Grade 7
Science
Unit 5: Balance within Ecosystems

Time Frame: Approximately six weeks

Unit Description

In this unit, activities will focus on adaptations of plants and animals for survival within an ecosystem and the essential roles of biotic and abiotic components in various ecosystems. The unit will address the concepts of *limiting factors* and *carrying capacity* with regard to populations that can be sustained in an ecosystem. The impacts of environmental factors and human interventions on ecosystems are analyzed.

Student Understandings

The students will understand that ecosystems function with a delicate balance in the short term and as dynamic entities in the long term. Provided illustrations of ecosystems, students will identify both the biotic and abiotic factors that must balance to sustain the system. Balance is supported and affected by the immediate and long-term impacts of factors such as overpopulation, widespread death and disease, and biotic and abiotic changes in certain habitats and in the overall ecosystem. Students will identify behavioral and structural adaptations while providing multiple examples of each. Provided an ecological description, students will describe the impact of introducing a specific non-native species into this ecosystem.

Guiding Questions

1. Can students explain how animals develop behaviors specific to their biomes?
2. Can students describe the behavioral and physical adaptations of animals in a given biome?
3. Can students predict the impact of introducing a nonnative species into an ecosystem?
4. Can students describe survival of organisms in terms of the environmental factors that impact the survival of a population, the ability of the organism to change, and the variations in individual organisms within a population that aid in the survival of the species?
5. Can students identify and analyze the human factor as it affects ecosystems' health and productivity?

Unit 5 Grade-Level Expectations (GLEs)

GLE #	GLE Text and Benchmarks
Science as Inquiry	
Note: The following Science as Inquiry GLEs are embedded in the suggested activities for this unit. Other activities incorporated by teachers may result in additional SI GLEs being addressed during instruction on the Balance within Ecosystems unit.	
1.	Generate testable questions about objects, organisms, and events that can be answered through scientific investigation (SI-M-A1)
2.	Identify problems, factors, and questions that must be considered in a scientific investigation (SI-M-A1)
3.	Use a variety of sources to answer questions (SI-M-A1)
4.	Design, predict outcomes, and conduct experiments to answer guiding questions (SI-M-A2)
5.	Identify independent variables, dependent variables, and variables that should be controlled in designing an experiment (SI-M-A2)
6.	Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations (SI-M-A3)
7.	Record observations using methods that complement investigations (e.g., journals, tables, charts) (SI-M-A3)
8.	Use consistency and precision in data collection, analysis, and reporting (SI-M-A3)
9.	Use computers and/or calculators to analyze and interpret quantitative data (SI-M-A3)
10.	Identify the difference between description and explanation (SI-M-A4)
11.	Construct, use, and interpret appropriate graphical representations to collect, record, and report data (e.g., tables, charts, circle graphs, bar and line graphs, diagrams, scatter plots, symbols) (SI-M-A4)
12.	Use data and information gathered to develop an explanation of experimental results (SI-M-A4)
13.	Identify patterns in data to explain natural events (SI-M-A4)
16.	Use evidence to make inferences and predict trends (SI-M-A5)
18.	Identify faulty reasoning and statements that misinterpret or are not supported by the evidence (SI-M-A6)
19.	Communicate ideas in a variety of ways (e.g., symbols, illustrations, graphs, charts, spreadsheets, concept maps, oral and written reports, equations) (SI-M-A7)
20.	Write clear, step-by-step instructions that others can follow to carry out procedures or conduct investigations (SI-M-A7)
22.	Use evidence and observations to explain and communicate the results of investigations (SI-M-A7)
23.	Use relevant safety procedures and equipment to conduct scientific investigations (SI-M-A8)
24.	Provide appropriate care and utilize safe practices and ethical treatment when animals are involved in scientific field and laboratory research (SI-M-A8)

GLE #	GLE Text and Benchmarks
26.	Use and describe alternate methods for investigating different types of testable questions (SI-M-B1)
30.	Describe why all questions cannot be answered with present technologies (SI-M-B3)
32.	Explain the use of statistical methods to confirm the significance of data (e.g., mean, median, mode, range) (SI-M-B3)
33.	Evaluate models, identify problems in design, and make recommendations for improvement (SI-M-B4)
36.	Explain why an experiment must be verified through multiple investigations and yield consistent results before the findings are accepted (SI-M-B5)
37.	Critique and analyze their own inquiries and the inquiries of others (SI-M-B5)
38.	Explain that, through the use of scientific processes and knowledge, people can solve problems, make decisions, and form new ideas (SI-M-B6)
Life Science	
30.	Differentiate between structural and behavioral adaptations in a variety of organisms (LS-M-D1)
31.	Describe and evaluate the impact of introducing nonnative species into an ecosystem (LS-M-D1)
32.	Describe changes that can occur in various ecosystems and relate the changes to the ability of an organism to survive (LS-M-D2)
33.	Illustrate how variations in individual organisms within a population determine the success of the population (LS-M-D2)
34.	Explain how environmental factors impact survival of a population (LS-M-D2)
Science and the Environment	
35.	Identify resources humans derive from ecosystems (SE-M-A1)
36.	Distinguish the essential roles played by biotic and abiotic components in various ecosystems (SE-M-A1)
37.	Identify and describe the effects of limiting factors on a given population (SE-M-A2)
38.	Evaluate the carrying capacity of an ecosystem (SE-M-A2)
39.	Analyze the consequences of human activities on ecosystems (SE-M-A4)
43.	Identify and analyze the environmental impact of humans' use of technology (e.g., energy production, agriculture, transportation, human habitation) (SE-M-A8)

Sample Activities

Activity 1: Bird Beak Adaptations (SI GLEs: 7, 11, 12, 16, 32; LS GLEs 33, 34)

Materials List: instructions for Bird Beak Buffet; beaks (one of the following items per group)-clothespin, toothpicks, straw, spoon; paper plate for feeding dish (one per student); small cup for stomach; whistle/bell; suggested food resources (uncooked shell macaroni, goldfish crackers, mini-marshmallows, peanuts, sunflower seeds, raisins); learning log

The teacher should obtain a copy of the activity Bird Beak Buffet from the following website http://pubs.usgs.gov/of/of98-805/lessons/chpt2/act5.htm and use it as written, as an introduction to the concept of *adaptation*. One adaptation that is important to birds is the shape and size of its beak. Provide students with pictures of bird beaks and allow them it infer the types of food eaten and the environment in which the bird lives. Bird beak pictures may be obtained at http://birds.ecoport.org/Identification/EBbeaks.htm.

The web site containing the Bird Beak Buffet activity provides instructions for using common objects to model bird beaks and to gather various types of food. Be sure to have several variations of a similar beak as suggested in the materials list (wooden\plastic spring clothes pin, non-spring clothes pin, etc.) so that students can see how variations in individual organisms within a population may determine the success of the population. Based on the shape of the beak and the food available, allow students to predict which beak will be best suited for each food type prior to the start of the activity. Students should create a data table to count and record the amount of food collected by each beak type in their science *learning logs* (view literacy strategy descriptions). Science learning logs are student-created booklets where students record information. Using the collected information, students should create a class table and graph to analyze the mean and median and identify the mode. In order to do so, students should complete the activity at least three times.

After students have completed the hands-on part of the investigation, they should complete extensions 1 and 2 as listed in the activity and discuss specialization of each beak type. Have students speculate (a) how an individual bird would survive if its primary food source was eliminated and (b) how the entire bird population would survive if its primary food source was eliminated.

Activity 2: Adaptations (SI GLEs: 3, 10, 11, 13, 19; LS GLEs: 30, 34)

Materials List: pictures of biomes, access to research material, poster supplies, computer access (optional), copy of Adaptation BLM (one per student)

Provide a student copy of the Adaptation BLM that utilizes the *vocabulary self-awareness* strategy (view literacy strategy descriptions); this strategy involves identifying target vocabulary in order for students to rate according to their understanding. Over the course of the unit, students add new information to the chart. Relate the terms on the *vocabulary self-awareness*

chart to what was learned in Activity 1 relative to the importance of the size and shape of a bird's beak for its survival. Differentiate between behavioral and structural adaptations, providing examples of each type. If available, students should view a short video such as *World of Plants: The Plant Adaptation* or *Concepts in Nature* available from the LPB Cyberchannel (http://www.lpb.org/cyberchannel). Discuss any patterns of behavior that emerge from the video.

Distribute to each student group a picture of one of the following biomes: tundra, taiga, deciduous forest, grassland, desert, or tropical forest. (Try not to include pictures of animals.) Each group should create a list describing adaptations that might be found in plants and animals that live in the identified biome. Initially, the students do not need to think of a specific species, just the types of organisms and their adaptations.

Provide each group with the name of a specific animal or plant that lives in their assigned biome. Students are to prepare a report on the assigned plant or animal; the report should describe and explain the types of behavioral and structural adaptations that help their assigned animal or plant to survive. Ancestors and mutations should be presented along with descriptions of any related environmental problems that have impacted the species in that biome. Have students include a simple food web of the selected biome. The following site www.mbgnet.net/bioplants/adapt.html, should be used as a reference, in addition to textbooks and other grade-appropriate materials. Students should use all available resources. Student groups should either include a poster or multimedia component in their presentation to the class. Caution students that it is necessary to compare and critique scientific investigations when gathering research information.

Following all presentations, conduct a class discussion on how extinction can occur within an environment because of the rapid change in environmental factors and the gradual change in adaptations.

Note: Students will use the information gathered in this activity in Activity 8.

Activity 3: Seeing Is Believing (SI GLEs: 7, 19, 22, 23, 37; LS GLE: 30)

Materials List: nearby location for seed collection, hand lenses or dissecting microscope, container for seeds, seeds from supply house (if field experience is not available), plastic gloves, science learning logs, habitat video (optional), Seed Dispersal BLM (one per student)

*Safety Note***:** *Students with known plant allergies should not serve as seed collectors. Caution students to beware of poison ivy, poison sumac, and fire ants.*

Introduce common methods of seed dispersal by soliciting examples from students. Provide students with a copy of the Seed Dispersal BLM, which is an example of a *graphic organizer* (view literacy strategy descriptions), to help them with their suggestions. *Graphic organizers* are useful for students when arranging content information in a logical order. A graphic has been provided; however it can serve as a template for students to create their own, if desired.

Each of the following tasks provides students with hands-on experiences and opportunities to see plant and animal adaptations in nature.

(1) Take students on a seed hunt around the campus or other location, if available. This activity will provide better results during spring time. Prior to the field activity, allow students to generate a list of safety procedures that should be followed during the collection on the seeds. Explain methods of seed collection and discuss how students should use precision and consistency in collection and in recording data. Have them group the seeds they find by methods of dispersal and discuss how each is adapted for its environment, focusing on the seed's structural adaptations, if applicable. Students could also group the seeds as to whether they are from a Louisiana native plant or non-native plant. If necessary, provide hand lenses and/or dissecting microscopes to view the seeds. Using their collected seeds, students should summarize their findings, including sketches of the seeds in their science *learning logs* (view literacy strategy descriptions). Science *learning logs* are student created booklets used to record data and information.

(2) Take a field trip to a local wildlife refuge, arboretum, zoo, historic site, farm, etc. to see animal and plant adaptations. Divide students into small groups (2–4) and have each group make a list of adaptations they observe. Discuss the lists with students and what type of adaptation (structural and or behavioral) is needed for survival. Have students construct a *graphic organizer* to summarize their understanding, using illustrations where necessary. Students should critique and analyze the other groups' graphic organizers and list any improvements or changes they would make to their own.

Note**:** Alternatives to a field experience to collect seeds would be to simulate a seed hunt by using seeds obtained from supply houses or seeds gathered near students' homes. In lieu of a field trip to a refuge or zoo, etc., students could view a series of videos depicting various habitats and record animal and plant adaptations observed on the video.

Activity 4: Natural and Man-Made Changes in an Ecosystem (SI GLEs: 1, 13, 19, 22; LS GLE: 31, SE GLEs: 39, 43)

Materials List: access to research materials, index cards, individual copies of Ecosystem Vocabulary Cards BLMs (one per student), video Non-Native Invasion

Have students create a list of the possible effects of natural changes (i.e., weathering, erosion, hurricanes, earthquakes, and drought) and man-made changes (i.e., clearing of land, human use of technology, and the introduction of non-native species) on the various species within an ecosystem. Be sure to discuss Louisiana-specific examples, such as hurricanes Katrina and Rita, flooding on the Mississippi River prior to building the levee system, cutting bottomland hardwood forests, introduction of the water hyacinth and the nutria, and the use of technology in agriculture.

Part A:
Divide students into small groups and provide each group with two sets of index cards, the first containing the following terms: *pest, native species, non-native species,* and *invasive species*. Then provide students with another set of index cards containing the descriptions of the terms and allow them time to match the terms and their descriptions. Next, distribute copies of the Ecosystem Vocabulary Cards BLMs (view literacy strategy descriptions) and instruct students to record the information from the index cards on them. *Vocabulary cards* highlight student understanding of what they know, as well as what they still need to learn in order to fully comprehend text. Over the course of the activity, students should add new information to the cards and continue to revise their entries to extend their knowledge. Discuss each term as a class; then have student groups develop a potential checklist of questions that could be answered to determine if a particular species might be classified as invasive. Discuss findings. Answers will vary, but the checklist should include questions such as Does it have a direct negative effect on humans, agriculture, or other animals or plants? Does it cause negative changes in an ecosystem? etc. Students should be made aware of the fact that not all non-native species are harmful. For example, roses are not native to the United States but are neither considered a pest nor an invasive.

Part B:
Student groups should research the impact of introducing a non-native species to an area. Examples might include the impact of starlings on bluebirds, water hyacinths and hydrilla on waterways, fire ants on agriculture, nutria on wetlands, and the zebra mussel on marine interests (see Reference section for Internet sites that provide information these topics). A video such as *Non-Native Invasion* from the Enviro-Tacklebox™ series, provided through the LPB Cyberchannel (see Resource section), provides an excellent introduction to this topic. Other videos may substitute if it contains information depicting non-native relationships within an ecosystem. Student groups should give short oral presentations to the class and provide information about how and why their assigned species was introduced to the particular area. Note: Many school libraries and individual teachers have copies of this video.

Part C:
Divide students into two teams. Using one of the examples from part B, have students debate the issues surrounding the introduction of a non-native species to an area. Instruct students to provide evidence to justify their arguments and include any current technologies used to address the problem, as well as evidence of the usefulness/failure.

Activity 5: Wetland Wonders (SI GLEs: 3, 18, 19; LS GLE: 32; SE GLE: 35)

Materials List: pictures of wetlands; student project boards; access to Internet & computer; grade-appropriate resource materials - library resources, textbooks, and trade books

Students should research and describe the importance of the wetlands and explain the current campaign to save them. Information may be obtained at http://www.americaswetland.com and http://www.epa.gov/owow/wetlands. Library resources, textbooks, and trade books may also

provide relative information. If Internet access is not available, provide students with pictures and short descriptions of different types of wetlands.

Explain that wetlands are classified as inland or coastal wetlands and by 1. the presence of water (soil is saturated with water), 2. vegetation (hydrophytes: plants adapted to flood conditions), 3. unique soil conditions (hydric soil – saturated with water; anoxic soil – no oxygen available), and 4. animal species. Students should discuss how changes in one or more of these factors would affect the ability of the organisms, both plant and animal, living there to survive.

Where technology is available, students can complete Louisiana Wetlands Web Quest at http://www.lacoast.gov/education/index.htm based on information discussed. Discuss and provide examples of temporary wetlands, emphasizing those found in Louisiana and the human resources found in or near them. For many years, wetlands have been thought of as soggy, useless land areas. The importance of these wetlands is now being realized, and many efforts to conserve them are in effect. Have students identify some of the faulty reasoning that led to the misconception that these wetlands were not a valuable resource.

Now that students have identified and discussed the types of wetlands in small groups, they will create a wetland project display board to include visual displays and examples of the variety of resources and/or products that are obtained from Louisiana wetlands and how the use has affected the environment. These projects should be placed on display throughout the classroom and possibly the school.

Geographical Information System (GIS) can be used to identify different types of wetlands found in the world. If feasible, have students use the Internet to gather wetland geographical location information from GIS reports. A GIS wetland activity resource may be obtained at http://serc.carleton.edu/eet/wetlands/teaching_notes.html.

Activity 6: Temporary Wetlands (SI GLEs: 1, 2, 5, 6, 7, 8, 9, 20, 23, 24, 37; LS GLE: 32)

Materials List: plastic bags, thermometer, aquarium fishnet, magnifying glass, ruler, string, pH strips, GPS (optional), water test kit, oxygen test kit, plastic gloves, Temporary Wetlands KWL BLM, science learning logs

Safety note: *Students who will come in contact with water samples should use disposable gloves both in the field and in the classroom.*

Review the importance of wetlands by creating a *KWL chart* (view literacy strategy descriptions). (See Temporary Wetlands BLM). This literacy strategy allows students to record known information and question the topic. This chart should also be revisited at the close of the lesson and used as a study guide or quiz. If conditions around the school campus are feasible, place students in small groups and take them outside where they can observe temporary wetland areas near school, in a nearby park, or other local area. Where GPS is available, students can mark their waypoints and the location of the wetlands by using longitude and latitude.

Back in the classroom, have students generate questions about the conditions they might monitor in the identified wetlands and how they might obtain the data. After these questions have been resolved, provide students with equipment to monitor their identified conditions in the wetland, including such items as a plastic bag, thermometer, aquarium fishnet, magnifying glass, ruler, string, and pH strips. Students can also collect temperature, light intensity, and pH data using data collectors, if available. Optional equipment might include specialized kits such as water test kits and dissolved oxygen test kits. During the collection process, students should write the step-by-step instructions they followed to collect their data. Have students monitor and calculate the average amount of rainfall for a specified number of days and relate this information to the depth of the wetland. They should monitor water temperature, diameter and average depth, and animal and plant types and numbers. Students should also look for indirect evidence of animals, such as tracks, egg cases, etc.

Have students predict the survival life of the temporary wetland. They should generate a recording log in their science *learning logs* (view literacy strategy descriptions) for the information and then construct a spreadsheet or data table using appropriate technology. Science *learning logs* are student created booklets used to record information as it relates to the text. The information collected should be used to create statistical review by calculating the average water depth. Student groups should periodically check with other groups to verify their data and to look for trends and discuss the variation of data collection by each group.

Through a question-and-answer strategy, discuss the function of organisms from the time a puddle forms until it dries up. Describe life processes (e.g., obtaining food, seeking shelter, reproducing) that must be carried out during the existence of the temporary wetland and the features that aided organisms in their survival. Students should identify limiting factors of their wetland and how they impact the population of the wetland. Students should also compare the groups' interpretations of the data. Conclude the activity with a review to the *KWL chart*.

If it is impossible to identify and monitor a wetland area, a classroom wetland model can be created using an aquarium or terrarium. When establishing an aquarium, discuss the appropriate care and safe and ethical practices when working with any living organisms within the classroom setting.

Activity 7: Alligators and Such! (SI GLEs: 1, 3, 11, 19, 22; LS GLEs: 32, 33)

Materials List: poster board or chart paper, markers, tape, glue, scissors, Internet access

In this activity, students will investigate selected organisms native to Louisiana. Begin the lesson by identifying various Louisiana habitats and major animals that reside there. As a research investigation, have each student or student group choose one habitat to focus on and identify an organism that resides there to study (e.g., crawfish, white tail deer, brown pelican, alligator, black bear, shrimp). The students, along with the teacher, should develop the criteria for the project. Students should generate a list of questions that they would like answered as a result of their investigation. Guide the students to such topics as the scientific classification of the animal, life span, habitat, diet, niche within the food chain, and physical attributes and adaptations.

Student presentations should include at least one feasible change that could occur to their selected habitat and relate this to the animal's ability to survive. Ask students to illustrate and describe how variations within their individual organism may have determined the success of the population. Students may produce a multimedia presentation of their research, but if technology is not available, then a poster or booklet can be used.

Activity 8: Relationships between Biotic and Abiotic Factors (SI GLEs: 7, 19; SE GLE: 36)

Materials List: pictures of ecosystems, data from Activity 2, Mikes' New Home BLM (per group)

If there is an aquarium or terrarium in the classroom, ask students to identify the biotic and abiotic factors that exist in this ecosystem. There are several textbook and online instructions available to create either an aquarium or terrarium. If this is not practical, provide pictures of ecosystems where students can identify the biotic and abiotic factors. Once they have a clear understanding of these living and non-living factors, take students outside on the school ground (or provide pictures of different ecosystems) and have each group select an area in which they will identify the biotic and abiotic factors and how they are related. Students should construct a *graphic organizer* (view literacy strategy descriptions) to show the relationship between biotic and abiotic factors in their ecosystem. Have students share their information with the other groups and critique each other's product.

Place students in small groups and provide a copy of Mikes' New Home *process guide* BLM (view literacy strategy descriptions) to complete by identifying the biotic and abiotic factors involved in creating a new enclosure for Mike the Tiger. This literacy strategy involves scaffolding students' comprehension within unique formats. It is designed to stimulate students thinking during or after involvement in any content area.

Using information gathered in Activity 2, students should also identify biotic and abiotic factors that are related to animal or plant adaptations for the specific biome studied.

Activity 9: Factors That Limit Plant and Animal Populations (SI GLEs: 2, 4, 5, 6, 9, 12, 20, 26, 33, 36; SE GLEs: 36, 37, 38)

Materials List: seeds for germination, potting soil, plant pots or containers, clear container, access to a computer program to create a simple graph, science learning logs

Following instruction on *limiting factors* and *carrying capacity*, use a local area to identify limiting factors in the area that might affect both plant and animal populations. Compare and contrast how biotic and abiotic factors could affect carrying capacity and limiting factors in a local ecosystem. Provide students illustrations or graphs showing how overpopulation can affect carrying capacity of the ecosystem. These references are found in most student textbooks. Have students identify places in the selected area in which carrying capacity has affected a population's growth. Instruct students to record their findings in their science *learning logs* (view

literacy strategy descriptions) and share through class discussion. Science *learning logs* are student created booklets used to record information as it relates to the text

Have students design an experiment to determine how a particular limiting factor, such as water, the amount of light, or soil conditions, affect the germination of seeds. The procedure should have multiple trials and should explain why this is important in an investigation. Allow each small group of students to select the variable (limiting factor) they wish to investigate. Instruct students to record a hypothesis for the outcomes of their experiment and determine what dependent variables they will measure or describe. Have students include the use of controls, identification of variables, and step-by-step procedures with appropriate data collection, analysis, and a written conclusion. Using the collected data, require students to create graphs or charts to help interpret and explain their results. If technology is available, graphs or charts should be electronically created and analyzed.

On completion of their experiment, have students evaluate their design and results and steps for improvement.

To help students identify factors that limit the growth of a population, discuss carrying capacity as it relates to a specific ecosystem.

Activity 10: Exploring the Environment (SI GLEs: 3, 12, 13, 16, 19, 30, 38; LS GLEs: 34; SE GLEs: 39)

Materials List: individual student copies of reference materials listed or computer access

NASA's Information Infrastructure Technology *and* Applications (IITA) Program supports the Exploring the Environment (ETE) online series at http://www.cotf.edu/ete/main.html. IITA facilitates public use of Earth and space science remote sensing databases over the Internet. The vision of the ETE online series is to encourage and enrich the learning of science-literate and reflective students who are knowledgeable of Earth's processes and their responsibilities for stewardship. Problems posed in the ETE modules and activities ask students to address human activities and their impacts on the environment. Featuring problem-based learning, the ETE series provides students with tools to investigate scientific, social, political, and cultural aspects of authentic and controversial environmental problems. Standard problem-solving models that include relevant satellite imagery and recommendations for extended inquiry are available to students online. Teachers can download and print selected modules for use in class. Suggested modules are

- *Florida Everglades*. In this module, students explore how environmental factors impact survival of a population. Specifically, students address their concern for the Florida panther, based on Earth system science analysis of the restoration of water to the Everglades. Students are asked to make predictions about the future of these panthers based on what they have learned.
- *Global Climate Change*. This module focuses on global warming and the greenhouse effect. It also discusses the impact that humans have had on the earth's changing climate. Specifically, students study wheat farms in Kansas and predict how

increasing atmospheric concentrations of carbon dioxide are changing the climate and what effects this might have on Kansas's wheat crops.

- *Yellowstone Fires*. This module also explores how environmental factors impact survival of a population. Specifically, students will examine the wildfires that burned one-third of this national park in 1988. Students help make a decision about what should be done the next time fire strikes in Yellowstone.

Discussion questions about the Florida Everglades:

- Why is the Florida panther considered to be an endangered species?
- How does inbreeding affect the population of the Florida panther?
- How will breeding programs help to increase the population in the Florida panther?

Discussion questions for global climate change:

- How do greenhouse gases increase Earth's temperature?
- This warming mechanism is called the "greenhouse effect." Explain the significance of using this term.

Discussion questions for Yellowstone National Park fires:

- What is the greatest cause of wildland fires?
- Generate a list of the major factors responsible for 80 percent of all fires in wildland areas.

For each module, instruct students to record the following information in report form to be shared with the entire class. The report can be a formal report or in electronic form.

- How did scientists know that there was a change?
- What caused the change?
- What effect did the change cause?
- What, if anything, did scientists do to reduce the effect of the change?
- Give specific examples of how technology has assisted scientists in the discovery of the information cited.
- Describe why all questions cannot be answered with the present technologies, citing specific examples

Have students retrieve or provide copies of articles from the Internet or textbooks about endangered species, the greenhouse effect, and wildland fires and formulate problems that are associated with these three issues. Based upon research, discuss, identify, and explain why, even in this scientific age of discovery, all questions cannot be answered with present technologies.

Sample Assessments

General Guidelines

Assessment will be based on teacher observation/checklist notes of student participation in unit activities, the extent of successful accomplishment of tasks, and the degree of accuracy of oral

and written descriptions/responses. Journal entries provide reflective assessment of class discussions and laboratory experiences. Performance-based assessment should be used to evaluate inquiry and laboratory skills. All student-generated work, such as drawings, data collection charts, models, etc., may be incorporated into a portfolio assessment system.

- Students should be monitored throughout the work on all activities.
- All student-developed products should be evaluated as the unit continues.
- When possible, students should assist in developing any rubrics that will be used and should be provided with the rubric during task directions.

General Assessment

- Create a poster or multimedia presentation illustrating a major biome.
- Design, conduct, and report a temporary wetland study.
- Create a graphic organizer to show the relationship between biotic and abiotic factors in the ecosystem.
- Design, perform, and report on an experiment to determine how water, the amount of light, or the soil conditions affect the germination of seeds.

Activity-Specific Assessments

- Activity 4: Students should create a commercial advertisement informing the public about an invasive animal discussed in the activity. The commercial should include a method of control that is not harmful to the environment. List any current technologies used to address the problems, as well as evidences of their usefulness/ failure.

- Activity 5: Provide students with a list of wetlands and a list of resources that are produced or supported by them. Students should match the proper resource to the wetland that produces it.

- Activity 9: Each student will create a comic strip showing the results of a population before and after the carrying capacity has been met. Students should select a species in their natural ecosystem to use as an illustration.

Resources

- Exploring the Environment. NASA Information Infrastructure Technology and Applications Program. Available online at http://www.cotf.edu/ete/main.html
- *GEMS: Mapping Animal Movements*
- *Project WET.* Western Regional Environmental Education Council
- *Project WOW Wonders of Wetlands*

- *Non-Native Invasion* Louisiana Public Broadcasting LPB Cyberchannel www.lpb.org/cyberchannel Check with school administration to see if this service is available for the school district.
- *Biomes of the World.* Available online at http://mbgnet.net/
- *Wetland resources* http://serc.carleton.edu/eet/wetlands/teaching_notes.html
- *Wetland resources* http://www.epa.gov/OWOW/wetlands
- *Bird beak resources* http://birds.ecoport.org/Identification/EBbeaks.htm
- *Critter Control: European Starlings* http://www.crittercontrol.com/animal-facts-starlings.php
- *European Starling Habits* http://www.wild-bird-watching.com/Starlings.html
- *Harmful Aquatic Hitchhikers: Plants: Water Hyacinth* http://www.protectyourwaters.net/hitchhikers/plants_water_hyacinth.php
- *Non-Native Freshwater Plants Hydrilla* http://www.ecy.wa.gov/programs/wq/plants/weeds/aqua001.html
- *USDA, Southern States to Release Fly Against Fire Ants* http://www.ars.usda.gov/is/pr/2000/001115.htm
- *Red Imported Fire Ants* http://www.lsuagcenter.com/en/environment/insects/ants/fire_ants
- *Frequently Asked Questions about the Zebra Mussel* http://cars.er.usgs.gov/Nonindigenous_Species/Zebra_mussel_FAQs/zebra_mussel_faqs.html