrient-filled water into my mouth. **B**

3. When first born, I move about in the water; when older I stay in one place. I use a special adhesive to glue myself to a rock, a boat, or a whale. **B**

4. I create my own limestone house from materials that I filter from the water. **B**

5. My leaves have a waxlike coating that limits water loss through evaporation. **S**

6. I have tiny, needlelike leaves that contain very little moisture to freeze in winter. **S**

7. Pointy, thin leaves and sturdy, flexible branches keep snow from weighing me down. **S**

8. My buds contain a chemical and are covered with a protective layer to keep them from freezing. **S**

9. My feet are webbed and used for steering. **S**

10. I wear a matted feather coat that keeps out wind and water. **S**

11. Blubber helps keep my body heat inside. **S**

12. I have wings that I use for flippers. **S** structural if you think the wings are structures that have evolved over time to also serve as flippers or **B** behavioral because they have "learned" to use the wings as flippers.

13. My accordion-like stems expand to hold great volumes of water. **S**

14. My root system is widespread and shallow for absorbing water. **S**

15. My thick skin limits evaporation, reducing water loss. **S**

16. I have a spiny skin to prevent other organisms from trying to get my stored water. **S**

17. I am able to drink great volumes of water and store it in the fat cells of my body. **P**

18. I sweat and urinate rarely, and do not pant or breather rapidly (to reduce evaporation). **P**

19. Fat stored in my hump is broken down for energy and in the process, water, which I can use, is released. **P**

20. I swim constantly to stay in one place where I live. **B**

21. I lay my eggs in ditches and cover them with sand. **B**

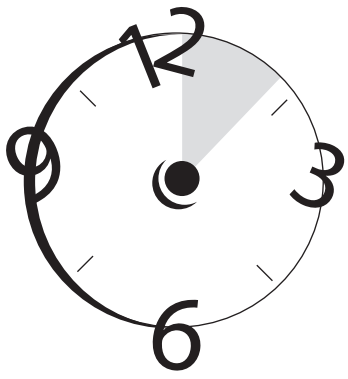
22. I am smooth and slippery, with fins and a large tail. **S**

23. I breathe using gills, which take oxygen from water. **S**

Adaptations

Core

Time Allocation: 1 hour 30 minutes
Required Materials and Resources on Page 206



Lesson Overview

Students will extend their understanding of adaptations in this lesson. They will finish the adaptation activity and further explore the concept of adaptation by playing a schoolyard game that revolves around the adaptation of camouflage. Camouflage is a protective adaptation that is used by organisms in many different ecosystems. The game serves to reinforce the idea that organisms living in a specific ecosystem must be well adapted to their environmental conditions.

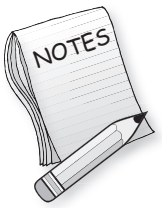
Guiding Questions

- How do animals' varying features help them to survive?
- What are the advantages and disadvantages of having specific adaptive features or behaviors?

BIG IDEA

Camouflage

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



Content Goals

Universal Themes

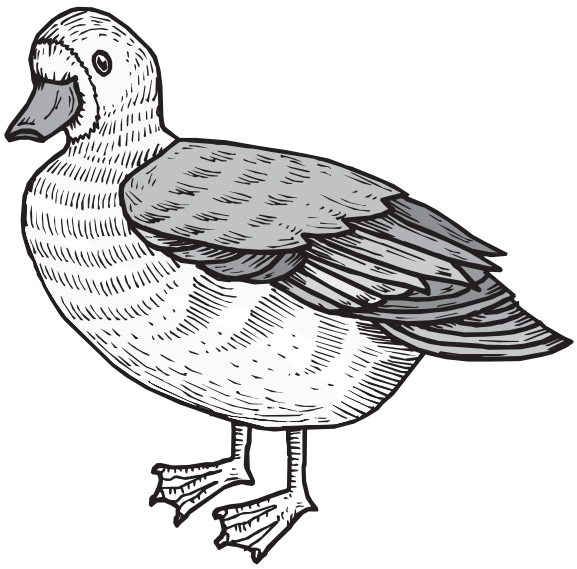
- The natural world is composed of systems, which are organized groups of related objects that together form a whole.
- Form and function are complementary aspects of objects, organisms and systems in the natural world. Form and function are interdependent.
- Properties of some objects and processes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

Principles and Generalizations

- Structural, physiological and behavioral adaptations affect the survival of organisms.

Concepts

- Survival
- Habitat
- Adaptation
- Form and function
- Structural adaptation
- Physiological adaptation
- Behavioral adaptation



Teacher Information

N/A

Skills

- Make observations
- Recognize attributes
- Identify relationships
- Compare and contrast

Materials and Resources

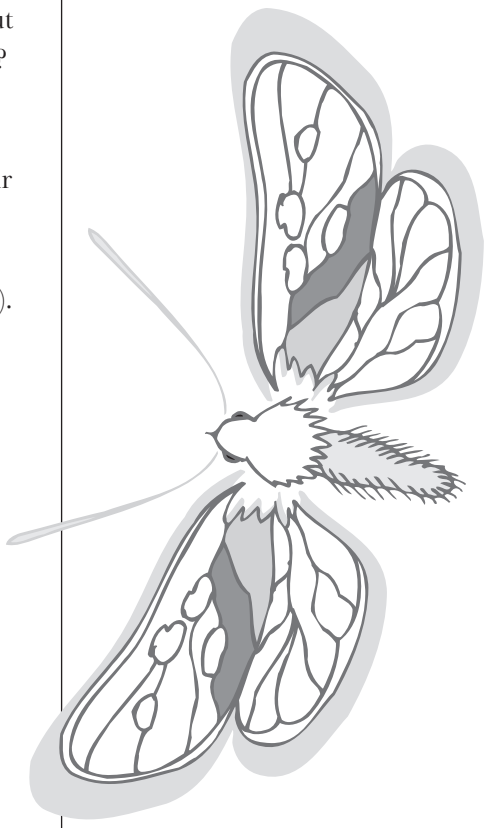
Various art materials such as paper, coloring markers or crayons, scissors, glue, tape, and pipe cleaners.

Preparation Activities

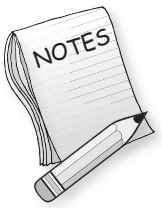
Find places for student groups to hide their organisms and mark off separately for each group. Do not make these areas too big.

Introductory Activities (10-15 minutes)

- Have students finish their **List of Adaptations** (Lesson 11).
- Convene students as a whole group and engage them in a discussion about their work. Which adaptations were structural? Physiological? Behavioral? Were there different opinions? Why might this have happened? Have students sharing their thoughts as to the nature of the adaptations on the list. It is important to tell students not to worry if they made errors in their efforts to identify the types of adaptation. What is important is the idea that they recognize that organisms have adaptations that are suited to the environment in which they live and that assist them with survival (Day 22).
- Continue with the discussion by asking students if there are any disadvantages to having specific adaptive features or behaviors. They should be able to suggest that if an organism's environment changes for any reason, the organism may not be suited for the new conditions. The example of what happened to the gray-colored peppered moth population in England during the Industrial Age could be used. The gray-colored moth population was predominant in England before 1850 because of its successful camouflage. It hid on tree bark, splotched with pale-colored lichens. Black peppered moths were rare at the time. The onset of the Industrial Revolution, accompanied by a host of factories, saw a decline in the gray peppered moth population. Birds, predators of the gray-colored moths, could spot them against the dark soot. Within 50 years the gray peppered moth population had all but disappeared.
- **SEARCHLIGHT:** If there are students who have a great deal of prior knowledge about adaptations or who display interest in the topic, invite them to conduct more in-depth research about this moth or other organisms that did or did not make adaptations. Provide these students with opportunities to share their findings with the class in an oral report, a poster, a PowerPoint display or a format of their own choosing.



STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



Pre-assessment

N/A

Teaching and Learning Activities (65-75 minutes)

1. Convene students as a large group. Explain that they will be creating their own organism that has adaptations that allow it to "survive" in a schoolyard habitat (Day 12). Their challenge will be to create adaptations for an organism (e.g., appropriate coloring and other structural adaptations) that will prevent it from being found by its predators (classmates) (Day 12).

2. Divide the class into predator groups, about 2-4 students per group. Every group will be assigned a habitat (an area) in which their creature must live. The areas should be separated somehow so that the students know clearly where they can place their organisms. (Day 12).

3. Take students outside to the designated area (Day 12). Show each group its assigned habitat.

4. Explain to students that when they hide their organism, at least half of it must be visible. This restriction will prevent students from burying their organisms out of sight (Day 12).

5. Return to the classroom and tell students to start creating an organism that will have the best chance of survival when the predators come looking for their prey (Day 12).

6. Rove from group to group. Listen carefully to students' discussions and ask probing questions to scaffold their work: What structural adaptations does your organism have that will help it avoid predators in its habitat? What kind of physiological adaptation will be easiest to add as you design your organism? Some answers might be "My organism has many short legs to enable it to run quickly" or "I am coloring my organism dark green with light green specks so that it can blend in with the bush that is by the edge of the building" (Day 12).

7. Explain to students that they will be searching for the organisms all at once. As they find an organism, they are to come and tell you where they found it (Day 12).

8. Take the students outside to hide their organisms (Day 13).

9. Record the order in which the organisms were found for discussion purposes later.

10. Discuss with students whether some organisms were easier to find than others. With students, examine the order in which they were found. Invite and support a student discussion about the following question: Are some adaptations better than others in terms of hiding an organism from predators? (Day 13).

Products and Assignments

- Students' completed **List of Adaptations**
- Student-created camouflaged organisms

Extension Activities

N/A

Post Assessment

N/A

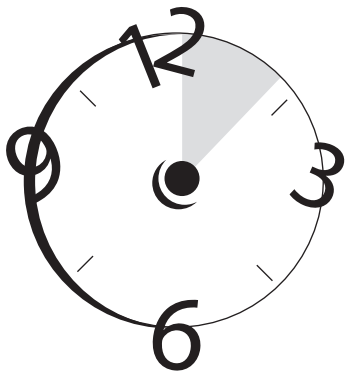
Debriefing and Reflection Opportunities (5-10 minutes)

Reconvene students in a large group. Review with them the different kinds of adaptations. Ask: What adaptations did the game illustrate? Is camouflage a structural adaptation? Physiological? Behavioral? What are the advantages for an organism of having specific adaptive features or behaviors? What are some possible disadvantages? Invite students to ask any puzzling questions about adaptations that have not been answered.

Adaptations

Core/AID

Time Allocation: 45 minutes
Required Materials and Resources on Page 206



Lesson Overview

Students further explore the concepts of habitats and adaptations by playing a game that has been adapted from *Project Wet*, called the "Salt Marsh Player." Students will be involved in a kinesthetic activity which will reveal to them how various plants and animals adapt to life in a tidal salt marsh. The activity serves to reinforce the idea that organisms must be well adapted for the environmental conditions if they are to survive.

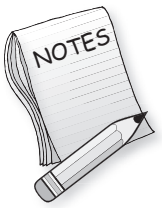
Guiding Question

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

BIG IDEA

Adaptation in a Salt Marsh

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



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

- Structural, physiological and behavioral adaptations affect the survival of organisms.
- Some organisms can be detrimental to an ecosystem (AID).

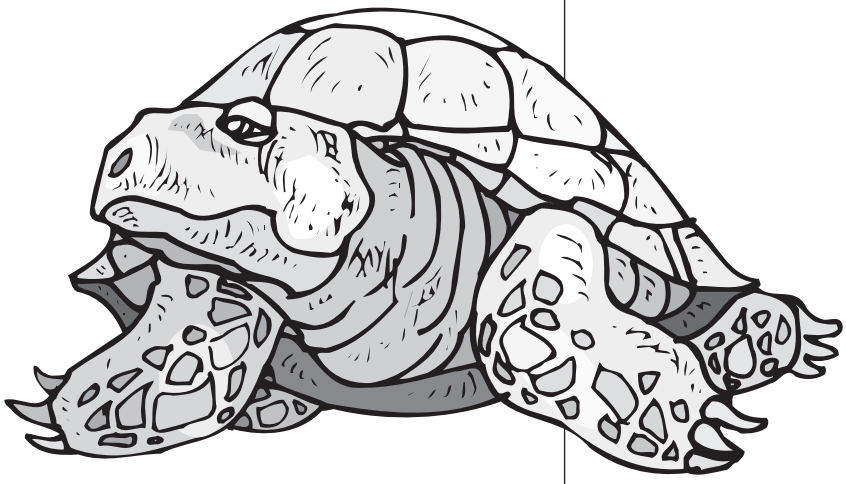
Concepts

- Interdependence
- Environmental factors
- Diversity
- Habitat
- Adaptation
- Environmental change
- Environmental stress (AID)
- Invasive organisms (AID)

Teacher Information

- High marsh is the area that is briefly covered with water each day by the tides.
- Low marsh is the area that is beneath the level of the tides for many hours each day.
- Subtidal zone is the area that is never exposed to the air.
- The high and low marshes make up the intertidal zone.

Adaptations



Skills

- Make observations
- Recognize attributes
- Recognize patterns
- Identify relationships
- Compare and contrast

Materials and Resources

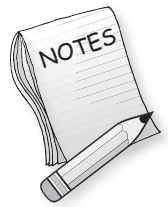
1. The following reference has information on projects associated with water ecosystems:

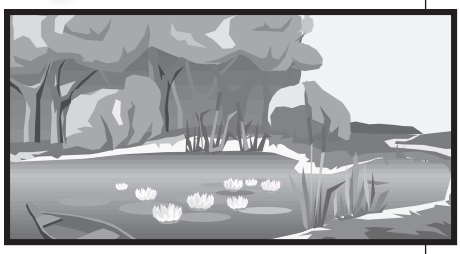
   Project WET: K-12 curriculum and activity guide. The Watercourse and Western Regional Environmental Educational Council, 1995.
2. The book *Aliens from Earth: When Animal and Plants Invade Other Ecosystems* by Mary Batten, published by Peachtree Publishers in 2003 is a beautifully illustrated picture book with simple but informative text about the significance of invasive species. It describes the history behind the invasions of such problematic species as the gypsy moth, killer bees and fire ants. All organisms are identified in the illustrations. It could be used as a "read-aloud" or as an introduction for the AID Extension Activity.
3. Two cardboard tubes (paper towel rolls)
4. One blue ribbon or cloth (12 - 20 feet long and 6-12" wide to serve as the ocean water. The wider the better, as it will behave more like waves if it has some width. Roll the ribbon on two tubes, like a scroll).
5. (Optional) Large bottle of soap bubbles and bubble maker wand
6. Diagram of salt marsh stage, i.e., placement of characters

Preparation Activities

1. Make and laminate pictures of the following salt marsh players: One cordgrass, one fiddler crab, one blue crab, two waters, one oxygen molecule, one striped bass, one worm, one marsh hay, one wind, one sun, one moon, one horseshoe crab, one periwinkle (salt marsh snail), one salt wort (sea pickle), one diamondback terrapin (turtle), one great blue heron, one clapper rail, one ribbed mussel, one raccoon, and one red fox
2. If there are more than 21 students in the class, make doubles of some of the marsh players.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?





Introductory Activities (15 minutes)

- Convene students as a whole class. Ask students if they have any questions related to the adaptations that organisms develop to help them survive.
- Share with students that they will be engaging in one more activity—a simulation—which will reveal how organisms do two things: (1) interact with their environment and (2) develop adaptations that optimize their survival in that environment.
- Show students the "Salt Marsh Player" Character Cards they will be wearing in this simulation. Also, explain a little about the simulation so that students have an idea how it will progress.
- Assign the 21 roles to students. Double up on roles if necessary.
- Continuing with the whole class grouping, have students identify and discuss what they know about each salt marsh organism.
- Engage students in a discussion of some of the stressful conditions in a salt marsh, i.e. mud, salt water and tides. Ask: Which animals get oxygen from water? Which ones get it from the air?

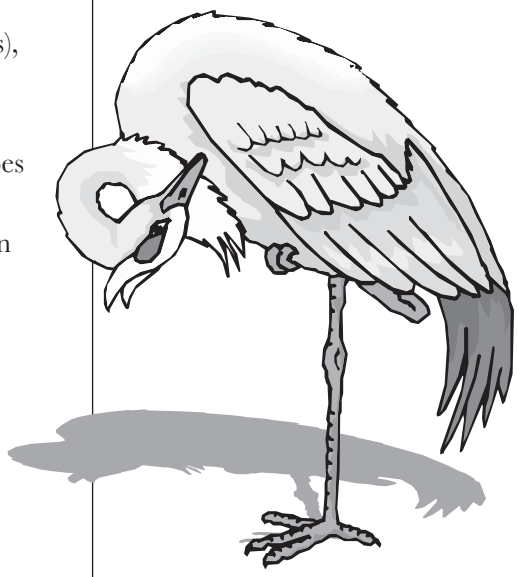
Pre-assessment

N/A

Teaching and Learning Activities (25 minutes)

1. Hand each student a "Salt Marsh Player" Character Card with an attached string which he or she can wear around his or her neck. Point out which end of the room represents the upland border of the marsh. The opposite end represents the sub-tidal zone and is bordered by a body of water (see diagram on page 6).

2. Ask the characters to read their cards silently and then take their low tide positions according to the diagram.
   - Tell the water characters to unscroll the water and stand 12 feet apart. Tell them that they will be making gentle waves with the ribbon water when instructed.
   - Tell the wind character(s) that they will be dancing and making wind-like sounds.
   - Tell the plant characters to assume the following positions: cordgrass stands and sways in the breeze, the salt marsh hay goes down on its knees and sways, and the salt wort crouches.



- Tell the following animals (blue crab, horseshoe crab, and striped bass), that they will be swimming with the water. As it moves forward and recedes, so do they.
- Tell the ribbed mussel to go down on its knees with arms closed. It does not move.
- Tell the worm, clapper rail, red fox, and raccoon and great blue heron that they will be walking and hunting.
- Tell the periwinkle snail and fiddler crab to crawl.
- Tell the diamondback terrapin to swim or walk.
- Tell the sun and moon characters to each stand on chairs.

3. Ask: What makes waves? Have the wind read his/her card.

4. Have the salt marsh plants read their cards.

5. Ask students: What makes the tides move in and out? Have the wind blow and make soft noises. Have the sun and moon read their cards while standing on chairs. You can tell students that when the sun and moon are in alignment, the highest tides are produced because of the gravitational pull they exert on the earth's waters.

6. Tell the oxygen character to enter the water blowing soap bubbles, if available.

7. Announce that the tide is rising!

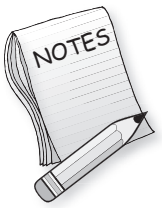
8. Tell the water characters to walk slowly into the high marsh, toward upland.

9. Tell the fish, blue crab, and horseshoe crab to follow water.

10. Tell the plants to stay rooted, to bend and sway and duck under the water scroll as it passes over.

11. Tell the fiddler crabs to plop down and make burrows.

12. Tell the periwinkle snails to pretend to climb up.



13. Tell the heron to walk to high marsh or flap its wings and fly away to the upland edge of room.

14. Tell the clapper rail to move a little closer to the upland.

15. Tell the worm to look for food and pretend to eat.

16. Tell the ribbed mussel to open its shell to take in water.

17. Tell the raccoon to walk quickly into the upland.

18. Tell the fox to run out of the marsh and into the upland.

19. Tell the terrapin that it should swim around or walk in any direction.

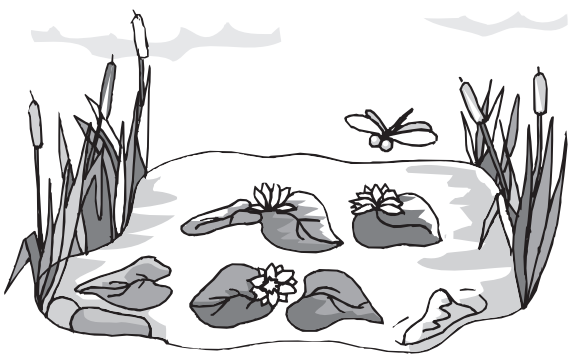
20. Announce that it is high tide! Now the water is retreating toward low tide position. All characters resume low tide positions and behavior.

21. Have students take their seats. Engage them in a discussion about how plants and animals in the salt marsh adapt to changes in their environment. Use questioning, if necessary, to ensure that students discuss what each organism did in the presence and absence of water. Discuss how crabs burrow into the mud when the tide recedes so they are protected. Discuss why the raccoon and fox leave the marsh when the tide rises. Discuss the habits of snails as the tide comes in i.e., they climb up the marsh hay to avoid drowning the rising tidal waters. Use Socratic questioning to ensure that students understand that each organism has adaptations that help it survive in the changing salt marsh environment.

22. **SEARCHLIGHT**: Make mental notes of students who display a heightened sense of enthusiasm for this topic of study. Invite these students to participate in the extension and/or AID activities that follow.

Products and Assignments

N/A



Extension Activities

1. Any student who is excited about the unit in general could go to the Missouri Botanical Garden site at www.mobot.org and explore river, stream, pond, lake and wetland ecosystems.
2. (AID) The Chesapeake Bay and its surrounding watershed provide ideal habitat for many organisms. Students can explore the concept of an "invasive organisms" by going to the web site www.chesapeakebay.net/baybio.htm Invite these students to compare and contrast fresh water ecosystems to the salt water ecosystem.

Post Assessment

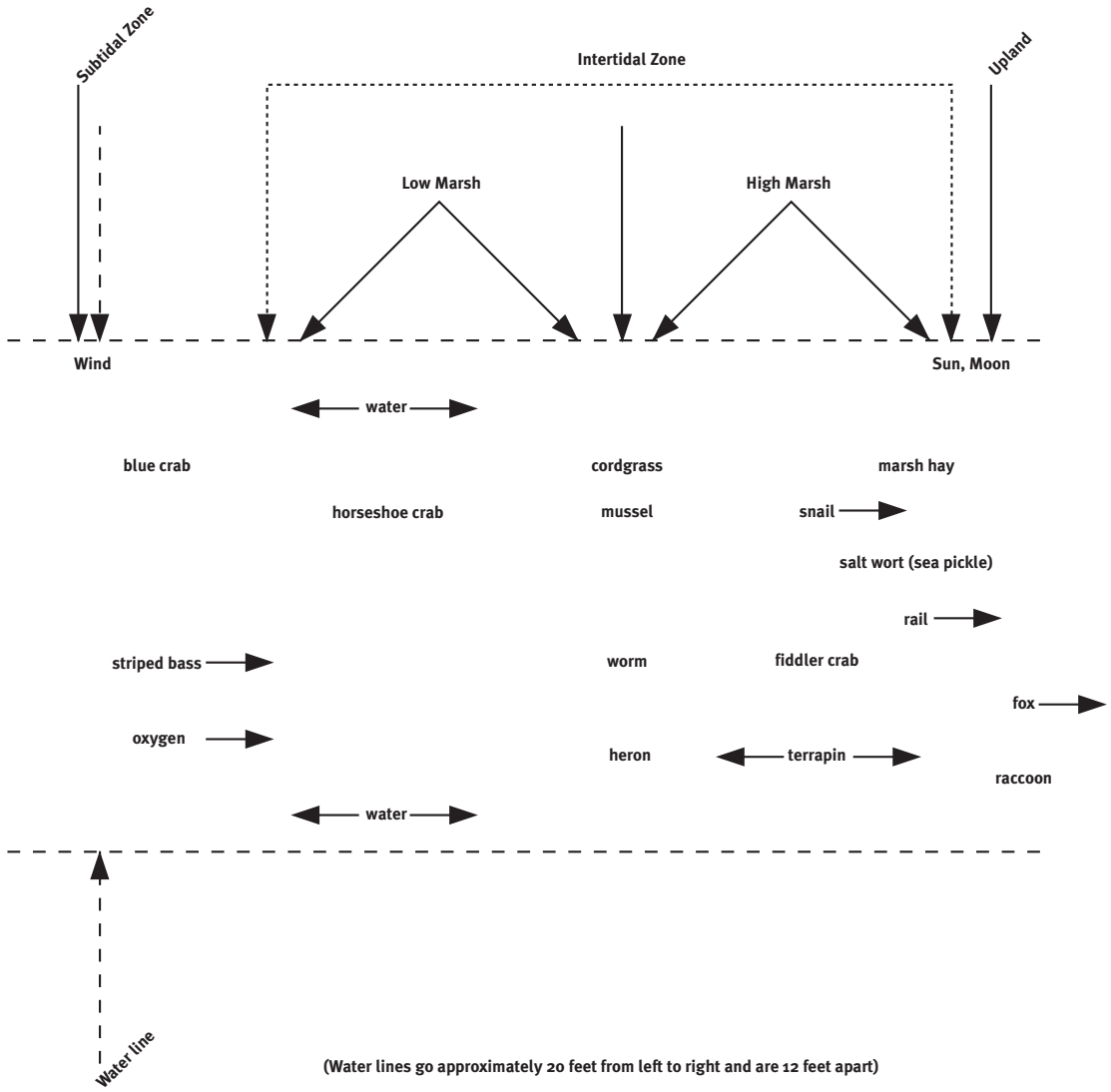
N/A

Debriefing and Reflection Opportunities (5 minutes)

1. This debriefing can be done as a large group or in small groups if there is enough time for both the small group discussion and a general sharing afterwards.
2. Pose the following question to students: How do people adapt to changes in environmental conditions? In what ways are people like the organisms in the salt marsh? People seek shelter when the environment has adverse changes (e.g., shortage of food, flood and drought) just as fiddler crabs seek shelter, as they burrow into the mud when the tide comes in.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

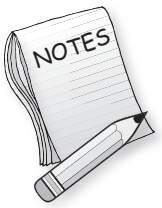
Salt Marsh "Stage"



(Water lines go approximately 20 feet from left to right and are 12 feet apart)

Salt Marsh Players	
Red Fox I am a mammal that does not live in the salt marsh, but I do come here to hunt rabbits, rodents, small marsh birds and eggs, and invertebrates. As the tide rises, I leave the marsh. I usually hunt in drier areas in winter.	**Cordgrass** I grow in the low marsh where the ground gets flooded by water for long periods of time each day. During the highest tides (spring tides) I might be completely under water. Since I am a rooted plant, I cannot move about except to sway with the breeze. I must tolerate salty sea water.
Raccoon Though I do not live in the salt marsh, I do come here to hunt for dragonflies, crabs, oysters, clams, fish and other good bits of food. I am not fond of swimming, so when the tide rises, I leave the marsh for higher ground.	**Sea Pickle (Saltwort)** I am a rather stiff, plump little plant that "crouches" down in the lower end of the high marsh, where I am alternately covered with water and exposed. I absorb a great deal of salt water, which gives me my fleshy appearance. I am considered a delicacy. Sea pickles make crunchy, salty addition to salads.
Moon I am the moon and I am the major force driving the tide! I create a gravitational pull as I rotate around the earth. This causes the water to "pile up," making a high tide, or to pull away from the shore, causing a low tide. I am about 70 percent responsible for the changing tide.	**Salt Meadow Hay (Salt Marsh Hay)** I am a grass, often called "marsh hay" because at one time I was harvested and fed to cattle. I grow in the high marsh where I get flooded for a few hours each day. When the wind blows, my neighbors and I sway softly, looking as though we were painted in water colors. At low tide, we lie in swirly cowlicks, with roots still in the mud.
Sun I am the sun and I help drive the tide! The sun's gravitational pull occurs as the earth rotates daily on its axis. This causes the water to "pile up," making a high tide, and then later to pull away from the shore, causing a low tide. I am about 30 percent responsible for the changing tide.	**Water** I am water and I am the tide. When it is time for the tide to rise, I move slowly into the low marsh, then up into the high marsh. At the high tide point, I stop and rest a minute, then turn in place and move slowly "out to sea."
Great Blue Heron I am a large, beautiful bird that wades gracefully in shallow water, hunting for food. With my long, pointed bill I snatch fish, crabs, water insects, and even small mammals out of the water. As the tide comes in, I move to higher parts of the marsh to stay in shallow water. Sometimes I just fly away.	**Oxygen** Water must contain gas to support all the living things that live in it. As the tide moves in and out, I move along just behind the water line, showering all things I encounter with bubbles. Bubbles are made by carbon dioxide gas that animals exhale or by oxygen given off by underwater plants.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



Striped Bass ("rockfish")
Like many kinds of fish, I use the marsh as a nursery area, a protected place to raise my young (called "fry" or "fingerlings" at different stages). My tiny offspring dart in and out of the marsh plants as they move with the tides. These hungry youngsters find lots of food here. (Remember, the fish filter oxygen from the water with gills.)

Wind
I help the sun and moon drive the tide in and out. If I blow very hard, I can force the water to come and go out farther than usual. I also add oxygen to the water, which helps to make the water healthy and keeps plants and animals alive.

Diamondback Terrapin
I am the only turtle that lives year-round in salty wetlands. I must breathe air, but I am really not affected much by tide, since I can swim to the surface and poke my head or nose out for a breath. I like to eat snails, crabs, worms, insects and fish, so I go where the food is.

Fiddler Crab
I run about the marsh at low tide, searching for bits of dead plants and animals to eat, which I shove into my mouth with my one large and one small claw (females have two small claws). I am an air breather, so when the tide comes in, I plop down into my mud burrow and shut the "door" (a mud ball) so I don't drown.

Sea Worm (clam worm)
I am a colorful worm who burrows in the mud in the sub-tidal zone or in the low marsh, where I build a tube out of sand. When the tide is high and my tube is underwater, I look for food, such as the soft insides of clams, dead fish or other small water animals. When the tide is low, I stay deep inside my tube.

Horseshoe Crab
I am really not a true crab at all. Some think that I am an odd, primitive creature. I stay at sea until a full moon in May when it is time to lay eggs. Female crabs, with the smaller males in tow, swim ashore with the incoming tide, crawl onto the sand above the tide line, burrow, lay thousands of tiny eggs, then catch an outgoing tide a few days later.

Clapper Rail
I am an elusive, hen-like bird, often called a "marsh hen" because I live and nest in salt marshes. At low tide I forage and probe my long bill into the mud, looking for fiddler crabs, worms, other small creatures and seeds. High tide limits my territory to the high marsh, but here I can still eat snails that climb up grasses to escape the water.

Blue Crab
I am the tasty blue crab who comes into the marsh with the tide. I find lots of oysters, fish and many other creatures to eat. Since I breathe with gills, I must swim out of the marsh with the retreating tide. When I am "soft" (I shed my shell to grow), the marsh is a great place to hide from predators.

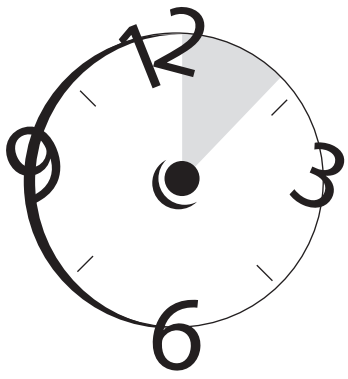
Ribbed Mussel
I am a bivalve, a two-shelled animal, like a clam. I live in mud in the low marsh, but half of me sticks above the mud. I cannot move about. At high tide I open my shell a bit, take in water, and strain out oxygen and tiny plants and animals to eat. At low tide I close up tightly to hold moisture in my gills for breathing until next high tide.

Salt Marsh Snail
I prefer to live in the high marsh, since I am an air breather and do not like to be too wet. During low tide, I glide around the mud flats looking for algae and bits of dead plants to eat. As the tide comes in, I crawl up the stems and leaves of grasses to keep from drowning.

Adaptations

Core

Time Allocation: 45 minutes
Required Materials and Resources on Page 206



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.

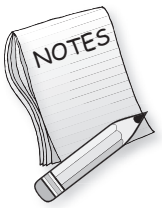
Guiding Questions

- 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

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



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
- Food web
- Diversity of organisms
- Change

Teacher Information

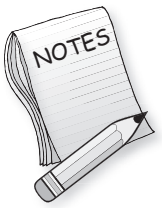
N/A

Skills

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

Materials and Resources

1. Butcher block paper and easel
2. Ecosystem posters – 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.
3. Ecosystem posters – The Bureau of Land Management offers the 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.
4. Ecosystem pictures - 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
5. Internet websites:
   - Stream ecosystem construction directions
     - o http://www.augusta.k12.wi.us/HS/dept/sci/stream.htm
   - Classroom ecosystems – four cell kit
     - o http://www.oceanarks.org/education/clm/lessons/
   - Ecosystems
     - o http://www.scienceteacherstuff.com/ecosystem.html



- Rain forest
    - o http://curry.edschool.virginia.edu/class/edis/590s4/Snead/Helpful_Web_Sites.html
    - o http://curry.edschool.virginia.edu/class/edis/590s4/Snead/RAIN_F~1.HTM
    - o http://curry.edschool.virginia.edu/class/edis/590s4/Snead/Resources.htm
    - o http://www.theteachersguide.com/Habitats.html#Rain
- Deserts
    - o http://www.theteachersguide.com/Habitats.html#Deserts
- Wetlands
    - o http://www.theteachersguide.com/Habitats.html#Wetlands
- Coral Reefs
    - o http://www.theteachersguide.com/Habitats.html#Coral
- Any of the ecosystems in this unit can be found by going to Google, then clicking on images and putting in the name of the particular ecosystem (polar, ocean, tundra, etc.) http://www.google.com

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

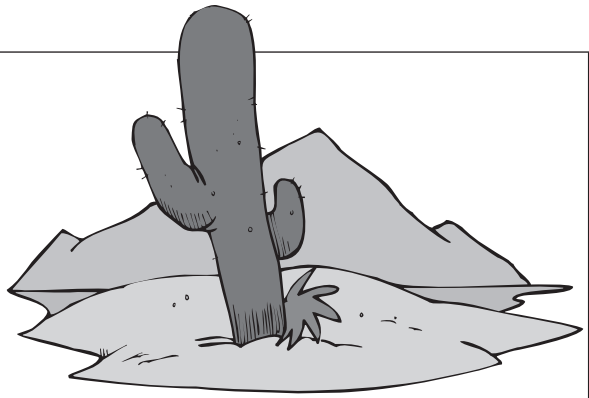
Preparation Activities

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 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**.

Adaptations



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 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 two wrap-up lessons. 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:

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Similarities among 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. Ecosystems have unique interactions in different ecosystems different.
4. Organisms are dependent on each other and on the non-living things in the ecosystems.	4. Organisms are dependent on different living things and on the non-living things in the different ecosystems
5. Ecosystems are stable until acted upon by some outside change.	5. Ecosystems are affected differently by changes (e.g., no 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 (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

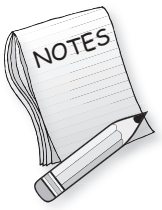
Post Assessment

N/A

Debriefing and Reflection Opportunities (5 minutes)

1. 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.
2. Tell students that in the next lesson they will be researching three animals and their adaptations in one of the ecosystems they visited today.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



Name _____ **Date**_____

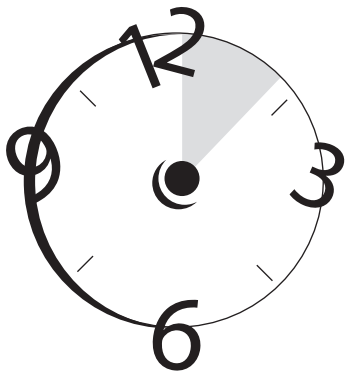
Table for Comparing Nature's Ecosystems

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.
10.	10.
11.	11.

Adaptations

Core

Time Allocation: 1 hour, 15 minutes
Required Materials and Resources on Page 206



Lesson Overview

Students continue to explore the relationship between habitats and adaptations by researching three different organisms from various ecosystems and biomes. They will explore a range of diverse habitats and discover the significant variety of adaptive structures and behaviors that exist in nature.

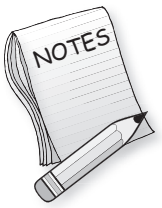
Guiding Questions

- How do animals' varying features help them to survive?
- What are the advantages and disadvantages of having specific adaptive features or behaviors?

BIG IDEA

Exploring Different Ecosystems

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



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

- Environmental factors affect the survival of organisms.
- Structural, physiological and behavioral adaptations affect the survival of organisms.

Concepts

- Survival
- Habitat
- Adaptation
- Form and function
- Structural adaptation
- Physiological adaptation
- Behavioral adaptation

Teacher Information

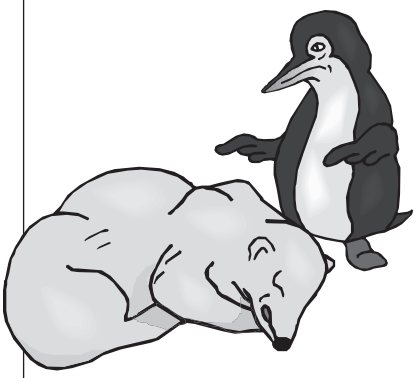
N/A

Skills

- Recognize attributes
- Identify relationships
- Compare and contrast
- Judge the accuracy of information

Materials and Resources

1. The book *Everyday Life of Animals: Adapting to the Environment* by Fulvio Cerfolli published in 1999 by Raintree Steck-Vaughn Publishers was used to select most of the organisms to be researched in this lesson. It can be purchased at www.amazon.com.
2. The following books are excellent resources for both information and photographs: Wiewandt, T. (1990). *The hidden life of the desert*. New York: Crown Publishers.
   Macquitty, M. (1994). *Eyewitness books desert.* New York: Alfred A. Knopf.
   Johnson, S. (1984). *Coral reefs*. Minneapolis: Lerner Publications.
   Taylor, B. (1992). *Rain forest*. New York: Dorling Kindersley.
   Cerrullo, M. (1996). *Coral reef: A city that never sleeps*. New York: Cobblehill Books.
3. The site below has lesson plans on adaptations:
   http://www.sciencenetlinks.com/lessons.com/lessons.cfm?BenchmarkID=5&DocID=232
4. The following site offers information on adaptations of organisms to fast flowing waters: http://users.aber.ac.uk/mjl1/page2.htm

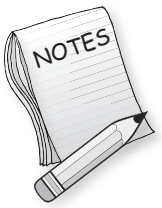


Preparation Activities

1. Collect and organize the necessary resources for students to do their research on their assigned animals.
2. Explore more animals from the same ecosystems if the class has more than 20 students or if some of the groups can go from two members to three.

Introductory Activities (10 minutes)

- Explain to students that they will be "traveling" today to explore different ecosystems (e.g., coral reef) and some large-scale ecosystems (biomes) such as oceans, deserts, tundra, rain forests, Polar regions, freshwater wetlands, coastal environment, grasslands and coniferous forests.
- In their travels they will be investigating animal adaptations that allow them to survive in their respective ecosystems.
- Provide students the opportunity to choose an ecosystem to research.
- Give each group their list of animals to explore (See pages 142-151).
- Tell students that their task is to find the many adaptations their animals have that enable them to live in their habitat. They are required to find a minimum of two adaptive features.



- Invite students to use their classroom, library and Internet resources to gather information.
- Share your expectations for the research that students will complete.

Pre-assessment

N/A

Teaching and Learning Activities (60 minutes)

1. Rove among the student groups. Use Socratic questioning to move each group forward, if necessary. Provide more questions and feedback to students who need more direction. **SEARCHLIGHT**: For students who demonstrate (1) facility with the research process or (2) enthusiasm for the topic, invite them to participate in the AID opportunity below.

2. At the conclusion of the research, provide the opportunity for each group of students to describe one animal's adaptations.

Products and Assignments

- Students' research notes

Extension Activities

Any of the following websites will extend students' understanding of animal adaptations to ecosystems and biomes. Invite students to visit these sites and to share their newly acquired information in any format they choose.

- Sites like the Environmental Protection Agency's Explorers' Club let students examine what happens to habitats and their dependent plants and animals if they are disturbed.
- The website on invasive species is: http://www.chesapeakebay.net/baybio.htm
- The website Journey North provides information on adaptations and migratory journeys of animals.
- The website MBGnet helps students explore the world's biomes. http://mbgnet.mobot.org/fresh/index.htm
- This website helps students explore rivers and streams: http://mbgnet.mobot.org/fresh/rivers/animals/index.htm
- The website below relates to plant adaptations: http://www.microscopy-uk.org.uk/mag/articles/anne1.html

Post Assessment

N/A

Debriefing and Reflection Opportunities (5 minutes)

1. Ask students to transfer their knowledge about animal adaptations. In a large group format, ask students: What would happen to an animal's adaptations (choose any animal) if it were put into a new ecosystem? Do you think the animal could survive in this new environment? What does that tell you about how animals adapt to their environments over long periods of time?
2. Listen carefully to students' responses to ensure that they understand the principles that guided this lesson.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

You must:

(a) Find a minimum of two adaptive features for each of the three organisms in your ecosystem.
(b) Describe each adaptation. If you find more than one for your organism, just add it to the list and use the back side of this paper if necessary.
(c) Identify it as structural, physiological or behavioral.
(d) Explain how the adaptation assists the organism in its survival (climate, movement, feeding, protection, and reproduction).

Coral Reef Animal List

1. Fire coral

   Adaptation:

   Type:

   Assists by:

2. Sea anemone or Crown of Thorns sea star

   Adaptation:

   Type:

   Assists by:

3. Tube worm (feather duster)

   Adaptation:

   Type:

   Assists by:

Name _____ **Date**_____

You must:

(a) Find a minimum of two adaptive features for each of the three organisms in your ecosystem.
(b) Describe each adaptation. If you find more than one for your organism, just add it to the list and use the back side of this paper if necessary.
(c) Identify it as structural, physiological or behavioral.
(d) Explain how the adaptation assists the organism in its survival (climate, movement, feeding, protection, and reproduction).

Desert Animal List

1. Desert hedgehog, sandfish or black-tailed jackrabbit

   Adaptation(s):

   Type:

   Assists by:

2. Thorny devil lizard (moloch), bearded dragon lizard or the frilled lizard (both live in Australian desert)

   Adaptation(s):

   Type:

   Assists by:

3. Desert sand fox or Fennec fox

   Adaptation(s):

   Type:

   Assists by:

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

You must:

(a) Find a minimum of two adaptive features for each of the three organisms in your ecosystem.
(b) Describe each adaptation. If you find more than one for your organism, just add it to the list and use the back side of this paper if necessary.
(c) Identify it as structural, physiological or behavioral
(d) Explain how the adaptation assists the organism in its survival (climate, movement, feeding, protection, and reproduction).

Polar Region Animal List

1. Polar bear

   Adaptation(s):

   Type:

   Assists by:

2. Walrus

   Adaptation(s):

   Type:

   Assists by:

3. Snowy owl or emperor penguin

   Adaptation(s):

   Type:

   Assists by:

Name _____ **Date**_____

You must:

(a) Find a minimum of two adaptive features for each of the three organisms in your ecosystem.
(b) Describe each adaptation. If you find more than one for your organism, just add it to the list and use the back side of this paper if necessary.
(c) Identify it as structural, physiological or behavioral
(d) Explain how the adaptation assists the organism in its survival (climate, movement, feeding, protection, and reproduction).

Coniferous Forest Animal List

1. Crossbill (bird)

   Adaptation(s):

   Type:

   Assists by:

2. North American porcupine

   Adaptation(s):

   Type:

   Assists by:

3. Horned owl

   Adaptation(s):

   Type:

   Assists by:

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

You must:

(a) Find a minimum of two adaptive features for each of the three organisms in your ecosystem.
(b) Describe each adaptation. If you find more than one for your organism, just add it to the list and use the back side of this paper if necessary.
(c) Identify it as structural, physiological or behavioral.
(d) Explain how the adaptation assists the organism in its survival (climate, movement, feeding, protection, and reproduction).

Tropical Rain Forest Animal List

1. Gibbon

   Adaptation(s):

   Type:

   Assists by:

2. Green anaconda snake

   Adaptation(s):

   Type:

   Assists by:

3. Northern tamandua (tree dwelling anteater) or the silky anteater

   Adaptation(s):

   Type:

   Assists by:

Name _____ **Date**_____

You must:

(a) Find a minimum of two adaptive features for each of the three organisms in your ecosystem.
(b) Describe each adaptation. If you find more than one for your organism, just add it to the list and use the back side of this paper if necessary.
(c) Identify it as structural, physiological or behavioral.
(d) Explain how the adaptation assists the organism in its survival (climate, movement, feeding, protection, and reproduction).

Freshwater Wetlands Animal List

1. Jacana

   Adaptation(s):

   Type:

   Assists by:

2. Water shrew

   Adaptation(s):

   Type:

   Assists by:

3. American alligator or Chinese alligator

   Adaptation(s):

   Type:

   Assists by:

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

You must:

(a) Find a minimum of two adaptive features for each of the three organisms in your ecosystem.
(b) Describe each adaptation. If you find more than one for your organism, just add it to the list and use the back side of this paper if necessary.
(c) Identify it as structural, physiological or behavioral.
(d) Explain how the adaptation assists the organism in its survival (climate, movement, feeding, protection, and reproduction).

Coastal Environment Animal List

1. Scarlet ibis

   Adaptation(s):

   Type:

   Assists by:

2. Octopus

   Adaptation(s):

   Type:

   Assists by:

3. Red crab

   Adaptation(s):

   Type:

   Assists by:

Name _____ **Date**_____

You must:

(a) Find a minimum of two adaptive features for each of the three organisms in your ecosystem.
(b) Describe each adaptation. If you find more than one for your organism, just add it to the list and use the back side of this paper if necessary.
(c) Identify it as structural, physiological or behavioral.
(d) Explain how the adaptation assists the organism in its survival (climate, movement, feeding, protection, and reproduction).

Grasslands Animal List

1. Weaverbird

   Adaptation(s):

   Type:

   Assists by:

2. Termite

   Adaptation(s):

   Type:

   Assists by:

3. Ostrich

   Adaptation(s):

   Type:

   Assists by:

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

You must:

(a) Find a minimum of two adaptive features for each of the three organisms in your ecosystem.
(b) Describe each adaptation. If you find more than one for your organism, just add it to the list and use the back side of this paper if necessary.
(c) Identify it as structural, physiological or behavioral.
(d) Explain how the adaptation assists the organism in its survival (climate, movement, feeding, protection, and reproduction).

Ocean Animal List

1. Purple sea urchin

   Adaptation(s):

   Type:

   Assists by:

2. Angler fish

   Adaptation(s)

   Type:

   Assists by:

3. Lionfish

   Adaptation(s):

   Type:

   Assists by:

Name _____ **Date**_____

You must:

(a) Find a minimum of two adaptive features for each of the three organisms in your ecosystem.
(b) Describe each adaptation. If you find more than one for your organism, just add it to the list and use the back side of this paper if necessary.
(c) Identify it as structural, physiological or behavioral.
(d) Explain how the adaptation assists the organism in its survival (climate, movement, feeding, protection, and reproduction).

Tundra Animal List

1. Arctic fox

   Adaptation(s):

   Type:

   Assists by:

2. Musk ox

   Adaptation(s):

   Type:

   Assists by:

3. Caribou

   Adaptation(s):

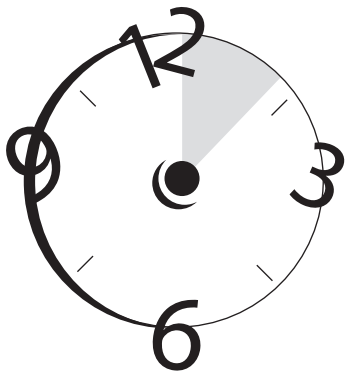
   Type:

   Assists by:

Adaptations

Core/Connections

Time Allocation: 1 hour, 30 minutes
Required Materials and Resources on Page 206

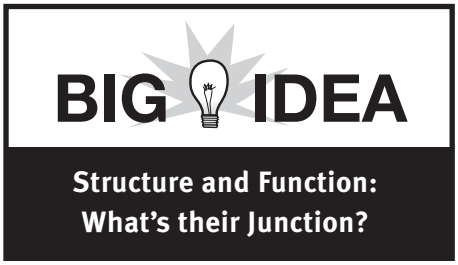


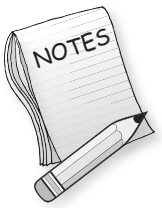
Lesson Overview

Students will prepare a presentation that focuses on their understanding of the connection between habitats and adaptations. They will share their findings in a format of their choice, such as a PowerPoint presentation, diorama, mobile, poster or skit.

Guiding Questions

- How do animals' varying features help them to survive?
- What are the advantages and disadvantages of having specific adaptive features or behaviors?
- How can we best communicate our understandings of the connections between habitats and adaptations?





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 places in which they live.
- Structural, physiological and behavioral adaptations affect the survival of organisms.

Concepts

- Survival
- Habitat
- Adaptation
- Form and function
- Structural adaptation
- Physiological adaptation
- Behavioral adaptation

Teacher Information

N/A

Skills

- Recognize attributes
- Identify relationships
- Compare and contrast
- Use creative thinking such as originality
- Make decisions

Adaptations

Materials and Resources

Materials for student presentations include, but are not limited to the following: poster board, projector, computer, cardboard boxes, wire hangers, string, single-hole puncher, index cards, glue sticks, tape, markers, paints, colored construction paper, scissors, etc.

Preparation Activities

Gather the materials needed for students to do their research on animal adaptations.

Introductory Activities (5 minutes)

- Explain to students that in pairs they will prepare a presentation on the connection between habits and adaptations, using three animals as examples.
- Share the variety of presentation formats: PowerPoint presentation, diorama, poster, mobile or skit.

Pre-assessment

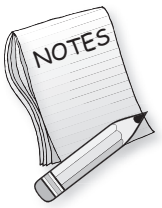
N/A

Teaching and Learning Activities (83 minutes)

1. Give students the opportunity to select a partner with whom to work. Explain to the pairs of students that they will be sharing their information about the animal adaptations with their classmates.

2. Provide students with details about the presentation. The presentation should be between five and eight minutes. It must include information about three animals and the specific adaptations each animal has that increase its chances of survival in its respective ecosystem.

3. Explain to students that they will have two class periods to complete the presentation.



4. Share with students the rubrics that will be used to assess their work. (See rubrics in lessons 20/21.) Review the rubrics to ensure that students: (1) understand the standards for their work and (2) have the opportunity to modify the rubrics, thereby increasing the ownership on the part of students and the likelihood of high quality products.

Products and Assignments

Students' Adaptation Presentation projects

Extension Activities

N/A

Post Assessment

N/A

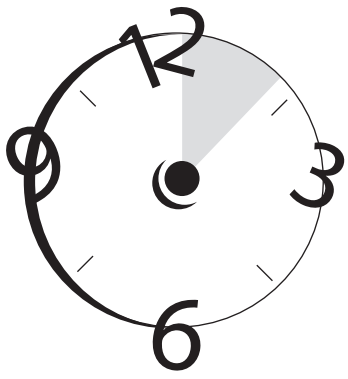
Debriefing and Reflection Opportunities (2 minutes)

Remind students that their presentations are due tomorrow and that they will be sharing their presentations with the class. Ask if there are any questions or concerns about the project. Listen carefully to their responses to ensure that they fully understand the assignment.

Adaptations

Core/AID

Time Allocation: 1 hour, 30 minutes
Required Materials and Resources on Page 206



Lesson Overview

Students will share their understanding of the connections between habitats and animal adaptations by presenting their PowerPoint presentations, posters, mobiles, dioramas or skits.

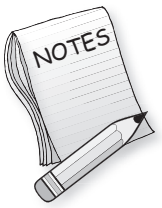
Guiding Questions

- How do animals' varying features assist them to survive?
- What are the advantages and disadvantages of having specific adaptive features or behaviors?
- Were we successful in communicating our understandings of the connections between habitats and adaptations?

BIG IDEA

Connection Between Habitats and Adaptations

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



Content Goals

Universal Themes

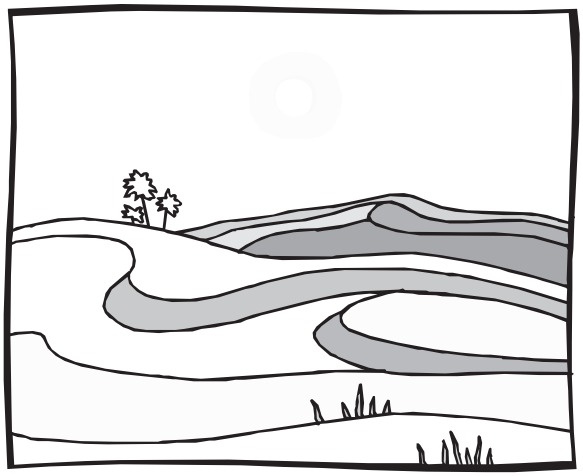
- The natural world is composed of systems, which are organized groups of related objects that together form a whole.
- Form and function are complementary aspects of objects, organisms and systems in the natural world. Form and function are interdependent.

Principles and Generalizations

- Structural, physiological and behavioral adaptations affect the survival of organisms.
- Environmental factors affect the survival of organisms.

Concepts

- Survival
- Interdependence
- Habitat
- Adaptation
- Form and function
- Structural adaptation
- Physiological adaptation
- Behavioral adaptation



Teacher Information

N/A

Skills

- Communicate findings
- Explain
- Summarize
- Justify thinking
- Formulate questions
- Evaluate evidence

Adaptations

Materials and Resources

Materials for presentations, such as a projector, computer, costumes, etc.

Preparation Activities

1. Copy the **Ecosystem Note-taking Sheet**.
2. Give each student enough copies of the **Ecosystem Note-taking Sheets** so that he/she can take notes on each presentation that will be shared.
3. Copy rubrics for assessment of projects.

Introductory Activities (5 minutes)

- Convene students as a large group. Explain that they are about to begin sharing projects with one another. They will be listening to each other's presentations. Because there will be a great deal of information that will be shared, it will be important for students to take notes. To assist them in taking notes, they can use a template, the **Ecosystem Note-taking Sheet**. These notes will be available to them during their final assessment.
- Share with students that you hope they will listen carefully, ask clarification questions and, when appropriate, challenge one another as to the validity of the information being provided. This is a protocol that all scientists use in order to understand phenomena.

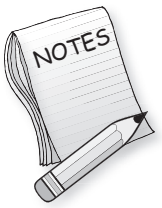
Pre-assessment

SEARCHLIGHT: Make a note of students who have demonstrated a great deal of zeal in this undertaking, who have investigated their organisms in a depth that exceeds the norm, who have demonstrated facility with scientific inquiry, or who may have the potential to demonstrate these habits of mind. Invite them to participate in the AID activity provided at the end of this lesson.

Teaching and Learning Activities (80 minutes)

1. Select the first presentation group as volunteers or randomly.

2. Lead students in questioning and discussing each group's presentation. If necessary, model for students the questioning and challenging that characterizes discussions within the scientific community.



Products and Assignments
Students' projects

Extension Activities
(AID) If there is time and for those students needing additional intellectual challenge, the discussion can be continued by introducing the concepts of "natural selection" and "survival of the fittest." With interested students, discuss the idea that if a population has some variety within it and the environmental conditions are changed, there may be some organisms that "fit" the new environment. The change in the moth population that occurred as a result of the pollutants from the Industrial Age in England is an example of this "fit."

Post Assessment
Students' rubrics

Debriefing and Reflection Opportunities (5 minutes)
At the conclusion of the student presentations, engage students in a final discussion about the advantages of adaptive features and behaviors and the possible disadvantages. Using questioning, bring students to understand that some adaptations are very closely associated with specific environmental conditions and that if those conditions are altered, the organism's adaptive features may be rendered useless, thus endangering the survival of that organism. Invite students to provide examples that have not yet been mentioned.

Name _____ Date_____

Ecosystem Note-taking Sheet

Ecosystem Presenter:

Name of Ecosystem being described:

Notes from presentation (animals, types of adaptations, other interesting information about the ecosystem):

Poster Rubric for Habitats and Adaptations

Criteria	1	2	3	4	Your Score
Quality of Science Content	Information is cursory or incorrect. Little understanding of content is evident from presentation.	Some solid information presented; however, some information is incorrect or cursory.	Information is clear and correct throughout most of presentation.	Information is well presented, clear, and correct throughout.	1 2 3 4
Criteria	Many of the criteria required to be included are missing or contain insufficient information.	Some of the criteria are missing and the lack of sufficient research is evident in some of the required areas	Although the criteria were addressed, they could have been addressed more thoroughly as a result of more extensive research.	All of the criteria are completely and thoroughly addressed.	1 2 3 4
Graphics	Images do not connect to text and/or are not relevant and do not deepen understanding of the element's story.	Images are not always relevant and thus do not provide additional insight as to the element's story. Text citations are not always present.	Images are mostly relevant and add to the understanding of the element's story. Text citations are usually present and identify the images.	Images are relevant, and complement the text. Each image is cited in the text and identified. The number of images is appropriate and they do enhance the understanding of the element's story.	1 2 3 4
Mechanics	Text contains many spelling/grammar errors. Sentences seem disconnected, and there is carelessness throughout.	Text contains some spelling/grammar errors. Little logical structure or flow to sentences. Evidence of carelessness in writing.	Grammar and spelling are nearly flawless. Logical sequence apparent. Some wording is careless, with inconsistency in style.	Grammar and spelling are flawless and the flow provides a logical pathway of ideas. Consistent and engaging style is present throughout.	1 2 3 4
Following Directions	Many of the directions such as poster size, keeping complete research notes, attaching research notes, no handwriting on the poster, etc. were not followed. Some deadlines were met	Many of the directions such as poster size, keeping complete research notes, attaching research notes, no handwriting on the poster, etc. are not followed and/or deadlines or are not met.	One or more of the directions such as poster size, keeping complete research notes, attaching research notes, no handwriting on the poster, etc. or deadlines are not followed or met.	All of the directions such as poster size, keeping complete research notes, attaching research notes, no handwriting on the poster, etc.) and deadlines were followed and/or met.	1 2 3 4

Poster Design	The poster is either cluttered or too empty. There is no text/image balance. No attention paid to variation in design.	Some parts of the poster are either cluttered or empty. Inconsistent attention paid to sizing of graphics, placement of graphics and text, and text wrapping.	Most of the poster contains well-placed objects, with thoughtful text/image balance and logical text wrapping.	Objects and test on the poster are well-placed and sized. Poster is not cluttered or too empty, with logical text wrapping.	1 2 3 4
Quality of Bibliography	The bibliography is incomplete and contains errors in format.	The bibliography is incomplete or contains errors in format.	The bibliography is complete but contains a few errors in format.	The bibliography is complete and contains no errors in format.	1 2 3 4

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Rubric for Research and PowerPoint Presentation on Habitats and Adaptations

Criteria	1	2	3	4	Your Score
Science Content	Information is cursory or incorrect; little understanding of content is evident from the presentation.	Some solid information presented; however, some information is incorrect or cursory.	Information is clear and correct throughout most of the presentation.	Information is comprehensive, clear, and correct throughout	1 2 3 4
Understanding of Material	Apparent misunderstanding of material	Limited understanding of material displayed by vague, unclear language	Demonstrates adequate understanding of the material in a logical presentation that delves into some conceptual ideas in science	Clear understanding of material displayed by clear, logical and fluid presentation of the science concepts and content	1 2 3 4
Quality of Research	Research is insufficient or so fragmented that the science understandings being presented is unclear to the observer. Research notes is incomplete, missing or not submitted	Research effort was incomplete or fragmented. Documentation is evident but not easy to follow. Research notes are submitted and some of the research information is evident in the presentation	Research is fairly comprehensive and clearly documented. Notes are submitted and the substantial research information is evident in the presentation	Research is comprehensive and clearly documented. Notes are submitted and the substantial research information is adeptly woven throughout the presentation	1 2 3 4
Intellectual contribution of each group member	Presenter has little or no grasp of context, sees task as isolated with no connection to past or future ideas.	Presenter is aware of overall context, but makes no connections on own, can recite connections of others but rarely can support them.	Presenter usually understands overall context of task and asks questions about context. He/she makes connections on own and "gets" those others make.	Presenter understands overall context of the task, contributes ideas and proposals, and extends connections to ideas past and future.	1 2 3 4
Engagement	Presenter waits for direction, knows little of what is going on or objectives, and cannot describe where group is in process.	Presenter seeks direction, but does not initiate action. Objectives seen as poorly defined external requirements, may know where group is	Presenter sometimes initiates action and always works well with direction. He/she generally knows the specific objectives and where group is.	Presenter enthusiastically initiates action and personalizes the task and takes ownership of the objectives. He/she always knows where group is.	1 2 3 4

Criteria	1	2	3	4	Your Score
Preparation	Unprepared; did not do necessary research	Attempted to research in preparation for the debate but was misdirected	Evidence of purposeful research in preparation for the debate	Thorough and purposeful research in preparation for the debate	1 2 3 4
Clarity	No apparent logical order of presentation, unclear focus	Content is loosely connected, transitions lack clarity	Sequence of information is well-organized for the most part; more clarity with transitions is needed	Development of thesis is clear through use of specific and appropriate examples; transitions are clear and create a succinct and even flow.	1 2 3 4
Speaking Skills	Monotone; speaker seemed uninterested in material	Little eye contact; fast speaking rate, little expression, mumbling	Clear articulation of ideas, but apparently lacks confidence with material	Exceptional confidence with material displayed throughout; poise, clear articulation, eye contact, and enthusiasm	1 2 3 4
Slide Effects	Effects are limited or not present.	One or more than one type of effect is used; however, some or all effects detract from presentation.	More than one type of effect is used. Effects enhance presentation.	Effects are varied, yet cohesive, and they significantly enrich the presentation.	1 2 3 4
Slide Graphics	Images do not connect to text and/or are not relevant.	Images are not always relevant; text citations are not always present and do not connect to images.	Images are mostly relevant; text citations are usually present and identify the images.	Images are relevant, and complement the text; each image is cited in the text and identified; the number of images is appropriate.	1 2 3 4
Mechanics	Text contains many spelling/grammar errors; sentences seem disconnected, and there is carelessness throughout.	Text contains some spelling/grammar errors; little logical structure or flow to sentences; evidence of carelessness in writing	Grammar and spelling are nearly flawless; logical sequence apparent; some wording is careless; inconsistency in style	Grammar and spelling are flawless and the flow provides a logical pathway of ideas; consistent and engaging style throughout	1 2 3 4

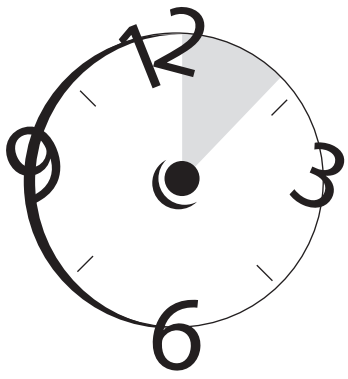
STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Criteria	1	2	3	4	Your Score
Overall Presentation Design	Many slides are either cluttered or empty; there is no text/image balance; no attention paid to variation in design	Some slides are either cluttered or empty; inconsistent attention paid to sizing of graphics, placement of graphics and text, and text wrapping	Most slides contain well-placed objects, with thoughtful text/image balance.	Objects on all slides are well placed and sized; slides are not cluttered or too empty.	1 2 3 4
Overall Effort	Actively avoids jobs when possible.; complains about others; has large set of excuses	Reluctantly completes jobs when asked; seeks easiest duties in group; sometimes works to completion	Willingly takes on jobs when asked; works to completion; will work long hours when required	Volunteers for jobs no matter how difficult; always works to completion; willing to work long hours	1 2 3 4
Symbol Size		Under use of the symbol size, shape, color, labels and position reduce the impact of the diagram on the reader.	Overuse of the symbol size, shape, color, labels and position reduce the clarity of the diagram.	Thoughtful and sensible use of symbol size, shape, color, labels and position to engage reader and convey meaning.	1 2 3 4

Adaptations

Core

Time Allocation: 1 hour, 30 minutes
Required Materials and Resources on page 206



Lesson Overview

Students in this lesson will discuss the salient points of the unit by creating a class book entitled, *Our Eurekas about Ecosystems*.

Guiding Questions

- What were the "eurekas" you experienced during this unit?
- Why should you care about the smallest snail, an endangered quail or the quality of air?

BIG IDEA

Eurekas about Ecosystems

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

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

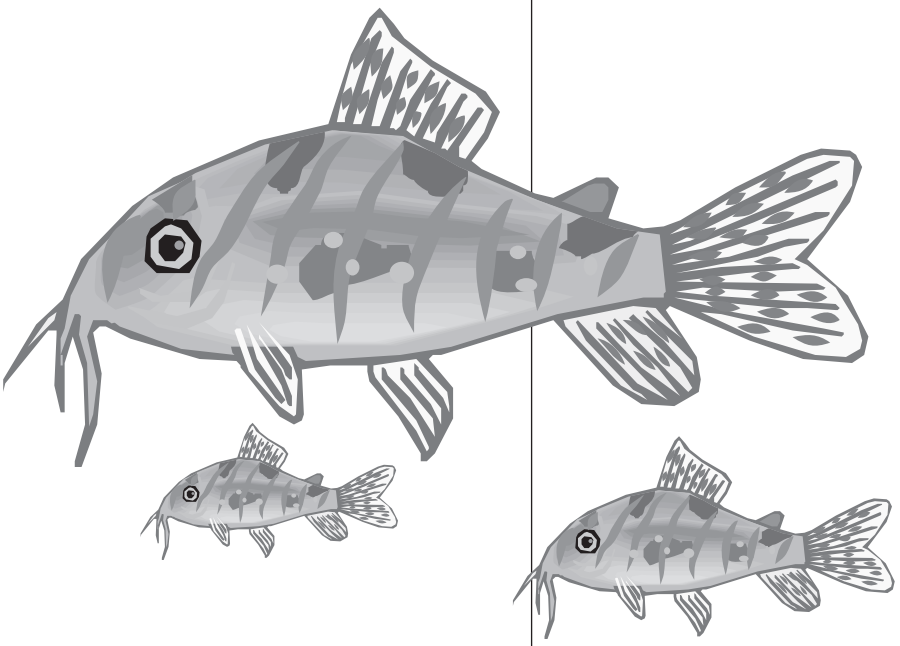
- Ecosystems have living and non-living things.
- Living and non-living things interact with one another in various ways.
- Organisms have needs that must be met in order to grow and live.
- Living things depend on other living things and on non-living things to meet their needs.
- Organisms have dependent and interdependent relationships that enhance survival.
- Ecosystems have producers, consumers and decomposers.
- Producers, consumers and decomposers have different functions in an ecosystem.
- Some of an organism's features help it survive.
- Features that help an organism survive are called adaptations.
- Adaptations are important for organisms to survive in their ecosystems.
- Structural, physiological and behavioral adaptations affect the survival of organisms.
- Organisms have preferred places in which they live.
- Ecosystems have a variety of habitats for the diversity of organisms.
- The adaptations that organisms have help them to adjust to and improve their habitats.
- Ecosystems and their specific habitats are important to all organisms and must be preserved.

Concepts

- Ecosystem
- Environment of non-living things
- Organism
- Interdependence
- Survival
- Habitat
- Producer

Adaptations

- Consumer
- Decomposer
- Adaptation
- Form and function
- Structural adaptation
- Physiological adaptation
- Behavioral adaptation
- Preservation



Teacher Information

N/A

Skills

- Discuss relationships
- Summarize
- Create visual representations
- Write

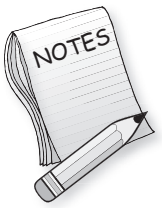
Materials and Resources

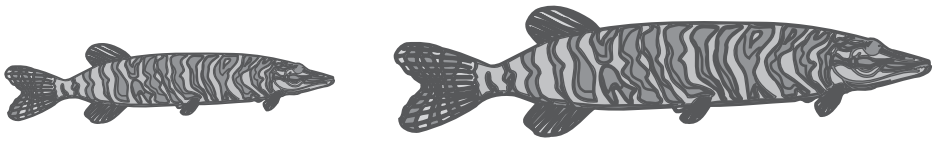
1. Writing paper (one page for each student)
2. Drawing paper to be bound for the *Our Eurekas about Ecosystems* book (one sheet for each student)
3. Crayons and or colored pencils
4. Colored markers
5. Glue
6. Computers if available can be used by students to type the information for the *Our Eurekas about Ecosystems*.

Preparation Activities

1. Give each student the resource materials to prepare his/her page for the *Our Eurekas about Ecosystems* book.
2. Copy Instructions for *Our Eurekas about Ecosystems* Class Book.
3. Copy **Our Favorite Ecosystem** page.
4. Copy Facts about **My Favorite Ecosystem**.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?





Introductory Activities (10 minutes)

- Share with students that the project they are about to embark upon will be the final activity in the ecosystem unit. Explain that they will be working in pairs to produce a page for the class book *Our Eurekas about Ecosystems*.
- The book will be copied and distributed to each student to take home and share with their family members. Maybe they could read it aloud to a sibling or grandparent.
- Assign partners or have students pick a partner with whom to work on the class *Our Eurekas about Ecosystems* book.

Pre-assessment

SEARCHLIGHT: Review your observations about students during the course of this unit. If you believe that you have students who have mastered the content contained within this last project, invite them into a conversation with you about alternative topics for their eurekas. Perhaps the content for students' "eurekas" will come from extensions they have completed or AID activities in which they have been involved. Entertain students' proposals and make accommodations as necessary.

Teaching and Learning Activities (70 minutes)

1. Invite pairs of students to identify their favorite ecosystems.

2. Give each student pair a copy of the instructions for the class book, *Our Eurekas about Ecosystems*, assignment.

3. Give students a copy of the **Our Favorite Ecosystem** page to use as a model for their page. Explain that they may use this page as a template, but that you would also entertain any modifications that students would wish to make to the template.

4. Give students a copy of the **Facts about Our Favorite Ecosystem** page.

5. These could be reviewed, edited, and eventually collected, copied and bound into and ecosystem book that each student could take home and share with family members.

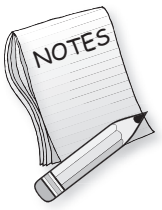
Products and Assignments
Class book, *Our Eurekas about Ecosystems* which contains students' pages, **Our Favorite Ecosystem**, and **Facts about Our Favorite Ecosystem**

Extension Activities
N/A

Post Assessment
N/A

Debriefing and Reflection Opportunities (10 minutes)
Once the presentations have been made, invite students to reflect with you. What principles were reflected in their pages? Were there patterns in the "aha's" that students documented? What proportion was about habitats, ecosystems or biomes? What proportion was about adaptations? What surprised them about the "aha's"? What questions do they have that are still puzzling?

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



Name _____ **Date**_____

Instructions for ***Our Eurekas about Ecosystems*** Class Book

1. Fill in the name of your favorite ecosystem.

2. Find or draw a picture of your favorite ecosystem (You may combine several pictures and/or drawings to represent your ecosystem).

3. Identify the ecosystem by name in a title placed above the picture/drawing(s).

4. Find or draw picture of at least one producer, consumer and decomposer in the ecosystem. You can draw more than one producer, consumer or decomposer, but you will have to describe at least one adaptation for each of these additional organisms.

5. Write the name of these organisms below these organisms.

6. Create a legend below the picture/drawing of the ecosystem.

7. Assign a color to each of the categories, producers, consumers and decomposers.

8. Use colored markers/pencils and place the appropriate colored dot on the organisms in the ecosystem picture/drawing (e.g., green dot on the producer(s), red dot on the consumer(s).)

9. Describe at least one adaptation that a consumer and a producer from this ecosystem have on the "Facts about Our Favorite Ecosystem" worksheet. If you drew more than one producer, consumer or decomposer in your ecosystem, ask for another "Facts about Our Favorite Ecosystem" sheet if you cannot fit all of the information on the first sheet.

10. Identify why these adaptations are important for the organisms' survival in that ecosystem on the "Facts about Our Favorite Ecosystem" worksheet.

11. Describe how two living components interact and ultimately depend on one another on the "Facts about My Favorite Ecosystem" worksheet.

12. Describe how a living component interacts with a non-living component in the ecosystem on the "Facts about My Favorite Ecosystem" worksheet.

13. Write several sentences as to why this ecosystem is important.

14. Write several sentences describing what you could do to help this ecosystem to survive.

Student Authors _____ & _____

Our Favorite Ecosystem -_____

Legend

	Color
Producer organisms:	
Consumer organisms:	
Decomposer organisms:	

Facts about My Favorite Ecosystem

The producer _____has an adaptation _____

This adaptation helps the producer to _____

The consumer _____has an adaptation _____

This adaptation helps the consumer to _____

Describe how two living components in your favorite ecosystem interact and ultimately depend on one another:

_____

_____

Describe how a living component and a non-living component in your favorite ecosystem interact:

_____

_____

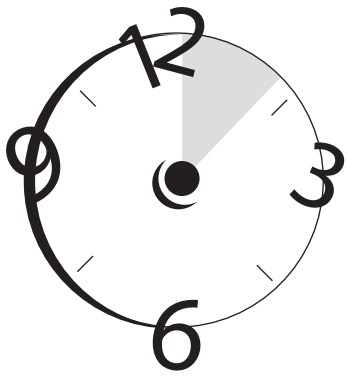
This ecosystem is important because _____

We can help this ecosystem survive by doing _____

Adaptations

Unit Debriefing

Time Allocation: 50 minutes
Required Materials and Resources on Page 206



Lesson Overview

Students in this lesson will share their understandings of ecosystems and their importance with each other. They will discuss the meaning of naturalist John Muir's quotation, "When we try to pick out something by itself, we find it hitched to something else in the universe." Students will discuss the growth of their understandings about ecosystems over time by comparing their current ideas with those from an earlier lesson.

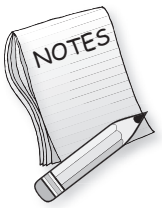
Guiding Questions

- What are ecosystems and their components?
- Have I learned more about ecosystems as a result of this unit's activities?
- Why should I care about ecosystems?
- Can I make a difference to the health of ecosystems?

BIG IDEA

Why Should I Care About Ecosystems?

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



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 and their specific habitats are important to all organisms and must be preserved.
- Organisms must have their needs met in order to grow and live.
- Living things depend on other living things and non-living things to meet their needs.
- Organisms have dependent and interdependent relationships that enhance survival.
- Ecosystems can change.
- Adaptations are important for organisms to survive in their ecosystems.
- Organisms have preferred places in which they live.
- Ecosystems have a variety of habitats for the diversity of organisms.

Concepts

- Ecosystem
- Environment of non-living things
- Organism
- Survival
- Basic needs
- Interdependence
- Adaptation
- Form and function
- Habitat
- Environmental change
- Habitat destruction

Adaptations

Teacher Information

John Muir was a famous naturalist who lived from 1838 to 1914.

Skills

- Compare and contrast
- Analyze
- Discuss relationships
- Ask questions
- Summarize

Materials and Resources

Butcher-block paper used in Lesson 15 that described the ecosystem pictures placed around the room

Preparation Activities

1. Write John Muir's quote on the board, "When we try to pick out something by itself, we find it hitched to something else in the universe."
2. Place the butcher-block papers, on which are listed students' early knowledge of specific ecosystems (Lesson 15), underneath each of the ecosystem pictures around the room.

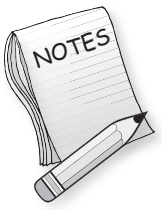
Introductory Activities (15 minutes)

- Ask students to use sticky notes to put down in writing one "eureka" that they had during this unit.
- Have students share their "aha's" with their class members by putting their "aha's" on sticky notes.
- Have students bring their sticky notes to the front of the room and place them all on the board.
- Read them and have the students react to them, grouping them where possible in categories related to the unit's main concepts of interdependence of organisms (food chains and webs) and organisms' adaptations and their relationship to habitats.

Pre-assessment

N/A

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



Teaching and Learning Activities (35 minutes)

1. Ask students to elaborate on the ecosystems pictured around the room.

2. Add their thoughts to the butcher-block papers under each ecosystem, reinforcing the concepts of interdependence of organisms, adaptation, and habitats.

3. Tell students a little about John Muir and his contribution to the study of nature. Share with them John Muir's quotation.

4. In small groups, invite students to discuss what they think the quotation means. Students should be able to appreciate the true nature of the words "interdependence of organisms" and that no matter how insignificant we make think some organism is, each and every one is connected in some way no matter how removed the connection may be. Ask them such questions as "Why should we care about ecosystems?" and "How can we make a difference to the health of ecosystems?"

Products and Assignments

Revised butcher-block lists of understandings with regard to various ecosystems

Extension Activities

N/A

Post Assessment

This entire activity is a post assessment and debriefing.

Debriefing and Reflection Opportunities

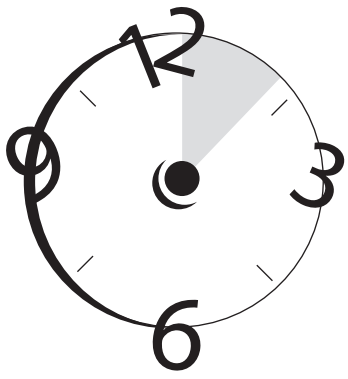
See Introduction and Teaching and Learning Activities.

Adaptations

Post Assessment

Time Allocation: 50 minutes

Required Materials and Resources on Page 206



Lesson Overview

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

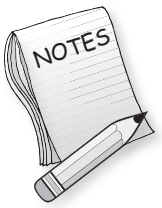
Guiding Questions

- 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

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



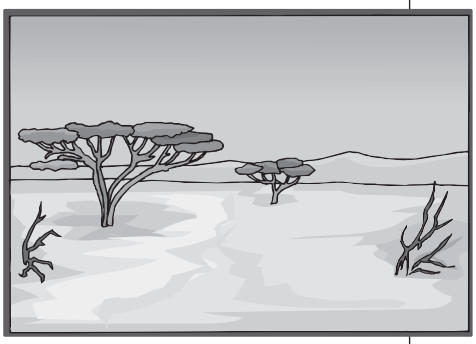
Content Goals

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.
- Adaptations are important for organisms to survive in their ecosystems.
- Structural, physiological and behavioral adaptations affect the survival of organisms.
- Ecosystems contain food chains.



Adaptations

- In order to meet their needs, some organisms live at the expense of others.
- Most ecosystems have multiple food chains.
- Organisms can be part of multiple food chains, thus forming food webs.

Concepts

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

Teacher Information

N/A

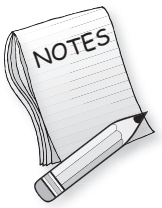
Skills

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

Materials and Resources

Poster of a pond ecosystem

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



Preparation Activities

Hang the pond ecosystem picture 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 his or her students know or do not know so that instructional activities can be improved for future students.

Products and Assignments

Completed post assessment

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

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

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 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 it make much of a difference in this ecosystem? Explain why or why not.

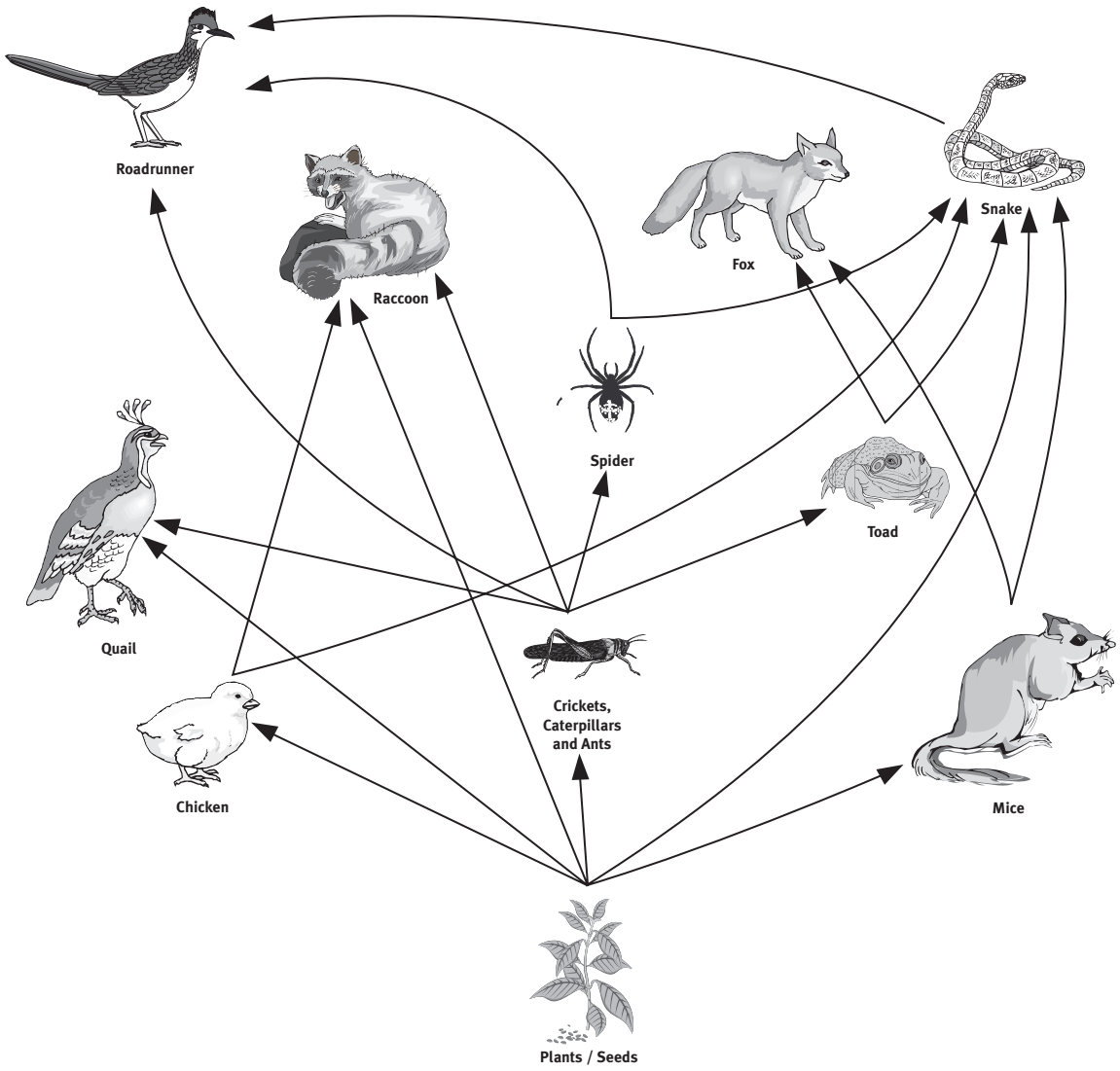
9. Examine the food chain below:

   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?

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

10. Examine the food web below and answer the following questions:



A. Pick out four organisms that are in one single, complete food chain that starts with the organisms that use sun to make food.

B. "Carne" means flesh. Carnivores eat meat. Which organisms are carnivores in your food web?

C. Identify the organisms in the food web that eat both plants and animals.

D. What would happen to the food web if crickets, ants and caterpillars died out? List three consequences.

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

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

12. Pretend you are part of a scientific study of a hummingbird that is an endangered species. It feeds on the nectar (sugar-like liquid) of only two types of plants on a small island off the coast of South America. You have found an unusual amount of dead hummingbirds in the area, so you decide to examine the stomach contents of these birds. Much to your surprise, you find remains of small insects. What do you think might have caused the hummingbird to eat insects?

13. Identify an adaptation for one of the organisms you listed in question #10 A above.

14. How does the adaptation identified in question #13 enable the organism to survive in its environment?

15. Why should you care about the smallest snail, an endangered quail and 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

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

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.

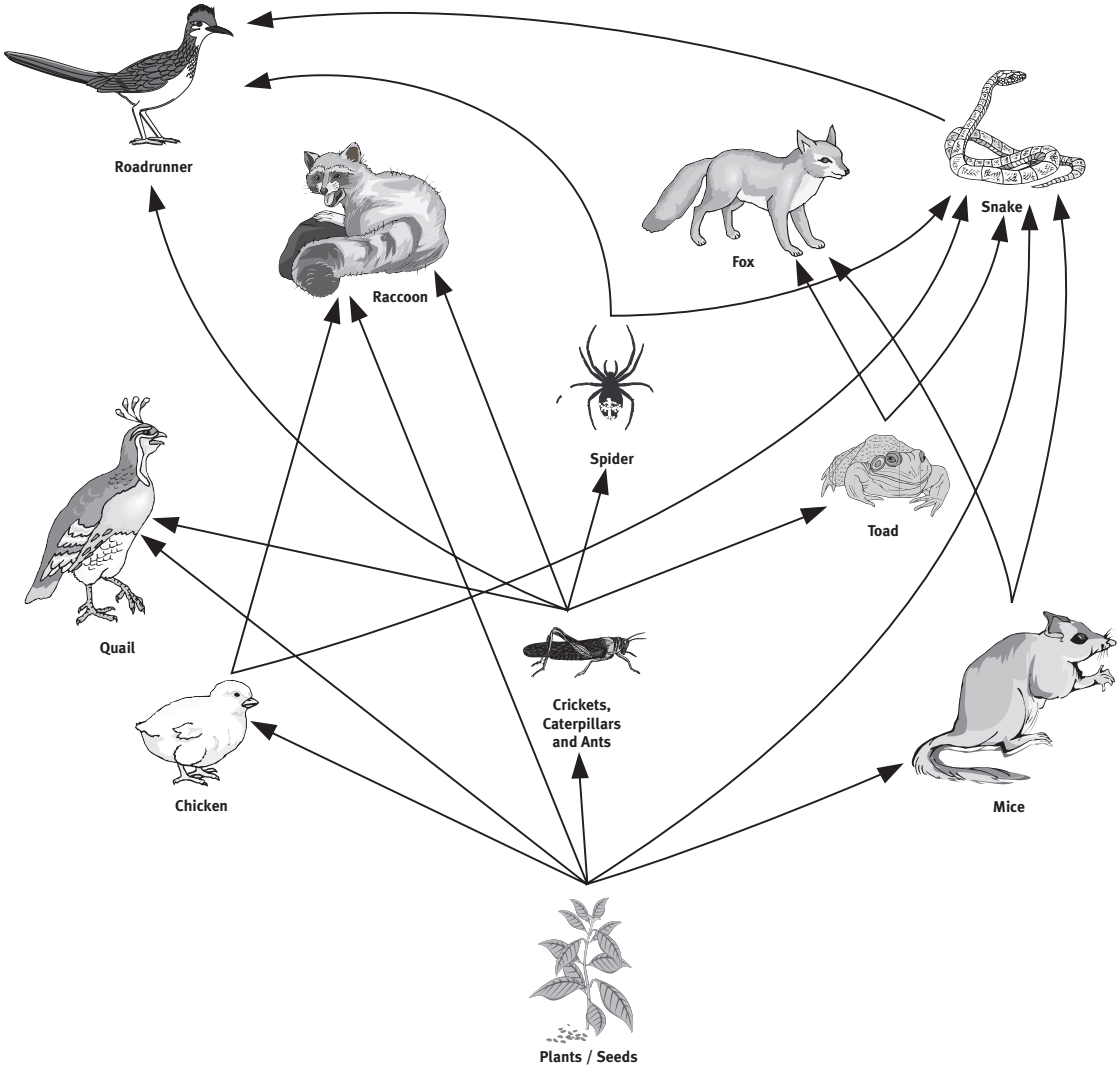
9. **Examine the food chain below:**

   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. Examine the food web below and answer the following questions:



STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

A. Pick out four organisms that are in one single, complete food chain that starts with the organisms that uses sun to make its food.

Plants/seeds ➔ Crickets/caterpillars/and ants ➔ toad ➔ fox

B. "Carne" means flesh. Carnivores eat meat. Which organisms are carnivores in your food web?

Toad, quail, spiders, roadrunner, raccoon, snake and fox

C. Identify the organisms in the food web that eat both plants and animals.

Snake

D. What would happen to the food web if crickets, ants and caterpillars died out? List three consequences.

Toads, quail and spiders would have nothing to eat.

.

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

The classroom ecosystem and terrarium ecosystems 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 plants in the terrarium would die unless water was added periodically.

12. Pretend you are part of a scientific study of a hummingbird that is an endangered species. It feeds on the nectar (sugar-like liquid) of only two types of plants on a small island off the coast of South America. You have found an unusual amount of dead hummingbirds in the area, so you decide to examine the stomach contents of these birds. Much to your surprise, you find remains of small insects. What do you think might have caused the hummingbird to eat insects?

The hummingbird could not find the nectar it normally feeds on and in desperation starting eating insects in order to survive.

13. Identify an adaptation for one of the organisms you listed in question #10 A above.

Toads have long quick tongues to catch insects.

14. How does the adaptation identified in question #13 enable the organism to survive in its environment?

Without a quick long tongue it may be harder for the toad to catch food and more of them may die.

15. 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.

“Curriculum Map”

Author: Fie Budzinsky
Curriculum Map: Structure and Function: What's Their Junction?
Grade Level: 6

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 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. • Adaptations are important for organisms to survive in their ecosystems. • Structural, physiological and behavioral adaptations affect the survival of organisms. • Ecosystems contain food chains. • In order to meet their needs, some organisms live at the expense of others. • Most ecosystems have multiple food chains. • Organisms can be part of multiple food chains, thus forming food webs.	• Ecosystems • Organisms • Microorganism • Animals • Plants • Interdependence • Survival • Environment of non-living things • Producer • Consumer • Decomposer • Pond ecosystem • Ecosystem • Adaptation • Food chain • Food web • 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. • Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena.	• 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
2. 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. • Most animals are ultimately dependent on plants for their food because animals are unable to make their own food.	• Model • Ecosystem • Consumer • Organism • Interdependence • Survival • Terrarium • Plant • Animal • Producer • Consumer	• Observe • Compare and contrast • Analyze • Organize • Measure	• 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.	• Is a terrarium an ecosystem? Why or why not? • What kinds of interactions are seen in a terrarium?
3. Scientists use tools to assist them in their scientific investigations.	CORE 45 minutes	• Concept maps are visual representations of concepts and their relationships • Concept maps can help us to understand science topics.	• Scientific investigation • Concept • Concept map • Relationship	• Organize • Sequence • Identify missing information • Identify relationships	• Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena.	• What are concept maps? • How do concept maps help users to understand content?
4. Scientists work by wondering, observing, describing, using data to explain phenomena, and sharing information.	PRACTICE/ IDENTITY/ AID 45 minutes	• Anybody can be a scientist.	• Science • Scientist • Scientific exploration • Scientific question • Curiosity • Information • Problems • Questions • Tools • Experiments • Data • Team of scientists • Plans • Discussions • Individual opinions • Conclusions • Right • Wrong • Different	• Organize • Sequence • Identify missing information • Identify relationships	• Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena.	• What is the nature of scientific explorations? • What do scientists do when they explore natural phenomena?

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
5 & 6. Most ecosystems contain multiple food chains, thus forming food webs.	CORE/AID 1 hour, 20 minutes	• Ecosystems contain food chains.	• Model • Ecosystem • Organism • Microorganism • Interdependence • Survival • Producer • Consumer • Decomposer • Carnivore • Herbivore • Omnivore • Predator • Prey • Phytoplankton • Zooplankton • Food chain • Food web • Desert (AID) • Biome (AID)	• Identify characteristics • Describe characteristics • Compare and contrast • Analyze • Identify relationships	• The natural world is composed of systems, which are organized groups of related objects that together form a whole.	• How can models help us understand some of nature's processes? • How does the interaction of organisms help them meet their needs? • How do food webs help organisms survive?
7.The availability of food sources determines the likelihood of an organism's survival in a food web.	CORE/AID 45 minutes	• Environments differ with respect to physical factors, such as temperature, moisture, light and soil type (AID). • Environments differ with respect to biological factors, such as the kinds and numbers of organisms and availability of food. (AID) • Environmental change can be brought about by natural or man-made causes. (AID) • Many types of man-made environmental changes are detrimental to organisms. (AID)	• Ecosystem • Organism • Microorganism • Interdependence • Producer • Predator • Prey • Consumer • Phytoplankton • Zooplankton • Food chain • Food web • Environmental stress (AID) • Ecosystem balance (AID)	• Identify characteristics • Describe characteristics • Compare and contrast • Analyze • Identify relationships • Judge the accuracy of information	• 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 (AID).	• How does the interaction of organisms help them meet their needs? • What are food webs, and how can they help organisms to survive?

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
8. The availability of food sources determines the likelihood of an organism's survival in a food web.	CORE/AID 45 minutes		• Ecosystem • Organism • Interdependence • Producer • Consumer • Predator • Prey • Phytoplankton • Zooplankton • Food chain • Food web	• Identify characteristics • Describe characteristics • Compare and contrast • Analyze • Identify relationships	• 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.	• How can models help us understand some of nature's processes? • How does the interaction of organisms help them meet their needs? • What are food webs and how can they help organisms to survive?
9. Ecosystems have similarities and differences.	CORE 1 hour, 5 minutes	• Organisms have dependent and interdependent relationships that enhance survival. • Ecosystems can change over time.	• Model • Ecosystem • Organism • Microorganism • Interdependence • Survival • Producer • Consumer • Decomposer • Predator • Prey • Food chain • Food web • Diversity of organisms • Change	• Describe characteristics • Identify characteristics • Compare and contrast • Analyze • Categorize • Identify relationships • Draw conclusions • Justify answers	• 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.	• What kinds of interdependence are seen in the mini-pond and terrarium ecosystems? • How can models help us understand some of nature's processes? • How are the model ecosystems similar to each other? • How are the model ecosystems similar to and different from their real-world counterparts?

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
10. Assessment	CORE 45 minutes	• Organisms have dependent and interdependent relationships that enhance survival. • Ecosystems have producers, consumers and decomposers, which have different functions in the ecosystem. • Environmental changes occur for various reasons and at varying rates and affect the survival of organisms in an ecosystem.	• Ecosystem • Environment of non-living things • Organism • Microorganism • Interdependence • Survival • Producer • Consumer • Decomposer • Food chain • Environmental conditions • Environmental change	• Recognize attributes • Organize • Sequence • Identify missing information • Identify relationships	• 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.	• Do you understand the basic components of ecosystems? • Can you identify and describe the interdependence of organisms in the terrarium "mini-ecosystem"? • Can you construct a food web and differentiate between producers, consumers, carnivores, herbivores and omnivores?
11. Structural, physiological and behavioral adaptations affect the survival of organisms.	CORE 45 minutes	• Features that help an organism survive are called adaptations.	• Survival • Adaptation • Form and function • Structural adaptation • Physiological adaptation • Behavioral adaptation	• Recognize attributes • Identify relationships • Compare and contrast • Judge the accuracy of information	• 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 assist them to survive?

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
12 & 13. Structural, physiological and behavioral adaptations affect the survival of organisms.	CORE 1 hour, 30 minutes		• Survival • Habitat • Adaptation • Form and function • Structural adaptation • Physiological adaptation • Behavioral adaptation	• Make observations • 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. • Properties of some objects and processes are characterized by constancy, while properties of others are characterized by change.	• How do animals' varying features help them to survive? • What are the advantages and disadvantages of having specific adaptive features or behaviors?
14. Structural, physiological and behavioral adaptations affect the survival of organisms.	CORE/AID 45 minutes	• Some organisms can be detrimental to an ecosystem. (AID)	• Interdependence • Environmental factors • Diversity • Habitat • Adaptation • Environmental change • Environmental stress (AID) • Invasive organisms (AID)	• Make observations • Recognize attributes • Recognize patterns • 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. • Properties of some objects and processes are characterized by constancy, while properties of others are characterized by change.	• 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
15. Ecosystems have similarities and differences.	CORE 45 minutes	• The diversity among ecosystems supports a wide variety of life forms on earth.	• Ecosystems • Environment of non- living things • Organism • Interdependence • Producer • Consumer • Decomposer • Food chain • Food web • Diversity of organisms • Change	• Describe characteristics • Identify characteristics • Compare and contrast • Analyze • Identify relationships • 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?
16 & 17. Structural, physiological and behavioral adaptations affect the survival of organisms.	CORE 1 hour, 15 minutes	• Environmental factors affect the survival of organisms	• Survival • Interdependence • Habitat • Adaptation • Form and function • Structural adaptation • Physiological adaptation • Behavioral adaptation	• Recognize attributes • Identify relationships • Compare and contrast • Use creative thinking such as originality • Make decisions	• 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? • What are the advantages and disadvantages of having specific adaptive features or behaviors? • How can we best communicate our understandings of the connections between habitats and adaptations?
18 & 19. Structural, physiological and behavioral adpations affect the survival of organisms.	CORE/ CONNECTIONS 1 hour, 30 minutes	• Organism have preferred places in which they live.	• Survival • Habitat • Adaptions • Form and Function • Structural adaptation • Physiological adaptions • Behavioral adaptation	• Recognize attributes • Identify relationships • Compare and contrast • Use creative thinking such as originality • Make decisions	• 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? • What are the advantages and disadvantages of having specific adaptive features or behaviors? • How can we best communicate our understandings of the connections between habitats and adaptations?

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
20 & 21. Environmental factors affect the survival of organisms.	CORE/ AID 1 hour, 30 minutes	• Structural, physiological and behavioral adaptations affect the survival of organisms.	• Survival • Interdependence • Habitat • Adaptation • Form and function • Structural adaptation • Physiological adaptation • Behavioral adaptation	• Communicate findings • Explain • Summarize • Justify thinking • Formulate questions • Evaluate evidence	• 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? • What are the advantages and disadvantages of having specific adaptive features or behaviors? • Were we successful in communiating our understandings of the connections between habitats and adaptation?

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
22, 23 & 24. Ecosystems and their specific habitats are important to all organisms and must be preserved.	CORE 1 hour, 30 minutes	• Ecosystems have living and non-living things. • Living and non-living things interact with one another in various ways • Living things depend on other living and on non-living things to meet their needs. • Organisms have dependent and interdependent relationships that enhance survival. • Ecosystems have producers, consumers and decomposers. • Producers, consumers and decomposers have different functions in an ecosystem. • Some of an organism's features help it survive. • Features that help an organism survive are called adaptations. • Adaptations are important for organisms to survive in their ecosystems. • Structural, physiological and behavioral adaptations affect the survival of organisms. • Organisms have preferred places in which to live. • Ecosystems have a variety of habitats for the diversity of organisms. • The adaptations that organisms have help them to adjust to and improve their habitats.	• Ecosystem • Environment of non-living things • Organism • Interdependence • Survival • Habitat • Producer • Consumer • Decomposer • Adaptation • Form and function • Structural adaptation • Physiological adaptation • Behavioral adaptation • Preservation	• Discuss relationships • Summarize • Create visual representations • Write	• The natural world is composed of systems, which are organized groups of related objects that together form a whole.	• What were the "eurekas" you experienced during this unit? • Why should you care about the smallest snail, an endangered quail or the quality of air?

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
25. Ecosystems and their specific habitats are important to all organisms and must be preserved.	CORE 50 minutes	• Organisms must have their needs met in order to grow and live. • Living things depend on other living things and non-living things to meet their needs. • Organisms have dependent and interdependent relationships that enhance survival. • Ecosystems can change. • Adaptations are important for organisms to survive in their ecosystems. • Organisms have preferred places in which they live. • Ecosystems have a variety of habitats for the diversity of organisms.	• Ecosystem • Environment of non-living things • Organism • Survival • Basic needs • Interdependence • Adaptation • Form and function • Habitat • Environmental change • Habitat destruction	• Compare and contrast • Analyze • Discuss relationships • Ask questions • Summarize	• 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 are ecosystems and their components? • Have I learned more about ecosystems as a result of this unit's activities? • Why should I care about ecosystems? • Can I make a difference to the health of ecosystems?

Major Principles and Generalizations	Time Allocation and Parallel	Minor Principles and Generalizations	Concepts	Skills	Themes	Guiding Questions
26. 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 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. • Adaptations are important for organisms to survive in their ecosystems. • Structural, physiological and behavioral adaptations affect the survival of organisms. • Ecosystems contain food chains. • In order to meet their needs, some organisms live at the expense of others. • Most ecosystems have multiple food chains. • Organisms can be part of multiple food chains, thus forming food webs.	• Ecosystem • Environment of non-living things • Organisms • Microorganism • Animals • Plants • Interdependence • Survival • Producer • Consumer • Decomposer • Pond ecosystem • Adaptation • Food chain • Food web • 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 Chart”

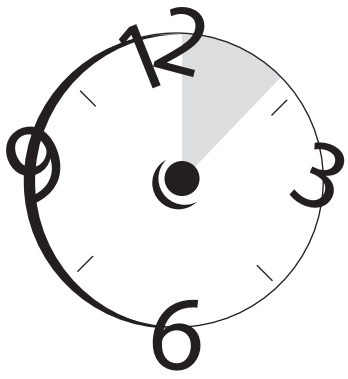
Lesson	Primary Materials	Books	Additional Materials (Supplied by Teacher)
1	Chart paper, markers, picture of pond ecosystem, 3-ring notebook for each student		Ask students to bring in a 2 liter soda bottle for lesson 4 two weeks prior to starting unit.
2	Droppers or straws for watering, index cards, wide rubber bands, regular rubber bands, markers, plastic cups, plastic spoons, scissors, rulers, 4" fiberglass screen per group, heavy tape, 3 kinds of seeds, such as grass, alfalfa, mustard (20-30 seeds for each group), 25-30 lb. bag of aquarium gravel, potting soil (1-2 cups per group)		Newspapers to cover tables, utility knife, leaf mulch or small twigs stones and pebbles—students will need empty 2 liter soda bottles
3			Overhead projector
4			Overhead projector
5/6	Map of the world that shows Africa and the country of Botswana, pushpins, ball of yarn, copies of **Common Food Web** (included in unit), labels and images of organisms from Okavango Delta in Africa, illustrations of simple food chains in which some of the organisms are common to each of the food chains		Internet access
7	Index cards, images and labels for salt marsh organisms, yarn, article for AID activity on blue crabs		Internet access
9	Picture of pond, pond ecosystem		Internet access
10	Article" Incredible Shrinking Polar Bears" from *National Wildlife*		Internet resources as needed
11			Internet resources as needed
12/13	Colored construction paper, markers, scissors, glue sticks, tape, pipe cleaners, crayons		
14	Wide blue ribbon or blue cloth (12" – 20" long), salt marsh pictures on cards, one bottle of soap bubbles + wand, 2 cardboard tubes (paper towel rolls)		Internet access

Lesson	Primary Materials	Books	Additional Materials (Supplied by Teacher)
15	Chart paper, posters of various ecosystems		Overhead projector (Save completed chart paper for lesson 25), Internet access
16/17		*Everyday Life of Animals: Adapting to the* Environment by Fulvio Cerfolli	Internet sites as needed
18/19	Poster board, single hole punch, oak tag, yarn, index cards, glue sticks, tape, markers, colored construction paper, crayons, paints, scissors. string		Wire coat hangers, cardboard boxes of various sizes, computer access, projector
20/21			Projector, computer, and any other equipment needed for student presentations
22/23/24	Composition paper, drawing paper, crayons and/or colored pencils, colored markers, glue sticks		Computer availability if desired
25			Chart paper used in Lesson 18
26	Poster of pond ecosystem.		

Ecosystems and Scientific Inquiry

Core/Practice

Time Allocation: 45 minutes to build,
2 to 3 weeks of observations



Lesson Overview

Students in this lesson will continue the process of studying ecosystems directly by building two other mini-ecosystems. This lesson will provide more evidence of the interdependence of organisms and the idea that living things interact with non-living things and sometimes depend on them for their survival. Students will build one of two mini-ecosystems, a worm mini-ecosystem or a "life in and on a log" mini-ecosystem. Students will observe these ecosystems and describe the interactions they see, as well as the relationships between living and non-living things. Students will eventually compare and contrast these ecosystems, so that they gain insights into the similarities and differences between various ecosystems.

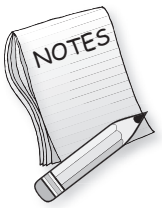
Guiding Questions

- What can we learn from studying other small ecosystems?
- How are ecosystems alike and how are they different?
- Are worms important?
- Is there really much going on when something rots?

BIG IDEA

Relationships Between Living and Non-living Things in an Ecosystem

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



Content Goals

Universal Themes

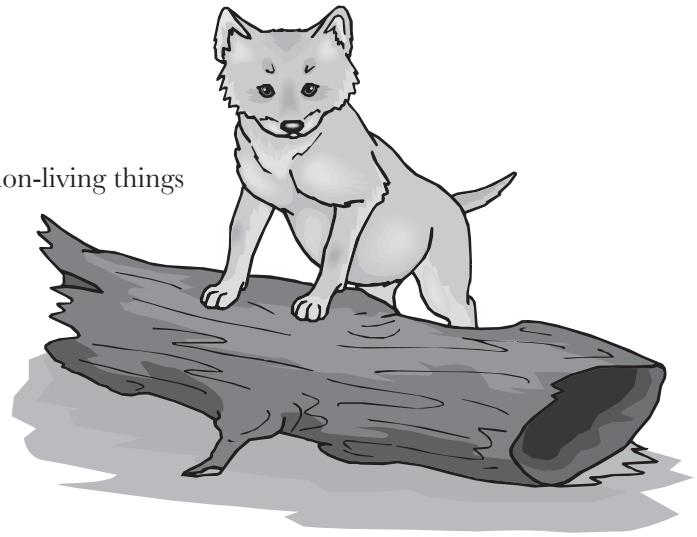
- The natural world is composed of systems which are organized groups of related objects that together form a whole.
- Science involves making hypotheses, theories and conceptual models to represent, explain and predict phenomena.
- Properties of some objects and processes are characterized by constancy,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

Principles and Generalizations

- Models are used to study the various aspects of nature.
- Organisms must have their needs met in order to grow and live.
- Living things depend on other living things and non-living things in order to meet their needs.
- Organisms have dependent and interdependent relationships that enhance survival.
- Decomposers have an important role in ecosystems.
- Decomposers recycle material from dead organisms back to the environment.
- Environmental factors affect the survival of organisms.
- Environmental changes occur for various reasons and at varying rates (extension).
- Ecosystems can change because of changes in environmental conditions (extension).

Concepts

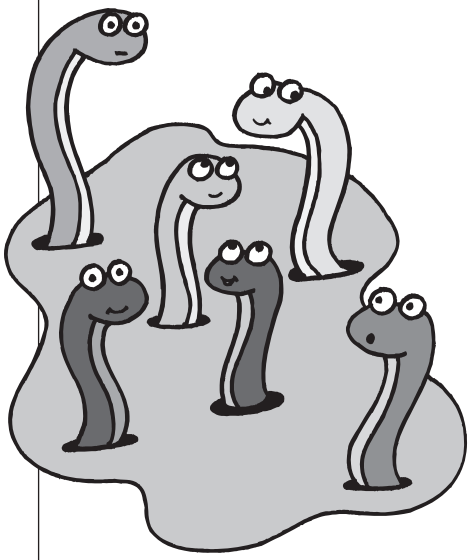
- Model
- Ecosystem
- Environment of non-living things
- Organism
- Plant
- Animal
- Interdependence
- Survival

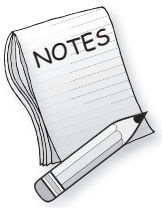


- Decomposer
- Environmental change (Extension)
- Environmental conditions (Extension)

Teacher Information

- Vermicomposting is composting with worms. Vermicompost is a type of soil that is made by red worms and other microorganisms as they eat through organic material such as leaves or food scraps. This type of soil or compost is basically worm castings or droppings.
- By the end of the worm column study, students should know that worms are decomposers and a very important contributor to the contents and health of soil. They should know that worm castings fertilize soil, as they add nutrients. They should know that as worms tunnel through soil they aerate soil so that plant roots and water can penetrate soil. Students will learn that the fruit, vegetable scraps, and leaves decompose at different rates with the fruit and vegetables decomposing faster than the leaves, twigs etc.
- Students will learn that worms push their way through the soil, swallow the earth and bits of plants and vegetable scraps as they move through the soil.
- Worms cannot see red light.
- The vibrations from low notes travel into a wormery and send a danger signal to worms that will cause them to leave their burrows. Students can try this at home by going outside during the day and hammering a stake into the ground. They should then rub a board over the stake, which sends vibrations into the ground and signals danger to the worms below. The students should see worms popping out of holes in the ground as they leave their tunnels.
- Rotting logs can be home to many organisms such as: fungi, lichens, mosses, yellow birch seedlings, hemlock seedlings, bristletails, bark beetles (live underneath the bark and make tunnel patterns), springtails, millipedes, centipedes, ground beetles and larvae, land snails, earth worms, termites, wood lice (also click beetles and larvae, daddy-long-legs, crickets, carpenter ants, moth cocoons, and butterfly chrysalides.
- Fungi and microscopic bacteria soften wood with special chemicals so that larger animals like the insects can eat it.





- When young insects hatch, they create tunnels by eating their way through the wood. As the insects grow, the tunnels they create get wider, as a result of their wider girth.

Skills

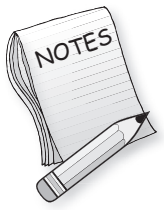
- Observe
- Organize
- Collect data
- Compare and contrast
- Analyze
- Follow directions
- Make decisions

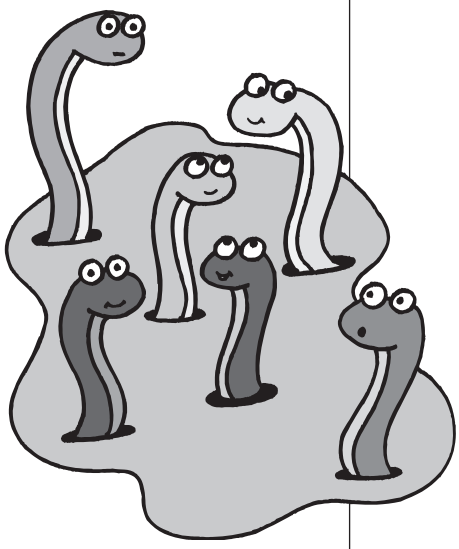
Materials and Resources

1. Two-liter soda bottles (2 per student or group)
2. Utility knife or scissors (1 per student or group
3. Hat or diaper pin (1 per student or group)
4. 8d common nail for the 3-mm hole and a 16d nail for the 5-mm holes (1 per student or group)
5. Brown or black construction paper or paper bag (1 per student or group)
6. Measuring cup or 400 ml beaker
7. (Optional) Charcoal (1 teaspoon per worm column)
8. Garden soil to provide some natural soil microorganisms (1 –2 cups per student or group)
9. Fallen leaves, twigs, and/or wood chips
10. Shredded newspaper and/or straw for worm "bedding"
11. Vegetable waste (e.g., carrot tops, lettuce, celery ends)
12. (Optional) Crushed egg shells (can be used to raise more neutral or basic condition which is preferred by red worms)
13. Newspaper to cover desktops
14. Paper towels for cleanup
15. Red worms (15-20 per student or group of students)- can be obtained from a local bait shop or from the following supply companies:
    - o Carolina Biological at (1-800-334-5551) at 2700 York Road, Burlington, North Carolina 27215
    - o Nasco Science (1-800-558-9595) 901 Jamesville Avenue Fort Atkinson, Wisconsin.

- o Edmund Scientific (609-573-6250) in Barrington, New Jersey.
- o Connecticut Valley Biological (1-800-628-7748) in Southhampton, Massachusetts
- o Science Kit and Boreal Labs (1-800-828-7777) in Tonawanda, New York.
- o The site www.wormwoman.com also sells red worms by the pound (200 red worms)

16. An article written by Daniel McLaughlin in 1987 on "worm bins" is available in *Science and Children* 24(6): 11-12.
17. One gallon jar (large condiment jar) or a small fish tank
18. Small pebbles or sand
19. Untreated charcoal pieces (available at the grocery or hardware store)
20. Dead logs and surrounding soil and decaying leaves (trowel to dig up the soil)
21. Fine screening or cheese cloth to cover the top of jar or tank
22. Tape for fish tank or elastic (for jar)
23. Butcher-block paper for the KWL chart
24. The following site at Rice University has a list of web sites addressing composting in general and vermicomposting in particular. http://www.ruf.rice.edu/~envintrn/composting_links.html (There is an underscore after the word "composting" and before the word "links."
25. For those students who become particularly interested in the value of composting the following develop composting projects:
    - o http://www.dep.state.pa.us; Put "compost" into search bar.
    - o http://www.deq.state.la.us; Put "compost" into search bar.
    - o http://www.bbg.org/gar2/topics/urban/composting/
26. There is a site at Michigan State University that describes a "Worm Bin Project" in which there are additional lessons related to vermicomposting such as Lesson 4 which contains resources on decomposition, soil and gardening. The address is:
    http://commtechlab.msu.edu/sites/letsnet/noframes/Subjects/science/b2u114.html





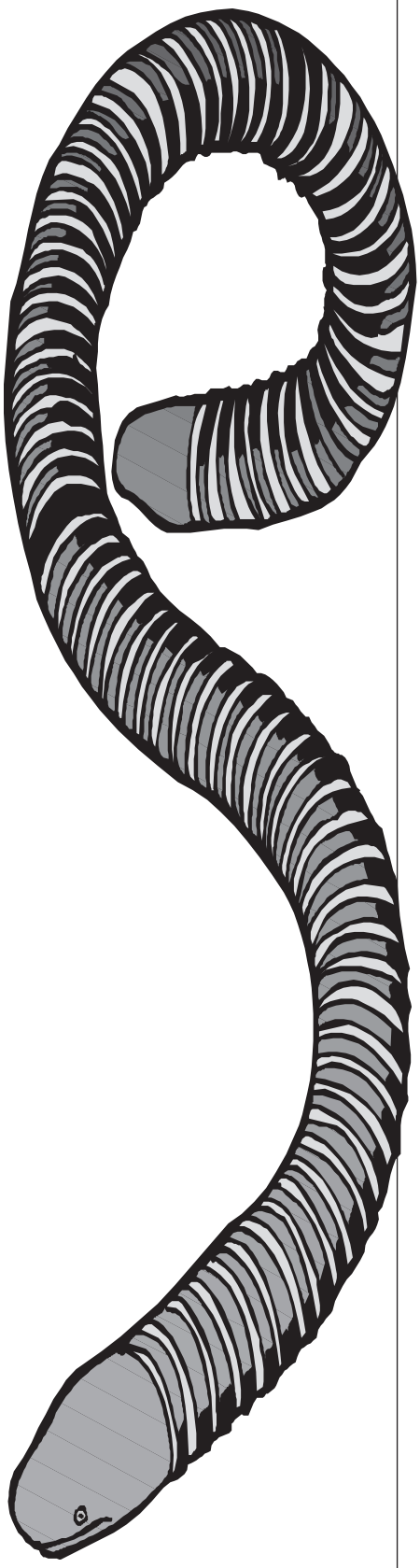
Preparation Activities

1. Worm mini-ecosystem:
   - o Several weeks prior to teaching this lesson send home requesting plastic soda bottles or post a notice in your newsletter.
   - o Remove the labels from the bottles (place the soda bottle in hot water to soften the glue on the base of the bottle).
   - o Wash the bottles, so the plastic is clear.
   - o Cut bottles (2 per student worm column) in advance or have students practice their measurement skills. Start each cut, thus making it safer for students. Be sure the cap is on the bottle and then (teacher only) use a knife to make initial cuts (if you have not done this in advance). The students can then complete the cutting using scissors.
   - o Make the cutting of the "mini-ecosystems" simpler by using a wide rubber band and placing it where you want to cut the bottle. Use a marker to draw a circle all the way around the bottle, running your marker along the rubber band.
   - o Pre-cut the top of the bottle #1 off about 2-3 cm above the shoulder of the bottle (the shoulder is located about 20 cm up from the base of the bottle)
   - o Pre-cut Bottle #2 about 13 cm from the bottom.
2. Log mini-ecosystem (Optional: to have only one log mini-ecosystem built by the teacher and used for observation purposes only or have each student or student group set up their own log mini-ecosystem):
   - o Go to a wooded area and find small rotting logs full of life
   - o With a trowel put about 7 cm (3 inches) of nearby soil and decaying leaves into the tank(s) or 1 gallon jar(s) depending on the number of groups that will be studying this log mini-ecosystem.
   - o Add water to make the soil mixture damp.
   - o Shape the soil into small hills so that it is more like the forest floor.
   - o On site carefully break of a small piece of rotting log.
   - o Put the piece of log and 2-cm of soil from beneath the log into fish tank or 1 gallon jar that will hold the log mini-ecosystem. The log must fit into the tank or jar without being squished.
   - o Dig up some mushroom-like fungi and small plants from around the log and plant them in the tank or jar.

- o Press the plants down firmly and water them.
- o Cover the tank or jar with the screening and secure it with tape or elastic.
- o On the day of the lesson place the materials (see above) for building the mini-ecosystems out on a table "buffet style."
- o Organize the supplies to enable students to file past them on both sides.
- o 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.
- o Make copies of the **Instructions for Building, Maintaining and Observing a Worm Mini-ecosystem** (one for each group).
- o Make copies of the **Instructions for Building a Log Mini-ecosystem** (one for each group).
- o Make copies of the of **Worm Mini-ecosystem Observations** sheet (one for each student).
- o Make copies of the of **Log Mini-ecosystem Observations** sheet (one for each student).

Introductory Activities (10-15 minutes)

- Tell students they will be studying two more mini-ecosystems, a log and a worm column that uses red worms to form a type of soil called vermicompost.
- Tell them that they will study a teacher-prepared log mini-ecosystem and build their own worm mini-ecosystems (Option is available to have students build their own log mini-ecosystem.).
- Have students take some paper from their loose leaf notebooks and set up a KWL chart while you do the same on butcher-block paper in preparation for a discussion on what students know and want to know about red worms and their habitat.
- This chart will be completed after students finish documenting observations of the worm columns and sharing conclusions with one another.
- Hand out and review **Instructions for Building, Maintaining and Observing a Worm Mini-ecosystem** (one per group).
- Hand out **Worm Mini-ecosystem Observations** sheets (one per student or group of students).
- Hand out **Log Mini-ecosystems Observations** sheets (one per student or group of students).



- Hand out **Conclusions Regarding Worm and Log Mini-ecosystems** sheets (one per student or group of students)

Pre-assessment

Students' KWL charts from Introductory Activities

Teaching and Learning Activities (30-35 minutes)

1. Have students build worm mini-ecosystems.

2. Discuss with students how you built the log mini-ecosystem (see Preparation Activities above or have them build it themselves).

3. Instruct students to place the mini-ecosystems in the appropriate areas. The log mini-ecosystem should be placed in a north-facing window where it will get natural light. Keep it away from heaters and drafts.

4. Invite some students to investigate the processes by which worms eat and digest their food and eliminate waste. Also have them explore how worms "breathe" while underneath the soil.

5. Explain to students that they will be observing their worm and log mini-ecosystems each day and recording observations in the **Worm Mini-ecosystem Observations** and **Log Mini-ecosystem Observations** sheets (at the end of this lesson). Remind students that when writing down their Day # in the first column that after weekends they must add two days to their total count number. The reason is that the "terrarium" has been changing, evolving during the weekend, and an accurate picture of how much change occurred during the entire period of the study is desired. Therefore, they must include all of days in their count.

6. Hand out and review the **Conclusions Regarding Worm and Log Mini-ecosystems** sheet.

7. At the conclusion of the observations (about 3 weeks), have students submit the answers to the questions on the **Conclusions Regarding Worm and Log Mini-ecosystems** sheet below. Note: It might be difficult for

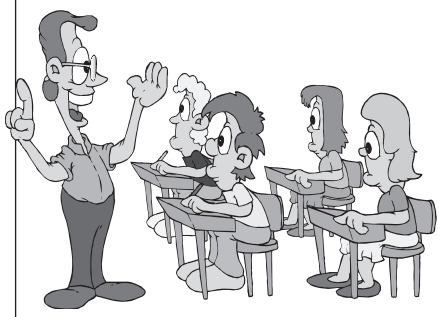
students to answer question #5 for the worm mini-ecosystem. They might see worms lying side-by-side with their heads at opposite ends, which indicates they are probably mating. This may be problematic to observe, so if it is spotted in any one of the worm habitats, students from other groups should be brought over to observe the process.

Products and Assignments

- Students' **Worm Mini-ecosystem Observations** sheets
- Students' **Log Mini-ecosystem Observations** sheets
- Students' **Conclusions Regarding Worm and Log Mini-ecosystems** sheets

Extension Activities

1. Invite some students to try some further investigations with the worm habitats. They could place different colored lights (red and yellow) over the column and see if there is any effect on the worms' behaviors.
2. Suggest that some students feed worms different leafy vegetables to determine whether worms are "picky eaters."
3. Have some students explore the effect of vibrations on worms, as Charles Darwin did over 100 years ago. Instruct them to place the worm mini-ecosystem on a piano and play high and low notes and observe the resulting behaviors (see Teacher Information).
4. Encourage students to further research logs by studying logs that have been down for varying amounts of time and collected at different times of the year.

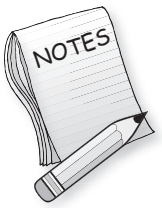


Post Assessment

N/A

Debriefing and Reflection Opportunities (10-15 minutes)

1. After the worm and log mini-ecosystems have been observed for several weeks, ask students to share their observations and fill in the last column of their KWL charts. Discuss the importance of worms as decomposers and nutrient providers.



2. Talk about the students' observations and discuss the answers to the questions on the **Conclusions Regarding Worm and Log Mini-ecosystems** sheets.
3. When discussing the log mini-ecosystems include a discourse about the existence of microorganisms students did not see, such as bacteria that aid in the initial stages of the decomposition process.
4. Have the students who further explored the worm's structures and functions share their knowledge regarding a worm's ability to "breathe" through its skin. Have them explain why worms are wet (oxygen is absorbed more easily through wet skin). Invite these students to also share their understandings about how a worm's skin is like its eyes, as it is sensitive to light. Worms instinctively avoid light, as it tends to dry out their skins. Ask students to talk about the worm's digestive system.
5. If any students pursued the suggested extended studies of the worm or log mini-ecosystems, invite them to share their findings with their classmates.

Instructions for Building, Maintaining and Observing Worm Mini-ecosystems

1. Get two bottles that have been pre-cut. Bottle #1 has the top cut off.
2. Put 3 rings of about eight 3-mm air holes around Bottle #1. Use a hat pin to start the holes and the 8d nail to get the hole to the proper size (3 mm)
3. Evenly space these rings and start the first ring several centimeters below the newly formed top and place the third ring above the "base feet."
4. Put about 4 or 5 drainage holes (about 4 -5 mm in size) using the 16d nail in the molded base of Bottle #1.
5. Cut Bottle # 2 about 13 cm up from the base. Bottle #2 will serve to catch any excess water that drips through Bottle #1.
6. Place a layer of gravel/rocks into the bottom of Bottle #1 (about 1-2 cups of materials).
7. If charcoal is available, sprinkle one teaspoon of charcoal over the rocks.
8. Cut two newspaper pages into strips that are .5-cm wide and then cut them in half to provide bedding for the worms.
9. Fill Bottle #1 with the bedding.
10. Add 1-2 cups of soil to the Bottle #1.
11. Place Bottle #1 in Bottle # 2 with the bottom of Bottle # 1 lowered into Bottle #2 (Bottle #2 will serve to catch any excess water that drips through Bottle #1.)
12. Add 2-3 cups of water to moisten the bedding. Do not saturate the bedding.
13. Place 1 to 2-cm pieces of vegetable scraps in the newspaper bedding and cover it with moist bedding. To avoid possible odors or pests, bury food scraps under the newspaper, leaves straw, wood chips.
14. Remember to feed the worms every 3 or 4 days. The food must be in small pieces and moist because worms feed by sucking or pumping material into their bodies using special muscles. Be careful not to overfeed them by checking to see if the food is almost gone before adding more.
15. Place the brown paper around the bottle to block out the light, as worms prefer the dark. If the paper covers the bottle and blocks the daylight, the worms will be more likely to come close to the sides of the bottle and will be easier to study. Tape the sides of the column-shaped paper together, so that it surrounds the bottle yet can be lifted up and down easily during observation periods. Place the worm mini-ecosystem in a cool environment (68°F to 74°F is the preferred temperature).
16. Using the **Worm Mini-ecosystem Observations** sheet, write down the changes every day that happen in the worm mini-ecosystem. Remember to look for changes in the organisms and in the environment. For instance, the color of the soil may change because of the products of decomposition.
17. Enter the number of the day in the column on the left. Remember after a weekend to add two days to your total count number. For instance, if Friday was Day #3 of growth, then on Monday when you come back from the weekend, you will enter Day #6 because Day #4 and #5 were weekend days during which you could not make observations, but the "worm mini-ecosystem" was still undergoing changes.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

Worm Mini-ecosystem Observations

	Worms	Soil	Leaves	Vegetable Scraps	Paper
Day #					
Day #					
Day #					
Day #					
Day #					

Partner Name _____ **Date**_____

Log Mini-ecosystem Observations

	Plant Life on Log	**Physical Features of Log**	**Organism in or on Log**	**Organisms in Soil**	**Soil Conditions**	**Interactions between organisms or between organisms and the non-living components**
Day #	(Make sure you lift up a piece of bark to see if anything is under it)	(Make sure you lift up a piece of bark to see if there are any patterns from organisms underneath)				
Day #						
Day #						
Day #						

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

Conclusions Regarding Worm and Log Mini-ecosystems

1. What are the living components of the worm and log ecosystems?

2. What are the non-living components of the worm and log ecosystems?

3. A. In the worm mini-ecosystem, did the soil change over time? If so, describe the major differences between what the soil looked like at the beginning of our observations and at the end of the week.

B. How can you tell the head from the tail of a red worm?

C. Did you notice any material coming out of the worms over time? If so, describe this material.

D. Did you notice any two worms lying side-by-side with their heads at opposite ends? If so why do you think they were doing that?

Name _____ **Date**_____

E. Are worms more active during the morning or afternoon?

F. Do worms live close together or are they usually alone? Why do you think they live like this?

G. How do red worms move?

H. In the log ecosystem, what did you notice about the size of the tunnels?

4. In the worm and log ecosystems describe evidence that organisms interact with non-living things in their environment.

A. Evidence from worm ecosystems:

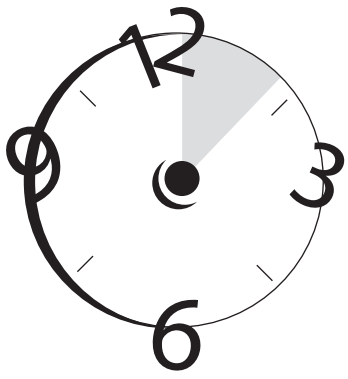
B. Evidence from log ecosystems:

5. In the worm and log ecosystems describe any evidence you found that organisms interact with living things in their environment.

Ecosystems and Scientific Inquiry

Core/Practice

Time Allocation: 45 minutes to build,
2 weeks of observations



Lesson Overview

Students in this lesson will build and 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.

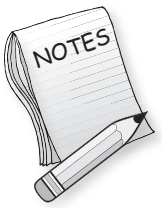
Guiding Questions

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

BIG IDEA

Succession

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



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 in 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.

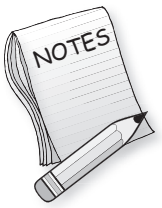
- While there is water in the jar, the seeds should germinate and then rot.
- As the water evaporates from the "mini-pond in a jar" down to the soil, the aquatic plant will die, thus modeling what would happen to plants in a pond if a long-term drought occurred.
- The birdseeds will find the environment suitable for successful growth after the water completely evaporates.
- Sunflower seeds, which grow large, can be added to represent forest trees.

Skills

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

Materials and Resources

1. Pint or quart jars (one per student or group)
2. Water
3. Soil
4. Aquatic plant (one per jar)
5. Two cups of birdseed with sunflower seed included. If this cannot be found, just mix a cup of sunflower seeds with a cup of regular birdseed. The seed should grow well near a window. If your classroom has no windows, substitute a grow-light
6. Rulers (one per student or group)
7. 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).



8. Pictures can be found on the Internet by using the Google Search engine and clicking on "Images" and typing in the name of the plant 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. Collect four gallons of pond water.
2. Obtain a small pail of pond silt/sand from the bottom of the pond.
3. Bring in some small pond plants and put them in a gallon jar.
4. Gather pint jars or have each student bring one in from home.
5. Mix the sunflower and regular bird seed together if a mixture cannot be purchased. The sunflower seeds will grow larger and could represent the "trees" in the evolving "mini-forest" ecosystem.
6. On the day of the lesson, set out the equipment on a table "buffet style."
7. Organize the supplies so that the students can file past them on both sides.
8. 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.
9. Make copies of the **Mini-pond Ecosystem under Stress Observations** sheet (one for each student).

Introductory Activities (5 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?"
- Tell them that they will be manipulating some environmental conditions in order to study the effect of stress on their mini-pond ecosystem.
- Hand out the instructions for the activity, **Can Ecosystems Change Their Identity?**
- Hand out the **Mini-pond Ecosystem under Stress Observations** sheet to each student and tell them they will be using it to record daily

- At the completion of the activity (it can last from several to many weeks) have the students talk about what they have learned about how environments can change.
- 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.
- Tell them they will make and document observations of the interactions of organisms with each other and with the non-living components within a model ecosystem.
- Share with them that they will discover the ways that living things depend on each other and on the non-living things in the environment.
- Hand out **Instructions for Building a Mini-pond in a Jar** to each group.
- Distribute **Mini-pond in a Jar Observations** sheet.
- Hand out **How Good Were Your Observations on Mini-pond Life?**

Pre-assessment

N/A

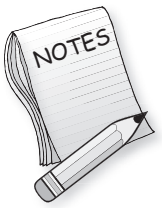
Teaching and Learning Activities (40 minutes)

1. Have students build their mini-ponds.

2. Instruct students to place the mini-ponds in a well-lighted area, not in the direct sun.

3. Explain to students that they will be observing their mini-ponds each day and recording observations in the **Mini-pond in a Jar Observation** sheet (at the end of this lesson). Remind students that when writing down their Day # in the first column, they must add two days to their total count number after a weekend. The reason is that the mini-pond has been changing, evolving during the weekend, and an accurate picture of how much change occurred during the entire period of the study is desired. Therefore, they must include all of days in their count.

4. Inform students that it will take three to four days for the seeds to germinate.

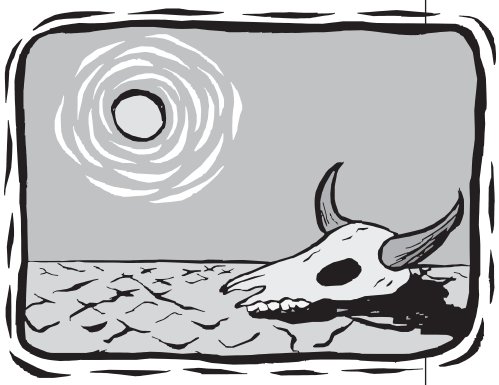


5. After seven school days, tell the students that they will stop watering the system.

6. Discuss why this might be considered stressful for the ecosystem.

7. The day students do not add water to the mini-pond, have them write their predictions as to what will happen to the model ecosystem when it experiences a "drought" on the **Can an Ecosystem Change Over Time?** sheet.

8. In addition, tell students to justify their predictions with some logical thinking. In other words, have students include why they believe their predictions are going to be correct.



9. Collect students' predictions and read some of them out loud.

10. Have students discuss any predictions that are different from one another and provide opportunity for students to support or disagree with the various predictions.

11. Tell students that scientists often meet in forums to share their research and during these times they can be challenged by other scientists. This sort of behavior is characteristic of scientific thinking.

12. Discuss what is meant by the statement "Scientists display skepticism."

13. At the end of the activity (approximately 2 weeks) have students answer the remaining questions on the **Can an Ecosystem Change Over Time?**

14. As the activity progresses and changes occur, discuss with students the concept of ecological stress and succession. Use the example of an area being destroyed by some atomic bomb (nuclear testing site in a desert area) in which all of the plants are destroyed, soil disturbed, etc. Describe 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).

15. Discuss the 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.

Products and Assignments

- Students' **Mini-pond in a Jar Observations** sheets
- Students' **Can an Ecosystem Change Over Time?** sheets

Extension Activities

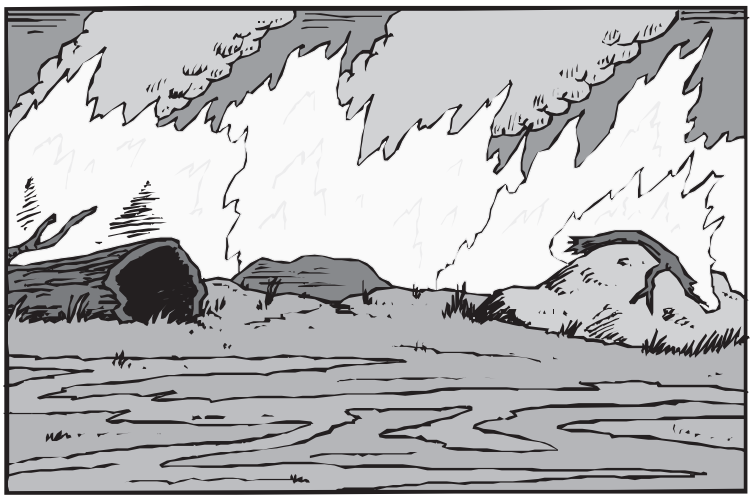
N/A

Post Assessment

N/A

Debriefing and Reflection Opportunities (10 – 15 minutes)

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



STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

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. At the end of class, place your jar in a relatively cool place (away from the direct sun and away from the radiator).

7. Do not shake the jar, as that will disturb the organisms in your "mini-pond."

8. You will NOT add additional pond water to keep the level in the jar approximately the same. This will cause the mini-ecosystem to undergo stressful conditions, as the system normally depends on you to give it water, which is like a rainfall in a pond ecosystem.

Name _____ **Date**_____

Mini-pond in a Jar Observations

	Plant Observations	**Interactions between Living and Non-living Things**
Day #1		
Day #		
Day #		
Day #		
Day #		

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

Can an Ecosystem Change Over Time?

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.

Can Ecosystems Change Their Identity?
Instructions:

1. Place two inches of soil and three inches of water in a jar.

2. Place the jar at a window, without a lid, and allow it to settle overnight.

3. Plant an aquatic plant in the jar on the following day.

4. Using the **Mini-pond Ecosystem Under Stress Observations** sheet, write down the changes every day that happen in the jar. Remember to look for changes in the organisms and in the environment. For instance, the water level may change height (rulers can be used to measure its height each day).

5. Enter the number of the day in the column on the left. Remember after a weekend to add two days to your total count number. For instance, if Friday was Day #3 of growth, then on Monday when you come back from the weekend, you will enter Day #6 because Day #4 and #5 were weekend days during which you could not make observations but the "mini-pond" was still undergoing changes.

6. Do not replace the water that evaporates from the jar.

7. Once or twice a week have students add three or four birdseeds to the jar.

8. After all the water has evaporated, continue adding seeds.

9. Water the seeds, as a substitute for rainfall, about once a week, making sure the soil is damp to keep things growing.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Partner Name _____ **Date**_____

		Soil	**Alfalfa Seeds**	**Grass Seeds**	**Mustard Seeds**	**Gravel/ Rocks**	**Water**
Day #	Color						
	Other Observations						
Day #	Color						
	Other Observations						
Day #	Color						
	Other Observations						
Day #	Color						
	Other Observations						
Day #	Color						
	Other Observations						
Day #	Color						
	Other Observations						

Mini-pond Ecosystem under Stress Observations
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:

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?

Name _____ **Date**_____

How Good Were Your Observations on Mini-pond Life?

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

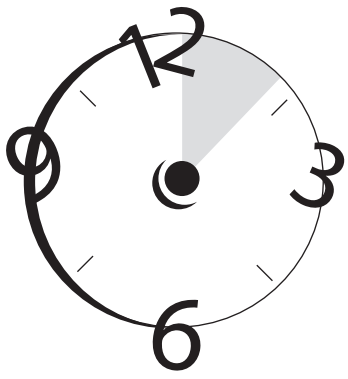
6. Do any of the animals stay below the surface? Would they have to have gills? If so, can you see the gills? Sketch pictures, or name the animals if you can.

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?

Ecosystems and Scientific Inquiry

Core

Time Allocation: 90 minutes
(Two 45 minute Lessons)



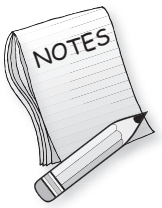
Session Overview

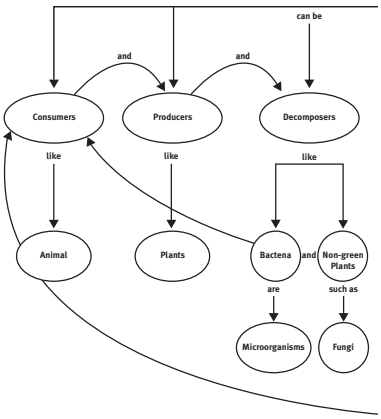
Students in this lesson will create a concept map using the majority of the concepts to be explored in the unit. This activity is used to reinforce the idea of using concept maps as a tool to communicate understandings and to assess prior knowledge.

Guiding Questions

- What are your understandings about the nature of ecosystems?

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?





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 from a whole.

Principles and Generalizations

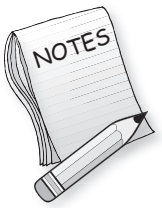
- Models are used to study the various aspects of nature.
- Ecosystems have living and non-living things.
- Living and non-living things interact with one another in various ways.
- Organisms have dependent and interdependent relationships that enhance survival.
- Organisms have needs that must be met in order to grow and live.
- Ecosystems have producers, consumers and decomposers.
- Producers, consumers and decomposers have different functions in an ecosystem.
- 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.
- Decomposers recycle material from dead organisms back to the environment.
- Many microorganisms are decomposers and are beneficial.
- Ecosystems have food chains.
- Most ecosystems have multiple food chains.
- Organisms can be part of multiple food chains, thus forming food webs.
- Environmental factors affect the survival of organisms.
- Ecosystems can change because of changes in environmental conditions.
- Organisms have preferred habitats.
- Structural, physiological and behavioral adaptations affect the survival of organisms.
- The adaptations that organisms have help them to survive.

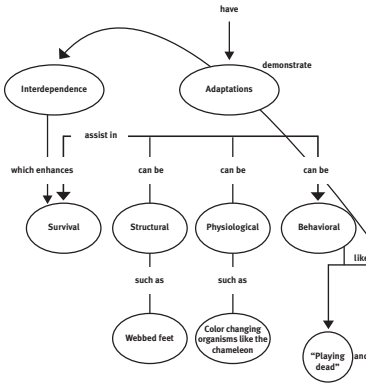
Ecosystems and Scientific INQUIRY

Concepts

- Model
- Concept map
- Ecosystem
- Environment of non-living things
- Organism
- Microorganisms
- Bacteria
- Animals
- Plants
- Non-green plants
- Fungi
- Interdependence
- Survival
- Basic needs
- Food
- Shelter
- Habitats
- "Homes"
- Plant roots growing down
- Populations
- Streams
- Producers
- Communities
- Color changing organisms
- Adaptations
- Structural
- Physiological
- Behavioral
- "Playing dead"
- Webbed feet
- Food chains
- Food web
- Stress
- Acid rain
- Deforestation
- Habitat destruction

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?





- Terrarium
- Bogs
- Ponds

Teacher Information

N/A

Skills

- Organize
- Sequence
- Identify missing information
- Identify relationships

Materials and Resources

1. (Optional) Concept map software such as Kidspiration or Inspiration would be helpful but is not necessary. If students have never used this type of software, paper and pencil is the preferred tool for assessment.
2. (Optional) Computer lab
3. Two examples of concept maps that students may produce are included in this lesson.
4. Pencils
5. Erasers (if they do their concept maps by hand)
6. Paper (11" x 14" preferred)

Preparation Activities

1. If paper is used, make a list of the 39 concepts associated with ecosystems to hand out to students.
2. (Optional) If software such as Kidspiration or Inspiration is used, prepare a new Kidspiration or Inspiration file that has the key concepts already listed in their symbol boxes so that student only have to move them around and link them.
3. (Optional) Load a copy of this "starter" file on each of the students' computers.
4. (Optional) Tell the student(s) to change the words in the "Main Idea" box to whatever concept they want to start their map with, such as "organisms," "ecosystems," etc. Have students move the remaining concepts around and make the relationship connections they see fit.

Introductory Activities (5 minutes)

- Have the student(s) observe and record their observations of the terrarium mini-ecosystem.
- Give each student pencils, erasers, and blank paper if they do their concept maps by hand.
- Tell the student(s) that understanding their knowledge as they proceed through instruction is important in implementing a unit of science instruction and that today's activity is an effort to better understand what they know or do not know about ecosystems at this time.
- Tell the student(s) they will be designing a concept map to demonstrate their current understandings of ecosystems.
- Give the student(s) the list of 39 concepts associated with ecosystems and have them design a concept map that reveals their understandings of the definitions and relationships between the concepts associated with ecosystems.

Pre-assessment

N/A

Teaching and Learning Activities (35 minutes)

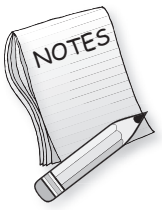
1. Distribute the handout, **List of 39 Concepts for the Ecosystem Concept Map**, to all students.

2. Tell the student(s) to use the list of concepts to build a concept map based on their understandings of the relationships among the concepts.

3. Give students time to will draw the concept maps. (Optional) Take the students to the computer lab if software is to be used.

Products and Assignments

- Students' concept maps



Extension Activities

N/A

Post Assessment

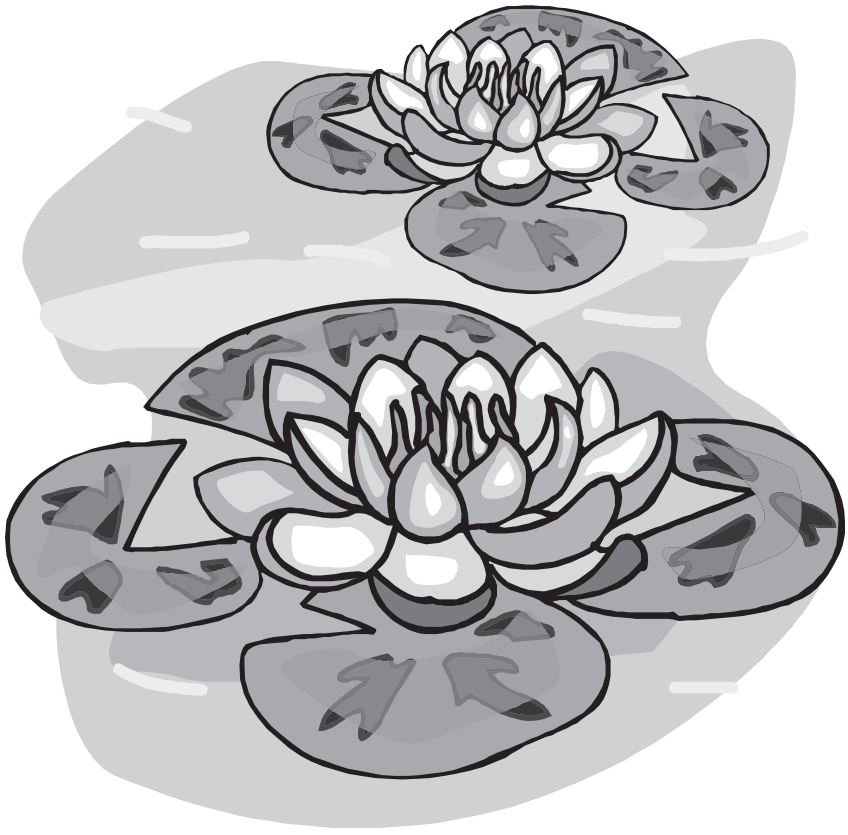
N/A

Debriefing and Reflection Opportunities (5 minutes)

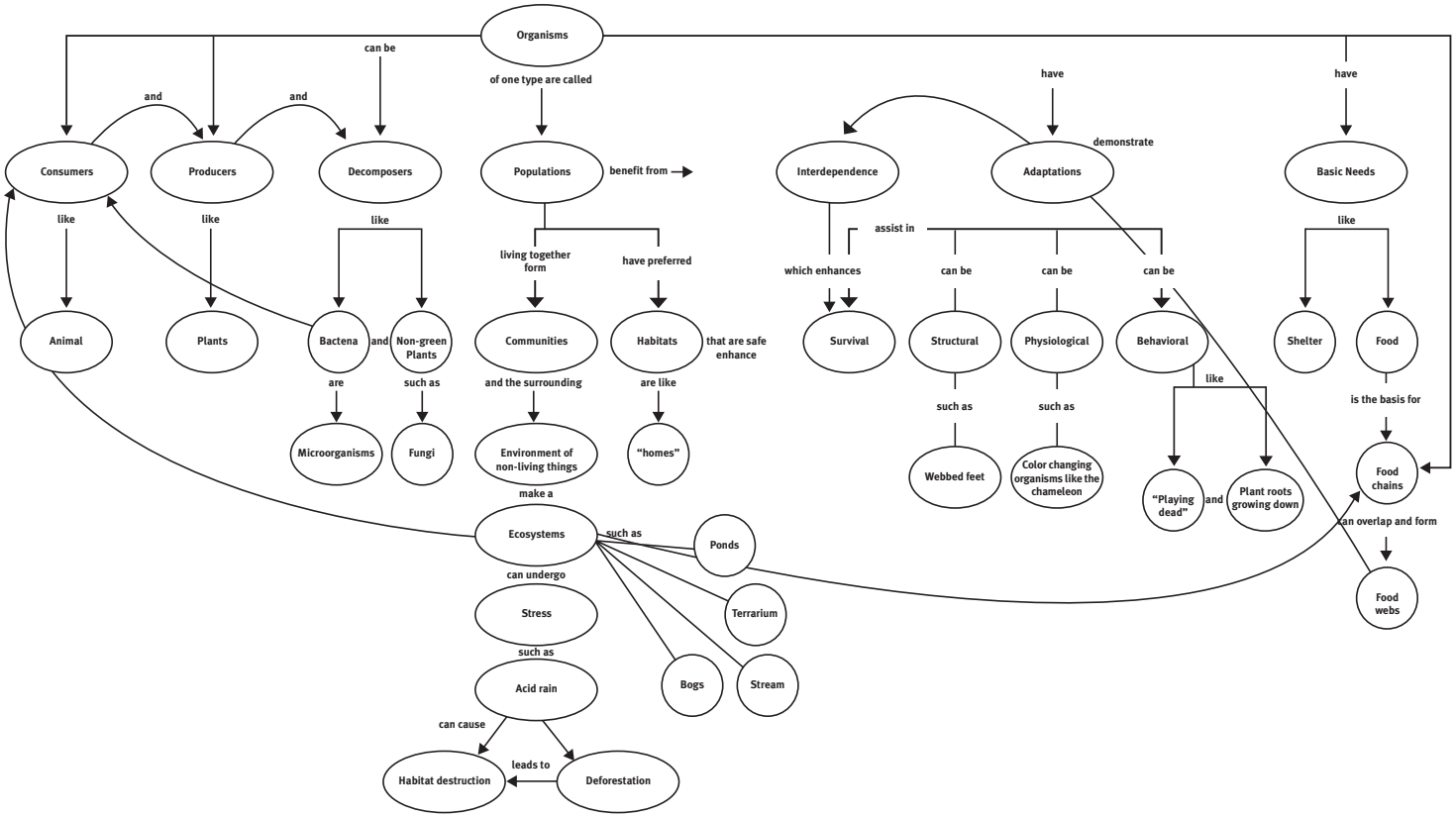
In a large group discussion, pose the following question and invite students' reflection: Why are concept maps valuable to all professionals, including scientists?

List of 39 Concepts for the Ecosystem Concept Map

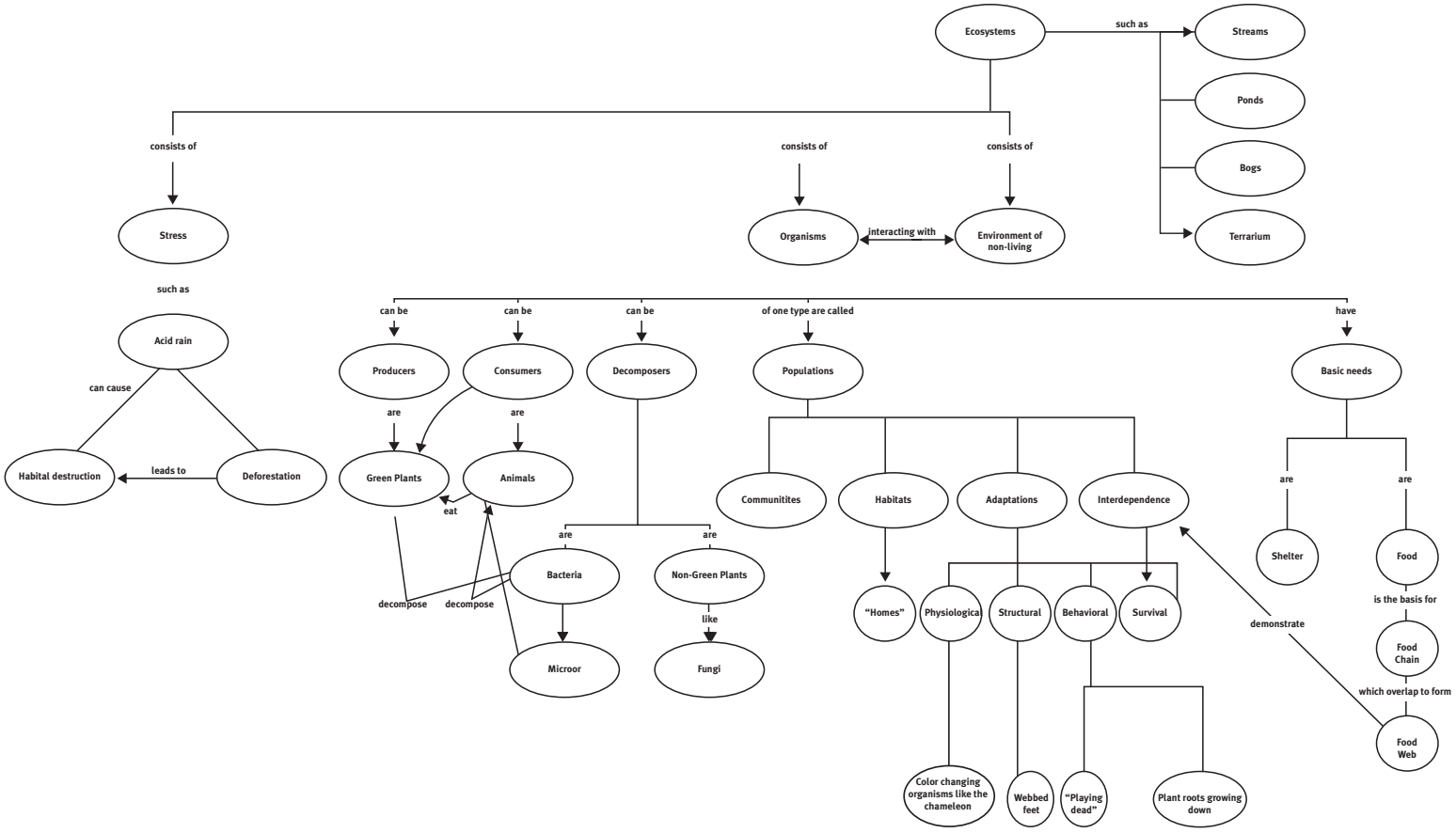
1. Ecosystems
2. Organisms
3. Food
4. Plants
5. Survival
6. Plant roots growing down
7. Habitats
8. Consumers
9. Environment of non-living things
10. Streams
11. Producers
12. Interdependence
13. Color changing organisms
14. Structural
15. "Playing dead"
16. Communities
17. Terrarium
18. Basic Needs
19. Deforestation
20. Shelter
21. Populations
22. Webbed feet
23. Deforestation
24. Bogs
25. Physiological
26. Adaptations
27. "Homes"
28. Bacteria
29. Ponds
30. Non-green plants
31. Stress
32. Acid rain
33. Habitat destruction
34. Animals
35. Microorganisms
36. Fungi
37. Behavioral
38. Food chains
39. Decomposers



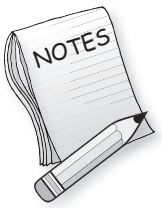
Example of concept map students could produce:



Alternate Ecosystem Concept Map:



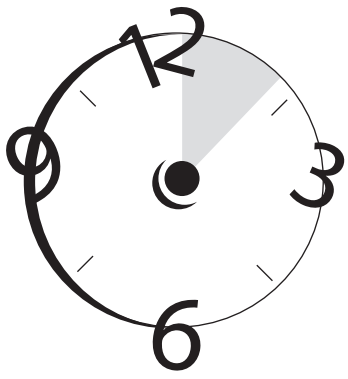
STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



Adaptations

Core/Practice

Time Allocation: Spring project - One week to build bluebird house and research bluebird habitat and many weeks of observation



Lesson Overview

Students will explore the concept of habitats through their research and observations of Eastern Mountain Bluebirds. Students will research what the environmental conditions are that bluebirds need to survive. In addition, they will build a bluebird house. They will use the knowledge gained from reading to determine an appropriate site for the bluebird house in the field and what food sources, plants or bushes, to place in the area, if necessary. In addition, they will learn what bluebird nests look like compared to other birds' nests so that they can determine when bluebirds have begun the nesting process. Once a nest is built, students will monitor the nest on a regular basis and record their observations throughout the reproductive process. They will have an opportunity to share their findings with other students and community members.

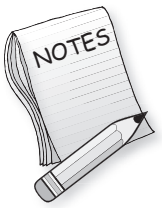
Guiding Questions

- How can you help ensure the survival of the Eastern Mountain Bluebird in Connecticut?
- Are bluebirds fussy like people about where they live?

BIG IDEA

Bluebirds

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



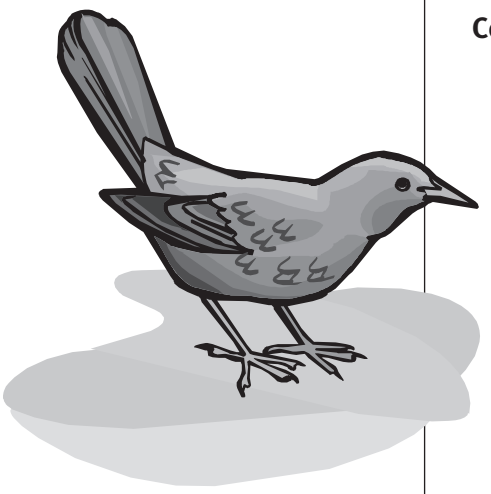
Content Goals

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 vary in their parts and in their interactions.
- Ecosystems have many parts that interact and influence other parts.
- Ecosystems have living and non-living components.
- Organisms have dependent and interdependent relationships that enhance survival.
- Most animals are ultimately dependent on plants for their food.
- Some animals eat plants.
- Environmental factors affect the survival of organisms.



Concepts

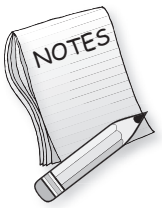
- Ecosystem
- Environment of non-living things
- Organism
- Plant
- Animal
- Producer
- Consumer
- Interdependence
- Survival
- Environmental conditions

Teacher Information

- The Eastern Bluebird is a cavity-nesting species, but it does not have the ability to create its own nesting cavity. It must rely on the abandoned cavities of woodpeckers or find other natural cavities such as open tops of rotted-out stumps or wooden fence posts. Nesting boxes are also readily accepted for nesting. Nesting pairs typically select cavities 3 to 20 feet

above ground in areas where abundant open space provides an insect base on which to forage. The role of the nesting cavity remains important throughout nestling development, as young remain in the nest dependent upon parent bluebirds until fledging, roughly 15 to 18 days after hatching. An optimal nesting habitat contains up to seven suitable cavities per acre and an adequate number of perches from which to forage in close proximity to the habitat. In areas that lack snags or natural cavities, nest boxes can be used to augment the availability of natural cavities. In areas where bluebirds winter, habitat requirements differ little from nesting or summer cover types. Woodland edges, fence rows, open fields, mowed yards, cemeteries, and farmlands provide adequate winter cover needs when mixed with snags, open grassy areas, and wild fruit-bearing trees and shrubs. Nest boxes can provide roosting cover for bluebirds in winter months as well. Due to the variability in climates between the cooler, northern reaches and warmer, southern reaches of the bluebird's range, available food sources may differ but habitat requirements remain constant. The year-round availability of insects determines where bluebirds winter.

- Bluebird nests are neat and are generally made of grass, straw and twigs sometimes with some additional fine rootlets, pine needles or deer hair. If there is moss in the nest, it probably is a chickadee nest. House sparrows have nests made from many different materials (e.g., bird feathers, straw, down, leaves).
- Some books indicate that bluebirds will not nest in a box that contains another bird's nest. It is recommended to remove any nests that are built by other birds. Students may have difficulty removing eggs that have been laid by other bird species (e.g., chickadee, sparrow), so it is important to keep the birdhouse clean of any other bird nest materials so that other bird species do not have an opportunity to lay their eggs in the bluebird house.
- Students may discover that some of the research information they find may not always hold true. For instance, in the article, "Bluebird Adventures", found in the journal *Science & Children*, April 2003, 10(7), the students discovered that a bluebird family had built a nest on top of a chickadee nest, contrary to what most texts indicate.



- Bluebirds prefer the following trees and plants as food sources: American Mountain Ash, Shadbush, Flowering Dogwood, American Holly, Highbush Cranberry, Gray Dogwood, Silky dogwood, Smooth Sumac and Staghorn Sumac, Virginia Creeper, and Grape.

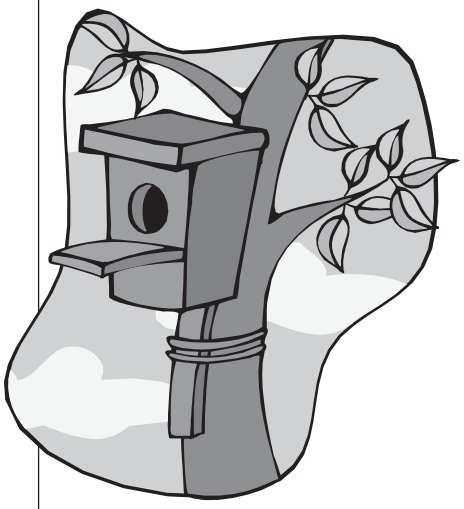
Skills

- Observe
- Organize
- Collect data
- Compare and contrast
- Analyze
- Follow directions
- Make decisions

Materials and Resources

1. Books that might be helpful for the bluebird research are as follows:
   - Davis, W. H. & Roca, P. (1995). *Bluebirds and their survival*. Lexington, KY: The University Press of Kentucky.
   - Grooms, S. & Peterson, D. (1991). *Bluebirds!* Minocqua, WI: Northwood Press.
   - Harrison, H.H. (1975). *A field guide to birds' nests found east of the Mississippi River*. Boston, MA: Houghton Mifflin Company.
   - Stokes, D. & Stokes, L. (1991). *The bluebird book: The complete guide to attracting bluebirds*. Boston, MA: Little Brown and Company.
   - Toops, C. (1994). *Bluebirds forever*. Stillwater, MN: Voyageur.
   - Zickefoose, J. (1993). *Enjoying bluebirds more*. Marietta, OH: Bird Watcher's Digest Press.
2. Videos, such as the following, can be used:
   - *Jewels of the blue: The story of the eastern bluebird*. (1988). Birds Eye View Productions, Afton, MN. (30 minutes)
   - *Bluebird trails: How to start and maintain a bluebird trail*. (1989). Birds Eye View Productions, Afton, MN. (37 minutes)
   - *Backyard blues*. (1991). Birds Eye View Productions, Afton, MN. (47 minutes)
3. Digital or disposable camera that can be used to document the students' activities as they progress with their study of bluebirds. The photos can be used in the student(s) PowerPoint presentations.

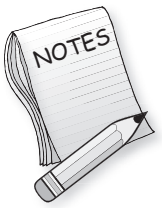
4. Procedures and pictures for building the birdhouse – The ones included in this unit were designed by the Morgan High School's Technology Education Department Bluebird Team that included students: Eaton, Ortiz, Cavanaugh, Mittica, Gonzalez, and Folsom. The team was under the direction of Mr. Jay Cole, Department Head. The birdhouse is made with five parts, top, two sides, front, back and floor. These students used the http://dep.state.ct.us/burnatr/wildlife/factshts/bbird.htm website to guide their construction efforts.
5. Other useful Internet sites are:
   • www.birds.cornell.edu/
   • www.nabluebirdsociety.org/
6. A bird observation worksheet is available on line at www.nsta.org/elementaryschool
7. Reference books can be used to encourage students to research solutions to any problems they incur. For instance, if wasps build their homes in the bird box, one solution students may discover is to put Ivory soap on the inside top of the box. It dissuades wasps and is harmless to bluebirds. This solution can be found in The bluebird book (Stokes, 1991).



Preparation Activities

1. Make a decision if any part of the student research will involve the location's effect on bluebirds' nesting habits. If so, more than one birdhouse will have to be constructed.
2. Make a decision where the bluebird house(s) will be generally located.
3. Make a decision as to whether students will be building the bluebird house(s) with assistance from parent volunteers or whether some other mechanism for obtaining a bluebird house will be pursued.
4. (There are Internet sites, such as http://dep.state.ct.us/burnatr/wildlife/factshts/bbird.htm, http://www.npwrc.usgs.gov/resource/1999/eastblue/eastblue.htm and books such as Bluebird Wood Working, which provide building plans for bluebird houses.)
5. If necessary, make copies of the bluebird house building instructions.

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



Introductory Activities (5 minutes)

- Inform students briefly about the history of the Eastern Mountain bluebird.

  The history of the bluebird spans a series of struggles and successes and only recently, through active wildlife management, has its future been considered secure. During the days of frontier settlement, the bluebird was among the wildlife species that benefited from the decimation of the eastern forests. The conversion of forest into pasture, orchards, and home sites created an abundance of ideal bluebird habitat - open areas that supported the nesting and foraging activities of the species. Farmers unintentionally assisted bluebirds by bordering their fields with wooden fence posts, thus supplying additional nesting sites. Combined, these factors led to a proliferation of bluebird numbers throughout the eastern United States through the mid-1800s. However, this situation changed in the late nineteenth century with the introduction of the European Starling and the English House Sparrow. In the twentieth century, increased use of harmful pesticides, replacement of wooden fence posts with metal posts, clearing of field borders and fences to increase cropland acreage and an increasing human population contributed to population reductions. Fortunately, the favored status of the bluebird and its acceptance of artificial nesting structures have led to increased efforts to boost its populations to sustainable levels. Placement of thousands of nest boxes by concerned individuals has contributed significantly to ensuring a future for the eastern bluebird.
- Ask students what they know about bluebirds.
- Help students to realize that bluebirds have needs just as we do for food, shelter and water.
- Share with students that they will be investigating the nature of a bluebird's habitat for the purpose of putting a bluebird box in an environment that will support bluebirds and their young.

Pre-assessment

N/A

Teaching and Learning Activities (one week)

1. Have students begin their research on bluebird by using books or the Internet (sites listed under Materials and Resources).

2. Tell students that they should be able to find information on the breeding and distribution in New England, physical and developmental characteristics of bluebirds, their preferred habitats, nest box location (direction the bird box should face, whether it should be near trees or not, etc.) food sources for bluebirds (see Teacher Information above), nest box construction, predator guard recommendations and nesting habits and schedules.

3. Tell students that they will be keeping Bluebird Journals in which they record observations of the bluebird box and associated activities, including any of a nest's contents, bluebird sightings, nest building activities, nestling and fledgling activities, problems with predators, notes on bluebird behavior and any other activities associated with this study of bluebirds.

4. Inform students that they will also keep a record of the materials used in the nest box construction as well as the dates of all observations, including the time and the weather conditions. The dated journal will allow them to make predictions regarding when eggs should hatch and when young are likely to take their first flights. The number of eggs, the dates when the first and last eggs were laid, the number of young to hatch, their hatch dates and condition, the number of fledglings and the date they first flew should all be recorded. The journal helps document box success or failure for end of season surveys.

5. Instruct students that they need to draw conclusions regarding the success of the bluebird house. Was the location good? If there were problems, do students have suggestions for a better location? Was there competition from other birds for the birdhouse? Were there problems related to other animals, such as ant or wasp infestations?

6. Inform students that they should share their results with the Department of Environmental Protection, Nonharvested Wildlife Program by sending them information on the details of their study, including both its successes and any related problems. The address is:

   Department of Environmental Protection
   Nonharvested Wildlife Program
   Sessions Woods Wildlife Management Area
   P.O. Box 1550
   Burlington, CT 06013

8. Encourage students to share any interesting findings with the experts at the Cornell and the North American Bluebird Society using the web addresses in the Materials and Resources section above.

Products and Assignments

- Students' Bluebird Journals
- Students' PowerPoint presentations

Extension Activities

N/A

Post Assessment

N/A

Debriefing and Reflection Opportunities

- At the conclusion of the school year it would be beneficial if students were provided a forum in which to share their findings. A PowerPoint presentation that includes a digital photo record of the students' bluebird study activities and findings could be given to the local Parents Teachers Organization or Board of Education. Encourage students to explain what they learned about habitats in general throughout the unit, especially the relationship between animal adaptations and specificity of habitats and the consequential importance of habitat preservation. They can use what they learned about bluebird habitats in particular to elucidate these major ideas.

Instructions for Building a Bluebird House

1. The wood should be rough on at least one side, as the baby birds need the rough texture to help them leave the nest. A #2, one-inch wide pine board with a total length of 58" will be sufficient.
2. The parts are cut as follows:

Rough length – 30"
- Top – 6" wide X 8" long
- Two sides – 6" wide X 11" long

Rough length – 27 1/2"
- Front – 4" wide X 91/2" long
- Back – 4" wide X 14" long
- Floor – 4" wide X 4" long

3. The parts were cut as follows:

TOP

	Machine	Operation	Dimension
1.	Panel saw	Rough cut	30" long
2.	Table saw	Rip to	6" width
3.	Table saw	Trim end	
4.	Table saw	Cross cut	8" long

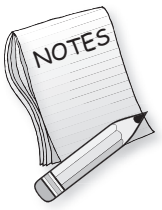
BACK

	Machine	Operation	Dimension
1.	Panel saw	Rough cut	27 1/2" long
2.	Table saw	Rip to	4" width
3.	Table saw	Trim end	
4.	Table saw	Cross cut	14" long

FRONT

	Machine	Operation	Dimension
1.	Panel saw	Rough cut	27 1/2" long
2.	Table saw	Rip to	4" width
3.	Table saw	Cross cut	9 1/2" long
4.	Table saw	Trim end	
5.	Drill press	Drill hole *(1 7/8" from top)*	1 1/2" diameter

STRUCTURE AND FUNCTION: WHAT'S THEIR JUNCTION?



FLOOR

	Machine	**Operation**	**Dimension**
1.	Panel saw	Rough cut	27½ " long
2.	Table saw	Rip to	4" width
3.	Table saw	Trim end	
4.	Table saw	Cross cut	4" long
5.	Drill press	2 vent holes	3/8" wide

6. Cut 3/8" off of each of the four corners of the floor to improve drainage

SIDES

	Machine	**Operation**	**Dimension**
1.	Panel saw	Rough cut	28" long
2.	Table saw	Diagonal cut	9" to 11" long
3.	Table saw	Rip to	6" width
4.	Drill press	Vent hole *(top corner)*	3/8" diameter

STEPS for CONSTRUCTION

1. Nail the two sides on to the back.
2. Place the floor on the bottom of the birdhouse and nail the sides and back to the bottom.
3. Then pre-drill holes for the door.
4. Screw in the door (not too tightly) from both the sides.
5. Then nail the top in.
6. Put a nail on the bottom of the door so you can open and close the door