Science Benchmark Clarification, Instruction, and Assessment

Strand: III. Use Scientific Knowledge from the Life Sciences in Real-World Contexts

Content Standard: 2. All students will use classification systems to describe groups of living things; compare and contrast differences in the life cycles of living things; investigate and explain how living things obtain and use energy; and analyze how parts of living things are adapted to carry out specific functions. (Organization of Living Things)

Benchmark
Explain characteristics and functions of observable body parts in a variety of animals (SCI.III.2.E.1).

Benchmark Clarification
Animals can be sorted by their observable body parts. Students will categorize an animal according to its characteristics and how the characteristics work.
Examples:

- Insulation: fur, feathers, blubber
- Support: exoskeleton (outer), endoskeleton (inner)
- Food-Getting: claws, beaks, teeth
- Protection: quills, horns, claws, eyes
- Movement: legs, wings, fins, webbed feet

Students will:

- Categorize an animal according to its characteristics and how those characteristics work
- Categorize vertebrates – animals with a backbone
- Categorize invertebrates – animals without a backbone

Key Concepts (voc.)
Observable characteristics:

- fur
- scales
- feathers
- horns
- claws
- eyes
- quills
- beaks
- teeth
- skeleton
- muscles
- exoskeleton

Functions:

- insulation
- support
- movement
- food-getting
- protection

Real-World Context
Vertebrate and invertebrate animals:

- humans
- cows
- sparrows
- goldfish
- spiders
- insects
- crayfish

Instructional Example SCI.III.2.E.1

Benchmark Question: What are the functions of observable body parts of animals?
Focus Question: It's a part; what's its function?

Students will select a familiar animal to analyze. All observable body parts of the chosen animal will be listed. Then students will work to put each of the body parts into at least one of the function categories listed in the Benchmark Clarification Section.

Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.2*), (*link to SCI.I.1.E.5*), *(link to SCI.II.1.E.3*), (*link to SCI.II.1.E.4*).

Resources/References:
Webliography
http://mtn.merit.edu/mcf/SCI.III.2.E.1.html

All About…Series. Scholastic.
Backyard Series: Are You a…? Kingfisher.
Know It All Series. McClanahan.
Look Once, Look Again Series. CTP.
National Audubon Society. *First Field Guide Series.* Scholastic.

Pictures of animals
http://www.selu.com/boi.wildlife/

Pictures of animals
http://www.zooregon.org/

Science of Living Things Series. Crabtree.

Classroom Assessment Example SCI.III.2.E.1

Each student will invent an animal that shows an observable body part for each of the following functions: insulation, support, movement, foodgetting, and protection. Each student must present his or her design in one of the following forms: storybook, flipbook, multi-media presentation, 3D model, or drama.

This presentation must also include a written explanation of the body's observable characteristics and the function that each fulfills. Written presentations may be in one of the following forms: story, poem, song, or report.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.III.2.E.1

Criteria	Apprentice	Basic	Meets	Exceeds
Completeness of design	Designs one observable body characteristic for two or fewer of the functions.	Designs one observable body characteristic for three of the five functions.	Designs one observable body characteristic for all five functions.	Designs more than one observable body characteristic for one or more of the five functions.
Explanation of function	Relates one observable body part to fewer than three of the five functions, including details.	Relates one observable body part to three of the five functions, including details.	Relates one observable body part to each of the five functions with accurate details.	Relates all observable body parts to each of the five functions with accurate details.

Strand: III. Use Scientific Knowledge from the Life Sciences in Real-World Contexts

Content Standard: 2. All students will use classification systems to describe groups of living things; compare and contrast differences in the life cycles of living things; investigate and explain how living things obtain and use energy; and analyze how parts of living things are adapted to carry out specific functions. (Organization of Living Things)

Benchmark
Compare and contrast (K-2) or classify (3-5) familiar organisms on the basis of observable physical characteristics (SCI.III.2.E.2).

Benchmark Clarification
Plants and animals may have similar and/or different features. Plants and/or animals may be put into groups based on similarities and differences.

K-2 groups will:
- Compare and contrast plants (bean) and animals (dog)
- Compare and contrast body coverings (feathers on a robin, scales on a trout)
- Compare and contrast edible parts and non-edible parts (apple on a tree, leaves on the same tree)

3-5 groups will:
- Compare and contrast flowering (tulip) and non-flowering (philodendron) plants
- Compare and contrast vertebrates (snake) and invertebrates (worm)
- Compare and contrast endoskeletons (human) and exoskeletons (lobster)

Key Concepts (voc.)
Words describing plant and animal parts:
- backbone
- skin
- shell
- limbs
- roots
- leaves
- stems
- flowers
- feathers
- scales

Real-World Context

Animals that look similar:

- snakes
- worms
- millipedes

Flowering and non-flowering plants:

- pine tree
- oak tree
- rose
- algae

Instructional Example SCI.III.2.E.2

Benchmark Question: How are groups of living things classified?
Focus Question: How can observable characteristics help us classify animals?

Read a biography of Gregor Mendel to students and discuss his contributions to the classification of living things.

LIFE SCIENCE: HEREDITY
Johann Gregor Mendel (1822 – 1884)
DISCOVERING THE LAWS OF HEREDITY

J. Gregor Mendel was born in Heinzendorf, Austria in 1822. His father was a peasant and his mother was the daughter of a village gardener. In fact, Mendel's ancestors were professional gardeners of one type or another. So it is no wonder that even as a child, Mendel was encouraged to plant and care for fruit trees.

The village vicar, who taught natural science to the children, saw that young Mendel had exceptional abilities and urged his parents to send him to a high school in Troppau called the Gymnasium. But, due to his father's illness, Gregor had to work to support himself and any schooling he wanted.

Later, he entered the Augustine Monastery as a way of freeing himself of financial burdens and leaving him time to study. (During these times, monasteries were the institutions of higher learning and scientific research.) Here, there was an experimental garden where heredity and evolution in plants was being studied.

As an adult, Mendel's most important work took place during a period of about 10 years. It involved experiments in growing and crossing plants (hybridization), as well as gathering, sorting, observing, and counting some 30,000 plants. Mendel worked primarily with the pea plant, which has a small number of physical characteristics. These included height, seed color, seed shape, flower color, seed texture, pod shape, pod and flower color, and position of the pod.

Mendel studied plants which were "true-breeding" (their offspring always looked just like the parent plants) for different forms of the same physical characteristic. So, if he wanted to look at seed color, for example, he would choose a plant that was true-breeding for yellow seed color and one that was true-breeding for green seed color. He would then cross pollinate the two and observe the offspring. Then he mated members of the offspring (the first filial generation), and looked at their offspring (the second filial generation).

In general, Mendel found that the parents' physical characteristics appeared time and time again in the crosses. In the first generation, all the offspring were alike and all showed the physical (phenotypic) characteristics of the "dominant" form. In the second generation, when he crossed two offspring that physically looked alike, Mendel would get mostly plants which looked like the "dominant" form parent and the rest looked like the other parent. (This parent is the "recessive" form or parent.) He also discovered that the ratio of dominant to recessive is about 3:1.

The work led to the development of the Mendelian laws of inheritance. The first of these is the Principle of Segregation which states that: 1) There are two hereditary determinants for each physical characteristic: 2) Each reproductive cell (gamete) of the plant has only one of the two possible determinants (either member of the pair) and that the two determinants occur the same number of times in the gametes; and 3) When the male and female gametes unite to form the zygote (fertilized egg), this happens randomly.

Mendel's second law is known as the Principle of Independent Assortment. It states that the separation or segregation of a pair of alleles happens independently of the segregation of other pairs of alleles when gametes are formed.

Glossary of terms

*__GENES__ are the particles of heredity.
*Each gene has two parts or determinants which are also called **ALLELES**. Determinants of alleles occur in two different forms, often denoted by using upper and lower case letters.

*When the two alleles are alike, they are **HOMOZYGOUS**

*When the two alleles are different, they are **HETEROZYGOUS**

*The actual genetic composition of an organism is the **GENOTYPE**

*The physical appearance of an organism is the **PHENOTYPE**

References

Experiments in Plant Hybridization. Gregor Mendel. Cambridge, Harvard University Press. 1965.

Mendel's Principles of Heredity. W. Bateson. Cambridge, Cambridge University Press. 1909.

Dictionary of Scientific Bibliography. Charles Coulston Gillispie. Charles Scribner & Sons. New York. 1974. Vol. IX, p. 277-283.

Divide students into groups of four. Provide each group with a container filled with approximately twenty different items. Ask each group to find a small, inconspicuous item in the container. Appoint one student in each group to be the "timer" and record how long it takes the group to find the item.

Challenge each group to divide the items in their container into three groups or categories. Groups then will explain the criteria they used to group the items. All of the items will then be returned to the container and the students will divide the items into four groups or categories, again providing their rationale. Repeat the process once more, this time challenging the groups to create *five* subdivisions.

With the items still sorted into five categories, ask each group to find another small, inconspicuous item and have the "timer" record how long it takes the group to find the item. Bring the whole class together and discuss the differences in the two times. (Reflect on how categorizing the items made it easier to find a specific item.)

As a class, use one of the team's groupings and further subdivide. The class will then create a graphic organizer of the new groupings.

Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.2*), (*link to SCI.I.1.E.3*), (*link to SCI.I.1.E.5*), (*link to SCI.I.1.E.6*).

Reflecting: (*link to SCI.II.2.E.1*), (*link to SCI.II.2.E.2*), (*link to SCI.II.2.E.5*).

Resources/References:

Webliography
http://mtn.merit.edu/mcf/SCI.III.2.E.2.html

Amazing Series. Knopf.
Animal Close-Ups Series. Charlesbridge.
Animal picture sources: *KidPix Studio Deluxe*, clip art programs, nature magazines, posters, dichotomous keys.

Animals.
http://encarta.msn.com/index/conciseindex/2A/02A8A000.htm?z=1&pg=2&br=1

Backyard Series. Kingfisher.

"Bones or Not?" *Sing the Science Standards (Songbook/CD)*.
http://scienceexplosion.indiegroup.com/

Creatures Features. AIMS.
http://www.aims.edu.org/aimscatalog/

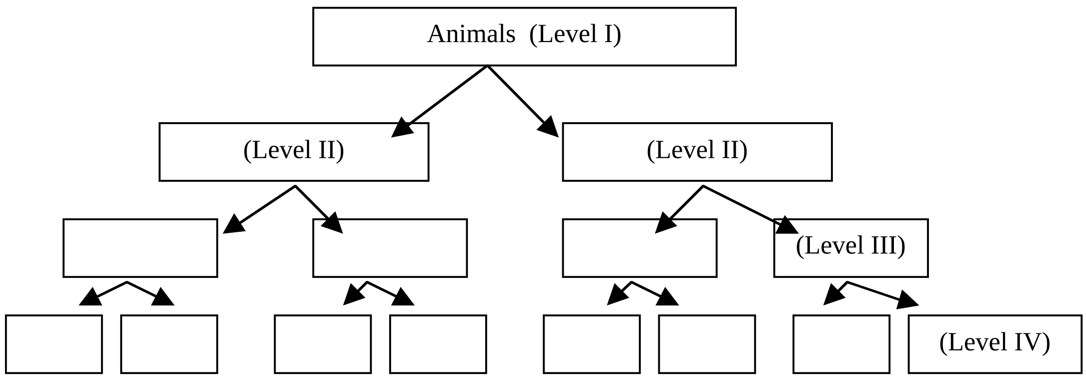
Graphic organizer software.
http://www.kidspiration.com/

It Could Still Be…Series. Children's Press.
Jackson, Ian. *Very Mixed Up Animals*. Millbrook Publishers, 1998.

Sorting All Sorts. AIMS.
www.aims.edu.org/aimscatalog/

Classroom Assessment Example SCI.III.2.E.2

Post the six animal characteristics (backbone, skin, shell, limbs, feathers, and scales) (*See Key Concepts*). Have students brainstorm a list of animals for each of the six categories. Students should then choose two of the categories. Challenge each student to consider the similarities and differences among the animals in the categories he or she has chosen and to create one more division for each category based on personal observation. Each student will then design a graphic organizer (*See graphic organizer in resources*) that begins with animals (Level I) and is



divided into two of the posted categories (Level II). From there, the student will divide each of the two chosen categories once more based on personal observation (Level III). The graphic organizer is then completed by adding the names of the animals from the original brainstormed list (Level IV).

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.III.2.E.2

Criteria	Apprentice	Basic	Meets	Exceeds
Completeness of characteristics	Completes Level II by choosing two of the posted characteristics (Level III is omitted).	Completes Level II by choosing two of the posted characteristics; creates two sub-divisions for one of those characteristics (part of Level III).	Completes Level II by choosing two of the posted characteristics; creates two sub-divisions for two of those characteristics (all of Level III).	Completes Level II by choosing two of the posted characteristics; creates two or more sub-divisions for each of those characteristics (Level III).
Completeness of animals	Lists all of the animals from the brainstormed list that fit the characteristics (Level IV).	Lists all of the animals from the brainstormed list that fit the new divisions (Level IV).	Lists all of the animals from the brainstormed list that fit the new divisions (Level IV).	Lists all or more animals that fit the new division (Level IV).

Science Benchmark Clarification, Instruction, and Assessment

Strand: III. Use Scientific Knowledge from the Life Sciences in Real-World Contexts

Content Standard: 2. All students will use classification systems to describe groups of living things; compare and contrast differences in the life cycles of living things; investigate and explain how living things obtain and use energy; and analyze how parts of living things are adapted to carry out specific functions. (Organization of Living Things)

Benchmark
Describe life cycles of familiar organisms (SCI.III.2.E.3).

Benchmark Clarification
A life cycle is a series of stages through which all living things (organisms) progress.

Students will:
- Sequence the life cycle stages of plants (seed, plant, flower, fruit)
- Sequence the life cycle stages of animals (egg, young, adult) (egg, larva, pupa, adult)

Key Concepts (voc.)
Life cycle stages:
- egg
- young
- adult
- seed
- plant
- flower
- fruit
- larva
- pupa

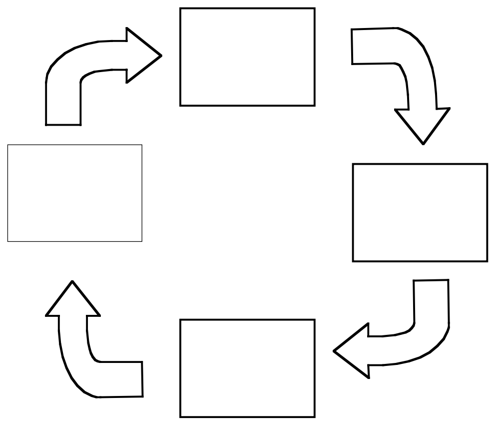
Real-World Context
Common plants and animals:
- bean plants
- apple trees
- butterflies
- grasshoppers
- frogs
- birds

Instructional Example SCI.III.2.E.3

Benchmark Question: What are the life cycle stages of living things (organisms)?
Focus Question: How do plants change as they grow?

Together, students will plant seeds and create a routine to care for and observe the plants. Students will observe the plants using measurement tools and as many of the five senses as possible. The class will begin recording common observations in a journal as modeled by the teacher. Use of computers or digital cameras would be appropriate. More mature students may record their own observations over a series of days or months. Students will measure the growth of the plants on a daily basis over several weeks and will record the information they gather using a table that will be the basis for a student-generated graph. Students will draw and label (classify) the four stages (seed, plant, flower, fruit) of the plant life cycle they have observed.

Example of life cycle graphic:



Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.3*), (*link to SCI.I.1.E.4*), (*link to SCI.I.1.E.6*).

Reflecting: (*link to SCI.II.1.E.1*), (*link to SCI.II.1.E.3*), (*link to SCI.II.1.E.5*).

Resources/References:
Webliography
http://mtn.merit.edu/mcf/SCI.III.2.E.3.html

Animal Lives Series. Kingfisher.
From…To…Series. Orchard.
How & Why Series. CTP
How Things Grow Series. Childrens Press.
Life Cycle Book. AIMS.

http://www.aims.edu.org/aimscatalog/
Life Cycles Series. CTP.
Life Story Series. Troll.

Seeds
http://www.carolina.com/

Classroom Assessment Example SCI.III.2.E.3

Students will complete a panel drawing (comic strip) showing the life cycle stages of a plant or animal. Each panel should correspond to one stage in the plant or animal's life cycle. Drawings must include speech bubbles explaining the stage and what is happening to the organism.**(Give students rubric before activity.)Classroom Assessment Example SCI.III.2.E.3**

Criteria	Apprentice	Basic	Meets	Exceeds
Correctness of order	Draws at least one life cycle stage.	Draws at least two life cycle stages in order.	Draws all life cycle stages in order.	Draws all life cycle stages in order and includes proper habitat -or- Expands on one or more of the life cycle stages.
Completeness of explanation	Writes life cycle stage explanation for one drawing.	Writes life cycle stage explanations for drawings.	Writes life cycle stage explanations for drawings.	Writes a detailed life cycle stage explanation for each drawing. Includes explanation of organisms' habitats.

Strand: III. Use Scientific Knowledge from the Life Sciences in Real-World Contexts

Content Standard: 2. All students will use classification systems to describe groups of living things; compare and contrast differences in the life cycles of living things; investigate and explain how living things obtain and use energy; and analyze how parts of living things are adapted to carry out specific functions. (Organization of Living Things)

Benchmark
Compare and contrast food, energy, and environmental needs of selected organisms(SCI.III.2.E.4).

Benchmark Clarification
All plants and animals have life requirements. Plants and animals obtain and use energy (sunlight and food) from their environment (water, air, minerals, space, and habitat) in a variety of ways. A basic understanding of photosynthesis (*link to Glossary*) is essential.

Students will:

- Compare and contrast how plants obtain and use energy directly from the sun and convert it to produce their own food to how animals use plants or other animals for their food

Photosynthesis: The formation of a carbohydrate from water and carbon dioxide using the sun's energy.

Key Concepts (voc.)
Life requirements:

- food
- air
- water
- minerals
- sunlight
- space
- habitat

See *SCI.III.5.E.2*

Real-World Context
Germinating seeds:

- beans
- corn

Aquarium or terrarium life:

- guppy
- goldfish
- snail

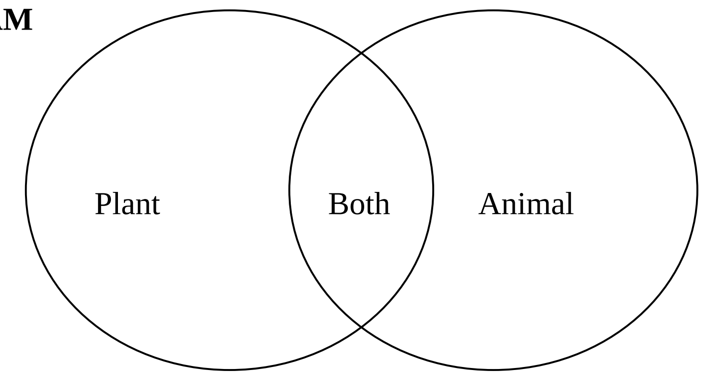
Instructional Example SCI.III.2.E.4

Benchmark Question: How do living things obtain and use energy?
Focus Question: How do the life requirements for a plant and animal compare?

Students will plant a seed in soil (for example, grass, corn, bean, Wisconsin Fast Plant). In a journal, students will record growth and <u>life requirements</u> (*See Key Concepts)* Students' data should contain what the plant needs to survive over a short period of time. The class will create a chart to organize and record data. This chart should include life requirements and energy sources. Students will then observe either an animal (e.g., mealworms) in the environment, classroom, or home and record observations for the same amount of time.

Students will work in small groups to complete a Venn diagram comparing their plant and animal. Groups will report their results to the class. The class will generalize that animals require food from another source while plants use the sun's energy to make their own food. The class should conclude that while habitats and food sources may differ, the need for air, food, water, minerals, sunlight, and space are similar.

VENN DIAGRAM



Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.3*), (*link to SCI.I.1.E.4*), (*link to SCI.I.1E.5*), (*link to SCI.I.1.E.6*).

Reflecting: (*link to SCI. II.1.E.1*), (*link to SCI.II.1.E.2*), (*link to SCI.II.1.E.3*).

Resources/References:
Webliography
http://mtn.merit.edu/mcf/SCI.III.2.E.4.html

Habitat Series. Barron's.
Himmelman, John. *Dandelion's Life*. Childrens Press, 1999.
Maestro, Betsy. *Why Do Leaves Change Color?* Harper, 1994.

"Special Needs." *Sing the Science Standards (*Songbook/CD*)*
http://scienceexplosion.indiegroup.com/

Classroom Assessment Example SCI.III.2.E.4

Students will create a graphic organizer displaying the following information for a selected plant and animal: food, air, water, sunlight, habitat, and food source. Using this information, students will construct a labeled three-dimensional model (diorama) that compares the life requirements of their plant to their animal. (Students should use half of the box for the plant, half of the box for the animal.)

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.III.2.E.4

Criteria	Apprentice	Basic	Meets	Exceeds
Completeness of graphic organizer	Shows two of the life requirements for both plant and animal.	Shows three of the life requirements accurately for both plant and animal.	Shows four of the life requirements accurately for both plant and animal. Shows food source accurately.	Shows all of the life requirements for both plant and animal. Shows food source accurately.
Construction of plant life requirements	Constructs two of the life requirements in the diorama.	Constructs three of the life requirements in the diorama.	Constructs four of the life requirements in the diorama.	Constructs five or more of the life requirements in the diorama.
Construction of animal life requirements	Constructs two of the life requirements in the diorama.	Constructs three of the life requirements in the diorama.	Constructs four of the life requirements in the diorama.	Constructs five or more of the life requirements in the diorama.

Strand: III. Use Scientific Knowledge from the Life Sciences in Real-World Contexts

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Benchmark
Explain the functions of selected seed plant parts (SCI.III.2.E.5).

Benchmark Clarification
All plants have parts that perform a specific function (job) to keep the plant alive. Each part of a plant works to support a plant's life.

Students will:
- Explain how roots anchor the plant and take in water and minerals
- Explain how stems provide support and carry water, minerals, and food to all parts of the plant
- Explain how leaves make food (site of food production)
- Explain how flowers produce fruit and attract pollinators (bees, birds, etc.)
- Explain how fruits hold and disperse seeds
- Explain how seeds carry embryos (*link to Glossary)* for new plants

Embryo: An undeveloped plant within a seed.

Key Concepts (voc.)
Plant parts:
- roots
- stems
- leaves
- flowers
- fruits
- seeds

See *SCI.III.4.E.2*, functions of selected animal body parts.

Real-World Context
Common edible plant parts:
- bean
- cauliflower
- carrots
- apples
- tomatoes
- celery
- spinach

Instructional Example SCI.III.2.E.5

Benchmark Question: How does each part of a seed plant support the plant's life?
Focus Question: What are the functions of seed plant parts?

Begin by reading a biography about plant expert Katherine Esau.

LIFE SCIENCE: CELLS
Katherine Esau (1898 -)
EXPERT PLANT VIRUS RESEARCHER

Katherine Esau was born and raised in what was formerly known as Russia, or the U.S.S.R. It was there that she was educated through her first year of college. Then the Esau family migrated to Germany where she completed her undergraduate college degree. In 1922, she and her family migrated a second time and came to the United States of America.

Some time later, Katherine Esau began graduate studies at the University of California (U.C.) in the field of botany. She completed her Ph.D. in 1931 and taught at U.C. Davis until 1963, when she transferred to U.C. Santa Barbara. But, most of Dr. Esau's research, dealing with effects of viral infection in plants, was performed at the Experiment Station of the Agriculture Department on the Davis campus.

In order to conduct these kinds of studies, Dr. Esau had to first study normal plants to understand the kinds of changes which occurred once plants became infected with a virus. Through this work, Dr. Esau became an authority on the structure and development of the phloem (plant tissue responsible for transporting food from the leaves to the rest of the plant).

In researching the effects of viruses on plants, Dr. Esau realized that she had to understand plant cell development – how cells differentiate and become specialized to carry out a particular function or process in the life of the plant.

Differentiation may be complicated, but it basically means trying to understand why one plant cell will develop to take part in one life process such as water storage, while another will develop to take part in a totally different life process such as transporting foodstuffs. This kind of reasoning and study is called ontology. Dr. Esau's work contributed a great deal to our knowledge of the ontology of plants.

She also realized that, in order to study plant viruses, she had to know a plant's ontology because the first symptoms of a viral infection occurred in plant parts which were still growing or developing. Further study showed that these viruses would infect only certain cells. For instance, a particular virus may only infect cells that store water. By knowing how a cell develops (differentiates) in order to become a water-storage cell, we can then accurately study the effects of that viral infection.

Dr. Esau's work led to the discovery of a phloem-limited virus; in other words, a virus which infects only a certain type of complex plant tissue. She also made a significant contribution to the scientific community by showing that that studying the ontology of an organism is important if we are to understand the differences which occur as a result of things such as viral infection.

References

Modern Men of Science. 1966. McGraw-Hill Book Company. NY. Pp. 157-158

As a review of plant parts and their functions, have children in small groups play "Concentration" where they match a plant part card with the correct function card (*link to Benchmark Clarification SCI.III.2.E.5*). Lead class discussion to insure correct matches. Provide examples of foods that represent each part of a plant:

Food	Part	Function
bean	seed	carries embryo for new plant
cauliflower	flower	produces fruit and attracts pollinators
carrots	root	anchors plant and takes in water and minerals
tomatoes	fruit	holds and disperses seeds; protects embryo
spinach	leaf	makes food (site of food production)
celery	stem	provides support and carries water, minerals, and food to all parts of the plant

Have students identify each item. In small groups, as food is passed to each group, have students classify each food as a root, stem, leaf, flower, fruit, or seed. Have groups record their placements on a chart or board visible to everyone. Through class discussion, clarify the part of the plant each food represents.

Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.2*), (*link to SCI.I.1.E.3*).

Reflecting: (*link to SCI.II.1.E.1*), (*link to SCI.II.1.E.2*).

Resources/References:

Webliography
http://mtn.merit.edu/mcf/SCI.III.2.E.5.html

Mayes, Susan**.** *What Makes a Flower Grow?* Usbourne, 1989.

Plant parts
http://www.fmi.org/coolscience/

"Salad Nutrition Chart." *Grow Lab: Activities for Growing Minds.*
http://www.kidsgardening.com/

"Seed Plants." *Sing the Science Standards (*Songbook/CD).
http://scienceexplosion.indiegroup.com/

Classroom Assessment Example SCI.III.2.E.5

Students will create a salad made of plant parts. They will incorporate each plant part in the salad. They will identify the part and the function of each part through a written "menu," a labeled diagram, or an oral presentation about the salad.

(Give students rubric before activity.)

Scoring for Classroom Assessment Example SCI.III.2.E.5

Criteria	Apprentice	Basic	Meets	Exceeds
Completeness of plant parts	Creates salad containing two or three plant parts.	Creates salad containing four or five plant parts.	Creates salad containing all plant parts.	Creates salad containing more than one of each of the plant parts.
Identification of plant parts	Identifies two or three plant parts.	Identifies four or five plant parts.	Identifies six plant parts.	Identifies six plant parts
Functions of plant parts	Identifies a function of two or three plant parts.	Identifies a function of four or five plant parts.	Identifies a function of six plant parts.	Identifies more than one of the functions of the six plant parts.

Strand: III. Use Scientific Knowledge from the Life Sciences in Real-World Contexts

Content Standard: 3. All students will investigate and explain how characteristics of living things are passed on through generations; explain why organisms within a species are different from one another; and explain how new traits can be established by changing or manipulating genes. (Heredity)

Benchmark
Give evidence that characteristics are passed from parents to young (SCI.III.3.E.1).

Benchmark Clarification
All living things pass on characteristics to their offspring. Common physical characteristics can be used to match the offspring of an organism with its parent.
Students will:

- Identify that a puppy looks like a dog
- Identify that a kitten looks like a cat
- Identify that saplings look like trees
- Identify that seedlings look like plants

Key Concepts (voc.)
Characteristics:

- hair and feather color
- eye color
- leaf shape
- flower structure

Real-World Context
Examples of mature and immature organisms:

- dogs/puppies
- cats/kittens
- maple trees/saplings
- plants/seedlings

Instructional Example SCI.III.3.E.1

Benchmark Question: What characteristics of living things are passed on through generations?
Focus Question: What physical characteristics are shared between a young living thing and its parent?

Students will each select a plant or animal (encourage no repeats!). Each child then will obtain two pictures of that plant or animal, one as an immature organism and one as a mature organism. Pictures can be provided by the teacher or found on the computer. Students then will mount the pictures on two 3 x 5 cards. The teacher then will divide the class into small groups. Each member will put his or her two picture cards face down on a desk, mixed with the other members' cards. In turn, students will flip one card over and attempt to find its mate. If no match is found after a child has turned up two cards, both cards are turned back over and play progresses to the next student. A student making a match must explain the shared characteristics to keep the matched cards. Play ends when all matches have been made.

Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.2*), (*link to SCI.I.1.E.5*).

Reflecting: (*link to SCI.II.1.E.1*), (*link to SCI.II.1.E.3*), (*link to SCI.II.1.E.5*).

Resources/References:
Darwin, Charles.

LIFE SCIENCE: EVOLUTION
Charles Robert Darwin (1809 – 1882)
THE FATHER OF EVOLUTION

Charles Robert Darwin, born February 12, 1809, was a gentle child – always deep in thought and sharply observant of the world around him. He collected all kinds of objects, from pebbles, shells and birds' eggs to flowers and insects.

This gentle nature came from his mother, who died when he was only eight years old. Little Darwin's relationship with his father was different, however. While he loved and respected his father, D. Robert W. Darwin didn't understand his son and considered him a "good-for-nothing."

So, young Darwin was sent away to get a classical education in Latin and Greek, in spite of the lad's preference for chemistry and physics. (Young Charles even conducted experiments in these areas in a secret laboratory.) The school's headmaster thought of him as deranged for having such interests. And Dr. Darwin, also disgusted by his son's experimenting, sent him off to medical school.

When medical school didn't work out, Darwin's father sent him to Christ's College in Cambridge, Massachusetts, hoping he would become a clergyman. But Darwin did not spend his years there wisely and drifted through his courses. During this time, he met a well-respected scientist, Professor Henslow. Henslow suggested that Darwin sail on a ship called *The Beagle* as a naturalist. The Beagle was to make a voyage around the world in search of scientific truth.

At the time, Darwin considered the world to be one big question, a mystery puzzle. He was forever observing and collecting, interested in only the facts. He was not thinking about evolution yet; his only goal was finding the truth about things. It wasn't until the five-year voyage of *The Beagle* was over and Darwin had returned home to start his own family that he began to search for the secret to the true ancestry of the human race.

He put together all his observations from the voyage because he felt it was important to present his findings in a simple and understandable fashion. He wanted to report the truth as it appeared to him. (Darwin's first book, Voyage of The Beagle, reads like a fine novel. His next book was more scientific, and dealt with the nature and habits of the barnacle. This one took Darwin eight years to finish.)

During this time, Darwin began developing his theory about the Origin of Species and the Ascent of Man. Although a theory of evolution had been around for thousands of years prior to Christianity, it was the belief in Creation which dominated society. So, bringing the idea of evolution back was a difficult task.

Darwin did not want there to be a battle between the two schools of thought; he just wanted to present his findings truthfully and honestly. But he knew that a battle was inevitable, so he spent 20 years reviewing his data—20 years going over and over his conclusions, testing every question which came to mind so that he could answer any questions asked of him.

Darwin's major contribution to the Theory of Evolution is that evolution takes place by a process called natural selection. In addition, certain truths about the world exist; living creatures are constantly multiplying in number, and can thus reach unlimited numbers. But, the food supply is limited, and so is living space. The result of all these conditions is that there is an ongoing life-and-death competition between all living things.

It also stands to reason, he said, that in order for a living thing to survive, it must be better suited to the environment (geography, climate, natural enemies and availability of food) than the other types of living things around it. Those less fit will die. This process is called survival of the fittest.

During the course of time, the world's environment is always changing. Mountains can form where there were valleys and seas, seas can form where there was land, and the climate can change from severe cold to tropical heat. Because of these changes, living things need to change in order to survive. The changes that living creatures undergo is called evolution. Evolution takes place by natural selection, nature's way of choosing those characteristics which enable a species to survive in a new environment. Natural selection also weeds out those characteristics which are no longer useful through the deaths of members of a species.

Interestingly, Darwin is often given credit for the theory that mankind is descended from monkeys. Actually, what Darwin said was that human beings and apes are **both** evolved from a common ancestor, thus apes are our distant cousins. Darwin also wanted it understood that, when speaking of the survival of the fittest, the word "fittest" does not necessarily mean the strongest but rather the most adaptable.

Darwin saw man's dominance as due not to strength, but to adaptability. And he pointed out that man has developed a system of social cooperation. We have learned that the best way to ensure the survival of the individual human being is to have a friendly cooperative relationship between the entire human race. Finally, Darwin saw human beings as not being separate from nature, but rather a part of nature—of all living things, including the animal kingdom.

Fifty Great Modern Lives. Henry Thomas and Dana Lee Thomas. Hanover House, Doubleday and Company, Inc. 1941.

Webliography.
http://mtn.merit.edu/mcf/SCI.III.3.E.1.html

Dinosaurs.
http://www.nationalgeographic.com/dinorama/

Evolution.
http://www.ucmp.berkeley.edu/education/explotime.html

Guarino, Deborah, *Is Your Mama a Llama?* Scholastic,1997.
Nature magazines, animal books, computer flip-art.

Wild animal photos.
http://www.nationalgeographic.com/kids/creaturefeature/0103/elephants2html/

Wildlife
http://www.selu.com/bio/wildlife/

Whose Baby Are You? Card game
http://www.frankschaffer.com/

Whose Baby Are You? 20 look and match photo puzzles
http://www.livingandlearning.com/

Classroom Assessment Example SCI.III.3.E.1

Students may use one set of the parent/offspring picture cards created for the Instructional Example (*link to SCI.III.3.E.1*) or brainstorm a set of parent/offspring organisms to create a Venn diagram. The diagram will illustrate the similarities and differences of the organism pictured on the cards or brainstormed.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.III.3.E.1

Criteria	Apprentice	Basic	Meets	Exceeds
Identification of common characteristics	Identifies up to one of the shared characteristics.	Identifies two of the shared characteristics.	Identifies three of the shared characteristics.	Identifies four or more of the shared characteristics -or- Identifies indistinct characteristics that may make a positive link questionable.
Completeness of Venn diagram	Constructs a Venn diagram with data missing from one or more sections.	Constructs a Venn diagram with data in all three sections; some data may be inaccurate.	Constructs a Venn diagram with complete and accurate data.	Constructs a Venn diagram and another graphic organizer with complete and accurate data.

Strand: III. Use Scientific Knowledge from the Life Sciences in Real-World Contexts

Content Standard: 4. All students will explain how scientists construct and scientifically test theories concerning the origin of life and evolution of species; compare ways that living organisms are adapted (suited) to survive and reproduce in their environments; and analyze how species change through time. (Evolution)

Benchmark
Explain how fossils provide evidence about the nature of ancient life (SCI.III.4.E.1).

Benchmark Clarification
Scientists who find and use fossils to create an understanding of the past are paleontologists (*link to Glossary*). A fossil is one of many tools used by scientists to study the history of life on Earth.
Fossils can take many forms:

- An impression of a dead plant or animal that has been replaced by minerals
- A cast formed by filling in spaces left from footprints or decaying bodies
- A mold, plant, or animal trapped in tree sap (amber)
- A preserved specimen of life from a specific time

Students will:

- Identify the following types of fossils:
  1. An impression of a dead plant or animal that has been replaced by minerals
  2. A mold of a footprint or a decaying body that has been filled in with sand/clay
  3. A fragment/whole animal that has been trapped in tree sap
- Match fossils with the time period when they were most likely formed
- Explain another tool scientists use to study the history of life on Earth

Paleontologist: A scientist who studies fossils.

Key Concepts (voc.)
Words describing types of evidence:

- fossil
- extinct
- ancient
- modern life forms

See *SCI.V.1.E.4*.

Real-World Context
Common contexts:

- plant and animal fossils
- museum dioramas
- paintings/drawings of ancient life and/or habitats

Instructional Example SCI.III.4.E.1

Benchmark Question: How do scientists acquire evidence about the nature of ancient life?
Focus Question: How are Earth's layers used to determine the age of a fossil?

Begin by reading a biography about **Mary Anning** (*see resources*).

Students will create a model of fossil layers similar to the Earth's. Each pair of students will use approximately one-third of a can of play dough (all one color or three separate colors) and two small items (twigs, leaves, bark, seeds, dead insects, fruit rinds, chicken bones, small shells, or small plastic insects) to make fossil layers in a paper cup. Guide students through the following steps: Put one-third of the play dough in the bottom of the cup, put a specimen on top of the play dough, cover it with another one-third of the play dough and press, put the second specimen on top of this layer, and cover with the remaining one-third of the play dough and press. Students then will discuss which layers in the cup are the oldest and youngest. Students will explain how this activity is similar to the idea that the age of a fossil layer is determined by the order in which it was formed.

Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.2*), (*link to SCI.I.1.E.5*).

Reflecting: (*link to SCI.II.1.E.1*), (*link to SCI.II.1.E.4*), (*link to SCI.II.1.E.5*).

Resources/References:

Anning, Mary.
http://www.teacher.scholastic.com/literacy place/

Biographies & fossil information.
http://www.npwrc.usgs.gov/resource/1998/agate/pale.htm

"Changes over Time." A Second Grade Unit by the Battle Creek Area Mathematics & Science Standards.

"Fossils, Fossils." *Sing the Science Standards (*Songbook/CD).
http://scienceexplosion.indiegroup.com/

Museum of Paleontology
http://www.ucmp.berkeley.edu/

Classroom Assessment Example SCI.III.4.E.1

The teacher will collect and redistribute cups, making sure that students do not receive their own cups. Students will open their cups by carefully tearing them down the sides. Students should carefully explore the shapes and patterns that were made by their casts. With a cautious approach, students may be able to keep the molds of their specimens intact. The teacher will ask students which specimens made a good impression or disintegrated, and which lived at an earlier time or lived later. Students will draw conclusions and present their findings based on their observations.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.III.4.E.1

Criteria	Apprentice	Basic	Meets	Exceeds
Identification of layers	Recognizes that objects were buried at different levels (layers).	Locates at least two distinct layers.	Locates all layers and finds evidence of fossils.	Locates all layers and explains that fragile materials disintegrate and therefore not all plants and animals from the past made fossils.
Demonstration of scientific methods	Preserves some evidence of the layers.	Preserves layers and some of the casts.	Preserves the layers and the casts.	Works meticulously like a paleontologist and identifies the specimens precisely.
Accuracy of relationships	Explains that some plants/animals lived a long time ago.	Recognizes that fossils exist within layers of the Earth.	Describes the relationship between layers and the age of specimens.	Provides evidence that not all members of a species (i.e., dinosaurs) became extinct at once -or- Links climate and other natural disasters with fossil findings.

Strand: III. Use Scientific Knowledge from the Life Sciences in Real-World Contexts

Content Standard: 4. All students will explain how scientists construct and scientifically test theories concerning the origin of life and evolution of species; compare ways that living organisms are adapted (suited) to survive and reproduce in their environments; and analyze how species change through time. (Evolution)

Benchmark
Explain how physical and behavioral characteristics of organisms help them to survive in their environments (SCI.III.4.E.2).

Benchmark Clarification
Organisms have physical and behavioral characteristics (adaptations) that help them survive. Different parts and/or behaviors of an organism help it survive in its living area (environment).

Students will:
- Explain the physical adaptation of owls – they have talons to catch small animals
- Explain the behavioral adaptation of bears – they learn to forage in state parks or dumps
- Explain the instinct adaptation of salmon – they swim upstream to mate
- Explain the physical adaptation of plants – they grow toward a light source

Key Concepts (voc.)
Words describing characteristics:
- adaptation
- instinct
- learning
- habit

Words describing traits and their adaptive values:
- sharp teeth or claws for catching and killing prey
- color for camouflage
- behaviors

Real-World Context
Common vertebrate adaptations:
- white polar bears
- sharp claws and sharp canines for predators
- changing colors of chameleon

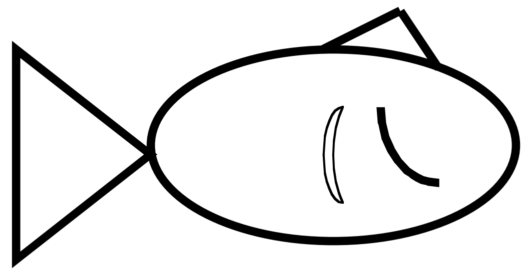
Behaviors:
- migration
- communication of danger

Instructional Example SCI.III.4.E.2

Benchmark Question: In what ways are living things adapted (suited) to survive in their environments?
Focus Question: How does an animal's camouflage affect its survival?

Divide the class into small groups. Using four different colors of construction paper, prepare a set of 12 fish of each color (48 fish in all) for each group. One set of twelve fish must be the same blue as the blue paper "water" habitat. Create "water" habitat by cutting a pond shape from a piece of large blue paper and placing it on the floor. In turn, each child in the group will use one hand to pick up ("catch") as many fish as possible, one fish at a time, in 10 seconds. All results will be charted. Compile total class data. Through class discussion of the data, respond to the focus question.

Fish shape example:



Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.2*), (*link to SCI.I.1.E.3*), (*link to SCI.I.1.E.5*), (*link to SCI.I.1.E.6*).

Reflecting: (*link to SCI.II.1.E.1*).

Resources/References:
Webliography
http://mtn.merit.edu/mcf/SCI.III.4.E.2.html

All About Series. Scholastic.

Critters. "Table Manners," "Hide and Seek," "Gone Fishing." AIMS.
http://www.aims.edu.org/aimscatalog/

Endangered Series. Crabtree.
Hide & Seek Series. Childrens Press.
How & Why Series. CTP.

Classroom Assessment Example SCI.III.4.E.2

Each student will invent an animal and design an environment (2D or 3D) that will support the invented animal. Students will develop and explain three physical adaptations and one behavioral adaptation that the animal uses to survive in the environment. Each student will then present the model in class with a two-minute presentation.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.III.4.E.2

Criteria	Apprentice	Basic	Meets	Exceeds
Design of environment	Designs (with teacher support) an environment that partially camouflages the animal.	Designs (with teacher support) an environment that camouflages the animal.	Designs (without teacher support) an environment that camouflages the animal.	Designs (without teacher support) an environment that camouflages the animal in more than one way.
Design of physical adaptations	Designs one or two physical adaptations.	Designs three physical adaptations.	Designs and explains three physical adaptations.	Designs and explains more than three physical adaptations.
Explanation of behavioral adaptations	Explains a behavioral adaptation.	Develops a behavioral adaptation.	Develops and explains one behavioral adaptation.	Compares behavioral adaptation to real animals.
Effectiveness of oral presentation	Gives an oral presentation with teacher support.	Gives a two-minute oral presentation with organized information and teacher support.	Gives a two-minute oral presentation with organized information.	Gives a two-minute oral presentation with eye contact, appropriate volume, good posture, and organized information.

Strand: III. Use Scientific Knowledge from the Life Sciences in Real-World Contexts

Content Standard: 5. All students will explain how parts of an ecosystem are related and how they interact; explain how energy is distributed to living things in an ecosystem; investigate and explain how communities of living things change over a period of time; describe how materials cycle through an ecosystem and get reused in the environment; and analyze how humans and the environment interact. (Ecosystems)

Benchmark
Identify familiar organisms as part of a food chain or food web and describe their feeding relationships within the web (SCI.III.5.E.1).

Benchmark Clarification
All living things depend on each other to survive. The parts of a food chain or food web have special names that describe the feeding relationships with the web.
Students will:

- Identify and categorize producers – they make their own food (plants)
- Identify and categorize consumers – they depend on producers or consumers for their food
- Identify and categorize decomposers – they break down dead plants and animals and return nutrients to the soil
- Identify and categorize predators – they hunt other animals and devour their prey
- Identify and categorize prey – they are animals that are hunted for food
- Define food chain (*link to Glossary*)
- Define food web (*link to Glossary*).

Food Chain: the flow of energy from the Sun to one plant, from one plant to one animal, from one animal to another animal.

Food web: the interrelationships among two or more food chains in a community.

Key Concepts (voc.)
Words describing parts of a food web:

- producer
- consumer
- predator
- prey
- decomposer
- habitat
- community

Real-World Context
Food chains and food webs involving these common organisms:

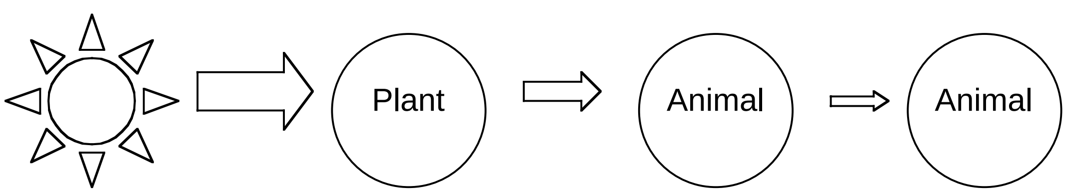
- rabbits
- birds
- snakes
- grasshoppers
- plants

Instructional Example SCI.III.5.E.1

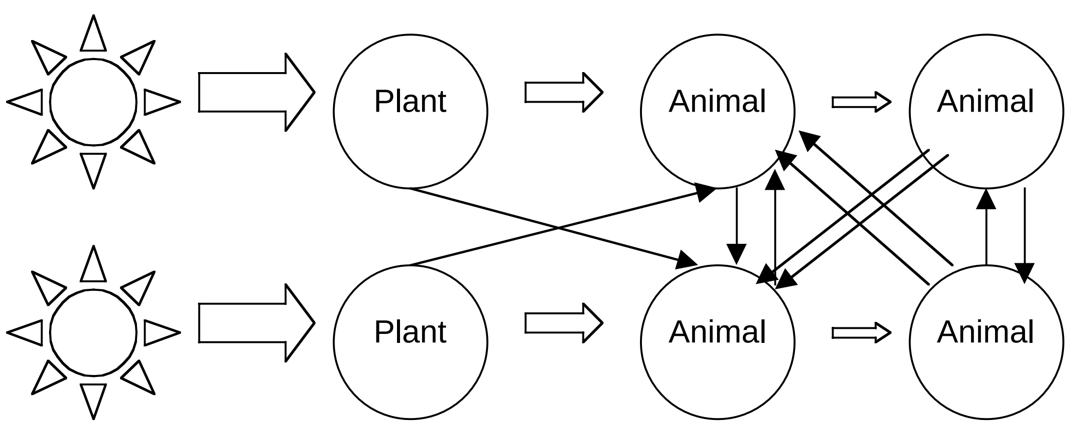
Benchmark Question: How are parts of an ecosystem related and how do they interact?
Focus Question: How are organisms linked together in a food chain or food web and what is the flow of energy in the chain or web?

Have each student make (draw) separate pictures of each member of a three-member food chain beginning with a plant. (For example: corn, field mouse, red-tailed hawk.) Each student will name and explain the roles (*link to SCI.III.5.E.1*) of the members of his or her food chain to the class. Once done, the food chains will be stapled to a bulletin board, as shown below. Then students will use yarn to connect the predators within their food chains to the prey in other food chains. The resulting food web will demonstrate the dependence of living things on one another for survival and the interdependence of food chains, which form a food web. Next, have students attach paper arrows (pointing *away* from the plant) to the pieces of yarn to show the direction of the flow of energy. Paper arrows closest to the plant should be larger than the arrows further away from the plant to show that the amount of usable energy decreases.

Simple food chain example (direction of arrow shows flow of energy; size of arrow shows amount of energy):



Simple food web example:



Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.2*), (*link to SCI.I.1.E.3*), (*link to SCI.I.1.E.5*), (*link to SCI.I.1.E.6*).

Reflecting: (*link to SCI.II.1.E.1*), (*link to SCI.II.1.E.2*), (*link to SCI.II.1.E.4*).

Resources/References:
Webliography
http://mtn.merit.edu/mcf/SCI.III.5.E.1.html

Animal Close-Up Series. Charlesbridge**.**
"Nature's Way." *Sing the Science Standards (*Songbook/CD).

http://scienceexplosion.indiegroup.com/
Pass the Energy, Please! Shawn McKinney Dawn Publishing, 2000.

Classroom Assessment Example III.5.E.1

Give each student a poster (teacher-created using words or pictures) with six organisms circled. At least one of each of the following is represented on the poster: producer, consumer, predator, and decomposer.
Using his or her poster, each student will choose four out of the six organisms and use them to construct a food chain. Each student will explain the feeding relationship within the new chain.

Place students in groups of three. Each student will contribute the four organisms from his or her food chain for a total of twelve organisms. Each group will then create a food web showing the interrelationships of the food chains.

Next, each student will choose one organism from his or her group's web to eliminate. Each student will write a list of predictions about what will happen to the food web if the chosen organism is eliminated. (For example, if a hawk is eliminated from the "corn, field mouse, red-tailed hawk" food chain, the mouse population will increase and the amount of grain will decrease, because more grain will be consumed by the mice, making less available for consumption by livestock and humans…) Students will share their predictions and the reasons for each prediction with the entire class.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.III.5.E.1

Criteria	Apprentice	Basic	Meets	Exceeds
Identification of feeding relationships	Recognizes that there are feeding relationships between organisms, but does not identify them specifically.	Identifies one or more feeding relationships.	Identifies at least three common feeding relationships.	Identifies common feeding relationships and also provides evidence of lesser known relationships.
Accuracy of predictions	Writes one prediction/ consequence but is unclear on the sequence of events/the reason.	Writes one or two predictions/ consequences and accurate reasons.	Writes three predictions/ consequences and accurate reasons.	Writes four or more predictions/ consequences and provides accurate reasons.

Strand: III. Use Scientific Knowledge from the Life Sciences in Real-World Contexts

Content Standard: 5. All students will explain how parts of an ecosystem are related and how they interact; explain how energy is distributed to living things in an ecosystem; investigate and explain how communities of living things change over a period of time; describe how materials cycle through an ecosystem and get reused in the environment; and analyze how humans and the environment interact. (Ecosystems)

Benchmark
Describe the basic requirements for all living things to maintain their existence (SCI.III.5.E.2).

Benchmark Clarification
All living things need energy and obtain it from the sun directly (plants/producers) or indirectly (animals/consumers). All living things also need a habitat that provides water, food, space, and minerals. Some living things also need air and light to survive.

Students will:

- Describe how a living thing gets water, food, space, minerals, and sometimes air and light from a habitat (*link to Glossary*)

Habitat: The place where an organism naturally lives or grows, such as a forest, stream, or prairie.

Key Concepts (voc.)
Needs of life:

- food
- habitat
- water
- shelter
- air
- light
- minerals
-

See *SCI.III.2.E.4*.

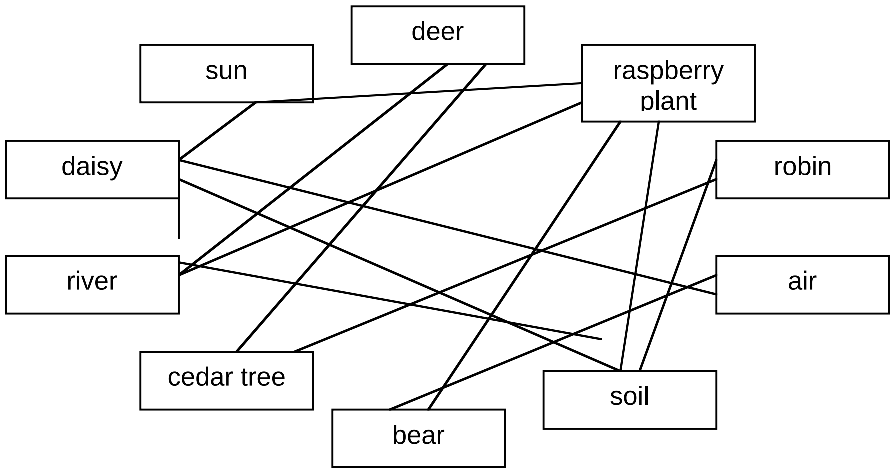
Real-World Context
Selected ecosystems:

- aquarium
- rotting log
- terrarium
- backyard
- local pond or wetland
- wood lot

Instructional Example SCI.III.5.E.2

Benchmark Question: How is energy distributed to living things in an ecosystem?
Focus Question: What does an animal need to survive?

Students will work in small groups to create a list of life requirements for a specific animal. Groups will post lists and analyze them to find common life requirements. The teacher will assign one role* in nature to each student. Each student will create a nametag for his or her role. Standing in a circle, the teacher will hold the end of a ball of string and start the web (see graphic below) by tossing the ball of string to a student while stating the relationship



(e.g., a bear eats) raspberries, the raspberry bush needs water, water supplies cedar trees, etc.). The recipient will hold the string in one hand and toss the ball of string to another student, stating the relationship between their roles. Students will continue this exercise until the web is complete. After the web is complete, the teacher will eliminate one role by having a student tug on the string and drop it. Anyone feeling the tug must also tug and subsequently also will be eliminated. At the end of the game, students will discuss how they were affected and why.

*Possible roles: air, Sun, water, soil, types of plants, types of animals.

Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.5*).

Reflecting: (*link to SCI.II.1.E.1*), (*link to SCI.II.1.E.4*), (*link to SCI.II.1.E.5*).

Resources/References:
Webliography
http://mtn.merit.edu/mcf/SCI.III.5.E.2.html

Know It All Series. McClanahan.
Life In…Series. World Book.
"Special Needs." *Sing the Science Standards* (Songbook/CD).
http://scienceexplosion.indiegroup.com/

"Web of Life." PROJECT LEARNING TREE.
http://www.affoundation.org/PLT/

Classroom Assessment Example SCI.III.5.E.2

Create a labeled drawing of an animal in its habitat. Use arrows labeled with food, water, shelter, air, light, or minerals to connect those life requirements to the animal. Then eliminate one plant or animal from the picture and predict the consequences of that action. Write the prediction and the reasons for it in a science journal.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.III.5.E.2

Criteria	Apprentice	Basic	Meets	Exceeds
Completeness of habitat drawing	Draws an animal in its habitat with three or more labels missing.	Draws an animal in its habitat with two or fewer labels missing.	Draws and labels an animal and each item in the picture of the habitat.	Draws and labels an animal and each item in the picture of the habitat, featuring more than one example of any of the life requirements.
Completeness of relationships	Places four or fewer labeled arrows correctly.	Places five labeled arrows correctly.	Places six labeled arrows correctly.	Places more than six labeled arrows correctly.
Accuracy of predictions	Writes one prediction but reasons are incomplete.	Writes one prediction but prediction is inaccurate or reason is inaccurate.	Writes more than one prediction and reasons are accurate.	Writes two or more predictions and reasons are accurate.

Strand: III. Use Scientific Knowledge from the Life Sciences in Real-World Contexts

Content Standard: 5. All students will explain how parts of an ecosystem are related and how they interact; explain how energy is distributed to living things in an ecosystem; investigate and explain how communities of living things change over a period of time; describe how materials cycle through an ecosystem and get reused in the environment; and analyze how humans and the environment interact. (Ecosystems)

Benchmark
Design systems that encourage the growing of particular plants or animals (SCI.III.5.E.3).

Benchmark Clarification
An ecosystem is a place where living and non-living things interact.
Students will:

- Design a controlled ecosystem *(reference Real World Context)* that provides or supplies the needs of life *(reference Key Concepts)* for specific animals or plants

Key Concepts (voc.)
Needs of life:

- food
- habitat
- water
- shelter
- air
- light
- minerals

Real-World Context
Ecosystems managed by humans:

- farms
- ranches
- gardens
- lawns
- potted plants

Instructional Example SCI.III.5.E.3

Benchmark Question: In what ways are various kinds of living things adapted (suited) to survive in their environments?
Focus Question: What do plants and animals need in order to live?

Tell students they are going to design an ecosystem that will include everything needed to sustain life for a specific plant or animal. Have one member from each group draw the name of an animal or plant from a bag, can, etc.

Students will research an ecosystem studied by Rachel Carson,

LIFE SCIENCE: ECOSYSTEMS
Rachel Louis Carson (1907 – 1964)
A CRUSADER AGAINST THE DANGERS OF PESTICIDES

Rachel Carson was raised in the towns of Springdale and Parnassus, Pennsylvania. It was here that she received her early education in the public school system, but it was her mother, Maria McLean Carson, who taught Rachel to love nature. She learned to appreciate birds, insects, and the wildlife in and around streams and ponds.

So, even though Rachel's first career goal was to become a writer, she later changed her mind and earned a B.A. in science from the Pennsylvania College for Women at Pittsburgh. She then enrolled in Johns Hopkins University in Baltimore, Maryland, where she received a master's degree in zoology.

Rachel Carson went on to work as an aquatic biologist with the U.S. Fish &Wildlife Service in Washington, D. C. Later, she became editor-in-chief of the bureau, responsible for issuing bulletins and leaflets aimed at preventing the depletion of the nation's wildlife. Through her writings, Carson wanted to make people aware of dangers to our environment such as pesticides.

Modern science has developed a variety of fertilizers for different purposes. Some provide mineral nutrients necessary for plant growth. Others are made to kill a specific kind of insect or a variety of insects. Then there are the kinds of pesticides that kill other plants or weeds which compete with crops for mineral nutrients in the soil. Even though fertilizers help increase the size and amount of crops, questions exist about their safety, both to nature and to mankind. In general, fertilizers are safe. But some fertilizers which contain pesticides can also be dangerous.

Rachel Carson told the world about the dangers of DDT, a pestiside widely used by farmers in the 1960's to control bugs. In her book, The Silent Spring, she told how DDT was poisoning parts of the food chain, and thus affecting all living things. In the food chain, all living things are connected in some way. When any part of the food chain is harmed, we all are harmed. The harm may not come in the same ways or to the same degree, but all living things are affected.

Pesticides can filter into waterways through the soil and through improper storage and disposal methods. Once in the water, they affect the aquatic life found in these ponds and streams, rivers and the oceans. Then it is only a matter of time before these pesticides begin to effect the animals which prey on aquatic animals and plant life.

For example, you can find fish with toxic levels of the pesticides in their bodies. When birds eat these fish, they will also become poisoned with pesticides. When they lay eggs, the shells are too fragile to protect the unborn baby birds, or their babies may be deformed. We must also consider the animals and insects living on or near lands where pesticides are used. They, too, can get sick from eating these plants or other small animals (prey).

Much of these contaminated lands are farms where our food is grown, where we get tomatoes, corn, wheat, beef and pork. And the list goes on and on. Ms. Carson warned that we all needed to stop using DDT or many animals and plants would die.

Rachel Carson made us all aware that it is important to know what pesticides are being used and how they are used – for the sake of all living things.

References

Current Biography 1951. H. W. Wilson Company. Nov. 1951. New York. P. 12-13.

The Sea Around Us. 1951. Rachel L. Carson.

The Silent Spring. 1962. Rachel L. Carson.

"Soiled Shores" by Marquerite Holloway & John Horgan. Scientific American. Oct. 1991.

Grace Chow,

LIFE SCIENCE: ECOSYSTEMS
Grace Chow
PROTECTING OUR CLEAN DRINKING WATER

Grace Chow is a civil engineer whose work centers on concerns for the environment. These concerns include questions like how we use what is available from nature in an efficient manner, how we can protect the environment in innovative ways, and how to develop new technologies and methods to achieve these goals.

Environmental problems occur in a variety of ways. When the water level on a lake or a waterway is high, it can cause the shoreline to erode away. When we build anything along a shoreline, we must realize that both the materials used in the building process as well as those materials in use after a building is complete can filter into the nearby waterways. Also, that heavy rains alone can cause flooding and soil erosion.

Cities build and maintain sanitary sewage treatment facilities designed to keep sewage (waste) water separate from clean drinking water. They are also designed to clean sewage from the water so that it can be reused. But storms can cause these treatment plants to flood. When this happens, sewage water spills out into the rivers, streams and other sources to clean water. Or, sometimes these facilities are designed incorrectly or operated in a careless manner. Then they can cause the same kinds of contamination of our clean water sources.

Grace Chow works on developing better water treatment systems. She is involved with a number of projects designed to recycle sewage water in such a way as to put the water to good use for not only people, but also other animals and plant life.

It is hoped that sewage water treated in new ways can be re-used for things like the irrigation of farms, parks and recreational areas, instead of using fresh water. That way the limited amount of available fresh water can be used for dinking.

Aldo Leopold,

LIFE SCIENCE: ECOSYSTEMS
Aldo Leopold (1887 – 1948)
FATHER OF MODERN CONSERVATION

Born in 1887, Aldo Leopold spent his boyhood years in Burlington, Iowa, and went on to attend Yale University's School of Forestry where he earned his professional degree.

When Aldo joined the U.S. Forest Service in 1909, his views were quite different from those around him. Leopold approached forest management from an ecological perspective. In his mind, forest management went beyond providing trees for industry. It should include watershed protection for the whole region from which a river receives it supply of fresh water, as well as grazing, fish and wildlife conservation, recreation and, of course, protecting land from the ravages of man.

In 1933, his treatise on Game Management led to a professorship at the University of Wisconsin. There, he sought to educate and involve youth in matters of ecology. He organized projects including counting nests, planting shelter belts, filling feeding stations, warning poachers, and recording weather conditions year round.

Leopold also established some conservation rules which he called Ecological Principles. These rules call upon us to do several things. First, to maintain soil fertility; second, to preserve the stability of water systems; and third, produce useful products. Fourth, he also called upon us to preserve our fauna and flora as much as possible. (Fauna refers to the animals of a given region and flora refers to the plants of a region.)

In Leopold's opinion, farmers and others interested in erosion prevention believed only in the first three conservation principles. The sportsman or hunter only believed in producing useful products for the purpose of hunting. But the "true" nature lover, he said, defined conservation in terms of preserving our flora and fauna as much as possible. Leopold believed that conservation was not only about prevention, but also about using natural resources wisely. Nature as a whole is a community of life including the soil, water, fauna, flora and people.

One of Aldo Leopold's last conservation fights was over the Wisconsin's whitetail deer management laws. The deer herd there had gotten so large that it was eating away the plant life faster than the land could replace it. They were ruining the land. Whitetail fawns were starving to death and bucks were not growing to maturity. Leopold knew the answer to this problem – reduce the size of the deer population.

The deer had no natural predators in this region, so their numbers increased beyond a natural balance. Leopold's advice was to lengthen the annual hunting season and allow the hunting of both bucks and fawns. (Fawns are not usually hunted.) Conservationists did not like what Leopold advised, so the battles began.

Today, arguments are still being waged over what role people should take in preserving nature and the balance of nature. Is it our responsibility only to oversee and protect the lands and animals, or is it our duty to keep animal populations at controlled levels by allowing hunting? What should our role be when an animal population gets too large to be supported by the vegetation of the region? How much human intervention is too much?

Because he knew more about land ecology than any other person of his time, many principles of wildlife management in practice today were developed by Aldo Leopold and his co-workers. He had a rare understanding of the way biotic (life) forces interact, and the ways in which these interactions occur, affecting the life and landscapes of America.

References

A Sand County Almanac and Sketches Here and There. Aldo Leopold. Oxford University Press. 1949, 1980.

A Sand County Almanac with other Essays on Conservation from Round River. Aldo Leopold. Oxford University Press. 1949, 1966.

Game Management. Aldo Leopold. Charles Scribner & Sons. 1933, 1961.

"Leopold Helped Set the Course of Modern Conservation." Wisconsin Conservation Bulletin. Dec. 1954.

"Aldo Leopold Remembered." By Clay Schoenefeld. Audubon. May 1978.

or another field biologist. Using the writing process, students will write a report explaining how the ecosystem they have researched supports the life of their plant or animal. Using the steps of the writing process, they will make sure that all vocabulary is used.

Each group will construct a model of the ecosystem they have researched and label the presence of the seven needs of life.

Each group will present their ecosystem model to the class and explain how the ecosystem supports the life of each plant or animal in the model.

Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.2*), (*link to SCI.I.1.E.5*).

Reflecting: (*link to SCI.II.1.E.1*), (*link to SCI.II.1.E.2*), (*link to SCI.II.1.E.3*), (*link to SCI.II.1.E.4*), and (*link to SCI.II.1.E.5*).

Resources/References:
Webliography
http://mtn.merit.edu/mcf/SCI.III.5.E.3.html

Computer programs: Power Point, Hyper Studio.

"An Earthworm Farm." *Science High Scope K-3 Curriculum Series.*
Echols, Jean. *Ant Homes Under the Ground.* GEMS, 1999.
Lauber, Patricia. *Earthworms: Underground Farmers*. Henry Holt, 1997.

"Special Needs." *Sing the Science Standards (*Songbook*/CD).*
http://scienceexplosion.indiegroup.com/

Classroom Assessment Example SCI.III.5.E.3

Research the ecosystem needed to support life for a specific plant or animal. Design an ecosystem that will include everything needed to sustain life for that specific plant or animal. Then present a model of the environment with a written report that includes the seven needs of life (*see Key Concepts*). This report may include information about the environmental studies of Rachel Carson (*link to Biography*), Grace Chow (*link to Biography*), Aldo Leopold (*link to Biography*), or another field biologist.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.III.5.E.3

Criteria	Apprentice	Basic	Meets	Exceeds
Completeness of ecosystem model	Identifies few needs of life.	Identifies some needs of life.	Identifies all needs of life.	Portrays all needs of life with many details.
Accuracy of scientific information	Includes at least one fact related to the scientist who was researched.	Includes at least two facts related to the scientist who was researched.	Includes at least three facts related to the scientist who was researched.	Includes at least four facts related to the scientist who was researched.
Correctness of format	Writes a report with many grammatical errors that interfere with the interpretation of content.	Writes a report with few grammatical errors that interfere with interpretation of content.	Writes a report with few grammatical errors that do not interfere with the interpretation of content.	Writes a report using complete sentences and no errors in capitalization, punctuation, spelling, or indentation.
Completeness of presentation/replica	Reflects research and some life needs.	Reflects research and most life needs.	Reflects research and all life needs.	Reflects research and all life needs, as well as a clear explanation of their relationship in the ecosystem.

Strand: III. Use Scientific Knowledge from the Life Sciences in Real-World Contexts

Content Standard: 5. All students will explain how parts of an ecosystem are related and how they interact; explain how energy is distributed to living things in an ecosystem; investigate and explain how communities of living things change over a period of time; describe how materials cycle through an ecosystem and get reused in the environment; and analyze how humans and the environment interact. (Ecosystems)

Benchmark
Describe positive and negative effects of humans on the environment (SCI.III.5.E.4).

Benchmark Clarification
Humans have the ability to change the environment. Human actions such as development, construction, pollution, maintenance, and preservation affect the environment.

Students will:
- Analyze the effects of development (community growth/creating parks) on the environment
- Analyze the effects of construction (roads, malls, parking lots) on the environment
- Analyze the effects of pollution (garbage, waste water treatment) on the environment
- Analyze the effects of land management practices on the environment
- Analyze the effects of land preservation on the environment
- Analyze the effects of the use of renewable and non-renewable natural resources (*link to Glossary*) on the environment

Natural resources: a material that is currently or potentially useful and that has been created by non-human processes. (Natural resources are often considered either renewable such as trees or non-renewable such as oil and natural gas.)

Key Concepts (voc.)
Human effects on the environment:
- garbage
- habitat destruction
- waste water treatment
- land management
- renewable and non-renewable resources

Real-World Context
- household wastes
- school wastes
- waste water treatment
- habitat destruction due to community growth
- reforestation projects
- establishing parks or other green spaces
- recycling

Instructional Example SCI.III.5.E.4

Benchmark Question: How do communities of living things change over a period of time?
Focus Question: How do community growth and pollution affect a frog?

Students will review life requirements (*link to SCI.III.5.E.*2) of a frog.

Each student will represent a frog.

Students will cut five 2” x 2” squares of each color of construction paper for a total of twenty squares: blue = water, green = food, yellow = air, and brown = space. The cards represent a frog’s life requirements. Every student will mark an “x” on the back of one square.

Students will pile all of the squares in the center of the room and then each student will take 20 cards.

Students will predict which life requirements each color represents.

Frogs live if they have one of every color. Living frogs remain standing and turn over water and space cards. If there is an “x,” they have died because of pollution or habitat destruction.

Students will write paragraphs summarizing the effects of pollution and land development on a frog.

Students will write paragraphs evaluating areas of their community that would be suitable for a nature park (frog habitat).

Students will create models of their nature park.

Constructing: (*link to SCI.I.1.E.1*), (*link to SCI.I.1.E.2*).

Reflecting: (*link to SCI.II.1.E.1*), (*link to SCI.II.1.E.2*), (*link to SCI.II.1.E.4*).

Resources/References:
Webliography
http://mtn.merit.edu/mcf/SCI.III.5.E.4.html

Animals in Danger Series. Heineman Library**.**
Community resources: DNR personnel and other individuals, books, internet, local maps.
Harlow, Rosie. *Nature in Danger*. Kingfisher, 1995.

“Waste Not.” *Sing the Science Standards (*Songbook/CD).
http://scienceexplosion.indiegroup.com/

Classroom Assessment Example SCI.III.5.E.4

Working alone, students will evaluate areas of their community suitable for a park, select a site, and create a map. In writing, students will justify their area and evaluate environmental influences in a multi-media presentation to the class. The class will vote for the most suitable plan and will present it to the local city council or another appropriate community governmental unit.

(Give students rubric before activity.)

Scoring of Classroom Assessment Example SCI.III.5.E.4

Criteria	Apprentice	Basic	Meets	Exceeds
Completeness of habitat map	Draws map with no key and no title.	Draws map that includes an incomplete key and/or an incomplete title.	Draws map that includes a complete key and a complete title.	Draws map that includes a complete key, a complete title, and an accurate scale.
Justification of area selection	Writes one reason without supporting data.	Writes one reason with supporting data.	Writes two reasons with supporting data.	Write three or more reasons with supporting data.
Explanation of influences	Explains an influence without distinction of positive or negative.	Explains a positive or negative influence.	Explains one positive and one negative influence.	Explains two or more positive and two or more negative influences.
Accuracy of presentation	Presents written and oral reports inaccurately.	Presents written and oral reports with one technology enhancement accurately.	Presents written and oral reports with more than one technology enhancement accurately.	Presents written and oral reports with more than one technology enhancement. Uses color and pictures accurately.