Project CONN-CEPT Science Units

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

Project CONN-CEPT Social Studies Units

Sound's Story: H-Ear the Pitch (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: Forces, Motion and Simple Machines (2-3)
Comparing Cultures: Traditions, Dwellings, Language and Cultural Evolution (2-3)
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)

Research for this grant was supported under the Javits Act Program (Grant No. S206A020086) as administered by the Institute of Educational Sciences, U.S. Department of Education. The opinions expressed in this report do not reflect the position or policies of the Institute of Education Sciences or the U.S. Department of Education.

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 already know, do, or understand at very different levels of sophistication.

ACKNOWLEDGEMENTS

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

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

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

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

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

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

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

Format for the Project CONN-CEPT Curriculum Units

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

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

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

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

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

Living Things: Changes, Stages, and Cycles - Grades 2-3

This unit on Living Things: Changes, Stages, and Cycles 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 contains several lessons that provide grade three students with opportunities to explore the methodology of the practicing professional (Curriculum of Practice) as well as a lesson that gives students the chance to connect the material to another discipline (Curriculum of Connections).

The unit contains 15 lessons, an introductory lesson and a post assessment that are outlined in the chart below. The first column contains the lesson number and the name of the parallel(s) that the lesson addresses. The second column contains a series of numbers. The numbers reflect the national standards—culled from *National Science Education Standards* (National Research Council, 1996) and *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993)—that are addressed in each lesson and that are listed and numbered below. For brevity's sake, only one or two standards are listed in each row of the chart and represent the major focus of individual sessions. However, the lessons have been designed to build upon each other, and each session builds iteratively upon many of the standards. Connecticut's standards are also referenced here and are cited in the same column.

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

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

National Standards

Life Science

1. Organisms have basic needs. Organisms can survive only in environments in which their needs can be met. The world has many different environments, and distinct environments support the life of different types of organisms. (*National Science Education Standards*, K-4)
2. Each plant or animal has different structures that serve different functions in growth, survival, and reproduction. (NSES*, K-4)
3. All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants. (NSES, K-4)
4. The behavior of individual organisms is influenced by internal cues. (NSES, K-4)
5. Plants and animals have life cycles that include being born, developing into adults, reproducing, and eventually dying. The details of this life cycle are different for different organisms. (NSES, K-4)
6. Plants and animals closely resemble their parents. (NSES, K-4)

The Scientific Enterprise

7. Science is an adventure that people everywhere can take part in, as they have for centuries. (*Benchmarks for Science Literacy*, 3-5)
8. Clear Communication is an essential part of doing science. (BSL*, 3-5)

Science as Inquiry

9. Scientific investigations involve asking and answering questions and comparing the answer to what scientists already know about the world. (NSES, K-4)
10. Scientists use different kinds of investigations depending on the question they are trying to answer. Types of investigations include describing objects, events and organisms; classifying them; and doing fair test (experimenting). (NSES, K-4)
11. Scientists use instruments, such as magnifiers, thermometers, and rulers, to provide more information than scientists can obtain using only their senses. (NSES, K-4)
12. Scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge). Good explanations are based on evidence from investigations. (NSES, K-4)
13. Scientists make the result of their investigations public; they describe the investigations in ways that enable others to repeat the investigations. (NSES, K-4)
14. Scientists share and ask questions about the results other scientists' work. (NSES, K-4)

Technology & Science

15. Technology enables scientists and others to observe things that are too small or too far away to be seen without them and to study the motion of objects that are moving very rapidly or are hardly moving at all. (BSL, 3-5)

* 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

LIVING THINGS: CHANGES, STAGES AND CYCLES

Connecticut Related Content Standards
Grades 3

I Scientific Inquiry

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

Scientific Literacy

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

Scientific Numeracy

Mathematics provides useful tools for the description, analysis and presentation of scientific data and ideas.

3.2 Heredity and Evolution

What processes are responsible for life's unity and diversity?

Organisms can survive and reproduce only in environments that meet their basic needs.

- Plants and animals have structures and behaviors that help them survive in different environments.

(B. 3 Describe how different plants and animals are adapted to obtain air, water, food and protection in specific land habitats.)

4.2 Matter and Energy in Ecosystems

How do matter and energy flow through ecosystems?

All organisms depend on the living and non-living features of the environment for survival.

- When the environment changes, some organisms survive and reproduce, and others die or move to new locations.

(B. 11 Describe how natural phenomena and some human activities may cause changes to habitats and their inhabitants. (AID)

Lesson	Standards	Lesson principles	Lesson description
Introduction (CORE/AID) 30 minutes	5, 7 CT Standards: I (Expected Performances: B INQ. 1, 2 ,5)	• Living things change as they grow and develop Over their lifetime. • Each type of plant and animal goes through a unique set of sequential stages as it grows and develops over its lifetime. • The growth, development, and reproduction of living things repeat in a cyclic pattern over generations. • The life functions (e.g. reproduction) of mature living things are dependent on the development and maturation of earlier stages (AID).	To build anticipation and excitement about the unit: Living Things: Changes, Stages and Cycles, students will be asked to become detectives. Using life cycle diagrams, they will hunt for clues that will help them make inferences and inferences and predict what they are about to study.
1 (CORE/ PRACTICE/ AID) 1 hour, 10 minutes	1, 10, 12 CT Standards: I (Expected Performances: B INQ. 1, 3, 5, 6)		In this lesson students will deepen their understanding of the characteristics of living things while acting like scientists. Through an informal pre-assessment activity, they will consider what common traits of living and non-living things they already know. The processes of scientific investigation are highlighted for them as they set out to investigate whether certain objects are living or non-living. Working in teams, students will visit assigned stations to observe, record data, and draw conclusions about the items at each station. Lastly, the class will compile the data each group has gathered to compare and contrast the additional characteristics of living and non-living things that they have discovered. Two AID activities are offered in the lesson.
2 (CORE) 45 minutes	5, 8, 10 CT Standards: I (Expected Performances: B INQ. 1, 3, 6)	• Living things change as they grow and develop over a lifetime. • Living things grow as they change in size. • Living things develop as they change shape and appearance.	In this lesson, students will come to understand that from their beginning all living things change as they grow and develop over their lifetime. After a brief written pre-assessment of the concepts, they are introduced to growth as change in size and development as change in shape, appearance or color. Using pictures of various living things, children work together to observe, describe and record changes in animals, plants and humans at various points in their life span. They will apply the skill of categorization by sorting the changes they've observed and recorded under the headings of growth or development. After reviewing the findings of each group, students are encouraged to discover other patterns in the data, such as which living things make the most dramatic changes.

LIVING THINGS: CHANGES, STAGES AND CYCLES

Lesson	Standards	Lesson principles	Lesson description
3 (CORE/AID) 1 hour, 30 minutes	5, 6, 14 CT Standards: I (Expected Performances: B INQ. 1, 2, 3, 5, 6, 7)	• Living things grow and develop in a common pattern that includes a beginning, early stages and an adult stage. • In their early stages living things are not fully formed. • When living things grow and develop to maturity, they are fully formed.	Students accept the fact that living things grow and develop in a common pattern that includes a beginning, early stages and mature adult stage in this lesson. As a check for understanding, students will begin by working with the teacher to map the relationship of some main concepts introduced in this unit thus far. Next, they are asked to define pattern, link this with their previous experience and then consider what patterns might be seen in how living things change, grow, and develop. Working in groups, students will use print references to locate evidence of these patterns in lives of certain organisms. Each student creates a poster of the living thing's beginning, early stages or adulthood. An AID activity invites them to design a concept map.
4 (CORE/ PRACTICE/ AID) 1 hour, 20 minutes	1, 10, 11 CT Standards; I (Expected Performances: B INQ. 1, 3, 5)	• Living things have basic needs that must be met to grow, reproduce and survive. • Living things will survive and grow only in environments where those needs are met. • The first stage of a seed plant's growth and development is seed germination. • Seed germination and plant growth are affected by light, temperature, and water. • Changing and controlling variables in an experiment help us study the effect of each	In this lesson, students come to understand that living things have basic needs that must be met in their environment to grow, reproduce and survive. They will use scientific methodology to plan and conduct a simple experiment and discover the effects of adjustments to environment on the germination of a bean seed. They will be introduced to terms such as hypothesis, control and variable and asked to predict what might happen when quantities of water, light and temperature are changed. Over the course of four or five days, students will record their observations. (It is highly recommended that Part One of this lesson be started on a Monday.) Core and AID extension activities are offered.
5 (CORE/AID) 1 hour, 5 minutes	2, 3, 5 CT Standards: I (Expected Performances: B INQ. 1, 3, 5, 6) 3.2 (Expected Performances: B 3)	• Living things will survive and grow only in environments where basic needs are met. •A butterfly begins as an egg; it then goes through a larval or caterpillar stage. •Each stage of a living thing's growth and development has special characteristics. • Each stage of a living thing's growth and development has special needs • Habitats have food, water, safety, and a place for reproduction and young.	Students realize during the course of this lesson that environments must supply the basic needs of living things in order for them to survive. They will examine the differences and similarities between a natural habitat and an unnatural one, such as a classroom. They will prepare for the arrival of Painted Lady butterfly larvae entrusted to their care by setting up a simulated habitat in a cup to ensure their growth and survival. Students will also assist in equipping a unique classroom observatory where butterfly chrysalises are placed with feeders so the emerging adult butterflies can be studied. Extension activities, including a butterfly garden, are offered for Core and AID.

Lesson	Standards	Lesson principles	Lesson description
6 (CORE/AID) 3 hours, 5 minutes Direct Instruction (Plus 30 minutes daily for 2-3 weeks for anchor activities)	2, 4, 5, 11, 12 CT Standards: I (Expected Performances: B INQ. 1, 3, 4, 5, 6, 9, 10) 3.2 (Expected Performances: B 3)	• Each type of plant and animal goes through a unique set of sequential stages as it grows and develops over its lifetime. • Each sequential stage of a living thing's growth and development has special events (or occurrences) and needs. • After its beginning as an egg, a butterfly larva goes through 4 to 5 stages or instars before it becomes a pupa or chrysalis and then emerges as an adult. • The rate of larvae development is affected by the temperature of their surroundings; the cooler the temperature, the slower they develop, and the warmer the temperature, the faster they develop. (AID)	Over a period of two to three weeks, students will have the opportunity to rear their own Painted Lady larva as it grows and develops as a chrysalis and then emerges as an adult. They will observe the caterpillars in their *Desktop Habitats* and describe in journal entries the caterpillar's appearance and behavior as it crawls, eats, grows, eliminates waste, rests, molts, spins silk, hangs upside down and pupates. Working together to create a class calendar, they will observe the sequence of change in the entire class population of larvae. When chrysalises are newly formed, students like seeing them transferred to the observatory. Students will construct an understanding of how these occurrences relate to a living thing's unique stages of growth and development. They will enjoy a read aloud that builds anticipation for the butterfly's emergence. The culmination of the lesson is the arrival of the adult Painted Ladies. Various Core and AID Extension activities are offered.
7 (CORE/ IDENTITY/ AID) 1 hour, 20 minutes	5, 7, 8 (AID), 9, 10 CT Standard: I (Expected Performance – B INQ. 1, 3) 5.1 (Expected Performance – B 18)	• Transition from one developmental stage to another comes when a living thing's cells change. • Living things are made up of units called cells. • A living thing's cells increase in number as it grows.	During this optional lesson students who show readiness for advanced content will explore cellular changes that take place inside the chrysalis. If Internet technology is available, students will download and listen to an audio clip; otherwise, they will read an expert's explanation of the mysterious changes in metamorphosis. Challenge questions will be posed; students will respond in their journals.
8 (CORE/ PRACTICE/ AID) 1 hour	5, 6, 11, 15 CT Standards: I (Expected Performances: B INQ. 1, 3, 5, 6)	• Every living thing has a typical lifespan that comes to an end. • Normally a life span ends after a living thing reaches maturity.	Students will explore how the human ear is built to detect sound. Specifically, in this lesson students will investigate how they actually hear sound by examining a diagram of an ear. It will be used to help students better understand the connection between the biological structures and functions of the ear's parts.

LIVING THINGS: CHANGES, STAGES AND CYCLES

Lesson	Standards	Lesson principles	Lesson description
9 (CORE/ AID) 1 hour	5, 7, 8 (AID), 11 CT Standards: I (Expected Performances – B INQ. 1, 3, 4, 5) 5.2 (Expected Performances – B 17, B 18)	• Cycles occur when a sequence of events repeats over and over again. • The growth, development, and reproduction of living things repeat in a cyclic pattern over generations. • Even though plants, animals, and humans die, life continues through reproduction. • Life cycles of animals, humans or plants are carried on when the mature animals, humans, or plants reproduce themselves. • The last stage in a life cycle, reproduction, brings the cycle back to the first stage.	Students will explore the cycle as a pattern by locating cyclic patterns in the world around them. They will dramatize the Painted Ladies' stages of growth and development. From this experience and their observation of newly laid eggs, they will predict the reoccurrence of these stages and come to understand that through reproduction, new generations are born; life begins and ends in a cycle. A shared reading will illustrate how this pattern is common to many different types of living things and prepares them for a post assessment. Core and AID extension activities are offered.
10 (AID) (optional) 1 hour, 30 minutes	1, 13 CT Standards: I (Expected Performances: B INQ. 2, 6, 7, 8) 3.2 (Expected Performances: B 3) 4.2 (Expected Performances: B 11)	• Extinction occurs when mature animals, humans or plants no longer reproduce themselves, and all members of a species die out. • Habitat loss, pollution and over-hunting can endanger the survival of a species.	Students will research an extinct animal or an animal in danger of extinction to answer these guiding questions: Why do animals become extinct? What does extinction have to do with life cycles? How can people protect endangered species? Using a research guide sheet students will follow steps to locate references, take notes and develop a product to share the problems and solutions they have found. The learners will come to understand that extinction brings life cycles to a halt and is related to habitat loss, pollution and over-hunting.
11 (CORE/AID) 140 minutes	6, 10 CT Standards: I (Expected Performances: B INQ. 2, 5, 6, 7, 8)	• similar kinds of living things experience similar • Similar kinds of living things experience similar stages of change over their lifetime. • Invertebrates generally go through either incomplete metamorphosis win which they young (nymphs) look like smaller adults, or complete metamorphosis. • Most vertebrates (except amphibians and some others) have offspring that resemble the adults but are much smaller. • After beginning as a fertilized egg, animal life cycles consist of stages that go from being born or hatched to maturing over time and then reproducing. • There is a relationship between complexity of an organism, the number of offspring it has, length of young stages and level and length of parental care given. (AID)	Through a jigsaw activity students will work in teacher-selected groups to become experts about stages of change for certain types of living things. Within groups individuals will be responsible for locating and describing the sequence of unique occurrences in the development for a particular group of animals (insect, mammal, reptile, bird, etc.). By completing individual graphic organizers and comparing individual findings as a group, students will locate patterns and share these with the class. Students will come to understand that similar kinds of living things experience similar stages of change over their lifespan. Through an optional extension activity, teachers may choose to have students create a life-cycle mobile that displays how these stages are repeated in cyclic fashion over generations.

Lesson	Standards	Lesson principles	Lesson description
12 (PRACTICE/ AID) (optional) 1 hour, 20 minutes	10, 13 CT Standards: I (Expected Performances: B INQ 1, 4, 5, 6)	• Similar living things progress through the same stages at the same rate. • Similar living things' stages of growth and development vary within a range of minimum to maximum length of time. (AID)	Students will investigate how much the developmental stages of living things vary in length. By plotting data from the Module 2, Lesson 6 Class Calendar on a number line, they will observe how stage lengths of individual Painted Ladies vary, but fall within a range between a minimum and a maximum number. While learning these new statistical terms they will construct an answer to the guiding question and have the option to examine the range of time for various developmental stags of other species.
13 (CORE) 60 minutes	5, 12, 14 CT Standards: I (Expected Performances: B INQ 1, 3, 5, 6)	• Humans move through stages, as they grow and develop over their lifetime. • Human growth and development includes stages of birth, infancy, childhood, adolescence and adulthood. • Each stage of human growth and development brings changes and milestones. • The stages of each human's birth, growth and development can vary in length of time.	Students will come to understand that humans like other living things, move through stages of growth and development. Using photographs of themselves or of family members, students will build a developmental timeline to identify the changes or milestones that characterize each stage. The project will be completed as an anchor activity and shared when completed.
14 (CONNECTIONS) 30 minutes	8, 13 CT Standards: I (Expected Performances: B INQ 1, 5, 6)	• Change patterns in the physical environment can occur in cycles. • As with life cycles, other cycles in the physical environment have a last stage that goes back to the first stage. • Water is carried back and forth from earth to its atmosphere in a four-part cycle: evaporation, transpiration, condensation and precipitation.	Students will connect their understanding of cycles to the exchange of water between earth and its atmosphere during the water cycle. First, they will enjoy the poetic verse of the book Water Dance during a read aloud. Next, they will be introduced to the names of each stage and asked to locate these during a second reading of the book. Interested students may design an original water cycle diagram as an extension.
Unit Debriefing (CORE/ CONNECTIONS) 30 minutes	All standards	All unit principles	To conclude the unit Changes, Stages and Cycles in Living Things, student will be asked to reflect on their learning. In a game-like fashion, they will be asked to connect what they have learned about the growth and development of living things to pictures of the building of a house. Together they will revisit the challenging question, "Why do living things change and develop in stages and cycles?" Finally, the building analogy will be explained to enhance their understanding of the necessary sequence of changes living things encounter on their way to maturity. A rubric is included so the teacher can evaluate student performance in the lesson in relationship to the big ideas presented in the unit.
Post Assessment (CORE) 30 minutes	All standards	All unit principles	Post assessment

References

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.

CONTENTS

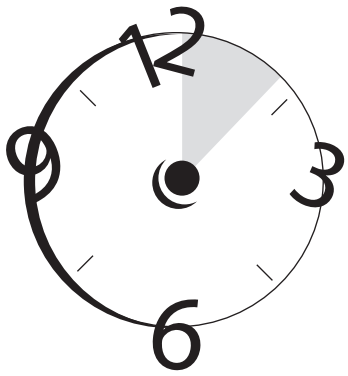
LIVING THINGS: CHANGES, STAGES AND CYCLES CONTENTS

Introduction

Core/Aid

Time Allocation: 30 minutes

Required Materials and Resources on Page 84



Lesson Overview

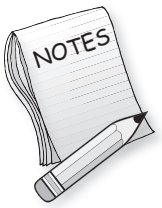
To build anticipation and excitement about the unit Living Things: Changes, Stages and Cycles, students will be asked to become detectives. Using stages and life cycle diagrams they will hunt for clues that will help them make inferences and predict what they are about to study.

Guiding Questions

- What predictions can we make about the focus of our new unit of study?
- What experiences are common to living things?
- What patterns can we observe in how living things change and grow?
- Why do living things experience change in stages and cycles? (AID)

BIG IDEA

Detectives



Content Goals

Universal Themes

- Patterns
- Cycles

Principles and Generalizations

- Living things change as they grow and develop over their lifetime.
- Each type of plant and animal goes through a unique set of sequential stages as it grows and develops over its lifetime.
- The growth, development, and reproduction of living things repeat in a cyclic pattern over generations.
- The life functions (e.g. reproduction) of mature living things are dependent on the development and maturation of earlier stages. (AID)

Concepts

- Living things
- Change
- Growth
- Develop
- Sequential
- Stages
- Repeat
- Cycles

Teacher Information

See "Why Do Organisms Need to Develop In Stages?" by Jim Trifone. pages 5-9 in this Introduction packet. This article is intended for teacher use only. The challenging question, "Why Do Organisms Need to Develop in Stages," should be posed as an AID during this Introduction and throughout the unit. Although the reading provides an evolutionary perspective on this question, something that is not explored in this unit, highlighted sections may offer a simplified explanation appropriate for some students.

Skills

- Observe
- Locate patterns
- Infer
- Predict

Materials and Resources

Unit Introduction Stages and Life Cycle Diagram Set. Teachers can make this set

by visiting the following websites and then printing off the diagrams. The following organisms with an image of their lifecycle should be included in the set:

Frog – www.enchantedlearning.com/subjects/amphibians/Frogprintout.shtml
Mosquito- http://images.google.com - Type "mosquito life cycle" in the search bar.
Moth – http://insected.arizona.edu/manduca/graphics/lifecycle.jpg
Sunflower – http://www.agr.unipi.it/diaporthe/photo/rossi/deter31.jpg
Human – http://www.bbc.co.uk/schools/revisewise/images/science/liv04/04fimg2.gif
Soybean- http://images.google.com - Type "growth stages of soybeans" in the search bar.
Ladybug – http://images.google.com - Type "life cycle of a ladybug" in the search bar.
Oviparous fish – http://www.rajidae.tmfweb.nl/life-cycle.jpg

Preparation Activities

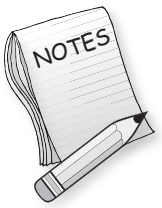
1. Check over the diagram set and delete any copy that indicates that it is a life cycle. Then copy Unit Introduction **Stages and Life Cycle Diagram Set**, one per group.
2. Arrange desks in clusters or locate tables where groups of students will work.
3. Place a Unit Introduction **Stages and Life Cycle Diagram Set** at each of these various locations around the room.
4. Determine heterogeneous groups of four.

Introductory Activities (5 minutes)

Gather students together on the floor in the front of an easel. Tell them. "Today you will all work as detectives to solve a mystery. Do you know how detectives solve mysteries?" Help them recall that detectives rely on clues. Explain that they will work to solve the mystery of what we are going to study in a new science unit. Tell them, "I will show you some pictures that contain clues. You may not say a word or start guessing." Place one set of diagrams on the easel. Do not refer to them as life cycle diagrams. Explain the following rules:

1. Each student will be assigned a table and work by himself/herself to examine the pictures for clues. No talking is allowed.
2. Each student will be allowed one guess or prediction based on what he or she observes. (This prediction is not to be shared until they are called back from their groups to the easel).

Give them this suggestion as a "hint": Look for a pattern or something happening



in all the pictures.

Pre-assessment
N/A

Teaching and Learning Activities (25 minutes)

1. Dismiss students to the tables. Circulate, making sure the rule about silence is being followed, and that students are sharing the pictures.

2. Call them back to in front of the easel after ten minutes.

3. Call on students one at a time to share their predictions. Explain that predictions can be more than one word. List their ideas on a chart. Refrain from commenting.

4. After everyone has shared, validate any of the predictions that included these concepts:
   • Living Things
   • Change
   • Growth
   • Develop
   • Sequential
   • Stages
   • Repeat
   • Cycles
   • Generations

5. Explain "We are going to investigate experiences common to living things: change and growth. We are going to explore patterns of change called stages and cycles."

6. Finally, tell them that you are going to ask them to consider a very challenging question that may take a long time to answer: "Why is it that living things experience change in stages and cycles?" Allow a few minutes and then ask if anyone has an idea.

7. Tell them you will post this question on the bulletin board as a challenge question. Any time during the unit that they feel they can answer it, they will be allowed to respond in their journal. Remember to assign this question occasionally throughout the unit as an anchor activity during reading or math.

Intro-duction

Products and Assignments

- List of predictions.
- Journal entry (Optional)

Extension Activities

N/A

Post Assessment

N/A

Debriefing and Reflection Opportunities

N/A

Why Do Organisms Need To Develop In Stages?

By Jim Trifone

There are several reasons depending upon a number of factors mainly: whether you are speaking of simple or complex plants or animals, whether the animals are invertebrate or vertebrate, whether the animals are external or internal fertilizers and with respect to mammals, whether they are egg-laying, marsupial or placental. The simplest answer to this question is that complexity in the structure and function of organisms did not evolve all at once. Rather, the general evolutionary trend was from simple to complex. However, this evolutionary development occurred in fits and starts and resulted in many dead-ends (e.g. 99% of all species ever evolved are now extinct!!!). Natural selection processes have left us with the diversity of life forms we see today. But this diversity is somewhat misleading, because underlying all of it is UNITY between the very small to the very large. All organisms are primarily made up of the same kinds of atoms (C, H, O, N, P, S, Ca, Fe, & Mg), which are arranged into the similar organic molecules of carbohydrates, lipids, proteins and nucleic acids. Therefore, all organisms share a similar biochemistry and actually genetic heritage. More specifically, we have bacterial, plant, invertebrate animal and other vertebrate genes in OUR cells.

Once the simplest type of organisms evolved (single celled bacteria-like organisms) the basic biochemistry and genetic informational storage system that all organisms now have was already developed. Subsequent evolution DID NOT "re-invent the biochemical wheel" but rather adopted it "as is" with actually very little modification (e.g. bacteria, fungi, green plants and animals all use DNA to code for proteins which serve as enzymes, hormones, structural components etc). What DID happen was an increase in structural complexity (e.g. multicellularity in the form of colonial protozoans, slime molds, fungi, algae, nonvascular plants, vascular plants, invertebrate animals and vertebrate animals). So what Nature did was to co-opt the metabolic and informational storage "machinery" that worked in simple organisms and create more sophisticated organisms which had different features that adapted them to new environmental constraints (e.g. while aerobic prokaryotic (e.g. bacteria) organisms evolved the ability to more efficiently make energy in the presence of oxygen that was being produced by photosynthetic organisms, they USED many of the same enzymes and energy-transfer pigments that photosynthetic organisms evolved in order to photosynthesize).

Soon a eukaryotic cell (modern more advanced cell with membrane-enclosed structures like a nucleus) evolved. However, this NEW type of cell evolved by "capturing" and "commandeering" the simple prokaryotic cells. What resulted was that these "captured" aerobic bacteria evolved into mitochondria while the photosynthetic prokaryotes evolved into the chloroplasts. With a eukaryotic cell came a more sophisticated "asexual" means to reproduce (i.e. mitosis rather than mere fission) as well as more regulatory controls and protective processes for ensuring long-term stability of DNA while fostering genetic continuity between generations. As the environment changed (as it always does) new "adaptations" were naturally selected eventually leading to true multicellular plants. However, many of the reproductive "cycles" of simpler organisms was retained (i.e. mitotic production of spores etc.). Eventually a "sexual" reproductive process (i.e. meiosis) was created. This provided organisms with the ability to create a lot more variety in their offspring, thus fostering the evolutionary process. With each new evolutionary stage came new features but the retaining of many of the OLD cycles. Basically, think of development of higher organisms as a process akin to building a house. You need to build the foundation first and then add the above ground structure.

Furthermore, you can't put up the siding or shingles until you build the framework. Similarly, you need to put in the plumbing, heating ducts and electrical circuitry and wiring before you put up the wallboard… Thus, organisms, especially complex organisms are built in DEVELOPMENTAL STAGES that are metaphorically similar to those followed in building a house. What is PARTICULARLY important is that the infrastructure needs to be laid down in a specific developmental sequence no matter how large or small the house is. So too is the case with organisms. Take for instance the embryonic development of humans. We begin as a "simple" undifferentiated embryo with no form. Yet in 26 days one can see a heart beating, a neural cord and brain forming etc. Morphogenesis of the once formless embryo has taken place as the architectural blueprint of our 3.7 billion year genetic ancestry unfolds and, in time, will develop into a several trillion celled human baby replete with organized cells, tissues, organs and organ systems requisite to maintain and sustain the living condition. What is REALLY interesting is that this embryo will pass through developmental stages that are reminiscent of the evolutionary pathway that all vertebrates took. More specifically, there is a stage when we were more fish-like, then amphibian-like, then reptile-like and only later became almost indistinguishable from other mammals and finally primates. At around 9-weeks we became truly and distinctly human in form and internal development. This has been referred to by the very intimidating phrase "ontogeny recapitulates phylogeny". This means that one's ontogeny (individual developmental pathway) recapitulates (summarizes) the phylogenetic pathway (developmental pathway followed by previous ancestors). The point of all of this being that we COULD NOT attain the form we now have if we did not follow this sequential developmental pathway of simple to complex that evolved over billions of years.

There are many other examples-take butterflies for instance. The niche of larval or caterpillar stage of the butterfly is to eat plants. It doesn't fly nor behave in any way like a butterfly. It doesn't even reproduce. It basically just eats. However, once it has amassed sufficient mass, it goes into metamorphosis. During the pupal stage imaginal cells that have lain dormant inside the caterpillar begin to develop as morphogenetic "islands" within the disintegrating body of the caterpillar. Were it not for the caterpillar stage these cells would not be able to unfold into the new forms of the adult butterfly. Soon thereafter a beautiful transformed butterfly emerges from her chrysalis to eventually mate and lay eggs and start the CYCLE all over again. One of the interesting advantages to having this complete metamorphosis is that the organism can take advantage of different niches in the environment and thus expand it s food and resource availability (e.g. caterpillars don't eat what butterflies do) thus enhancing the overall survival of the species. The same is true for tadpoles and frogs and other organisms that go through metamorphic changes. Thus, another strategy that nature utilizes in maximizing the success of the species is to have different life stages that feed on different things or exploit other environmental resources. Additionally, having organisms in two or more different forms (e.g. larval, pupal and adult) makes it more difficult for predators to wipe out the species. There are typically different predators for larval as for adult stages.

One last reason for why organisms develop in stages is a very practical one. Take humans for instance. If we developed fully formed we couldn't be born. More specifically, the birth canal can barely accommodate the head of a modern human baby let alone an adult. Therefore, since evolutionary pressure was placed on developing a larger brain, and therefore head, something had to give. What actually happened was a process called fetalization. Basically, mutations were selected that SLOWED down the development of humans. Therefore, human babies were born immature. A human newborn is basically equivalent to a chimpanzee fetus in its developmental form. The slowing down of our developmental unfolding allowed us to be born small and then grow large outside the womb. However,

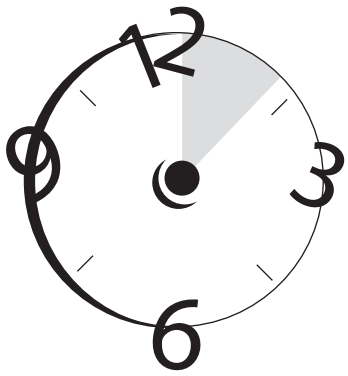
a LARGE price was paid. Human infants are fairly helpless and require a lot of parental care for several years (my wife would say decades in my case if not all men). Furthermore, organisms, especially human, need to learn how to do things. For instance, birds can't be expected to hatch and then start flying for the same reasons. They need to develop their skeletomuscular system, as well as nervous control of it in order to coordinate the muscles to fly.

So to make a long story short, organisms have cycles and develop in stages because life emerged in stages that were dependent on the development and maturation of earlier stages.

Basic Needs, Growth and Development

Core/Practice/Aid

Time Allocation: 1 hour, 10 minutes
Required Materials and Resources on Page 84

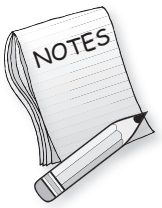


Lesson Overview

In this lesson students will deepen their understanding of the characteristics of living things while acting like scientists. Through an informal pre-assessment activity, they will consider what common traits of living and non-living things they already know. The processes of scientific investigation will be highlighted for them as they set out to investigate whether certain objects are living or non-living. Working in teams, students will visit assigned stations to observe, record data, and draw conclusions about the items at each station. Lastly, the class will compile the data each group has gathered to compare and contrast the additional characteristics of living and non-living things that they have
discovered.

Guiding Questions

- What characteristics do all living things have in common?
- How are living things different from non-living things?
- How can I act like a scientist to learn about living things?



Content Goals

Universal Theme

Characteristics

Principles and Generalizations

- Living things have characteristics and behaviors common to them that make them different from non-living things.
- Living things take in food for energy.
- Living things move.
- Living things eliminate waste.
- Living things respond to their environment.
- Living things experience respiration.
- Living things have parts inside them that keep them alive.
- Living things grow.
- Scientists begin their investigations with questions.
- Scientists sometimes gather data through observations to help them answer their questions.

Concepts

- Living
- Non-living
- Characteristics
- Behavior
- Energy
- Movement
- Response
- Growth

Teacher Information

Respiration is the term used to describe breathing or bringing oxygen into the body. Plants breathe or experience respiration (like people and animals) as they take in oxygen from the air and give out carbon dioxide. However, because plants take in oxygen through their pores and don't have lungs or a blood stream, we can't say they breathe the same way people or animals do. They make more oxygen than they use and, as a result, plants help people to survive.

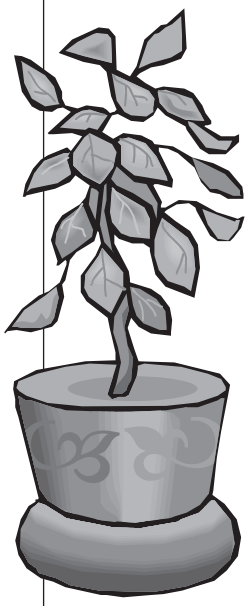
Skills

- Question
- Observe data

- Record data
- Compare/contrast
- Draw conclusions

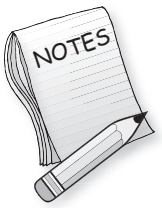
Materials and Resources

1. Dry lima bean seeds, one per student
2. Soaked lima bean seeds, one per student
3. Paper plates or bowls for dry and soaked beans
4. Five plastic knives
5. Five hand held magnifying lenses (optional)
6. Paper towels or small paper plates, one per student
7. One goldfish in a clear bowl or jar filled with water
8. Small stuffed animal
9. Wooden blocks, two or more
10. Pillar candle, candle holder or plate, and matches (alternative: photo of a lit candle)
11. One battery operated toy (optional)
12. **Module 1, Lesson 1 Observation Records, Station: 1, 2, 3, 4, 5, 6, and 7**; one of each sheet per student, per station
13. Timer to signal station changes (optional)
14. Easel, chart paper and markers
15. **Scientific Investigation Guide Sheet**, pebble, seed, pot, soil (for Extension Activity)
16. Magazines, poster board or 11" x 17" paper (for Extension Activity)
17. **Creative Writing Prompt,** (for Extension Activity)



Preparation Activities

1. Soak half of the lima bean seeds in water overnight. Keep half of the seeds dry. Each student will have one dry and one soaked seed.
2. Prepare six or seven observation stations by locating counter space, arranging tables or clusters of desks with chairs around them.
3. Place objects in the center of each table or desk cluster as follows:
   - Station 1: dry and soaked lima beans in separate bowls or plates, paper towels or paper plates, plastic knives, hand held magnifying lenses (optional)
   - Station 2: goldfish in water-filled bowl
   - Station 3: stuffed animal
   - Station 4: candle to be lit with matches when students are dismissed to stations (or photo of a lit candle if actual flame is prohibited in school)
   - Station 5: wooden block
   - Stations 6: potted plant



Station 7: (optional) battery operated toy

4. Copy the black line masters **Module 1, Lesson 1, Observation Records**, making enough for each student to have one copy per each station. Place copies at stations.
5. Determine which students will work together. Divide the class into six, heterogeneously grouped Observation Station Teams.

Introductory Activities (5 minutes)

- Gather the students together. Have them sit on the floor in front of an easel with chart paper. Introduce the unit and lesson by telling the students: "Today we are going to begin a unit of study about living things. During this unit we will have many opportunities to think and act like scientists do. Can you tell us what scientists do?" Call on a few students to share their ideas.
- Summarize what they tell you, for example, "Yes, scientists do experiments." Then say, "Scientists investigate and make discoveries. Scientists begin by considering what they already know about something they're interested in and then ask questions that they don't yet have the answers to. They decide if and how they can investigate their question."

Pre-assessment (10 minutes)

- Tell the students that we will start our investigation of living things by considering what we already know about the characteristics of living things. What makes a living thing different from a non-living thing? What characteristics do you know that living things share? What characteristics do non-living things share?
- Work with the students to define and find synonyms for the term characteristics. (i.e. traits, features, descriptions, "things common to them") Divide a piece of chart paper into two columns. Place the headings "Characteristics of Living Things" and "Characteristics of Non-living Things" on top of each column.

Characteristics of Living Things	Characteristics of Non-living Things

- Have them generate as many characteristics as possible, from types of living things. Have them use specific living things, like a puppy. However, since this exercise is meant to provide pre-assessment information, do not suggest characteristics to them. Only list as many ideas as the children can provide. The list will be completed at the end of the lesson.
- **SEARCHLIGHT**: This pre-assessment may provide an opportunity to spot talent. Students who demonstrate an advanced understanding of

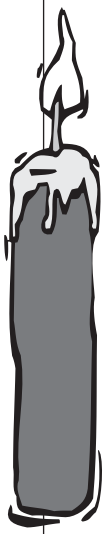
the characteristics of living things will be able to suggest and define life functions other than breathing, like getting food or nutrition for energy, movement, elimination, response or reproduction. They may also be able to provide examples. If students appear to have this advanced understanding, place them at the candle station first and then suggest they complete one of the Extension Activities to provide AID.

Teaching and Learning Activities

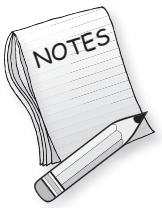
Preparing to Investigate Living and Non-living Things (5 minutes)

1. Prepare the children to work at the observation stations by explaining the importance of questioning and gathering information in a scientific investigation. Explain it this way: We are going to investigate some living and non-living things set around our classroom. Remember that scientists start their investigations with questions. The question you will work to answer is, "Is this a living thing or a non-living thing?" Because we are working like scientists, you can't simply decide, "Yes this living" or "No this is not living." Scientists use observations to gather information that will answer their questions or provide evidence for their ideas. When you observe, you use one or more of your senses—your sight, hearing, touch, smell and sometimes taste to learn. To keep ourselves safe and to show respect to some of the living things in our investigation, you will be told which senses you may use at each station.

2. Point out the items at each station and show them the **Observation Record** sheets that indicate which sense they will use to gather information. For safety purposes, they will not taste anything and only use their eyes, ears or nose when observing the fish and candle flame. Underscore how important it is that they follow these guidelines. Alternatively, if school rules or student conduct will prohibit use of a real candle, use a photo of a candle flame.



3. Place the children in groups of three to five and assign them to a beginning station. Model for them how they will work together to describe what they each observe and record all observations on their own record sheet. After they have recorded their observations, they will conclude together whether the item is living or non-living and mark the appropriate box on the sheet to indicate this.

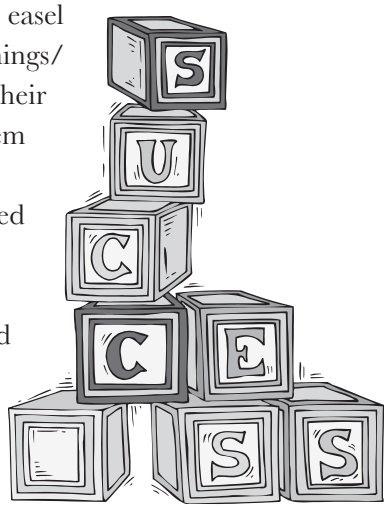


Observation Stations (30 minutes)

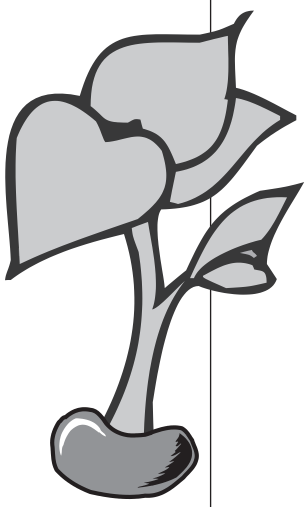
1. Allow each group six to eight minutes at each station. Determine how many stations each group will visit. These visits may be spread over two days. It is not necessary for each group to visit all the stations, just that they each observe one living and one non-living thing. Have the students rotate according to your plans. Use a timer to signal the end of the six-minute period, if possible.

2. Circulate around the room encouraging the children to share their observations with each other and recording all of these on their personal record sheets. Watch for students who need assistance in finding descriptive words for what they observe. Encourage those who want to conclude immediately whether the item is living or non-living to supply evidence by documenting what they see. Remain close to the candle station to ensure safe behavior and that no one touches the flame.

Reviewing the Data to Discover Additional Characteristics (15 minutes)



1. Bring the students together again in front of the easel and chart entitled "Characteristics of Living Things/ Characteristics of Non-living Things" that has their pre-assessment ideas on it in one color. Ask them to bring their Observation Records with them. Instruct the students to review what they observed at a station where they concluded a living thing was placed. Ask, "Why did you decide that the ____was a living thing?" What characteristics did it have from the list we made yesterday? What characteristics did it have, if any, that we should add to our list? Do other living things have this characteristic?" Using a different color marker, add any new characteristics to the chart. The new color will reveal what the group learned from their observations and this discussion.



2. Go through the same process, asking students to review their observations at a station where they concluded the item was non-living. "Why did you decide that the ____was a non-living thing?" What characteristics did it have from the list we made yesterday? What characteristics did it have, if any, that we should add to our list? Do other non-living things have this characteristic?" Using a different color marker, add any new characteristics to the chart.

3. Guide the students in comparing and contrasting living and non-living things characteristic by characteristic. In most cases, if a living thing possesses the characteristic, a non-living thing will not possess it. For example, living things respire or breathe; non-living things do not. However, some non-living things, like fire and a battery operated toy can move just like a living thing can move. Encourage them to add modifiers to the items on the chart like all, most, some. Ask them to consider, "Which are the most important characteristics for something to have to actually be living? How many of these characteristics does something have to have to be considered living?"

4. Remind the students that their observations were limited to one or two class periods. Ask them what they might have noted if they had been given several days or weeks to observe any of the items. "What do those ideas suggest that we may need to add to our chart?" If they suggest that they might have observed the seed or the fish grow, then add growth as a characteristic of living things.

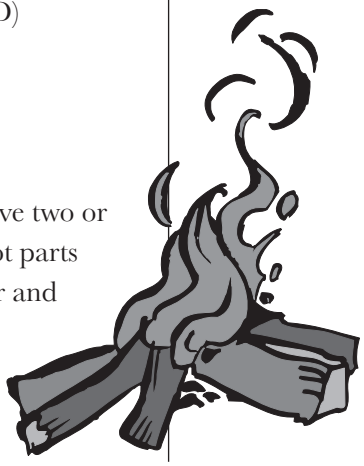
5. Refer to the principles and generalizations about living things for this lesson. With these in mind, guide the students with questions to recognize those characteristics of living things that may be missing from their chart. For example, you might ask "What would happen if we left that fish in its bowl and ignored it for several weeks? What would happen if we never watered the plant? Why? What do we want to state about the needs of living things for survival (as opposed to non-living things)?"

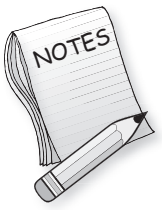
Products and Assignments

- Class chart: "Characteristics of Living Things/ Characteristics of Non-living Things"
- **Module 1, Lesson 1 Observation Record**, one completed for each station visited.
- Original experiment planned using the **Scientific Investigation Guide Sheet**, see Extension Activities (AID)
- "Don't Be Fooled" Poster or Book, see Extension Activity 1 (AID)
- Short story or fictional narrative, see Extension Activity 2 (AID)

Extension Activities

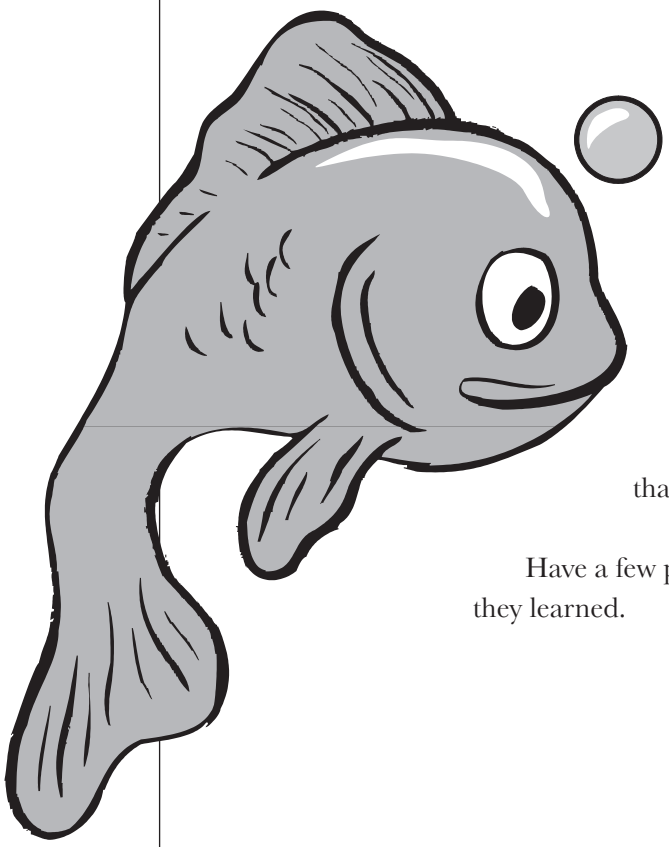
1. Create a "Don't Be Fooled" Poster or Book (AID) (60 Minutes)
   Have students gather pictures from magazines of objects that have two or more characteristics of living things, but are not alive and are not parts of living things. Examples of items are a balloon that takes in air and





grows or fire that uses oxygen and grows, as we saw in our observation station. Paste these pictures on poster board to create a poster or on the pages of a simple book made by folding 11"x17" paper in half.

2. Creative Writing (AID) (30 Minutes)
   Imagine you meet someone who has never seen fire before (a young child, an alien or a person from a strange, distant country). They are convinced that fire is alive. Write a short story or fictional narrative that explains how you convinced them that fire isn't living. What did you tell them? What did you show them? Don't forget to include characteristics of living things to convince your confused friend. See Module 1, Lesson 1 Extension Activity 2 Sheet
3. Design Your Own Experiment (AID, Practice) (60+ Minutes)
   Interested students who demonstrate readiness for more challenge with scientific processes can be encouraged to design their own experiment. Given a seed and a pebble or small rock, ask them how they would prove whether they are living or non-living. Their hypothesis and the steps for an experiment can be written using the **Module 1, Lesson 1 Extension Activity 1, Scientific Investigation Guide Sheet**. Conference with them to make revisions in their plan. Once they gain approval, allow them to carry out their plan.



Post Assessment

N/A

Debriefing and Reflection Opportunities (5 minutes)

Prompt the children to engage in a think-pair-share. Turning to someone sitting beside you, tell them which characteristic/s of living things or non-living you learned about for the first time through this lesson? Is there something on that chart that surprised you?

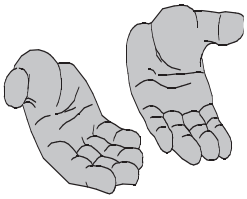
Have a few pairs to share with the whole group what they learned.

Module One, Lesson One
Observation Record

Name_____

Station 1: Lima Bean Seeds

Use these senses to observe.




	Describe what you feel.	**Describe what you see.**	**Describe what you hear.**	**Describe what you smell.**
Dry Lima Bean Seed				
Soaked Lima Bean Seed				

Is this object living or non-living?

❑ living

❑ non-living

Module One, Lesson One
Observation Record

Name_____

Station 2: Goldfish

Use these senses to observe.

	Describe what you see.	**Describe what you hear.**
Goldfish		

Is this object living or non-living?

❑ living

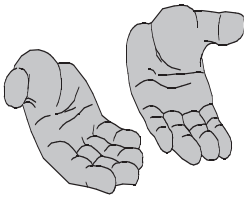
❑ non-living

Module One, Lesson One
Observation Record

Name_____

Station 3: Stuffed Animal

Use these senses to observe.




	Describe what you feel.	**Describe what you see.**	**Describe what you hear.**	**Describe what you smell.**
Stuffed Animal				

Is this object living or non-living?

❑ living

❑ non-living

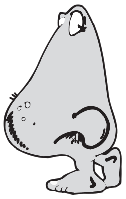
Module One, Lesson One
Observation Record

Name_____

Station 4: Candle Flame

Use these senses to observe.

WARNING: DO NOT GET CLOSE TO THE FLAME.



	Describe what you see.	Describe what you hear.	Describe what you smell.
Candle Flame			

Is this object living or non-living?

❑ living

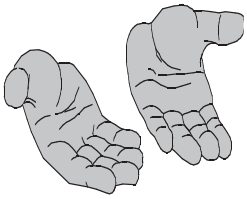
❑ non-living

Module One, Lesson One
Observation Record

Name_____

Station 5: Wooden Blocks

Use these senses to observe.




	Describe what you feel.	**Describe what you see.**	**Describe what you hear.**	**Describe what you smell.**
Wooden Blocks				

Is this object living or non-living?

❑ living

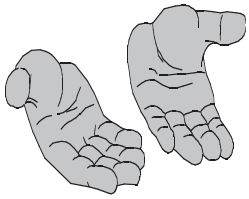
❑ non-living

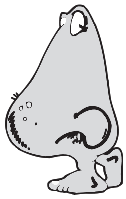
Module One, Lesson One
Observation Record

Name_____

Station 6: Plant

Use these senses to observe.



	Describe what you feel.	**Describe what you see.**	**Describe what you hear.**	**Describe what you smell.**
Plant				

Is this object living or non-living?

❑ living

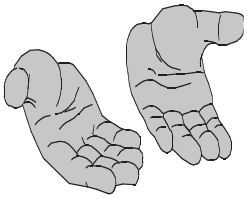
❑ non-living

Module One, Lesson One
Observation Record

Name_____

Station 7: Battery Operated Toy

Use these senses to observe..




	Describe what you feel.	**Describe what you see.**	**Describe what you hear.**	**Describe what you smell.**
Battery Operated Toy				

Is this object living or non-living?

❑ living

❑ non-livingCreative Writing Assignment

LIVING THINGS: CHANGES, STAGES AND CYCLES

Creative Writing Assignment Name_____

Imagine you meet someone who has never seen fire before (a young child, an alien or a person from a strange, distant country). He or she is convinced that fire is alive. Write a short story or fictional narrative that explains how you convinced them that fire isn't living. What did you tell them? What did you show them? Don't forget to include characteristics of living things to convince your confused and frightened friend. Use this paper or your own.

Scientific Investigation Guide Sheet Name_____

Directions:
Start with a pebble and a seed. Design your own investigation to answer this question: Are these living or non-living things?

Write a hypothesis.
This is a prediction that can be tested by an experiment. Your prediction should explain what might happen and why. A hypothesis is written with the words if, then and will. For example, your hypothesis might be "If the pebble is soaked in water, then the pebble will not sprout because it is not living."

If the_____
then the_____ will_____
_____

Plan the experiment.
What will you do to test your hypothesis? In any experiment there are "variables"--things that can be adjusted or that are changed. For example, where you place the pebble or seed can be changed. You might place it in water, soil or in the dark. You can study what changes happen to it.

Variables you will change:

_____ _____ _____ _____

Materials you will need:

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

Scientific Investigation Guide Sheet - Page 2 Name_____

Steps to complete your experiment:

Gather Data

Scientists record what happens during their experiment. This gives them information (or data) related to their hypothesis. How will you gather data and record your observations? Will you measure something? Will you make drawings or graphs? Explain how and when you will gather data.

Analyze the Data

You will need to examine the data to see if your hypothesis is supported. What changes will you observe if your prediction is correct?

Scientific Investigation Guide Sheet - Page 3 Name_____

Share the Results

How will you share the outcome of your experiment? Will you publish a report, like scientists sometime do? List your ideas here.

_____

_____

_____

_____

_____

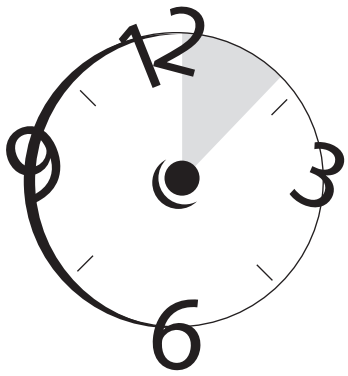
When you complete this investigation plan, work with your teacher to revise it. Get approval to begin.

LIVING THINGS: CHANGES, STAGES AND CYCLES

Basic Needs, Growth and Development

Core

Time Allocation: 45 minutes
Required Materials and Resources on Page 84



Lesson Overview

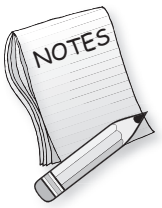
In this lesson, students will come to understand that from their beginning all living things change as they grow and develop over their lifetime. After a brief written pre-assessment of the concepts, they will be introduced to growth as change in size and development as change in shape, appearance or color. Using pictures of various living things, children will work together to observe, describe and record changes in animals, plants and humans at various points in their life span. They will apply the skill of categorization by sorting the changes they've observed and recorded under the headings of growth or *development*. After reviewing the findings of each group, students will be encouraged to discover other patterns in the data, such as which living things make the most dramatic changes.

Guiding Questions

- What changes can we observe in living things?
- What does it mean to grow and develop?

BIG IDEA

Understanding Growth and Development

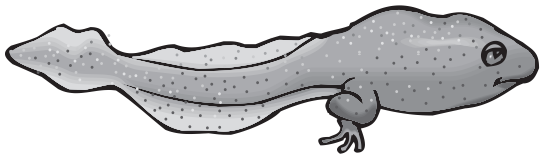


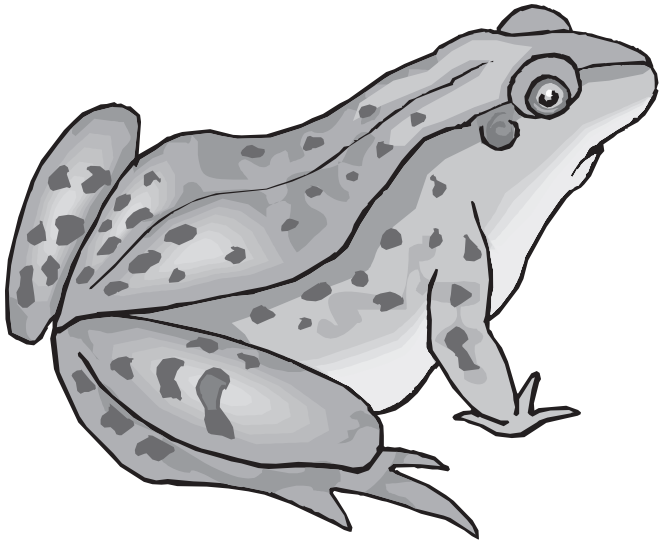
Content Goals

Universal Theme
Change

Principles and Generalizations
- Living things change as they grow and develop over their lifetime.
- Living things grow as they change in size.
- Living things develop as they change shape and appearance.

Concepts
- Living things
- Lifetime
- Change
- Grow
- Develop
- Size
- Shape
- Appearance



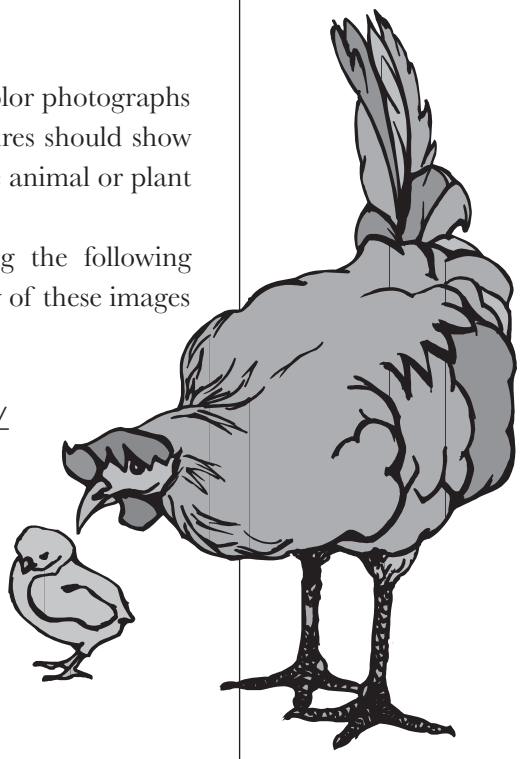


Teacher Information
N/A

Skills
- Observe
- Describe
- Record
- Sort
- Categorize
- Find Patterns

Materials and Resources
- **Beginnings Pictures** Packet
- Books with color photographs and drawings of developing animals and plants
- Student science journals
- Post-It Note pads, one per student team

- Easel, chart paper and markers
- Copies of **Module 1, Lesson 2: Growth and Development Task Sheet,** one per team
- Martin, Linda. (1994). *Watch them grow: The amazing ways that animals and plants change as they grow.* Dorling Kindersley Limited. (ISBN#: 1564584585) This book is strongly recommended for the Extension Activity.

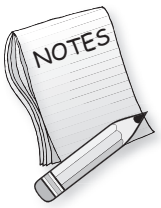


Preparation Activities

1. Ask your school librarian to help you locate books with color photographs or drawings of developing animals and plants. The pictures should show beginning, young and adult stages. One book on the same animal or plant should be available per student team.
2. Prepare the **Beginnings Pictures Packet** by visiting the following websites and then printing the desired image. Make a copy of these images for each team.
   - Eaglet - http://images.google.com
   - Sprouting bean – http://www..EnchantedLearning.com/subjects/plants/label/sproutingbean/labelanswersGIF
   - Newborn child - http://images.google.com
   - Salmon – http://oceanlink.island.net/oceanmatters/salmon.html
   - Frog - http://EnchantedLearning.com/subjects/amphibians/labael/froglifecycle/label.shtml
3. Determine which students will work together in heterogeneous triads.
4. Copy the **Growth and Development Task Sheet**, one for each team.

Introductory Activities (5 minutes)

Call the students to sit on the floor in front of the easel. Request that they bring their science journals and a pencil with them. Place the four **Beginnings Pictures** of living things on the easel. Taking one picture at a time, ask the students if they think they know what the living thing (i.e. the frog) might look like one week, one month or one year after that picture was taken. Listen to their ideas, asking them to be as specific as possible. Assuming none of the students will suggest that the living things will remain unchanged, ask them, "Why do you think these living things will



look different in the future?" Guide the students in concluding that all living things change over their lifetime. Tell them "We are going to explore the kinds of changes living things experience in this lesson and through out this unit."

Pre-assessment (10 minutes)

Write these words on the chart paper side by side as column headings: *To Grow* and *To Develop*. Have the students copy these words on different pages of their journals. Ask them to think about what it means to grow and to develop. Tell them you want to understand what they know already about these concepts before you begin the unit. Pre-assess their understanding in one of three ways below:

1. Instruct them to write their own definitions for each word. Remind them that we can define words with other words that mean the same thing or with an explaining sentence. Encourage them to think of examples and permit them to draw pictures. OR

2. To scaffold this activity, give students the option to draw three cartoon style boxes or frames showing a living thing growing and developing. Have them add arrows to highlight development. (An example they might chose is a plant stem that grows taller and then flowers as it develops.) OR

3. To further simplify this task, assign either plant or caterpillar illustrations, rather than giving them a choice. Instruct them to use the frames to draw the plant or caterpillar growing and developing. Make sure they point out the development.

After they have worked for about five to seven minutes, instruct the students to put their pencils down and close their journals. Collect their journals to review later in this lesson.

SEARCHLIGHT: Reviewing the journals is an opportunity to spot talent. Students with advanced conceptual development will be able to articulate that living things experience changes as they develop. They may be able to also provide examples, such as the change in form a tadpole experiences. Refer those students to the extension activities later on.

Teaching and Learning Activities (20 minutes)

1. Under the words *To Grow* on the chart paper, write *to change in size*. Under the words *To Develop*, write *to change in shape or appearance*. Explain to the students that appearance means the way something looks. Although when something grows in size its appearance does not necessarily change dramatically, development includes all other changes in appearance (such as color).

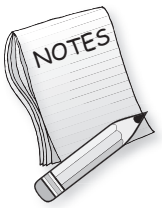
2. Next, tell the students that they are going to use the skill of observation to identify evidence of growth and development in living things. Just like in the last lesson, they will work together to observe and describe. However, they will examine pictures with their eyes only that show living things changing as they grow and develop. Since they have several pictures of the living thing overtime, they will need to compare and contrast the pictures to observe differences in appearance.

3. Explain the role of each triad member as follows. Everyone in the group will have the job of observing changes in the pictures, but each group will also be assigned a *recorder*, *sorter* and *reporter*. The recorder will write what the team observes, putting one change per Post-It Note. For example, if the puppy's tail looks longer in one picture as compared to another, the recorder will write tail got longer on a Post-It Note. If they observe a change in color, the recorder will write something like turned deeper green.

4. After triad members have located all the changes they can find, they will work to decide how to categorize the types of changes they have observed. Students will read each change written on a Post-It Note and then consider: Is it a change in size (evidence of growth) or a change in appearance or shape (evidence of development)? The sorter will be responsible for placing the Post-It Notes in the appropriate column on the **Module 1, Lesson 2: Growth and Development Task Sheet**.

5. In addition to these responsibilities, let the students know that when the whole class reconvenes, the reporter will share the team's findings.

6. Divide the students into triads. Select a recorder, sorter and reporter for the triad. Give each triad one set of pictures or a book with photos of



living things growing and developing. Hand one pad of Post-It Notes to the recorder. Remind him/her to bring a pencil. Give the sorter the **Module 1, Lesson 2: Growth and Development Task Sheet**. Designate where each group will work.

7. Circulate from triad to triad to assist them in working cooperatively. After the students have worked for 20 minutes, make an announcement that they need to start sorting their observations into the growth or development columns.

Products and Assignment

1. **Module 1, Lesson 2: Growth and Development Task.** (Students record observations and sort the changes into categories.)
2. Class growth and development chart with definitions and team contributions of observed examples.

Extension Activities

- *Watch Them Grow: The Amazing Ways That Animals and Plants Change As They Grow*, by Linda Martin (60 Minutes)

Assign this book for independent reading. Have students create an additional chapter to this book using the same format the author uses. Their chapter should include an introduction to the living thing, illustrations of various stages of development and captions explaining these changes. Give them the option of using a picture set that accompanies this lesson rather than doing their own illustrations.

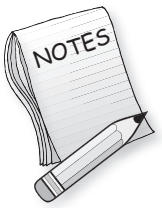
Post Assessment

Assess if the students have constructed an understanding of what growth and development means by asking each to explain one of their group's contributions under each column's heading (*To Grow* or *To Develop*) on the class chart. Being able to define the terms and then explain why an observation fits one definition or the other is a good indication that they understand the differences in the two types of change that living things experience. Use the rubric below to assess their concept development.

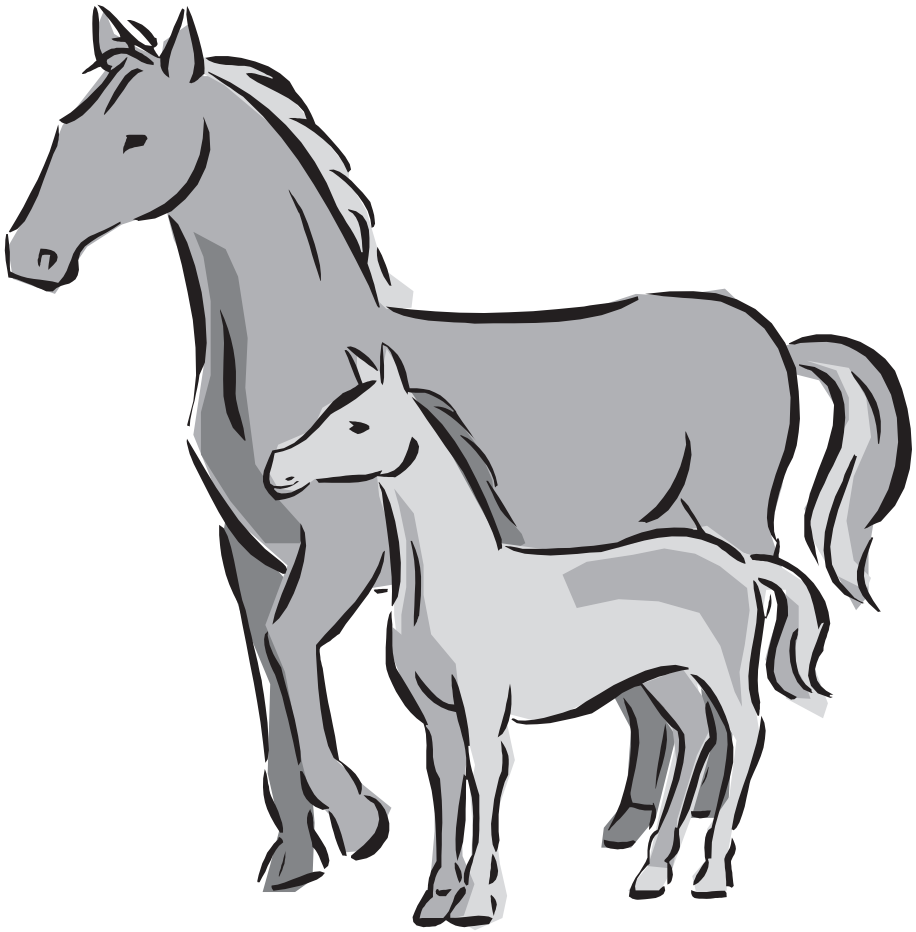
Rubric for Assessing Levels of Understanding			
	Beginning	**Emerging**	**Solidified**
Growth	*Growth* is explained as "getting bigger." Nonspecific or inaccurate examples are given from the pictures.	*Growth* is explained as both a change and an increase in size. A comparison is made between a plant or animal's smaller (beginning) and larger (mature) sizes.	*Growth* is explained as a change that results in an increase in size. Specific examples of incremental size increases are provided.
Development	*Development* is used as a synonym for growth. Nonspecific or inaccurate examples are given from the pictures.	*Development* is explained as a change in "how a living things looks." Color or form or another aspect of appearance is used to illustrate this.	*Development* is explained as a change in "how a living thing looks" or appears. Color, form or other aspects of appearance (like texture) are explained. Numerous examples are used to illustrate this.

Debriefing and Reflection Opportunities (10 minutes)

1. Call the students to sit in front of the easel. Ask each triad's reporter to first show the class the pictures they were working with and then read their observations of growth and development. Place each Post-It Note they read under the appropriate category heading (*To Grow* or *To Develop*) on the large chart. Have each triad go through the same process. Assist the students as they share in sorting according to the definition of growth and development should it be necessary.
2. Guide the students in locating other patterns in their recorded observations of growth and development. Tell them, "Let's look at your descriptions in the two columns. Do you see any similar kinds of changes? Do you see



any patterns in the kinds of changes certain living things experience? For example, they might notice that insects experience a change in color or a complete transformation in which they do not resemble their parents. Validate their recognition of other patterns in the data. For example, all living things appear to start smaller and grow into an adult size.



Module 1, Lesson 2 Name_____

Growth and Development Task Sheet

Station 7: Battery Operated Toy

Triad Member Names:_____ _____ _____

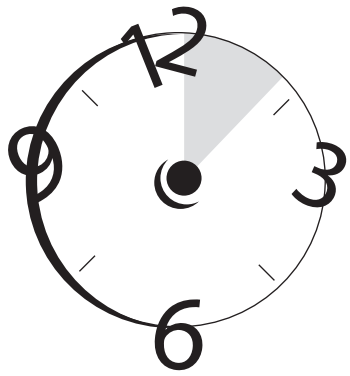
Decide together how to sort the sticky notes that describe changes in your living thing. Have the "Sorter" place them under the correct heading.

Growth	**Development**

Basic Needs, Growth and Development

Core/AID

Time Allocation: 1 hour, 30 minutes
Required Materials and Resources on Page 84



Lesson Overview

In this lesson, students will come to understand that living things grow and develop in a common pattern that includes a beginning, early stages and mature adult stage. As a check for understanding, students will begin by working with the teacher to map the relationship of some main concepts introduced in this unit thus far. Next, they will be asked to define pattern, link this concept with their previous experience and then asked to consider what patterns might be seen in how living things change, grow and develop.

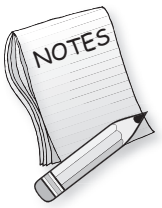
While working in groups of three, they will use print references to locate evidence of these patterns in lives of certain organisms. Each student will create a poster of the living thing's beginning, early stages and adulthood.

Guiding Questions

- What similar patterns and stages in growth and development do living things experience?

BIG IDEA

Patterns of Change on the Way to Maturity



Content Goals

Universal Theme

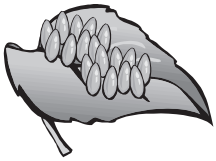
Patterns

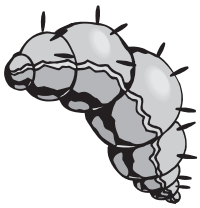
Principles and Generalizations

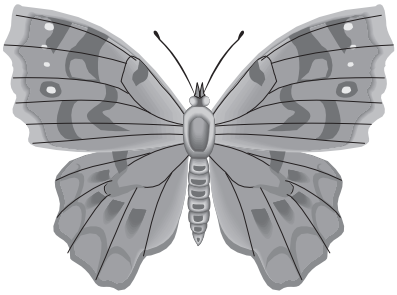
- Living things grow and develop in a common pattern that includes a beginning, early stages and an adult stage
- In their early stages living things are not fully formed.
- When living things grow and develop to maturity, they are fully formed.

Concepts

- Change
- Beginning
- Young
- Early
- Grow
- Develop
- Mature
- Immature
- Adult
- Pattern







Teacher Information

N/A

Skills

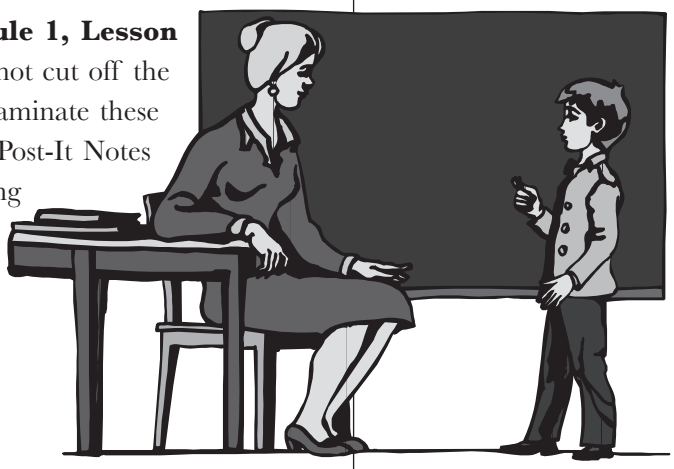
- Observe
- Record
- Locate Patterns
- Sequence

Materials and Resources

1. Erasable white board and markers
2. Concept Cards copied and cut from **Module 1, Lesson 3 Concept Cards Black Line Master** or Post-It notes with handwritten concepts

3. Reference books for each group's investigation of a plant or living thing, one – three books per group. Recommended books are listed in **Module 1, Lesson 3 Bibliography**.
4. Large white construction or computer paper, 11" x 17", three pages per group
5. Word strips cut from copies of **Module 1, Lesson 3 Patterns of Growth Black Line Master**, one set per group
6. Changes, Stages and Cycles in Livings Things Unit Concept Map

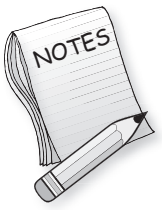
Preparation Activities

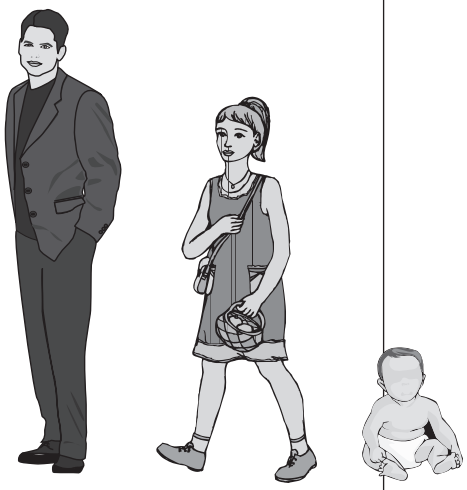


1. Copy and cut out Concepts Cards from **Module 1, Lesson 3 Concept Cards Black-Line Master.** Do not cut off the black lines that outline each card. If possible, laminate these to use throughout the unit. Alternatively, have Post-It Notes available to write concept words while working with students.
2. Pre-determine student groups of three. Group students according to reading level.
3. Copy one **Module 1, Lesson 3 Patterns of Growth Black-Line Master** per group. Cut each copy into word strips, creating one set per group.
4. Locate the books listed in the bibliography. When a title is not available, attempt to substitute a book that includes pictures (preferably photos) of the organism's life cycle and has text at an appropriate reading level for each group of students' readiness.
5. Print a **Beginning, Early and Adult Stages Poster Rubric** and copy one per student to assess his/her learning at the end of this lesson.

Introductory Activities (15 minutes)

Gather students together in front of a white marker board. Tell them, "We are going to be doing some research on how living things begin, grow and change. However, first we will map out what we've already learned about living things." Ask them if they have ever created a concept map before or ask them to recall a time when they designed one. (They may know these as mind maps or webs). Tell them that we're going to create a concept map to organize what we've learned so far about living

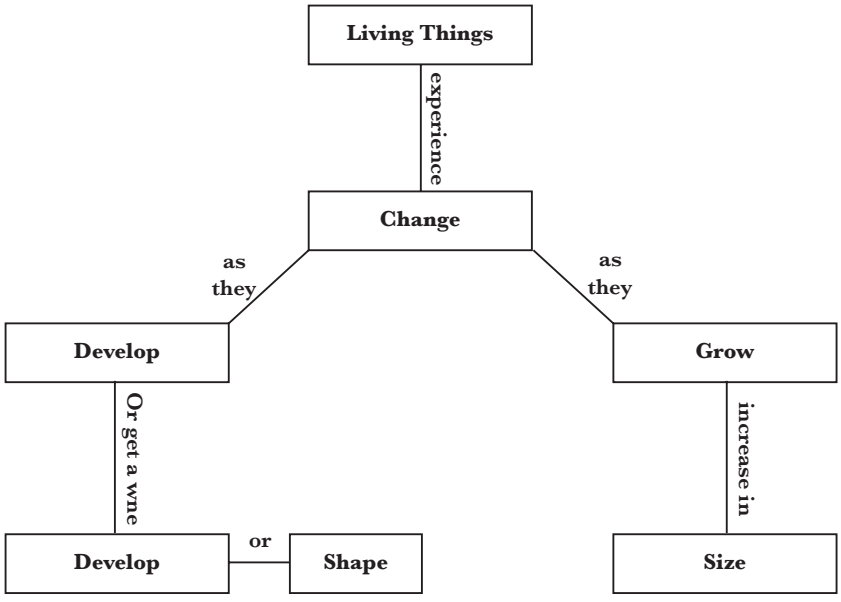




things. The map will grow each time we learn a new idea. A concept map will help us organize our thinking and understanding.

- Then tape the *Living Things* concept card to the board or write the concept on a Post-It Note and place it in the center of the white board. Tell them you are starting with the biggest or most general idea.
- Explain the rules for designing concept maps are to first connect one concept (ideas on the cards or Post-It Notes) with another concept to form a meaningful statement and then to repeat this process.
- Set these concept cards on the ledge of the board: *Change*, *Grow* and *Develop*.
- Tape the word Change beneath Living Things. Draw a line between the two words and ask the students to suggest connecting words that will make a meaningful statement that shows how the two words in the boxes (*Living Things* and *Change*) are related.
- Say, "We will write our connecting words on this line." Doing this on the white board will allow erasures for changes. Consider the students' suggestions and work to create propositional statements that incorporate as many of the unit concepts (*Change, Grow, Develop, Lifetime* and others) as time permits.

There are many ways the map could be constructed. Avoid giving the statements to the children. Allow it to become their own map, correcting any inaccuracies as necessary. It also may make more sense at times to not use one of the concept cards, but to use that word or words on the line as a connector completing the propositional statement. Below is one possible example. Also, see the **Growth of Living Things Concept Map** that accompanies this unit.



Pre-assessment

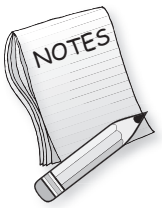
- Working with the students to design a concept map is an informal way to assess students' current understanding of how those words are defined and how the concepts relate. Use the unit concept map as a resource, but encourage the students to generate ideas for how the map should be organized, rather than doing it for them. However, be sure to correct misconceptions.
- **SEARCHLIGHT**: This is an opportunity to spot talent. Students with the most advanced conceptual understanding and non-verbal organizational skills will recommend a hierarchical arrangement that integrates what they've learned and organizes the ideas. The propositions they suggest will contain two or more concepts connected with other words to form a meaningful statement. Consider having these students do the My Own Concept Map Extension Activity explained at the end of this lesson.

Teaching and Learning Activities (60 minutes)

1. Begin the discussion by asking the students what a pattern is. Ask them for examples. Students should be able to provide examples and be familiar with the fact that there is repetition in patterns. As you work together towards a definition, emphasize that patterns have order.

2. Tell them, "We are going to do some research to look for evidence of a pattern of growth common to all living things." Put the words *beginning*, *early stages* and *mature adult* on the chart paper or tape a copy of the **Module 1, Lesson 3 Patterns of Growth Black-Line Master**. Tell them that all living things have a beginning, experience early stages in their growth and end up as mature adults. Define stages as steps or levels of growth. Ask them if they know what *mature* means. Define it as being fully grown and developed. Tell them that their parents or grandparents are a good example of mature adults because they are not going to grow or develop any more. Then explain that their job will be to find evidence of this pattern for a particular living thing.

3. Arrange the students in groups of three. Inform each group of the particular living thing that they will be in charge of researching. Students can be grouped by reading level if sharing books. Alternatively, three



students of mixed reading ability can work together if there are enough books for each child to be given a book about his/her assigned living thing that is appropriate to his/her reading level. When assigning certain living things, it will also be helpful to consider the complexity and detail used in each book to describe the plant's or animal's stages of growth. See the bibliography at the end of this lesson with recommendations of books by developmental reading level. (AID)

4. Tell students they will each take responsibility for researching, describing and drawing one stage of the living thing's life, either its beginning, early stages or adulthood. Hand each student a word strip cut from a copy of **Module 1, Lesson 3: Patterns of Growth Black-Line Master.** This will indicate their assigned responsibility.

5. Clarify, that the person in charge of the early stages may have several drawings or descriptions to complete. He/she may want to sub-divide or number their paper to organize his/her work. (This responsibility offers an AID for a student who can handle more detailed work.)

6. Give each student a piece of 11"x 17" paper. Instruct the class to paste the word strips cut from the **Patterns of Growth** sheet on the large white paper as a title. Students will create a poster by writing descriptions and drawing pictures of their living thing's stages of growth under the pasted title.

7. Instruct students about how you will evaluate quality work by explaining the criteria in the rubric supplied in the Post Assessment section. If the children are aware of what is a quality product is (one that show's understanding, accuracy and clarity), it is more likely that they will work towards those standards. The criterion terms may have to be explained to the children.

Products and Assignment

- *Concept map* constructed as a class using concept cards, markers and a white board
- Posters with researched drawings and descriptions of beginning, early and adult stages for each living thing, one per student.

Extension Activities

1. Research the Patterns of Change in Another Living Thing (60 Minutes) (CORE)

   Students interested in exploring the changes other living things experience as they grow and develop may select another plant or animal and research its beginning, early stages and form as a mature adult. Give them a word strip set and three pieces of paper. Instruct them to proceed as they did in class with a group but this time independently.

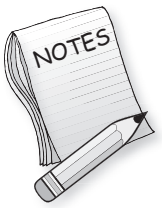
2. My Very Own Concept Map (60 Minutes) (AID)

   Give students a set of the concept cards from **Module 1, Lesson 3: Concept Cards Black Line Master** and a piece of large poster or chart paper. Instruct them to cut up the cards and arrange them with the largest, most general ideas on the top. Have them draw lines between concept cards with connecting words to make true, complete statements that reveal how the words relate. Ask them to include concepts not illustrated on the class chart done at the beginning of the lesson. Alternatively, if *Kidspiration* software is available, allow students to design a concept map on the computer that utilizes the concepts introduced in the unit thus far and others on the cards. Give them feedback to assure the propositional statements include accurate information.

Post Assessment

The student posters can serve as a product used to assess learning. The posters should be judged by criteria to evaluate student understanding of the principles and generalizations in this lesson, and accuracy and clarity in describing each stage of development. The questions below can be used to examine students' work. A scoring rubric is also provided.

- Is there evidence in the drawing and description that the student understood the meaning of the stage he/she was assigned to research—beginning, early stages or adult? (The pictures and description will be appropriate for that particular stage and not others. Vocabulary will be appropriate to that plant or animal).
- (For the students assigned to beginning stage) Do the drawings and descriptions actually show the very beginning, not just the plant or animal



as a youngster? For example, did they include one of these: a seed and germination, egg and hatching, or womb and birth; or the pupa before metamorphosis?

- Does the student's poster show evidence of collaboration with his/her group mates to convey the life span of the plant or animal? (The student's drawings and description should be accurately sequenced and not replicate information from their partners' assigned stage.)
- (For the students assigned to early stages) Do the drawings and descriptions explain all of the steps (stages) after the plant's or animal's beginning and before it is a fully formed adult?
- (For the students assigned to the adult stage) Do the drawings and descriptions explain how the plant or animal looks as a fully formed, mature adult? With some animals the most significant different between early and adult stage is size. Changes in size should be noted.

Debriefing and Reflection Opportunities (15 minutes)

Bring the students together to share their findings. Allow each group member to briefly share a summary of the stages written and illustrated. To underscore the pattern of development common to all living things, instead of having a complete group share at one time, have students present by stage: all students who researched beginning first, early stages second and mature adulthood last. Display the posters around the room.

Name_____

Beginning, Early and Adult Stages Poster Rubric				
	4	**3**	**2**	**1**
Concept Understanding	Pictures and description show a thorough and complete understanding of *beginning*, *early* stages or *adult* stage	Pictures and description show a substantial understanding of *beginning*, *early* stages or *adult* stage	Pictures and description show a partial or incomplete understanding of *beginning*, *early* stages or *adult* stage	Pictures and description show a mis-understanding of *beginning*, *early* stages or *adult* stage
Accuracy of Information	All *facts* and *vocabulary* correctly describe the species' beginning, early stages or adult stage.	*Facts* and *vocabulary* have minor inaccuracies that do not affect the overall of description of the species' beginning, early stages or adult stage.	*Facts* and *vocabulary* have numerous errors that detract from the description of the species' beginning, early stages or adult stage.	*Facts* and *vocabulary* are missing or have significant errors in describing the species' beginning, early stages or adult stage.
Clarity	The events and details described in words and pictures for this stage of development are exceptionally clear or very easy to follow.	The events and details described in words and pictures for this stage of development are generally clear or can be followed.	The events and details described in words and pictures for this stage of development lack clarity or are difficult to follow.	The events and details described in words and pictures for this stage of development are unclear or impossible to follow.

Module 1, Lesson 3 Bibliography (Continured)		
Living Thing	**Book**	**Developmental Reading Level**
All Categories of Living Things: Amphibians (Frog) Mammals (Cats, Rabbit, Horse, Dog) Birds (Chicken, Duck) Fish, Plants	Martin, L. (1994). Watch them grow: The amazing ways that animals and plants change as they grow. New York: Dorling Kindersley Publishing, Inc. (ISBN# 1564584585)	Early or Transitional Reader
Amphibian: Frog	Milbourne, A. (2002). Tadpoles and frogs. London: Usborn Publishing. London. (ISBN# 9780794501648)	Early Reader
Amphibian: Frog	Wallace, K. (1998). Tale of a tadpole. New York, NY: DK Publishing, Inc., (ISBN# 0789434377)	Early Reader
Bird: Chicken	Patchett, F. (2002). Eggs and chicks, London: Usborn Publishing. (ISBN# 9780794501662)	Early Reader
Bird: Chicken	Life Cycle of a Chicken. Des Plaines, IL: Hinemann Library. (ISBN# 157572698X)	Transitional Reader
Amphibian: Frog	Life cycle of a frog. Des Plaines, IL: Hinemann Library, (ISBN# 1575726130)	Transitional Reader
Insect: Beetle	Stefoff, R. (1997). Beetle. Tarrytown, NY: Benchmark Books. (ISBN# 0761 404104)	Transitional Reader
Insect: Butterflies and Moths	Kidman Cox, R., & Cork, B. (1980). Butterflies and moths. London: Usborn Publishing. (ISBN# 0860204774)	Transitional Reader
Insect: Butterfly	Chinery, M. (1991). Life story butterfly. Troll Associates. (ISBN# 0816721017)	Fluent Reader
Insect: Butterfly	Terry, T. & Linton, M. (1998). The life cycle of a butterfly. New York, NY: The Bookwright Press. (ISBN# 053118188 X)	Transitional Reader
Insect: Butterfly	Ling, W. (1992). See How They Grow Butterfly. New York, NY: Dorling Kindersley Publishing, Inc. (ISBN# 9781564581129)	Early Reader

Module 1, Lesson 3 Bibliography (Continued)		
Insect: Butterfly	Life cycle of a butterfly. Des Plaines, IL: Hinemann Library. (ISBN# 1575726971)	Transitional Reader
Insect: Butterfly or Moth	Morgan, S. (2000). Looking at minibeasts butterflies and moths. North Mankato, MN: Thameside Press. (ISBN# 1929298803)	Transitional Reader
Insect: Butterfly, Moth, Caterpillar, Wasp, Mosquitoes	Goor, R & Goor, N. (1990) Insect metamorphosis. New York, NY: Aladdin Paperback. (ISBN# 0689821964)	Fluent Reader
Insect: Ladybug or Beetle	Morgan, S. (2000). Looking at minibeasts ladybugs and beetles, North Mankato, MN: Thameside Press. (ISBN#192929879X)	Transitional Reader
Insect: Grasshoppers or Beetles	Dickins, R. (2002). Bugs. London: Usborn Publishing. (ISBN# 9780794502676)	Fluent Reader
Mammal: Kangaroo	Life cycle of a kangaroo. Des Plaines, IL: Hinemann Library. (ISBN# 1575726157)	Transitional Reader
Mammal: Guinea Pig	Life cycle of a guinea pig. Des Plaines, IL: Hinemann Library. (ISBN# 1575726149)	Transitional Reader
Plant: Apple Tree	Life cycle of an apple. Des Plaines, IL: Hinemann Library. (ISBN#157572)	Transitional Reader
Plant: Flower	Kidman Cox, R., and Cork, B (1980). Flowers. London: Usborn Publishing. (ISBN# 0860204790)	Transitional Reader
Plant: Flower	Royston, A. (1998). Life cycle of a sunflower. Des Plaines. IL: Hinemann Library. (ISBN# 1575726998)	Transitional Reader
Plant: Bean	Life Cycle of a Bean. Des Plaines, IL: Hinemann Library (ISBN# 1575726122)	Transitional Reader

Module 1, Lesson 3 Name_____

Conscept Cards Black Line Master

Living Things	Non Living Things	Characteristics	Move
Food	Energy	Eliminate	Breath
Lifetime	Change	Respiration	Waste
Grow	Develop	Size	Shape
Immature	Beginning	Appearance	Early

 Name_____

Conscept Cards Black Line Master (Continued)

Pattern	Mature	Sequential	Stages
Respond	Needs	Reproduce	
		Survive	
		Environment	

Module 1, Lesson 3 Name_____

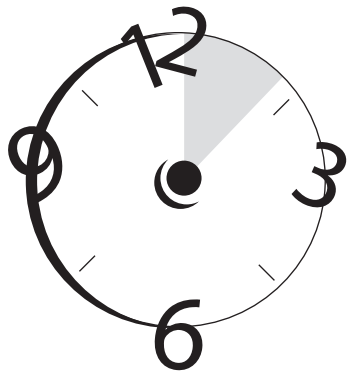
Patterns of Growth Black Line Master

Beginning
Early Stages
Mature Adult

Basic Needs, Growth and Development

Core/Practice/AID

Time Allocation: 1 hour, 20 minutes
Required Materials and Resources on Page 84



Lesson Overview

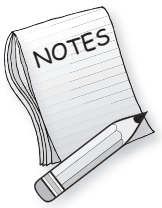
In this lesson, students will come to understand that living things have basic needs that must be met in their environment to grow, reproduce and survive. They will use scientific methodology to plan and conduct a simple experiment and discover the effects of adjustments to environment on the germination of a bean seed. They will be introduced to the terms such as *hypothesis*, *control* and *variable* and be asked to predict what might happen when quantities of water, light and temperature are changed. Over the course of four or five days, students will record their observations. (It is highly recommended that Part One of this lesson be started on a Monday).

Guiding Questions

- How is a bean seed affected when certain basic needs are not met?
- What will our classroom organisms need to grow and survive?
- What methods do scientists use to answer questions?

BIG IDEA

Basic Needs Must Be Met



Content Goals

Universal Theme

Needs

Principles and Generalizations

- Living things have basic needs that must be met to grow, reproduce and survive.
- Living things will survive only in environments where those needs are met.
- The first stage of a seed plant's growth and development is seed germination.
- Seed germination and plant growth are affected by light, temperature and water.
- Changing and controlling variables in an experiment help us study the effect of each.

Concepts

- Needs
- Grow
- Germination
- Reproduce
- Survive
- Environment
- Habitat

Teacher Information

- Experiments contain a set of **controls** or control group. These are conditions that do not change and provide a standard of comparison.

- **Variables** are conditions in an experiment that can be changed.

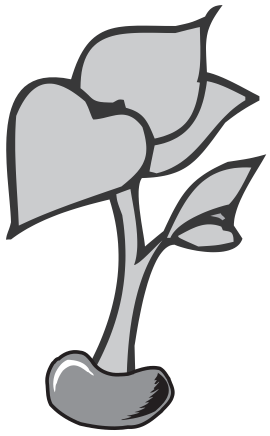
- A seed contains an **embryo** or baby plant. A seed is **dormant** or asleep until certain conditions in its environment are right to promote its growth

- The beginning stage of a plant's growth starts with **germination** or

sprouting. If placed in the right environment, first the seed swells from taking in water. Then its seed coat splits open. After the seed coat splits, an **embryonic root** or **radicle** will emerge. The radicle grows downward, develops tiny root hairs and absorbs minerals through these hairs. Next, the **hypocotyl** or embryonic stem grows upward and pulls the **cotyledon** (its food supply) and above the soil. The cotyledons form the first leaves that appear above the ground. They also store food for the new plant. Later, the real leaves of the new plant develop.

From: http://www.hydroponicsonline.com/images/bean1.jpg

- Temperature, water, light, oxygen and genetic make-up will determine how fast a seed germinates.

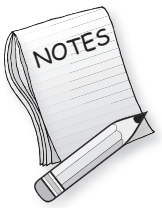


Skills

- Identify Variables
- Hypothesize
- Predict
- Experiment
- Observe
- Describe
- Record

Materials and Resources

- Part of this lesson was adapted from a more sophisticated high school lesson on the same subject found at http://www.howe.k12.ok.us/~jimaskew/hbio.htm
- Lesson 4 Observation Sheet, one per student
- **Module 1, Lesson 4 Observation Sheet 2, one per student**
- **Module 1, Lesson 4 Experiment Design Sheet,** one per student pair
- Water, one cup per pair
- Plastic zip lock baggies, two per student pair
- Paper towels, two per student pair
- Eyedropper or spoon, one per student pair
- Lima bean seeds, four per student pair



- Blank white labels or permanent markers to label each zip lock baggies
- **Module 1, Lesson 4 Germination Picture Set**
- Chart paper, easel and markers
- One-16 oz plastic cup per student
- One large bag potting soil (enough to fill each 16 oz cup half way)
- Large spoon or potting trowel
- Small watering can or pitcher
- Student science journals
- Rulers for measuring

Preparation Activities

1. Make copies for each student from **Module 1, Lesson 4 Observation Sheets 1 and 2 black line Master**.
2. Make copies for each student pair from **Module 1, Lesson 4 Experiment Design Sheet black line master.**
3. Gather all other materials listed above.
4. Plan what mixed ability student pairs will work together or alternatively plan on allowing the students to choose a partner.
5. Create labels for student zip lock bags that say the following: **CONTROL** and **EXPERIMENT**

Introductory Activities (5 minutes)

- Gather the students around the easel or on the floor in front of the board. Tell them that today we're going to begin an investigation of what living things need in order to grow, develop and survive. Check their understanding of the term survive and use "to stay alive" as a definition if clarification is needed. Ask them to suggest what people, plants and animals need to survive. Most likely their suggestions will include food, air and water. Continue the conversation by holding up a bean seed and saying, *"A seed is the beginning of a living thing, a plant. But a seed is dormant (or not active, asleep). It won't start growing unless its environment includes what it needs."*
- Check their understanding of *environment*. A simple definition is "one's surroundings." What should we give this seed if we want it to begin to grow? Listen to the suggestions. Then tell them that we can find out exactly what a seed needs to grow and survive by working like scientists and conducting some experiments. We can experiment to see what happens when we give a bean seed some of the things you said it needs and what will happen when we don't give it some of those things.

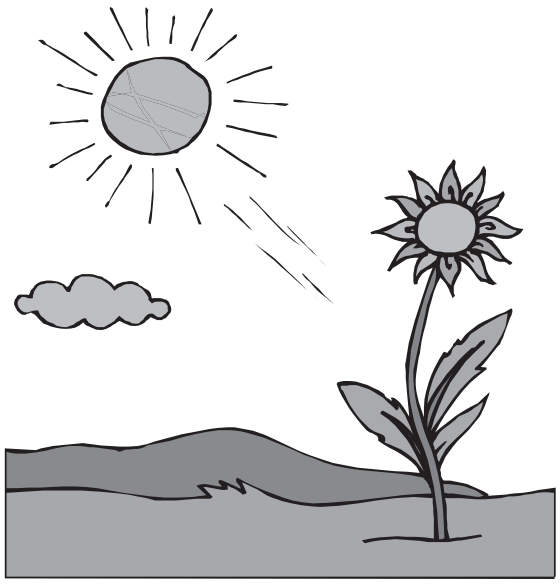
Pre-assessment

N/A

Teaching and Learning Activities

(60 minutes on Monday; 10 minutes for daily morning observations)

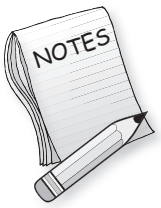
1. Using the **Module 1, Lesson 4 Germination Picture Set** explain normal seed germination as the beginning of a plant's growth and development. "*When* a bean seed gets what it needs, it grows and develops in a similar pattern as the other animals and plants we researched. It goes through a beginning stage, early stages and adult stage. Pictures 1 are of just the beginning stage of seed plant growth called *germination*. They describe what happens when the seed first awakens and sprouts." Show them the pictures and explain the sequence of events: seed swelling, seed coat splitting, radicle emerging and cotyledons coming out. (Picture 2 in the Germination Picture set shows all stages of a bean plant's growth.) Explain that germination usually occurs in the spring when conditions are right. Ask them to suggest what a seed needs from its environment in order to sprout. Allow them to generate ideas and then emphasize the importance of water, light and temperature. Tell them the cotyledons inside the seed store the food it needs.



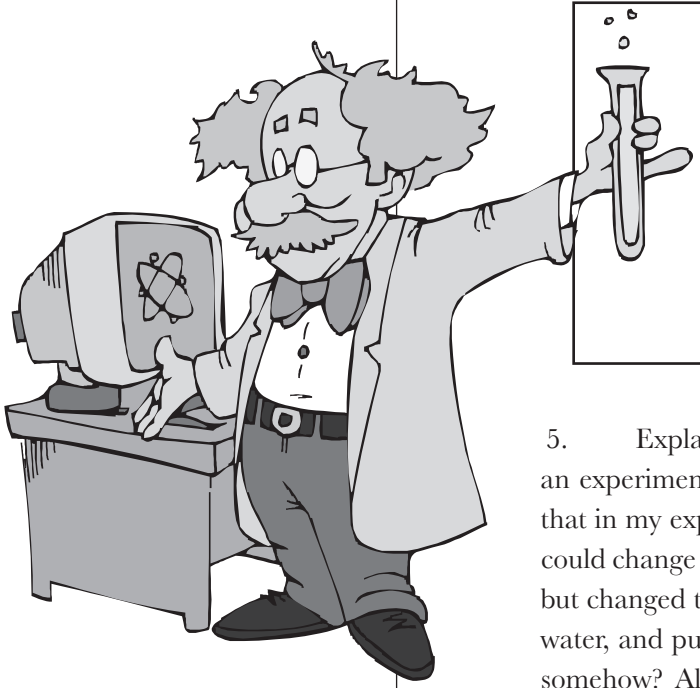
2. Next, explain the experimental method by telling them that scientists design experiments to answer questions. Our question today is "What do seeds need to germinate?" Write this question on chart paper.

3. Then say, "Scientists begin with an idea or hunch about what the answer to their question is. Scientists call their hunch a *hypothesis*." Have them repeat the word. Write *hypothesis* on the chart. We already discussed our hunches about what a seed needs to start growing. Write on the chart under hypothesis: "Seeds will germinate with the right amount of light, water and temperature." Have them read this statement. If the students mention food, remind them that a seed stores the food it needs inside.

4. Explain that scientists do experiments as tests to see if their hunches or



hypotheses are the right answers to their questions. They imagine what they can try or change in an experiment to test their hypotheses. The parts of an experiment which scientists consider leaving the same ("controlling") or changing are called variables. Write "*Variables* We Could Change or Control" on the chart paper. Tell them, "We could give all our seeds the same amount of light, temperature and water and see what happens or we could experiment by giving some of them a different amount of what we think they need." Encourage them to read the hypothesis and see if they can identify what could be changed in an experiment with bean seeds. Then, list *light, water, temperature* under variables. See example of chart paper below.



What do seeds need to germinate?

Hypothesis:

Seeds will germinate with the right amount of light, water and the temperature.

Variables We Could Control or Test:

Light
Water
Temperature

5. Explain that scientists study the effects of changes to variables in an experiment. They prepare by asking "What if I tried changing this or that in my experiment?" Now, let's act like scientists and consider what we could change in our experiment. What if we gave our seeds water and light, but changed the temperature to very, very cold? What if we gave the seeds water, and put them by the window for warmth, but took away their light somehow? Allow them to make predictions. Then, ask them to imagine what variable they might change by saying, "Give me a 'what if' question to show me your idea of what we could change in an experiment."

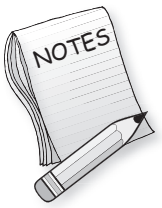
6. Tell the students that they will work with a partner to design and conduct an experiment. Explain, "You will each have four seeds for your experiment. First, everyone will give the same amount of all of the variables--water, light and temperature--to two of their seeds. These will be called our *control seeds*.

In science experiments controlling variables means keeping things the same or making no changes. Demonstrate set-up procedures for the control seeds. Take a zip lock bag labeled *CONTROL*. Fold one paper towel in quarters. Use the eyedropper or spoon to soak the paper towel. Then, place it in the zip lock bag, so it lies flat. Count the number of filled eyedroppers or spoonfuls it takes to wet the toweling and instruct students to use the same amount. Place the seeds on top of the toweling. Close the zip lock bag. Tell the students that they will all place the control seeds near the window to get the same light and temperature. Explain to them that these seeds will have their basic needs met: temperature, water and light.

7. Tell the students they will work with their partner to test the needs of their second set of seeds. They will decide what variable to change for these seeds and how they will change it. Ask the students why is it important for us as scientists to have two sets of seeds, a control set and a set where we change the water, temperature or light. After hearing their responses explain, "We can compare the control seeds to other seeds that will not have one of their basic needs met. We will be able to see if our hypothesis about what seeds need to germinate is true. We will see the effects of taking one of these needs away from the seed."

8. Pair the students with their partners. Distribute the **Experiment Design Sheet.** Have them complete their plan together. Tell them to explain how they will actually change the light, water, or temperature. Make sure they understand that they will be given another set of materials to test the variable of their choice in a way they'd like. They will need to consider where they will put the seeds (i.e. in a frig in the teacher's lounge) or what else they will need (e.g. a cloth to block the light). Define prediction for them as a statement of what they think will happen during their experiment. Explain that this should be based on what they have observed in their prior knowledge.

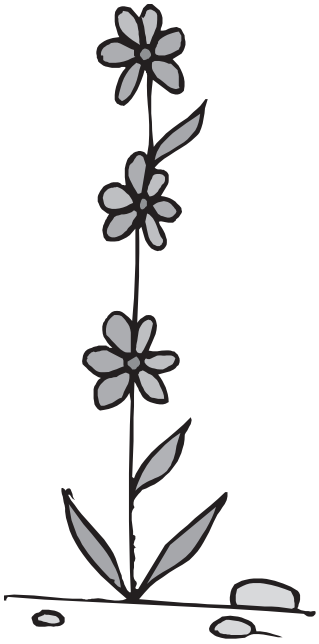
9. Once they have shown you their plan, distribute the materials for the students to set up both of their control seeds and experiment. Instruct them to put their name on the label or tape on both of the plastic bags.



10. **SEARCHLIGHT:** Students who easily understand the principle "changing and controlling variables in an experiment allow us study the effect of each" will be able to explain why it is important to have a set of control seeds. These students may also be interested in other experiments that examine the effects of a combination of variables. Encourage them when appropriate to complete the extension activity at the end of this lesson.

11. Allow ten minutes daily for the students to check the progress of both their control seeds and seeds with tested variables. They will mark observations, write simple descriptions and draw what they see on the **Module 1, Lesson 4 Observation Sheets 1 and 2.** (By day seven a root should appear.)

    From: http://www.ext.nodak.edu/extpubs/plantsci/hay/r648w.htm



12. Set up a *transplant center* on a counter, table or corner of the floor lined with newspaper. Place the potting soil, cups and large spoon at the center where students will transplant their germinated bean seeds. Instruct the students to add soil to their cup, place the germinated seed in the cup and cover it with soil until the cup is one half to three quarters full. Place it on the counter in front of the window.

13. Assign students to water cups daily. Devise a way for students to continue to monitor the growth and changes of the plants. See Extension Activities

Products and Assignments

- **Module 1, Lesson 4 Black Line Master Experiment Design Sheet**
- **Module 1, Lesson 4 Observation Sheet 1: Beginning of a Bean Plant: What Does a Seed Need to Germinate? Control Seeds**
- **Module 1, Lesson 4 Observation Sheet 2: Beginning of a Bean Plant: What Does a Seed Need to Germinate? Seeds with Tested Variables**
- Two Student Experiments with Control Seeds and Tested Variables
- Daily student observations of bean germination and record keeping
- Transplanted bean sprout into container of potting soil

Extension Activities

1. Daily Observations in Science Journals (10 to 20 minutes Daily) (CORE)
   Encourage students to visit the counter where their transplanted germinated bean seeds are placed to record daily observations. Journal entries can consist of a date, picture, height and width of plant (measured with a ruler)

and description of changes.

2. Great Plant Escape (30-90 Minutes) (AID)
   http://www.urbanext.uiuc.edu/gpe/index.html
   Have students who are strong readers and can work independently visit the Great Plant Escape online. This is a program designed by University of Illinois Extension to introduce 4th and 5th grade students to plant science. Cases are presented as mysteries and deal with seed growth, plant life cycles and reproduction Students may choose one or more of the cases and their suggested activities and work independently. Some are geared for group work.

   See Unit Appendix for additional extension activities.

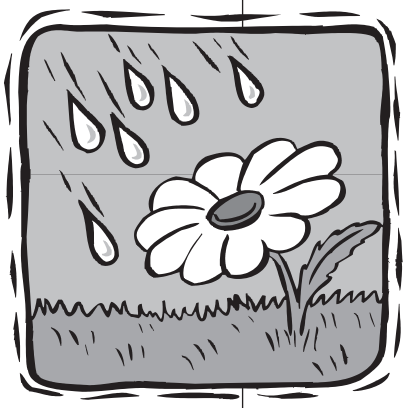
Post Assessment

To check for understanding of principles and skills in this lesson review the students':

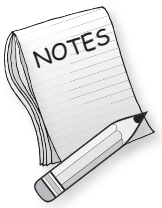
- **Module 1, Lesson 4 Observation Sheet**
- **Module 1, Lesson 4 Observation Sheet 2**
- **Module 1, Lesson 4 Experiment Design Sheet**
- Journal entries

Debriefing and Reflection Opportunities (15 minutes)

1. Gather the students to sit on the floor in the front of the room. Guide the students in reflecting on what seeds need in order to survive and grow. Possible questions to guide the conversation might be:
   - What did we learn from our experiments?
   - Which seeds went through all the stages of germination? Describe a seed that did not. What was missing from among that seeds' basic needs?
   - What did we learn about the effects of water, light and temperature on seed germination? Were your predictions correct?
   - What do you think our experiment with seeds tells us about the needs of other living things?
   - (Refer to this lesson's principles to help structure your discussion.)



2. End the discussion by explaining to the students that they will continue to be responsible for caring for the germinated bean seeds. As time permits in the next day or so, allow the children to work at the transplanting center to transplant their healthy germinated seeds to soil. Explain that daily watering will become part of the assigned classroom jobs.



References

Experiments with Plants. (1992). National Academy of Sciences, National Science Resource Center, Smithsonian Institution, Washington, D.C.

The Life Cycle of a Bean Plant
http://www.sparta.k12.il.us/SID/plantunit/growthofbeanseed.htm

Germination
http://www.yahooligans.com/reference/dictionary/illus/germin.html

Clip Art
http://www.hydroponicsonline.com/images/bean1.jpg
http://www.ext.nodak.edu/extpubs/plantsci/hay/r648w.htm

Module 1, Lesson 4 Name_____

Observation Sheet 1

Control Seeds **Variables We Did Not Change: Water, Temperature, Light**				
Date of Observation				
Normal Signs of Growth and Development During Germination	Seed Swells	Seed coat cracks	Hypocotyl-Radicle comes out	Cotyledons come out
Mark with an X if observed				
Drawing				

Module 1, Lesson 4 Name_____

Observation Sheet 2

Seeds with Tested Variables **Variable We Changed:**				
Date of Observation				
Normal Signs of Growth and Development During Germination	Seed Swells	Seed coat cracks	Hypocotyl-Radicle comes out	Cotyledons come out
Mark with an X if observed				
Drawing				

Module 1, Lesson 4

Experiment Design Sheet Date_____

Partner's Names_____ Recorder_____

Check one variable you will change in your experiment.

- ❑ Water
- ❑ Temperature
- ❑ Light

How will you change that variable? What will you do?

_____

_____

_____

_____

_____

What do you predict will happen to the seed?

_____

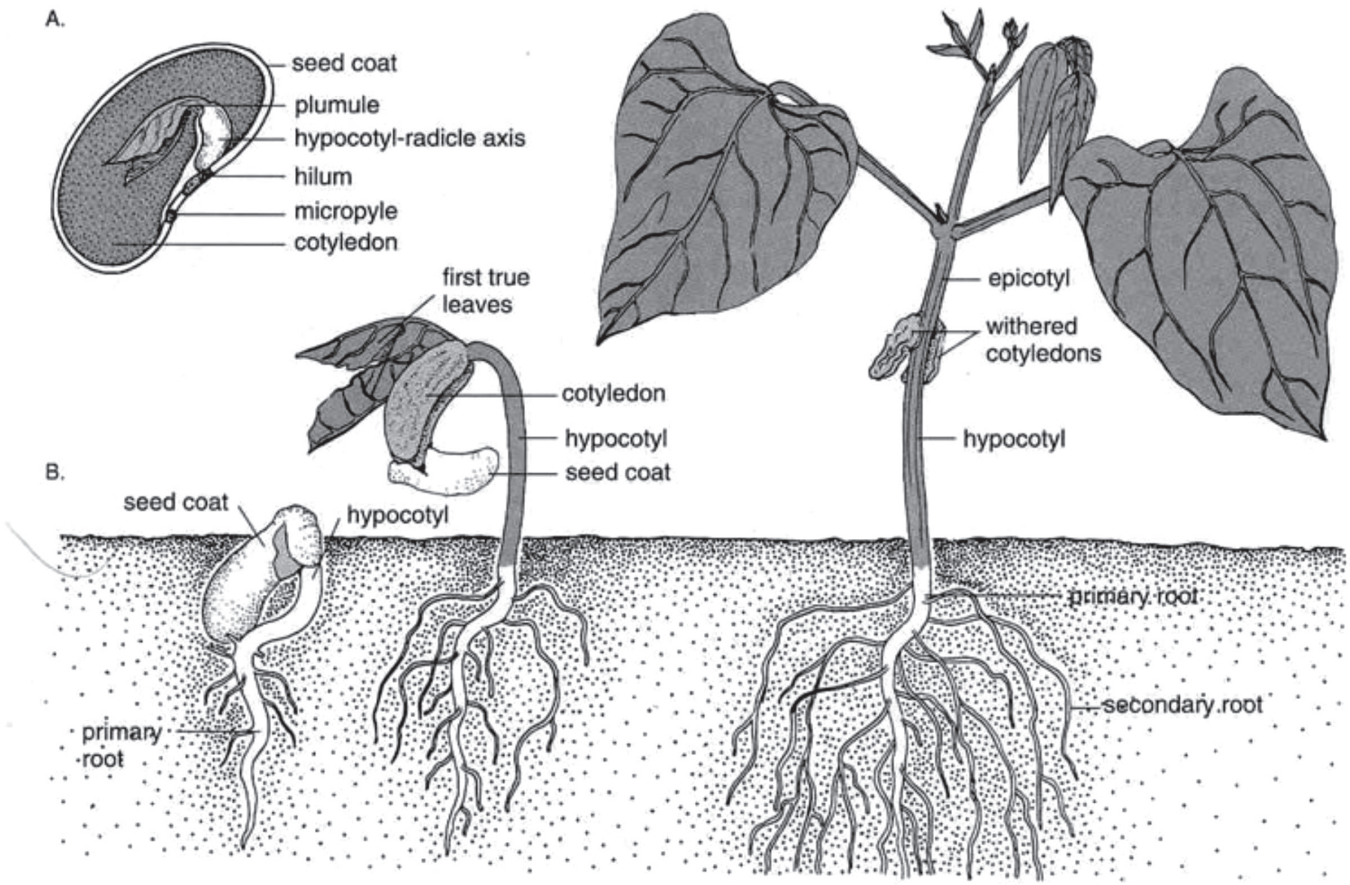
_____

_____

_____

Module 1, Lesson 4 Germination Picture Set Name_____

From http://www.yahooligans.com/reference/dictionary/illus/germin.html



Module 1, Lesson 4 Bean Plant Growth Stages Name_____

Adapted from http://www.sparta.k12.il.us/SID/plantunit/growthofbeanseed.htm

Some plants do not have fruit that the seed grows in, but have a pod called a bean. A bean is the part of the plant that holds the seeds. There are many different kinds of bean plants but they all grow in a similar way.

Stage One

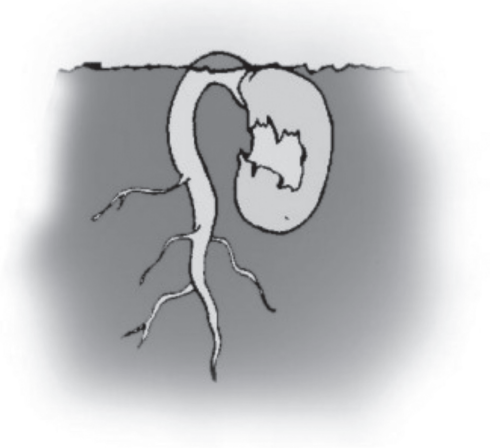
The bean seed is covered in a hard outer shell. When water is added to the seed, it swells and the seed bursts open.

Module 1, Lesson 4 Bean Plant Growth Stages Name_____

Adapted from http://www.sparta.k12.il.us/SID/plantunit/growthofbeanseed.htm

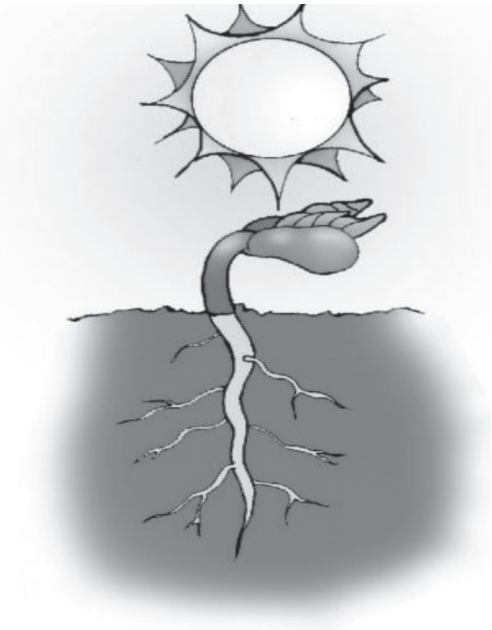
Stage Two

As the roots grow, a stem will also appear. The bean uses the food in the seed to grow.



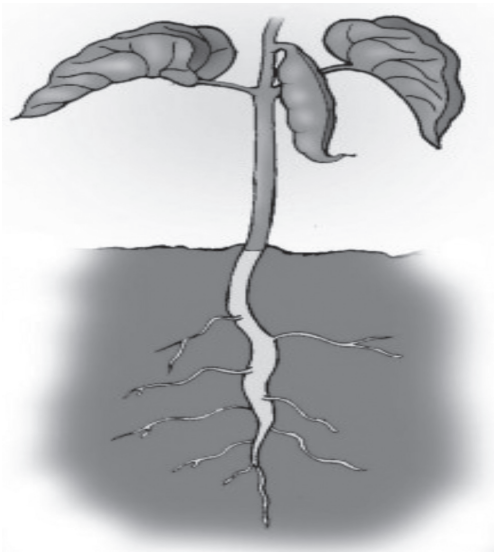
Stage Three

Leaves will grow on the stem and stretch towards the light.



Stage Four: Bean seed

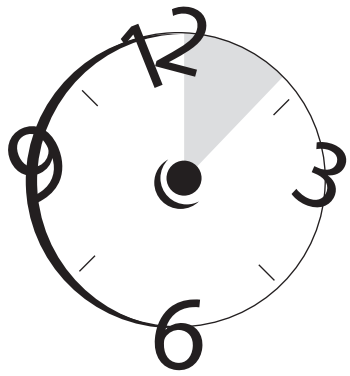
The bean seed is the part of the plant that is eaten. Peas and lima beans are bean seeds. The cycle is complete.



Basic Needs, Growth and Development

Core/Practice/AID

Time Allocation: 1 hour, 5 minutes
Required Materials and Resources on Page 84



Lesson Overview

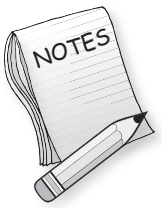
In this lesson, students will come to understand that environments must supply the basic needs of living things in order for them to survive. They will examine the differences and similarities between a natural habitat and unnatural one, such as a classroom. They will prepare for the arrival of Painted Lady butterfly larvae entrusted to their care by setting up a simulated habitat in a cup to ensure their growth and survival. Students will also assist in equipping a unique classroom observatory where the butterfly chrysalises will be placed with feeders so the emerging adult butterflies can be studied. This work will be completed in centers as time permits.

Guiding Questions

- How can we assure the survival and growth of a living thing outside of its natural habitat?

BIG IDEA

Creating A Classroom Habitat



Content Goals

Universal Theme

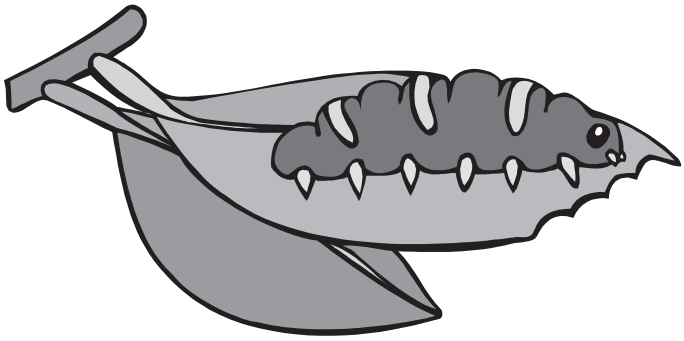
Needs

Principles and Generalizations

- Living things will survive and grow only in environments where basic needs are met.
- A butterfly begins as an egg; it then goes through a larval or caterpillar stage.
- Each stage of a living thing's growth and development has special characteristics.
- Each stage of a living thing's growth and development has special needs.
- Habitats have food, water, safety, and a place for reproduction and young.

Concepts

- Needs
- Grow
- Stage
- Survive
- Environment
- Natural
- Unnatural
- Habitat
- Host
- Species



Skills

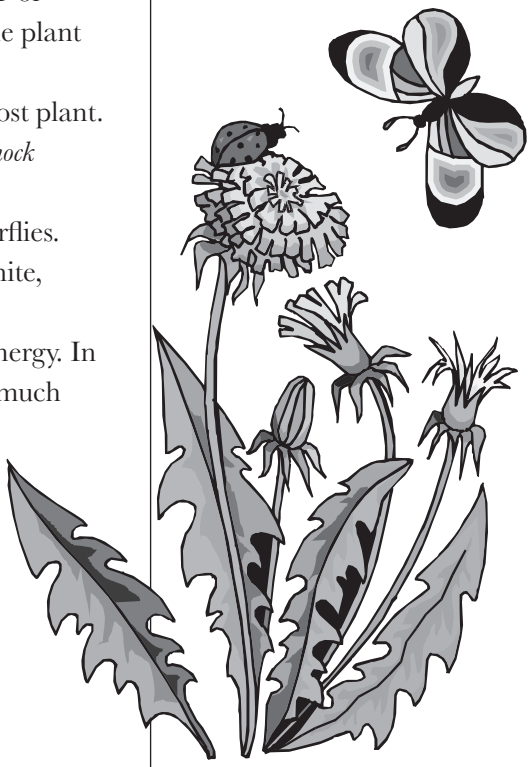
Compare and Contrast

Teacher Information

- Many caterpillars (larvae) can eat the leaves of only one type of plant. They are called *specialists*. Some can eat many kinds of plants (*generalists*). Most female butterflies lay their eggs on the leaves of the plant that their caterpillars will need when they hatch. The plant where the eggs are laid

is called a *host plant*.

- When the female butterfly finds the host plant, she attaches sticky glue to the leaf and lays an egg. Luckily, the egg will not be knocked off or snatched by a predator. When the caterpillar hatches, it can eat the plant it needs.
- Butterfly habitat is closely linked to the emergence of this larval host plant. Painted Lady butterflies will lay their eggs on *thistle, mallow or hollyhock* leaves as well as numerous other plants such as sunflowers.
- Some garden flowers may be beautiful, but do not appeal to butterflies. Butterflies are attracted by color and scent. Many are drawn to white, yellow or purple flowers.
- Butterflies rely on the nectar of flowers as a food source of high energy. In turn, butterflies pollinate the flowers. Nectar is very sweet, with a much higher sugar concentration than soft drinks.
- Wildflowers are a source of nectar for butterflies. Butterflies use their proboscis to drink nectar from flowers. As adults Painted Lady butterflies will sip sweet nectar of many flowers, such as: thistle, clover, aster, dogbane, goldenrod, marigold, milkweed and vetch. Thus, they are generalists.
- Larvae and butterflies need appropriate temperature and light in order to grow and breed.



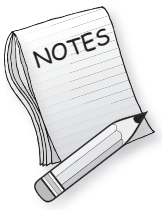
Materials and Resources

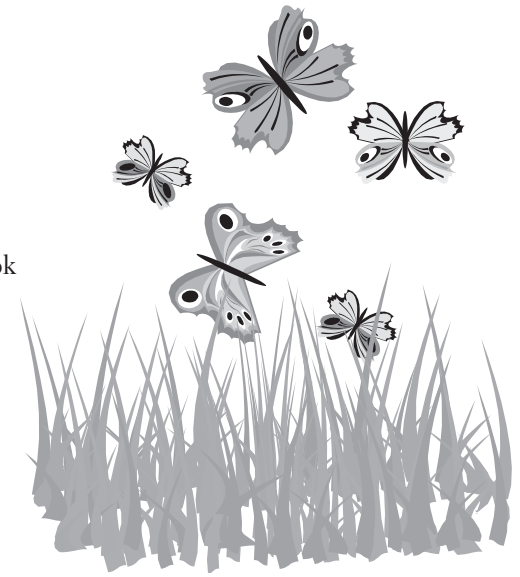
See **What To Order From Educational Science** at the end of this lesson. This order should be completed at least six weeks before that start of this lesson.

1. Painted Lady Classroom Breeding Kit, Certificate for 70 larvae, food, 60 cups, (PLKB100)
2. Rearing Cup Filters, 11 cm, 100/box (FP100)
3. Butterfly Farm Mini-Greenhouse Seed Starter System with professional soil, (GH 72)

For butterfly observatory:

1. Eight meters of netting (a little more than 9 yards) available at any fabric store
2. One hula hoop
3. One large sheet of butcher paper (brown paper bag-like paper)





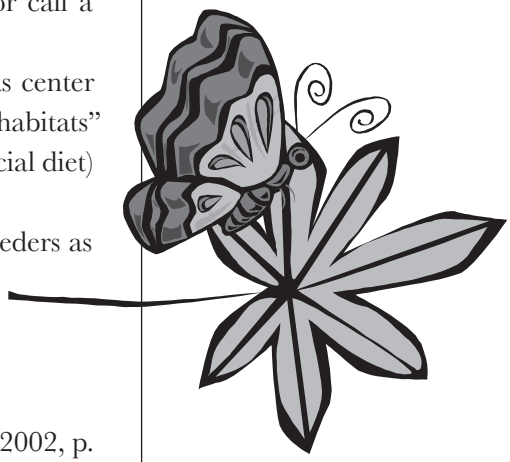
4. One roll of masking or Scotch tape
5. (Optional) hot glue and hot glue gun
6. One S-hook screw or plastic plant hook
7. One roll of string
8. One package of colored tissue paper
9. Large hardwood or plastic spring clothespins - 16
10. One plastic drop cloth or old shower curtain
11. Large pipe cleaners (12 -15), 1 pipe cleaner per student pair
12. 12-15 colored sponges, 1 per student pair (to be cut into 5 cm circles for circle sponge feeders)
13. Two medium containers (e.g., pie tins)
14. ingredients for adult butterfly food source, one of the following:
    - 1 gallon apple juice
    - jar of sweetened, red drink mix powder (i.e., Kool-Aid containing sweetener) and water
    - 1 jar honey and water
    - *Artificial Nectar* from Educationalscience.com and water
    - Sugar and water
15. One eye dropper and dropper bottle
16. **Module One Lesson 5 Post Assessment**

Preparation Activities

1. At least six weeks before the start of this lesson, order butterfly rearing material. See **What To Order From Educational Science** at the end of this lesson.
2. As soon as the rearing kit is received, decide on what date you'd like to receive the butterfly larvae. Indicate that date on the certificate that came with the butterfly rearing kit and mail it. The date selected should be a day or two after this lesson is completed when the butterfly observatory and desktop habitats are set up. The date selected should also coincide with the start of the next lesson (Module 2, Lesson 6).
3. As soon as the items are received, plant hollyhock seeds in **Greenhouse Starter Seed** *System*. The plants will serve as an additional source of larval food and increase the possibility that females will lay eggs on them as host

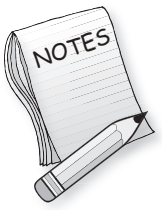
plants for a second generation of butterflies. (If a local source of mallow or thistle is available, then planting the hollyhock seeds won't be necessary. Check a field guide to see if it is grows naturally in your area or call a garden center.)

4. Arrange for one or two parents or teacher's aides to be in class as center helpers after this lesson's introduction to assist with the "desktop habitats" (rearing cups to be lined and filled with micro-wave prepared artificial diet) and creation of **flower-sponge feeders.**
5. Set up a center where students will work to make flower-sponge feeders as explained below.



To construct the butterfly observatory:
(Adapted from: Daniel C. Dobey and Heidi S. Springer's article "Simply Butterflies" in The Elementary Science Classroom, November/December 2002, p. 16-21) See references.

1. Put the S-hook screw or plastic plant hook in the ceiling to position observatory where it is accessible to students.
2. Measure from the ceiling to determine an appropriate length of string to suspend the hula-hoop, taking into consideration the height of the students in your class who will enter the observatory by stepping under it. The observatory will be about 2 meters or about 7 feet from hoop top down.
3. Cut four equal-size pieces of string and tie them to the hula-hoop at four equal distances around the hoop.
4. Trace the inside circle of the hula-hoop on butcher paper, cut out the circle, and with masking tape or hot glue attach the paper circle to the hula-hoop on what will be the underside of the top of the observatory.
5. Next, connect the four strings attached to the hula-hoop to the S-hook in the ceiling.
6. Cut the 8 m of netting into two 4 m pieces and drape the netting over the hula-hoop (drape one piece in a north-south direction and the other in an east-west direction). There should be four seams where the netting from the two pieces overlap.
7. Seal the seams with large hardwood spring clothespins.
8. Place the plastic drop cloth under the observatory, being careful to center it directly under the butcher paper where the chrysalises will be hatching.
9. Complete and hang the butterfly observatory, prior to the lesson.



10. Create one colorful tissue paper flower as a model to show to the children. Use 5 or more tissue paper sheets cut into 6" to 8" squares. Lay them on top of each other. Place tissues on top of your fisted hand. With the other hand push the center of the tissue papers with a pencil and twist together to create a stem. Then wrap a pipe cleaner around the stem. The pipe cleaner's ends will be placed through the netting to attach the flowers to the inside of the observatory.
11. Make a model sponge feeder by cutting one sponge into an approximately 5 cm circle. Poke two holes in the sponge circle's center. Fold a pipe cleaner and put each end through a center hole. Attach the sponge circle to the center of the paper flower, securing it by wrapping the pipe cleaner over the flower's pedals and around the stem.
12. Pre-cut tissue paper squares with a paper cutter, enough for each student pair to make one flower.
13. (Optional) Pre-cut sponge circles and poke center holes, enough for each student pair to have one sponge (that will become the flower's center).
14. Later, when the butterflies emerge from the chrysalis stage, pour one of the following liquids into small dropper bottles and soak the sponges to feed the butterflies. The sponges should be wet to touch.
    - Apple juice
    - Red drink mix (made with water at a concentrate 2 times what is recommended)
    - *Artificial Nectar* according to instructions
    - Honey solution (1 part honey to 1 part water)
    - Sugar solution (1 teaspoon per cup of water)
15. Also, when the butterflies emerge from the chrysalis stage, place the pie tins on the floor, fill with "nectar" and place 3 to 5 circle sponges in each dish. These should be wet to touch.

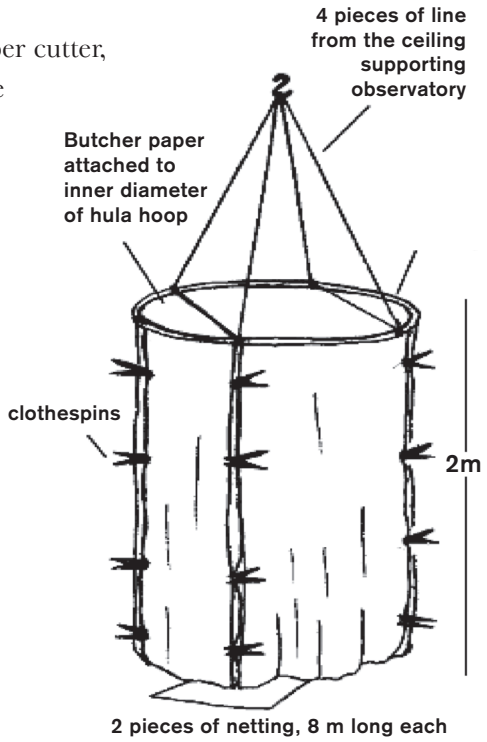
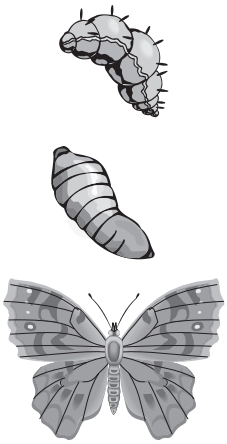


Diagram reprinted with permission from Daniel C. Dobey and Heidi S. Springer's article"Simply Butterflies" in The Elementary Science Classroom. November/ December 2002, p. 16-21.

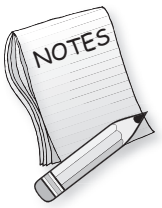


Introductory Activities (5 minutes)

- Begin this lesson with the butterfly observatory hanging. Ask the students if they have noticed anything new in the classroom. Ask them what they believe it is. Allow them to guess and then in a manner that will build excitement and anticipation tell them that they are about to receive living creatures to care for as they change, grow and develop. Tell them what looks like a cage is actually an *observatory*. Define the word as "a special place to observe."
- Connect to the students' previous learning by asking them to recall from their research with print references about the stages in a butterfly's development. Ask them what they remember about the beginning, early and adult stages of a butterfly. Listen to their responses and if posters are still on display, refer to them.
- See who might be able to explain any or all of these stages: a butterfly begins as an egg, and then becomes a caterpillar (or larva) that goes through numerous early changes (as many as 4 to 5) before it becomes a pupa (or chrysalis). Explain that the observatory will allow us to see the last stage the caterpillar goes through (called chrysalis) before a butterfly emerges.
- Tell students that they are each going to be in charge of their own caterpillar or larva. They won't be able to put the caterpillars in the observatory until the last stage before they emerge as butterflies. They must prepare to meet their needs.

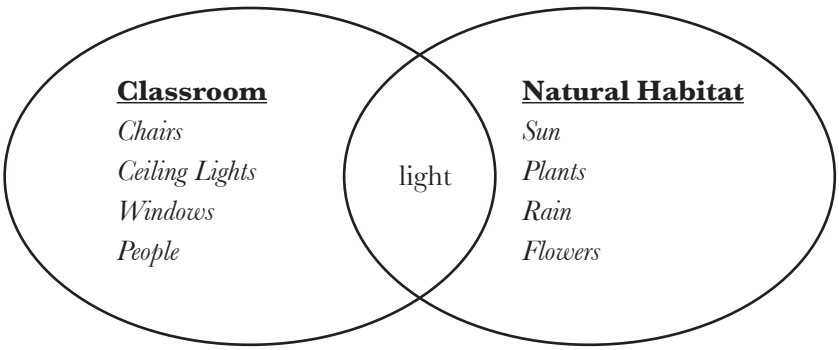
Pre-assessment (15 minutes)

- Have the students remain at their desks. Assess their prior knowledge of natural habitats as a source of basic needs by telling them, "I want you to think about the differences and similarities between our classroom and where caterpillars and butterflies really live." Draw a simple Venn diagram on the board. On one side write "*classroom*" and the other, write "*natural habitat*." Define the word *habitat* as "a place where a particular kind



of animal (species) is usually found because the place has what it needs."

- Tell them that in the outside world caterpillars or butterflies almost always live in places that have what they need to survive and grow.
- Instruct them to draw a Venn diagram in their journals like the one the chart. Say, "I want you to use the diagram to compare these two places: the place where a caterpillar or butterfly usually lives (natural habitat) and the classroom (unnatural habitat) where we will care for them."
- Remind them that when we compare using a Venn diagram, the center shows the ways the two items are alike. Supply one example and then have them work on their own for no more than ten minutes.



SEARCHLIGHT: Students who already understand what a caterpillar or butterfly needs to survive will be able to explain that a living thing's basic needs must exist in its environment. They will comprehend the difference between a natural and classroom environment or habitat. They may be able to suggest from their own previous reading and research that caterpillars feed on different kinds of plants (depending on the kind of butterfly, for example: Monarch larva eat milkweed.) Or they may already know that butterflies like the sweet nectar of flowers. Students who are exceptionally ready for more in-depth content will understand the implications of the presence or non-presence of certain plants in certain areas for a species' survival. See the extension activities for students who appear to be ready and interested in exploring additional related content (larval food sources and butterfly gardens).

Teaching and Learning Activities (30 minutes)

1. Ask the students, "Knowing that caterpillars and butterflies are living things, what do you suppose they need to survive?" They should suggest the need for food, moisture (water), temperature and light. Help them to recall from Lesson 4 that living things need these elements to survive and grow. Caterpillars and butterflies go to areas where they can find those things.

2. Tell them you want to hear the ideas they wrote in their journal on how our classroom is different than a caterpillar's or butterfly's natural habitat. Incorporating their suggestions, compare and contrast the two environments.

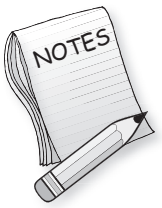
3. Ask them "Do you know what caterpillars and butterflies eat in their natural environments?" Explain that certain caterpillars will only eat certain plants. "The caterpillars that we will care for and observe are called Painted Ladies. They like to eat the leaves of plants called thistle, mallow or hollyhock." Add the plant names to the natural habitat side of the diagram. Also explain to the children that the adult butterflies look for the leaves of these plants to "host" their eggs. They know that their caterpillars will eat these leaves when they hatch, so they lay them on the leaves of those plants.

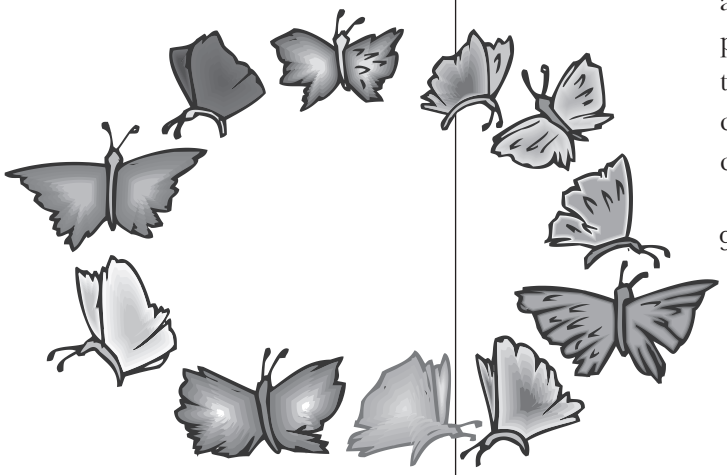
4. Explain to the students that adult butterflies need the sweet nectar inside flowers and that they are attracted to certain flowers by their color and scent. Add *flowers* and *nectar* to the natural habitat side of the diagram.

5. Guide the children in observing that because there are few similarities between the classroom and a butterfly's natural habitat, we need to make a *simulated* (pretend, copy, replicated) habitat to supply the caterpillars' and butterflies' needs indoors. We will do this by adding things to our classroom to provide for the larva and butterflies' needs."

6. Introduce the *rearing cups* as a *desktop habitat* that will contain the *artificial diet*. After explaining what an artificial diet is and why it is necessary, tell the student that when called upon, they will work in small groups at the designated center to line their cups with the filter. (It is recommended that the preparation of the rearing cups be facilitated with the assistance of a teacher's aide or parent helper who will work with small groups of students at a table in one corner of the room.) Have students attach filter paper to the cup's inner lid with rolled masking tape so the chrysalis-to-be-formed will have something from which to hang. Partially fill the cups with the microwavable food. This preparation will allow for the completion of the remaining activities in this lesson.

7. Tell students, "Our caterpillars won't stay caterpillars for very long. So, we also have to prepare a way to make the butterflies feel at home within the observatory when they emerge. We will do this by making colorful tissue paper flowers to place inside our observatory. We will fill them with something very sweet for the butterflies to drink, something that will remind





them of the nectar of real flowers. The flowers will invite the insects to feed more frequently while we observe them." Explain how the simulated nectar (apple juice or drink mix) will be made and poured onto sponges when the butterflies emerge.

8. Introduce the flower design center by telling them they will work there with a partner. Each pair will make one flower-sponge feeder. (One per student would be too many.) Demonstrate how to assemble the flowers from tissue paper and attach the sponge circle to its center. Provide instructions as to when they are to work in the center.

9. Explain that later you will take charge of attaching the tissue paper flowers by the pipe cleaners to the netting walls of the butterfly observatory. You will do this before any chrysalises have formed and are placed in the observatory. Attaching the flowers after the chrysalises have formed would cause too much movement and disturb them.

Products and Assignments

- Desktop Habitat
- Classroom Butterfly Observatory
- Tissue paper flowers with circle center sponge feeders

Extension Activities

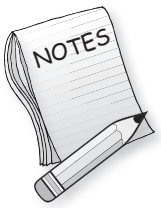
1. What Do Caterpillars Eat?: Larval Food Favorites (60-120 minutes) (Core or AID)

   Give students who show readiness and interest the opportunity to research what different butterfly larva eat. Have them make a set of cards, each illustrating and labeling a species of butterfly on one side of an index card and the host plant for its eggs and caterpillars' food on the other. These cards could be hole-punched and tied together to create a field guide. This task can be scaffolded for students who work less independently and who need assistance with using print or Internet references. Do this by assigning one to three butterfly species to each student and pre-selecting materials that picture the insects and host plants. Alternatively, create a class field guide by having all students illustrate just one butterfly and host plant on the two sides of a single, large size index card. Put all the cards together for a collaboratively illustrated book.

There are numerous published field guides and books that could supply this information such as:

- Hamilton, Kersten. The butterfly book: A kid's guide to attracting, raising and keeping butterflies. Avalon Travel Publishing. (ISBN# 156261309X)
- Opler, Paul A., Wright & Bartlett, Amy. Field guide to western butterflies.(ISBN# 0395791510)
- Schappert, Philip J. World for butterflies: Their lives, habitats and future. (ISBN#1552095509)
- Mitchell, Robert Zim & Spencer, Herbert. Butterflies and moths (Golden Guides). (ISBN#0307640523)
- Fandex. Butterflies of the world (Fandex Family Field Guides). (ISBN# 0761125779)
- Glassberg, Jeffrey. (1999). Butterflies through binoculars: The East. (ISBN# 0195106687)
- Glassberg, Jeffrey. (2001). Butterflies through binoculars: The West. (ISBN# 0195106695)
- Opler, Paul, & Walton, Richard K. Familiar butterflies North America. (Audubon Society Pocket Guide). (ISBN# 067997981X)
- Mikula, Rick. The family butterfly book. (ISBN# 158017292X)
- Mikula, Rich & Mikula, Claudia. Garden butterflies of North America: A gallery of garden Butterflies & how… (ISBN# 1572233060)
- Turner, Brian. Illustrated encyclopedia of butterflies and moths. (ISBN# 155218814)
- Landman,Wijbren. Illustrated encyclopedia of butterflies. (ISBN# 1840134097)
- Pyle, Robert Michael. (1990).National Audubon Society pocket guide to familiar butterflies of North America. (ISBN# 0394519140)
- Opler, Paul A. & Wright, Amy Bartlett. Peterson first guide to butterflies and moths. (ISBN# 0395906652)
- Opler, Paul A. & Wright, Amy Bartlett. Peterson First Guide to Caterpillars.(ISBN# 0395911842)
- Stokes, Donald & Brown, Justin L. & Stokes, Lillian Q. Stokes Beginner's guide to butterflies. (ISBN# 0316817805)
- Stokes, Donald & Williams, Ernest & Stokes, Lillian Q. Butterfly book. The complete guide to butterfly gardening,... (ISBN# 0316817805)
- Sabula, Robert & Reinhart, Matthew. Young naturalist pop-up handbook: Butterflies. (ISBN# 0789805587)

An online guide that could be used for this extension activity is located at:



http://www.enature.com/

Websites that list or show pictures of butterfly host plants:

http://www.baylink.org/host_nec.html
http://www.cnps.org/gallery/callahan/index/.htm

2. Nectar Rich Butterfly Garden (60 Minutes) (CORE) or (AID)
   The extension is similar to the previous one (Larval Food Favorites). In addition to (or instead of) investing host plants, students use field guides to research flowering plants that are good sources of nectar for adult butterflies. Together they construct a large mural or wall painting that illustrates a garden that would attract butterflies. Each student draws or paints a particular plant or flower and type of butterfly it attracts on separate sheets of paper. These are attached to the mural paper to create a large, garden illustration designed cooperatively. To break this down into manageable steps for students have them complete the research guide sheet provided and entitled Butterfly Garden Research Guide Sheet.

Post Assessment

Assess student understanding of the generalizations and concepts presented in this lesson by administering the written post assessment at the end of this lesson.

Debriefing and Reflection Opportunities (15 minutes)

1. When the flower-sponge feeders and desktop habitats are completed, gather the students and ask them, "Have we properly prepared the classroom for our living visitors? Have we assured their survival by providing for their basic needs?"
2. Review with them what was changed in the classroom to create a simulated habitat. Ask for their comments on what other preparations might be made. For example, you might draw their attention to the hollyhock plants that are growing as a backup food source or discuss how to regulate temperature in the classroom.
3. Ask them why it was necessary to do all the work on the desktop habitats and observatory.
4. Reinforce the lesson's principle that *Living things will survive and grow only in environments where basic needs are met.*
5. End by validating the students' hard work to ensure a safe environment for these living things.

References

Websites:

Journey North Internet Archives:
http://www.learner.org/jnorth/tm/monarch/NectarPollenObservation.html
http://www.learner.org/jnorth/tm/monarch/EggDayLife.html

Oberhauser, K. (1997). Monarchs in the classroom, University of Minnesota.
http://www.monarchlab.umn.edu/research/Mwd/locke.html

http://www.uky.edu/Ag/Horticulture/butterflypages/detailpages/ampaintedlady.htm

http://www.naturepark.com/pladyinf.htm

Journal Articles:
Dobey, D. C. & Springer, H, S. (2002) Simply Butterflies, The elementary science classroom, November/December, 16-21

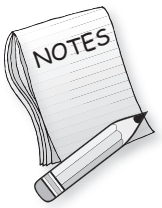
Books:
Hamilton, K. (1997, 2002). The Butterfly Book: A kid's guide to attracting, raising and keeping butterflies, Emeryville: Avalon Travel Publishing. (ISBN# 156261309X)

What To Order From Educational Science

From http://educationalscience.com/
Phone 281.554.9783
Fax 281.538.4731

(Caterpillars and Artificial Diet)

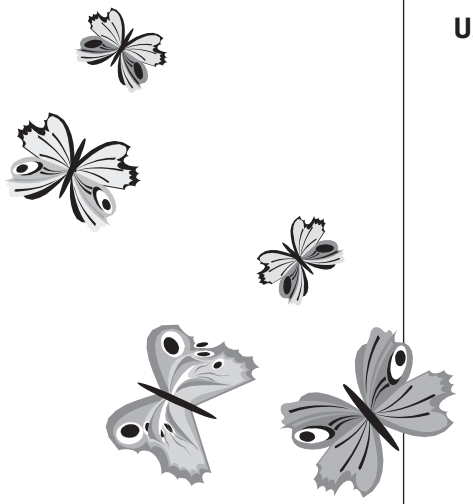
Important: Butterfly Farm Kits and butterfly and moth larvae can be shipped with certificate or ASAP (without certificate). The letter (A) following the catalog number designates kits shipped with larvae (not with a certificate). Kits without the (A) designation include a butterfly certificate that you mail in when you are ready to receive your livestock. If you have not raised butterflies before, we recommend that you purchase a kit with certificate. It is imperative that someone is available to accept the package during the dates marked on the butterfly certificate or when kits are ordered with livestock (A). These kits are not available outside the continental United States, Alaska, and Canada. In Canada, add $10.00 to the price of each Butterfly Farm Kit. Butterfly farm kits will soon be available in Canada, UK, and Hawaii.



Important: If ordering species other than Painted Lady and Monarch, please inquire about availability before placing order. Not all lepidoptera species can be shipped to your state. Some species of lepidoptera may require that you have a host plant available prior to ordering. USDA Permits may be required to order some of the lepidoptera species listed below. Either Eastern, Western, or Floridian monarch livestock, depending on your location, will be shipped by our associate breeders. Some states (Arizona, New York, Alaska) do not allow butterfly releases. An exception to this policy is the release of small numbers (30 or fewer per month) as part of an educational program.

Living Organism Release Advisory

Other insect pests may be regulated in your particular state. Since state and federal laws regulating live materials may change without notice, we strongly recommend following the guidelines outlined below for all pest insect species.



USDA STANDARD SAFEGUARDS FOR INSECT PEST

1. Upon receiving insect pest, all packing material media, substrate, soil and shipping containers shall be destroyed immediately upon removing insects.
2. Pest shall be kept only within the laboratory, classroom, or designated area at the purchaser's address.
3. No living pests kept under this permit shall be removed from confined area except by prior approval from State and Federal regulatory officials.
4. Without prior notice and during reasonable hours, authorized Plant Pest Quarantine and State regulatory officials shall be allowed to inspect the conditions under which the pests are kept.
5. All pests kept under this permit shall be destroyed at the completion of the intended use.
6. All necessary precautions must be taken to prevent escape of pest.

What To Order From Educational Science (Continued)

From http://educationalscience.com/
Phone 281.554.9783
Fax 281.538.4731

MANDATORY ITEMS TO ORDER

CATEGORY: BUTTERFLY BREEDING SUPPLIES:

Painted Lady Classroom Breeding Kit, Certificate for 70 larvae, food, 60 cups, PLKB100

This popular kit was designed for the classroom. Rear painted lady larvae into beautiful butterflies (14 days), breed them (3-4 days) and then rear second generation caterpillars (3-4 days)! The kit includes certificate for 60-70 Painted Lady larvae with instant easy to use microwave food, 60 rearing cups and lids, forceps(2), butterfly feeding kits(2), Hollyhock seeds, butterfly tents(2), Painted Lady lifecycle chart, and breeding manual. Excellent for the classroom or do-it-yourself butterfly releases, birthday parties, or special events! Ages 4 and up

CATEGORY: BUTTERFLY FARM ACCESSORIES:

Rearing Cup Filters, 11 cm, 100/box (FP100)
Circular filter, 11cm, protects artificial diet from airborne microorganisms and controls humidity in cup. Fits Solo and Polar 9 oz. Rearing cups and Highland 8 oz. Rearing cups.
Price: $ 8.00 Each Product Code: FP100

CATEGORY: GREENHOUSES AND EQUIPMENT:

Butterfly Farm Mini-Greenhouse Seed Starter System with professional soil, GH 72
The Butterfly Farm Mini-Greenhouse Seed Starter System makes seed germination and plug development a snap. The system allows you to start your favorite butterfly host plants indoors or in the Butterfly Farm portable greenhouse (GH 1000), for earlier butterfly host and food plant crops at a fraction of the cost of buying plants. Using this system, seedlings grow to a uniform height and width, in the form of a plug, which is then transplanted as the seedling matures to 4," a quart, one, and five gallon containers. The seed starter system includes a plastic base unit with 72 individual growing wells, professional soil (growing media), and a clear plastic dome, so your seeds receive before and after germination with the perfect combination of humidity, light and heat. Simply wet growing media, add three seeds per well and finally cover seeds with a thin layer of growing media. Butterfly host plant seeds can be found under the category Butterfly Host Plants and Seeds.
Price: $ 9.99 Each Product Code: GH72

What To Order From Educational Science (continued)
From http://educationalscience.com/
Phone 281.554.9783
Fax 281.538.4731

OPTIONAL ITEMS:

CATEGORY: BUTTERFLY FARM ACCESSORIES :

(2-4) Larvae Handling Brush, Pack of 5 (LB101)
Brush for the delicate work of handling larvae; pack of 5
Price: $ 1.00 Each Product Code: LB101

Artificial Nectar, non-fermenting, 2 Liters (AN100)
Non-fermenting artificial nectar to attract and feed most species of butterflies. Makes two liters of nectar. Scientifically formulated and pH balanced with natural butterfly attractants, including pollen and complex sugars. Just add hot water to dry mix.
Price: $ 6.50 Each Product Code: AN100

CATEGORY: BUTTERFLY HOST PLANTS AND SEEDS:

Painted Lady Host Plant (HH100)
Depending on availability, we will ship you one of the species-specific host plants from each group of certified pesticide-free butterfly host plants. If you have a preference, please call.
Painted Lady Host Plant - Hollyhock (*Malvaceae* family), Malva sylvestris (In stock), Malvae Alcea roses, Cheeseweed (*Malva parviflora*), or White Mallow - depending on availability
Host plant for Painted Lady butterfly
Price: $ 10.00 Each Product Code: HH100

Module 1, Lesson 5 Name_____

Butterfly Garden Research Guide Sheet

Before you draw or paint a plant for the class garden mural, research and complete the page below.

Name of plant:

_____

Is this plant a host plant or flowering plant?

_____

Name of butterfly attracted to this plant

_____

Where the plant can be found

_____

Would the butterfly use this plant for its eggs or as a source of nectar?

_____

What color is this plant?

_____

Sketch the plant below before you design your picture for the mural on a separate piece of paper.

LIVING THINGS: CHANGES, STAGES AND CYCLES

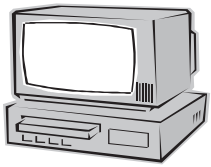
Module 1, Lesson 5 Name_____

Post Assesment

1. Habitat means the same as:

tree home cup habit

2. What would not be found in a butterfly's natural habitat?



computer

rain

sun and clouds

flowers and leaves

3. <u>Survive</u> means the same as:

eat larva stay alive rest

4. What do butterfly and their larva need to survive? (Circle all the correct answers.)

food light fun water

5. <u>Simulated</u> means the same as:

big pretend fuzzy good

Post Assesment (page 2)

6. Draw what we will use as a simulated classroom habitat for the larva.
   Show how we will meet the larva's basic needs.

7. Draw what we will use as a simulated classroom habitat for the butterflies.
   Show how we will meet the butterflies' basic needs.

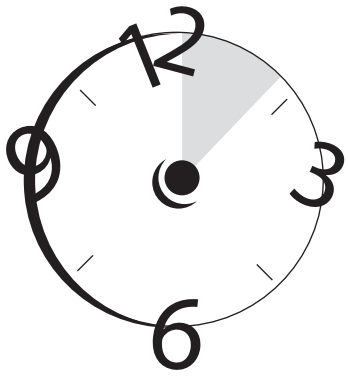
LIVING THINGS: CHANGES, STAGES AND CYCLES

Changes and Stages

Core/AID

Time Allocation: 3 hours, 5 minutes Direct Instruction (Plus 30 minutes daily for 2-3 weeks for Anchor Activities)

Required Materials and Resources on Page 84

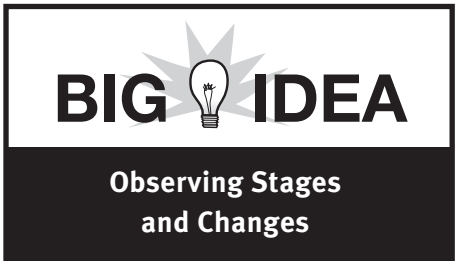


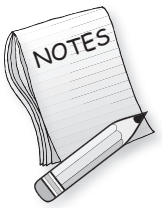
Lesson Overview

Over a period of two to three weeks, students will have the opportunity to rear their own Painted Lady larva as it grows and develops a chrysalis and then emerges as an adult. They will observe the caterpillars in their *Desktop Habitats* and describe in journal entries the caterpillar's appearance and behavior as it crawls, eats, grows, eliminates waste, rests, molts, spins silk, hangs upside down and pupates. Working together to create a class calendar, they will observe the sequence of change in the entire class population of larvae. When chrysalises are newly formed, students will enjoy seeing them transferred to the observatory. Students will construct an understanding of how these occurrences relate to a living thing's unique stages of growth and development. They will enjoy a read aloud story that builds anticipation for the butterfly's emergence. The culmination of the lesson will be the arrival of the adult Painted Ladies.

Guiding Questions

- What special occurrences can be observed in the Painted Lady butterfly's stages of change?





Content Goals

Universal Theme

Change

Principles and Generalizations

- Each type of plant and animal goes through a unique set of sequential stages as it grows and develops over its lifetime.
- Each sequential stage of a living thing's growth and development has special events (or occurrences) and needs.
- After its beginning as an egg, a butterfly larva goes through four to five changes or instars before it becomes a pupa or chrysalis and then emerges as an adult.
- The rate of larvae development is affected by the temperature of their surroundings: the cooler the temperature, the slower they develop and the warmer the temperature, the faster they develop (AID).

Concepts

- Growth
- Development Sequence
- Occurrences
- Instar
- Larva
- Pupa
- Chrysalis
- Adult
- Metamorphosis

Teacher Information

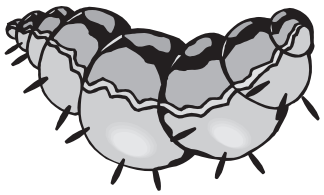
Adapted from these sources: *http://www.enchantedlearning.com/subjects/butterfly/* and *http://www.naturepark.com/pladyinf.htm*

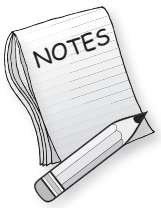
- The Painted Lady may be the most widespread butterfly in the world. It is also known as the Thistle butterfly and the cosmopolitan (because it is so widespread, occurring in North and South America, Europe, Asia and Africa). Its scientific name is *Vanessa, Cardui*. (See classification, below). This

Changes and Stages

flying insect lives in temperate and some tropical areas.

- Like all butterflies, Pained Ladies undergo complete metamorphosis, which means they have four distinct stages in their life: egg, caterpillar (larva), chrysalis (pupa) and adult butterfly.
- **Egg:** The Painted Lady begins its life cycle as an egg that is the size of a pinhead. Eggs are pale green with 12 to 14 longitudinal ridges; they are laid on thistle, mallow, or hollyhock leaves. The incubation period is three to five days.
- **Caterpillar (larva):** The newborn caterpillar is called a *pinhead*. The yellow-green striped, purple to black caterpillar has long spines on each segment. The caterpillar grows up to 1.25 inches (3 cm) long during this stage that usually lasts about 12 to 18 days. (In the classroom this time will be less, due to transport time from the supplier and room temperature.)
- Butterfly larvae breathe through tiny holes on each side of the first segment in their thorax and the first eight segments of their abdomen. Their first three pairs of legs are jointed and become legs of the adult butterfly. The back legs are called *prolegs* meaning false legs. These disappear later in the chrysalis.
- A caterpillar feeds continually as it grows on thistle, mallow, hollyhock, sunflower, or canola in their natural habitats. The small pellets the caterpillars deposit are waste, called *frass*.
- As the larva grows, it sheds its skin four to five times. This is called *molting*. The time between moltings is called an instar. During this time the caterpillar may appear lifeless. Each instar has slightly different coloring. (The caterpillars may have undergone at least two molts by the time the students observe them).
- When the caterpillar has grown to the right size, it sways its head back and forth rhythmically to spin silk. The silk functions like a bridge, aides its movement and provides shelter in its natural environment. The caterpillar uses the silk to hang upside-down as it eats, rests or molts. At the end of the caterpillar stage, it stops eating and spins a sturdy silk button called the *cremaster* on a tree branch outdoors or on the cup lid in the classroom. It then forms a *J-shape*, attaches itself with a single silken string and hangs head down. The caterpillar remains motionless and then sheds its skin to reveal a shining hard covering—the chrysalis. In the classroom it will take from as little as a few hours up to two days for the

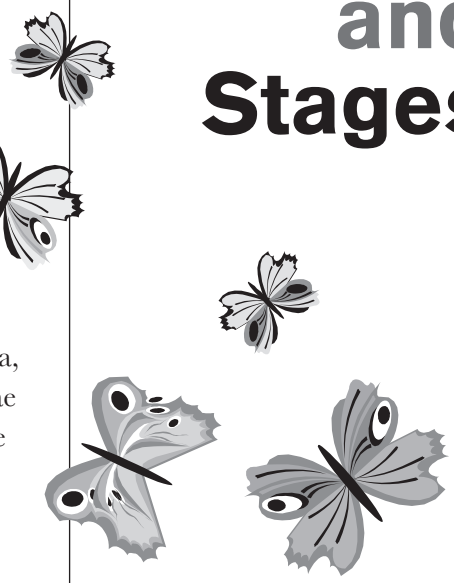




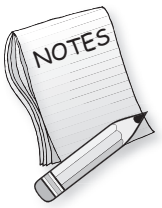
larva to go from the J-shape to chrysalis.

- **Chrysalis (pupa):** During this stage an adult forms from the caterpillar, whose internal structure changes completely. Occasionally there is motion in the chrysalis. Some butterfly structures can be seen forming under the shell. For example, the long straw-like mouth, or proboscis, is visible between the eyes.
- The chrysalis becomes almost transparent when the butterfly is about to emerge. A day or two before the butterfly emerges the chrysalis looks darker. The orange, black and white wing pattern is now visible inside the chrysalis.
- In the classroom, at room temperature, an adult may emerge as soon as 3 to 4 days after the chrysalis has formed. Usually, the chrysalis will begin to "twitch" several hours before the butterfly emerges. This takes 7 to 10 days in a natural environment. Air temperature and moisture levels affect how long it takes for the chrysalis to metamorphose into an adult butterfly.
- **Adult:** When the butterfly emerges from the split chrysalis, its wings are small, soft and slightly crumpled. It hangs upside down and waits for its delicate scale-covered wings to dry. With its wings downward it *pumps* them to force blood up into the four wings to inflate them. It can fly a few hours after emerging. Red liquid may come from the tail end when the butterfly emerges. This is not blood; it's waste.
- The adult Painted Lady is mostly black, brown, and orange with some white spots; the underside is gray with white and red markings. The adult has a 2 - 2 7/8 inch (5.1 - 7.3 cm) wingspan. Adults have compound eyes and a *proboscis* that can be as long as their body that they use to sip sweet thistle and clover nectar.
- Mating can occur within days after emerging. Females have larger abdomens than males, and males have claspers at the end of the last body segment. Adult Painted Ladies usually have two broods per year in northern areas, more in the South. The spring brood tends to be darker colored than later broods as temperature determines color.
- Adult Painted Ladies only live about two weeks.
- **Classification:** Order Lepidoptera (butterflies and moths), Family Nymphalidae (brush
- footed butterflies), Genus Vanessa, Species cardui.
- Teacher Information (continued)
- What to Expect During Rearing

Changes and Stages



- Adapted from Painted Lady Butterflies at http://lhsfoss.org/fossweb/teachers/materials/plantanimal/ladybutterfly.html
- The Painted Ladies will spend all of their larval days, perhaps two weeks or a little more, in the container eating the food layer, molting, and growing to a length of 4 cm (1-1/2") or a little more. They require no special attention other than to keep them in a well-lighted area, but out of direct sun and safe from temperature extremes. After the larvae are about 2 cm (3/4") long, it is all right for students to remove the larvae from the containers from time to time for close observation of structures and behaviors.
- In due course the larva receives a biological message to climb to the top of the container, spin a little knob of silk onto the filter paper, and attach its rear end firmly to the knob. The larva hangs head down and assumes a characteristic J shape, indicating that pupation is only a few hours away. If you are vigilant, you might be able to observe the final molt as the fuzzy outer skin splits near the head to reveal the smooth, curiously molded, slightly iridescent pupa ensconced in its chrysalis. As the pupa writhes around, the skin is pushed up and off the body until it is a crunchy little nub pressed up against the paper. The Painted Lady lapses into a period of relative quietude, hanging motionless except for brief fits of wriggling, especially when disturbed. At this time the pupae attached to the paper should be moved to a larger cage [observatory].
- For a week or ten days the pupa undergoes dramatic physical and biochemical transformations. The chrysalis gradually darkens until it is dark gray-brown, and the orange color of the wings starts to show through. This is when you can expect the adult to emerge, which happens quickly. The chrysalis shell splits near the bottom (head end), and the butterfly reaches out with its legs and grasps the outside of the chrysalis. The head comes out, and then the abdomen and wings are pulled free of the chrysalis shell. The emergence takes a minute or less.
- The fresh new butterfly clings to the chrysalis shell with its soft, crumpled wings hanging down. Over the next hour or two the abdomen pulses as it pumps fluid into the veins of the wings, expanding them to their fully extended shape. During this time the butterfly ejects a splat of red liquid. Students may be alarmed, thinking it is blood, but it is a waste fluid that the butterfly unloads as it prepares for its new life. In 3 or 4 hours the butterfly takes wing as a flying insect.



- Painted Lady butterflies don't require much as adults. They will drink diluted sugar solution and fly around looking for mates. Place the cage [observatory] where sunshine will fall on it for a few hours each day.
- Butterflies don't live long. In 3 weeks they will be tattered and tired. With luck they will have fulfilled their destiny by producing eggs. After a month the adults will die, not because of any ill effects caused by captivity, but because that is their normal life span. Discuss the inevitability of the death of the butterflies and that it is not caused by captivity or the result of any failing on the part of the caregivers. Butterflies just don't live very long.

Skills

- Observe
- Describe
- Record
- Sequence
- Compare

Materials and Resources

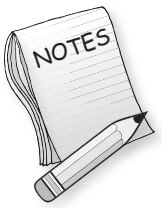
1. Painted Lady butterfly larvae
2. *Desktop Habitats* (rearing cups and artificial diet for caterpillars)
3. Hollyhock plants purchased or raised in classroom (or local mallow or thistle plants)
4. **Module 2, Lesson 6: Painted Lady Butterfly Life Cycle Sequencing Cards**
5. Student journals
6. Rulers (preferably with centimeter markings), 1 for each student
7. A free printable centimeter ruler is available at: http://www.vendian.org/mncharity/dir3/paper_rulers/
8. **Module 2, Lesson 6: Weekly Class Calendar,** 3 copies of each page
9. **Module 2, Lesson 6: Weekly Class Calendar Cutouts**, 1 copy per student
10. **Module 2, Lesson 6: Weekly Class Calendar Cutouts Pages 2-4** (optional), 1 copy
11. **Module 2, Lesson 6: Life Cycle: A Timeline of Transformation**
12. Envelopes, 1 per student (optional)
13. Scotch Tape

14. Heavy-duty double-sided tape
15. Ehlert, Lois. *Waiting for Wings. (2001).* Hartcourt, Inc. (ISBN# 0152026088)
16. Nectar for flower sponge feeders (created in Module 1, lesson 5), from one of the following:
    - Apple juice
    - Red drink mix (made with water at a concentrate two times what is recommended)
    - *Artificial Nectar* from Educational Science according to instructions
    - Honey solution (one part honey to one part water)
    - Sugar solution (one teaspoon per cup of water)
17. Eye dropper
18. Sponge feeders in tissue paper flowers
19. Plastic cup with lid and hole punch; or clay pot with modeling clay or Styrofoam (to hold host plant stems)
20. Pie tins

Preparation Activities

1. The mail-in certificate that comes with the butterfly rearing kit should be sent back to Education Science prior to the start of this lesson. Indicate a date for receipt of larvae that will be a day prior to beginning this lesson.
2. Make sure the *Desktop Habitats* are prepared. Each rearing cup should have artificial diet in it. Label cups with students' names and place a caterpillar in each rearing cup.
3. Borrow or purchase the book *Waiting for Wings* by Lois Ehlert.
4. Copy **Module 2, Lesson 6: Painted Lady Butterfly Life Cycle Sequencing Cards** one for each student and one for the introductory activity. Cut the four cards and enlarge them on a copier to be at least 8-1/2 by 11" if possible.
5. Copy calendar pages and locate wall space to build a 3 weeklong calendar to which students will contribute data. Do this by posting the pages with the days of the week side by side.

Sunday 20	Monday 21	Tuesday 22	Wednesday 23	Thursday 24	Friday 25	Saturday 26

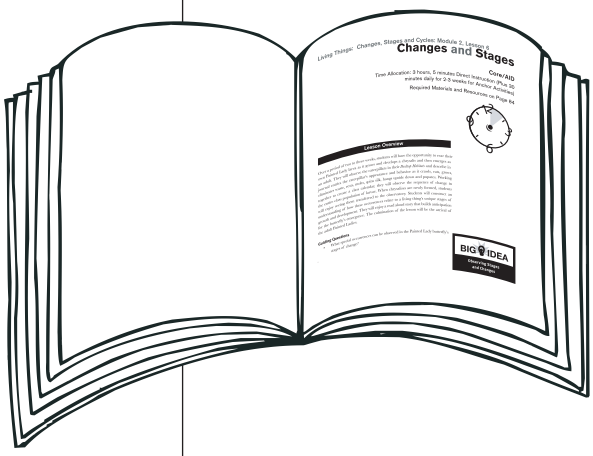


6. Copy **Module 2, Lesson 6: Weekly Class Calendar Cutouts**, one copy per student and **Module 2, Lesson 6: Weekly Class Calendar Cutouts pages 2-4**, one set only
7. Copy any **Extension Activity Worksheets** that will be used.
8. Later, when the butterflies emerge from the chrysalis stage, pour one of the following liquids into small dropper bottles and soak the sponges to feed the butterflies. The sponges should be wet to touch.
   - Apple juice
   - Red drink mix (made with water at a concentrate 2 times what is recommended)
   - *Artificial Nectar* according to instructions
   - Honey solution (1 part honey to 1 part water)
   - Sugar solution (1 teaspoon per cup of water)
9. In addition to flower sponge feeders, when the butterflies emerge from the chrysalis stage, place pie tins on the floor, fill with "nectar" and place three to five circle sponges in each dish. These should be wet to touch.
10. Set up host plants in the observatory. Take hollyhock plants grown in classroom (started in **Butterfly Farm Mini-Greenhouse Seed Starter System**) or purchased; or mallow (a common weed in many parts of the country); or thistle and place a small bouquet of leaves in a vial of water. Use a hole punch to punch a few holes in a plastic cup lid. Fill the cup with water and snap on the lid. Stick leaves and small branches of plant through the holes. Alternatively, take softened modeling clay or florist Styrofoam and place it in a flowerpot. Insert the plant stems in the clay upright. After the butterflies mate, they will lay eggs on the leaves.
11. Decide whether you will raise a second generation of Painted Lady butterflies. The eggs will hatch in a week or so, and it is possible to start the whole process over again. If so, keep the larva in a covered container because they are very mobile. In order for them to thrive, you will need to have a fresh supply of hollyhock, mallow or thistle leaves or artificial food. Plant leaves can be put in the refrigerator to keep fresh. Even if you do not raise the second generation of butterflies, you will need the eggs for the next lesson's discussion of reproduction. Inspect the plants every day after the adults emerge for tiny green eggs. If you do not want to let the eggs hatch, put them in the freezer for a few days.

Changes and Stages

Introductory Activities (15 minutes)

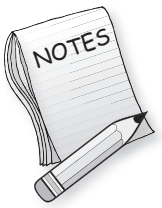
- Gather students together in front of the easel and tape up all four enlarged sequencing cards out-of-order without telling them anything about them. Ask them to look at the cards. Next, pose this provocative question to hook them and also check their current understanding of stages of development: "If these were the pictures that started different chapters in a book and you were the author of this book, what would the book's title be? (If necessary, remind them what a chapter book is by showing them one.)
- After they have come up with suggestions, then tell them "This book might be called Butterfly Stages because these are the stages in a Painted Lady butterfly's development. What is a stage?" Explain that, "Stages are like chapters in a book because they occur in order (or have a sequence)." Check their understanding of the word *sequential.*
- Go on to say, "In the chapters of a book different things happen. Events in a book unfold step-by-step and so do the events in stages of growth and development. Emphasize the details of a chapter as well as its proper place in the book's sequence of events.
- Then check their current knowledge of the actual sequence of butterfly development. Put our book's chapters in order. What should the beginning, middle and ending chapters be? Listen to the students' suggestions. Many of them will already know the sequence of stages. Place the cards in order without commenting, following the majority's suggestion.



- The analogy is intended to introduce the principle of each stage as sequential and involving special occurrences. Explain further by saying, "We've talked about beginning, early and adult stages when you did your research posters. We are going to learn that every living thing goes through its own stages, and each stage, like a chapter in a book, usually has a name and certain events or 'occurrences'." Here you might ask them to recall the name of the early stages of a seed plant's growth (*germination*) and ask them to describe some of the events observed during seed germination stage. Tell them that in a little while they are going to receive a butterfly larva to care for and observe. Ask them where they think the larvae came from. Then remind them that it began as an egg that hatched into a larva and was sent to the classroom. Dismiss them to their desks.

Pre-assessment

N/A



Teaching and Learning Activities (2 hours, 40 minutes)

1. (This activity may be done right after the introduction to this lesson or after the students' initial caterpillar observation activity and prior to their first caterpillar journal entry.) Pass out a copy of the **Module 2, Lesson 6: Painted Lady Butterfly Life Cycle Sequencing Cards**. Instruct the students to cut the cards out and paste them in their journal with these instructions explained and modeled very clearly:

   "These cards will make title pages to chapters in our journals. They will be pasted in order with pages in between each title (or card) page. First paste the egg card. Then you must leave 2 pages in between (or following) the egg card before you paste the next card. Now, paste the caterpillar card and leave 10 pages following the caterpillar card; and then paste the butterfly card. There should be at least 10 pages following the butterfly card left in your journal." Show them how-to. Count sheets of paper as pages to give the students 20 single sides of paper to record their observations. (20 minutes)

2. Have a discussion with the students about respecting living things. Tell them that too much handling could harm the caterpillars because of the acid on our skin. Remind them that we observe to learn with all our senses except taste (eyes, hands, nose, ears). Students should be instructed to view the caterpillar in the cup and learn as much as they can. Distribute the rearing cups and allow time for the first observations. (10 minutes)

3. Establish a routine of having the students observe their caterpillar every day or as often as possible. Then have them respond in their journal to what they found. (This can occur as an anchor activity used as seatwork during reading or math groups.) Use a variety of prompts to encourage the students to gather data during their observation time and describe it in writing and drawings. Write the prompt on the board or chart for the day. Require them to date their entries and place the first entry in the "caterpillar chapter" after the caterpillar title page. (10 minutes daily)

One way to guide student observation and prompt journal entries is to ask the children to choose from the lists of words in the table below (written on chart paper) prior to observation. Tell them to pick a word as a focus for their observations and writing. These are intended to foster both qualitative and quantitative observations.

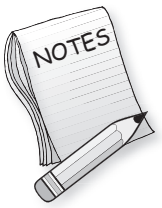
SEARCHLIGHT: Although you won't need to explain to all students that your goal is for both qualitative and quantitative data, or to use those terms, some

students might easily recognize the difference between the two types of information. Encourage students who are strong in math to decide which of their observations can be described with numbers. Suggest that they note these measurements in their journal daily. After several days have them organize the data on a simple bar graph made with graph paper. For example, they might create a graph of timed caterpillar rest periods for day 1, day 2, and day 3.

Qualitative Observations:	Quantitative Observations:
Shape, Form	Number of legs
Colors	Amount of food eaten (i.e. fraction of whole)
Textures	Length
Smells	Distance moved
Sounds	Seconds or minutes at rest

Other possible prompts to guide observations and journal entries are:

a. Describe what you learned from one or more of your senses. Use descriptive words that go with that sense such as: sound words, sight words, smell words, feeling words. Or answer: how does it sound, look, smell, or feel?
b. Pick a word from the list of possible caterpillar behaviors at this stage and observe for that behavior. Describe it in your journal.
c. (Define as necessary and list on the board for them: *crawling, eating, growing, eliminating waste, resting, molting, spinning silk, hanging upside down*)
d. List questions that came to your mind after you observed today.
e. What impressed you most about what you saw today?
f. Is the caterpillar growing and developing? How do you know? (Remind them that growth is a change in size and development is a change is shape or appearance.)
g. How has your caterpillar changed since yesterday (or two days ago or Monday)?
h. How are the caterpillar's changes like the changes of our bean seed?
i. How do you know your caterpillar is alive?
j. List the special events (occurrences) that you have observed so far during the caterpillar stage? Did any of these happen today?



It is recommended that students be required to respond in complete sentences and to write at least one sentence, depending on their writing ability. Drawings should be encouraged.

4. Make measuring the caterpillar another part of the daily routine until it forms a chrysalis. Depending on the children's experience with a ruler and what is available, have them measure their caterpillar within the cup in inches or centimeters. (Centimeters will be easier, since children struggle with fractions of an inch at the primary level and the caterpillar will not grow more than 1-1/2 inches. Any concrete alternative such as very small plastic cubes will help those who struggle with a ruler. A paper ruler can be slipped in the cup, marked with a pencil and the measurement read later with help.) Next, have them record the measurement in their journals next to the date. This measurement will also be used for the class calendar. (5 minutes daily)

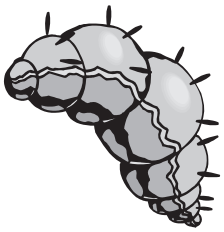
Daily Journal Entry
Date
Size of caterpillar
Sentence/s that respond to prompt
Picture (optional)

5. The caterpillar's size can also be placed on a simple graph each day. This can occur during math. (See Extension Activities **Module 2, Lesson 6: Caterpillar Growth Graph.**)

6. In addition to caterpillar observations and journal entries, have students complete a calendar picture as a daily routine during this module to contribute to the class calendar. Give each student a copy of **Module 2, Lesson 6: Weekly Class Calendar Cutouts**. They will use the cutouts (picture boxes) to describe their caterpillar each day and contribute that data to a class calendar. Each cutout requires student initials and a measurement of the caterpillar's size until it J-shaped. It may be easier to have the students cut out all the picture boxes at once and place them in an envelope. Alternatively, they can cut out the picture that most represents their caterpillar each day from the cutout page and then place the remaining page in a safe place. After initialing the picture boxes and writing the caterpillar size on the line, the children can also color the caterpillar pictured since the appearance of their real larva will change in color between molting at each instar. The "J" picture box is intended to represent the last instar before the caterpillar molts a final time to reveal a chrysalis. (5 minutes daily)

7. Hold a brief class calendar time to generate discussion about patterns in the total class larvae population or any larva that stands out as different. For example, students might be asked, "How many have molted or changed color? Which is the largest today? Based on our observations, what special occurrences take place in the caterpillar stage? Have any caterpillar not experienced that yet? Why do think a few have not yet formed a J-shape?" Some students will be ready to make generalizations about the variation between the minimum and maximum time it takes for these changes to unfold. Encourage them to share these observations and insights. (More detailed analysis of the minimum and maximum stage lengths will occur in Module 2, lesson 7. Therefore, the calendar should be left up.) (10 minutes daily)

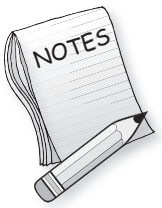
   SEARCHLIGHT: Questions about why some caterpillars stand out as different (i.e. they seem late to molt) suggest that a number of variables contribute to their growth. Ask students what variables related to caterpillar need are in the classroom habitat. Ask them to predict what might happen if some were not in the warm classroom but in temperatures more like the outdoors. Those that show an interest can be encouraged to design a simple experiment to put "extra" caterpillar/s in rearing cup/s in a colder or warmer place (i.e. like the refrigerator). Have them complete the **Module 2, Lesson 6: Experiment Design Sheet**. Students will recognize it from Module 1, Lesson 4. Help the students to understand that the rate of larva development is dependent on the temperature (See minor principles.) A similar experiment can be done with chrysalises once they are formed.

   The calendar may also be used during this module to show changes from chrysalis to butterfly once the chrysalises are moved to the observatory. If this option is chosen, additional copies should be made of the calendar weekdays and the emerging. Distribute adult butterfly picture box cutouts. See **Module 2, Lesson 6 Weekly Class Calendar Cutouts Page 2-4.** (5-10 minutes daily)

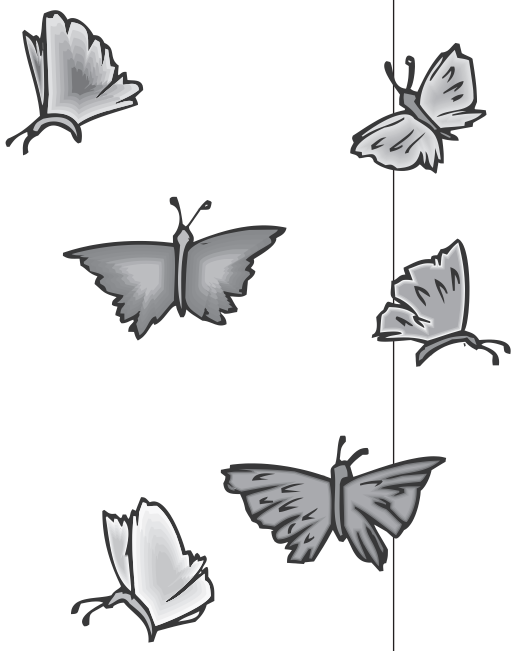
8. Provide background content by having students work in leveled reading groups to read the **Module 2, Lesson 6: Life Cycle Timeline**. (Note that the term *life cycle* is not formally introduced in this module. Instead the emphasis is on *sequential* stages. The concept of life cycle will be introduced in Lesson 9 when reproduction is the focus.) Other shared and individual reading experiences can occur using books from the **Butterfly and Moth Bibliography** provided. (30+ minutes)



At the end of a two-week period the caterpillars will pupate, and a chrysalis will hang from the cremaster or silk knob and be ready for placement in the observatory. Tell students to inform you when this happens. Have students bring their cup to you in the observatory (or a teacher's aide or parent volunteer). Carefully remove the filter paper from the rearing cup lid. Attach it to the butcher paper ceiling of the observatory with heavy-duty double-sided tape or rolled masking tape. If the pupa detaches from the silk thread that connects it to cremaster (spun silk knob) formed on the cup lid lining, tie and knot sewing thread around the cremaster to reattach the pupa. Then tape the pupa to the ceiling of the observatory by the sewing thread. Write each student's name next to his/her chrysalis on the butcher paper with a marker. This will enable the children to recognize their own chrysalis when they step into the observatory. (45 minutes)

9. Continue daily observations and journal entries once the chrysalises are formed. Allow students time to observe from inside or outside the observatory. Usually, the chrysalis will begin to twitch a few hours before the adult emerges. After the chrysalis splits, it is just seconds before it emerges. Whenever possible, allow students to observe the butterflies emerge from within the observatory.

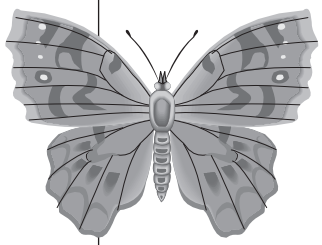
10. Share the book Waiting for Wings by, Lois Ehlert in a read-aloud. The rich text (printed below) and colorful illustrations present a poetic and factual time-line of each stage of the butterfly's development. Reread the story as many times as possible. Consider having the students commit the text to memory, recite or act it out for an audience. (20 minutes)

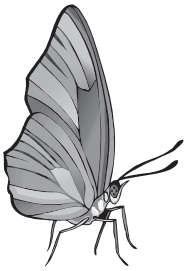


"Waiting for Wings"
By, Lois Ehlert

Out in the fields, eggs are hidden from view,
clinging to the leaves with butterfly glue.
Soon caterpillars hatch. They creep and chew.
Each one knows what it must do:
Find a place where winds don't blow,
Then make a case in which to grow.
Caterpillar now begin—
Body and wings take shape within.
When it's time, each case is torn-
wings unfold; new butterflies are born!

They pump their wings, get ready to fly,
then hungry butterflies head for the sky.
Looking for flowers with nectar to eat,
they catch a whiff of something sweet.
They follow that fragrant scent of perfume,
until they find our garden in bloom
We've been waiting for wings!
We watch them circle, land on their feet,
Unroll their tongues, and begin to eat.
They dip and sip,
then fly away,
back home to the fields.
They have eggs to lay.



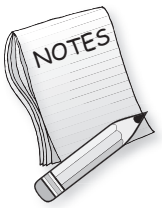


Products and Assignments

- Daily journal entries
- Class calendar
- Shared reading/s
- Labeled diagrams (Extensions, Core)
- **Caterpillar Growth Graph** (Extension, Core)
- Original experiment (Extension, AID)
- Original video tape or multi media program (Extension, AID)

Extension Activities

1. Graph Caterpillar Growth (Core) (10 minutes Daily)
   Have students organize the data from in their journal on caterpillar size in a graph of their own. Using **Module 2, Lesson 6 Caterpillar Growth Graph** students can create a simple bar graph by coloring boxes for each fraction of a centimeter in growth.
2. Anatomy Terms (Core) (30 minutes)
   Use the **Extension Activity Worksheets** entitled **Label the Caterpillar Diagram and Label the Butterfly** to give students practice in reading and writing the names of each part of the larva and adult anatomy. They may work independently to self-correct with the corresponding **Answer Sheet.**
3. **Vocabulary Challenge** (Core or AID) (60 + minutes)
   Differentiate vocabulary expectations by giving students leveled lists of words. Students who love words and have good memory skills will enjoy all or the most advanced lists provided. There are numerous possibilities: have students commit these to memory, research and study illustrations of



corresponding anatomy, create a word search or simply label their own drawings in their journals. A competition can be created as students are challenged to learn the words for each level. The worksheets for this extension activity show vocabulary and definitions for *butterfly watchers, experts or advanced lepidopterist* levels.

See additional extensions in Unit Appendix.

Post Assessment (10 minutes daily)

- Review journal entries in an on-going fashion to check for student understanding of the module's principles. You should see evidence that students can:
  - Understand the butterfly and (bean plant) go through its own unique set of stages as it grows and develops; and
  - Describe some of the special events, occurrences and needs experienced by Painted Lady at each stage.

Below is a rubric to communicate general expectations for journal entries to students. It can be copied and pasted on the inside cover of each student's journal as a reminder.

Rubric for Daily Journal Entry			
Date	I forgot to write the date.	I wrote only part of the date.	I wrote the day, month, and year.
Measuring larva and pupa	I forgot to measure.	I took a measurement, and wrote it in my journal.	I carefully and correctly measured. I wrote it in my journal and placed it on the class calendar.
Describing My Observations	I did not describe changes or special events.	I used describing words to tell about a change or special event that I observed.	I described a change or special event that I observed with complete sentences.

Debriefing and Reflection Opportunities

- When possible, use class calendar time for students to reflect on their observations and read journal entries to one another.

Teacher Resources:

(See additional print Teacher Resources and Websites in Unit Appendix.)

A Teacher-to-Teacher guide to raising Painted Ladies that contains tips and pitfalls:
http://www.teacherwebshelf.com/classroompets/insectsandco-butterflies.htm

Bibliography of Butterfly & Moth Books for Children

Bibliography created and maintained by Laura Mitchell, Reference Librarian and Amateur Lepidopterist

(OP) - Not listed in *Books in Print*, no longer available from publisher

(*) - Title recommended by our bibliographer for either content, illustrations, or both

Arnosky, Jim (1996). Crinkleroot's guide to knowing butterflies & moths. Simon & Schuster. (32 pages)
A very colorfully illustrated book for ages 4-10; Crinkleroot, who says he was born in a tree and raised by the bees, introduces common moths and butterflies; illustrations of the moths and butterflies are realistic, while the other forest life is more fanciful.

Boyd, Lorenz. (1971). Follow the butterfly stream. Abington Press.(40 pages) [OP]
Color photographs and text follow the path of a mountain stream in the Great Smoky Mountains describing the insects, butterflies, flowers and scenery.

*Carle, Eric. (1979). The very hungry caterpillar. Philomel Books, (28 pages)
A hungry little caterpillar eats nonstop, until, full at last, he forms a cocoon and goes to sleep.

The caterpillar who turned into a butterfly. (1980).Little Simon, Series: a Chubby Board Book. (16 pages)
An unhappy caterpillar is convinced he will never be anything else other than a caterpillar.

References

Websites:

http://www.enchantedlearning.com/subjects/butterfly/

http://www.naturepark.com/pladyinf.htm

http://www.ethosinc.org/why.html

http://lhsfoss.org/fossweb/teachers/materials/plantanimal/ladybutterfly.html

http://www.earthsbirthdaystore.org/products.asp?dept=1

http://courses.dsu.edu/eled320-360/Fall2001units/Fall%202001/Murphy/Life%20Cycle%20Page.htm

Journal Articles:

Dobey, D. C. & Springer, H, S. (2002). Simply butterflies, The Elementary Science Classroom, November/ December 16-21.

http://www.nsta.org/main/news/stories/science_and_children.php?category_ID=86&news_story_ ID=47570

Books:

Rezba, R & Sprague, C. &, Fiel, R. (2003), Learning and assessing science process skills 4th edition, Kendall Hunt.

Module 2, Lesson 6 Name_____

Caterpillar Growth Graph

In the date column write today's date. Then color in the rectangles to show the increase in size next to the date.

Date											
	1/4 cm	1/2 cm	1-1/4 cm	1-1/2 cm	1-3/4 cm	2 cm	2-1/4 cm	2-3/4 cm	3 cm	3-1/4 cm	3-1/2 cm

Module 2, Lesson 6 Name_____

Painted Lady Butterfly Life Cycle Sequencing Cards

From: http://www.enchantedlearning.com/subjects/butterfly/
Print diagrams from this site for each stage of butterfly life.

Sunday_____

Monday_____

Tuesday_____

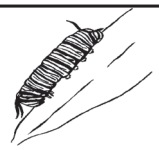
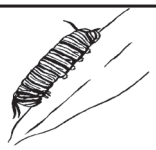
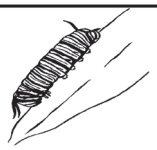
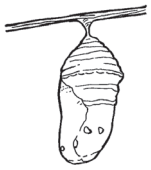
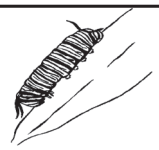
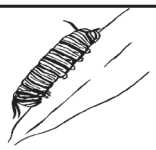
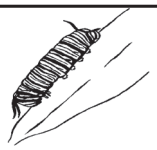
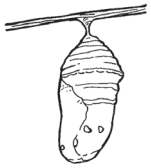
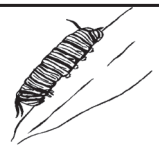
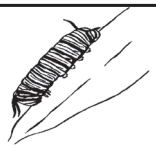
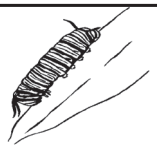
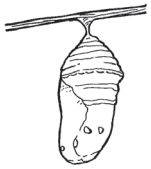
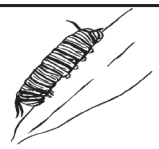
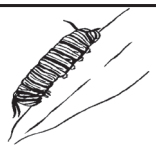
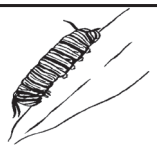
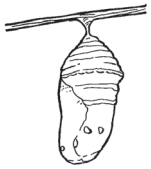
Wednesday_____

Thursday_____

Friday_____

Saturday_____

Directions: What does your caterpillar (larva) look like? Cut out the picture and place on the class calendar.
Source: http://courses.dsu.edu/eled320-360/Fall2001units/Fall%202001/Murphy/Life%20Cycle%20Page.htm

 Initials_____ Size_____	 Initials_____ Size_____	 Initials_____ Size_____	J Initials_____	J Initials_____	 Initials_____
 Initials_____ Size_____	 Initials_____ Size_____	 Initials_____ Size_____	J Initials_____	J Initials_____	 Initials_____
 Initials_____ Size_____	 Initials_____ Size_____	 Initials_____ Size_____	J Initials_____	J Initials_____	 Initials_____
 Initials_____ Size_____	 Initials_____ Size_____	 Initials_____ Size_____	J Initials_____	J Initials_____	 Initials_____

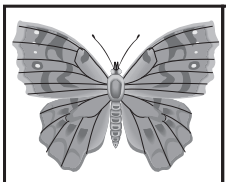
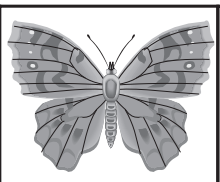
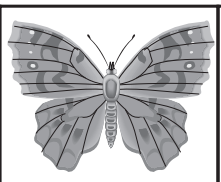
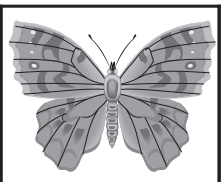
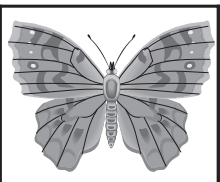
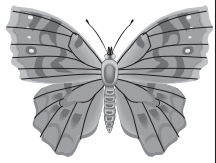
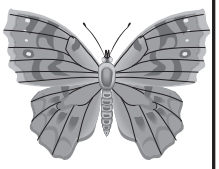
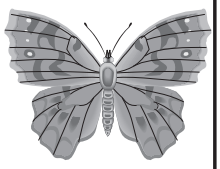
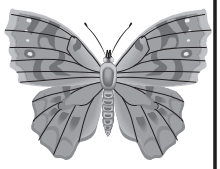
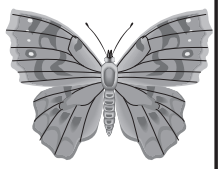
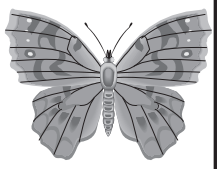
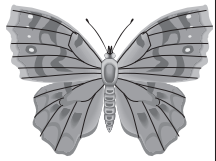
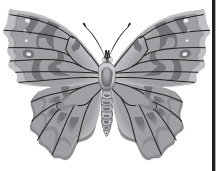
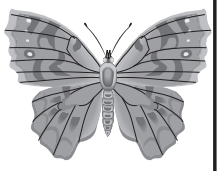
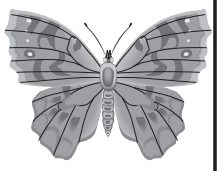
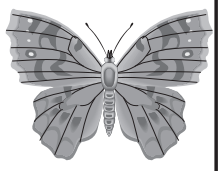
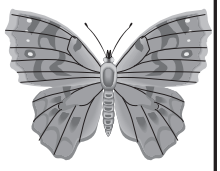
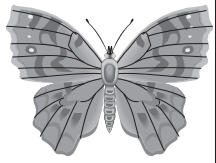
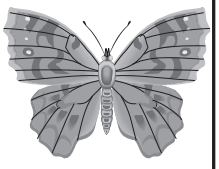
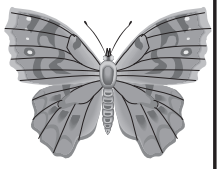
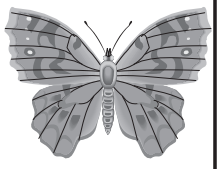
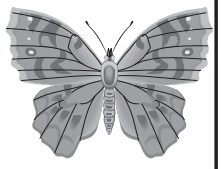
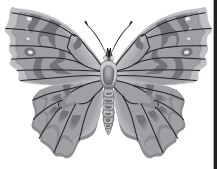
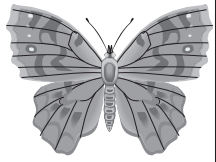
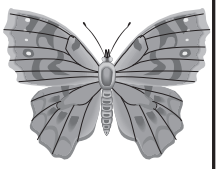
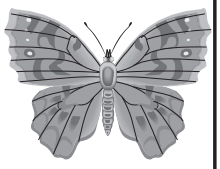
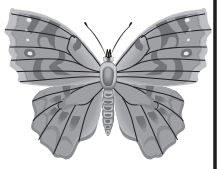
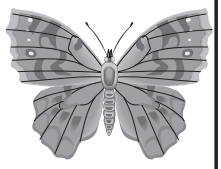
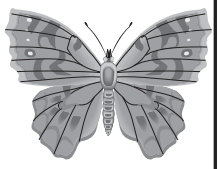
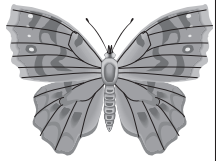
LIVING THINGS: CHANGES, STAGES AND CYCLES

Directions for Teacher: Distribute one of these cutouts per student.

 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____
 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____
 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____
 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____
 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____

 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____
 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____
 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____
 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____
 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____

LIVING THINGS: CHANGES, STAGES AND CYCLES

 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____
 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____
 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____
 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____
 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____	 Initials_____

Module 2, Lesson 6 Extension Activity Worksheet Name_____

Label the Caterpillar Diagram

Directions: Print out a diagram and definition of the parts at the following website. Copy the diagram and definitions for a key. Then block out the answers and distribute to students.
http://www.enchantedlearning.com/subjects/butterfly

Module 2, Lesson 6 Extension Activity: Experiment Design Sheet Name_____

Label the Butterfly

Directions: Print out a diagram and definition of the parts at the following website. Copy the diagram and definitions for a key. Then block out the answers and distribute to students. http://www.enchantedlearning.com/subjects/butterfly

Module 2, Lesson 6 Extension Activity: Experiment Design Sheet

Partners Names_____

Question: What are the effects of different temperature on caterpillar growth?

❑ **The variable you will change in your experiment is <u>temperature</u>.**

How will you change that variable? What will you do with the caterpillar and rearing cup?

_____

_____

_____

_____

What do you predict will happen to the caterpillar?

_____

_____

_____

What data will you collect every day? How will you measure growth and record change?

_____

_____

_____

_____

_____

Module 2, Lesson 6 Extension ActivityWorksheet Name_____

From: http://www.zoomschool.com/subjects/butterfly/activities/printouts/index.shtml

Write the butterfly growth stage on the line under the picture.

Adult Butterfly Butterfly egg Caterpillar Chrysalis

From the website above, print images of each of the above stages. You will also find other diagrams and activities that you might want to use as additional activities.

Module 2, Lesson 6 Extension ActivityWorksheet Name_____

From: http://www.zoomschool.com/subjects/butterfly/activities/printouts/index.shtml

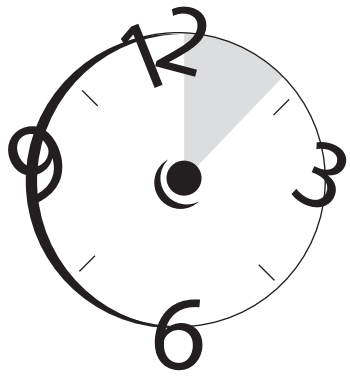
From the website above.

LIVING THINGS: CHANGES, STAGES AND CYCLES

Changes and Stages

Aid (Optional)

Time Allocation: 1 hour, 5 minutes
Required Materials and Resources on Page 84



Lesson Overview

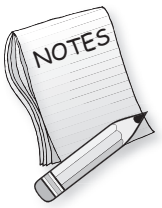
During this optional lesson students who show readiness for advanced content will explore cellular changes that take place inside the chrysalis. If Internet technology is available, students will download and listen to an audio clip; otherwise, they will read an expert's explanation of the mysterious changes in metamorphosis. Challenge questions will be posed; students will respond in their journals.

Guiding Questions

- How are cells involved in the changes that a living thing goes through as it develops toward maturity?

BIG IDEA

Stages and Changes Beneath What the Eye Can See



Content

Universal Theme
Change

Principles and Generalizations
- Transition from one developmental stage to another comes when a living thing's cells change.
- Living things are made up of units called cells.
- A living thing's cells increase in number as it grows.

Concepts
- Cells
- Niche
- Metamorphosis

Teacher Information
N/A

Skills
Explain

Materials and Resources
1. **Module 2, optional lesson - Inside the Monarch Chrysalis** reading
2. **Module 2, optional lesson - Try These! Journaling Questions**
3. **Module 2, optional lesson - Butterfly Expert's Answers**
4. Computer with Internet connection, (optional)
5. Print references: encyclopedia, dictionary
6. Microscope (optional for Extension)

Preparation Activities
1. Determine what group of students will complete this lesson: select advanced readers, science enthusiasts and those who work at an above average level

of independence with listening, reading and writing.

2. Schedule time at a computer workstation or in the computer lab, if possible, to allow students to utilize the recommended Internet resources.
3. If possible, request and schedule a gifted education, library-media specialist or other professional to work with the students on this lesson.
4. If computer resources will be used, locate the recommended Internet site and *Bookmark* or add it to *Favorites* on the browser to aid students in finding the site quickly.
5. If computer resources will be used, download the audio file recommended ahead of time.

Introductory Activities (5 minutes)

- Ask students if they've ever considered how the caterpillar is transformed into a butterfly. Ask them, "Is metamorphosis magic? How do biologists explain the changes that living things go through as they develop toward maturity? Tell them they are going to listen and/or read about how cells are working in ways our eyes can't see to affect changes that transform a chrysalis to a butterfly.

Pre-assessment (5-20 minutes)

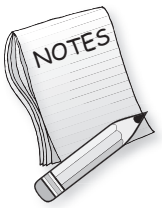
- Check for prior knowledge to see who may have developed some expertise in the area of biology already. Ask students what they already know about cells. If cell is a new concept to the children, have them spend 20 minutes or so using print references (encyclopedias) getting a definition and understanding. A good internet site with a short definition and printable materials is http://www.enchantedlearning.com/subjects/animals/cell/

Teaching and Learning Activities (45 minutes)

1. Have students download and listen to the audio clip at the Journey North website or read the reprinted text from the site included in this lesson. http://www.learner.org/jnorth/tm/monarch/ChrysalisDevelopmentLPB.html

2. If possible, have them listen first and follow along with the printed text.

3. Instruct them to highlight and look up unfamiliar words in a dictionary to



assist them in comprehending the text.

4. Assign them the journal entries that accompany the reading. (**Module 2, lesson 7- Try These Questions in Your Journal!**)

5. When the journal entries are completed, have them read the expert's response. Do not distribute it prior to their attempting a response.

6. As time permits have the class listen to the audio clip and have the students who participate in the AID read their journal entries to the entire class.

Products and Assignments

- Journal entry
- Choice of product from list (Extensions)

Extension Activities

1. Show What You Learned Your Way (60 Minutes) (AID)

After responding to the audio clip or reading in their journals, have students choose a creative way to explain what they learned about cells and what goes on inside the chrysalis. Give them a choice of making the following:

- cartoon
- video or tape recording explanation in their own words
- report to class with visuals
- Power Point slides
- X-ray drawings

2. Looking Beneath the Surface (30 minutes) (AID)

   If a microscope is available, have students view the molted skin of their caterpillar, a dead caterpillar, caterpillar's silk, butterfly or butterfly egg under the lens. The purpose would be to give them a sense of the power of this instrument. Even if magnification does not reveal the cells, students will be fascinated with this powerful tool. Alternatively, there are many sites that show magnified images such as this one, part of Journey North that shows the caterpillar:
   http://www.learner.org/jnorth/tm/monarch/ChrysalisFormationLPB.html

3. How Do Scientists Know? (30-60 minutes) (AID)

   Ask students how scientists have learned about cellular changes in the

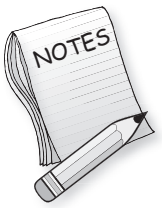
chrysalis? Interested, advanced readers may enjoy books that discuss the world of microscopy such as: The Usborne Complete Book of the Microscope, Paul Dowswell and Kirsteen Rogers, editors [ISBN 0746031068]. This book explores objects and organisms that can be viewed with a microscope and discusses various kinds of microscopes and microscopy techniques.

Post Assessment

From their own reading and from the expert's material entitled Inside the Chrysalis students should be able to supply a definition of the cell as the unit that make up living things. Their journal entries should show they understand that cells have a role in the mysterious and fascinating process of metamorphosis.

Debriefing and Reflection Opportunities (10 minutes)

Prompt the children who participated in this lesson in a think-pair-share. Have a few pairs share with each other what they learned about changes on the cellular level occurring in the pupa. If participants will be sharing with the rest of the class, have them highlight sections of their journal entry to read aloud.



Inside the Monarch Chrysalis

Written by Dr. Lincoln Brower, Butterfly Expert
What Takes Place Inside The Chrysalis, After It Has Formed?

Print from the following website: http://www.learner.org/jnorth/tm/monarch/ChrysalisDevelopmentLPB.html

Try this question in your journal in addition to the questions on the website. The answers to the questions are at the end of the questions.

From reading, explain in your own words, what is a cell? What does it have to do with the changes of a chrysalis?

When you are finished with your reading and journal questions, ask your teacher if you can read Dr. Brower's answer. (Be prepared for a challenge! You will need your dictionary for help wit the scientific words!)

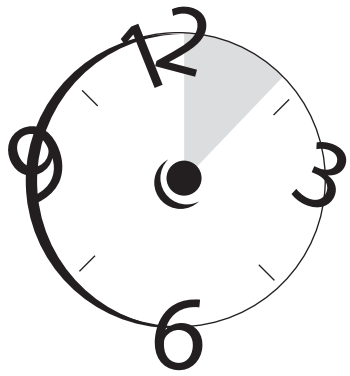
References

http://www.learner.org/jnorth/tm/monarch/ChrysalisDevelopmentLPB.html

Stages and Changes

Core/Practice/Aid

Time Allocation: 1 hour
Required Materials and Resources on Page 84



Lesson Overview

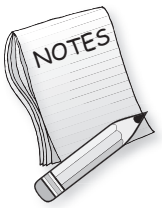
In this lesson students will consider the time it took for their Painted Lady butterflies to reach maturity and their inevitable death, days after their emergence as adults. They will be presented with data on the lifespans of other living things and organize the data in a graph to make comparisons. Lastly, they will enjoy either a short read aloud that explains death to children in a sensitive, caring manner or one that supplies an intriguing comparison of species' lifetimes.

Guiding Questions

- How do the typical lifespans of plants, animals and people compare with one another?

BIG IDEA

Every Life Has a Span



Content Goals

Universal Theme

Patterns

Principles and Generalizations

- Every living thing has a typical lifespan that comes to an end.
- Normally a life span ends after a living thing reaches maturity.

Concepts

- Typical
- Average
- Lifespan
- Death
- Maturity
- Maximum

Teacher Information

N/A

Skills

- Organize Data
- Graph Data
- Compare/Contrast

Materials and Resources

1. Mellonie, Bryan & Ingren, Robert. (1983). *Lifetimes: The beautiful way to explain death to children.* Bantam Books. (ISBN# 0553344021)
2. (Alternative book for read aloud: Rice, David L. (1997). Lifetimes. Nevada City, C: Dawn Publications)
3. **Module 2, Lesson 8 Lifespan Data Sheet**, one per student
4. Highlighters
5. Poster-size graph paper, or mural paper and Post-It Notes or other materials for a class graph (See preparation activities.)

Stages and Changes

Preparation Activities

1. Locate the book *Lifetimes: The Beautiful Way To Explain Death To Children*
2. Copy **Module 2, Lesson 8 Lifespan Data Sheet**, one per student
3. Highlight one line of data on each student copy of the **Module 2, Lesson 8 Lifespan Data Sheet** to indicate student data assignments.
4. Decide how the children will collaboratively construct a class bar graph and gather materials. Consider using a poster size sheet of graph paper for students to color each unit. Other possibilities include using Post-it Notes, yarn or adding machine tape on mural paper to represent units of data; Unifix cubes could be used to build a three-dimensional bar graph.

Introductory Activities (5 minutes)

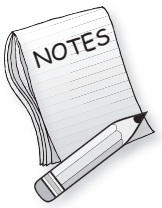
- Ask students to predict how long their Painted Ladies will live based on what they've read and observed. Next ask, "Have our larvae reached maturity? How do you know?" Discuss the emergence of adults and newly laid eggs as evidence of the larvae reaching maturity (growing old). Encourage the students to watch the behavior of the butterflies over the next weeks as they appear weaker and tired. If this has already occurred, remind them of these changes. Tell them, "Our class calendar shows the number of days each Painted Lady spent as a caterpillar and as a pupa. If we also add up the days that our Painted Ladies lived as eggs, caterpillars, pupas and adults, we would get numbers that match what scientists have also discovered. That is because there is a pattern or predictable length of time for all Painted Ladies to live. This is called a lifespan."

Pre-assessment

N/A

Teaching and Learning Activities (20 minutes)

1. Pass out the **Module 2, Lesson 3 Lifespan Data Sheet**. Ask students to study the title and any other information on the chart. Ask them these questions, "*What does lifespan mean? What do those numbers by each animal mean? What do you think maximum lifespan means?*" The maximum lifespans listed are actually the average maximum lengths, which seems contradictory. The term actually speaks to a statistical average, or central tendency for the length of the lifespan. Tell students that maximum means the longest.



Explain that the numbers show the typical length of time each animal or human lives or, in other words, how long we *expect* a life to last when it ends *naturally*. You might use the Painted Ladies as an example to explain *premature* death. If they live to the maximum of their lifespan indoors, it might be as long as three weeks. However, if one were to be stepped on, it would be a premature death.

Throughout this discussion, be alert and sensitive to student feelings, concerns and cultural differences as they pertain to the issue of death. The **Debriefing and Reflection Opportunities** offer two possible read alouds to choose from depending on whether you determine it is better to address the topic or de-emphasize it. One gently addresses the death; the other supplies an appealing comparison of lifespan data and other facts on unusual species.

Students will notice humans on this list. They may mention an elderly person that they knew who is older than 80 years. Explain that the numbers shown are not *records* (or what are statistically referred to as *outliers* or extremes in the data). Some human and animal records are listed in the chart on the bottom of the page. Help students see how the maximum human lifespan has increased over the centuries.

SEARCHLIGHT: Students who are fascinated with lifespan data can be encouraged to complete the Extension graphing activity that requires more complex data analysis.

2. Work with the learners to create a graph. Tell them, "Together we will construct a graph to organize the data and compare the lifespans of living things." Explain that a graph has an x-axis and y-axis. "The x-axis goes across the bottom of the paper and will help us show the length of time a living thing lives." We will need to create a scale that can show the smallest lifespan up to the longest lifespan. What is the smallest lifespan listed? What is the longest?" Instruct them to scan the first table on the data sheet and give you the name of the animals that have the shortest and longest maximum lifespans. They may need some assistance in understanding the decimal given for the lifespan of a fruit fly or spider. Explain this as a small number that is a fraction of a year (3-4 days to be exact). Explain that the smallest

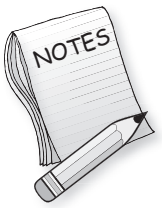
lifespan number (.01) and the largest (177) form what we call a *range of data* from less than a year to almost 200 years. Decide how many years each unit (block on the graph) or data point will represent. Count by that number 5's, 10's or 20's) as you plot out the numbers with the students. Next, write the numbers on the x-axis.

horse																				
dog																				
cat																				
bear																				
ox																				
	10	*20*	*30*	*40*	*50*	*60*	*70*	*80*	*90*	*100*	*110*	*120*	*130*	*140*	*150*	*160*	*170*	*180*	*190*	*200*

3. Draw the students' attention to the highlighted line of data on Lesson 8 **Lifespan Data Sheet**. Tell them that they will graph the lifespan for that animal.

4. Call one student to the graph. Instruct him/her to find the point on the *x-axis* that represents the animal's lifespan. Depending on what you've decided, have him/her add to the graph to represent his/her data (possibly by attaching Post-It Notes to mural paper for every unit of measurement, shading unit blocks on the graph paper or taping a length of yarn that stretches to the correct numerical point). Have students write the animals' names along the *y-axis*. Allow as many students to contribute to the graph as time allows. Tell them everyone will have a chance to plot his/her animal at a designated time. (Perhaps during seatwork, math time or during a free choice time.)

5. If the Painted Ladies are still living, ask students to predict what the typical maximum lifespan will be. In other words, how long will most of them live? If they have died already, refer to the class calendar or student journals for recorded dates of death. The lifespan should include estimated days as an egg, plus time as a larva, pupa and adult. Since students did not have their Painted Ladies for their entire lifespan, this time will have to be estimated. If a second generation is raised, students can observe the entire lifespan and check their predictions.



6. Work with the class to create a title for the graph.

7. When several have contributed, ask students to make comparisons and other observations about the data. Repeat this when all the data is posted on the graph.

See Post Assessment.

Products and Assignments

- Class graph of lifespans
- Shared read aloud

Extension Activities

1. **Everything You Always Wanted to Know About Animal Lifespans** (30+ Minutes) (AID)
   Select students who work well independently and appear ready (after the class graphing activity) for a multi-step data organization task. Give them the article at the end of this module. Encourage students to decide which data mentioned in the article they want to use to create a histogram or other graph of their choice. Explain the key in the beginning of the article that designates lifespans in captivity compared to those the natural and typical lifespans versus world records. Instruct them to pick a theme for their graph such as "all animal lifespan records" or "comparison of the life spans of two species' in captivity and in the natural." Provide graph paper (18" by 36," if possible). If students can work independently and AppleWorks, Microsoft spreadsheet or other graphing software is available, schedule a time at a computer station or in the lab for students to design computer-generated graphs of their data.

2. **Look-It-Up** (30+ minutes)
   The book *Lifetimes* by David L. Rice (mentioned earlier) highlights the longevity and special quality of the lifetime of selected plants and animals of the world. At the bottom of each page mini research suggestions are given for students under "Look-It-Up headings, such as: "A lifetime for an army ant is about three years, where do army ants live?" Allow interested students to work through the book and document the answers they find to

self-selected questions. Provide assistance to students who need it.

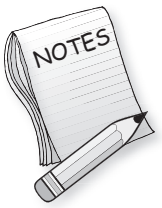
Post Assessment (20 minutes)

Check for understanding once all the data is graphed by asking the guiding question one more time. How do the typical lifespans of plants, animals and people compare with one another? Have each student make one comparison. Require that they not repeat any statement made previously by their peers. Model a few examples for them. Since comparison statements will require reading the graph and identifying similarities and differences, ask the students who are likely to need assistance first before those needing challenge, as the task will get more difficult with time.

Comparing Life spans: Rubric for Student Responses to Data			
	Partially Proficient	**Proficient**	**Advanced**
Chooses appropriate characteristics for comparison	Selects two animals or plants from chart, but cannot independently identify the numbers that correspond to each lifespan	Selects two animals or plants from chart and independently and identifies the numbers corresponding to each lifespan	Selects more than two animals or plants from chart and independently identifies the numbers corresponding to each lifespan
Identifies similarities and differences among items, using the characteristics	Cannot identify similarities or differences in two life spans independently, but does so with help	Can identify similarities or differences in two life spans independently	Can identify similarities or differences in numerous life spans independently
Develops conclusion from the comparison	Struggles to make conclusions that go beyond obvious numerical comparisons	Develops a conclusion that represents a valid inference (for example, "the clam lives longer than any other animal".)	Develops a unique conclusion that displays a greater leap in thought (for example, "humans are living longer and longer")

Debriefing and Reflection Opportunities (15 minutes)

- Gather the students in the front of the room for a shared reading of one of the books described below:
    - *Lifetimes: The Beautiful Way to Explain Death to Children*: This book poetically explains the end of each living thing's lifetime. After reading it aloud, discussion could be fostered by asking the



students what a lifetime means to the author. "Is a lifetime the same as a lifespan?" If this book is used, be sensitive. Do not force a conversation about death, but assure the children they are being heard by validating their feelings, thoughts and personal narratives. Conclude by linking your conversation about the text with the principle: Every living thing has a typical lifespan that comes to an end.

- Should you decide the book above not appropriate, use *Lifetimes* by David L. Rice for the read aloud. This book has much more text, but with rich illustrations highlights the longevity and special quality of the lifetime of selected plants and animals of the world. It is formatted with headings that could be read from each page to limit read aloud time. Students could go back to additional information and suggestions for research later. (See Extension Activities). Unlike the other, this book does explicitly not deal with death as an ending to living things.

References:

http://www.saczoo.com/3_kids/8_lifespans/_lifespans_zooanimals.htm

www.tesarta.com/www/resources/library/lifespans.html

http://www.lef.org/newsarchive/aging/2001/03/11/eng-beaufort_lifecolum/eng-beaufort_lifecolum_030629_74_7578441421501.html

Lifespan Data Sheet			
Mammals:	**Maximum Lifespan***	**Reptiles:**	**Maximum Lifespan***
Bat	2 years	Alligator	56 years
Bear	31 years	Box Turtle	123 years
Cat	21 years	Giant Tortoise	177 years
Dog	34 years	Amphibians	
Elephant	57 years	Salamanders	3-25 years
Horse	62 years		
Lion	29 years	**Fish:**	
Mouse	3 years	Eel	6 years
Ox	30 years	Goldfish	25 years
		Sturgeon	50 years
Humans:			
Human, Neanderthal	20 years	**Spiders**	
Human, Neolithic	20 years	House Spider	.01 (3-4 days)
Human, Classical Greece	28 years	Bird Spider	15 years
Human, Classical Rome	28 years		
Human, Medieval England	33 years		
Human, end of 18th Century	37 years	**Birds:**	
Current	80 years	Blue Jay	4 years
Human, early 20th Century	50 years	Canary	24 years
		Macaw	64 years
Insects:		Nightingale	3.8 years
Fruit Flies	.1 years (30 days)	Pigeon	69 years
Ant	15 years		

Record Holders	
Oldest recorded Quahog (clam)	220 years
Oldest recorded Tortoise	152 years
Oldest recorded Human	120 years
Oldest Recorded Giant Salamander	55 years
Oldest recorded Queen Ant	18 years
Oldest recorded Housefly	

Sources: http://www.saczoo.com/3_kids/8_lifespans/_lifespans_zooanimals.htm and http://www.tesarta.com/www/resources/library/lifespans.html

Module 2, Lesson 8 Name_____

Everything You Always Wanted to Know About Animal Lifespans

From: *Beaufort Gazette Online*
March 11, 2001

From: http://www.lef.org/newsarchive/aging/2001/03/11/eng-beaufort_lifecolum/eng-beaufort_lifecolum_030629_74_7578441421501.html

Question: I've often wondered how long pigs, dogs, elephants, snakes, spiders and other animals live.

Answer: I suggest you clip out the following list for future reference. Figures refer to number of years. KEY TO ABBREVIATIONS: A= "average life span"; W= "life expectancy in the wild"; C= "life expectancy in captivity"; and OL= "oldest age on record or observed in captivity."

African Buffalo (OL 29); African Civet (OL 28); Alligator Snapping Turtle (OL 58); American Alligator (OL 66); American Bison (OL 33); American Manatee (OL 30+); Andean Condor (OL 72+); Asian Otter (C 11); Ass (A 8-20; OL 63); Australian School Shark (OL 32+); Bactrian Camel (A 40, OL 45+); Baringo Giraffe: (W 25; C up to 28); Bear (A 15-30; OL 47); Beaver (A 9-11); Black and White Columbus Monkey (C 23+); Black Rhinoceros (C up to 50 years); Blue Macaw (OL 64); Blue Sheep (OL 20 ?); Blue Whale (OL about 45); Bobcat (OL 32 1/3); Bottlenose Dolphin (A 20; OL 48); Brittlestar (OL about 15); Canadian Otter (OL 21); Canary (OL 34); Cape Giraffe (OL 36); Capybara (OL 12); Cheetah (W about 12; longer in captivity); Chicken (A 7-8; OL 14); Chimpanzee (A 40-45; OL 55); Cockatoo (C 100+); Common Boa (OL 40); Common Bobwhite Quail (A 1 or less); Common Toad (OL greater than 40); Common Wombat (OL 26); Cotton-Top Tamarin (C 7-16); Cougar (A 10-20); Cow (A 9-12; OL 39); Coyote (OL 21+); Deep Sea Clam (OL about 100); Deer (A 10-15); Domestic Cat (A 10-12; OL 34); Domestic Dog (A 10-12; OL 29); Domestic Goose (OL 49); Domestic Pig (A 10; OL 27); Donkey (up to 50); Duck (A 10; OL 15); Dyeing Poison Arrow Frog (C up to 10); Earthworm (maximum life span 10); Eastern Box Turtle (OL 123); Egyptian Spiny-Tailed Lizard (up to 15); Egyptian Vulture (OL 118); Elephant (A 30-40; OL 71); Emperor Tamarin (C about 17); Emu (OL 42+); European Brown Bear (OL 47); European Catfish (OL 60+); European Eel (OL 88); Fat Dormouse (OL 8 2/3); Feather-star (OL 20+); Fox (A 8-10; OL 14); Freshwater Mussel (OL 70-80); Frog (maximum life span 12-16 years); Giant Centipede (OL greater than 10); Giant Panda (OL 26+); Giant Tortoise (OL 200); Golden Hamster (A 2; OL 8; OL 10 in one source); Goat (A 12; OL 17); Domestic Goat OL 20); Goldfish (OL 41); Gorilla (OL 53); Grant's Gazelle (W10-12; longer in captivity); Gila Monster (up to 20); Great Eagle-Owl (OL 68+); Great White Shark (up to 50); Greater Egyptian Gerbil (OL 8+); Green Turtle (OL 50+); Grey Parrot (OL 49; less substantiated: 72 years); Grey Seal (OL 46+); Groundhog (A 4-9); Guinea Pig (A 3; OL 6; OL 14 7/8 in one source); Guppy (A 2; maximum life span 5-6); Hawk (into the 50s-60s); Hippopotamus (A 30; OL 54 1/3); Hedgehog (OL 16+); Herring Gull (OL 44); Hoffman's Sloth (W 12-20; C up to 32; OL 34+); Horse (A 20-25; OL 62); Horseshoe Bat (A 16-18); Human (A 76.7; OL female 122); Hummingbird (A 5 or less); Indian Flying Fox (OL 31+); Indian Pangolin (OL 13); Indian Rhinoceros (OL 49); Japanese Giant Salamander (OL 51+); Jaguar (C 20+); Kangaroo (A 4-6; OL 23);

Everything You Always Wanted to Know About Animal Lifespans (Page 2)

Killer Whale (OL greater than 90); King Baboon Spider (females A 20-30; males A 7-10); Koala (W 12+; C 16+); Koi Carp (OL greater than 50); Land Snail (OL 15); Lion (A 10; OL 29); Loggerhead Sea Turtle (A 60-75+) ; Mandrill (OL about 46); Marion's Tortoise (OL 152+); Medicinal Leech (OL 27); Metallic Wood Borer (OL 42); Millipede (OL 7); Monarch Butterfly (OL 1 1/8); Monkey (A 12-15, depending on kind; OL 29); Moonrat (OL 4); Moose (A 15-25); Mouse (A 1-3; OL 4; OL 6 in one source); Mouse Lemur (A 10); Naked Mole Rat (C 15-20); Neptune Crab (OL 29+); Nile Crocodile (up to 100); North American Lobster (OL about 50); Orangutan (OL 57+); Oregon Sturgeon (OL 150); Ostrich (OL 62); Owl (into the 50s-60s); Parakeet/Budgerigar (A 8; OL 12+; OL 29+ in one source); Philippine Tree Shrew (OL 11); Pigeon (A 10-12; OL 39); Pike (OL 55); Purse Web Spider (OL 9+); Pygmy Hippo (C up to 42); Pygmy White-Toothed Shrew (OL 2); Quahog (OL about 150); Queen Ant (OL18+); Queen Bee (maximum life span 5+); Rabbit (A 6-8; OL 15); Raccoon (A 3-4 ; OL 13); Rat (A 3; OL 5); Red Deer (OL 26 ?); Red Spotted Newt (A 12 -15); Rock Hyrax (A 9-12); Royal Albatross (OL 58+); Sea Anemone (OL 80-90); Segmented Worm (OL 5+); Serval (C at least 13); Sheep (A 12; OL 16; Short-Nosed Echidna (C 50); Siberian Flying Squirrel (OL 3) ; Siberian Tiger (W 15; longer in captivity); Siberian White Crane (OL 62+); Slow-worm (OL 54+); Snakes (maximum life span 20-30); Snow Leopard (C up to 15); Spectacled Bear (C up to 20); Spiny Starfish (OL 7+); Spur-Thighed Tortoise (OL 116+); Squirrel (A 8-9; OL15); Grey Squirrel OL 23 in one source); Squirrel Monkey (C 9+); Sterlet (OL 69); Stinkpot (OL 53 1/3); Sulfur-Crested Cockatoo (OL 56); Sumatran Crested Porcupine (OL 27 ?); Theraphosid Spider (OL about 28); Tiger (OL 26); Tuatara (OL 77); Vicuna (OL 24); White-Cheeked Gibbon (A 25+); White-Throated Capuchin (OL 46+); White Pelican (OL 51); Wild Turkey (A 2-3); Wolf (A 10-12; OL16); Woodchuck (A 2-3); Wren (A 5 or less) · and pity the poor mayfly, which lives but half a day (one week at the most)! The female lovebugs that swarm over Beaufort each spring and fall live only 72-86 hours (males 92 hours). For the record, adult houseflies last about 20-30 days.

Nature has a way of complicating things, however. In "A New Bestiary for Aging Research" (Science, Nov. 2, 1990), Virginia Morrell reported that the life expectancy of an opossum on the small islands along the Georgia coast averages 3 years, but 'possums on the Georgia mainland - where automobiles kill many of the animals - live only about 1.3 years (regardless of cause of death). Researchers believe that risks facing the mainland animals speed up reproductive maturity, thus assuring the survival of the population. This also causes the animals to age faster than their cousins on the islands.

Sources of this morning's facts: Coastal Research and Education Society of Long Island "Loggerhead Sea Turtle" Web site at http://www.cresli.org/cresli/turtles/loggerhd.html ; Guinness Book of Answers ; "Longevity of Animals" in the Charleston Post and Courier (Jan. 25, 2001); Lincoln Park Zoo (Chicago) Web site at http://zoo.interaccess.com/index.html ; New Book of Popular Science; 1997 Information Please Almanac ; Ohio History Central "Animals" pages at http://www.ohiokids.org/ohc/nature/animals/ ; Sea World "Bottlenose Dolphins" Web site at http://www.seaworld.org/bottlenose_dolphin/bottlenose_dolphins.html , "Top 5 Longest-Living Animals" (Time for Kids , April 26, 1996).

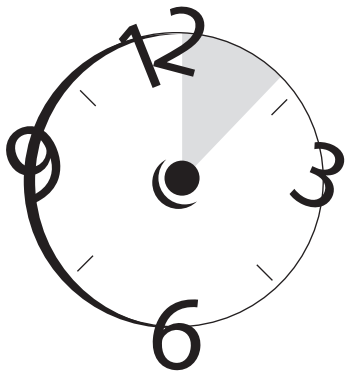
Dennis Adams is Information Services coordinator at Beaufort County Library.

LIVING THINGS: CHANGES, STAGES AND CYCLES

Stages and Changes

Core/Aid

Time Allocation: 1 hour, 21 minutes
Required Materials and Resources on Page 84

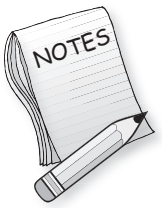


Lesson Overview

Students will explore the cycle as a pattern by locating cyclic patterns in the world around them. They will dramatize the Painted Ladies' stages of growth and development. From this experience and their observation of newly laid eggs, they will predict the reoccurrence of these stages and come to understand that through reproduction, new generations are born; life begins and ends in a cycle. A shared reading will illustrate how this pattern is common to many different types of living things and prepare them for a post assessment.

Guiding Questions

- Why are there people, animals and plants on the earth even though people, animals and plants die?
- What pattern can be seen as living things go from generation to generation?



Content Goals

Universal Theme

Cycles

Principles and Generalizations

- Cycles occur when a sequence of events repeats over and over again.
- The growth, development and reproduction of living things repeat in a cyclic pattern over generations.
- Even though plants, animals and humans die, life continues through reproduction.
- Life cycles of animals, humans or plants are carried on when the mature animals, humans or plants reproduce themselves.
- The last stage in a life cycle, reproduction, brings the cycle back to the first stage.

Concepts

- Pattern
- Repeat
- Cycle
- Continue
- Reproduction
- Life cycle
- Generations
- Offspring

Teacher Information

N/A

Skills

- Observe
- Locate a pattern
- Predict
- Make connections

Materials and Resources

1. Kalman, Bobbie & Langille, Jacqueline. (1998). *What is a life cycl**e, (The science of living things).*** Crabtree Publishing. (ISBN# 0865058865) This book explains the life cycles of all animal groups with simple text and photos.
2. **Module 2: Lesson 9 Extension Life Cycle Diagram**
3. (Optional) Bicycle wheel, toy truck with wheels
4. **Module 2: Lesson 9 Post Assessment**

Preparation Activities

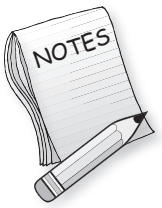
1. Locate book *What is a Life Cycle, (The Science of Living Things)*
2. Copy **Module 2: Lesson 9 Post Assessment**, one set per student.
3. Locate a bicycle wheel or toy truck to use in a simple demonstration during the module introduction.

Introductory Activities (1 minute)

Gather students in front of the easel. Tell them "We've been working like scientists to observe our butterflies while they change and grow. Scientists look for certain patterns in their observations of living things."

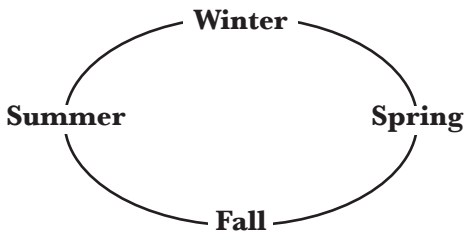
Pre-assessment (5 minutes)

- To find out their current understanding of patterns and cycles ask, "What is a *pattern*?" Students should recognize that patterns repeat
- Then ask, "Do you know what a *cycle* is?" If they are unable to define the word, ask when they've heard the word before. They might recall words like *bicycle*, *tricycle* and *motorcycle*. If students need help defining *cycle*, using those examples, ask them what a bicycle, tricycle and motorcycle have in common. Guide them in recognizing that all have wheels that go round and round.
- Show them how the bicycle or toy truck wheel spins around and around if you've located one to demonstrate. Tell them, "Another meaning for cycle is a kind of pattern that goes round and round. Cycles are a series of events that repeat." Ask them if they can name anything that occurs in a cycle pattern.



Teaching and Learning Activities (45 minutes)

1. Work with the children to list all cycles they know that occur in the world around them. To assist students who may need help with the concept, provide an example by explaining that seasons occur in a cycle each year. Have them name the seasons. Ask them all to join you in saying *winter-spring-summer-fall*. Then ask, "What comes after fall?" Emphasize that the cycle pattern starts over again and repeats again and again. In a cycle the last stage, brings the cycle back to the first stage. Draw a large circle on chart paper. Draw a simple picture or write the name of each season on points around the circle. Repeat the seasons with them several times while pointing to the names/pictures around the circle.



Some possible cycles that could be listed are: days of the week, months of the year, the moon's movement around the earth, phases of the moon, recycling--when paper and plastic materials are made, used and reused; and so on. Reinforce their answers. As long as the pattern of events repeats, you can call it a cycle. For example, beginning-middle-end of a book is a cycle if the book is read over and over. Verses in certain songs sung over and over make a cycle.

SEARCHLIGHT: Students who are fascinated by cycles or who can name some natural occurring cycles can be encouraged to pursue their own research of a natural cycle. See Module Two, Lesson 9 for ways to foster this AID opportunity and Connections Parallel.

2. Based on their observations, ask students to predict a cycle that occurs with the Painted Ladies. (If they have observed the adults laying eggs already, ask them to explain the cycle rather than predict.) Use the **Module 2: Lesson 9 Life Cycle Diagram** if necessary, to remind them of the stages of development. Place the names of the stages around a newly drawn circle or continue to use the diagram by pointing the sequential stages repeatedly

to make a cycle. It is important to clarify that it is only when the egg stage starts again that we have a cycle. In other words, the stages themselves are not a cycle.

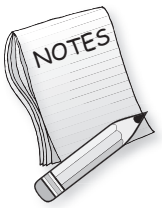
3. Dramatize the Painted Lady life cycle through pantomime and movement. Pick four students to form a circle in the middle of the rug/floor with the rest of the class seated around them. Tell them they will each act out a stage. One child can squat down and curl up to look like an egg. Another can act out a caterpillar possibly by squirming or lying down. Another can be a pupa by being still and looking like he/she is hanging. The fourth child can be the female adult pumping-up her wings. Put a fifth student at the center of the four children and have him or her point to each actor as he/she spins slowly like the arm of a clock. Ask the other students to repeat the name of each stage as the actors are pointed at. Make sure the cycle is repeated numerous times. The students who are watching can be in charge of counting how many times the cycle is repeated.

4. Ask them what a generation is. Tell them each time the eggs are laid a new *generation* is born. Ask what would happen if no eggs were laid. Introduce the word *reproduction*. Define it as living things creating offspring.

5. Pose the lesson's guiding question: *Why are there people, animals and plants on the earth even though people, animals and plants die?* Ask them what reproduction has to do with future generations. Discuss reproduction as the reason cycles continue.

6. **SEARCHLIGHT:** Ask the students, "What happens when an entire group of living things stops reproducing?" Listen to see who might recognize that when reproduction stops for an entire species that species becomes extinct. (Plan to involve students who are in need of a challenge and interested in extinction or the problem of endangerment in Lesson 10 AID.)

7. Read at least pages 4 through 6 of *What is a Life Cycle, (The Science of Living Things)* with the students. As time permits throughout the next few days, read through this entire book that examines the life cycles of various kinds of living things.



Products and Assignments

- List of cycles
- Dramatization of a life cycle

Extension Activities

1. **Life Cycle Diagram Extension Activity** (Core) (20 minutes)
   Have the all students complete the Life Cycle Diagram Extension Activity according to the directions as an anchor activity during reading or choice time.
2. **How Long are Human Generations?** (Practice) (AID) (90 minutes)
   Interested math-strong students can consider the length of generations produced in human life cycles. These and other related questions posed by the Journey North project can be found at http://www.learner.org/jnorth/tm/monarch/GenerationDefined.html
3. Students are prompted to draw a simple family tree, record the year each person was born in each generation and then calculate the age of each person when their first child was born. Finally, they calculate the average age at which each generation produced their first child and compare the length of generations for the families in the class. This might be a good independent project for students to work on at home or with a gifted education specialist.

4. **Yearly Cycle of Monarch Generations** (AID) (60 minutes)
   Students who seem fascinated by butterfly generations and ready to explore the concept at greater depth can research Monarch butterfly generations. Tell them they will find out the answer to these questions: Do all Monarch butterfly generations live the same length of time? How many generations can be born in a year? Is there a pattern that occurs as different Monarch generations are born during spring, summer or fall? Direct them to read the background information at:

   http://www.learner.org/jnorth/tm/monarch/GenerationDevelopmentTime.html or
   http://www.learner.org/jnorth/tm/monarch/LifeLengthWorksheet.html
   Alternatively, they can also use print references in the library. Then have them complete the **Module 2, Lesson 4, Extension Activity 1** cut

and paste diagram. (Although students could attempt to complete this without reading and researching the questions, it would be significantly less meaningful if they did not do the suggested reading.)

Post Assessment (30 minutes)

Have students complete the two-page **Module 2: Lesson 9 Post Assessment**. Correct these with the answer page once students have pasted word to describe the parts of the cycle.

Debriefing and Reflection Opportunities (30 Minutes overlapping with Post Assessment time)

Meet with students in small groups as they complete the **Module 2: Lesson 9 Post Assessment** to discuss and assess their understanding of the cycle as a repeating pattern. Ask them to explain how the diagram in the **Post Assessment** illustrates these concept words:

- Pattern
- Repeat
- Cycle
- Continue
- Reproduction
- Life Cycle
- Generations
- Off Spring

References:

Rosenblatt, L.M. (1998). *Monarch Magic Butterfly Activities and Nature Discoveries.* Charlotte, Vermont: Williamson Publishing. (ISBN# 9781885593238)

http://www.enchantedlearning.com

http://www.learner.org/jnorth/

Module 2, Lesson 9 Name_____

Life Cycle Diagram

Directions: Cut out each box. Paste them in the diagram to show stages that repeat in the life cycles of living things.

Early Stages (Not Yet Mature)

Early Stages (Not Yet Mature)

Reaching Maturity (Adulthood)

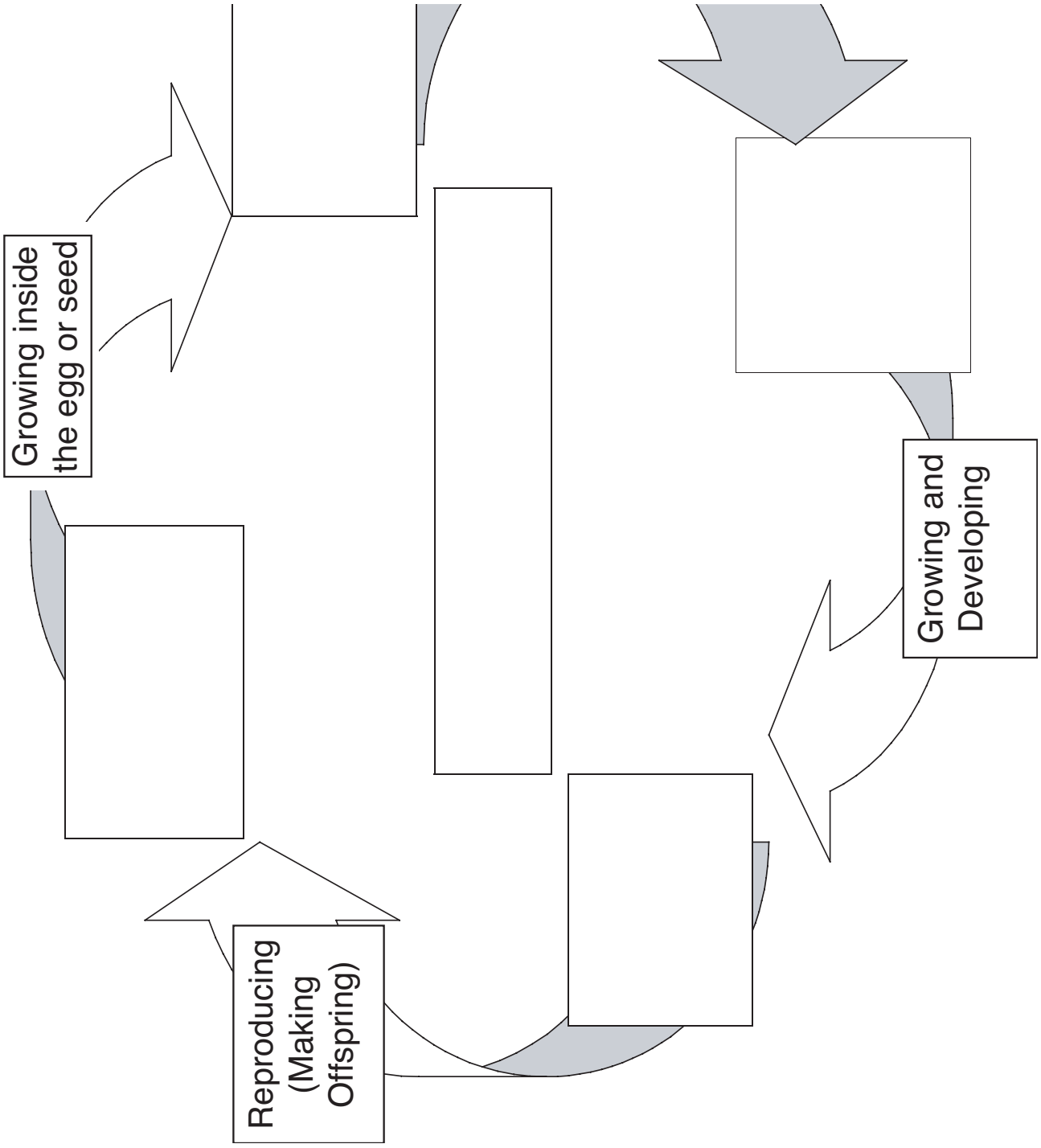
Being Born, Hatching or Sprouting

Beginning as Egg or Seed

Module 2, Lesson 9

Name_____

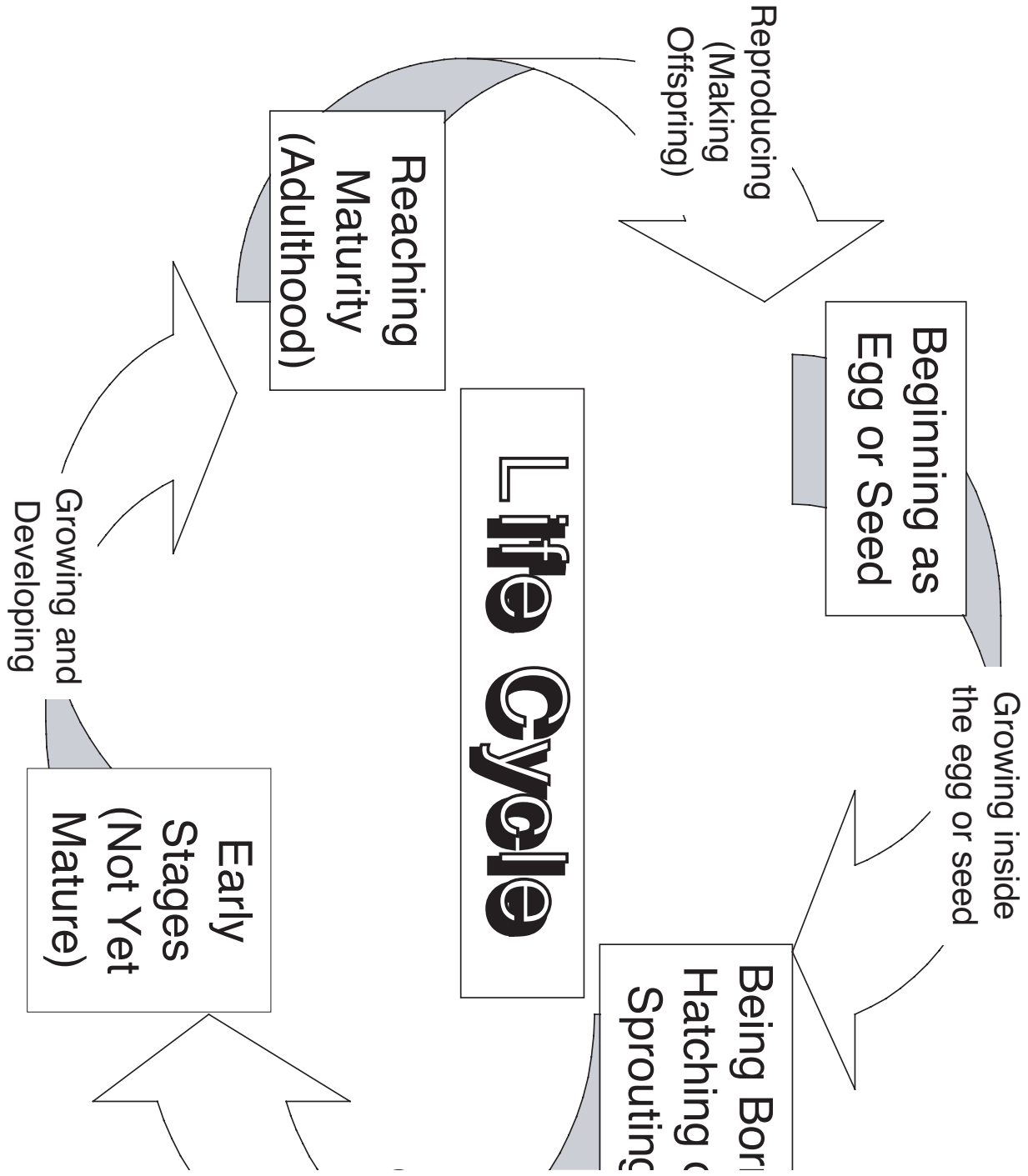
Life Cycle Diagram



Module 2, Lesson 9

Name_____

Life Cycle Diagram



Module 2, Lesson 9 Name_____

Life Cycle Diagram

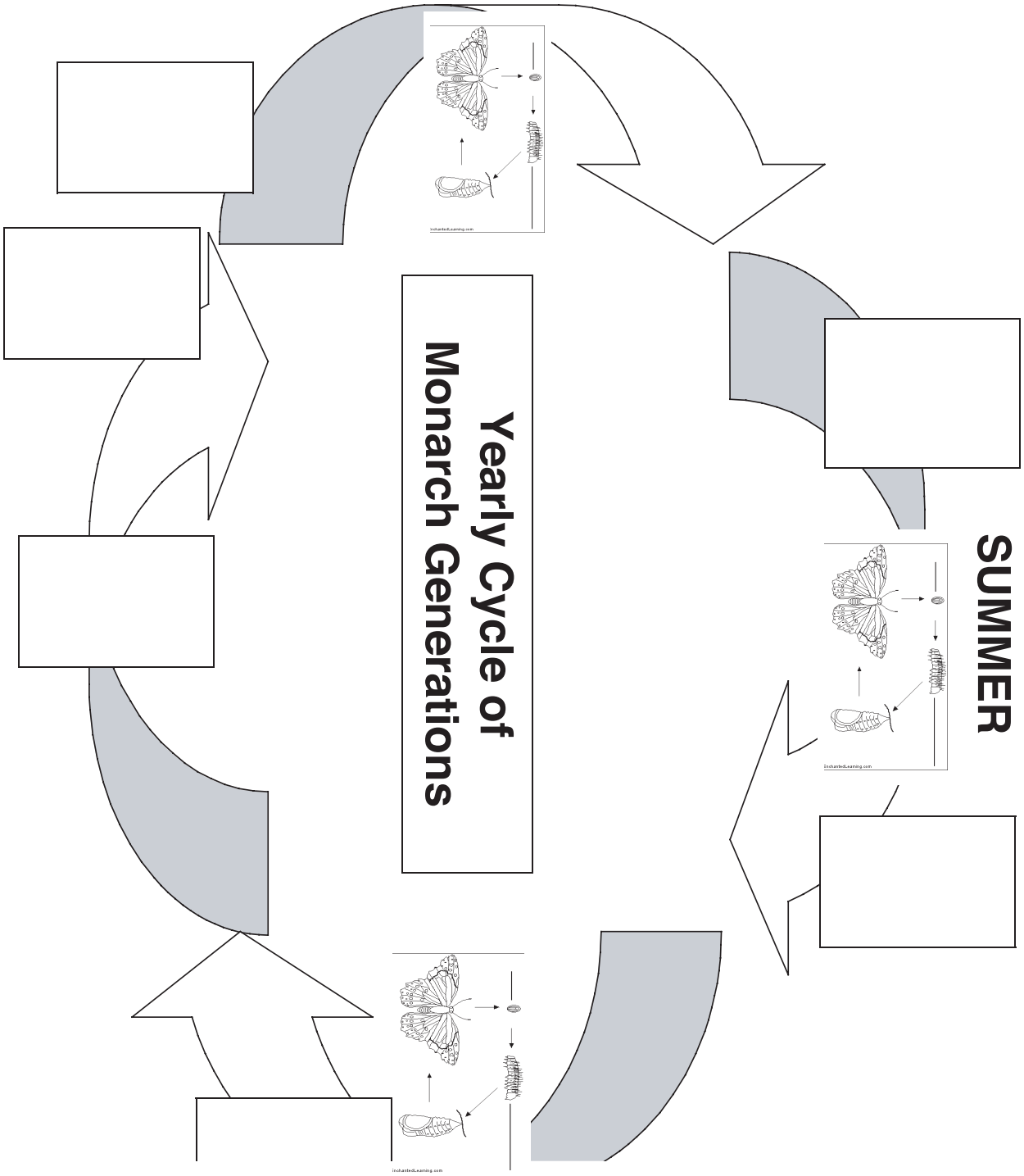
Source: http://www.enchantedlearning.com/subjects/butterfly/

Print out the diagram of the Painted Lady life cycle from the above website. Butterflies undergo complete metamorphosis. The larva (caterpillar) hatches from an egg that the female usually lays on the underside of leaves. After growing, it enters the seemingly inactive pupal phase during which it forms a protective chrysalis and metamorphoses into a winged insect - the adult butterfly. After mating, the female lays eggs and the cycle begins again.

Label the butterfly life cycle diagram below.

Module 2, Lesson 9 Name_____

Life Cycle Diagram



Module 2, Lesson 9 Name_____

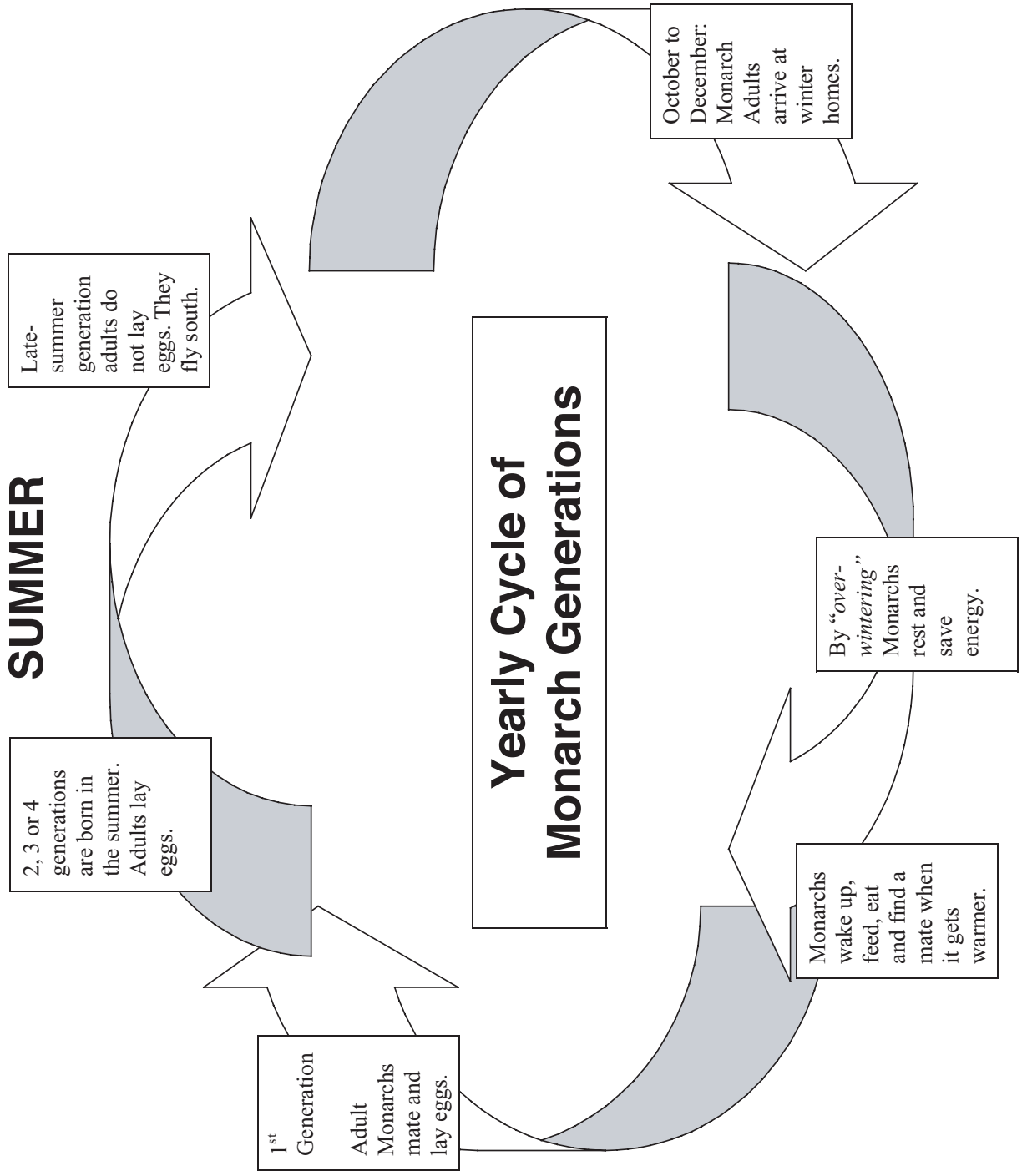
Life Cycle Diagram

A new spring generation starts the cycle all over again.	The Monarchs migrate by flying north, then lay eggs and die.	1st Generation Adult Monarchs mate and lay eggs.	Monarchs wake up, feed, eat and find a mate when it gets warmer.
Late-summer generation adults do not lay eggs. They fly south.	By "over-wintering" Monarchs rest and save energy.	October to December: Monarch Adults arrive at winter homes.	2, 3 or 4 generations are born in the summer. Adults lay eggs.

Module 2, Lesson 9

Name_____

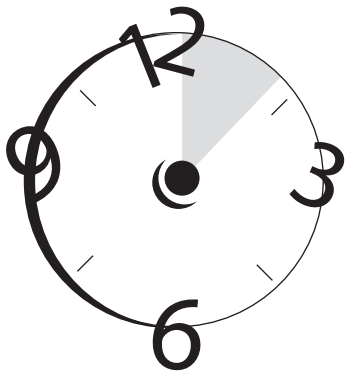
Life Cycle Diagram



Changes and Stages

Aid (Optional)

Time Allocation: 1 hour, 5 minutes
Required Materials and Resources on Page 84



Lesson Overview

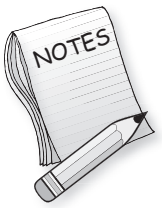
Students will research an extinct animal or an animal in danger of extinction to answer these guiding questions: Why do animals become extinct? What does extinction have to do with life cycles? How can people protect endangered species? Using a research guide sheet students will follow steps to locate references, take notes and develop a product to share the problems and solutions they have found. The learners will come to understand that extinction brings life cycles to a halt and is related to habitat loss, pollution and over-hunting.

Guiding Questions

- What does extinction have to do with life cycles?
- Why do animals become extinct?
- How can people protect endangered species?

BIG IDEA

Stages and Changes Beneath What the Eye Can See



Content Goals

Universal Theme

Patterns

Principles and Generalizations

- Extinction occurs when mature animals, humans or plants no longer reproduce themselves and all members of a species die out.
- Habitat loss, pollution and over-hunting can endanger the survival of a species.

Concepts

- Extinction
- Survive
- Species
- Endanger
- Habitat loss
- Pollution
- Over-hunting
- Protect
- Solutions

Teacher Information

N/A

Skills

- Find a problem
- Find a solution

Materials and Resources

1. Print references (encyclopedias, books)
2. Internet access (Optional)
3. 1/2 sheets of paper for or index cards for note taking, 10 per student
4. **Module 2, Lesson 10 Research Guide**

5. **Module 2, Lesson 10 Product Menu**
6. **Module 2, Lesson 10 Assessment Rubric**

Preparation Activities

1. Cut note-taking sheets or locate index cards.
2. Locate print references and/or recommended Internet sites.
3. Copy **Module 2, Lesson 10 Research Guide**, one per student
4. Copy **Module 2, Lesson 10 Assessment Rubric**, one per student

Introductory Activities (10 minutes)

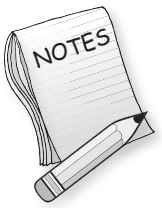
- Gather the students together who will be involved in this lesson. Introduce the lesson by saying: "Scientists have observed that changes in the world sometimes occur in a cyclic pattern. We've learned this through our study of life cycles. What happens when an entire group of living things stops reproducing?"
- Students should recall from your earlier discussion in Module 2, Lesson 4 that this leads to extinction. Ask them "What does extinction have to do with life cycles?" After they attempt an explanation, tell them "Scientists understand that regular cycles of reproduction, growth and change can be interrupted or stopped. Extinction interrupts life cycles. Your job is going to be to explain how and why this happens."

Pre-assessment

N/A

Teaching and Learning Activities (70 minutes)

1. Further explain the assignment by telling the students they will work to locate a species that they are interested in that is endangered or that has already become extinct. They will read to find out what happened to this entire animal (or plant) group and then explain what extinction has to do with life cycles. They must also suggest a solution or solutions if it is not too late to save the species from complete extinction or, if it is, what might have been done to save the species. Their findings will be presented in a product of their choice. A menu of simple products is included on the **Module 2, Lesson 10 Guide Sheet.**



2. Scaffold this activity for students by pre-selecting a number of appropriate print resources for students and then assisting them in locating an endangered or extinct species. Provide examples of problems and solutions through a reading on a selected species. The National Wildlife Foundation explains threats and actions on its website (http://www.nwf.org/action/) where examples are easily accessible.

3. Provide note cards for students to record what they learn. Model note taking for them (brief, restatement of relevant facts).

4. Have them place headings on their note cards such as *problems* or *solutions* to help them later organize their facts.

5. When the information gathering is complete, introduce the **Module 2, Lesson 10 Assessment Rubric** to explain criteria for evaluating quality projects.

6. Allow time for product completion.

Products and Assignments

- Notes from research on endangered or extinct living thing
- Student chosen product: illustrated storyboard with captions, taped recorded report, diorama, clay model display with labels, book.

Extension Activities

N/A

Post Assessment

Introduce **Module 2, Lesson 10 Assessment Rubric** before students begin their products. Rate each student project when complete. Have them rate themselves. Discuss any differences between the teacher and student assessment with each individual.

Debriefing and Reflection Opportunities (10 minutes)

Using the Concepts and Principles of the lesson, ask students how each of these ideas relates to the animals they chose to research.

Module 2, Lesson 10 Name_____

Assessment Rubric

Extinction Research Project Rubric				
	1	2	3	4
Research Process	Information on cards does not appear to be relevant to guiding questions.	Note cards show relevant facts from references; however, these are not re-phrased or summarized.	Note cards show relevant facts were gathered and rephrased accurately.	Note cards show facts were gathered, and rephrased accurately; headings were used to categorize facts.
Understanding of extinction, its causes and life cycle interruption	None of the problems the species encountered are shown.	Problems are mentioned or shown but not explained.	Problem explanations suggest why reproduction was stopped and life cycles ended (or are at risk).	Problem explanations include accurate facts that clearly show implications for reproduction and life cycles
Solution Finding	No possible solutions are cited.	One possible solution is mentioned or shown but not explained.	Two or more solutions are shown and explained.	Two or more solutions are explained and supported with facts as to why/ how each would (have) prevent(ed) extinction
Product as a Communication Tool	The product is complete but lacks both neatness and sufficient details.	The product is complete but lacks in neatness or details. The ideas or message is not clear or logically organized.	The product is neat, attractive and detailed. The ideas are clearly and logically organized.	The product is neat, highly attractive and very detailed. The ideas are clearly presented and organized to create an impact.

Module 2, Lesson 10 Name_____

Research Guide Sheet

Directions: You will research an extinct animal or an animal in danger of extinction to answer these questions: **Why do animals become extinct? What does extinction have to do with life cycles? How can people protect endangered species?** Follow these steps:

1. Locate encyclopedias, the Internet or any books that might help you find out what animals have become extinct or are *endangered.*

2. Chose one animal to investigate.

3. Read to find out the problems this animal had before it became extinct. If it is not extinct but endangered, find out the problems it is experiencing now.

4. Find two or more solutions or things that people could have done to prevent extinction or should do now before it is too late.

5. When your research is complete, choose a product to share what you've learned.

6. Check your work. Make sure you have shown answers to the questions above.

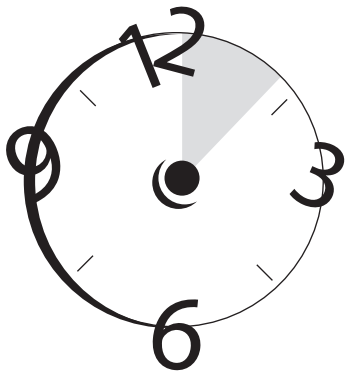
Product Choices:

Illustrated Storyboard with Captions
Taped Recorded Report
Diorama
Clay Model Display with Labels
Book
Skit
Your Own Product Idea (Ask your teacher for approval.)

Changes and Stages

Aid (Optional)

Time Allocation: 2 hours, 15 minutes – 2 hours, 45 minutes
Required Materials and Resources on Page 84



Lesson Overview

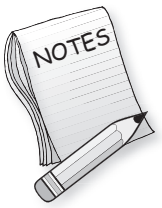
Through a jigsaw activity students will work in teacher-selected groups to become experts about stages of change for certain types of living things. Within groups individuals will be responsible for locating and describing the sequence of unique occurrences in the development for a particular group of animals (insect, mammal, reptile, bird, etc). By completing individual graphic organizers and comparing individual findings as a group, students will locate patterns and share these with the class. Students will come to understand that similar kinds of living things experience similar stages of change over their lifespans. Through an optional extension activity, teachers may chose to have students create a life-cycle mobile that displays how these stages are repeated in cyclic fashion over generations.

Guiding Questions

- What kinds of living things experience similar stages of change over their lifespan?

BIG IDEA

Similar Stages in Similar Living Things



Content Goals

Universal Theme

Patterns

Principles and Generalizations

- Similar kinds of living things experience similar stages of change over their lifespans.
- Invertebrates generally go through either incomplete metamorphosis in which the young (nymphs) look like smaller adults, or complete metamorphosis
- Most vertebrates (except amphibians and some others) have offspring that resemble the adults but are much smaller.
- After beginning as a fertilized egg, animal life cycles consist of stages that go from being born or hatched to maturing over time and then reproducing
- There is a relationship between complexity of an organism, the number of offspring it has, length of young stages, and level and length of parental care given. (AID)

Concepts

- Similar
- Stages
- Sequence
- Invertebrates
- Complete metamorphosis
- Incomplete metamorphosis
- Vertebrates
- Offspring
- Reproduction
- Life cycle

Teacher Information

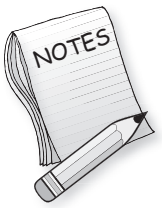
- Invertebrates are animals such as insects or worms that do not have a backbone. Vertebrates are animals with a segmented spinal column and a

well-developed brain such as a mammal, bird, reptile, fish or amphibian.

- Metamorphosis refers to the way that insects develop, grow, and change form. Metamorphosis actually means "change." Generally, there are two types of metamorphosis: *incomplete* and *complete*. Sometimes other types are referred to, such as *gradual* (similar to incomplete metamorphosis).
- Some insects go through no *metamorphosis*. Some insects go through incomplete metamorphosis. Incomplete metamorphosis has three stages: Egg-Nymph-Adult:
    - Egg Stage- A female insect lays eggs. These eggs are often covered by an egg case that protects the eggs and holds them together.
    - Nymph Stage- The eggs hatch into *nymphs*. Nymphs look like small adults, but usually don't have wings. Insect nymphs eat the same food that the adult insect eats. Nymphs shed or molt their *exoskeletons* (outer casings made up of a hard substance called chitin) and replace them with larger ones several times as they grow. Most nymphs molt four-eight times.
    - Adult Stage- The insects stop molting when they reach their adult size. By this time, they have also grown wings.
- Most insects go through c*omplete metamorphosis.* Complete metamorphosis has four stages: Egg-Larva-Pupa-Adult:
    - Egg Stage- A female insect lays eggs.
    - Larva Stage - Larvae hatch from the eggs. They do not look like adult insects. They usually have a worm-like shape. Caterpillars, maggots, and grubs are all just the larval stages of insects. Larvae molt their skin several times, and they grow slightly larger.
    - Pupa Stage- Larvae make cocoons or chrysalis around themselves. Larvae don't eat while they're inside their cocoons or chrysalis. Their bodies develop into an adult shape with wings, legs, internal organs, etc. This change takes anywhere from four days to many months.
    - Adult Stage- Inside the cocoon (called pupa in butterfly metamorphosis), the larvae change into adults. After a period of time, the adults emerge from the cocoons.

- Patterns of Growth and Development in Vertebrate and Invertebrate
  By Jim Trifone

Invertebrates generally go through either incomplete metamorphosis (e.g. like a grasshopper) in which the young (nymphs) look like smaller adults, or complete metamorphosis (e.g. like the butterfly). Vertebrates, on the other hand, with some exceptions like amphibians go through more of an incomplete developmental



sequence. Thus frogs (one of the exceptions) have a tadpole stage where they feed like a fish, and actually occupy a fish-like niche, followed by the adult stage where they now are air-breathing landlubbers who nonetheless need to return to the water to breed to start the cycle all over again.

However, more common with vertebrates is seeing young resemble adults; only they are much smaller but not usually different in what they feed on and look like. What is more interesting is to compare developmental stages on the basis of whether the vertebrates are internal or external fertilizers.

External fertilizers are not constrained by birth canals since they are not born at all but rather hatch or emerge from eggs. Internal fertilizers are constrained because they either have to be laid as eggs (e.g. reptiles and birds and egg-laying mammals) and then only later develop into adults or they are born live (marsupial and placental mammals) and need to be born immature so they can "get out." The more complex the organism is, the more immature they must be when hatched or born and the more parental care they need. Thus, birds and mammals need longer periods of parental care than fish that rarely have any. Furthermore, placental mammals (those born full term like us) have the longest juvenile period. Hence, while chimps have longer juvenile periods than cows, we have longer ones than chimps.

Thus, it would be interesting for students to compare the length of the juvenile period amongst invertebrates and various kinds of vertebrates. They could then look for patterns among them and maybe see that there is a relationship between complexities of an organism, whether it is an internal or external fertilizer, the number of eggs it lays, length of juvenile period and level and length of parental care given.

Skills

- Locate information
- Compare/contrast
- Locate patterns

Materials and Resources

For optional pre-assessment:

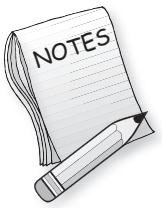
1. Post-It Notes (sticky notes), 1/2 pack per student pair for pre-assessment
2. **Module 2, Lesson 11 Pre-assessment: Concept Map Words**, one per student pair as needed
3. **Module 2, Lesson 11 Pre-assessment: Concept Map Challenge Words**, one per student pair as needed
4. **Module 2, Lesson 11 Pre-assessment Complete the Growth and**

Development Concept Map, one per student pair as needed

5. **Module 2, Lesson 11: Names of Living Things to Investigate** or simplified version
6. **Module 2, Lesson 11: My Living Thing's Stages Graphic Organizer,** one per student
7. (Optional) **Module 2, Lesson 11: Expert Group Summary Graphic Organizer,** one per student group
8. Print reference materials: any available recommended books below along with other appropriate books, magazines, encyclopedias and Internet sites (below also), if access is available
    - Kalman, Bobbie & Langille, Jacqueline. (1998). (*The science of living things*). Crabtree Publishing. (ISBN# 0865058741) (Also used in Lesson 9. This book explains the life cycles of all animal groups with simple text and photos.)
    - Kalman, Bobbie & Smithyman, Kathryn & Rouse, Bonna. (2002). The life cycle of a frog, (*The Life Cycle Series*), Crabtree Publishing. (ISBN# 0778706818)
    - Kalman, Bobbie & Smithyman, Kathryn & Rouse, Bonna. (2002). The life cycle of a bird, (*The Life Cycle Series*). Crabtree Publishing. (ISBN# 0778706842)
    - Kalman, Bobbie & Levigne, Heather. (2002) The life cycle of a koala (*The Life Cycle Series*). Crabtree Publishing. (ISBN# 0778706850)
    - Kalman, Bobbie. (2002). The life cycle of a sea turtle, (*The Life Cycle Series*), Crabtree Publishing. (ISBN# 0778706826)

If Internet access is available students can use the sites below. (Consider bookmarking or adding them as favorites on the computer's browser):

- An online field guide organized by or animal groups: or animal sub-categories
  http://www.nature.com/guides/select_group.asp.
- For insect research geared towards advanced readers:
  http://www.uen.org/utahlink/activities/view_activity.cgi?activity_id=2024
- For initial information about various mammals (not necessarily specifics about life cycles):
  http://www.nature.ca/notebooks/english/mammpg.htm



9. For optional mobile project: Wire coat hangers or large dinner size paper plates, one per student (or one per student group if mobiles are made cooperatively)
10. Large index cards, four - five per student (or student group)
11. Markers or crayons
12. String or yarn
13. Hole punch

Preparation Activities

1. Determine *expert* groups for the jigsaw activity consisting of three to five students based on readiness for content (ranging from simple to complex) and reading level. Consider availability of print reference material, class size and range of readiness levels to decide how many groups there will be. Each group will be responsible for a brief investigation of a different type of living thing. To increase the variety of stages and life cycles investigated, it is recommended that four to eight groups be formed.
2. Prepare to have each expert group investigate one of these possible sub-categories of animals: amphibians, birds, crustaceans, fishes, insect group 1, insect group 2, mammals, or reptiles. (Having two insect groups will promote the exploration of incomplete or complete metamorphosis.) Locate print reference materials for expert groups or schedule library time for students to find materials.
3. Plan to allow students as much choice of group assignment as possible. This might be accomplished once students of like readiness are identified, by having students choose what kind of expert they want to become. If more material appropriate for lower level readers is available on mammals and insects, give them a choice between those two assignments. A good elementary school library should have books of a variety of levels on all categories.
4. Allow students to choose a particular animal within their expert group category. Do this by copying the **Module 2, Lesson 11: Names of Living Things to Investigate sheet**, one per group. This sheet will give them a way to choose their personal research assignment. Alternatively, make your own shortened list for students based on books or magazines in your library that include information on particular animal life cycles (See recommended books under Materials.) Encourage students to investigate a different animal than they researched during Lesson 3, unless you believe this repetition will contribute to the success of certain students.
5. Determine if you will pre-assess or post-assess students. Options are explained.
6. (Optional) Copy **Module 2, Lesson 11 Pre-assessment: Concept**

Map Words, one per student pair as needed

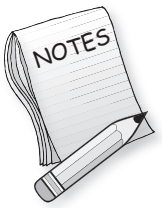
7. (Optional) Copy **Module** 2, Lesson 11 Pre-assessment: Concept Map Challenge Words, one per student pair as needed
8. (Optional) Copy **Module 2, Lesson 11 Pre-assessment: Complete the Growth and Development Concept Map**, one per student pair as needed
9. Copy **Module 2, Lesson 11: My Living Thing's Stages Graphic Organizer**, pages 1 and 2, one per student
10. Copy **Module 2, Lesson 11: Expert Group Summary Graphic Organizer**, pages 1 and 2, one per group

Introductory Activities (5 minutes)

- To guide the student in focusing on the lesson's principles, pose the question, "How are the Painted Lady's stages of growth and development similar to the changes a frog experiences?" Listen to their responses. Some will recall that all living things go through a beginning, early and adult stage. Some will offer different insights and comparisons.
- Tell students they are going to investigate the changes that similar kinds of living things experience. Ask them to name similar groups of living things.
- Introduce the word *category* and *sub-category* by offering mammals as an example of a sub-category of animals. List all the ideas on chart paper. Say, "Each of you will work with a team to become an expert on the stages of growth and development of one category of living things."

Pre-assessment (20 minutes)

- This assessment may be used as a pre or post assessment or both. Determine if and how you will use it.
- For pre-assessment, tell students that before they are assigned to an expert group you want to find out what they already know about how similar living things grow and develop. Remind them of what a concept map is by referring to the concept map you created as a class and the one they did in their journal. Explain that they will be given a list of words and set of Post-It notes. They are to start with just a few concepts, write one on each note and work to create a statement. Model how they will place two Post-It Notes on blank paper (after concepts from the list are written on each of them), and then draw a connecting line and write other words on the line that will complete their idea.
- Differentiate the assessment by placing each student with a partner that appears to be at a similar level of understanding of the unit's principles thus far. Give each pair either **Module** 2, Lesson 11 Pre-assessment: Concept Map Words or **Module** 2, Lesson 11 Pre-Assessment: Concept



Map Challenge Words. Students who need more structure can complete a fill in the blank style (or cloze activity) concept map. (See **Module 2, Lesson 11 Pre-assessment--Complete the Growth and Development Concept Map**)

- Instruct students to make as many sentences as possible until you tell them time is up. Tell them it is OK if they construct only one sentence. The concept maps can also be completed as an extension activity.
- If used as a pre-assessment, review student concept maps, and if necessary, reconfigure student expert groups. Learners who can already name the stages of insect metamorphosis or can explain mammal growth from birth should be encouraged to choose a species new to them (such as a crustacean like the fiddler crab) and references with challenging text.

Teaching and Learning Activities (1 hour, 40 minutes – 2 hours, 10 minutes)

1. Have students at their desks if using an overhead, or up front if using the easel. Tell them "Together we will be investigating the question 'What kinds of living things experience similar stages of change over their lifespan?' Each group will find out whether the animals in their category of living things experience similar changes." Explain that first they will each have an individual job, to read about one animal in that group. Then they will work with their partners to complete a summary of the research. Show them the **Module 2, Lesson 11: My Living Thing's Stages Graphic Organizer** and type of note taking they will do. Point out that there are rows for each stage, but because not every animal that will be investigated goes through the same number of stages, they will have to determine how many rows need to be completed. Explain that in most cases this research will be more detailed than when they did *beginning*, *early* and *adult* stage posters. The difference is that they will be writing the names that scientists give the stages and listing the occurrences that go with each. Point out that a picture can be drawn in the *What It Looks Like* column. Yes or No can be written in column two to answer if the animal looks likes its parent at each stage. Using the Painted Lady butterfly as an example, briefly model how to complete each cell of the graphic organizer for individual work. (**Module 2, Lesson 11: My Living Thing's Stages Graphic Organizer**). Use the Painted Lady Life Cycle Diagram included in this Module as a reference from which to model note taking. (10 minutes)

2. Inform students who the members of each group will be.

3. Briefly work with the students to determine which category of living thing will become their expertise (amphibians, birds, crustaceans, fishes, *insect*

group 1, *insect group 2*, mammals, and reptiles). You might ask each group to see you and allow them some choice. Limit the choice as necessary. **(5 minutes)**

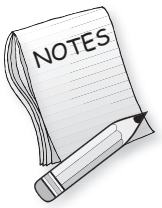
4. Distribute **Module 2, Lesson 11: Names of Living Things to Investigate** sheet or a similar one you create. Ask students to select a specific animal within the group's assigned category they might like to be personally responsible for researching. Have them coordinate with their teammates and also select a second choice in case information is not available on their first choice. To avoid devoting too much time to this, tell them they have five minutes to decide. **(5 minutes)**

5. Allow time for students to select and use resources in the library or classroom. Books listed under Materials are recommended because they make the information accessible to primary age children. If Internet access is available, students can use the sites you have *bookmarked* or added as *favorites* on the computer's browser. Once each student has a reference, limit the time for individual work. Circulate to aid student success with completing the graphic organizer. **(30-60 minutes)**

6. When all individuals within a group have completed their own graphic organizer, explain to them how to synthesize the group's findings. One way to do this would be to use **Module 2, Lesson 11 Expert Group Summary Graphic Organizer** with all or some of the groups. To use this tool, students compare each individual graphic organizer and an assigned *recorder* writes common findings in each cell. Alternatively, if this process requires too much independence and is too complex, facilitate the summary discussion for each group. Ask them to take turns reading their individual organizers to each other row-by-row. While listening to their partners, have students highlight similar findings with a yellow crayon or highlighter. The highlighted portions can be shared out later. **(20 minutes)**

7. Pull the class together. Give each expert group an opportunity to briefly highlight their findings. Help the students focus their presentations by asking them to tell the class if their group of similar animals experience similar stages of change and to provide examples. Ask them, "What patterns did you see? How did the length of each stage compare for different animals within the same group?" Direct them to compare the young stages and resemblance of off spring to parents. **(20 minutes)**

8. Refer them to the question on their charts Does this animal have a backbone?



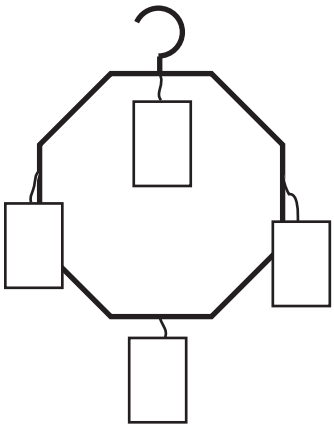
Ask the students what animals with backbones are called. Introduce the terms *vertebrate* and *invertebrate*. Tell the students, "Let's re-sort the animals we researched into just two groups: vertebrates or invertebrates." Designate one spot in the room for vertebrates and another for invertebrates. Instruct the students to move to the correct spot for their animal. Then guide them in comparing growth and development between these two categories. Have them compare the length of the juvenile period (or young stages) amongst invertebrates and vertebrates to locate patterns among them. Ask them what group of animals spends more time with their young. Advanced learners may see that there is a relationship between complexity of an organism, the number of offspring it has, length of juvenile period and level and length of parental care given. For example, mammals being the most complex, have fewer young to care for who are born live and go through stages that are longer when compared to less complex animals, like insects. **(10 minutes)**

Products and Assignments

- Concept map
- Completed **Module 2, Lesson 11: My Living Thing's Stages Graphic Organizer,**
- Completed **Module 2, Lesson 11: Expert Group Summary Graphic Organizer**
- Life cycle mobile, optional

Extension Activities

- Life Cycle Mobile (Core) (45 minutes)
  Depending on time, have students work with their group or as individuals to construct a life cycle mobile. This activity is well suited to artistic students or those who are kinesthetic in expression style. If they work as a group they can represent the stages of one particular animal or the entire category. Show students how to stretch and bend the base of a wire coat hanger to form a circle. See picture below. Tell them the circle will symbolize a cycle. Have students recreate the stage pictures on their graphic organizer on separate index cards. Instruct them to punch holes with a hole-puncher in the top center of each card. Putting a piece of string or yarn through the hole in the card, have them tie each card to the hanger in sequential order. Make the spot under the hanger's hook the beginning of the cycle. (A large, sturdy paper plate may be used instead of a hanger. Punch holes around the edge of the plate for each index card to be attached to the plate with yarn. Also, punch a hole in the top of the plate when the mobile is finished and hang it with a long piece of yarn. Write the name of the species in the center of the plate. It should look similar to the drawing below.)



See additional **Module 2: Lesson 11** extension activities in Unit Appendix.

Post Assessment

See Pre-assessment for Post Assessment option.

Debriefing and Reflection Opportunities (10 Minutes)

Use the expert group sharing time to debrief and reflect on the guiding question of this **Module**: What kinds of living things experience similar stages of change over their lifespan? Students should be able to understand these principles based observations about stages of change and life cycles:

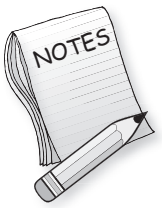
- Similar kinds of living things experience similar stages of change over their lifespan.
- Invertebrates generally go through either incomplete metamorphosis in which the young (nymphs) look like smaller adults, or complete metamorphosis.
- Most vertebrates (except amphibians and some others) have offspring that resemble the adults, but are much smaller.
- Animal life cycles consist of the stages they go through from a beginning as a fertilized egg, to being born or hatched, maturing over time and then reproducing.
- Similar living things' stages of growth and development may differ in length of time.

References:

Books:

BSCS Science T.R.A.C.S. (1999) *Investigating life cycles*, Dubuque: Kendall Hunt.

Internet Web Sites:



http://www.uen.org/utahlink/activities/view_activity.cgi?activity_id=2024

http://www.nature.ca/notebooks/english/mammpg.htm

http://www.ento.vt.edu/ihs/distance/

http://www.arboretum.fullerton.edu/

e-mail correspondence with biologist Jim Trifone.

Module 2, Lesson 11 Name_____

Growth and Development Concept Map: Challenge Words

Build your concept map. Start with any of the words in bold. Place them in boxes you draw on or on sticky notes. Draw connecting lines and add your own words to make sentences. Keep building your concept map with the other words on this page. Words can be used twice.

develop **grow** **life cycle** **lifespan** **living things**	**reproduce** **similar** **stages**
adult offspring invertebrates vertebrates birth complete metamorphosis egg embryo fertilization flowers germination hatch	incomplete metamorphosis insect larva mammals nymph plants pollination pupa roots seed stem young

Module 2, Lesson 11 Name_____

Growth and Development Concept Map: Words

Use any of these words from the list below to build your concept map. Place them in boxes you draw on or on sticky notes. Words can be used twice. Add your own words on connecting lines to make sentences.

living things	**stages**	**grow**
develop	**lifespan**	**maturity**
reproduce	**life cycle**	**similar**

Module 2, Lesson 11 Name_____

Complete the Growth and Development Concept Map

Use the words below for the boxes and put your own words on the lines to make sentences.

develop
grow
insects
lifespan
metamorphosis
similar
stages

living things [ ] _____ **similar**

[ ] **as they** [ ] _____ [ ]

_____ **lifespan** .

Butterflies and [ ] _____ [ ] .

Module 2, Lesson 11 Name_____

Names of Living Things to Investigate

*Shading represents invertebrates.

Amphibian Group	**Bird Group**	**Crustaceans***	**Fishes**	**Reptile**
frog	chicken	crab	salmon	crocodile
newt	duck	crayfish	trout	lizard
salamander	eagle	lobster		skink
toad	robin	shrimp		snake

Insect Group One* (Complete Metamorphosis)		**Insect Group Two* (Incomplete or Gradual Metamorphosis)**	
antlion	fly	aphid	earwig
ant	lacewing	booklice	grasshopper
bed bug	moth	cockroach	mayfly
bee	scorpionfly	cricket	stonefly
beetle	twist-winged parasite	dragon fly	true-bug
caddisfly	wasp		
flea	white pine weevil		

Mammal Group			
anteater	cougar	kangaroo	otter
antelope	coyote	koala	panda
armadillo	dog	kudu	pika
baboon	elephant	least weasel	platypus porcupine
badger	elk	lemur	raccoon
bat	ermine	leopard	rat
bear	ferret	lion	rhinoceros
beaver	fox	lynx	seal
bighorn sheep	gibbon	manatee	skunk
bison	giraffe	marmot	squirrel
bobcat	goat	mink	tasmanian devil
buffalo	gorilla	mole	tiger
camel	hare	mongoose	walrus
cape	hippopotamus	moose	wart hog
caribou	hoary	mouse	whale
cat	horse	muskrat	wild yak
cheetah	hyena	ocelot	wildebeest
chimpanzee	jaguar	orangutan	wolf
chipmunk			wolverine
			zebra

Module 2, Lesson 11 Name_____

Stages of Growth and Development

Name _____ Expert Group Title _____

Name of Animal _____ Does this animal have a backbone? _____

Name of Stage	**What It Looks Like at this Stage**	**Does It Look Like Its Parents? Yes or No**	**Special Events (Occurrences) During this Stage**	**How Long in this Stage?**
Stage 1:				
Stage 2:				
Stage 3:				
Stage 4:				

Module 2, Lesson 11 Name_____

Stages of Growth and Development: Group Summary

Expert Group Title _____

Members _____ _____ _____ _____ _____

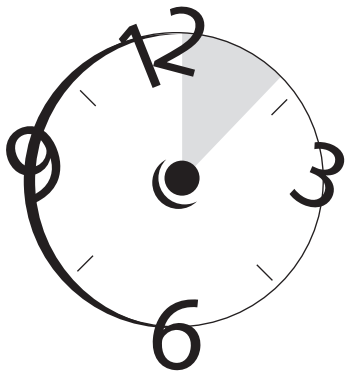
Name of Stage	**What this Animal Group Looks Like at this Stage**	**Do They Look Like their Parents?** ***Yes*** **or** ***No***	**Common Events (Occurrences) During this Stage**	**How Long in this Stage?** (List the shortest and the longest times.)
Stage 1:				From _____ To_____
Stage 2:				From _____ To_____
Stage 3:				From _____ To_____
Stage 4:				From _____ To_____
				From _____ To_____

Print the example of the life cycle of the painted lady butterfly at the following website:
http://www.enchantedlearning.com/subjects/butterfly/species/paintedlady.shtml

Changes and Stages

Practice/Aid (Optional)

Time Allocation: 1 hours, 20 minutes
Required Materials and Resources on Page 84



Lesson Overview

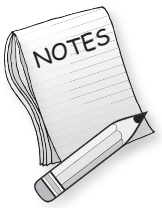
Students will investigate how much the developmental stages of living things vary in length. By plotting data from the Lesson 12 **Class Calendar** on a number line, they will observe how stage lengths of individual Painted Ladies vary, but fall within a *range* between a *minimum* and *maximum number*. While learning these new statistical terms, they will construct an answer to the guiding question and have the option to examine the range of time for various developmental stages of other species.

Guiding Questions

- Do the same living things progress through the same stages at the same rate?
- How much do the developmental stages of certain animals vary in length of time?

BIG IDEA

Similar Stages in Similar Living Things



Content Goals

Universal Theme

Patterns

Principles and Generalizations

- Similar living things' stages of growth and development may differ in length of time.
- Similar living things' stages of growth and development vary within a range of minimum to maximum length of time. (AID)

Concepts

- Length of Time
- Maximum
- Minimum
- Range
- Variation

Teacher Information

N/A

Skills

- Graph
- Organize data
- Observe patterns
- Create a timeline

Materials and Resources

1. **Class Calendar** developed in Lesson 11
2. Student science journals
3. Chart size paper or pre-made number line or blank sentence strips
4. **Module 2, Lesson 11 Stages of Growth and Development: Group Summary Charts**
5. **Lesson 12 Vocabulary Words Sheet**

Changes and Stages

Preparation Activities

1. Locate paper or pre-made number line or blank sentence strips
2. Select students for this module who fit one or more of the following descriptions:
    - show readiness for a challenging data analysis experience
    - get excited about graphs and solving puzzles
    - work well independently
3. Copy Lesson 12 **Vocabulary Words Sheet**, one per student

Introductory Activities (10 minutes)

- Gather students together on the floor, preferably near the **Class Calendar**. Connect to the students' previous learning by asking, "What did you learn about the stages of similar living things from your work in groups during our last lesson?" Refer if necessary to **Stages of Growth and Development: Group Summary Charts** developed during Lesson 11. Check for their understanding of the principle: *Similar kinds of living things experience similar stages of change over their lifetime.*
- Say to them, "We saw through our research that similar animals (like mammals, fish or insects) experience changes and stages that are similar. For example, a number of insects go through complete metamorphosis. Today you will investigate whether the same stages in the same animals last the same amount of time. Here's another way to think about the problem: Do two or more of the same animal progress through the same stage at the same rate?" (Make sure they understand the word *rate*.) Ask, "Who thinks they already know the answer to that question?" Allow them to give their answers. Then say, "You will have to support your answer by using data we have collected already."

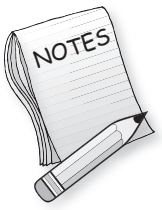
Pre-assessment

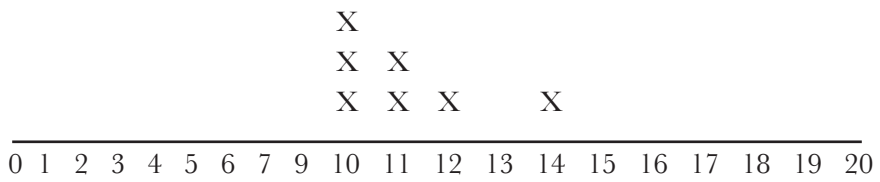
N/A

Teaching and Learning Activities (30 minutes)

1. Tell the students that the **Class Calendar** might help them understand whether or not the same kinds of living things go spend the same amount of time in their stages of development. Guide them to consider the Painted Lady's stages (caterpillar, pupa and adult) by asking, "Let's compare the length of time our Painted Ladies spent as caterpillars or pupas or adults."

2. Draw a number line on the chart paper or sentence strip, or tape up a pre-made number line. Tell the students, "We will plot our data on this number line. The numbers represent days in a stage."





3. Ask each student to look at the calendar or in their journals to find the number of days their Painted Lady spent as a caterpillar.

4. Instruct the students to each place an X on the number representing the length of time in that stage.

5. Use questions to guide them in making observations in the plotted data while introducing new vocabulary. "What was the least number of days in this stage when we compare all the numbers we plotted?" Tell them this is called the *minimum*. "What was the greatest number of days in this stage?" Introduce the word *maximum*. "What two numbers do all other numbers fall between? Explain that the numbers between the minimum and maximum create a *range* of data. This range refers to how spread-out the numbers are from each other or how much the length of each stage can vary. Make the introduction of these statistical terms exciting. Help them to see the terms enhance their ability to describe the data in more detail. To scaffold this for the children, write each word and a brief definition on chart paper so they can refer back to them.

6. Have a discussion with the students' about the length of time similar living things spend in the same stage. Start by asking students, "What did our data show us? Do two or more of the same animal progress through the same stage at the same rate? Would it be possible for a caterpillar to spend thirty days in larva stage? Would it be possible for a caterpillar to develop in one day?" Help them understand the principle *similar living things' stages of growth and development vary within a minimum and maximum length of time.* A misconception would be that the length of a stage could exceed the maximum significantly.

7. Using the **Module 2: Lesson 11 Stages of Growth and Development: Group Summary Charts,** have students locate and then list the ranges for the animals they researched. (These are listed in the column called *Shortest of Longest Time in This Stage.*)

8. Ask students to work to plot the data for the pupa stage on another number line as an independent activity. Each will come to the board and place an X over the appropriate number to represent their Painted Lady's length of time in this stage. Then have them write their observations incorporating new vocabulary in their journal. Distribute the **Lesson 12 Vocabulary Words Sheet.**

Products and Assignments

- Number lines with plotted data
- Summary statement
- Journal entry using vocabulary

Extension Activities

N/A

Post Assessment (20 minutes)

- Review student journal entries to check for understanding of vocabulary and principles in this unit.

Debriefing and Reflection Opportunities (20 minutes)

Prompt the children who participated in this lesson to share what they learned with the class. Guide them to connect the activities they completed with the principles and general concepts of the lesson.

Module 2, Lesson 12 Name_____

Journal Entry Vocabulary Words Sheet

Look at the data plotted on the number line. Write your observations about the length of time the Painted Ladies spent in the pupa stage in your journal. Use as many of these new words as you can to describe the data.

length of time

maximum

minimum

range

vary

mode

rate

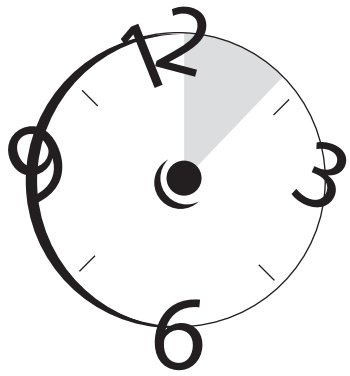
median

average

Changes and Stages

Core

Time Allocation: 1 hour
Required Materials and Resources on Page 84



Lesson Overview

Students will come to understand that humans, like other livings things, move through stages of growth and development. Using photographs of themselves or of family members students will build a developmental timeline to identify the changes or milestones that characterize each stage. The project will be completed as an anchor activity and shared when completed.

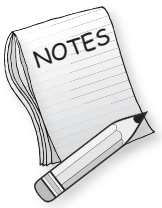
Guiding Questions

- How I am like other living things but still unique?
- What stages of growth and development do people experience in their life cycle?

BIG IDEA

People Have Stages and Cycles Too

LIVING THINGS: CHANGES, STAGES AND CYCLES



Content

Universal Themes

- Patterns
- Cycles

Principles and Generalizations

- Humans move through stages as they grow and develop over their lifetime.
- Human growth and development includes stages of birth, infancy, childhood, adolescence and adulthood.
- Each stage of human growth and development brings changes and milestones.
- The stages of each human's birth, growth and development can vary in length of time.

Concepts

- Birth
- Infancy
- Childhood
- Adolescence
- Adulthood
- Milestone
- Developmental
- Timeline
- Length of time

Teacher Information

N/A

Skills

- Identify
- Sequence
- Observing Patterns

Materials and Resources

Changes and Stages

1. **Lesson 13 Parent Letter**
2. **Lesson 13 Vocabulary Word Cards**
3. Photos of students or their family members
4. Magazines
5. Construction paper, six sheets per student
6. **Lesson 13 Milestones Cutouts**

Preparation Activities

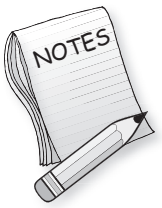
1. About two weeks before this module, send **Lesson 13 Parent Letter** (or a modified version) home to parents requesting that students bring in photos of themselves or an adult family member whose development they will chronicle in a timeline.
2. Locate magazines that can be cut up. Students will use magazine pictures to extend their timeline into adolescence and adulthood. In the unfortunate case that some students do not have any photos of themselves or a family member to use for their timeline, magazine pictures can be used to represent various stages of their development. Plan to explain this option to students who do not bring in pictures to protect them from feeling left out.
3. Locate pictures of your own growth and development or a family member's (e.g. daughter, son, brother, sister) to use during the introduction.
4. Cut out magazine pictures to represent these stages: pregnancy, birth, infancy, childhood, adolescence and adulthood.
5. Copy **Lesson 13 Vocabulary-Concept Cards**, one set per student and one set for introduction

Introductory Activities (1 minute)

- Gather students around the easel. Introduce the module by telling the students, "We've been investigating the changes, stages and life cycles of plants and animals. Today we're going to take a close look at human growth and development."

Pre-assessment (10 minutes)

- Find out what the students already know about the stages of human growth and development, by starting with the statement and question, "We've learned that all living things have a beginning, either as a seed or an egg. Which do you think a human begins as? Check student understanding.
- Then place the magazine picture of a pregnant woman on the easel. Say, "We all begin as an egg in our mothers. The egg grows in a special place inside the mother and becomes a fetus." Place the **Lesson 12 Vocabulary-Concept Card**: beginning as an egg under the magazine



picture.

- Next, ask, "After this beginning, a baby comes into the world. What do we call that stage?" Place a magazine picture and card on the easel to represent birth, moving horizontally across the easel.
- Continue in this way until you have assessed their knowledge of the other stages and corresponding vocabulary (infancy, childhood, adolescence and adulthood).

SEARCHLIGHT: Students who have a good grasp of these stages can complete the Extension Activity called Developmental Milestone Facts to add depth to the forthcoming timeline project.

Teaching and Learning Activities (20 minutes)

1. After the vocabulary has been introduced, model the creation of a developmental timeline by telling a narrative of your own growth and development or that of a child, sibling or other family member for whose developmental stages you are able to locate photos. In a story-like fashion post a photo alongside the vocabulary-word cards and describe details of an event at each stage. For example, you might explain that the baby arrived at birth and then tell whether you (or your son/daughter/brother/sister) came early or late as compared to the typical nine month or 40 week pregnancy prior to birth. Birth weight or length could be shared. When speaking of infancy you might mention when the infant in the photo first turned his/her head toward sound or turned-over.

2. Introduce the word *milestone* as a synonym for each special occurrence during a human's stages of development. Continue with the narrative highlighting as many individual developmental milestones as possible. Try to emphasize that there are events common to each stage of normal human development, but a progression through stages that varies (within limits) for each individual.

3. Have the students work on their own (or family member's) developmental timeline as an anchor activity during literacy block. Distribute the construction paper and **Lesson 13 Vocabulary-Concept Cards**. Instruct the students to paste one vocabulary-concept card to each piece of construction paper. Then sequence and tape the photos at each stage. Next, have them paste the pieces of construction the paper together horizontally.

4. Have students use the information gathered from parents to create "milestone" captions. Distribute **Lesson 13 Milestone Cutouts**. Show them how to include each fact in each cutout and add to the appropriate

stage of development.

5. If the students have created their own timeline, consider having them predict some milestones they will experience during adolescence and adulthood (i.e. height, change in hair color, wrinkles) and show these with selected magazine pictures or illustrations.

Products and Assignments

Developmental Timeline

Extension Activities

Developmental Milestone Facts (AID) (30 minutes)

Have students who can work independently and take on more multifaceted content, research specific physical characteristics and changes at each stage of human growth and development. Have them add each relevant fact to the appropriate stage on their timeline in a milestone cutout.

Post Assessment

Developmental timeline

Debriefing and Reflection Opportunities (29 minutes)

Gather students to share their timelines during class meeting or sharing time at the end of the day. Structure the time by asking them to share one milestone per stage. Encourage comparison among student timelines to reinforce the concepts of patterns of development, but uniqueness within these. Emphasize the principles, generalizations, and concepts from the lesson.

Module 2, Lesson 13 Name_____

Parent Letter

Dear Parent (s),

As part of our unit on the growth and development of living things each student is going to create a timeline of his/her own development or the development of a parent, sister or brother or other family member. Please help your son/daughter complete this project by sending photos to school that show that person at various stages at different points in time. For example, your child might bring a picture of mom during pregnancy, himself or herself a few days after birth, as a toddler and during each year of his or her childhood. If your child chooses to create a timeline for an older family member instead, then he or she can also bring pictures of the person as a teenager and adult.

Please work with your child to answer any of the questions on the next page that will give us information to include in the timeline.

Please label back of each photo and send them and the information sheet to school by _____. The photos will be returned at then end of this unit as part of the timeline students will create.

Thank you very much for helping us to make this a successful project! Feel free to call if you have any questions about this unit of study.

Sincerely,

Name of the person in these pictures _____.

Directions: Please answer any of these questions you can.

Birth

When was this person born? _____

Was the baby born earlier or later than the doctor expected or right on time? _____

How much did he/she weigh at birth? _____

How long was he/she at birth? _____

Module 2, Lesson 13 Name_____

Parent Letter (Page 2)

Infancy

When did the baby first smile? _____

When did the infant first crawl? _____ months old

When did the infant first say a word? _____ months old

Other important facts or "firsts":

Toddler and Childhood

When did the child first walk? _____ months old

When did the child first lose a tooth? _____ years old

Other important facts or firsts:

Adolescence: Important Facts or "Firsts"

Adulthood: Important Facts or "Firsts"

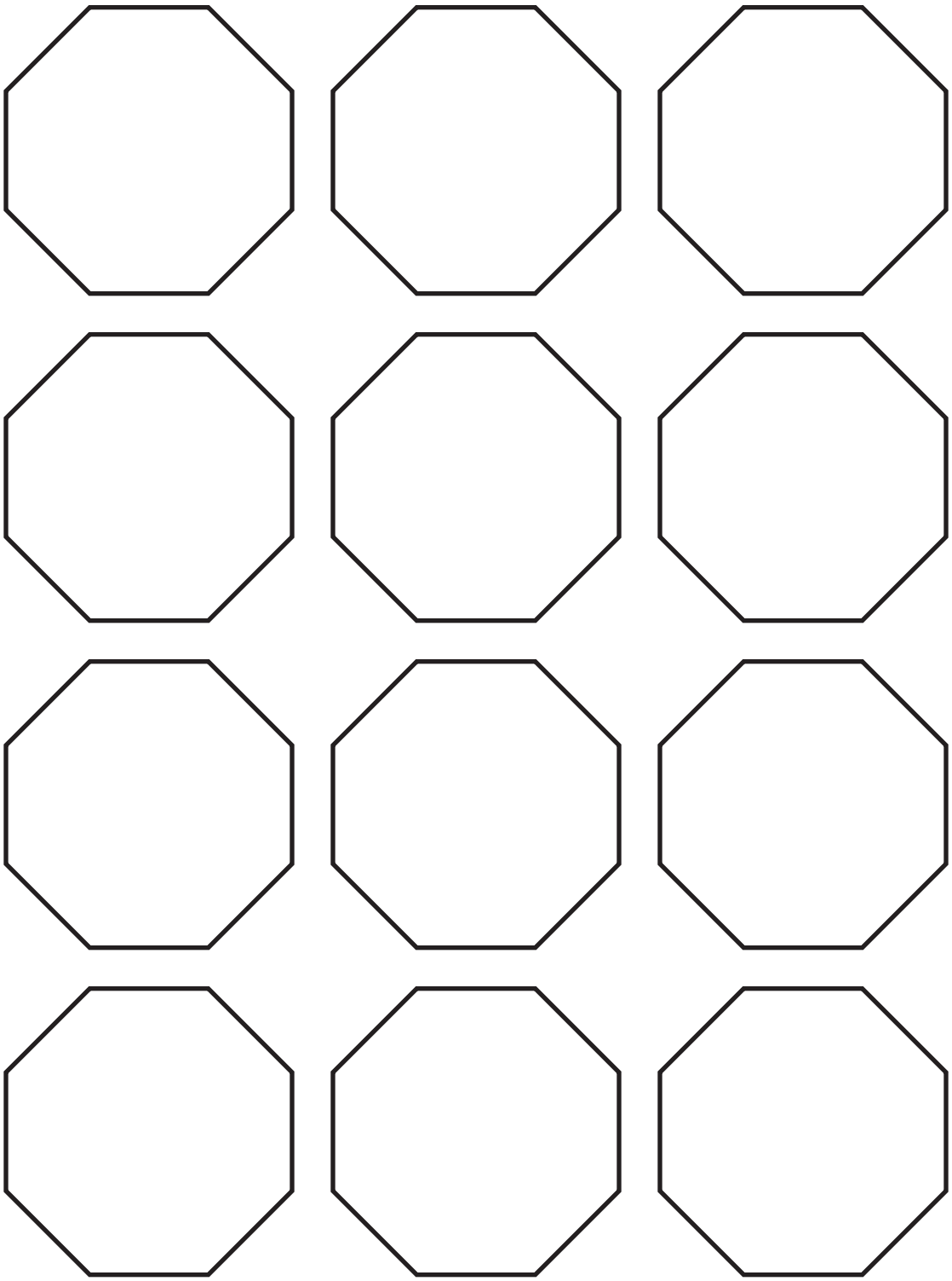
Module 2, Lesson 13 Name_____

Concept Cards

Beginning as an Egg	**Infancy**
Birth	**Childhood**
Adolescence	**Adulthood**

Name_____

Concept Cards



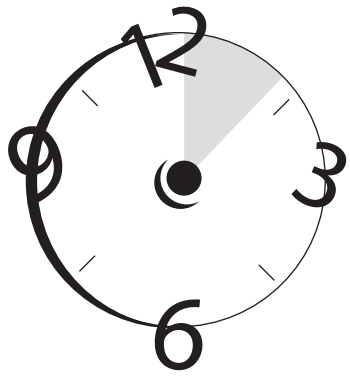
LIVING THINGS: CHANGES, STAGES AND CYCLES

Changes and Stages

Connections

30 Minutes

Required Materials and Resources on Page 84



Lesson Overview

Students will connect their understanding of cycles to the exchange of water between earth and its atmosphere during the water cycle. First, they will enjoy the poetic verse of the book *Water Dance* during a read aloud. Next, they will be introduced to the names of each stage and asked to locate these during a second reading of the book. Interested students may design an original water cycle diagram as an extension.

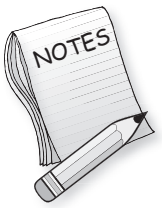
Guiding Questions

- What cycles of change can be observed in the physical world?
- How is water carried back and forth from earth to its atmosphere in a cycle?

BIG IDEA

Cycles in the Physical World: Water

LIVING THINGS: CHANGES, STAGES AND CYCLES IN LIVING THINGS



Content

Universal Theme

Cycles

Principles and Generalizations

- Change patterns in the physical environment can occur in cycles.
- As with life cycles, other cycles in the physical environment have a last stage that goes back to the first stage.
- Water is carried back and forth from earth to its atmosphere in a four-part cycle: evaporation, transpiration, condensation and precipitation.

Concepts

- Physical environment
- Evaporation
- Transpiration
- Condensation
- Precipitation

Teacher Information

- Evaporation: a process in which water is changed from a liquid to a vapor without it reaching a boiling point.
- Transpiration: a process of giving off water vapor through plant or animal pores
- Condensation: a process in which water vapor changes to a liquid form
- Precipitation: any deposit of a form of water (rain, snow, sleet, or hail) that falls to the earth's surface

Skills

- Compare
- Explain
- Connect

Materials and Resources

1. Locker, T. (1997). *Water Dance* 1997. San Diego: Harcourt Brace and

Company. (ISBN# 0152012842)
2. **Module 2, Lesson 14: Water Cycle Stages**
3. **Module 2, Lesson 14: Water Cycle Diagrams on Changes, Stages and Cycles in Living Things** printed from websites.

Preparation Activities

1. Locate book *Water Dance* by Thomas Locker.
2. Copy **Module 2, Lesson 14: Water Cycle Stages**
3. Use one of the following websites for the diagram for the handout, **Lesson 14 Water Cycle Diagram**. Save the other sites as browser bookmarks or favorites.

   http://www.greenwing.org/teachersguide/spring01/water-cycle.jpg
   http://www.carillionplc.com/sustain/images/water-cycle.gif
   http://k12s.phast.umass.edu/~kberti/cycle.gif
   http://pubs.usgs.gov/of/of98-805/lessons/chpt5/cycle-sm.gif
   http://on.ec.gc.ca/greatlakeskids/Images/water-cycle-large.gif
   http://www.mcwa.com/kids.htm

Introductory Activities

See Pre-assessment.

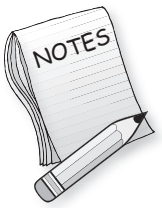
Pre-assessment (5 minutes)

- Gather students together on the floor in the front of an easel. Tell the children, "We've spent a long time examining cycles of growth, development and reproduction in living things. We call these, what? (Life cycles) We talked a little about cycles in the physical world. Today we're going to read about the water cycle. What do you already know about the water cycle?" Allow the students time to share. Note in student responses possible interest and readiness for an extension project that following the read aloud.

- Explain that the book you are going to read aloud explains how water is carried back and forth over and over again between the atmosphere and earth in a repeating pattern.

Teaching and Learning Activities (20 minutes)

1. Read Water Dance to the students, only stopping occasionally to allow them to comment on the content and beautiful illustrations.



2. Put the **Module 2, Lesson 14: Water Cycle Stages** on the easel. Read the terms to the students. Briefly define each term and point out the sequential stages on the **Module 2, Lesson 14: Water Cycle Illustration.**

3. Tell the students you will read the book again. Together you will identify each stage of the cycle. Tell them to put their hand up when they think the author's poetic verse is describing a new stage. Call on them and allow them to name a stage they believe they can name. Alternatively, while some are listening to the read-aloud again, have interested students begin the Module 2: Lesson 14 Extension Activity.

Products and Assignments

- Read aloud
- Original Water Cycle Diagram (Extension)

Extension Activities

Original Water Cycle Diagram (60 Minutes)

Print the variety of water cycle diagrams and show these to students. Invite those interested to illustrate one of their own. Have them note some are wordless and rely more on symbols. Have them decide if they will include the terms for each stage and additional words of explanation.

Post Assessment

N/A

Debriefing and Reflection Opportunities (5 minutes)

1. Ask, *"How does water change in a cycle on the earth?"* Have students explain. Make sure you require they explain why these occurrences make a cycle. Have students who worked on the extension activity share their diagrams of an original water cycle.
2. Engage the children in questions that link the connections between this water cycle and the other cycles they have studied.
3. Emphasize the principles and generalizations from the lesson.
4. Finally, show the students the factual summary of the water cycle in the back of the book. Invite interested students to examine it during free time.

Changes and Stages

Module 2, Lesson 13 Name_____

Water Cycle Illustration

Evaporation
Transpiration
Condensation
Precipitation

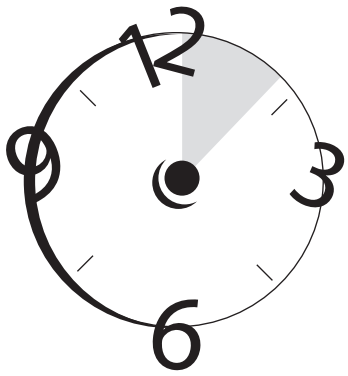
Print the diagram you prefer from the list of websites listed under Preparation Activities.

What Have We Learned?

Connections

30 Minutes

Required Materials and Resources on Page 84



Debriefing Overview

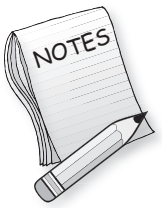
To conclude the unit Living Things: Changes, Stages and Cycles, students will be asked to reflect on their learning. In a game-like fashion, they will be asked to connect what they have learned about the growth and development of living things to pictures of the building of a house. Together they will revisit the challenging question, "Why do living things change and develop in stages and cycles?" Finally, the building analogy will be explained to enhance their understanding of the necessary sequence of changes living things encounter on their way to maturity.

Guiding Questions

- What have we learned about the changes, stages and cycles of living things?
- What patterns have been observed in how living things change and grow?
- Why do living things experience change in stages and cycles? (AID)

BIG IDEA

Cycles in the Physical World: Water



Content

Universal Theme

- Patterns
- Stages
- Cycles

Principles and Generalizations

See unit principles and generalizations.

Concepts

See unit concepts.

Teacher Information

See Why Do Organisms Need to Develop In Stages? by Jim Trifone at the end of this Unit Debriefing (Reprinted from Unit Introduction). Again, this article is intended for teacher use only. The challenging question, *Why Do Organisms Need to Develop in Stages*, can be explained with portions of this article. See the underlined sections to offer a simplified explanation.

Skills

- Reflect
- Make Connections
- Explain

Materials and Resources

1. **Unit Debriefing Building Photos** or Books on building or construction.
2. **Computer** (Optional)

Preparation Activities

1. **Print Unit Debriefing Building Photos** from a computer (try the following website: http://www.a-house-in-crete.com/work_examples.htm) or alternatively locate books on building or construction that illustrate stages in building.

Unit Debriefing

2. **Student Journals**

Introductory Activities (5 minutes)

- Gather students together on the floor in the front of an easel or the computer.
- Tell them, "Today we will reflect on what we've learned throughout this unit. We will also try to answer that big challenge question, 'Why do living things grow and develop in stages?'
- First we're going to play a game with these pictures."
- Place the Unit Debriefing Building Photos on the easel (Or Show one at a time on the computer.) Explain the "rules" of the games as follows:
    - Each student will take a turn sharing something he or she learned by making a connection to one or all of the pictures.
    - No talking is allowed while someone is thinking and trying to make a connection.
    - Students will be allowed an optional second opportunity to make a connection only after everyone has had a chance.

Pre-assessment

N/A

Teaching and Learning Activities (25 minutes)

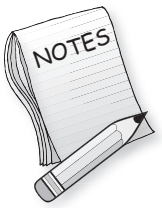
1. Give the students an example such as, "The foundation for the house looks like it went from a beginning to an end." How do living things go from a beginning to an end?"

2. Call on the students one at a time to share their connections. Call first on the students for whom this type of abstract, metaphoric thinking will be difficult.

3. Validate and list each idea on a chart. Help students construct the most accurate statements based on the principles and concepts learned in this unit.

4. Finally, ask the students to consider the very, "big" challenging question that they have considered throughout the unit: "Why is it that living things experience changes in stages and cycles?" Allow a few minutes wait time and then ask if anyone has an idea.

5. Instruct students to look at the sequenced building pictures and then return to their seats and write about one connection in their journals.



6. Call students back to the group and have them share their connections. Then sum up the points students have made as well as prompting them with guided questions for the points they have overlooked.

7. End by summing up the analogy with something like the following: "We can think of the growth and development of animals like the building of a house. When a house is built the foundation (or basement) is made first and then the aboveground structure is added. The framework is made when the wooden beams "frame" the shape of the house and its rooms are added on top of the foundation or basement. The siding or shingles can't be added to the outside of the house until this work is done. Similarly, the plumbing, heating ducts and electrical circuitry and wiring have to be put in before the wallboard. These building stages are like the developmental stages living things go through. The growth has to happen in a certain specific sequence or pattern or else the next stage can't occur. A Painted Lady has molt to develop into a pupa where it will eventually form wings. It could never go from caterpillar to butterfly, because its wings aren't built yet. That's one way to answer our big challenge question.

Products and Assignments.

- Connections Chart
- Class Discussion
- Journal entry (option)

Extension Activities

N/A

Post Assessment

See rubric on next page to evaluate student performance in the lesson in relationship to the big ideas presented in this unit.

Unit Debriefing

Demonstrating Understanding of Changes, Stages and Cycles through an Analogy

	Foundational Understanding	**Growing Understanding**	**Transformational Understanding**
Growth and development as change	Students provide examples of growth and development.	Students describe growth and development as change and provide supporting examples.	Students describe growth and development as change and provide supporting examples. They can further explain growth and development by comparing it to a change process in another setting (like a building site).
Growth and development in stages	Students see growth and development as sequential and occurring in steps. The butterfly's stages are given as examples.	Students see growth and development as sequential and occurring in steps or phases. They can explain the common patterns (or general stages such as beginning as a seed or egg) common to all living things.	Students see growth and development as sequential and occurring in steps or phases. They can explain the common patterns (or general stages) common to all living things by comparing it to another setting in a novel way. Their analogies are accurate and supported with examples.
The why of growth and development in stages	Students do not formulate a why answer beyond "because it is common to all living things."	Students see that one stage is a prerequisite of another.	Students see that one stage is a prerequisite of another. They also recognize that biologically living things become more complex as they mature. The ability to reproduce is cited as evidence of that complexity.

Debriefing and Reflection Opportunities

The entire lesson is really an opportunity for debriefing and reflection.

Unit Debriefing, Lesson 15 Name_____

Why Do Organisms Need To Develop In Stages?

By Jim Trifone

There are several reasons depending upon a number of factors mainly: whether you are speaking of simple or complex plants or animals, whether the animals are invertebrate or vertebrate, whether the animals are external or internal fertilizers and with respect to mammals, whether they are egg-laying, marsupial or placental. The simplest answer to this question is that complexity in the structure and function of organisms did not evolve all at once. Rather, the general evolutionary trend was from simple to complex. However, this evolutionary development occurred in fits and starts and resulted in many dead-ends (e.g. 99% of all species ever evolved are now extinct!!!). Natural selection processes have left us with the diversity of life forms we see today. But this diversity is somewhat misleading, because underlying all of it is UNITY between the very small to the very large. All organisms are primarily made up of the same kinds of atoms (C, H, O, N, P, S, Ca, Fe, & Mg), which are arranged into the similar organic molecules of carbohydrates, lipids, proteins and nucleic acids. Therefore, all organisms share a similar biochemistry and actually genetic heritage. More specifically, we have bacterial, plant, invertebrate animal and other vertebrate genes in OUR cells.

Once the simplest type of organisms evolved (single celled bacteria-like organisms) the basic biochemistry and genetic informational storage system that all organisms now have was already developed. Subsequent evolution DID NOT "re-invent the biochemical wheel" but rather adopted it "as is" with actually very little modification (e.g. bacteria, fungi, green plants and animals all use DNA to code for proteins which serve as enzymes, hormones, structural components etc). What DID happen was an increase in structural complexity (e.g. multicellularity in the form of colonial protozoans, slime molds, fungi, algae, nonvascular plants, vascular plants, invertebrate animals and vertebrate animals). So what Nature did was to co-opt the metabolic and informational storage "machinery" that worked in simple organisms and create more sophisticated organisms which had different features that adapted them to new environmental constraints (e.g. while aerobic prokaryotic (e.g. bacteria) organisms evolved the ability to more efficiently make energy in the presence of oxygen that was being produced by photosynthetic organisms, they USED many of the same enzymes and energy-transfer pigments that photosynthetic organisms evolved in order to photosynthesize).

Soon a eukaryotic cell (modern more advanced cell with membrane-enclosed structures like a nucleus) evolved. However, this NEW type of cell evolved by "capturing" and "commandeering" the simple prokaryotic cells. What resulted was that these "captured" aerobic bacteria evolved into mitochondria while the photosynthetic prokaryotes evolved into the chloroplasts. With a eukaryotic cell came a more sophisticated "asexual" means to reproduce (i.e. mitosis rather than mere fission) as well as more regulatory controls and protective processes for ensuring long-term stability of DNA while fostering genetic continuity between generations. As the environment changed (as it always does) new "adaptations" were naturally selected eventually leading to true multicultural plants. However, many of the reproductive "cycles" of simpler organisms was retained (i.e. mitotic production of spores etc.). Eventually a "sexual" reproductive process (i.e. meiosis) was created. This provided organisms with the ability to create a lot more variety in their offspring, thus fostering the evolutionary process. With each new evolutionary stage came new features but the retaining of many of the OLD cycles. **Basically, think of development of higher organisms as a process akin to building a house. You need to build the**

foundation first and then add the above ground structure. Furthermore, you can't put up the siding or shingles until you build the framework. Similarly, you need to put in the plumbing, heating ducts and electrical circuitry and wiring before you put up the wallboard… Thus, organisms, especially complex organisms are built in DEVELOPMENTAL STAGES that are metaphorically similar to those followed in building a house. What is PARTICULARLY important is that the infrastructure needs to be laid down in a specific developmental sequence no matter how large or small the house is. So too is the case with organisms. Take for instance the embryonic development of humans. We begin as a "simple" undifferentiated embryo with no form. Yet in 26 days one can see a heart beating, a neural cord and brain forming etc. Morphogenesis of the once formless embryo has taken place as the architectural blueprint of our 3.7 billion year genetic ancestry unfolds and, in time, will develop into a several trillion celled human baby replete with organized cells, tissues, organs and organ systems requisite to maintain and sustain the living condition. What is REALLY interesting is that this embryo will pass through developmental stages that are reminiscent of the evolutionary pathway that all vertebrates took. More specifically, there is a stage when we were more fish-like, then amphibian-like, then reptile-like and only later became almost indistinguishable from other mammals and finally primates. At around 9-weeks we became truly and distinctly human in form and internal development. This has been referred to by the very intimidating phrase "ontogeny recapitulates phylogeny". This means that one's ontogeny (individual developmental pathway) recapitulates (summarizes) the phylogenetic pathway (developmental pathway followed by previous ancestors). The point of all of this being that we COULD NOT attain the form we now have if we did not follow this sequential developmental pathway of simple to complex that evolved over billions of years.

There are many other examples-take butterflies for instance. The niche of larval or caterpillar stage of the butterfly is to eat plants. It doesn't fly nor behave in any way like a butterfly. It doesn't even reproduce. It basically just eats. However, once it has amassed sufficient mass, it goes into metamorphosis. During the pupal stage imaginal cells that have lain dormant inside the caterpillar begin to develop as morphogenetic "islands" within the disintegrating body of the caterpillar. Were it not for the caterpillar stage these cells would not be able to unfold into the new forms of the adult butterfly. Soon thereafter a beautiful transformed butterfly emerges from her chrysalis to eventually mate and lay eggs and start the CYCLE all over again. One of the interesting advantages to having this complete metamorphosis is that the organism can take advantage of different niches in the environment and thus expand its food and resource availability (e.g. caterpillars don't eat what butterflies do) thus enhancing the overall survival of the species. The same is true for tadpoles and frogs and other organisms that go through metamorphic changes. Thus, another strategy that nature utilizes in maximizing the success of the species is to have different life stages that feed on different things or exploit other environmental resources. Additionally, having organisms in two or more different forms (e.g. larval, pupal and adult) makes it more difficult for predators to wipe out the species. There are typically different predators for larval as for adult stages.

One last reason for why organisms develop in stages is a very practical one. Take humans for instance. If we developed fully formed, we couldn't be born. More specifically, the birth canal can barely accommodate the head of a modern human baby, let alone an adult. Therefore, since evolutionary pressure was placed on developing a larger brain, and therefore head, something had to give. What actually happened was a process called fetalization. Basically, mutations were selected that SLOWED down the development of humans. Therefore, human babies

were born immature. A human newborn is basically equivalent to a chimpanzee fetus in its developmental form. The slowing down of our developmental unfolding allowed us to be born small and then grow large outside the womb. However, a LARGE price was paid. Human infants are fairly helpless and require a lot of parental care for several years (*my wife would say decades in my case if not all men*). Furthermore, organisms, especially human, need to learn how to do things. For instance, birds can't be expected to hatch and then start flying for the same reasons. They need to develop their skeletomuscular system, as well as nervous control of it in order to coordinate the muscles to fly.

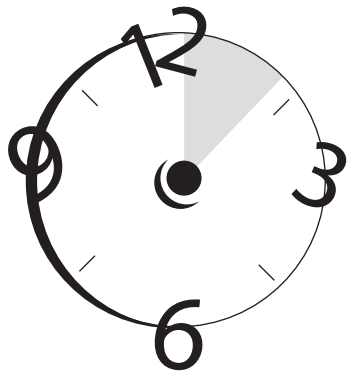
So to make a long story short, organisms have cycles and develop in stages because life emerged in stages that were dependent on the development and maturation of earlier stages.

Post Assessment

Core

30 Minutes

Required Materials and Resources on Page 84



Lesson Overview

Students take the unit post assessment for the entire class time today.

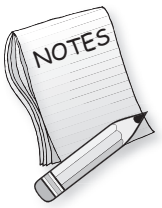
Guiding Questions

- What do I know about the characteristics of living things vs. nonliving things?
- What does it mean to grow and develop?
- What changes can we observe in living things?
- What similar patterns and stages in growth and development do living things experience?
- What kinds of living things experience similar stages of change over their lifespan?
- What methods do scientists use to answer questions?
- How do the typical life spans of plants, animals and people compare with one another?
- What pattern can be seen as living things go from generation to generation?
- Why have I learned about the changes, stages and cycles of living things?

BIG IDEA

Cycles in the Physical World: Water

LIVING THINGS: CHANGES, STAGES AND CYCLES



Content Goals

Universal Themes
See unit universal themes

Principles and Generalizations
See unit principles and generalizations

Concepts
See unit concepts

Teacher Information
N/A

Skills
- See relationships
- Explain
- Make connections

Materials and Resources
Living Things: Changes, Stages and Cycles Post Assessment

Preparation Activities
Copy **Living Things: Changes, Stages and Cycles Post Assessment**

Introductory Activities (30 minutes)
Explain to students that the post assessment will be used as a tool by you to measure their knowledge about this unit. Emphasize that they should make their best effort on the assessment.

Products and Assignments
Students' assessment results

Post Assessment

Extension Activities
N/A

Post Assessment
Living Things: Changes, Stages and Cycles Post Assessment

Debriefing and Reflection Opportunities
N/A

Module 2, Lesson 13 Name_____

Post Assessment

1. Find the living and non-living things in the picture. Put their names under the title in each column.

Draw or copy a picture that includes the objects listed below. If it is difficult to find such a picture, simply substitute one that has a similar number of living and nonliving things that is suitable for third grade.

tent
water
fire
fish
fishing pole
man
grass
rocks

Living	Non-Living

2. Put an X by **all** the sentences that are true for **all** living things.

❑ Living things take in food for energy.
❑ Living things move.
❑ Living things are warm.
❑ Living things breathe.
❑ Living things have parts inside them that keep them alive.
❑ Living things grow tall.

3. When scientists make **observations** what are they doing? Put an X by **all** the sentences that are true.

❑ Using their senses
❑ Making wishes
❑ Keeping living things alive
❑ Getting answers to questions

4. If a scientist wanted to find out how tall a plant grows each day, what would he do? Mark one answer.

❑ Give the plant a cup of water each day.
❑ Put the plant under a light each day.
❑ Measure the plant with a ruler each day.
❑ Put the plant on a scale and weigh it each day.

5. What **always** happens when living things grow and develop? Mark one answer.

❑ They change.
❑ They get taller.
❑ They stop eating.
❑ They change color.

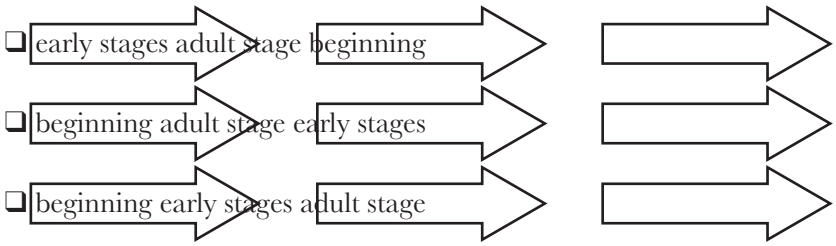
6. Put an X by the sentence in each column that is under the wrong title.

TO GROW	TO DEVELOP
❑ The cat's tail gets longer.	❑ Inside the chrysalis wings are formed.
❑ The dog's paws get bigger.	❑ The larva was 3 centimeters. Now it's 5.
❑ The caterpillar sheds its skin.	❑ The seed germinates.
❑ The toddler is 2 inches taller.	❑ A flower blooms.

7. A third grade student named Juan is investigating plant growth. The student can change the amount of light, heat and water the seeds are given. During his experiments, the amounts of light and heat are kept the same. The amount of water given to the seeds is increased. What is the one **variable** in this experiment that was **changed**? Mark one answer.

❑ Light
❑ Heat
❑ Water
❑ Dirt

8. Mark the pattern of growth and development that happens for most living things.



9. Which pair of words below best follows the pattern in this pair of words?
Mark one answer.

PUPA: BUTTERFLY

❑ worm : snake
❑ tadpole : frog
❑ branch : tree
❑ egg : seed

10. Which pair of words below best follows the pattern in this pair of words?
Mark one answer.

CHAPTER: BOOK

❑ beginning : end
❑ stage : cycle
❑ circle : cycle
❑ young : adult

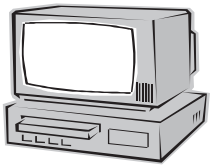
11. A **mature** living thing is the same as:

❑ a baby
❑ an adult
❑ growing
❑ a tall plant

12. **Habitat** means the same as:

❑ sky
❑ home
❑ observatory
❑ butterfly garden

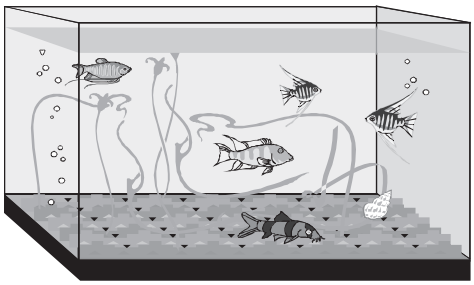
13. Put an X by **all** the things that would be found in a butterfly's natural habitat.




❑ computer ❑ rain ❑ sun and clouds ❑ flowers and leaves

14. What do butterfly and their larva need to survive? Put an X by all the correct answers.

❑ food
❑ light
❑ fun
❑ water

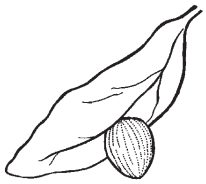
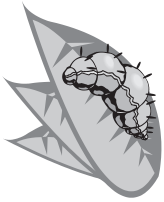
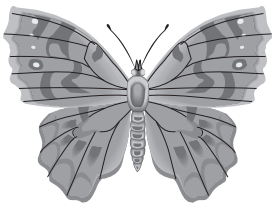


15. To survive in aquarium a fish does not need

❑ water
❑ food
❑ light
❑ shells

16. Write the word under the picture that goes with each stage.

adult butterfly
egg
chrysalis
caterpillar

17. What has the longest **lifespan**?

- ❑ butterfly
- ❑ man
- ❑ beetle
- ❑ frog

18. Which living thing **does not** go through **metamorphosis**?

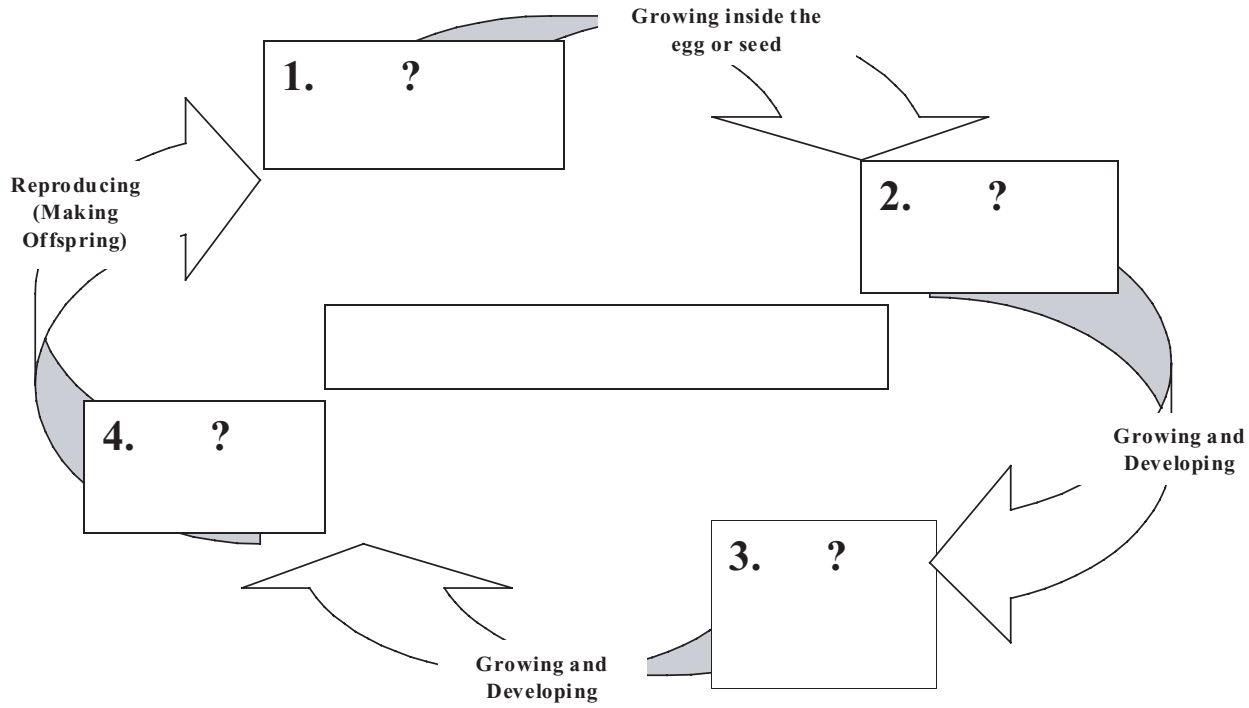
- ❑ people
- ❑ frogs
- ❑ butterflies
- ❑ lady bugs

19. The title of the picture below should be

- ❑ circle
- ❑ life cycle
- ❑ reproduction
- ❑ beginning

20. Put numbers on the lines to match the labels to the correct box.

_____ Reaching Maturity (Adulthood)
_____ Beginning as Egg or Seed
_____ Early Stages (Not Yet Mature)
_____ Being Born, Hatching or Sprouting



“Materials and Resources List”

Lesson	Primary Materials	Books	Additional Materials (Supplied by Teacher or Students)
Introduction	Stages and Life Cycle Diagram Set (websites given for suitable pictures to print)		Internet access
1	Dry lima bean seeds (1 per student), soaked lima bean seeds (1 per student), paper plates or bowls for beans, 5 plastic knives, 5 hand held magnifying lenses, small paper plates or paper towels (1 per student), a goldfish in a clear bowl or jar of water, small stuffed animal, wooden blocks (2 or more), pillar candle and candle holder or plate, matches (alternative: photo of a lit candle), one battery operated toy (optional), timer, easel, chart paper, markers, pebble, seed, pot and soil (for extension activity), magazines, poster board (for extension activity), creative writing prompt (extension activity)		
2	Beginnings Picture Packet (websites given for suitable pictures to print), student science journals, Post-It note pads (1 per student team), easel, chart paper, markers	Books with color photos of developing animals and plants, Watch Them Grow: The Amazing Ways that Animals and Plants Change as They Develop by Linda Martin (extension activity)	Internet access
3	Erasable white board and markers,	Reference books for each student group's investigation of a plant or living thing (see recommended books in Lesson 3)	
4	Water (1 cup per student pair), plastic zip lock baggies (2 per student pair), paper towels (2 pieces per student pair), eyedropper or spoon (1 per student pair), lima bean seeds (4 per student pair), blank white labels or permanent markers to label each zip lock baggie, chart paper, easel, markers, 16 oz. plastic cups (1 per student), large bag of potting soil (enough to fill each 16 oz. cup half-way), large spoon or potting trowel, small watering can or pitcher, student science journals, rulers for measuring (1 per student pair)		

LIVING THINGS: CHANGES, STAGES AND CYCLES

Lesson	Primary Materials	Books	Additional Materials (Supplied by Teacher or Student
5	Note: See lesson for materials that need to be ordered at least 6 weeks before start of this lesson. Painted Lady Classroom Breeding Kit, Certificate for 70 larvae, 60 cups, rearing cup filters (100/ box), Butterfly Farm Mini-Greenhouse Seed Started System with professional soil, For butterfly observatory: 8 meters of netting, one hula hoop, one large sheet of butcher paper, one roll of masking tape or cellophane tape, hot glue and hot glue gun (optional), one S-hook or plastic plant hook, one roll of string, one large package of colored tissue paper, 16 large hardwood or plastic spring clothespins, one plastic drop cloth or old shower curtain, 12-15 large pipe cleaners (1 pipe cleaner per student pair), 12-15 colored sponges (1 per student pair) to be cut into 5 cm circles for circle sponge feeders, 2 medium containers (such as pin tins), ingredients for adult butterfly food source, one of the following: 1 gallon of apple juice, jar of sweetened, red drink mix powder and water (i.e., Kool-Aid containing sweetener), 1 jar honey and water, Artificial Nectar and water from Educationalscience.com, sugar and water, 1 eye dropper and dropper bottle		
6	Painted Lady butterfly larvae, Desktop Habitats (rearing cups and artificial diet for caterpillars), hollyhock plants purchased or raised in the classroom (or local mallow or thistle plants), student journals, rulers, preferably with centimeter markings (1 per student), envelopes (1 per student), Scotch tape, heavy duty, double-sided tape, nectar for flower sponge feeders (see suggestions in Lesson 5), eye dropper, sponge feeders in tissue paper flowers, plastic cup with lid and hole punch, pie tins	Waiting for Wings by Lois Ehlert	Internet access
7	Microscope (extension activity)	Print references: encyclopedias, dictionaries	Internet access
8	Highlighters, poster-size graph paper or mural paper and Post-It Notes	Lifetimes: The Beautiful Way to Explain Death to Children by Bryan Mellonie and Robert Ingren, or alternative book: Lifetimes by David L. Rice	
9		What is a Life Cycle (The Science of Living Things) by Bobbie Kalman and Jacqueline Langille	Bicycle wheel or toy truck with wheels
10	Index cards or _ sheets of paper for note taking (10 per student)	Print references (encyclopedias, reference books)	Internet access
11	Post-It Notes (1/2 pack per student for pre-assessment), for optional mobile project: wire coat hangers or large dinner size paper plates (1 per student), large index cards (4-5 per student), markers or crayons, string or yarn, hole punch	Print reference materials (see recommended books in Lesson 11 and recommended websites)	Internet access
12	Student science journals, chart size paper or pre-made number line or blank sentence strips		

Lesson	Primary Materials	Books	Additional Materials (Supplied by Teacher or Student
13	Construction paper (6 pieces per student)	Magazines with pictures of people	Photos of students or their family members
14		Water Dance by T. Locker	Internet access
Post Assessment	Living Things: Changes, Stages and Cycles Post Assessment (included in unit)		Internet access

“Unit Appendix”

Module 1: Basic Needs, Growth and Development

Lesson 4: Basic Needs Must Be Met

Additional Extension Activities

4. **Read About Bean Plant Growth Stages** (20 Minutes) (CORE)

After student seeds have germinated, use the Module Four Bean Plant Growth Stage sheets or other print references to have students read about stages after germination in a bean plant's growth and development. Possible titles:

My Bean Plant, by Joseph Ciciano, National Geographic Windows on Literacy, Science Set B, Level 14. [ISBN 0792243234] (An inexpensive set of multiple copies geared towards early or fluent readers) www.nationalgeographic.com/education/windows/

Schwartz, David M. & Kuhn, Dwight (photographs). (2001).Bean. Milwaukee, I: G. Stevens. (ISBN# 0836829700)

5. **What are the Effects of Adjusting Other Variables** (60 Minutes) (PRACTICE/AID)

Allow students who show readiness and interest the opportunity to design another germination experiment. Give them a **Module Four Experiment Design Sheet** to plan what variables they will adjust. You may scaffold this activity for students who need an idea by having them select one of the questions below:

What are the effects of colored light on seed germination?
What are the effects of artificial light on seed germination?
What are the effects of salt water [or other liquids] on seed germination?
What are the effects of freezing temperature on seed germination?
What are the effects of large quantities of water on seed germination?
What are the effects of music on seed germination?
What are the effects of selected seed size on seed germination?

Require them to record their observations on a daily basis and summarize their findings in a report or presentation to the class.

Module 1: Lesson 4 Observation Sheet 1

Beginning of a Bean Plant: What Does a Seed Need to Germinate?

Name				
Control Seeds Variables We Did Not Change: Water, Temperature, Light				
Date of Observation				
Normal Signs of Growth and Development During Germination	Seed Swells	Seed coat cracks	Hypocotyl-Radicle comes out	Cotyledons come out
Mark with an X if observed				
Description				
Drawing				

Design A Nectar Rich Butterfly Garden: Real World Application (3 hours) (AID)
Students who become passionate about butterfly gardens or recognize the need to conserve habitat can work to design and actually plant a butterfly garden at school or in the community. This project would begin by having students research what species of butterflies are found in your part of the country and then deciding which ones to attract to the garden. Plans for both larval host plants and flowers as nectar sources would be made. Locating materials and space would also be part of the challenge.

There are numerous books on the topic; some are listed above. One inexpensive paperback that would be a good place to start and is geared toward the elementary age student is: Hamilton, K. (2002).
The Butterfly Book: A Kid's Guide to Attracting, Raising and Keeping Butterflies. Emeryville: Avalon Travel Publishing. [ISBN 156261309X]

This site lists and sells plants for butterfly gardens. http://butterflybushes.com/

A Day in the Life of A Butterfly Egg (30-60 Minutes) (CORE)
Interested students with an artistic bent will enjoy reading a short piece about a day in the life of a butterfly egg. (See **Module 1, Lesson 5 Extension Activity Sheet.**) They will be asked to think about what a mother Monarch butterfly would be thinking as she looks for a safe place to lay her eggs. Then they are asked to imagine what an egg would be thinking (if it could think) once it was laid. On a large piece of white paper they will create a cartoon with speech bubbles showing the thoughts and concerns of Mother Monarch and those of her egg. Students should be encouraged to show what the butterfly does to increase the chances of the egg's survival, as explained in the story.

Threats to Caterpillar Survival (1 – 1 _ hours) (AID)
A female butterfly may lay hundreds or even thousands of eggs, but only a few may survive as caterpillars. This is related to a number of factors (environment—weather, space, and food shortages; accidents—(for example, flying into cars or being crushed by animals or people); and predators that kill the caterpillars directly or use their nutrients. Have students use print references to locate and draw six of these threats. They may want to focus only on predators or include items from all three categories (environment, accidents, and predators). Their drawings can be done in each six boxes created by folding an 18" by 36" piece of white paper vertically in half and then in thirds. On the back of the paper, students can illustrate ways in which the caterpillar protects itself. Examples of this might be color or chemical defenses. One possible on-line source is: C*aterpillar and Butterfly Defense Mechanisms* at: http://www.enchantedlearning.com/subjects/butterfly/

Module One: Lesson Five Extension Activity

Name_____

A Day in the Life of a Butterfly Egg*
From http://www.learner.org/jnorth/tm/monarch/EggDayLife.html

Directions:

Read the story *A Day in the Life of a Butterfly Egg*. Think about what a mother Monarch butterfly would be thinking as she looks for a safe place to lay her eggs. What do you imagine an egg would be thinking (if it could think) once it was laid? On a large piece of white paper create a cartoon with speech bubbles showing the thoughts and concerns of Mother Monarch and those of her egg. Make sure you show what the butterfly does to increase the chances of the egg's survival.

Monarch butterflies abandon their eggs the instant they're laid. (And the fathers are long gone, since a female can lay eggs her whole life after a single mating.) If you were a butterfly egg, your mother couldn't afford the time to raise you. You'd be just one of the several hundred siblings she'd try to produce in her short life. So she'd have to move on! To increase your chances of survival she would try to:

**Find your host plant, milkweed (since that's the ONLY food you'd eat when you hatch).*
**Lay only one egg on the plant, so you'd have it all to yourself.*
**Lay the egg on a young milkweed plant, to provide you with the freshest leaves.*
**Attach the egg with an adhesive substance, so you won't fall off the leaf!*
**Lay the egg on the underside of the leaf, where you'd be hidden from the strong sun and a little less conspicuous to predators.*

And although your parents wouldn't be there to protect you, your egg would have a hard shell and even a wax coating to keep you from drying out. You'd be tiny and somewhat camouflaged but still, a nutritious meal for a predator.

Module 2: Changes and Stages

Lesson 1: Observing Stages and Changes
Additional Extension Activities

Design Your Own Experiment to Investigate the Effects of Temperature on Caterpillar Growth (20 Minutes Daily) Have students use the Module 2, Lesson 6: Experiment Design Sheet to plan a way to adjust the variable of temperature. Give them an additional caterpillar/s and rearing cup/s. Have them measure and record daily growth and change. The first caterpillar will become a "control" for comparison purposes. Ask them to report their findings to the class.

Download and View Painted Lady Video (Core) (30 Minutes)
Short video clips are available on the Internet of Painted Ladies laying eggs, hatching from eggs, and eating at:
http://www.fcps.k12.va.us/StratfordLandingES/Ecology/mpages/painted_lady.htm
Add the link to the browser's bookmarks or favorites menu for students to observe during their free time at a classroom computer station or school lab. Students can observe the egg stage that was not observed prior to receiving their larvae. The site also provides print information about stages of growth and development. Tips and questions to guide student in observations skills while viewing the video are provided by the Journey North Global Research project below. Consider posing some of these to students before they view the clips.

Video Clips and the Scientific Process
From: http://www.learner.org/jnorth/tm/tips/VideoClipScientificProcess.html

Observation is the first step in the scientific process. Scientists themselves sometimes use video to enhance their own, direct observations. With video, they can replay an event, see it in fast or slow motion, make time-lapse observations, document changes, focus more closely, freeze action, etc.

Video clips provide an opportunity for students to make authentic scientific observations, too. Here are some suggestions for viewing video clips as a scientist:

What do you see?
The first time you watch, record what you notice, in writing. If viewing a short clip, play it two or three times. Give yourself time to look again and confirm what you think you saw. Write down everything you noticed, like brainstorming.

What questions do you have?
During observation, we see things that make us wonder. It is common, during a rich observation period, for many good questions to come to mind. When observing video clips, capture the questions you have as you watch. (You might use a different color pen to take notes each time a clip is viewed. It's interesting to watch how observations improve and questions develop.)

What do others see and wonder?
Each individual sees and interprets things differently. Come together with your class and compare notes. Watch how your ideas expand after sharing with the group. View the clip again several times so you can see the new things other people noticed, and the questions they had.

How might observations be explained?
After observing events, scientists try to explain what they have seen by forming a hypothesis. A hypothesis is a possible explanation. How do you think your observations could be explained? Form a hypothesis.

How could you find out?
After forming a hypothesis, the scientist's next step is experimentation. How might you design an experiment to test your hypothesis?

Create a Painted Lady Video and Multi Media Program (AID) (1 hour+)
After students have viewed the video clips from the site above, allow interested students who can work independently with technology an opportunity to videotape their own brief segments of their caterpillar's behavior. Later, these can played for classmates to observe and discuss using the protocol for **Video Clips and the Scientific Process**. If a digital camera is used, the video can also be downloaded on the computer into I-Movie, Hyper Studio or QuickTime. If time permits, students can add subtitles and other text to their clips.

Module 2: Changes and Stages

Lesson 1: Observing Stages and Changes
Additional Teacher Resources

DeLuise, Dom. (1990). *Charlie the Caterpillar*. Simon and Schuster Books for Young Readers. (33 pages)
A caterpillar is rejected by various animals until he becomes a beautiful butterfly. He befriends another unhappy caterpillar.

Facklam, Margery. (1996). *Creepy, Crawly Caterpillar*s. Little, Brown and Company. (32 pages)
Large illustrations show 13 caterpillars, (one per two-page spread) with smaller drawings of the egg, pupal stage, and adult moth or butterfly. Some of the caterpillars look like their color is almost olive green, which is disappointing, but most children will neither notice nor care. They will be captivated and excited by the awesome caterpillars shown.

Fischer-Nagel, Heiderose. (1987, c1983). *Life Of The Butterfly*. Carolrhoda Books. (47 pages)
Great photos of the life cycle of the Peacock butterfly {not found in the USA}; a few other American butterflies are mentioned

George, Jean Craighead (1993). *The Moon of the Monarch Butterflies*. Harper Collins Publishers. (48 pages)
Describes a female Monarch's journey from Arkansas to Michigan as she lays eggs that will hatch and repeat her life cycle.

Gibbons, Gail. (1989). *Monarch Butterfly*. Holiday House. (32 pages)
A very colorful book; drawings are "cute" but not completely realistic; describes the life cycle, body parts, and behavior of the Monarch; includes instructions on how to raise a Monarch

Harvey, Diane Kelsay. (1991). *Melody's Mystery*. Beautiful America Publishing Co, (Pages not numbered [about 46 pages]
Dramatic, artistic photographs, different from most Monarch books. The sequence on changing into the chrysalis is especially good. Melody is a Monarch. The text appears in English and Spanish on each page.

Heligman, Deborah. (1996). *From Caterpillar to Butterfly*. HarperCollins Publishers, (31 numbered pages)
[Let's-Read-And-Find-Out Science, Stage 1] Young schoolchildren follow the development of caterpillar in their classroom through its emergence as a Painted Lady butterfly. Stage 1 books target preschool and kindergarten-age children. The appealing illustrations are colorful and moderately realistic.

Herberman, Ethan. (1990). *The Great Butterfly Hunt: The Mystery of the Migrating Monarchs*. Simon and Schuster Books for Young Readers. (48 pages)
For older children; much scientific information, good photographs, charts, illustrations; an outstanding source for those who want more than just the basic life cycle story

Herold, Ann Bixley (1991). *The Butterfly Birthday*. Macmillan. (46 pages)
Matt collects caterpillars, but is afraid of spiders. He discovers others have fears too.

Hines, Anna Grossnickle (1991). *Remember The Butterflies*. Dutton Children's Books. (32 pages)
Grandfather who taught grandchildren about butterflies dies; his grandchildren reflect on the special times they shared with him

Klass, David (1994). *California Blue*. Scholastic. (200 pages)
A teen boy wants to save an endangered butterfly, but it could jeopardize his dying father's job at the mill.

Lasky, Kathryn (1993). *Monarchs*. Harcourt Brace & Co. (63 pages)
Excellent photographs and information, especially on migration to Mexico. Discusses Pacific Grove CA, and Mexican overwintering sites. A unique and outstanding book on Monarchs for Grades 3-6.

Lavies, Bianca (1992). *Monarch Butterflies: Mysterious Travelers*. Dutton Children's Books. (Pages not numbered)
Text and photographs describe the physical characteristics, life cycle, migration and study of Monarch butterflies.

Lepthien, Emilie U. (1989). *Monarch Butterflies*. Children's Press. (44 pages)
Series: A New True Book {excellent photographs; text for very young readers, very large print}.

Mitchell, Robert T. (1987). *Butterflies and Moths: A Guide to the More Common American Species*. Revised edition. Golden

Press. (160 pages)

Moncure, Jane Belk (1988). *Butterfly Express*. Child's World. (31 pages)
A little girl's butterfly emerges during a snowfall and is sent to California so it can live.

Pascoe, Elaine. (1997). *Butterflies and Moths*. Blackbirch Press. (48 pages)
Many excellent photographs. Includes information on raising butterflies and moths. Some simple experiments involving host plant food preferences bring some extra science education into the content.

Pringle, Laurence. (1997). *an Extraordinary Life: The Story of a Monarch Butterfly*. Orchard Books. (64 pages)
Excellent realistic illustrations, much scientific information in the form of a lengthy story about a monarch's life from egg to adult female, migration from Massachusetts to Mexico, overwintering, and then starting the return journey north in the spring. Brief information on the roosting sites in Mexico and how to raise a monarch. For the older reader, probably grades 3 and up.

Ring, Elizabeth. (1994). *Night Flier*. Millbrook Press. (Pages not numbered)
Terrific photos of the life cycle of the Cecropia moth.

Rotter, Charles (1993). *Monarch Butterflies*. Child's World. (Pages not numbered) Contains 14 full-pages color photographs; discusses the life cycle.

Rowan, James P. (1983). *Butterflies and Moths*. Children's Press, (45 pages)
Series: A New True Book. For very young readers; beautiful photographs, very large print.

Ryder, Joanne. (1989).*Where Butterflies Grow*. Lodestar Books. (32 pages)
Told as a story, contains beautiful drawings depicting the life cycle of the Black Swallowtail butterfly. The illustrations will please all ages, and contain many details.

Sandved, Kjell Bloch (1996). *The Butterfly Alphabet*. [photographs] Scholastic. (Pages not numbered)

Schaffer, Donna. (1999) consultant, Phil Schappert. *Painted Lady Butterflies*. Mankato, Minn:Bridgestone Books (ISBN# 0736802118)

Selsam, Millicent Ellis (1987). *A First Look at Caterpillars*. Walker. (34 pages)

Stratton-Porter, Gene. (1986). *A Girl of the Limberlost*. Dell. (416 pages)
Reprint of a classic early twentieth century novel based on Geneva Stratton-Porter's true life experiences with moths, butterflies, and nature.

Whalley, Paul (1988). *Butterfly & Moth*. Knopf. (63 pages)
An outstanding pictorial guide to detailed information about butterflies and moths, although many are not found

in the USA. For the older reader. Series: Eyewitness Books.

Wright, Amy Bartlett. (1993). *Peterson First Guide to Caterpillars of North America*. Houghton Mifflin. (128 pages)
A pocket-sized paperback guide to common butterfly & moth caterpillars. Excellent illustrations.

(Resource list from Laura Mitchell, Reference librarian and amateur Lepidopterist
Last Updated: February 17, 1998: butterfly@mgfx.com)

Painted Lady (Vanessa cardui) Information and Picture Web Sites

http://butterflyhaven.com/photosoflifecycle.htm

http://www.fcps.k12.va.us/StratfordLandingES/Ecology/mpages/painted_lady.htm

http://www.whatsthiscaterpillar.co.uk/america/list.htm

http://www.npwrc.usgs.gov/resource/distr/lepid/bflyusa/usa/225.htm

http://www.butterfly-guide.co.uk/species/nymphAIDs/turk8.htm

http://www.parfaitimage.com/Rhopalocera/vanessa_cardui.html

http:www.kolumbus.fi/esko.viitanen/ccardui_e.htm

http://www.butterflygarden.fsnet.co.uk/butterflies/paintedlady.htm

http://www.enature.com/partners/nwf/showSpeciesLG_nwf.asp?showType=4&rgnID=1599&curGroupID=2&curPageNum=100&recnum=BU0047

http://imnh.isu.edu/digitalatlas/bio/insects/butrfly/famnymph/vacaf.htm

http://vireos.com/paintedlady.html

http://www.inra.fr/papillon/papilion/nymphali/texteng/v_cardui.htm

http://animaldiversity.ummz.umich.edu/accounts/vanessa/v._cardui$media.html

http://www.greennature.com/article1416.html

Module 2: Changes and Stages

Lesson 6: Similar Stages in Similar Living Things
Additional Extension Activities

Read What is a Life Cycle, (The Science of Living Things) (Core) (30 Minutes) As mentioned in Materials section and Module Two, Lesson 4, this book provides a wonderful overview of life cycles with photos and illustrations for every animal group and humans. As a read aloud it will provide addition reinforcement for the whole class of unit principles, even if it is also used as a reference for expert groups.

Crazy About Life Cycles (Core) (30+ Minutes)
Lead students to this simple tutorial on the life cycles of birds, turtles, frogs, grasshopper and butterflies geared towards emergent or transitional readers. It begins with a pre-test and includes a post-test. Students may be inspired to design their own tutorial based on their research in Hyper Studio or PowerPoint.
http://esd.iu5.org/LessonPlans/LifeCycle/animals.htm

“Curriculum Map”

LIVING THINGS: CHANGES, STAGES AND CYCLES

Major Principles and Generalizations	Time Allocation And Parallel	Minor Principles and Generalizations	Concepts	Skills	Universal Themes	Guiding Questions
• Introduction: • Living things change as they grow and develop over their lifetime. • Each type of plant and animal goes through a unique set of sequential stages as it grows and develops over its lifetime. • The growth, development, and reproduction of living things repeat in a cyclic pattern over generations. • The life functions (e.g. reproduction) of mature living things are dependent on the development and maturation of earlier stages. (AID).	CORE//AID 30 minutes		• Living things • Change • Growth • Develop • Sequential • Stages • Repeat • Cycles	• Observe • Locate patterns • Infer • Predict	• Patterns • Cycles	• What predictions can we make about the focus of our new unit of study? • What experiences are common to living things? • What patterns can we observe in how living things change and grow? • Why do living things experience change in stages and cycles? (AID)
1. Living things have characteristics and behaviors common to them that make them different from non-living things.	Core/Practice/ AID 70 minutes	• Living things take in food for energy. • Living things move. • Living things eliminate waste. • Living things respond to their environment. • Living things respond to their environment. • Living things experience respiration. • Living things have parts inside them that keep them alive. • Living things grow. • Scientists begin their investigations with questions. • Scientists sometimes gather data through observations to help them answer their questions.	• Living • Non-living • Characteristics • Behavior • Energy • Movement • Response • Growth	• Question • Observe Data • Record Data • Compare/ contrast • Draw Conclusions	• Character-istics	• What characteristics do all living things have in common? • How are living things different from non-living things? • How can I act like a scientist to learn about living things?

Major Principles and Generalizations	Time Allocation And Parallel	Minor Principles and General-izations	Concepts	Skills	Universal Themes	Guiding Questions
2. Living things change as they grow and develop over their lifetime.	CORE 45 minutes	• Living things grow as they change in size. • Living things develop as they change shape and appearance.	• Living things • Lifetime • Change • Grow • Develop • Size • Shape • Appearance	• Observe • Describe • Record • Sort • Categorize • Find Patterns	• Change	• What changes can we observe in living things? • What does it mean to grow and develop?
3. Living things grow and develop in a common pattern that includes a beginning, early stages and an adult stage.	CORE/AID 1 hour, 30 minutes	• In their early stages living things are not fully formed. • When living things grow and develop to maturity, they are fully formed.	• Change • Beginning • Early • Young • Grow • Develop • Mature • Immature • Fully Formed • Adult • Pattern	• Observe • Record • Locate Patterns • Sequence	• Patterns	• What similar patterns and stages of growth and development do living things experience?
4. Living things have basic needs that must be met to grow, reproduce and survive.	CORE/ PRACATICE// AID 80 minutes	• Living things will survive and grow only in environments where those needs are met. • The first stage of a seed plant's growth and development is seed germination. • Seed germination and plant growth are affected by light, temperature and water. • Changing and controlling variables in an experiment help us study the effect of each.	• Needs • Grow • Germination • Reproduce • Survive • Environment • Habitat	• Identify Variables • Hypothesize • Predict • Experiment • Observe • Describe • Record	• Needs	• How is a bean seed affected when certain basic needs are not met? • What will our classroom organisms need to grow and survive? • What methods do scientists use to answer questions?

LIVING THINGS: CHANGES, STAGES AND CYCLES

Major Principles and Generalizations	Time Allocation And Parallel	Minor Principles and Generalizations	Concepts	Skills	Universal Themes	Guiding Questions
5. Living things will survive and grow only in environments where basic needs are met.	CORE/AID 1 hour, 5 minutes	• A butterfly begins as an egg; it then goes through a larvae or caterpillar stage. • Each stage of a living thing's growth and development has special characteristics. • Each stage of a living thing's growth and development has special needs. • Habitats have food, water, safety, and a place for reproduction and young.	• Needs • Grow • Stage • Survive • Environment • Natural • Unnatural • Habitat • Host • Species	• Compare and Contrast	• Needs	• How can we assure the survival and growth of a living thing outside of its natural habitat?
6. Each type of plant and animal goes through a unique set of sequential stages as it grows and develops over its lifetime.	CORE/AID 3 hours, 5 minutes Direct Instruction (Plus 30 minutes daily for 2-3 weeks, for anchor activities)	• Each sequential stage of a living thing's growth and development has special events (or occurrences) and needs. • After its beginning as an egg, a butterfly larva goes through 4 to 5 changes or instars before it becomes a pupa or chrysalis and then emerges as an adult. • The rate of larvae development is affected by the temperature of their surroundings; the cooler the temperature, the slower they develop and the warmer the temperature, the faster they develop. (AID)	• Growth • Development Sequential • Occurrences • Instar • Larva • Pupa • Chrysalis • Adult • Metamorphosis		• Change	
7. Transition from one developmental stage to another comes when a living thing's cells change.	AID 1 hour, 5 minutes (Optional)	• Living things are made up of units called cells. • A living thing's cells increase in number as they grow.	• Cells • Niche • Metamorphosis		• Change	

Major Principles and Generalizations	Time Allocation And Parallel	Minor Principles and Generalizations	Concepts	Skills	Universal Themes	Guiding Questions
8. Every living thing has a typical lifespan that comes to an end.	CORE/ PRACTICE/ AID 1 hour	• Normally a life span ends after a living thing reaches maturity.	• Typical • Average • Lifespan • Death • Maturity • Maximum	• Organize Data • Graph Data • Compare/ contrast	• Patterns	• How do the typical lifespans of plants, animals and people compare with one another?
9. The growth, development and reproduction of living things repeat in a cyclic pattern over generations.	CORE/AID 1 hour, 21 minutes	• Cycles occur when a sequence of events repeats over and over again. • Even though plants, animals and humansdie, life continues through reproduction. • Life cycles of animals, humans or plants are carried on when the mature animals, humans or plants reproduce themselves. • The last stage in a Life cycle, reproduction, brings the cycle back to the first stage.	• Pattern • Repeat • Cycle • Continue • Reproduction • Life cycle • Generations • Offspring	• Observe • Locate a pattern • Predict • Make connections	• Cycles	• Why are there people, animals and plants on earth even though people animals and plants die? • What pattern can be seen as living things go from generation to generation?
10. Extinction occurs when mature animals, humans or plants no longer reproduce themselves and all members of a species die out.	AID (optional) 1 hour, 30 minutes	• Habitat loss, pollution and over-hunting can endanger the survival of a species.	• Extinction • Survive • Species • Endanger • Habitat loss • Pollution • Over-hunting • Protect • Solutions	• Find a problem • Find a solution	• Patterns	• What does extinction have to do with life cycles? • Why do animals become extinct? • How can people protect endangered species?

LIVING THINGS: CHANGES, STAGES AND CYCLES

Major Principles and Generalizations	Time Allocation And Parallel	Minor Principles and General-izations	Concepts	Skills	Universal Themes	Guiding Questions
11. Similar kinds of living things experience similar stages of change over their lifespans.	CORE/AID 2 hours, 15 minutes – 2 hours, 45 minutes	• Invertebrates generally go through either incomplete metamorphosis in which the young (nymphs) look like smaller adults, or complete metamorphosis. • Most vertebrates (except amphibians and some others) have offspring that resemble the adults, but are much smaller. • After beginning as a fertilized egg, animal life cycles consist of stages that go from being born or hatched to maturing over time and then reproducing. • There is a relationship between complexity of an organism, the number of offspring it has, length of young stages, and level and length of parental care given. (AID)	• Similar • Stages • Sequence • Invertebrates • Complete metamorphosis • Incomplete metamorphosis • Vertebrates • Offspring • Reproduction • Life cycle	• Locate information • Compare/ contrast Locate patterns	• Patterns	• What special occurrences can be observed in the Painted Lady butterfly's stages of change?
12. Similar living things' stages of growth and development may differ in length of time.	PRACTICE/ AID (Optional) 1 hour, 20 minutes	• Similar living things'Stages of growth and development vary within a range of minimum to maximum length of time. (AID)	• Length of time • Maximum • Minimum • Range • Variation	• Graph • Organize data • Observe patterns • Create a timeline	• Patterns	• Do the same living things progress through the same stages at the same rate? • How much do the developmental stages of certain animals vary in length of time?
13. Humans move through stages as they grow and develop over their lifetime.	CORE 1 hour	• Human growth and development includes stages of birth, infancy, childhood, adolescence and adulthood.	• Birth • Infancy • Childhood • Adolescence • Adulthood • Milestone • Developmental • Timeline • Length of time	• Identify • Sequence • Observe a pattern	• Patterns • Cycles	• How am I like other living things, but still unique? • What stages of growth and development do people experience in their life cycle?

14. Change patterns in the physical environment can occur in cycles.	CONNECTIONS 30 minutes	• As with life cycles, other cycles in the physical environment have a last stage that goes back to the first stage. • Water is carried back and forth from earth to its atmosphere in a four-part cycle: evaporation, transpiration, condensation and precipitation.	• Physical environment • Evaporation • Transpiration • Condensation • Precipitation	• Compare • Explain • Connect	• Cycles	• What cycles of change can be observed in the physical world? • How is water carried back and forth from earth to its atmosphere in a cycle?
15. Unit Debriefing Unit principles and generalizations	CONNECTIONS 30 minutes		Unit concepts	• Reflect • Make connections • Explain	• Patterns • Stages • Cycles	• What have we learned about the changes, stages, and cycles of living things? • What patterns have been observed in how living things change and grow? • Why do living things experience change in stages and cycles? (AID)

LIVING THINGS: CHANGES, STAGES AND CYCLES

Major Principles and Generalizations	Time Allocation And Parallel	Minor Principles and General-izations	Concepts	Skills	Universal Themes	Guiding Questions
Post Assessment Unit principles and generalizations	CORE 30 minutes		Unit concepts	• See relationships • Explain • Make connections	Unit universal themes	• What do I know about the characteristics of living things vs. nonliving things? • What does it mean to grow and develop? • What changes can we observe in living things? • What similar patterns and stages in growth and development do living things experience? • What kinds of living things experience similar stages of change over their lifespan? • What methods do scientists use to answer questions? • How do the typical life spans of plants, animals and people compare with one another? • What pattern can be seen as living things go from generation to generation? • What have I learned about the changes, stages and cycles of living things?

“Materials and Resources”

LIVING THINGS: CHANGES, STAGES AND CYCLES

Lesson	Primary Materials	Books	Additional Materials (Supplied by Teacher)
Introduction	Stages and Life Cycle Diagram Set (websites given for suitable pictures to print)		Internet access
1	Dry lima bean seeds (1 per student), soaked lima bean seeds (1 per student), paper plates or bowls for beans, 5 plastic knives, 5 hand held magnifying lenses, small paper plates or paper towels (1 per student), a goldfish in a clear bowl or jar of water, small stuffed animal, wooden blocks (2 or more), pillar candle and candle holder or plate, matches (alternative: photo of a lit candle), one battery operated toy (optional), timer, easel, chart paper, markers, pebble, seed, pot and soil (for extension activity), magazines, poster board (for extension activity), creative writing prompt (extension activity)		
2	Beginnings Picture Packet (websites given for suitable pictures to print), student science journals, Post-It note pads (1 per student team), easel, chart paper, markers	Books with color photos of developing animals and plants, Watch Them Grow: The Amazing Ways that Animals and Plants Change as They Develop by Linda Martin (extension activity)	Internet access
3	Erasable white board and markers,	Reference books for each student group's investigation of a plant or living thing (see recommended books in Lesson 3)	

Lesson	Primary Materials	Books	Additional Materials (Supplied by Teacher)
4	Water (1 cup per student pair), plastic zip lock baggies (2 per student pair), paper towels (2 pieces per student pair), eyedropper or spoon (1 per student pair), lima bean seeds (4 per student pair), blank white labels or permanent markers to label each zip lock baggie, chart paper, easel, markers, 16 oz. plastic cups (1 per student), large bag of potting soil (enough to fill each 16 oz. cup half-way), large spoon or potting trowel, small watering can or pitcher, student science journals, rulers for measuring (1 per student pair)		

LIVING THINGS: CHANGES, STAGES AND CYCLES

Lesson	Primary Materials	Books	Additional Materials (Supplied by Teacher)
5	Note: See lesson for materials that need to be ordered at least 6 weeks before start of this lesson. Painted Lady Classroom Breeding Kit, Certificate for 70 larvae, 60 cups, rearing cup filters (100/box), Butterfly Farm Mini-Greenhouse Seed Started System with professional soil, For butterfly observatory: 8 meters of netting, one hula hoop, one large sheet of butcher paper, one roll of masking tape or cellophane tape, hot glue and hot glue gun (optional), one S-hook or plastic plant hook, one roll of string, one large package of colored tissue paper, 16 large hardwood or plastic spring clothespins, one plastic drop cloth or old shower curtain, 12-15 large pipe cleaners (1 pipe cleaner per student pair), 12-15 colored sponges (1 per student pair) to be cut into 5 cm circles for circle sponge feeders, 2 medium containers (such as pin tins), ingredients for adult butterfly food source, one of the following: 1 gallon of apple juice, jar of sweetened, red drink mix powder and water (i.e., Kool-Aid containing sweetener), 1 jar honey and water, Artificial Nectar and water from Educationalscience.com, sugar and water, 1 eye dropper and dropper bottle		

Lesson	Primary Materials	Books	Additional Materials (Supplied by Teacher)
6	Painted Lady butterfly larvae, Desktop Habitats (rearing cups and artificial diet for caterpillars), hollyhock plants purchased or raised in the classroom (or local mallow or thistle plants), student journals, rulers, preferably with centimeter markings (1 per student), envelopes (1 per student), Scotch tape, heavy duty, double-sided tape, nectar for flower sponge feeders (see suggestions in Lesson 5), eye dropper, sponge feeders in tissue paper flowers, plastic cup with lid and hole punch, pie tins	Waiting for Wings by Lois Ehlert	Internet access
7	Microscope (extension activity)	Print references: encyclopedias, dictionaries	Internet access
8	Highlighters, poster-size graph paper or mural paper and Post-It Notes	Lifetimes: The Beautiful Way to Explain Death to Children by Bryan Mellonie and Robert Ingren, or alternative book: Lifetimes by David L. Rice	
9		What is a Life Cycle (The Science of Living Things) by Bobbie Kalman and Jacqueline Langille	Bicycle wheel or toy truck with wheels
10	Index cards or ½ sheets of paper for note taking (10 per student)	Print references (encyclopedias, reference books)	Internet access
11	Post-It Notes (1/2 pack per student for pre-assessment), for optional mobile project: wire coat hangers or large dinner size paper plates (1 per student), large index cards (4-5 per student), markers or crayons, string or yarn, hole punch	Print reference materials (see recommended books in Lesson 11 and recommended websites)	Internet access
12	Student science journals, chart size paper or pre-made number line or blank sentence strips		

LIVING THINGS: CHANGES, STAGES AND CYCLES

Lesson	Primary Materials	Books	Additional Materials (Supplied by Teacher)
13	Construction paper (6 pieces per student)	Magazines with pictures of people	Photos of students or their family members
14		Water Dance by T. Locker	Internet access
Post Assessment	Living Things: Changes, Stages and Cycles Post Assessment (included in unit)		Internet access