Sixth Grade Companion Document

6-Unit 2: Ecosystems

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Introduction to the K-7 Companion Document
An Instructional Framework

Overview

The Michigan K-7 Grade Level Content Expectations for Science establish what every student is expected to know and be able to do by the end of Grade Seven as mandated by the legislation in the State of Michigan. The Science Content Expectations Documents have raised the bar for our students, teachers and educational systems.

In an effort to support these standards and help our elementary and middle school teachers develop rigorous and relevant curricula to assist students in mastery, the Michigan Science Leadership Academy, in collaboration with the Michigan Mathematics and Science Center Network and the Michigan Science Teachers Association, worked in partnership with Michigan Department of Education to develop these companion documents. Our goal is for each student to master the science content expectations as outlined in each grade level of the K-7 Grade Level Content Expectations.

This instructional framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings and expanding thinking beyond the classroom.

These companion documents are an effort to clarify and support the K-7 Science Content Expectations. Each grade level has been organized into four teachable units- organized around the big ideas and conceptual themes in earth, life and physical science. . The document is similar in format to the Science Assessment and Item Specifications for the 2009 National Assessment for Education Progress (NAEP). The companion documents are intended to provide boundaries to the content expectations. These boundaries are presented as “notes to teachers”, not comprehensive descriptions of the full range of science content; they do not stand alone, but rather, work in conjunction with the content expectations. The boundaries use seven categories of parameters:

a. **Clarifications** refer to the restatement of the “key idea” or specific intent or elaboration of the content statements. They are not intended to denote a sense of content priority. The clarifications guide assessment.
b. **Vocabulary** refers to the vocabulary for use and application of the science topics and principles that appear in the content statements and expectations. The terms in this section along with those presented

within the standard, content statement and content expectation comprise the assessable vocabulary.

c. **Instruments, Measurements and Representations** refer to the instruments students are expected to use and the level of precision expected to measure, classify and interpret phenomena or measurement. This section contains assessable information.
d. **Inquiry Instructional Examples** presented to assist the student in becoming engaged in the study of science through their natural curiosity in the subject matter that is of high interest. Students explore and begin to form ideas and try to make sense of the world around them. Students are guided in the process of scientific inquiry through purposeful observations, investigations and demonstrating understanding through a variety of experiences. Students observe, classify, predict, measure and identify and control variables while doing “hands-on” activities.
e. **Assessment Examples** are presented to help clarify how the teacher can conduct formative assessments in the classroom to assess student progress and understanding
f. **Enrichment and Intervention** is instructional examples the stretch the thinking beyond the instructional examples and provides ideas for reinforcement of challenging concepts.
g. **Examples, Observations, Phenomena** are included as exemplars of different modes of instruction appropriate to the unit in which they are listed. These examples include reflection, a link to real world application, and elaboration beyond the classroom. These examples are intended for instructional guidance only and are not assessable.
h. **Curricular Connections and Integrations** are offered to assist the teacher and curriculum administrator in aligning the science curriculum with other areas of the school curriculum. Ideas are presented that will assist the classroom instructor in making appropriate connections of science with other aspects of the total curriculum.

This Instructional Framework is NOT a step-by-step instructional manual but a guide developed to help teachers and curriculum developers design their own lesson plans, select useful portions of text, and create assessments that are aligned with the grade level science curriculum for the State of Michigan. It is not intended to be a curriculum, but ideas and suggestions for generating and implementing high quality K-7 instruction and inquiry activities to assist the classroom teacher in implementing these science content expectations in the classroom.

6th Grade Unit 2:
Ecosystems

Content Statements and Expectations

Code	Statements & Expectations	Page
L.OL.M.5	**Producers, Consumers, and Decomposers- Producers are mainly green plants that obtain energy from the sun by the process of photosynthesis. All animals, including humans, are consumers that meet their energy by eating other organisms or their products. Consumers break down the structures of the organisms they eat to make the materials they need to grow and function. Decomposers, including bacteria and fungi, use dead organisms or their products to meet their energy needs.**	1
L.OL.06.51	Classify producers, consumers, and decomposers based on their source of food (the source of energy and building materials).	1
L.OL.06.52	Distinguish between the ways in which consumers and decomposers obtain energy.	2
L.EC.M.1	**Interactions of Organisms - Organisms of one species form a population. Populations of different organisms interact and form communities. Living communities and nonliving factors that interact with them form ecosystems.**	3
L.EC.06.11	Identify and describe examples of populations, communities, and ecosystems including the Great Lakes region.	3
L.EC.M.2	**Relationships of Organisms – Two types of organisms may interact with one another in several ways: They may be in a producer/consumer, predator/prey, or parasite/host relationship. Some organisms may scavenge or decompose another. Relationships may be competitive or mutually beneficial. Some species have become so adapted to each other that neither could survive without the other.**	4
L.EC.06.21	Describe common patterns of relationships between and among populations (competition, parasitism, symbiosis, predator/prey).	4
L.EC.06.22	Explain how two populations of organisms can be mutually beneficial and how that can lead to interdependency.	5
L.EC.06.23	Predict and describe how changes in one population might affect other populations based upon their relationships in the food web.	5

6 - Unit 2: Ecosystems

Big Ideas (Key Concepts)

- All life forms, including humans, are part of a global food chain in which food is supplied by plants, which need light to produce food.
- Ecosystems continually change with time as environmental factors and populations of organisms change.

Clarification of Content Expectations

Standard: Organization of Living Things

Content Statement – L.OL.M.5

Producers, Consumers, and Decomposers- Producers are mainly green plants that obtain energy from the sun by the process of photosynthesis. All animals, including humans, are consumers that meet their energy by eating other organisms or their products. Consumers break down the structures of the organisms they eat to make the materials they need to grow and function. Decomposers, including bacteria and fungi, use dead organisms or their products to meet their energy needs.

Content Expectations

L.OL.06.51 Classify producers, consumers, and decomposers based on their source of food (the source of energy and building materials).

Instructional Clarifications

1. Classify is to arrange or order producers, consumers, and decomposers by the source of food for growth and development.
2. Producers obtain food by trapping light energy and to make food and supply their energy needs (plants are examples of producers).
3. Consumers obtain their food directly from another organism by eating it or being a parasite on or in it (animals, including humans are examples of consumers).
4. Decomposers use plants and animals as well as animal waste products as their food source. (Examples include bacteria and fungi.)
5. Decomposers release chemicals into the soil and water to break down these materials. This allows the decomposers to take in small particles and release minerals back to the environment to be recycled into plants.

6. A common misconception is that food accumulates in an ecosystem so that a top consumer (predator) has all the food from the organisms below it.

Assessment Clarification

1. Classify plants, animals (including humans), bacteria and fungi based on their source of energy into the categories: producer, consumer, and decomposer.
2. Producers obtain food by trapping light energy and to make food and supply their energy needs (plants are examples of producers).
3. Consumers obtain their food directly from another organism by eating it or being a parasite on or in it (animals, including humans are examples of consumers).
4. Decomposers use plants and animals as well as animal waste products as their food source. (Examples include bacteria and fungi.)
5. Decomposers release chemicals into the soil and water to break down these materials. This allows the decomposers to take in small particles and release minerals back to the environment to be recycled into plants.

L.OL.06.52 Distinguish between the ways in which consumers and decomposers obtain energy.

Instructional Clarifications

1. Distinguish means to recognize or know the difference between the ways in which consumers and decomposers obtain energy.
2. Consumers obtain their energy directly from another organism by eating it or being a parasite on or in it. Examples: rabbit eating a plant, mosquito eating blood.
3. Decomposers include a variety of organisms. Bacteria and fungi obtain their energy as they play a more fundamental role in the process of decomposition and nutrient recycling. Other decomposers help decomposition by breaking down larger particles of organic matter.

Assessment Clarifications

1. Consumers obtain their energy directly from another organism by eating it or being a parasite on or in it such as a rabbit eating a plant or a mosquito eating blood.
2. Bacteria and fungi obtain their energy as they play a more fundamental role in the process of decomposition and nutrient recycling. Other decomposers help decomposition by breaking down larger particles of organic matter.

Standard: Ecosystems

Content Statement: LEC.M.1

Interactions of Organisms - Organisms of one species form a population. Populations of different organisms interact and form communities. Living communities and nonliving factors that interact with them form ecosystems.

Content Expectations

L.EC.06.11 Identify and describe examples of populations, communities, and ecosystems including the Great Lakes region.

Instructional Clarifications

1. Identify and describe means to recognize and to tell or depict in spoken or written words examples of populations, communities, and ecosystems including the Great Lakes region.
2. A population is a group of organisms of the same species living in a particular area at a particular time and can include plant or animal examples.
3. A community consists of populations of organisms living in a general area. Communities could include urban examples such as squirrels, bird populations, trees and other plants.
4. An ecosystem is an area whose communities are determined by the environmental conditions (abiotic factors) of the area. Example: Forests of Michigan thrive with certain soil conditions and amounts of rainfall per year. Michigan ecosystems include forests, wetlands, ponds, lakes and others.

Assessment Clarifications

1. A population is a group of organisms of the same species living in a particular area at a particular time and can include plant or animal examples.
2. A community consists of populations of organisms living in a general area. Communities could include urban examples such as squirrels, bird populations, trees and other plants.
3. An ecosystem is an area whose communities are determined by the environmental conditions (abiotic factors) of the area. Example: Forests of Michigan thrive with certain soil conditions and amounts of rainfall per year. Michigan ecosystems could include forests, wetlands, ponds, lakes and others.
4. Differentiate between the concepts of populations, communities and ecosystems.
5. Name or describe populations, communities or ecosystems within local or regional area. Examples of populations and communities should be limited to major ecosystems of Michigan --- forests, wetlands and lakes.

Content Statement – L.EC.M.2

Relationships of Organisms – Two types of organisms may interact with one another in several ways: They may be in a produce/consumer, predator/prey, or parasite/host relationship. Some organisms may scavenge or decompose another. Relationships may be competitive or mutually beneficial. Some species have become so adapted to each other that neither could survive without the other.

Content Expectations

L.EC.06.21 Describe common patterns of relationships between and among populations (competition, parasitism, symbiosis, predator/prey).

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words patterns of competition and predator/prey interactions between populations.
2. Organisms interact with one another in a variety of ways.
3. Populations of similar organisms have similar needs and compete more directly than dissimilar organisms. Example: populations of two species of squirrels compete more directly than a population of squirrels and a population of rabbits.
4. Symbiosis describes types of relationships or interactions between different species. One symbiotic relationship can be explained as organisms living together mutually benefiting (as with the lichen, an alga photosynthesizes and produces food to itself and a fungus in whose body it lives and is protected from drying out).
5. Parasitism is a type of relationship where one organism benefits (the parasite) from living on or within their hosts with the hosts being harmed, but not necessarily killing it. Examples: a lamprey attaches to a living fish; a brown-headed cowbird lays its eggs in another bird's nest.
6. Predator populations may be limited by the size of prey populations they depend upon. Prey populations may be prevented from overpopulating an area by predation limiting their population growth. Examples may include, among others, robin-worm, human-deer, coyote-mice, spider-fly, frog-insect, bat-moth.
7. The terms "beneficial" and "harmful" may be applied to describe relationship patterns between populations. For example:
    a. Competition may be negative for both populations in the competitive relationship. Examples of competition include gray squirrels and fox squirrels competing for acorns, forest trees competing for light.
    b. Parasitism is beneficial to the parasite and has a harmful effect on the host.
    c. Predator populations benefit and prey populations are harmed.

Assessment Clarifications

1. Give an example of a predatory prey relationship found in a Michigan ecosystem. Examples may include, among others, robin-worm, human-deer, coyote-mice, spider-fly, frog-insect, bat-moth.
2. Give an example of a symbiotic relationship such as lichens.
3. Give an example of competition such as gray squirrels and fox squirrels, forest trees competing for light.
4. Give an example of a parasitism. Examples: a lamprey attaches to a living fish; a brown-headed cowbird lays its eggs in another bird's nest.

L.EC.06.22 Explain how two populations of organisms can be mutually beneficial and how that can lead to interdependency.

Instructional Clarifications

1. Explain is to clearly describe by means of illustrations (drawing), demonstrations, and/or verbally ways in which populations of organisms may benefit from each other and become interdependent.
2. Two populations may develop a mutually beneficial relationship and come to depend upon one another. For example, the flowers of a particular plant population may come to depend on the services of a particular pollinator such as bees, just as the bee population comes to depend on the flower population.

Assessment Clarification

1. Two populations may develop a mutually beneficial relationship and come to depend upon one another. For example, the flowers of a particular plant population may come to depend on the services of a particular pollinator such as bees, just as the bee population comes to depend on the flower population.
2. Explain how a flower population and bee population have a mutually beneficial relation and are interdependent upon one another.

L.EC.06.23 Predict and describe how changes in one population might affect other populations based upon their relationships in the food web.

Instructional Clarifications

1. Predict and describe means to foretell and depict in spoken or written words how populations are dynamic and change over time.
2. An increase in the population of a predator could decrease the population of its prey. For example, as a fox population increases, the mouse and grasshopper population may decrease.
3. An increase in the population of a prey species could increase the population of species preying upon it. For example, as the fly population increases, the population of spiders and frogs may increase.
4. An increase in the population of plant eaters could decrease the populations of several plants species.

Assessment Clarifications

1. Describe what will happen to the populations of prey in an area where the population of predators increases such as an increasing fox population causing the mouse and grasshopper populations to decrease.
2. Describe what will happen to the population of plants in an area where the population of plant eaters decreases.

Content Statement – L.EC.M.3

Biotic and Abiotic Factors – The number of organisms and populations an ecosystem can support depends on the biotic (living) resources available and abiotic (nonliving) factors, such as quality of light and water, range of temperatures, and soil composition.

Content Expectations

L.EC.06.31 Identify the living (biotic) and nonliving (abiotic) components of an ecosystem.

Instructional Clarifications

1. Identify means to recognize that biotic (living) components of an ecosystem include all forms of life including plants, animals, and microorganisms such as bacteria.
2. Abiotic component examples include sunlight, air, water, heat, soil and other non-living factors that may affect living things.

Assessment Clarification

1. Given a description of an ecosystem, identify its biotic and abiotic components. Ecosystem examples may include forests, wetlands and lakes.

L.EC.06.32 Identify the factors in an ecosystem that influence changes in population size.

Instructional Clarifications

1. Identify means to recognize different factors or conditions that may lead to the change in population size within an ecosystem.
2. Changes in the amount of rainfall or average temperature may directly influence some populations such as plants and indirectly influence others such as the animal populations that depend on these plants for food.
3. Factors that influence the population size in an ecosystem include food supply, temperature, rainfall, disease, pollution, invasive species, and human development.
4. Changes in populations may be influenced by the introduction of new species to the ecosystem. Invasive species such as zebra mussels and purple loosestrife cause change in the populations of native species.

Assessment Clarifications

1. Identify biotic factors in an ecosystem that may influence changes in populations. For example invasive species such as zebra mussels and purple loosestrife.
2. Identify abiotic factors in an ecosystem that may influence changes in populations such as temperature and rainfall.
3. Factors that influence the population size in an ecosystem include food supply, temperature, rainfall, disease, pollution, invasive species, and human development.

Content Statement – L.EC.M.4

Environmental Impact of Organisms – All organisms (including humans) cause change in the environment where they live. Some of the changes are harmful to the organism or other organisms, whereas others are helpful.

Content Expectations

L.EC.06.41 Describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance in ecosystems.

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words one or more ways in which humans alter ecosystems.
2. Human populations have the same basic biological needs (food, water, shelter) as other animal populations in ecosystems.
3. Human activity may intentionally destroy ecosystems as cities are built, for example, filling in wetlands and removing forests.
4. Human activity may accidentally alter ecosystems, for example, raising average global temperatures.

Assessment Clarification

1. Humans are part of ecosystems
2. Humans may intentionally destroy ecosystems as cities or roads are built, by deforestations or filling wetlands.
3. Humans may accidentally destroy ecosystems by introducing invasive species or raising average global temperatures.

L.EC.06.42 Predict and describe possible consequences of overpopulation of organisms, including humans, (for example: species extinction, resource depletion, climate change, pollution).

Instructional Clarifications

1. Predict and describe means to foretell and depict, in spoken or written words, the effect of human overpopulation on
    a. habitat destruction

    b. species extinction
    c. resource depletion
    d. climate change
    e. pollution
2. As human population of the world has increased, habitat destruction has led to species extinction.
3. Historical data is used to:
    a. Compare increases in human populations and deforestation.
    b. Compare use of fossil fuels and changes in world temperature.
4. Overpopulation of invasive species often displaces native species, possibly leading to localized extinction of them.

Assessment Clarification

1. Describe the consequences of overpopulation of organisms in an ecosystem.
2. Predict and describe the effect of human overpopulation on
    a. species extinction
    b. resource depletion
    c. climate change
    d. pollution
3. Overpopulation of invasive species often displaces native species, possibly leading to localized extinction.

Inquiry Process, Inquiry Analysis and Communication, Reflection and Social Implications

Inquiry Process
S.IP.06.11 Generate scientific questions about populations, communities and ecosystems, based on observations, investigations, and research.
S.IP.06.12 Design and conduct scientific investigations to study the communities within ecosystems (such as collecting water and organisms from different bodies of water and comparing them).
S.IP.06.13 Use tools and equipment (hand lens, microscopes, thermometer) appropriate to the scientific investigation.
S.IP.06.15 Construct charts and graphs from data and observations (such as number of organisms, growth of organisms, temperature)
S.IP.06.16 Identify patterns in data collected from the various ecosystems.
Inquiry Analysis and Communication
S.IA.06.11 Analyze information from data tables and graphs to answer scientific questions on the patterns of relationships between the communities within ecosystems.
S.IA.06.12 Evaluate data, claims, and personal knowledge of ecosystems through collaborative science discourse.
S.IA.06.14 Draw conclusions from sets of data from multiple trials (all of the students' model ecosystems) of the scientific investigation.
S.IA.06.15 Use multiple sources of information to evaluate strength and weaknesses of claims and data of the populations and communities within the Great Lakes region.
Reflection and Social Implication
S.RS.06.22 Describe limitations in personal and scientific knowledge regarding the relationships of populations within an ecosystem.
S.RS.06.25 Demonstrate the relationships between populations through various illustrations
S.RS.06.27 Describe the effect humans and other organisms have on the natural balance of ecosystems.
S.RS.06.29 Describe how the study of ecosystems has advanced because of the contributions of many people (such as Rachel Carson, Ed Ricketts, Simon Levin, Drew Lanham) throughout history and across cultures.

Vocabulary

Critically Important–State Assessable	Instructionally Useful
ecosystem biotic components abiotic components population community producers consumers decomposers bacteria fungus parasite predator prey symbiosis competition pollution resource depletion species extinction	ecological role climate change

Instruments, Measurements, Representations

meter tape	use to measure for area of a "habitat"
representations	create & utilize population data tables
representations	labeled ecological collages and brochures
model	symbolic representation of a select ecosystem

Instructional Framework

Instructional Examples

Producers, Consumers, Decomposers: L.OL.06.51, L.OL.06.52
Interactions of Organisms: L.EC.06.31, L.EC.06.11, L.EC.06.21, L.EC.06.22, L.EC.06.23, L.EC.06.32, L.EC.06.41, L.EC.06.42

Objectives

- Students identify the biotic and abiotic factors in ecosystems.
- Students define and identify producers, consumers and decomposers in ecosystems that could be found in Michigan.
- Students describe the characteristics of populations and communities within Michigan ecosystems.
- Students identify characteristics of parasitic relationships.
- Students understand how human activities change environmental conditions and impact ecosystems

Engage and Explore

- While sitting comfortably on the ground in the schoolyard, students sketch all that they see in the surrounding area in a map format (to scale). After making the map drawing of the schoolyard, students create two separate lists, one listing the living things they saw or drew and another listing the non-living things they observed such as the sun, wind, clouds, temperature, soil. Introduce the terms biotic and abiotic. From the list of living things, students discuss with each other the ways in which the living things obtain energy to sustain life. Introduce the terms producers, consumers, and decomposers and the ways in which these groups obtain energy to sustain life. (L.EC.06.31, L.OL.06.51, S.IP.06.11)
- Take students on a walk around the school building to look for biotic and abiotic components and identify examples of producers, consumers, and decomposers. Have students explain why they categorized organisms into these particular categories. Introduce the terms populations and communities. Have students use these terms in relation to the living things they observed in the schoolyard and listed. For example, students could make note of a population of ants (consumers) and hypothesize about the ways in which it obtains energy for survival. Students observe the schoolyard and surrounding area to talk about how the original land was altered in order to build the school. (L.OL.06.51, L.OL.06.52, L.EC.06.41, S.IP.06.11, S.IP.06.16, S.RS.06.27)

Explore and Define

- Students work in groups to select, from a suggested list, a Michigan ecosystem on which they focus. Each group researches a different ecosystem. Students brainstorm on all the types of populations and communities of organisms they might see in their ecosystem and then confirm this information by finding actual pictures of animals, plants and abiotic factors (from magazines or Internet) which are found within their selected ecosystem. Using these pictures, students make an ecosystem collage that is placed on the classroom walls. In a classroom discussion, students identify the attributes and value of each ecosystem (such as the interdependence of biotic and abiotic factors) and well as discuss their benefits to the world and how humans alter these natural ecosystems. (L.EC.06.31, L.OL.06.51, L.OL.06.52, L.EC.06.11, S.IP.06.11, S.IP.06.15)
- Ask students why they eat (to obtain energy and building materials to sustain life). Then have students list what they have eaten for one or two days. For each food item, have students identify from what their food item was derived and how the item obtained its energy to sustain life. For example, if students gain energy from eating a hamburger, the meat would be traced back to a steer, which gained its energy from eating grass and the grass made its own food by using converting energy it gained from the sun. Have students trace back where the food energy came from select items and make a representation of this in a form of a diagram. Have students find out from where the non-food items are from (such as plastic utensils, paper plates). Students identify the sources of energy as having come from producers or consumers. (L.OL.06.51, L.OL.06.52, S.IP.06.11)
- Pairs of students work together with one student researching information about symbiotic and parasitic relationships. Students think-pair-share with each other about what they found interesting about these relationships. Students get together with others to compare the similarities between the organisms they studied. Students uncover the characteristics of these types of relationships. (L.EC.06.21, S.IP.06.11, S.IP.06.16)
- Build a classroom habitat with a variety of organisms that are indigenous to Michigan, (pill bugs, snail, slug, earthworms, grass, fern, millipede, etc.) Conduct long-term observations of the role of the organisms in the model ecosystem.

Elaborate and Apply

- Ask students to brainstorm how the number of individuals in a group (population) may affect other organisms of its own kind and of other populations. Students do an activity to see how much space each person has in the classroom. Students work in pairs to measure the length and width of the classroom to find the area of the room in square meters. Students divide the number of square meters in the classroom by the number of individuals to find out how much space each person has. Have

students calculate the population density of the class by dividing the number of individuals by the area to get individuals per unit area. (L.EC.06.23, L.EC.06.32, S.IP.06.11, S.IP.06.14, S.RS.06.27)

- Have students role play changes in population and loss of space by physically moving closer or further apart as they calculate new numbers as the population of the class doubles or if the size of the room (loss of habitat space) is reduced. Have students note how they feel as their amount of space is reduced. Class discussion focuses on factors that influence changes in populations within ecosystems students have studied. Adapted from: http://sftrc.cas.psu.edu/LessonPlans/Wildlife/Organisms.html (L.EC.06.23, L.EC.06.32, S.IP.06.11, S.IP.06.14, S.RS.06.27)
- Students research data for the moose/wolf population on Isle Royale in Lake Superior and focus upon how they are interdependent and how the populations have changed over time and what has happened as either population changed in numbers. (L.EC.06.21, L.EC.06.22, L.EC.06.23, L.EC.06.32, L.EC.06.41, S.IP.06.11, S.IP.06.15, S.IP.06.16, S.IA.06.11, S.IA.06.14)
- Students research the deer population in Michigan and understand hunting assists in managing the deer population due to deer no longer having a natural predator (the wolf). Students uncover case studies for managing deer populations in local county or state parks where hunting is not permitted. (L.EC.06.21, L.EC.06.22, L.EC.06.23, L.EC.06.32, L.EC.06.41, S.RS.06.22, S.RS.06.27, S.IA.06.11)
- Students use an indigenous vegetation map of the United States to observe the defined eco-regions such as deciduous forests, prairies, deserts, and others. Relate the abiotic factors (such as climate and soil types) to the various zones of indigenous vegetation. Students compare current and historical maps to identify changes in human related changes in ecosystems. Through guided observations and questioning have students think about how these areas could be or could have been managed or developed in a way so that there is less of a loss of habitat for native plants and animals. Have students dialog in groups of 3-4 to discuss how these changes and how these changes by people affect other organisms and how humans could make reduce negative impacts. (L.EC.06.41, L.EC.06.42, S.RS.06.27, S.IP.06.11, S.IP.06.16, S.IA.06.11, S.IA.06.14, S.RS.06.27)
- Groups of students research one of three topics affecting watersheds: waste water treatment, invasive “water” species (purple loosestrife, Zebra or Quagga mussels) and impervious surfaces (pavement and buildings). Each group becomes “expert” on the history of their selected topic as well as understanding differing views or issues related to their topic. (L.EC.06.41, L.EC.06.42, S.IA.06.13, S.IA.06.15, S.RS.06.21, S.IP.06.13, S.IP.06.11, S.IP.06.12, S.IP.06.16, S.IA.06.12, S.IA.06.14, S.RS.06.22, S.RS.06.27, S.RS.06.25)
- Groups design their own scientific study, then generate questions to study such as how an invasive species spread or arrived, the amount of impervious surfaces in their school yard or local area, how waste water

treatment works and how it could be improved. Each group conducts activities appropriate to their selected topic. Water filtration columns are used to remove water contaminants and demonstrate infiltration through pervious surfaces. Students then present findings (including data tables if applicable), discuss the topic, and develop a reasonable solution to the problem where appropriate. (L.EC.06.41, L.EC.06.42, S.IA.06.13, S.IA.06.15, S.RS.06.21, S.IP.06.13, S.IP.06.11, S.IP.06.12, S.IP.06.16, S.IA.06.12, S.IA.06.14, S.RS.06.22, S.RS.06.27, S.RS.06.25)

Evaluate Student Understanding

Formative Assessment Examples

- Select an ecosystem found in Michigan (forests, wetlands or lakes) and create a tri-fold brochure to "sell its value". A rubric of requirements such as naming some animals (from several group classifications), plants, and defining populations and communities within this ecosystem and human uses of this ecosystem (positive and negative uses) and ways in which these can be managed for sustainability is developed and then provided to students. Students design a promotional campaign convincing classmates why they should visit their selected ecosystem during their summer vacation. (L.EC.06.11, L.EC.06.41)

Summative Assessment Examples

- Divide the class into groups to research an assigned ecosystem in the Great Lakes region and prepare a report. Students find out about the unique features of their ecosystem including plant and animal populations and communities. Students design an ecosystem poster displaying the ecosystem for a class presentation. Students label or list the producer, consumer, decomposer and abiotic components in the ecosystem. (L.OL.06.51, L.EC.06.31)
- Make diagrams or illustrations of relationships and connections found within ecosystems. (L.OL.06.51, L.EC.06.31, L.EC.06.32)
- Create a concept map with linking words representing relationships and connections within ecosystems. (L.EC.06.11, L.EC.06.21, L.EC.06.22, L.EC.06.23, L.EC.06.31, L.EC.06.32, L.EC.06.41, L.EC.06.42)

Enrichment

- Museums or science centers with appropriate displays.
- Naturalist guided tours of various ecosystems at local parks
- Assembly with educational programming related to ecosystems
- Students participate in activities from Project Wild (for example: Oh Deer! for demonstrating changes in populations).

Intervention

- Students view a short video relevant to the above content expectations, from United Streaming, Annenberg or other sources.
- Provide alternative print material (with diagrams, photographs, illustrations or appropriate to the student's literacy level).
- Create a concept map with linking words to use throughout teaching cycle

Examples, Observations, and Phenomena (Real World Context)

Students are a part of their surrounding ecosystem. They interact with their natural environment everyday. Students who have taken vacations "up north" or to Michigan's many lakes have observed that Michigan has a variety of distinct ecosystems. Students observe seasonal populations of animals such as the American Robin during the spring and summer months. Students are able to observe man's impact on the environment on a regular basis such as by seeing what used to be a farmer's field being developed into a new subdivision. Students think about the choices they make in their own lives in order to lessen their negative impacts on the environment such as by recycling or riding bikes rather than in automobiles.

Literacy Integration

Reading

R.NT.06.04 analyze how authors use literary devices including dialogue, imagery, mood, and understatement to develop the plot, characters, point of view, and theme.
R.CM.06.01 connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

Books:
Sand County Almanac, Aldo Leopold
Silent Spring, Rachel Carson
The Woods Scientist, Stephen R. Swinburne, 2002

- Students read *Sand County Almanac* by Aldo Leopold or *Silent Spring* by Rachel Carson to learn about the beginning of modern environmental ethics and conservation. (S.RS.06.29)

Writing

W.PR.06.01 set a purpose, consider audience, and replicate authors' styles and patterns when writing a narrative or informational piece.

W.PS.06.01 exhibit personal style and voice to enhance the written message in both narrative (e.g., personification, humor, and element of surprise) and informational writing (e.g., emotional appeal, strong opinion, and credible support

- Students write a natural history story of a select organism describing its interactions and life cycle within the selected ecosystem or tell its story along with the components of the ecosystem from the organism's point-of-view.

Speaking and Listening

S.CN.06.01 adjust their use of language to communicate effectively with a variety of audiences and for different purposes by asking and responding to questions and remarks to engage the audience when presenting.

S.DS.06.03 discuss written narratives that include a variety of literary and plot devices (e.g., established context plot, point of view, sensory details, dialogue, and suspense).

L.CN.06.01 respond to, evaluate, and analyze the speaker's effectiveness and content when listening to or viewing a variety of speeches and presentations.

- Students prepare and present in first person information about the life and contribution of influential people in the field of environmental education and natural history such a Rachel Carson. Students listen to others doing the same and engage in discourse for peer review of presentations. (S.RS.06.29)

Mathematics Integration

N.FL.06.10 Add, subtract, multiply and divide positive rational numbers fluently.

- Students chart population fluctuations as a result of studying deer populations in Michigan. (S.IP.06.15, S.IA.06.11)
- Students chart population fluctuations of the moose and wolf on Isle Royal (S.IP.06.15, S.IA.06.11)