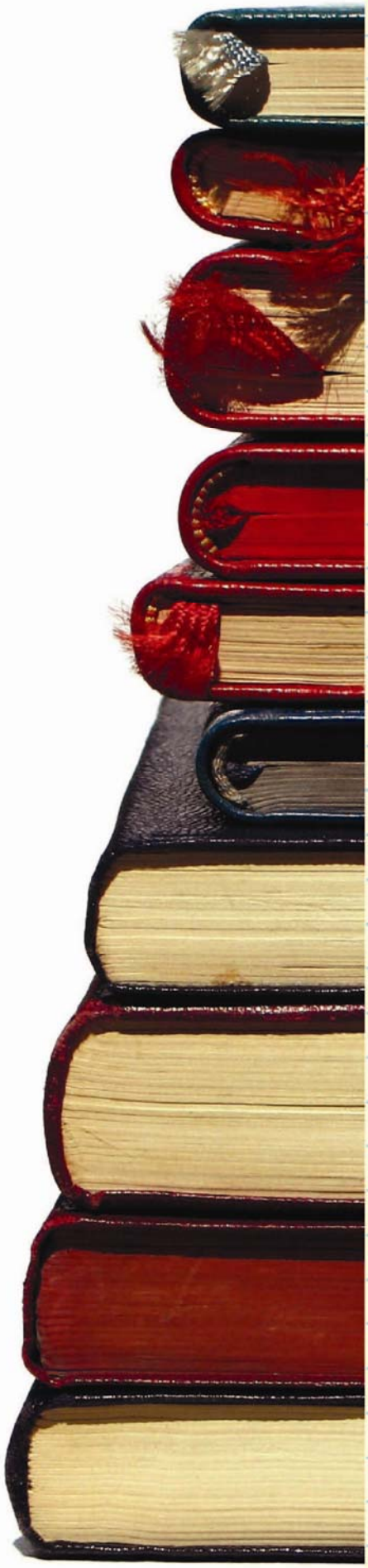

Comprehensive Curriculum

Revised 2008

Environmental Science

Louisiana Department of EDUCATION

Paul G. Pastorek, State Superintendent of Education

Environmental Science

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***Louisiana Comprehensive Curriculum*, Revised 2008**
Course Introduction

The Louisiana Department of Education issued the *Comprehensive Curriculum* in 2005. The curriculum has been revised based on teacher feedback, an external review by a team of content experts from outside the state, and input from course writers. As in the first edition, the *Louisiana Comprehensive Curriculum*, revised 2008 is aligned with state content standards, as defined by Grade-Level Expectations (GLEs), and organized into coherent, time-bound units with sample activities and classroom assessments to guide teaching and learning. The order of the units ensures that all GLEs to be tested are addressed prior to the administration of *i*LEAP assessments.

District Implementation Guidelines
Local districts are responsible for implementation and monitoring of the *Louisiana Comprehensive Curriculum* and have been delegated the responsibility to decide if

- units are to be taught in the order presented
- substitutions of equivalent activities are allowed
- GLES can be adequately addressed using fewer activities than presented
- permitted changes are to be made at the district, school, or teacher level

Districts have been requested to inform teachers of decisions made.

Implementation of Activities in the Classroom
Incorporation of activities into lesson plans is critical to the successful implementation of the Louisiana Comprehensive Curriculum. Lesson plans should be designed to introduce students to one or more of the activities, to provide background information and follow-up, and to prepare students for success in mastering the Grade-Level Expectations associated with the activities. Lesson plans should address individual needs of students and should include processes for re-teaching concepts or skills for students who need additional instruction. Appropriate accommodations must be made for students with disabilities.

New Features
Content Area Literacy Strategies are an integral part of approximately one-third of the activities. Strategy names are italicized. The link (view literacy strategy descriptions) opens a document containing detailed descriptions and examples of the literacy strategies. This document can also be accessed directly at http://www.louisianaschools.net/lde/uploads/11056.doc.

A *Materials List* is provided for each activity and *Blackline Masters (BLMs)* are provided to assist in the delivery of activities or to assess student learning. A separate Blackline Master document is provided for each course.

The *Access Guide to the Comprehensive Curriculum* is an online database of suggested strategies, accommodations, assistive technology, and assessment options that may provide greater access to the curriculum activities**.** The *Access Guide* will be piloted during the 2008-2009 school year in Grades 4 and 8, with other grades to be added over time. Click on the *Access Guide* icon found on the first page of each unit or by going directly to the url http://mconn.doe.state.la.us/accessguide/default.aspx.

Environmental Science
Pre-course Planning

Materials List: Sample Mini-Project Ideas BLM

Throughout the Environmental Science course, students should be actively involved in science-writing activities and subject-related career studies. [Refer to the Unit 1 Resource list for science *learning log/*journaling (view literacy strategy descriptions) resources. Career-related resources are included within activities throughout the course.] Students should also be provided stories/real-life examples of role-models in environmental studies (with emphasis upon female and minority role models, especially those from our area). Sources of these stories include human interest articles in newspapers, textbooks and text-teacher resources, the Marsh Mission Web site (www.marshmission.com), and Louisiana-related sections of libraries and bookstores. Students should also be encouraged to participate in contests related to environmental studies. Contests to consider include, but are not limited to, the Toshiba/NSTA ExploraVision Contest, Louisiana Environmental Education Art and Writing Contests, and the Soil and Water Conservation Stewardship Poster Contest.

Environmental stewardship is best taught by example and experience. Community organizations and state and federal agencies such as the Louisiana State Parks, Jean Lafitte National Park, and Kisatchie National Forest offer volunteer opportunities and educational programs as well as fieldtrip experiences and guest speakers. One way to encourage students to become involved in their own education and to take Environmental Studies outside the classroom is to have them participate in "mini-projects". Mini-projects might include local stewardship projects, environmental studies-related programs, developing and maintaining classroom or schoolyard habitats (aquariums, terrariums, butterfly gardens…), book reports, fieldtrips, and more. (Refer to the Sample Mini-Project Ideas BLM for ideas, but remember to use local resources.)

While several topics including *recycling* (Unit 3), *air and water quality monitoring* (Unit 4), and *composting* and *succession* (Unit 3) are not covered in the first unit, they offer the potential for meaningful long-term projects. If they are utilized in this way, most must be started prior to the unit of study and, in some cases, relatively early in the year.

Some activities have students actively involved in inquiry investigations. A sample experimental design format is included in the Black Line Masters. The sample Investigation Analysis BLM is designed to specifically address GLE SI 2, 5, 6, 7, 10, and 12 by guiding students in summarizing what they have learned and having them indicate the means and materials utilized in the learning process. Use the Investigation Analysis Format BLM as a part of students' reflection upon closure of each of the specified exercises.

Environmental Science
Unit 1: Environment Earth

Time Frame: Approximately six weeks

Unit Description

This unit focuses on the atmosphere, lithosphere, and hydrosphere and how changes in these areas might impact living organisms in the environment.

Student Understandings

Students will be able to identify Earth's five interconnected spheres, describe the importance of selected components, examine biogeochemical cycles, and describe processes and theories associated with major changes in Earth's surface.

Guiding Questions

1. Can students explain and provide examples of how investigations can be observational, descriptive, literature surveys, classification exercises, or experimental?
2. Can students employ science lab safety procedures/ techniques?
3. Can students locate and effectively utilize emergency safety equipment?
4. Can students identify Earth's five interconnected spheres and explain the importance of selected components?
5. Can students describe the processes that alter Earth's surface environment and identify the impact of selected processes?
6. Can students apply the concept of *systems* as it applies to environmental studies?
7. Can students apply concept knowledge of biosphere structure and interaction?
8. Can students relate the roles of the oxygen, carbon, and phosphorus cycles to the existence/ survival of the Earth's life forms?
9. Can students discuss the stages of the hydrologic cycle and relate them to energy release/absorption and with regard to the introduction and filtering of pollutants?
10. Can students relate geologic processes to the development of photosynthesis and discuss the use of fossils and radioactive isotopes in studying the history of Earth's atmosphere?

Unit 1 Grade-Level Expectations (GLEs)

GLE #	GLE Text and Benchmarks
Science as Inquiry	
1.	Write a testable question or hypothesis when given a topic. (SI-H-A1)
2.	Describe how investigations can be observation, description, literature survey, classification, or experimentation (SI-H-A2)
3.	Plan and record step-by-step procedures for a valid investigation, select equipment and materials, and identify variables and controls (SI-H-A2)
4.	Conduct an investigation that includes multiple trials and record, organize, and display data appropriately (SI-H-A2)
5.	Utilize mathematics, organizational tools, and graphing skills to solve problems (SI-H-A3)
6.	Use technology when appropriate to enhance laboratory investigations and presentations of findings (SI-H-A3)
7.	Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations) (SI-H-A4)
8.	Give an example of how new scientific data can cause an existing scientific explanation to be supported, revised, or rejected (SI-H-A5)
9.	Write and defend a conclusion based on logical analysis of experimental data (SI-H-A6) (SI-H-A2)
10.	Given a description of an experiment, identify appropriate safety measures (SI-H-A7)
11.	Evaluate selected theories based on supporting scientific evidence (SI-H-B1)
12.	Cite evidence that scientific investigations are conducted for many different reasons (SI-H-B2)
Science and the Environment	
1.	Describe the abiotic and biotic factors that distinguish Earth's major ecological systems (SE-H-A1)
5.	Examine and discuss the major stages of succession, describing the generalized sequential order of the types of plant species (SE-H-A4)
6.	Analyze the consequences of changes in selected divisions of the biosphere (e.g., ozone depletion, global warming, acid rain) (SE-H-A5) (SE-H-A7)
7.	Illustrate the flow of carbon, water, oxygen, nitrogen, and phosphorus through an ecosystem (SE-H-A6) (LS-H-D1)
8.	Explain how species in an ecosystem interact and link in a complex web (SE-H-A7) (SE-H-A10)
9.	Cite and explain examples of organisms' adaptations to environmental pressures over time (SE-H-A8)
12.	Give examples and describe the effect of pollutants on selected populations (SE-H-A11)
19.	Determine the interrelationships of clean water, land, and air to the success of organisms in a given population (SE-H-C1)
26.	Determine local actions that can affect the global environment (SE-H-D4)

GLE #	GLE Text and Benchmarks
Earth and Space Science	
2.	Trace the flow of heat energy through the processes in the water cycle (ESS-H-A1)
8.	Explain why weather only occurs in the tropospheric layer of Earth's atmosphere (ESS-H-A5)
9.	Compare the structure, composition, and function of the layers of Earth's atmosphere (ESS-H-A6)
12.	Relate lithospheric plate movement to the occurrences of earthquakes, volcanoes, mid-ocean ridge systems, and off shore trenches found on Earth (ESS-H-A7)
13	Explain how stable elements and atoms are recycled during natural geologic processes (ESS-H-B1)
15.	Identify the sun-driven processes that move substances at or near Earth's surface (ESS-H-B2
20.	Determine the chronological order of the five most recent major lobes of the Mississippi River delta in Louisiana (ESS-H-C3)
21.	Use fossil records to explain changes in the concentration of atmospheric oxygen over time (ESS-H-C4)

Sample Activities

Activity 1: Opening Safety Activity (SI GLE: 10)

Materials List**:**

per group - several markers or colored pencils, one sheet poster board or newsprint

per student - class established safety guidelines/contract

It is essential that safety be addressed in class activities early in the course and prior to students engaging in hands-on activities, including teacher demonstrations.

While most textbooks and teacher resources include materials that review/reinforce lab safety precautions and procedures, the location and use of available emergency safety devices and their effective use should also be included. To be assured that the lab situation conforms to local, state, and federally mandated lab safety standards, the teacher might refer to one of the several National Science Teachers Association (NSTA) materials, such as *Investigating Safely: A Guide for High School Teachers (*NSTA Press: Julianna Texley, Terry Kwan, and John Summers, 2004).

An exercise in which students (working in small groups) develop creative visuals to illustrate safety rules is recommended. The visuals could be posted around the classroom.

Students and parents should sign a safety contract (samples can be found in the teacher resources for most texts and in resources listed at the end of this unit).

Prior to initial lab work, administer a lab safety test which includes a description of an experiment for which students will identify safety issues and indicate the appropriate safety measures/tools to be utilized. In addition, questions relating to relevant safety issues should be included on tests and in pre-lab discussions throughout the year.

Please note: Mercury thermometers are "banned" from schools and learning programs. If mercury thermometers are in your classroom they should not be used and should be disposed of properly

Activity 2: Pre-Course Survey: What's Your Environmental IQ? (SE GLES: 6, 12, 19, 26)

Materials List:

per teacher - survey answers (one copy per instructor)

per student -Louisiana Roper ASW Study of Environmental Attitudes and Knowledge Survey

As an introductory activity, download, print, and distribute copies of the Louisiana Roper ASW Study of Environmental Attitudes and Knowledge Survey 2002. The survey, available at http://dnr.louisiana.gov/enviroquiz1.ssi, is based upon the Roper 1997 National Survey. (Answers are available at http://dnr.louisiana.gov/enviroquiz2.ssi.) Although the results are not current, the content is still relevant; therefore, this survey remains a good general introduction to the course and also as a "pre-test' of both concept knowledge and attitudes. In addition, class review and discussion of the survey will provide the student and the teacher with a "snapshot" of the state of environmental literacy in his/her classroom. While student knowledge and interest will determine the direction of class discussion, guide the discussion to ensure inclusion of the effects of pollutants on local populations; the interrelationships of clean water, land, and air to success of organisms in given populations; local actions (such as wetlands protection) on the global environment; and consequences of changes in selected divisions of the biosphere (such as global climate change or acid rain).

Student assessment should be based upon participation in the survey, class discussion, and accuracy of essay questions in which students discuss effects of pollutants on local populations, interrelationships of clean water, land, and air in given populations, local actions and their affect on the global environment, global climate change, and topics generated during class discussion. Students could then administer the survey to the entire school or to their families and analyze the data they collect. Questions from the survey could also be incorporated into tests throughout the curriculum and the "pre-test" could become a course "post-test" as well.

Activity 3: Introduction to Earth Systems and to Note Taking (SI GLE: 7; SE GLE: 1)

Materials List:

Part A:
per teacher - Split-Page Notetaking Teacher Sample BLM, transparency of the Split-Page Notetaking Sample BLM
per student - three-ring binder or spiral bound notebook, copy of Split-Page Notetaking Sample BLM

Part B: apple (one per class), knife (to be used by the instructor), paper towels (for clean-up)
per group - poster boards or bulletin board paper, assorted markers, *PowerPoint*™ access, overhead transparencies or individual copies of each group's notes.

Part A: Note taking skills
The process of taking notes provides students with a permanent record of information covered and encourages active participation during presentations and readings. Notetaking and reviewing of notes is conducive to long-term memory storage and to the recall of information. However, many students lack the skills for taking and utilizing effective notes. The *split-page notetaking* strategy (view literacy strategy descriptions) is an effective strategy and is easy to learn. Prior to having students complete a note-taking practice exercise on Earth Systems Science, use the Split-Page Notetaking Sample BLM to prepare an overhead transparency or computer graphic of that document. Begin instruction of *split-page notetaking* by explaining the value of taking notes in this format by saying it logically organizes information and ideas from multiple sources: it helps separate big ideas from supporting details, it promotes active reading and listening, and it allows inductive and deductive prompting for rehearsing and remembering the information. Then, provide students with a blank copy of the Split-Page Notetaking Sample BLM. Announce that they are to take split-page notes on the topic "*split-page notetaking*". Using the "Split-Page Notetaking Teacher Sample BLM and the Literacy Strategy Descriptions (view literacy strategy descriptions) as guides, present a brief lecture of the first few steps of this *split-page note taking* process. After they have practiced the procedure, students should compare notes with a partner. To provide clarification, answer any questions that might arise. Present the last steps of the material while students attempt to take *split-page notes* on their own. Again, have students compare their notes and elicit questions/discussion of the note-taking process.

Throughout the course, guide students as they take *split-page notes* and increase their effectiveness with this technique. Guided practice time is the best way to ensure students learn and take full advantage of the note taking system. Activity assessments should include information that students record in their *split-page notes*. In this way, they will see the connection between taking notes in this format and their achievement on quizzes and tests.

Part B: Introduction to Earth Systems Science
To provide them with an introductory overview of the course (and with an opportunity for guided *split-page notetaking*), introduce students to Earth Systems Science. Earth Systems Science focuses upon interactions among the Earth's five interconnected spheres: (1) the biosphere (living systems, fossils, and fossil fuels), (2) the geosphere (plate tectonics, volcanoes, earthquakes, and "solid" earth), (3) the atmosphere (air, climate, and weather), (4) the hydrosphere (the water cycle and water in all its liquid forms), and (5) the cryosphere (ice, glaciers, and ice ages). Note**:** Earth System resources for teachers are included in the Resources at the end of this unit.

Use Earth: The Apple of our Eye (http://www.accessexcellence.org/AE/AEPC/WWC/1991/earth.html) exercise as a demonstration to model concepts discussed in this activity. Variations of this exercise are available in some teacher resources and on the World Wide Web, including an online presentation, "The Apple as Planet Earth" at www.farmland.org/news/audiovideo/AVArchive.asp# (the link is in the right-hand column).

Assign each student to read and take *split-page notes* related to one of the five spheres. Most text materials provide this information as does *Earth Systems* http://gpc.edu/~pgore/Earth&Space/GPS/Earth-systems.html (pages 3-15). Afterward, students should compare notes with other students who have been assigned the same topic and should develop a common notebook entry. (To provide clarification and ensure accuracy, confer with each group and answer any questions that might arise.) In addition, each group should create posters or murals that visually represent their assigned sphere and then use their notes and visuals to peer-teach the class. (Group *split-page notes* could be copied and distributed to classmates or be provided for them to copy via PowerPoint™ access or overhead transparencies.)

Activity 4: The Biosphere (SI GLEs 2, 4, 6, 7; SE GLEs: 1, 6)

Materials List:

per student - science learning log, plastic bag, *Biospheres* activity instructions and worksheets

per group - gallon-sized jar, small plants, small fish (if selected), measuring cup, ruler, hand trowel, soil (quantity will vary); per class -florescent light source, 2 aquarium-sized fish nets, buckets, sponges, soap, sealing tape, permanent markers, cameras and/or colored pencils, and sketch pads

Hydroponics Exercise - (these materials are generally available from hydroponics suppliers or nurseries) per group - polycrystals (to fill growth/viewing container), rockwool (six ½-inch cubes per group), 3 peanut and 3 mung bean seedlings per group (seedlings of other fast germinating plants can be substituted), plant nutrient solution (to

hydrate polycrystals), a commercial viewing tank is suggested (however, a small goldfish-type fish bowl should suffice)

Introduce the topic of science *learning logs* (view literacy strategy descriptions) as a means of communication. Science *learning logs* are notebooks in which students record ideas, questions, reactions, hypotheses, new understandings, and reflections. Documenting ideas in a log about content being studied forces students to "put into words" what they know or do not know. This process offers a reflection of understanding that can lead to further study and alternative learning paths. It combines writing and reading with content learning. Invite students to personalize their log covers with their names and illustrations. As they complete entries, encourage students to express themselves through a variety of techniques, including prose, poetry, sketches, leaf rubbings, and photos. Science *learning logs* and nature journal resources (available in bookstores, libraries, and via the internet), provide examples of writing cues and suggested techniques to enhance student communication skills.

Take students on a nature walk on the school grounds. While on the walk, have them collect samples (storing these in plastic bags) and classify each of the items as living or nonliving within their science *learning logs*. They should suggest criteria for classifying components of the environment as living or non-living as well. Upon return to the class, record the list on the chalkboard or a transparency. A class discussion categorizing all the components observed as *biotic* or *abiotic* should follow. Be sure that students comprehend that a scientific investigation can be observational, descriptive, and even conducted through a literature search and does not always have to be experimental in nature.

Using the nature walk discussion as a lead-in, have students infer how changes in a component of the environment might affect the organisms in the environment. Follow up by having students work in cooperative lab groups to complete the *Access Excellence* lesson *Biospheres* at http://www.accessexcellence.org/AE/AEC/AEF/1995/kobayashi_biospheres.html.

This lesson includes hands-on activities, modeling, inquiry skills, cooperative learning, and concept reinforcement. In this lesson, students, acting as aliens from a distant planet, investigate the biosphere of the Blue Planet and create models of its biosphere (in gallon-size jars), collect data from the jars over a period of about five weeks, and report on their findings. As alien exobiologists, they will determine the type of ecosystem that will be the most successful on their long 5 week journey home, and select the type (and number) of organisms able to survive in such limited living space and resources. For about five weeks, they take observations (multiple times per week), and create colorful sketches or take photographs which they eventually put together into a report. This group report should include written observations, the sketches or photos, analysis of group findings, and discussion of biogeochemical cycles (as they relate to the biosphere). Peer (and teacher) evaluation of each group member's contributions should be part of the project overall evaluation as well.

Note: To complete the hydroponics exercise, some materials such as rockwool and polycrystals, that are not generally found in the classroom, may need to be obtained\ordered in advance. (Polycrystals can absorb over 200 times their weight in water and will expand when hydrated. Rockwool is spun basalt and is a lightweight medium in which to grow plants.)

Careers associated with gardening/agriculture should be introduced here, especially those related to Louisiana crops in general and local crops in particular. Utilize individuals from the community, if applicable; local Cooperative Extension specialists can also serve as a valuable resource for this information. Discussion and readings associated with hydroponics and "organic" gardening could be introduced at this time as well.

Activity 5: Surface Changes and the Environment (SI GLEs: 6, 7, 9, 11, 12; SE GLE: 6; ESS GLE: 12)

Materials List:

per group - *RAFT writing* assignment, Internet-accessible computer for NASA exercise or *The Earth: Work in Progress* video, and individual copies of *The Earth: Work in Progress Lesson 1 Activity: Natural Disaster Lists* background and activity sheets

Use appropriate teacher-selected reading materials including Earth and Environmental Science text readings and an introductory discussion to introduce relationships of geologic surface changes and the biotic environment. Exercises are offered for classes with and those without multiple internet-accessible computers. Aspects of both exercises are conducive to the use of *RAFT writing* strategies (view literacy strategy descriptions). RAFT is an acronym that stands for R- role of the writer, A-audience to whom or what the RAFT is being written, F-the form the writing will take, T- the topic focus of the writing. This strategy gives students the freedom to project themselves into unique, complex roles and to look at content from unique perspectives. *RAFT writing* has been used to explain certain processes, describe a point of view, envision a potential job assignment, or solve a problem. It's the kind of writing that when crafted appropriately is creative and informative. The NSTA *Science Teacher* article, "Becoming Environmentally Literate Citizens" by Susan Groenke and Randall Puckett (November 2006) serves as a good *RAFT writing* resource and background information for teachers and includes an assessment rubric as well. (Archived copies of this article are available to NSTA members via the NSTA website.)

Introduce students to the assignment, by telling them that they will be analyzing an open-ended, real-world problem by using this basic problem-based learning format:

1. Determine whether a problem exists.
2. Create an exact statement of the problem.
3. Identify the information needed to understand the problem.
4. Identify resources to be used to gather information.

5. Generate possible solutions.
6. Analyze the solutions and determine a feasible plan of action/recommendation.

Discuss each of the steps and have students record them within their notebooks. Divide students into small, heterogeneous groups and distribute the appropriate *RAFT writing* assignment to each (refer to the samples below). Then, familiarize students with the issue(s) to be considered and inform them that you will provide academic (and behavioral) support but that they must make the decisions within their groups.

For classes with access to computers with Internet access, utilize the NASA *Classroom of the Future-Exploring the Environment* module, *Volcanoes*, www.cotf.edu/ete/modules/volcanoes/volcano.html and the *RAFT writing* assignment on the next page.

Living with Volcanoes---RAFT Writing Assignment
Role: team of science experts
Audience: appropriate (local and national) government agencies
Format: a risk analysis/ recommendation report
Task:
Situation 1. Determine whether to build a new high school in the shadow of Mt. Rainier.
Situation 2. Determine what the prospects are for the population near Kilauea.
Situation 3. Determine what should be done in the Portland area when Mt. Hood starts acting like Mt. St. Helens (sputtering/pre-eruption activities).
Situation 4. Determine if we are facing an eruption in Yellowstone as devastating as a nuclear attack.

For classes without computers or Internet access, have students view the Louisiana Public Broadcasting's (LPB) *EnviroTacklebox*™ video, *The Earth: Work in Progress*, available via LPB Cyberchannel. Ask your school principal for access information. Note: Some teachers and/or school libraries may have individual copies of this video. Next, students should complete *The Earth: Work in Progress Lesson 1 Activity: Natural Disaster Lists* (www.lpb.org/education/classroom/itv/envirotacklebox/teacherguide/module4/4natln1.htm). When assigning student groups specific natural disasters, include examples such as earthquakes, volcanoes, hurricanes, floods, glaciers, and erosion of Louisiana's coastline. Other relevant EnviroTacklebox™ programs/lessons are listed in the resources for this unit. If utilizing the EnviroTacklebox™ exercise, the *RAFT writing* assignment will look like.

Disaster Preparedness -- RAFT Writing Assignment
Role: Science writer
Audience: General public
Format: "Disaster Preparedness and Information Booklet"
Task: Inform the general public of past natural disasters (specific to your assigned topic) and describe current precautions that are taken (or are recommended) in event of reoccurrence of the disaster.

After generating their solutions, students should present the RAFT products to their classmates.

Activity 6: Change in the Weather (SI GLEs: 6, 7; ESS GLEs: 8, 9)

Material List: per student - hurricane tracking map, hurricane tracking data

As part of their Earth systems studies, instruct students to read text material and conduct research of written and electronic resources to investigate the structure, composition, and functions of Earth's atmosphere in order to explain why weather only occurs in the tropospheric layers.

As this unit is to be completed during hurricane season, use current or archived storm information to teach students to track hurricanes. Incorporate discussion of hurricane escape routes and hurricane preparedness needs into the class discussion as well. Have students read and discuss one or more of the numerous articles that have been published since Hurricanes Katrina and Rita. Include articles about wetlands values, loss, and restoration projects and/or articles about the interrelationships between human habitats and the coastal environment. Sources of some articles are listed in the Resource section of this Unit.

Hurricane tracking data are available at National Weather Service National Hurricane Center (www.nhc.noaa.gov). Hurricane tracking maps are usually available at no cost from local merchants, or a copy can be downloaded from www.nhc.noaa.gov.

In addition to serving as a resource about current weather conditions, several websites provide excellent information on selecting meteorology as a career. Students can learn what courses to take in high school, appropriate amateur pursuits, and the various types of professional positions within the field by visiting
www.ametsoc.org/careercenter/careers.html#meteorologistscareer
www.black-collegian.com/career/career-reports/meteorology2006-2nd.shtml
www.theweatherchannelkids.com/weather_ed/careers_in_meteorology

Activity 7: Change Closer to Home (SI GLEs: 2, 3, 4, 5, 6, 7, 9, 10, 12; SE GLE: 6; ESS GLE: 20)

Materials List:

per student - Experimental Design Diagram BLM, Investigation Analysis Format BLM

per group - water source container (such as a large watering can, bucket, or hose), stream table or plastic plant tray, sand (enough to fill stream tables within a few cm. of its upper surface)

per class - one transparency per class and/or one diagram per group of images of recent lobes of the Mississippi River (One source of the images is the *New Orleans, a Natural History* website referenced at the end of this activity.)

Prior to beginning the inquiry investigation, have students identify and discuss safety guidelines and concerns that they should follow in this activity. They will be simulating river changes using a stream tray set-up.

Coastal Louisiana is an area of continued surface change. In one way or another, an ancestral river to the current Mississippi system has been draining the changing continent for the past 7500-8000 years. As the river changed its path, new deltaic lobes formed over time as sediments were deposited as the river made its way to the ocean.

Students may be familiar with what happens when a garden hose is left on a surface and then turned on at full force. It will wiggle and squirt in a changing pattern first one way and then another (to simulate river meandering). Using stream tables or plastic plant trays containing sand and a water source, have students (working in cooperative groups) set up a river system in which they will design and conduct an inquiry investigation simulating river changes. *Teacher Note: It will be necessary to slightly elevate the stream tables relative to the water source to establish a flow pattern.*

1. Provide instruction with regard to use of the stream model and have students identify and discuss safety/behavioral guidelines.
2. After setting up their stream table, have each group allow water to flow over the model for at least five minutes **(**allow sufficient time for features such as meanders, channels, and deltaic lobes to develop). This should be considered "Trial One" and each group should prepare a labeled illustration (on a paper labeled "group data sheet") for later comparison.
3. Each group will develop an inquiry investigation in which they will alter some aspect of the model (for example, new position of the water source, change in the angle of elevation, additional sediment in the flowing water, an increase in flow of river water). After receiving teacher approval for the adjustment, distribute and have each student complete an Experimental Design Diagram BLM—identifying and recording the hypothesis, variables and controls, step-by-step procedures, and safety guidelines needed for their investigation.
4. Have student groups run two trials incorporating their adjustment. They should label these "Trials Two" and "Trial Three" and a labeled illustration should be prepared after each trial (and will serve as data).
5. Students are to then analyze their illustrations and relate their observations to the Mississippi River.
6. One of the student systems should be selected for class discussion, and students from the other groups should be asked to establish a sequence or order by age for the features they are observing. Students must defend their answers with evidence observed while working with their own systems. Providing an image of the recent lobes of the Mississippi River, the teacher will ask the students how they would sequence the lobes in the system. What evidence would they want to look for? What information would they need? Conclude with an introduction to the

developing Atchafalaya Delta and the attempts to manage the Mississippi River through levees, spillways, the Old River Control Structure, and the proposed diversion projects.

7. Issue copies of the Investigation Analysis Format BLM. Each student should complete and submit this form and the completed experiment report.

The DVD, *New Orleans, a Natural History* by Walter Williams, would be an excellent resource for this activity. It is available as a streaming video at www.NewOrleansHistory.net **.** A natural history of the development of the Mississippi River Delta and the evolution of the lobes at the mouth of the river is available at http://www.loyno.edu/lucec/mrddocs/11.doc.

Activity 8: Biogeochemical and Hydrologic Cycles (SI GLE: 2, 5, 6, 7, 10, 12; SE GLE: 7; ESS GLEs: 2, 13, 15)

Materials List:

per group - several small potted plants and covered jars, aquaria or plastic bags to use as terrariums (one/plant)

per class - art supplies for visual displays or *PowerPoint*™ access, overhead transparencies or slides of the water cycle

Use appropriate teacher-selected reading materials including Earth Science and Environmental Science text readings to introduce the topic. After participating in an introductory discussion, students will complete two exercises to demonstrate the hydrologic, oxygen, carbon, nitrogen, and phosphorus cycles. (The exercises below also offer an opportunity for reinforcement of the five interconnected Earth spheres.)

Oxygen, Carbon, Nitrogen, Phosphorus Cycles

For oxygen, carbon, nitrogen, and phosphorus cycles, students will work in small groups to produce presentations that should include visual displays, such as pictures, models, or a multimedia presentation to represent the cycles. Assign a different cycle to each collaborative group of students. With large classes, assign each cycle to two groups. Inform those assigned the carbon cycle that they are to include information on coal and petroleum formation, those focusing on the nitrogen cycle are to explain the importance of bacteria to that cycle, and those focusing on the phosphorus cycle are to explain why phosphorus is important to life. Each group will present a visual display illustrating the cycle as well as an informative, relevant presentation of the cycle's basics and the additional information designated above. During concluding discussions, review the processes of photosynthesis and aerobic respiration to ensure that students understand the importance of these processes in the cycling of oxygen and carbon.

Hydrologic (Water) Cycle

After basic instruction in plant care, students should create a closed-system plant-growth chamber (covered jars, aquaria, or plastic bags could suffice). Then, after having them read appropriate text

materials, use overhead transparencies or a slide presentation to review/clarify the stages of the water cycle with students. During the concluding discussion, ask students to identify the points in the water cycle where energy is released or absorbed and where polluting chemicals may be introduced, such as run-off and bonding with gas molecules to form acid rain during condensation. A complete review of the water cycle must include the ground phase, where infiltration/percolation accomplishes the removal of some pollutants from the surface water discharge as well as tracing the flow of heat energy through the various stages. This is an important function and value of the Louisiana wetlands**.** The *Louisiana 4-H Environmental Science Project Book* serves as an excellent source of water cycle materials as they apply to Louisiana and may be obtained from the Cooperative Extension Office located in each parish.

Activity 9: Establishing a Compost Bin (SI GLEs: 1, 2, 3, 4, 5, 6, 7, 9, 10, 12; SE GLEs: 5, 8, 9)

Materials List:

per student - lab apron, lab safety goggles, several pairs of gloves,, Investigation Analysis Format BLM, Experimental Design Diagram BLM, science learning log

per class - utility knife (to be used under teacher supervision), drill or nail for making holes (to be used under teacher supervision)

per group - compost bins; two 2-liter or 3-liter soda bottles; one smaller container (about 5-cm high) that fits inside the soda bottle; one foam plate or tray; duct tape or clear packaging tape; insulation materials (such as sheets of fiberglass or foam rubber, or foam peanuts); fine-meshed screen or fabric large enough to cover top of soda bottle and air holes in bottom half; temperature probe that will fit into the top of the soda bottle and be long enough to reach down into the center of the compost; pH meters; soil moisture sensor; chopped vegetable scraps such as lettuce leaves, carrot or potato peelings, and apple cores, or garden wastes(such as weeds or grass clippings); bulking agent (such as wood shavings or 1-2 cm pieces of paper egg cartons, cardboard, or wood); hand lens or microscope; optional - hollow tubing to provide ventilation

Note: If the decision is made to set up a compost bin on the school campus rather than small, individual units within the classroom, permission should be obtained from the administration.

This is a long-term activity. The stages of succession will be observed over several weeks and the resulting compost will be utilized in resource management activities in Unit 3. Composting is the process of combining organic materials such as grass clippings and food scraps under conditions that enhance the rate at which they decompose. In the United States, organic wastes make up a large percentage of what is thrown away. Composting provides an opportunity to keep organic materials out of landfills and to create a useful end product instead. A compost pile also provides opportunities for direct observation of succession. In this aspect of the long-term project, student groups will learn/utilize basic lab protocols and explore basic biology, chemistry, and physics

concepts. Safety concerns should be addressed in all aspects of the investigation. Note: It may be necessary to provide ventilation if containers are otherwise "air tight" to release any gases that might build up.

Introduce the topic of composting through use of teacher-selected reading materials, including text readings and resources such as the following:

- *Building a Soda Bottle Bioreactor*, http://compost.css.cornell.edu/soda.html, provides instruction for building a soda-bottle compost bin.
- *Composting in the Classroom: Scientific Inquiry for High School Students* by Nancy Trautmann and Marianne Krasny is a comprehensive guide for teachers interested in guiding composting research projects by high school students. This reference can be downloaded (http://compost.css.cornell.edu/CIC.html) or purchased from NSTA. It presents a detailed scientific exploration of several methods of composting methods and classroom applications. It also provides the framework for an interdisciplinary experience for students; algebraic equations for evaluating mixtures; and scientific techniques for setting up, monitoring, and evaluating results from experiments. There are suggestions for independent research projects.
- The activity *Cornell Composting: Invertebrates of the Compost Pile*, http://compost.css.cornell.edu/monitor/monitoring.html, provides background and activities for investigating succession within a compost pile through observation of changes in moisture, odor, microbes, invertebrates, temperature, and pH.
- *Invertebrates of the Compost Pile*, http://compost.css.cornell.edu/invertebrates.html, is useful.
- *Compost Physics*, http://compost.css.cornell.edu/physics.html also provide materials useful to the investigation.

After engaging students in an introductory discussion of the process and the merits of composting, distribute individual copies of the Investigation Analysis Format BLM. Instruct students to complete sections 1-3. After students identify and address safety issues or concerns (section 3), review to assure they have included wearing gloves, aprons, and goggles and that they should wash their hands prior to and following handling the lab materials. Then, place students in small, heterogeneous lab groups. Distribute copies of the Experimental Design Diagram BLM and instruct students to complete these as they develop a compost investigation. After each cooperative lab group develops an experimental design to guide them through their inquiry, the class will establish a starting baseline by measuring soil temperature, pH, and moisture levels. All student investigation plans should be reviewed and approved by the teacher prior to beginning the investigations.

Direct student groups to look for signs of life within a small sample of the material to be composted by observing that sample with a hand lens or a microscope, counting the number of species observed, and counting the number of organisms per population. Have the class share data and estimate the number of species and organisms in the entire (class) sample. (These samples are being taken to establish a baseline for Unit 3- Activity 10.)

Allow the decomposition/succession process to continue for three to four weeks. During that time, students should monitor water and food levels, adding water and/or food items once weekly or as necessary. At the end of the third or fourth week (and again each week thereafter), student groups should repeat the battery of tests done on the original samples and should share results. Observations, data tables, inferences, sketches, organism factoids and reflections should be recorded within the science *learning logs* (view literacy strategy descriptions). After sharing results, each student should work individually to complete the data analysis and conclusion portions of the Investigation Analysis Format BLM lab.

Activity 10: Evidence of Atmospheric Oxygen (SI GLEs: 6, 8; SE GLE: 6; ESS GLE: 21)

Materials List:

per student - copies of guiding questions

per class - reference materials (books, articles, and websites) related to the topic

Begin the activity with the question, "Do all forms of life on Earth require oxygen in their environment?" Guiding questions may be used to elicit desired responses. Next, ask students to identify the organisms that produce the oxygen in Earth's atmosphere. Inform students that because of geologic processes and the development of life forms that could photosynthesize, the gases in our atmosphere have changed over time. Ask them if organisms dependent on aerobic respiration could have been the first life forms to develop on Earth. Explain that in this activity, they are to explore the changes in the oxygen content of Earth's atmosphere through fossil records. Prior to beginning student investigation, review the meaning of the term *isotopes*, using oxygen and carbon isotopes as examples. Instruct students to conduct research of written and/or electronic resources to find out how fossils provide evidence of changes in the oxygen content of the atmosphere and climatic changes such as temperature fluctuations. Allow students to work in pairs. If computers with Internet access are available, develop a webquest that includes the URLs for teacher-selected websites and also includes guiding questions. If computers are unavailable, provide students with copies of selected articles from Earth Science references and from internet sources such as "Silence of the Clams" (described in the Unit 1 resources). An internet search using the key term, "isotonic oxygen composition of fossil shells" will provide samples of related articles.

Whether utilizing the webquest or the articles, provide students with questions that guide their studies:

- Fossils from which animal group provide the best evidence of changes in oxygen content? Explain why.
- What part of shellfish makes them valuable fossil evidence of oxygen content, and why?
- Which isotopes provide evidence of atmospheric changes?
- Which isotopes provide evidence of temperature changes?

- What technological tool is used in analyzing the isotopes present in fossils? What is its function?
- How can iron in rock layers provide evidence of atmospheric oxygen content?
- What are three processes that reduce oxygen in the atmosphere?

In addition, students should print out one graph from their research and write an interpretation of the data illustrated. They should also use the information studied in this unit to cite an example of how new scientific data can result in an existing scientific explanation being supported, reviewed, or rejected.

See the reference section at the end of this unit for websites on this topic. After webquest data sheets are collected, conclude the activity by conducting a class discussion in which students reach a consensus on the correct answers to the questions.

Sample Assessments

General Guidelines

Assessment techniques should include drawings/illustrations/models, laboratory investigations with reports, a laboratory practicum (problem-solving and performance-based assessments), group discussion and journaling (reflective assessment), and paper-and-pencil tests (traditional summative assessments).

- Students should be monitored throughout the work on all activities via teacher observation of their work and lab notebook entries.
- All student-developed products should be evaluated as the unit continues.
- Student investigations should be evaluated with a rubric.
- For some multiple-choice items on written tests, ask students to write a justification for their chosen responses.

General Assessments

- Students will reflect on the following questions for journal or notebook entry: How do the abiotic factors of an environment affect the biotic factors and vice versa? How are the biotic and abiotic factors affected when a single factor is no longer in the environment? (Examples of these factors include milkweed plant for monarch butterflies, a large tree for shade, or rocks for organisms to hide under.)
- Students will summarize the processes of photosynthesis and respiration and relate their roles in the carbon and oxygen cycles.

When given scenarios describing changes in components of the biosphere, students will describe the probable impact on selected components of ecosystems.

Activity-Specific Assessments

- Activity 1: Prior to initial lab work, administer a lab safety test which includes a description of an experiment for which students will identify relevant safety issues and indicate the appropriate safety measures/tools to be utilized. (Questions relating to relevant safety issues should be included on tests and pre-lab discussions throughout the year.)

- Activity 2: Student assessment should be based upon participation in the survey, class discussion and accuracy of essay questions in which students discuss effects of pollutants on local populations, interrelationships of clean water, land, and air in given populations, local actions and their effect on the global environment, global climate change, and topics generated during class discussion. Students could then administer the survey to the entire school or to their families and analyze the data they collect.

- Activity 8: As an assessment of the Hydrologic Cycle material, have students create an educational game, video, skit, or booklet to teach fourth graders the water cycle. After contacting a fourth grade teacher to establish the cooperative relationship, have the fourth graders review and evaluate your students' projects based upon student-selected criteria.

Resources

Learning Logs/Journaling

- Leslie, Clare Walker and Charles E. Roth. *Keeping a Nature Journal: Discover a Whole New Way of Seeing the World Around You (*2nd edition).North Adams, MA: Storey Publishing,2003
  Simple techniques to give first-time journal-keepers the confidence to go outside, observe the natural world, and sketch and write about what they see

- Nature Journaling: Some Ideas to get you started (excerpted from: *Keeping a Nature Journal* by Clare Walker Leslie and Charles E. Roth
  http://share3.esd105.wednet.edu/rsandelin/Resources/journaling.htm
  This excerpt is a user-friendly introduction to journaling techniques and tools and provides sample journal pages.

Earth Systems Science

- Georgia Perimeter College—Earth Systems Workshop for High School Teachers
  http://gpc.edu/~pgore/EarthSystems/EarthSystemscontents.html
  Includes numerous links to activities and resources related to teaching from an Earth Systems perspective

- *Earth Systems Education Framework*
  (http://earthsys.ag.ohio-state.edu/framework.html) Describes the seven basic understandings of Earth Systems Science

Safety

- The Laboratory Safety Institute (Free Documents)
  http://www.labsafety.org/freedocs.htm
  This site includes safety contracts/signoffs, lab inspection checklists, and related links and articles.

Biogeochemical Cycles

- California State Univ.-Monterey's Life and Biogeochemical Cycles
  http://essp.csumb.edu/esse/climate/climatebiogeo.html An overview of biogeochemical cycles and highlights their role in climate, agriculture, acid precipitation, and organisms

- Environmental Literacy Council's Biogeochemical Cycles
  http://www.enviroliteracy.org/subcategory.php/198.html Descriptions of each cycle and links to related sites

- USGS Water Science for Schools: The Water Cycle
  http://ga.water.usgs.gov/edu/watercycle.html Interactive water-cycle diagrams and a one-page cycle summary suitable as a student "hand-out"

- EnviroTacklebox™ Module-Carbon: The Element of Surprise.
  A video, Teacher's Guide, Student Activities, and Curriculum Standards Correlations are available from LA Public Broadcasting Cyberchannel. Contact your school principal for access information.

Earth Studies and Weather

- USGS Major Ecosystems and Regions of the Acadian-Pontchartrain NAWQA
  http://la.water.usgs.gov/nawqa/ecology.htm Ecological regions and natural history including formation of the Mississippi Delta

- Access Excellence Activities Exchange: Bioforum for High School Teachers, "Silence of the Clams" by Dr. Peter D. Roopnarine http://www.accessexcellence.org/BF/bf06 A talk and slides discussing deltaic system building and analysis of Oxygen 16 and 18 in clam fossils in analyzing oxygen-temperature relationships within the Colorado River

- Exploring the Environment: Severe Weather: Hurricanes! http://www.cotf.edu/ete/modules/sevweath/sevweath.html
  Students review Hurricane Andrew data in preparation for tracking, analyzing, and predicting the course of a fictional new hurricane threatening North America

- US Geological Survey: A Virtual Tour of the 1906 San Francisco Earthquake http://earthquake.usgs.gov/regional/nca/virtualtour
  The tour explores the earthquake and its aftermath from scientific, engineering, and human perspectives.

- US Geological Survey: Earthquake Center
- http://earthquake.usgs.gov/eqcenter
  Search by location and magnitude for earthquakes that have occurred within the past seven days anywhere in the world

- Environmental Literacy Council (http://www.enviroliteracy.org) provides teachers with tools to help students develop environmental literacy. Included are modules (in pdf format) of the publication, *Resources for Environmental Literacy*. Each of the five modules is designed to build skills in critical thinking and analytical reasoning about complex issues. Each module includes background information detailing the environmental context of each topic, recommends supplementary texts and lists online teaching resources, and suggests activities for further classroom exploration. This publication is available for purchase in print from NSTA. The "Earthquakes, volcanoes, and tsunamis" module is relevant to Unit 1.

- The Joint Oceanographic Institutions (Microfossils: The Ocean's Storyteller), www.joilearning.org. includes an activity, *Secrets of Sediments,* that uses fossils to provide evidence of oxygen content in the atmosphere and climatic changes. The activity, teacher's guide, and a poster can be viewed at the mentioned site by clicking on *Posters*.

Environment

- *NASA Classroom of the Future--Exploring the Environment* (ETE) http://www.cotf.edu

Environmental Science
Unit 2: Development and Succession in Ecosystems

Time Frame: Approximately 10 weeks

Unit Description

This unit introduces the study of ecology as it focuses upon major ecosystem types and upon the interrelationships among and between populations and their abiotic environment.

Student Understandings

Students develop an understanding of ecological systems including the characteristics of major global aquatic and terrestrial ecosystems (biomes) and Louisiana ecological regions/ecosystems. They gain an understanding of the interactions within these ecosystems, and the ramifications of change (both natural and human-induced) upon the specific ecosystems and upon biodiversity in general.

Guiding Questions

1. Can students explain how species in an ecosystem interact and link in complex webs?
2. Can students compare characteristics of the major kingdoms and use taxonomic keys to identify organisms?
3. Can students describe the abiotic and biotic factors that distinguish Earth's major ecological systems?
4. Can students use the 10% rule and data analysis to discuss the flow of energy through the various trophic levels within a community?
5. Describe the characteristics of major biomes on Earth and major Louisiana bioregions or ecosystem types?
6. Can students examine and discuss the major stages of succession, describing the generalized sequential order of the types of plant species?
7. Can students analyze the effect of an invasive species on the biodiversity within an ecosystem?
8. Can students determine the effects of limiting factors on a population and describe the concept of carrying capacity?
9. Can students cite examples and describe the effect of pollutants on selected populations?
10. Can students identify the factors that affect sustainable development?
11. Can students describe how accountability toward the environment affects sustainability?

12. Can students identify the factors that cause the inequitable distribution of Earth's resources?
13. Can students explain why biodiversity is essential to the survival of organisms?

Unit 2 Grade-Level Expectations (GLEs)

GLE #	GLE Text and Benchmarks
Science as Inquiry	
2.	Describe how investigations can be observation, description, literature survey, classification, or experimentation (SI-H-A2)
4.	Conduct an investigation that includes multiple trials and record, organize, and display data appropriately (SI-H-A2)
5.	Utilize mathematics, organizational tools, and graphing skills to solve problems (SI-H-A3)
6.	Use technology when appropriate to enhance laboratory investigations and presentations of findings (SI-H-A3)
7.	Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations) (SI-H-A4)
8.	Give an example of how new scientific data can cause an existing scientific explanation to be supported, revised, or rejected (SI-H-A5)
13.	Identify scientific evidence that has caused modifications in previously accepted theories (SI-H-B2)
Science and the Environment	
1.	Describe the abiotic and biotic factors that distinguish Earth's major ecological systems (SE-H-A1)
2.	Describe the characteristics of major biomes on Earth (SE-H-A1)
3.	Use the 10% rule and data analysis to measure the flow of energy as represented by biomass in a system (SE-H-A2)
4.	Determine the effects of limiting factors on a population and describe the concept of carrying capacity (SE-H-A3)
5.	Examine and discuss the major stages of succession, describing the generalized sequential order of the types of plant species (SE-H-A4)
6.	Analyze the consequences of changes in selected divisions of the biosphere (e.g., ozone depletion, global warming, acid rain) (SE-H-A5) (SE-H-A7)
8.	Explain how species in an ecosystem interact and link in a complex web (SE-H-A7) (SE-H-A10)
9.	Cite and explain examples of organisms' adaptations to environmental pressures over time (SE-H-A8)
10.	Analyze the effect of an invasive species on the biodiversity within ecosystems (SE-H-A9)
11.	Explain why biodiversity is essential to the survival of organisms (SE-H-A9)
12.	Give examples and describe the effect of pollutants on selected populations (SE-H-A11)

GLE #	GLE Text and Benchmarks
15.	Identify the factors that cause the inequitable distribution of Earth's resources (e.g., politics, economics, climate) (SE-H-B3)
18.	Identify the factors that affect sustainable development (SE-H-B6)
27.	Describe how accountability toward the environment affects sustainability (SE-H-D5)
Life Sciences	
18.	Classify organisms from different kingdoms at several taxonomic levels, using a dichotomous key (LS-H-C4)
19.	Compare characteristics of the major kingdoms (LS-H-C5)

Sample Activities

Activity 1: Introduction to Ecology (SI GLE 2; SE GLE 1; LS GLEs 18, 19)

Materials List:

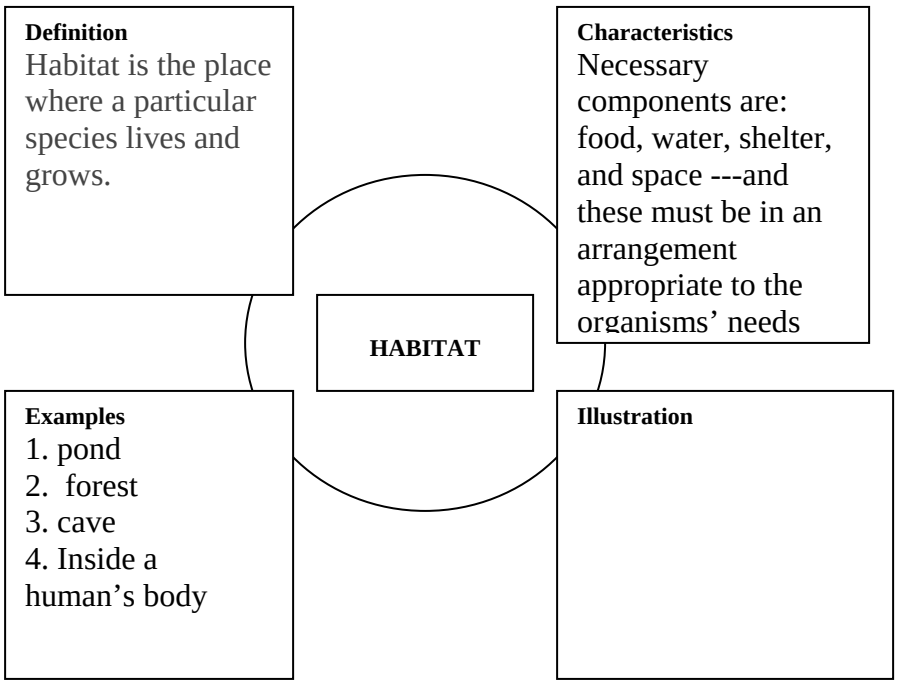
per student- teacher-created pre-test, index cards, science learning logs

per class- taxonomic keys of trees, insects, fish, etc.

Administer a pre-test to reveal the degree to which it is necessary to review the levels of biological organization and basic ecology concepts. Then, for remediation purposes, assign appropriate teacher-selected reading materials including biology and environmental science text readings and conduct an introductory class discussion. The discussion of ecological systems (ecosystems) should introduce ecology-related terms (including, but not limited to, *ecology, environment, biotic factors, abiotic factors, habitat, niche* and each of the levels of biological organization) and a general exploration of the major biomes.

To develop their knowledge of the key vocabulary, have students create *vocabulary cards* (view literacy strategy descriptions) for the terms. Ask the students to follow your example as you create a sample card. (Refer to the sample included in this activity.) On the board, place a targeted word in the middle of the card, as in the example below. Ask students to provide a definition. It is best if a word can be defined in the students' own words. Write the definition in the appropriate space. Next, have students list the characteristics or description of the word and write that information in the appropriate space. Then, ask for examples of the term and include one or two of the more accurate ones in the designated area on the card. Finally, create a simple illustration, if possible, of the term in the last area of the card.

Once the sample card is created, ask students to make their own word cards for the other ecology-related terms (listed above) as homework.



As ecological studies will include the identification and study of various organisms, a review of the general characteristics of each of the six biological kingdoms is in order. Students should participate in the use, and development of taxonomic keys (biology texts and their teacher resources generally have examples).

Present students with "unknowns" to identify, such as plants on the school grounds or animals in the classroom. To reinforce their taxonomy skills, have students develop science *learning log* entries (view literacy strategy descriptions) about their "unknowns." To develop a greater awareness of habitats and/or organisms, have students "adopt" an organism and then, within their science *learning logs*, record their observations and new understandings and reflections about this organism throughout the year. In addition (within their *learning logs*), students should discuss the roles of observation, description, and classification in scientific investigations.

Activity 2: Energy Flow Efficiency in Ecosystems (SI GLEs: 2, 5, 7; SE GLEs: 3, 8)

Materials List:

Part A- Vocabulary Cards: one pack per student - 3x5 or 5x7 inch index cards

Part B- The Living Marsh: One per teacher- instructions/background; one per group - 100 mini-marshmallows, plastic knife; one per student - *Marshmallow Energy Flow* activity sheet, science learning logs

Part C- Owl Pellet Dissection Exercise: one per group - owl pellet; one per student - disposable plastic gloves (pair), dissecting needle, FYI: Owl Pellets

BLM, Owl Pellet Dissection - Lab Procedures BLM, Owl Pellet Dissection Lab Report BLM, Lab Investigation Analysis Format BLM (see Unit 1 Activities 7 and 9)

Part D- Owl Pellet Inquiry Exercise: one per group- owl pellet; one per student - disposable plastic gloves (pair), dissecting needle, FYI: Owl Pellets BLM, Owl Pellet Dissection-Lab Procedures BLM, Owl Pellet Inquiry Exercise BLM

Part A: Use appropriate teacher-selected reading materials including Environmental Science text readings to introduce the topic of energy flow through ecosystems. Assign students to create *vocabulary cards*(view literacy strategy descriptions) for topic-related terms including but not limited to *food (energy) chain, food web, trophic level, autotroph, heterotroph, herbivore, carnivore, omnivore, decomposer/detritivore, calorie, kilocalorie, pyramid of biomass, pyramid of energy,* and *pyramid of numbers*. A review of the instructions for creating *vocabulary cards* may be necessary (refer to Activity 1).

As part of the discussion of the vocabulary, introduce the interpretation and development of food (energy) webs and use an energy flow pyramid to illustrate the ten percent rule of energy flow from trophic level to trophic level. (Examples of energy webs and energy-related pyramids are generally available in student texts and their accompanying teacher resources.) Such pyramid displays convey both the relative size of the trophic level (in terms of biomass and number) and the decreasing amount of energy passed on. Students should include an energy pyramid within their science *learning logs* (view literacy strategy descriptions), adding details as they are discussed in class.

Part B: To apply their understanding of these concepts, students are to complete *The Living Marsh: Exercise 2-Marshmallow Energy Flow Activity* (http://www.louisianaschools.net/lde/uploads/2541.pdf).This exercise illustrates energy flow efficiency through a Louisiana marsh ecosystem by having students visualize energy being passed-on between trophic levels within a food web. It also includes background information, instructions, and an activity sheet that calls upon students to express their knowledge in other contexts. *Note:* As *Marshmallow Energy Flow* includes use of a plastic knife and edible items, have students identify and discuss safety guidelines and concerns before conducting the activity.

Part C: After completion of the *Marshmallow Energy Flow Activity* and discussion, have students participate in an investigation of an owl pellet. Owl pellet dissection activities provide opportunities for study, not only of food webs, but also for the study of small mammals and their distribution, food webs, predator/prey relationships, population studies, habitats, use of dichotomous keys, owl behavior patterns, niche, adaptation, and sustainability. Pellet dissection and analysis activities are readily available in lab books and from biological supply companies. Distribute copies of the FYI: Owl Pellets BLM, Owl Pellet Dissection –Lab Procedures BLM, Owl Pellet Dissection Lab Report BLM to each student. They will also each need a copy of the Lab Investigation Analysis Format BLM from Unit 1. Before beginning the dissection, conduct a pre-lab discussion in which students identify and discuss safety guidelines and concerns and complete sections 1-3 of

the Lab Analysis Format BLM. Place students in small heterogeneous groups and review individual and group assignments. After monitoring the dissections and clean-up, guide class discussion of the data, vocabulary, and lab problems. When reviewing the lab materials, emphasize energy flow and its relationship to ecosystem stability. Remind students to complete the lab-related *vocabulary cards* including the terms *ventriculus, proventriculus, predator, prey, range, habitat,* and *diversity.*

Part D: If owl pellets from a number of differing species or from differing parts of the country are available, have student groups participate in an investigative exercise. (Individual owl pellets and kits can be purchased from a number of biological supply companies that can provide pellets from both the northwest and southeast US.) Each group will need copies of the FYI: Owl Pellets BLM and Owl Pellet Dissection –Lab Procedures BLM (as in Part C). However, in this exercise, the Owl Pellet Inquiry Lab Report BLM replaces the Owl Pellet Dissection Lab Report BLM. The inquiry lab exercise incorporates more sophisticated questions and calls upon students to utilize higher level reasoning/process skills. They will also each need a copy of the Lab Investigation Analysis Format BLM. Before beginning the dissection, conduct a pre-lab discussion in which students identify and discuss safety guidelines and concerns and complete sections 1-3 of the Lab Analysis Format sheet. Place students in small heterogeneous groups and review individual and group assignments. Assign half the groups pellets from one region (or species) and half with pellets from a second region (or species). After monitoring the dissections and clean-up, guide class discussion of the data, vocabulary, and lab problems. When reviewing the lab materials, emphasize energy flow and its relationship to ecosystem stability. Remind students to complete the lab-related *vocabulary cards*. Provide time for students to review construction of the cards and to discuss the definitions.

If Internet access is available, students can participate in virtual dissection of a variety of pellets, research owl species, and complete investigation analysis at *Virtual Owl Pellet,* www.kidwings.com/owlpellets/index.htm.

Throughout this activity, students are to discuss (within their *learning logs*) the various ways in which scientific investigations can be conducted and data gathered other than just experimentation.

Activity 3: Effects of Pollutants (SI GLEs: 5, 6; SE GLE: 12)

Materials List:

per student- index (vocabulary) cards, notebook, serial dilution demonstration

per class- food coloring, 2 dropping pipettes, several numbered test tubes or beakers

As a follow-up to the discussion of energy flow, acquaint students with the concept of biomagnification and bioaccumulation. To help students grasp the concept of parts per

thousand (ppt), parts per million (ppm), and parts per billion (ppb), include a serial dilution demonstration in your discussion. Text resource materials frequently contain serial dilution introductory activities. Useful on-line resources include *Serial Dilutions Made Easy* (www.accessexcellence.org/AE/AEPC/WWC/1993/serial.html) which is designed to assist teachers in helping students improve their skills and in understanding applications of serial dilutions.

Next, review use of *split-page notetaking* (view literacy strategy descriptions) with students. (An abbreviated example is included below.) Use the first reading selection to guide the class through the note-taking process. Working individually, students are to complete the next selection. To assure that students understand the material and that they are using the *split-page notetaking* technique appropriately, provide opportunity for them to discuss their notes with partners or within small groups.

Topic: Pollution, Biomagnification, and Bioaccumulation	
Big Ideas	**Supporting Information**
Bioaccumulation	-Sometimes pesticides wash off of crops and get into water bodies -Some pesticides do not degrade but enter food chains by collecting in microorganisms. - As organisms at higher trophic levels feed, they pick up and retain the pesticides for a long time.
Biomagnification	-The amount of pesticide continues to be more concentrated along the food chain (The higher the feeding level, the greater the concentration of pesticides).

The student teams can then create and discuss aloud their topic-related *vocabulary cards* (view literacy strategy descriptions) such as *concentration, parts per thousand (ppt), parts per million (ppm), parts per billion (ppb), serial dilution, bioaccumulation,* and *biomagnification*. To further reinforce the concepts, provide students with video focus questions to answer as you show the EnviroTacklebox™ video *The Aggravation of Accumulation*. (The video is available via LPB Cyberchannel. Ask your school principal for access information.) This video serves as a good introduction to the topic of bioaccumulation of synthetic chemicals and its impact on food chains. After discussing the video focus problems, have students complete the Project WILD "Deadly Links" exercise. If WILD is not available, an adaptation, "The Food Chain Game," is available at http://educ.queensu.ca/~science/main/concept/biol/b14/foodchaingame.html

Note: School libraries and some teachers have copies of the *Envirotacklebox* ™ series which may be borrowed for this activity.

Additional resources are included in the Unit 2 Resource List.

Activity 4: Major Ecosystem Types: (SI GLEs: 6, 7; SE GLEs: 1, 2, 6)

Materials List:

per class- materials to create a mural or diorama and/or computer with multimedia software installed

one per student- blank matrix table

Use appropriate teacher-selected reading materials, including Environmental Science text readings, to introduce the topic of *biomes*. After participating in an introductory discussion, student groups will each research one of the major terrestrial biomes, major aquatic/marine ecosystem types, or a Louisiana bioregion/ecosystem and prepare an illustrated presentation. Where available, students should either use multimedia software or should create a mural or diorama for display in the school library or hallway.

Presentations should include the physical characteristics, average temperature, annual average rainfall, and dominant plant and animal forms in their study area. Students should also explain how the topography and climate of these biomes affect the distribution of the Earth's natural resources. Students should also reflect on and discuss the following questions:

- Which plant and animal adaptations are necessary in each of the biomes?
- How might global warming or pollution such as acid rain or water pollution impact the biome?
- How would the climate, topography, and resources of the area likely affect the economics of humans residing there?

Have students construct a blank matrix *graphic organizer* (view literacy strategy descriptions) with plenty of columns and rows. (Consider using the sample that follows.) As groups present, the other students should record their notes on the matrix. A matrix is a type of *graphic organizer*. This type of *graphic organizer* is an arrangement of words and phrases in a table format that can be read horizontally and vertically. It is used to compare and contrast concepts or classify attributes. Tell students that in this activity, they will be building a matrix in which the major ecosystem types are listed on the vertical axis of the grid and the ecosystems' characteristics and dominant life forms are important are listed on the horizontal axis. To demonstrate how to use the grid, a large version could be put on poster paper and attached to the wall or one could be projected from an overhead or computer.

(Sample) Matrix *Graphic Organizer* for Major Ecosystem Types

Ecosystem	**Physical Characteristics**	**Avg. Temp.**	**Avg. Rainfall**	**Dominant Plants**	**Dominant Animals**
Tropical Rainforest					
Desert					
Grasslands					

As they listen to presentations, students are to fill in the table, indicating the manner in which the ecosystems exhibit the stated features. Once the table is completed, students are led to discover both the shared and unique characteristics of the properties of the ecosystems listed. Allow students to study from the matrix *graphic organizer* and then be given questions that ask them to compare/contrast the ecosystem types.

Activity 5: Succession (SI GLE: 6; SE GLEs: 5, 8, 9)

Materials List: print and electronic topic–specific resources, art/craft materials for visuals, computers with multimedia software such as *PowerPoint*® installed (optional)

Ensure that students have a basic knowledge of succession (primary and secondary) by assigning appropriate teacher-selected reading materials and topic-related *vocabulary cards* (view literacy strategy descriptions). (Vocabulary terms should include but not be limited to *succession, sere, primary succession,* and *secondary succession.*)

After an introductory discussion that includes review of the *vocabulary cards,* have students review their ecosystem notes from Activity 4 and then, allow each cooperative group to select one ecosystem to research more fully. (While the systems identified should not be limited to Louisiana, the teacher should facilitate the discussion to ensure that several Louisiana systems are included, e.g., hardwood forests along the Mississippi River Delta, pine forests, coastal prairie). If possible, take students to the school library to conduct research on their topics. Emphasize that their research report should include examples of specific interactions between species and links among species. They should also include examples and discussion of adaptations organisms have developed to environmental pressures typical to the ecosystem.

Next, inform the students that they will demonstrate their understanding of succession through use of a type of *graphic organizer* (view literacy strategy descriptions) known as a "time line." This type of display is effective because when used in conjunction with the text, both verbal memory (the text material) and spatial memory (the placement of events occurring over time) are utilized. In this activity, each group will use illustrations to represent the processes of both primary and secondary succession noting the predominant plant and animal life forms each supports. The *graphic organizer*s could take the form of poster boards on which they illustrate primary succession along the left edge and add illustrations of successive stages to the right; dioramas, or if available, *PowerPoint*® slide presentations are appropriate. Visual imagery helps students to see what they are thinking and understanding and their illustrations can then be used to generate "poster session" verbal presentations and written "essay question" discussion of the material.

Where possible, a field trip to a pond, forest, barrier island, deserted field, or nearby vacant lot would help students visualize the concept of *succession* and would provide additional opportunities for science *learning log* (view literacy strategy descriptions) entries.

Activity 6: To Disturb or Not to Disturb (SI GLEs: 5, 6, 13; SE GLEs: 5, 6, 27)

Materials List:

per teacher- *Rebirth in Fire* video, *Rebirth in Fire* Activity Guide *EnviroTacklebox*™ Module 4: Forces in the Environment Teacher's Guide, *Rebirth in Fire*— Lesson 1 Activity:" Fireproof Plants", *Rebirth in Fire*—Lesson 2 Activity: "The Wildland/ Urban Interface Dilemma", *Smokey's Message*: Culminating Activities

per student- "Fireproof Plants" instructions, *Smokey's Message*: Culminating Activities instructions

per group- art/craft materials for visuals; if available, a Burning Issues CD-ROM and a set of "I-ZONE" student materials

A change in environmental conditions that disrupts an ecosystem or community is referred to as a *disturbance*. Disturbances can be gradual or catastrophic. They may be caused by natural forces or may result from human activities. While many catastrophic disturbances devastate communities, others (like fire), frequently result in rejuvenation that, in the long run, leads to increased biodiversity. Some ecosystems, including Louisiana's Longleaf Pines, are fire-dependent. For many years, the control of fire in wild areas has been controversial (notably in our National Parks, like Yellowstone). However, as more and more American cities and suburbs spread into and along forested areas, fires can pose problems for homeowners, forest managers, and the ecosystems themselves. Prior to teaching the unit, download the EnviroTacklebox™ video, *Rebirth in Fir*e (available via LPB Cyberchannel. Ask your school principal for access information.) *Rebirth in Fire* Teacher's Guide: Background Information materials are available via www.lpb.org/education/classroom/itv/envirotacklebox (Refer to Module 4). Preview the "Background Information" before introducing the material to the class as it contains information on heat transfer and on the characteristics of fuel, weather, and topography that will enhance the understanding of fire in ecosystems. Note: School libraries and some teachers have copies of the Envirotacklebox™ series, which may be borrowed for this activity.

Use appropriate teacher-selected reading materials including Environmental Science text readings to introduce the environmental disruptions topic. Next, engage students in discussion of "man-made" environmental disturbances, the consequences of these disturbances and the interrelationships of these to human daily life, particularly in our state. Guide students through a discussion of the "natural" role of fire in ecosystems and have them *brainstorm* (view literacy strategy descriptions) examples of human habitats/fire interface issues. Brainstorming is an effective method of activating prior knowledge. It helps students understand what they know about a topic and enables them to connect their prior knowledge to that of their classmates. In introducing this strategy to the class, explain that in *brainstorming*, all ideas are accepted. Then, present the format to be used for this assignment. This could be a list or a *graphic organizer* (view literacy strategy descriptions) such as a flowchart or a web. As students share their ideas, record

them on the board, a poster, or a computer display. When students have exhausted their ideas, invite them to contribute to the discussion of the compiled list.

Use the discussion as a lead-in to the EnviroTacklebox™ video, *Rebirth in Fire* video, and to the completion of Lesson 1:"Fireproof Plants" in which student groups research plant adaptations to fire and design fire-resistant plants.

Next, students should complete "*Smokey's Message", Culminating Activities"* or the "I-Zone" exercise if multiple computers and copies of the CD-Rom *Burning Issues* are available. Both options offer opportunities to "teach the moment" by incorporating any recent wildfires or those which gained national attention, such as the burning of Yellowstone.

A.) *Smokey's Message:* "Culminating Activities"
http://www.lpb.org/education/classroom/ntti/lessons/html2003/9mtSmokey.html
This exercise is a modification of "Rebirth in Fire" Lesson 2, in which students address a wildlife/urban interface dilemma. (They role-play in a debate regarding land use/management.) Written in the National Teacher Training Institute format, this exercise presents detailed lesson plans. To reduce anthropomorphism, this exercise, written for use in high school classes, varies slightly from "Rebirth in Fire" Lesson 2. The exercise also provides opportunities for students to examine related careers.

B.) If multiple computers and copies of the CD-ROM *Burning Issues* are available, the *I-Zone Activity* is a more challenging program. It challenges users to learn about prescribed burns, wild land fire suppression, the relationships between fire and invasive plant species, and how to build "fire wise" homes. The CD includes four EcoTours of different biotic communities, an interactive field guide containing more than 300 slides and descriptions of organisms, four on-line activities, print materials for educators and students, and more. *Burning Issues* is a joint project of the Bureau of Land Management and Florida State University. It can be ordered at http://eea.freac.fsu.edu/bi.html for a fee.

Activity 7: Carrying Capacity (SI GLEs: 4, 5, 7; SE GLE: 4)

Materials List**:** one bag of dried beans (enough for five per student) and a kitchen timer or stopwatch

Use appropriate teacher-selected reading materials, including Environmental Science text readings, to introduce concepts of *limiting factors* and *carrying capacity*. After completing the reading and concept-related *vocabulary cards*, students will simulate herds of animals seeking food. The activity is a modification of the lesson, *Carrying Capacity* in *Ecosystem Matters: Activity and Resource Guide for Environmental Educators,* published by the US Forest Service Rocky Mountain Region. The activity can be found at www.na.fs.fed.us/spfo/pubs/misc/eco.

After completing the activity, students should summarize their most important findings, observations, or conclusions in a table or activity report. In addition to recording options available for re-establishing the herd size within the carrying capacity of the area, students' discussions should include limiting factors and reflect upon the concept of *sustainability*.

To relate a Louisiana species to the concepts, consider having students complete the *Project WILD* lesson, "How Many Bears Can Live in This Forest?" It utilizes a physically-active process to introduce students to the concepts addressed in SE GLE 4. It, too, incorporates basic math skills. An adaptation of this lesson can be found at www.dfg.ca.gov/projectwild/bear/19-23.pdf. Louisiana Black Bear resources are available through the Black Bear Conservation Committee. (Refer to the Unit 2 Resources.)

Activity 8: Populations, Migrations, and Seasonal Change (SI GLEs: 5, 6; SE GLEs: 8, 9)

Materials List:

per teacher - "Birds of Prey" materials produced by Silver River Museum Project WILD: Standards- based Writing prompts, Standards-based Reading Questions, Standards-based Math Questions and Answer sheets; "Behind the Numbers" video and Lesson 2 background and exercise instructions

per group - Large sheet of paper, several markers of various colors; per student- "Birds of Prey": Background information and graphs A-E, several index cards, "Behind the Numbers" Lesson 2

Study of *inter-population relationships, migration,* and *seasonal influences on populations* encourages interdisciplinary studies that include biology, climate studies, math, and geography. Prior to completing the exercises, have students read text material and conduct research of written and electronic resources (such as the *Journey North* sites referenced below) to investigate *inter-population relationships, migration*, and *seasonal changes on populations*. Students should also complete topic-related *vocabulary cards* (view literacy strategy descriptions).

If *Project WILD* materials are available, have students complete, "Birds Of Prey." This activity is designed to allow students to note changes in population sizes over time by interpreting graphs, to hypothesize the relationship among temperature, squirrel behavior, and falcon populations and to research and develop potential explanations for population changes. The activity has closed inquiry and open inquiry approach variations.
Begin by having students read the "Background" material (from the WILD Activity Guide) and participate in a discussion to ensure student understanding of the vocabulary. Then, distribute copies of the writing prompts. Have students complete these as homework. Each student should receive a copy of the graphs A-E (from the WILD Activity Guide), the Standards-based reading questions, and the Standards-based math questions (from the Silver River Museum Project WILD materials). Have students

complete these assignments, The Silver River Museum Project WILD /FCAT workshop includes the "Birds of Prey" writing prompts and standards-based reading and math questions and an answer sheet at http://myfwc.com/educator/PDF/birdsofpreyfcat.pdf

For information about upcoming *Project WILD* workshops, visit the Louisiana Department of Wildlife and Fisheries website or contact the State Coordinator at 985/882-9601.

If *Project WILD* is not available, the EnviroTacklebox™ video, *Behind the Numbers*, addresses the same GLEs, (The video is available via LPB Cyberchannel. Ask your school principal for access information). The video examines the effects of several biotic and abiotic factors on population fluctuations within ecosystems and describes population cycles—both annual and over longer periods of time. After viewing the video, have the students complete Lesson 2, (http://www.lpb.org/education/classroom/itv/envirotacklebox/teacherguide/module5/5popln2.htm). This lesson has students choose an ecosystem and design an interaction web for this ecosystem. Note: School libraries and some teachers have copies of the *Envirotacklebox*™ series, which may be borrowed for this activity.

If multiple computers with Internet access are readily available, the web-based *Journey North: A Global Study of Wildlife Migration and Seasonal Change*, www.learner.org/jnorth, is highly recommended. It enables students to track migrations and to investigate relationships among geography, temperature, and seasonal changes. In addition, the teacher resource materials include descriptions and samples of relevant inquiry, reading and instructional strategies, and reading/writing connections sample lessons.

Activity 9: We Don't Want You Here (SI GLE: 2; SE GLEs: 8, 9, 10)

Materials List:

per teacher - *Non-Native Invasion* video, *Non-Native Invasion* Lesson 2 background information and lesson plans

per student- set of *Non-Native Invasion* Lesson 2 student materials

After having students read relevant text material and introducing the topic of Invasive species, review associated vocabulary terms such as *Native species, Non-Native, Exotic* or *Alien species, Introduced species*, and *Invasive species*.(Have students create *vocabulary cards* (view literacy strategy descriptions) for these terms as homework.) Ask students to *brainstorm* (view literacy strategy descriptions) to generate a list of non-native/invasive species that have created problems in Louisiana and/or North America. Students should classify the "invasions" as being" natural" or "human-caused". Guide students through a discussion the changes that the introduction of each of these species seems to have produced in the community or ecosystem. (Refer to the Unit 2 Resources for materials relevant to Louisiana.)

The *EnviroTacklebox*™ video, *Non-Native Invasion*, (Available via LPB Cyberchannel. Ask your school principal for access information.) explores environmental impacts and measures used in control of non-native invasive plants and animals in North America. The video is divided into segments. Provide the students with video focus problems that encourage them to focus upon particular concepts you wish to discuss/reinforce after the viewing. Lesson plans can be printed from the *EnviroTacklebox*™ website. Have students complete "Non-Native Invasion" Lesson 2 (http://www.lpb.org/education/classroom/itv/envirotacklebox/teacherguide/module3/3nnslsn2.htm). Note: School libraries and some teachers have copies of the *Envirotacklebox*™ series, which may be borrowed for this activity.

While the *EnviroTacklebox*™ video and materials enhance the teaching/learning of the concepts, if they are not available, students can complete a comparable exercise. Working in cooperative groups, students are to investigate non-native, invasive species. Each group will select, research, and report on one species and present their findings as a press release to inform the public of the potential threat from the selected species. Student groups might present their press releases to the class as public service announcements or written press releases. Online resources applicable to Louisiana are included in the Unit 2 Resources.

Throughout Activity 9, have students discuss the roles of observation, description, and literature survey in scientific investigation.

Activity 10: Human Population Studies (SI GLEs: 6, 7, 8; SE GLEs: 4, 15, 18, 27)

Materials List:

per teacher - wood strips, white paint, green paint

per group - 250 colored cubes; a coffee can; graph paper; one copy each of the investigation instructions, data table, analysis problems, and research criteria

Advanced Preparation by Teacher: 1 cm by 1 cm (or 2 inch by 2 inch) trim strips can be purchased from a lumber supply store. One side of the strip should be painted white, and one side should be painted green. The number of strips purchased will depend on the number of student groups planned. Each group will need 250 colored cubes. Once the paint is dry, the strips should be cut into cubes and put into empty two-pound (or three-pound) coffee cans.

Human population size is a key component of sustainable living. Have students read text material and then consult written and electronic references to research various aspects of human population size and to discuss these in relationship to resource consumption and quality of life. To model human population growth, have students complete the activity, *A Simulation of Human Population Growth* by Janice Anderson, adapted from CORD Materials, www.nps.gov/piro/forteachers/simulationpopulationgrowth.htm . In this investigation, each student group models one of three patterns of human population

growth. Their studies include data collection and analysis and making inferences with regard to global human population change.

As part of their research, students are to identify factors that affect sustainable development, explain how accountability toward the environment affects sustainability, identify factors that cause the inequitable distribution of Earth's resources, and state examples of how new scientific data can alter previous scientific explanations.

The lesson can easily be modified to include research of growth patterns in Louisiana. As textbooks are not likely to include Louisiana data or data collected since Hurricanes Katrina and Rita impacted Louisiana during the 2005 hurricane season, make students aware of these resources:

- *Louisiana Demographics: Census Data Center*
  http://louisiana.gov/wps/wcm/connect/Louisiana.gov/Explore/Demographics+%26+Geography/
- *U.S. Census Bureau: State & County Quick Facts*
  http://quickfacts.census.gov/qfd/index.html
- Local newspaper reports relevant to hurricane-induced changes.
  Major newspapers generally have archives on-line. Back issues of articles/series may be available for purchase.

National and/or global population studies and activities are available in resource materials provided with most textbooks. In addition, the *Temperate Forest Foundation: Population* page, www.forestinfo.org/Discover/population.htm, provides background materials. The *Population Connection* (formerly ZPG), *Population Education* page, www.populationeducation.org/index.php , features links to hands-on activities, research materials, and a free newsletter.

Activity 11: Biodiversity (SI GLE 6; SE GLEs 6, 8, 11)

Materials List: Materials will vary with the selected biodiversity lessons.

The purpose of this activity is to have students recognize connections between human activities and the health and diversity of Earth's species and ecosystems. This activity is included at the end of this unit as students are called upon to take the concepts and skills learned in the previous activities and apply them to new situations.

Select, or allow the class to select, a biodiversity-related issue. Place students in small *professor know-it-all* (view literacy strategy descriptions) groups. Tell the groups that they will be called upon randomly to come to the front of the room and provide "expert" answers to questions from their peers about the content. Give the groups time to research the topic and/or review notes of previously studied topics and to develop three to five questions about the content they might anticipate being asked and that they can ask other experts.

Information relating to biodiversity-related issues can be found in most textbook resource materials. Some additional resources of local/regional interest include the following:

- The Barataria-Terrebonne National Estuary Program Estuary Issues (http://www.btnep.org/home.asp)
- LA Sea Grant Marine Education Resources website (http://www.lamer.lsu.edu/index.htm)
- *Living on the Edge* (produced by the LA Seafood Promotion and Marketing Board).
- NOAA *Expedition to the Deep Slope 2007*(refer to unit 2 resources) is an exploration of hydrocarbon seep communities deeper than 1000 meters in the Gulf of Mexico and includes researchers from LSU. It also provides opportunities for students to relate to female and minority field-science role models.

Call a group to the front of the room and ask them to face the class standing shoulder to shoulder. Invite questions from the other groups. Students should ask their prepared questions first and then add others if more information is desired. As this strategy may be new to students, demonstrate how the *professor know-it-alls* should respond to their peers' questions. Typically, students huddle after receiving a question, discuss briefly how to answer it, then have a spokesperson give the answer.

Remind students asking the questions to think carefully about the answers received and to challenge or politely correct the *professor know-it-alls* if answers are not correct or need elaboration and amending. After five minutes or so, ask a new group to take their place in front of the class until all groups have had a chance to serve as experts. Make sure students are holding the *professor know-it-alls* accountable for the completeness and accuracy of their answers.

Initially, it may be necessary and helpful to model the various types of questions expected from students about the content. For example, students should ask the *professor know-it-alls* both factual and higher level questions.

For unit closure, students are to reflect upon a biodiversity-related issue and to express themselves from unique perspectives through use of the *RAFT writing* strategy (view literacy strategy descriptions). This strategy gives students the freedom to project themselves into unique, complex roles and to look at content from unique perspectives. *RAFT writing* has been used to explain certain processes, describe a point of view, envision a potential job assignment, or solve a problem. It's the kind of writing that, when crafted appropriately, is creative and informative. Remind students that RAFT is an acronym that stands for R- role of the writer, A-audience to whom or what the RAFT is being written, F-the form the writing will take, T- the topic focus of the writing.
To reacquaint students with this writing strategy, choose a biodiversity-related issue activity and record it on the board. (For example: "Cutting of the Rain Forests" or "Wetland loss in Louisiana" or the *professor-know-it-all* topic from above.) Then, have students *brainstorm* (view literacy strategy descriptions) all the people or groups who are affected/ involved. When students have exhausted their ideas, have each one select one of the persons on the board and write a description of the issue from that perspective. The

description could take on a number of forms, such as a conversation, a newspaper article, a letter, an editorial, or a diary entry.

A possible *RAFT writing* assignment for this activity might be the following:

Wetland Loss in Louisiana -- RAFT Writing Assignment
Role: Wildlife Biologist
Audience: members of the "Friends of Louisiana Wildlife"
Format: an illustrated article for the club's monthly magazine
Task: Discuss wetland loss in Louisiana since the hurricanes of 2005, the impact of this loss on Louisiana's wildlife, and what citizens can do to help remediate this situation

While creativity is integral to this assignment, emphasize the need for accuracy, as well.

Sample Assessments

General Guidelines

Assessment techniques should include drawings/illustrations/models, laboratory investigations with reports, laboratory practicals (problem-solving and performance-based assessments), group discussion and journaling (reflective assessment), and paper-and-pencil tests (traditional summative assessments).

- Students should be monitored throughout the work on all activities via teacher observation of their work and lab notebook entries.
- All student-developed products should be evaluated as the unit continues.
- Student investigations should be evaluated with a rubric.
- For some multiple-choice items on written tests, ask students to write a justification for their chosen response.

General Assessments

- Students will diagram, label, and discuss food (energy) chains and food (energy) webs.
- Students are to complete video focus problems (provided by the teacher) as they watch video clips. The answers should be included in class/ student discussion and in analysis of the concepts under study.
- When given scenarios describing changes in components of an ecosystem, students should describe probable impact of these changes on specific populations or on the diversity of the ecosystem overall.

Activity-Specific Assessments

- Activity 1: Students participate in a lab practicum during which they use a dichotomous key to identify local organisms.

- Activity 2: Each student constructs a three-dimensional pyramid (from a sheet of unlined paper). On one side of the pyramid the student is to produce a pyramid of biomass that illustrates a food chain of 4 or 5 links; on a second side, label the name of the trophic level corresponding to the organism "links" on the first side; and on the third side, design a pyramid of energy" corresponding to the trophic levels indicated and based upon the 10% Rule.

- Activity 8: Have students complete, *Journey North: How is a Human Vacation Like an Animal Migration?* http://www.learner.org/jnorth/tm/MigrationVacationA.html. Evaluate the students' work based upon the comparisons they are able to add to their charts during the Journey North season and how these reflect student understanding. Check that they're able to identify some of the "whys" and "hows" of migration and the adaptations (structural and behavioral characteristics) that enable animals to make the journeys.

Resources

General

- The Environmental Literacy Council http://enviroliteracy.org/ provides teachers with tools to help students develop environmental literacy. Included are modules (in pdf format) of the publication, *Resources for Environmental Literacy*. Each of the five modules is designed to build skills in critical thinking and analytical reasoning about complex issues. Each module includes background information detailing the environmental context of each topic, recommends supplementary texts and lists online teaching resources, and suggests activities for further classroom exploration. This publication is available for purchase in print from NSTA. The module "Biodiversity" is relevant to Unit 2.

Earth Systems Science

- GLOBE Earth Systems Resources Home www.globe.gov/fsl/html/templ.cgi?esmovie_solar&lang=en&nav=1 Investigation protocols and activities including migration/seasonal change-related protocols for tracking Arctic bird migration, budburst, green-down, green-up, and Ruby-throated hummingbirds

- NOAA Ocean Explorer
  http://oceanexplorer.noaa.gov
  In addition to field reports from ocean exploration expeditions this site includes lesson plans, ocean career component, and professional development opportunities. A down-loadable curriculum guide, *Learning Ocean Science through Ocean Exploration*, takes lesson plans that were developed for NOAA Voyages of Discovery and the Ocean Explorer Web Site and presents them in a comprehensive scope and sequence through subject area categories that cut across individual expeditions. Each lesson focuses on an inquiry-based approach to teaching and learning and is correlated to the National Science Education Standards.

Ecosystems, Biodiversity, Species

- Black Bear Conservation Committee's "Black bears and Songbirds of the Lower Mississippi River Valley" is a free CD-ROM available via request, www.bbcc.org/web/index.php?option=com_content&task=view&id=53&Itemid=55.
  It includes video clips, interactive maps, and quiz games to help stimulate interest in forests and the wildlife that depends on them for survival. The CD discusses the ecology of bears and forest interior birds and forest loss and fragmentation in the region.

- Biology of the United States http://nationalatlas.gov/biology.html
  Mapped biological data of and articles about ecoregions, ecosystems, species, and special issues (such as invasive species)

- Portals and Pathways: Invasive Species of Louisiana http://is.cbr.Tulane.edu
  Invasive species issues related specifically to Louisiana, maps, species info pages, and "What to do."

- Nutria Biology www.nutria.com
  Extensive information with regard to nutria history, biology, and damage in Louisiana (LA Dept. of Wildlife and Fisheries)

- Louisiana Sea Grant: Exotic Aquatics of the Gulf of Mexico
  http://lamer.lsu.edu/exotics.htm
  Includes links to species-related facts, posters, how to prevent spread of invasive species, and to the *Project Tellus* exotic species curriculum

- National Teacher Training Institute/ LPB: *Smokey's Message*
  www.lpb.org/education/classroom/ntti/lessons/html2003/9mtSmokey.html
  Lesson plan and exercises based upon the *Rebirth in Fire video*

- NOVA: Fire Wars www.pbs.org/nova/fire

Includes video clips, resources (including fire-growth computer modeling, fire maps and a virtual laboratory), and a teachers guide (Copies of the video are available for a fee.)

- *Countering Contamination: Data and DDE* curriculum Lesson 2. The lesson introduces the topic of ecotoxicology and guides students through the scientific process of gathering raw data and drawing conclusions about the impact of pesticides (DDE and DDT) on osprey and bald eagles. The lesson is found at http://www.pwrc.usgs.gov/contaminants-online. Click on "Tools for Teachers" and select "Lesson 2". The lesson's materials include a slide show which can be made into overhead transparencies, if necessary.

Environmental Science
Unit 3: Resources and Resource Management

Time Frame: Approximately eight weeks

Unit Description

This unit emphasizes the use of natural resources and the consequences of their overuse or misuse. The concepts of renewable resources, non-renewable resources (energy resources), degradability of materials, Louisiana's natural resources, and management techniques are considered.

Student Understandings

Students develop an understanding that benefits, costs, and long-term consequences should be considered when making environmental decisions and formulate an understanding of the values and functions of Louisiana's varied natural resources. In addition, they distinguish between renewable and non-renewable resources and understand that it is through wise use and management that the continued availability of these resources will be ensured.

Guiding Questions

1. Can students describe the difference between renewable and a non-renewable resources, discuss advantages for using renewable resources in place of non-renewable ones, and identify renewable resources that could be used to replace non-renewable ones?
2. Can students interpret a fictional resource issue story or scenario relating the situations presented in the story to real situations in present-day society?
3. Can students identify Louisiana's major natural resources, identify their sources and use/values, identify the resource agency responsible for the management of each, and evaluate the effectiveness of their management?
4. Can students utilize maps to identify principal locations of Louisiana's *Black Gold* resources and identify the geologic processes that resulted in Louisiana deposits of lignite, gas, and oil and the age of the formations?
5. Can students summarize the history of the petroleum industry in Louisiana and discuss the uses of this resource, careers associated directly and indirectly with the industry, and repercussions of oil use on society and the environment?
6. Can students recognize the various factors that come into play when considering wildlife species as resources? Can they develop a resource management plan that takes various perspectives into account?

7. Can students study map sequences of Louisiana coastal/estuarine environments, analyze data, and relate wetland loss to their lives?
8. Can students explain how composting reduces the amount of waste sent to landfills, discuss advantages and disadvantages of placing organic materials into compost bins as opposed to landfills, and propose incentives or penalties that could be used to encourage more people to compost household wastes?
9. Can students discuss how people have managed waste throughout time and how it affected their lives?
10. Can students discover connections between the types of natural resources found in products and what is thrown away and investigate their school's waste stream by collecting, analyzing, and graphing data?

Unit 3 Grade-Level Expectations (GLEs)

GLE #	GLE Text and Benchmarks
Science as Inquiry	
1.	Write a testable question or hypothesis when given a topic (SI-H-A1)
2.	Describe how investigations can be observation, description, literature survey, classification, or experimentation (SI-H-A2)
4.	Conduct an investigation that includes multiple trials and record, organize, and display data appropriately (SI-H-A2)
5.	Utilize mathematics, organizational tools, and graphing skills to solve problems (SI-H-A3)
6.	Use technology when appropriate to enhance laboratory investigations and presentations of findings (SI-H-A3)
7.	Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations) (SI-H-A4)
9.	Write and defend a conclusion based on logical analysis of experimental data (SI-H-A6) (SI-H-A2)
10.	Given a description of an experiment, identify appropriate safety measures (SI-H-A7)
12.	Cite evidence that scientific investigations are conducted for many different reasons.

GLE #	GLE Text and Benchmarks
Science and the Environment	
4.	Determine the effects of limiting factors on a population and describe the concept of carrying capacity (SE-H-A3)
5.	Examine and discuss the major stages of succession, describing the generalized sequential order of the types of plant species (SE-H-A4)
6.	Analyze the consequences of changes in selected divisions of the biosphere (e.g., ozone depletion, global warming, acid rain) (SE-H-A5) (SE-H-A7)
8.	Explain how species in an ecosystem interact and link in a complex web (SE-H-A7) (SE-H-A10)
13.	Evaluate whether a resource is renewable by analyzing its relative regeneration time (SE-H-B1)
14.	Analyze data to determine the effect of preservation practices compared to conservation practices for a sample species (SE-H-B2)
15.	Identify the factors that cause the inequitable distribution of Earth's resources (e.g., politics, economics, climate) (SE-H-B3)
16.	Evaluate the effectiveness of natural resource management in Louisiana. (SE-H-B4) (SE-H-B5)
17.	Analyze data to determine when reuse, recycling, and recovery are applicable (SE-H-B5)
18.	Identify the factors that affect sustainable development (SE-H-B6)
20.	Relate environmental quality to quality of life. (SE-H-C2)
21.	Analyze the effect of common social, economic, technological, and political considerations on environmental policy (SE-H-C3)
23.	Describe the relationship between public support and the enforcement of environmental policies (SE-H-C5)
24.	Identify the advantages and disadvantages of using disposable items versus reusable items. (SE-H-D1)
26.	Determine local actions that can affect the global environment (SE-H-D4)
27.	Describe how accountability toward the environment affects sustainability (SE-H-D5)
Life Science	
27.	Analyze positive and negative effects of human actions on ecosystems(LS-H-D4)
Earth and Space Science	
19.	Interpret geological maps of Louisiana to describe the state's geologic history (ESS-H-C3)
22.	Analyze data related to a variety of natural processes to determine the time frame of the changes involved (e.g., formation of sedimentary rock layers, deposition of ash layers, fossilization of plant or animal species) (ESS-H-C5)

Sample Activities

Activity 1: An Introduction to Resources (If Project Learning Tree® materials are available - SI GLEs: 7, 9; SE GLEs: 13, 14) (If Project Learning Tree materials are not available - SE 13)

Materials List:

per student - Resources - Renewable or Not? *Opinionnaire* BLM; Project Learning Tree® materials

per group - Part A student page

per class - Part B demonstrations: large quantity of popcorn, 88 cookies, large jar or plastic container, 44 slips of paper, 15 paper or plastic bags, *A Classroom Full of Resources*: student handouts

Begin developing the theme of resource management by assigning students appropriate teacher-selected reading materials and have them define on their *vocabulary cards* (view literacy strategy descriptions), the terms *natural resource, non-renewable resource, perpetual resource,* and *recycling*, preferably in their own words. Then, distribute and discuss use of the "Resources - Renewable or Not" *Opinionnaire* BLM (view literacy strategy descriptions). *Opinionnaires* are developed by generating statements about a topic that force students to take positions and defend them. The emphasis is not on the correctness of their opinions but rather on the students' points of view. Tapping the personal dimension in comprehension, teaching and learning is necessary in order to ensure that students are engaged, find relevance, and feel valued as members of the classroom culture.

If Project Learning Tree® resources are available, incorporate the activity and demonstrations included in the exercise, *Renewable or Not*. Through *Renewable or Not* type activities, students develop operational definitions of resource-related terms and participate in activities in which they discover why sustainable use of resources is important. Engage the students in discussions of their exercise answers and refer back to the *opinionnaire*.

If Project Learning Tree® materials are not available, students, working individually or in small groups, should make two lists: one that lists items in their homes or classroom that are made of renewable resources, the other that lists items made of non-renewable resources. (For ideas see, *A Classroom Full of Resources,* www.mii.org/pdfs/classroom.pdf, and *Your House,* www.mii.org/pdfs/yourhouse.pdf.) Class discussion of the definitions of *renewable* and *non renewable* and of the lists should follow.

As closure for both options, guide class discussion by asking the following:

- What renewable resources could be used to replace the non-renewable ones?

- What advantages might there be for using renewable resources in place of non-renewable ones?
- What reasons might people have for not switching from use of non-renewable to renewable sources?
- Which resources will continue to be available no matter how much people use them? Why don't we use these more?

Activity 2: Resources for Many Reasons (SI GLE 7; SE GLEs: 13, 14, 15)

Materials List:

per teacher - *The Lorax*© by Dr. Seuss, "Trees for Many Reasons" activity from *Ecosystem Matters* (book available on-line), video camera (optional)

per group - We Need Thneeds RAFT BLM, writing materials

per student - several crayons or markers, "Trees for Many Reasons" focus and analysis questions

This activity introduces the concept of resource use/misuse and has students look at the issue from more than one perspective. It includes use of the video or text versions of *The Lorax*© by Dr. Seuss. (The book is available in most bookstores and public libraries. The video can be rented or purchased inexpensively from many discount stores.) The activity also incorporates the related exercise, "Trees for Many Reasons" from the National Forest Service's book, *Ecosystem Matters.* The book is currently out of print but can be down-loaded and printed from www.na.fs.fed.us/spfo/pubs/misc/eco/.
(While appropriate for grades 9-12, the exercise was "misfiled." To view/download "Trees for Many Reasons," it is necessary to click on "Grades 4-5.")

Engage students in review of the terms *sustainable use, conservation, preservation,* and *deforestation*. Then, distribute copies of the "Trees for Many Reasons - Part A" focus questions (listed below). Give students time to read the questions before you begin to read *The Lorax*© or play the video.

- Why did the Once-ler act as he did?
- What patterns of change in the environment were observed?
- What were environmental conditions before the company began making Thneeds? What were they like afterward?
- What was the author's message concerning what one person can do to save or destroy the environment?

Show the video or read the story to the class. Discuss the focus questions listed above. During the discussion, ask students to distinguish between the terms *preservation* and *conservation* and to explain how each applies to this scenario.
Have students analyze the story by answering the "Trees for Many Reasons - Variation 2: Grades 9-12" questions (found within the exercise and listed below) in their science *learning log* (view literacy strategy descriptions). They should develop each response carefully, citing specific examples from the story.

- What seems to be the author's intent in writing the book? To what age group is it directed? Why?
- Are any of the situations presented in the story similar to real situations in present-day society? If so, describe which resources and which groups of people are involved.
- What values appear to be important to the characters of the story? Who might these characters represent in real life? Are any of their values in conflict? Which ones? For what reasons?

Place students in small heterogeneous groups. Distribute one copy of the We Need Thneeds! RAFT BLM to each group and review the instructions. Emphasize the need for accuracy, creativity, and relevance in the written aspects and in the presentation.

After group presentations, have students consider the "Trees for Many Reasons - Extension 1" questions:

- Does either the original story or your sequel accurately portray industry? How do you know?
- Which version, the original or your sequel, best describes the attitudes of people in the region where you live? Explain your answer.

Activity 3: An Introduction to Louisiana's Natural Resources (SI GLEs 6; SE GLEs: 16, 21, 23)

Materials List: print and electronic natural resources reference materials, especially as they apply to Louisiana (will vary with student group)

Working in small groups, the students will select a Louisiana natural resource (such as salt, oil, natural gas, sulfur, waterways, wildlife [game or non-game species], forest resources, seafood,) and produce an illustrated brochure and class presentation (or, if the technology is available, a *PowerPoint*® presentation or video) that incorporates the following:

- The name of the resource
- The major production area(s) of this resource in Louisiana
- Use(s) of the resource
- The economic value of the resource to the state
- The state resource agency responsible for management of the resource
- How the agency defines resource management
- The agency's major objectives
- The most difficult challenges facing the agency at this time
- Summary of the agency's management program(s) for this resource
- Issues associated with management of the resource
- The influence/effect of common social economic, technological, and/or political considerations on the agency's policies

- The effectiveness of management of this resource in Louisiana (Include a description of the relationship between public support and the enforcement of the agency's environmental policies.)

Careers associated with production, use, or management of the resource should be investigated. Local specialists with these various agencies can serve as a valuable resource for this information.
State agencies produce publications (electronic and print) and several have education divisions which may provide guest speakers as well as classroom materials. The websites of these agencies include the postal addresses and phone numbers of state offices and, in some cases, regional offices:

LA Environmental Resource Directory
www.leeric.lsu.edu/erd/index.htm
LA Department of Agriculture and Forestry
www.ldaf.state.la.us
LA Economic Development
http://www.lded.state.la.us/home.aspx?ref=404
LA Department of Environmental Quality
www.deq.state.la.us
LA Department of Natural Resources
www.dnr.state.la.us/teach.ssi
LA Department and Wildlife and Fisheries
www.wlf.state.la.us

Also useful:

Louisiana Geological Survey
http://www.lgs.lsu.edu
Louisiana State Minerals Information (each yearbook includes a minerals map)
http://minerals.usgs.gov/minerals/pubs/state/la.html

Be sure that students comprehend that investigations can be observational, descriptive, or conducted through literature search and do not always have to be experimental.

Activity 4: Louisiana Black Gold and the Future (SI GLE 7; SE GLEs: 16; ESS GLEs: 19, 22)

Materials List: *Black Gold Beneath the Bayous*, computers with Internet access (one per group) or LCD projector (if multiple computers with internet access are not available), learning log

Most texts lack information specific to Louisiana; therefore, it will be necessary for students (and teachers) to obtain current print and electronic resources from various agencies such as the LA Department of Natural Resources, LA Geological Survey, and the LA State Minerals Information sites listed in Activity 3. If the technology allows,

direct students to *Black Gold Beneath the Bayous* (or download, print, and distribute copies of relevant information).
(http://dnr.louisiana.gov/sec/execdiv/techasmt/educational_resources/BGBB/toc.html)

Black Gold Beneath the Bayous is a classroom teaching aid designed for Louisiana science teachers. Funded and sponsored by the state Department of Natural Resources, Technology Assessment Division, this outstanding instructional tool offers factual text and graphics, music, animation, and classroom experiments.
Have students, working in teams, identify the principal locations and the geologic processes that resulted in Louisiana deposits of lignite, gas, and oil and the age of the formations. Reports should include maps to show location, a history of the industry in Louisiana, uses of the resource, careers associated directly and indirectly with the industry, estimated costs and profits for the business owner, and production impacts on the environment.
Then, have student groups

1. Discuss the relationship of use of fossil fuels to worldwide resource depletion.
2. Identify and briefly discuss various alternative fuels: include the history and current use of each. Discussions should also include advantages and disadvantages associated with the use of each fuel. (This list will be incorporated into Activity 5 exercises.)

If a computer with a DVD drive is available, have students utilize the Louisiana GIS Digital Map (May 2007 Compilation DVD). Published by the Louisiana Oil Spill Coordinator's Office (LOSCO)/Office of the Governor, the two volume DVD set is a compilation of publicly available geospatial data for oil spill prevention, contingency planning, response, and natural resource damage assessment. Additional information (including an order form for this free resource) is available from the LA GIS Digital Map DVD Website, http://lagic.lsu.edu/geodata/#. Note: A DVD set was sent to every Louisiana school teaching grades 6-12. Contact your principal or department head for its location.

If the technology permits, teachers should access the 2004 PBS series, *Extreme Oil* video series and lesson plans. The series examines the drawbacks of a country having oil deposits and how oil wealth can benefit developing countries. Two high-school-level activities have been developed to be used in conjunction with the video. The lessons can be accessed at www.pbs.org/wnet/extremeoil/teachers/index.html. The video is also available for purchase from PBS.

Information about related job options in the energy field is summarized at http://www.energy4me.org/careers/index.htm. The energy4me site includes profiles of 15 (ethnically diverse) energy industry professionals. As a science *learning log* (view literacy strategy descriptions) entry, provide each student with a copy of one of the profiles. (To access the profiles from the energy4me site, click on "Young Professionals discuss their careers in the oil and gas industry.") Instruct the students to summarize the profile received as it relates to the individual's job and to his/her career-related education. After recording the summaries in their science learning logs, have students conduct a

round-table discussion of their entries. (Additional resources are available on the energy4me site by clicking on the "Careers," "Educators," "Students," and "Speakers" tabs.)

Activity 5: Energy Alternatives (SI GLE 6; SE GLEs: 15, 18, 27)

Materials List:

Concept maps: poster board or newsprint (optional - one per group)

Solar Devices: will vary with project choice(s)

Research Project: print and electronic reference sources, either computer with *Powerpoint*® (or similar program) or poster boards (per group)

Project Learning Tree® option: *Energy Sleuths - Energy Primer* (one per student or small group), list of guiding questions (one per student)

Non-Project Learning Tree® option: variety of "alternative" energy reference materials

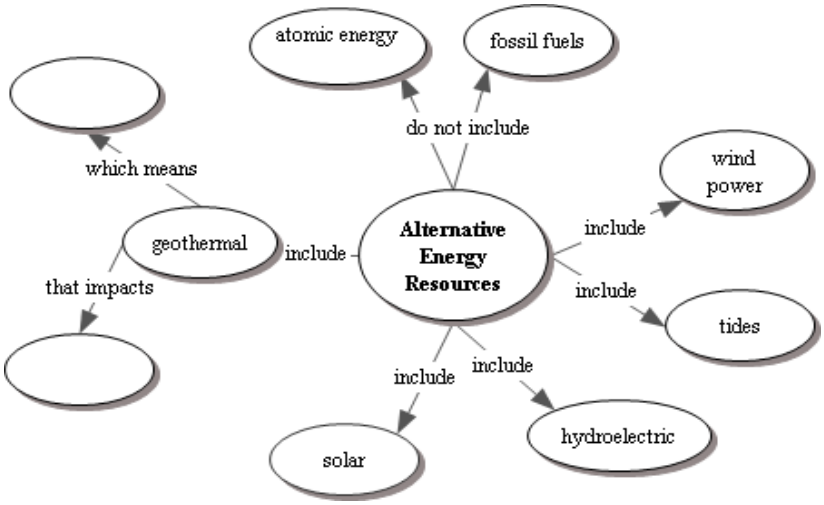
Among our major resource management concerns is the growing scarcity of energy resources and rising fuel costs, which have resulted in more attention being given to finding alternative fuel sources. To introduce the theme of alternative energy sources, assign students appropriate teacher-selected reading materials and have them complete *vocabulary cards* (view literacy strategy descriptions) as homework. Then, working individually or in small groups, have students develop an "alternative energy concept map." They should use their maps to distinguish among renewable, non-renewable, and perpetual energy sources, their associated forms of "alternative" energy and their uses. The concept maps could be stored in their science *learning logs* (view literacy strategy descriptions) and/or exhibited as posters in the classroom or hallway.

Graphic organizers (view literacy strategy descriptions), such as concept maps, promote relational knowledge by emphasizing connections among ideas and, thereby, leading to in-depth understanding of concepts. Review of the concept mapping technique is suggested and, to ensure student knowledge of concept mapping, "walk students through" development of a sample map. It may be necessary to remind students that to create the map

1. They must concentrate on relationships among the concepts under study.
2. Concepts are to be connected with labeled lines, frequently in a downward-branching hierarchical structure as a web or as a split tree.
3. The relationship between two concepts is indicated through linking phrases (for example, "consists of," "results in," "includes").

The partial concept map below could be used as a "getting started" sample to illustrate the strategy for students. After copying and discussing the sample, they

may complete the rest of the concept map individually or in pairs. To assure that all students understand the material and are using the concept mapping technique appropriately, provide opportunities for them to share their notes within small groups.



To help students visualize means by which perpetual energy sources are/can be utilized in meeting energy needs, have them design, construct, and use a device that incorporates a perpetual energy source (such as a solar oven, solar heater, or windmill) and relate the structure to energy conservation, air pollution, and /or deforestation. Note: Design and construction ideas for these devices are available from textbook resources, the Internet, and several energy-conservation-related organizations.

If Project Learning Tree® materials are available: After the students share their concept maps with the class, distribute copies of the *Energy Sleuths-Energy Primer* to each student or small group. In "Energy Sleuths," students learn about different sources of energy, how energy is used in their lives, and the sustainability of the sources. Each group will develop an energy policy they would like to see enacted. Assign each cooperative group one "alternative" fuel source to research. (Students should utilize electronic and print references. Encourage them to contact local organizations and resource professionals, as well.) Each group should develop a report on the assigned resource. Guiding questions and assessment suggestions are included in *Energy Sleuths-Part A- Energy Round-Up*.

If Project Learning Tree® resources are not available: After the students share their concept maps, divide the class into pairs or small cooperative groups and, using the list of alternative fuels generated in Activity 4, assign each group one type of fuel to research. Research materials are available in most textbook resources. Students should also utilize electronic and print references. Encourage them to contact local organizations and resource professionals, as well.

Each group should prepare a *Powerpoint*® or poster presentation used as part of a persuasive sales-pitch on the merits of their assigned fuel type. (While encouraging students to be creative, also stress accuracy and honesty in advertising.) For consistency

in reporting, instruct each group to include the relative availability of the fuel, how it is extracted and processed, its economic potential, the feasibility of its long-term use, its environmental impacts, and the economic/social impacts of its use. Have them discuss the factors that might cause the inequitable distribution of this resource.

After group presentations, have student groups develop an "Energy Policy for the Twenty-first Century" that addresses predicted energy demands and energy conservation issues, identifies/addresses factors that affect sustainable development, and addresses how accountability toward the environment affects sustainability. Their policies should be shared with the class via presentations or round-table discussions.

Activity 6: Wildlife as Resources (SI GLEs: 1, 2, 5, 6, 7, 10, 12; SE GLEs: 4 14, 21)

Materials List:

per student - worksheets for the selected exercises, vocabulary cards Investigation Analysis Format BLM (see Unit 1); *Dropping in on Deer*

per class - small piles of dry dog food pellets scattered randomly over the study area

per group - colored survey tape or 10 wire survey flags, measuring tape, 3.58 m string tied to a wooden stake, compasses, clip boards, student worksheet

Note: The *Dropping in on Deer* option has students conducting field "research" and requires pre-field trip preparation by the teacher and collection of simulated deer pellets (dry dog food pieces).

In Activity 3, wildlife species were introduced with reference to resources. Ask students to refer back to the discussion of the selected wildlife resources and to offer operational definitions of the terms *game species, non-game species, threatened species,* and *endangered species*. Guide student discussion to include various aspects of consumptive and non-consumptive uses of wildlife. Ask students to list questions that they have about wildlife management in addition to identifying and discussing various factors that are involved in wildlife management decisions (political, economic, social/emotional, and biological). Remind students to complete *vocabulary cards* (view literacy strategy descriptions) for these terms. Allow them to quiz each other over the content of their cards in preparation for tests and other class activities.

For background information on management of wildlife species refer to Project WILD®, the US Fish and Wildlife Service or the Louisiana Department of Wildlife and Fisheries Wildlife/Aquatic Educator for your region (for materials or to request a guest speaker for your class). Louisiana Wildlife News is a bi-monthly publication intended to serve as an outlet for wildlife issues relevant to Louisiana and the Southeast. In addition to current news events, profiles on specific plant, wildlife, and nuisance wildlife species are

included in each issue. It can be accessed from http://www.lsuagcenter.com/en/environment.

Two Project WILD® activities, *Dropping in on Deer* and *Deer Dilemma*, present opportunities for students to consider the biology and management of a Louisiana species, the white-tailed deer, and the issues associated with its management.

In *Dropping in on Deer*, students

- Conduct habitat surveys (using dried dog food to represent deer pellets)
- Apply field methodology reflecting wildlife management practices
- Explain the importance of scientific knowledge and technical skills in conservation and enhancement of wildlife and its habitat
- Incorporate an experimental design into their investigation
- Identify and incorporate appropriate safety measures.

If Project WILD® is not available or if "field work" is not possible, the following activities have students simulate wildlife management situations: *Classroom Mark-Recapture with Crickets* lab manual which utilizes live crickets (www.bioed.org/ECOS/inquiries/inquiry_crickets.pdf) and Duke University's "Mark and Recapture" exercises which utilize small objects such as dried beans. (Teacher materials are found at http://www.biology.duke.edu/cibl/exercises/mark_recapture.htm and student instructions at http://www.biology.duke.edu/cibl/exercises/mark_recapture_ifs.htm). Have each student submit a lab report that includes a completed copy of the Investigation Analysis Format BLM.

In *Deer Dilemma*, students conduct a Board of Commissioners meeting (simulation) to hear the concerns of constituents regarding the ever-increasing deer population in and around a local park and make a decision concerning this issue. In this activity, students must consider the needs of both people and wildlife in the sustainability of the resource (the deer). If access to *Deer Dilemma* is not possible, the video *"What They Say About Hunting"* includes a "debate" by high school students and interviews professionals from groups with varying opinions on hunting/wildlife management. The video can be downloaded or teachers can request a free copy. A teacher's guide and student activity masters can also be obtained:
Activity masters - http://www.unendangeredspecies.com/pdfs/WTSAHActMstrs.pdf
Teacher's Guide - http://www.nssf.org/conservationvideos/pdfs/WTSAH_TG.pdf
Streaming video and request form - http://www.nssf.org/conservationvideos/vidReq.cfm

Activity 7: Louisiana Coastal Wetlands: Resources at Risk (SI GLE 6; LS GLE 27; SE GLEs: 6, 20, 21, 26, 27; ESS GLE 19)

Materials List:

per class - *We Can Still Turn the Tide* lesson: *Washing Away* video clips (specified within activity); *It's a Wonderful Life* lesson: *Washing Away* video clips (specified within activity); aerial photos of wetland loss; a sample of cloth,

paper or wood one-square yard (91.44 cm^2) in size; computers with Internet access (if possible)

per group - topic sheet for their assigned presentation topic, topographical maps of coastal Louisiana

Louisiana's wetlands are disappearing at an alarming rate and have been exacerbated by Hurricanes Katrina and Rita. In this investigation, students will engage in exercises to investigate Louisiana wetlands from various perspectives. While texts are unlikely to have Louisiana-specific materials, several resources (both print and electronic) are available from state and local agencies and organizations. (Refer to unit resources.) Utilize relevant readings from these sources and the slide presentation, "Envisioning the Future of the Gulf Coast," to introduce the "wetlands - resources at risk" topic. The slide presentation is available from *America's Wetland* education home page, http://www.americaswetland.com/custompage.cfm?pageid=28.

Download the LPB/America's WETLAND lesson plans: *We Can Still Turn the Tide* and *It's a Wonderful Life.* The lesson plans are designed to be used with video clips from the LPB documentary, *Washing Away.* The lesson plans are available at the *America's Wetland* education home page. The materials are also available via LPB. The lesson plans are available at www.lpb.org/programs/washingaway (click on For Educators) and the video clips at www.lpb.org/programs/washingaway/video.html. (The video clips used with each of the two exercises are specified within the exercise descriptions on the next page.) The entire video is available as streaming video at the LPB video link at http://www.americaswetland.com/assets/EFGCReport.pdf.
Before incorporating the "Suggested Procedures" into your *We Can Still Turn the Tide* plans download and save the three suggested *Washing Away* video clips (Ted Falgout [14:13-17:33], Ted Falgout [31:51-35:05], and Kerry St. Pe [38:02-40:36]). Students should discuss the facts included on *Hurricane Impacts on America's Wetland*, http://www.americaswetlandresources.com/background_facts/basicfacts/hurricane.html and have them view and discuss the suggested video clips. Following the video clips, engage students in a discussion of coastal wetlands.

Each student group should then be assigned one of the six suggested topics, receive a copy of the topic worksheet, and be instructed to develop a presentation based upon the criteria specified for their topic. Presentations should include maps, audio-visual components or other graphic displays, and computer technology, if possible. Online reference suggestions are included on each topic sheet, but students should refer to other current, accurate, and relevant resources (print, electronic, and/or interviews of professionals), as well.

It's a Wonderful Life focuses on the economic and cultural impacts of wetland loss. Before incorporating the "Suggested Procedures" into your lesson plans, it will be necessary to download and save the two suggested *Washing Away* video clips (Mr. Dore of Delcambre [11:30-14:14] and Dominigue farm in Erath [8:38-11:29]). During this exercise, students will have to locate coastal towns. It will, therefore, be necessary to

provide each group with topographical maps of coastal Louisiana. Be sure that Delcambre and Erath are included. Some sources of appropriate maps are included at the end of this activity.

Consider having students submit their reports in the form of an illustrated newspaper article or as an informative "virtual web page." You may wish to invite a guest speaker from the LSU Cooperative Extension Service, Louisiana Department of Wildlife and Fisheries, Louisiana Department of Agriculture and Forestry, or Louisiana Seafood Board to speak about the "costs" of wetland loss/hurricane impact on wetlands-related professions (and recreation).

Some websites listed in the *It's a Wonderful Life* exercise have been changed. Listed below are some updated and some additional sites useful to both teacher and students:

- "Preliminary Estimates of Cumulative Economic Impact from Hurricanes Katrina and Rita to Louisiana Agriculture Due to Reduced Revenue and Increased Costs" http://www.lsuagcenter.com/NR/rdonlyres/2FDFD2B9-A6EC-4F95-8089-71B14A69DBA6/18453/Hurricanelosses.pdf

- "Assessment of Damage to Louisiana Agricultural, Forestry, and Fisheries Sectors by Hurricane Katrina" http://www.lsuagcenter.com/NR/rdonlyres/FA82C5A0-F646-4ED0-8821-C460B4352F3B/18459/Katrinalosses.pdf

- Parish by parish summary of major commodities http://www2.lsuagcenter.com/agsummary
- Louisiana maps: http://atlas.lsu.edu/rasterdown.htm
  http://www.lib.utexas.edu/maps/louisiana.html
  http://www.nwrc.usgs.gov/ Click on "Louisiana Land Changes"
  http://wetmaap.org

- *Lessons on the Lake*: *an Educator's Guide to the Pontchartrain Basin*
  The guide facilitates instruction for teachers, allows easy access to information on environmental issues surrounding the Lake Pontchartrain watershed, and provides students with skills to identify environmental concerns, make changes, solve problems and acquire a sense of stewardship.
  http://pubs.usgs.gov/of/1998/of98-805/lessons/

- Louisiana Seafood Board
  Teachers can order *Living on the Edge-Guide to the Documentary*, and the *Habitat Study Guide* to accompany the *Living on the Edge* documentary on the history, culture, economics, and science associated with Louisiana's seafood industry. (The video is available via LPB Cyberchannel.)
  http://www.louisianaseafood.com/education.cfm

- U.S. Geological Survey National Wetlands Research Center
  Click on-"The Fragile Fringe: A Guide for Teaching About Coastal Wetlands"
  http://www.nwrc.usgs.gov/

Activity 8: Waste Not, Want Not. (SI GLEs: 4, 5, 7, 9; SE GLEs: 13, 17, 24)

Materials List:

per class - waste materials generated around the school

per group - broom stick or similar object for moving trash; per student - gloves and protective eye goggles, vocabulary cards, one sheet of graph paper

Safety Note: If students sort through the trash, be sure to have them wear gloves and protective eye goggles and to use a broom stick (or similar object) for moving the trash.

After students have read and discussed the text material related to solid waste management, inform them that they will be participating in a hands-on investigation of household/school solid wastes. Remind students to complete *vocabulary cards* (view literacy strategy descriptions) as new terms are introduced. Be sure to allow students to quiz each other over the content of their cards in preparation for tests and other class activities. Make sure students are holding their partners accountable for the completeness and accuracy of their definitions and examples.

In the activity "What's in my Trash?"(Lesson 3 of *An Ounce of Prevention*, available via the NSTA Source Reduction Curriculum, http://cygnus-group.com/use-less-stuff/NSTA.html, students will identify the various waste materials generated in the school. They will also describe the sequence of collection and the destination of the materials identified (compost bin, recycling center, landfill, or incinerator).

Or, if available, use the Project Learning Tree® Secondary Environmental Education Program module, Exploring Environmental Issues: Municipal Solid Waste; assign students Activity 1 of the module, Introduction to Municipal Solid Waste: The Waste Stream. In this lesson, students learn how people have managed waste throughout time and how it affected their lives, discover connections between the types of natural resources found in products and what is thrown away, and investigate their school's waste stream by collecting, analyzing, and graphing data.

In both options, students must develop and utilize classification systems, analyze data, and draw conclusions/make recommendations with regard to solid waste management.

Activity 9: Wasting Away (SI GLE 2; SE GLEs: 17, 24)

Materials List: per class - Project Learning Tree® materials include tea bags, loose tea, concentrated juice, juice boxes, individually packaged and bulk packaged cookies,

unconcentrated and concentrated detergent (per class); per student one copy (or an overhead transparency) of "Packaging Profile" student page

After assigning appropriate teacher-selected reading materials, including text readings, introduce the concept of municipal solid waste management by engaging students in class discussion and operational definition of associated vocabulary. (Remind students to complete their *vocabulary cards* (view literacy strategy descriptions). Again, allow students to quiz each other over the content of their cards in preparation for tests and other class activity. Make sure students are holding their partners accountable for the completeness and accuracy of their definitions and examples.

Then, if Project Learning Tree® materials are available, have students complete Lesson 2-*Source Reduction Part A* and Enrichment activities #2 and #3 from the secondary module, *Exploring Environmental Issues: Municipal Solid Waste*. In these exercises, students will look at ways to prevent and reduce waste and to examine connections between waste reduction and conservation of natural resources. Students will be classifying product packaging materials and it will, therefore, be necessary to collect product packaging prior to beginning the activity.

If Project Learning Tree materials® are not available, Lesson 4, "Where Does the Trash Go?" in *An Ounce of Prevention* (from the NSTA Source Reduction Curriculum, http://cygnus-group.com/use-less-stuff/NSTA.html), makes students aware of disposal options and their advantages and disadvantages, recognize the role of energy and byproducts in the evaluation of a disposal method, and begin to think about ways to prevent or reduce waste, rather than finding places to "throw it away." Both options include background information and student worksheets that should be copied and distributed prior to beginning the assignment.

As an overarching exercise, students should develop and, with administrative approval, initiate a school-wide or class waste-source- reduction project. Before allowing students to develop their action plans, have them identify safety issues and develop appropriate safety measures. Project ideas include school recycling projects, such as "Recycling: at school " resources available from the Paper Industry Association Council (PIAC) (www.paperrecycles.org/recycling/school/index.html) and end of school year projects like Locker Cleanout Tips (www.deq.louisiana.gov/portal/tabid/2098/Default.aspx). Holy Cross High School in New Orleans has an on-going motor oil recycling program (Project F.U.R.). As a homework assignment, distribute copies of Project F.U.R. (http://www.deq.louisiana.gov/portal/Default.aspx?tabid=1971) information sheet and have students read and reflect upon the impact teenagers can have on resource management.

Activity 10: Composting Déjà vu (SI GLEs: 2, 4, 5, 6, 7, 9, 10, 12; SE GLEs: 5, 8)

Materials List:

per group - compost bins, hand lenses or microscope, temperature probes, pH paper, soil moisture tests, gloves, protective eye goggles, pencils or chopsticks

per student - Investigation Analysis Format BLM (see Unit 1)

Safety Note: Before collecting data, students are to identify and record appropriate safety measures on an Investigation Analysis Format BLM. As they sort through the compost, students must wear gloves and protective eye goggles and use a pencil or chopstick for moving the trash. Be cognizant of the fact that mercury thermometers are "banned" from schools. If mercury thermometers are in your classroom they should not be used and should be disposed of properly.

After completing the *Waste Not, Want Not* activity, have students refer to the compost bins they produced in Unit 1 - *Establishing a Compost Bin*. Remind students to complete the Investigation Analysis Format BLM and to record their data as they work on this activity. Each group should repeat the battery of tests done on the original samples (measure soil temperature, pH, and moisture levels; using a hand lens or a microscope, count the number of species observed and the number of organisms per population). The class should then share data and estimate the number of species and organisms in the entire soil sample.

After sharing results, each student should work individually to complete the data analysis and conclusion portions of the lab report making sure to answer the questions posed and commenting upon the hypothesis. The conclusion should reflect upon the succession that has occurred. It should also include answers to the following problems:

- Define *biodegradable*.
- Discuss biodegradability with regard to the organic materials within your compost bin.
- How does composting reduce the amount of waste sent to landfills?
- What are the advantages of placing organic materials into compost bins as opposed to in landfills?
- What are the disadvantages? (Why doesn't everyone compost?)
- What are some incentives or penalties that could be used to encourage more people to compost household wastes?

Sample Assessments

General Guidelines

Assessment techniques should include drawings/illustrations/models, laboratory investigations with reports, laboratory practicals (problem-solving and performance-

based assessments), group discussion and journaling (reflective assessment), and paper-and-pencil tests (traditional summative assessments).

- Students should be monitored throughout the work on all activities via teacher observation of their work and lab notebook entries.
- All student-developed products should be evaluated as the unit continues.
- Student investigations should be evaluated with a rubric.
- For some multiple-choice items on written tests, ask students to write a justification for their chosen response.

General Assessments

- Students should construct Venn Diagrams to distinguish among types of natural resources.
- Students should self-evaluate and peer-evaluate projects using class-developed rubrics specific for each presentation.
- Students should construct Concept Maps appropriate for natural resources concepts.

Activity-Specific Assessments

- Activity 1: Incorporate the opinionnaire questions and guided discussion questions into a post-activity quiz.

- Activity 4: Student groups should provide group presentations and conduct peer and self-evaluation of the resource presentations using a class-determined rubric.

- Activity 8: "Island Survival" (Lesson 5 in *An Ounce of Prevention"* from NSTA Source Reduction Curriculum available at http://cygnus-group.com/use-less-stuff/NSTA.html) is a simulation in which students make lifestyle choices while considering the effect of these choices on waste generation. Have students work individually or in groups to prioritize personal needs, desires, essentials, and source reduction strategies necessary for their stay on an uninhabited island. Utilize a student-designed rubric to evaluate understanding.

Resources

- America's Wetland- Basic background and facts about Louisiana wetlands. http://www.americaswetlandresources.com/background_facts/index.html http://www.americaswetlandresources.com/background_facts/whytheconcern.html
- America's Wetland- Living by the Seasons in America's wetland

http://www.americaswetlandresources.com/voices/stories/AmericasWETLANDChicken.html

- Iowa DNR Wildlife Management (background info) www.iowadnr.com/education/backinfo/wldmang.pdf
- Lake Pontchartrain Basin Foundation www.saveourlake.org
- Louisiana Department of Natural Resources - Office of Coastal Restoration and Management www.dnr.state.la.us/crm
- Louisiana Dept. Natural resources- teacher resources www.dnr.state.la.us/teach.ssi
- National Energy Education Development Program (NEED Project) Energy-related activities and curriculum guides in PDF format. http://need.org/curriculum.php
- Nature Conservancy -- Information related to Louisiana ecoregions. http://nature.org/wherewework/northamerica/states/louisiana/preserves
- U.S. Forest Service Conservation Education Home Page http://www.na.fs.fed.us/spfo/ce/
- U.S. Geological Survey National Wetlands Research Center http://www.nwrc.usgs.gov/

Environmental Science
Unit 4: Environmental Awareness and Responsible Actions

Time Frame: Approximately six weeks

Unit Description

This unit focuses on environmental awareness and protection with respect to water and air quality, hazardous waste, risk management, and environmental policy.

Student Understandings

Students develop an awareness of the relationships between human actions and environmental quality.

Guiding Questions

1. Can students analyze the risk-benefit ratio for selected environmental situations?
2. Can students analyze the effect of common social, economic, technological, and political considerations on environmental policy?
3. Can students identify major sources of water pollution in Louisiana and make inferences about the potential effects of these pollutants on local wildlife and the hydrosphere?
4. Can students conduct water quality monitoring tests and relate local water quality to environmental accountability and sustainability?
5. Can students distinguish among the five major air pollutants, discuss each, and using the Air Quality Index, engage in discussions comparing and contrasting air quality in different Louisiana locations (or in different time periods)?
6. Can students discuss relationships between CO_2 levels and global warming, global temperature and atmospheric greenhouse gases, auto emissions and air pollution, and auto emissions and global climate changes?
7. Can students identify and locate potential sources of hazardous waste in their community, parish, or state?
8. Can students discuss how common household products may become hazardous waste and propose local hazardous waste management education measures?
9. Can students analyze the effect of common social, economic, technological, and political considerations on environmental policy?

Unit 4 Grade-Level Expectations (GLEs)

GLE #	GLE Text and Benchmarks
Science as Inquiry	
4.	Conduct an investigation that includes multiple trials and record, organize, and analyze data appropriately (SI-H-A2)
5.	Utilize mathematics, organizational tools, and graphing skills to solve problems (SI-H-A3)
6.	Use technology when appropriate to enhance laboratory investigations and presentations of findings (SI-H-A3)
7.	Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations) (SI-H-A4)
9.	Write and defend a conclusion based on logical analysis of experimental data (SI-H-A6) (SI-H-A2)
10.	Given a description of an experiment, identify appropriate safety measures (SI-H-A7)
11.	Evaluate selected theories based on supporting scientific evidence. (SI-H-B1)
12.	Cite evidence that scientific investigations are conducted for many different reasons (SI-H-B2)
13.	Identify scientific evidence that has caused modifications in previously accepted theories. (SI-H-B2)
14.	Cite examples of scientific advances and emerging technologies and how they affect society (e.g., MRI, DNA in forensics) (SI-H-B3)
15.	Analyze the conclusion from an investigation by using data to determine its validity (SI-H-B4)
16.	Use the following rules of evidence to examine experimental results: a. Can an expert's technique or theory be tested, has it been tested, or is it simply a subjective, conclusive approach that cannot be reasonably assessed for reliability? b. Has the technique or theory been subjected to peer review and publication? c. What is the known or potential rate of error of the technique or theory when applied? d. Were standards and controls applied and maintained? e. Has the technique or theory been generally accepted in the scientific community? (SI-H-B5) (SI-H-B1) (SI-H-B4)
Science and the Environment	
6.	Analyze the consequences of changes in selected divisions of the biosphere (e.g., ozone depletion, global warming, acid rain) (SE-H-A5) (SE-H-A7)
12.	Give examples and describe the effect of pollutants on selected populations. (SE-H- A11)
15.	Identify the factors that cause the inequitable distribution of Earth's resources (e.g., politics, economics, climate) (SE-H-B3)
19.	Determine the interrelationships of clean water, land, and air to the success of organisms in a given population (SE-H-C1)

GLE #	GLE Text and Benchmarks
20.	Relate environmental quality to quality of life (SE-H-C2)
21.	Analyze the effect of common social, economic, technological, and political considerations on environmental policy (SE-H-C3)
22.	Analyze the risk-benefit ratio for selected environmental situations (SE-H-C4)
23.	Describe the relationship between public support and the enforcement of environmental policies (SE-H-C5)
25.	Discuss how education and collaboration can affect the prevention and control of a selected pollutant (SE-H-D2) (SE-H-D3)
26.	Determine local actions that can affect the global environment (SE-H-D4)
27.	Describe how accountability toward the environment affects sustainability (SE-H-D5)
28.	Discuss the reduction of combustible engines needed to significantly decrease CO_2 in the troposphere (SE-H-D6)
Earth and Space Science	
1.	Describe what happens to the solar energy received by Earth. (ESS-H-A1)
10.	Analyze the mechanisms that drive weather and climate patterns and relate them to the three methods of heat transfer. (ESS-H-A6)

Sample Activities

Activity 1: Introduction to Risk (SI GLEs 5, 7, 9; SE GLEs 20, 22)

Materials List:

per teacher - EPA *Super Fund for Students and Teachers*: *Risk Concepts, How Risky Is It?* teacher materials, Risk Perception Anticipation Guide BLM, Risk Perception Anticipation Guide Answer Sheet BLM, *EnviroTacklebox*™ video, *At Your Own Risk*

per student - science learning log, vocabulary cards, Risk Perception Anticipation Guide BLM, and *Risks and Benefits*- student worksheet

per group - *How Risky Is It?* student worksheet, flip chart paper, assorted markers, a penny, a piece of paper, a pencil

Environmental risk refers to the probability that the environment will be harmed by a particular situation or technology. Before discussing environmental risk, ensure that students understand the concept of probability by assigning them appropriate teacher-selected reading materials and engaging them in an introductory probability exercise such as the EPA *Super Fund for Students and Teachers*: *Risk Concepts* http://www.epa.gov/superfund/students/clas_act/haz-ed/rskcncpt.htm (Procedure 6 steps 1-6). (In this exercise, students investigate the meaning of risk in terms of a simple exercise in probability. They explore the idea that not all risks have the same

consequences and are not likely to occur at the same rate. The exercise helps students to evaluate the impact of risk on the basis of probabilities, benefits, and their perceptions.) After class discussion of their answers, distribute copies of the Risk Perception Anticipation Guide BLM on which the students will rank perceived risk associated with everyday events. An *anticipation guide* (view literacy strategy descriptions) helps instill interest in material prior to its presentation and prompts students to become active seekers of important information and ideas. After distributing the *anticipation guide* to each student

1. Review the definition of *perception* with the class.
2. Explain that they are to complete the "Before" section of the *anticipation guide* before engaging in reading, research, or discussion.
3. Instruct students to read each of the risk activities/situations and to rank these, with the situation they perceive as presenting the greatest risk ranked 1 and proceeding through the list with the least risky ranked as 10. (Response options of *anticipation guides* are frequently "true/false" or "agree/disagree". However, the ranking modification works best with this exercise.)
4. After students have initially ranked the situations, have them share their responses with a partner or within a small group. This is a critical step because it allows alternative points of view to be expressed and activates relevant prior knowledge. Ask for volunteers to share their responses with the class but do not give away the correct rankings. The more eager the students are to find out whether their anticipations are verifiable, the better.
   (Refer to the Risk Perception Anticipation Guide-Answer sheet BLM**.)**
5. Tell students they will view the probability portion of the LPB EnviroTacklebox™ video, *At Your Own Risk* (available through LPB Cyberchannel; some school libraries and teachers have personal copies of this video, as well) and will read the assigned text material. If the video is not available, refer students to print or Internet resources such as The National Safety Council's "The odds of dying from" (www.nsc.org/lrs/statinfo/odds.htm) or Dom Nozzi's Listing of Comparative Risks (www.afn.org/~savanna/risk.htm).
6. After viewing the video and reading the text material, students are to determine whether their initial responses are supported by the material presented. If supported, their after-reading /viewing ranking will differ from their "Before" ranking. In either case, they should record a brief explanation for their "After" answers, preferably in the form of numerical probabilities.
7. Finally, ask for volunteers to share their responses and their explanations. During sharing, misconceptions about risk probabilities should be clarified.

As follow-up, assign the *Risks and Benefits*- Student Worksheet as homework (http://www.epa.gov/superfund/students/clas_act/haz-ed/riskwsht.htm). This exercise is "procedure 7" of the *Super Fund for Students and Teachers*: *Risk Concepts* utilized above. After downloading and copying the worksheet, distribute one copy to each student. Students should record their worksheet answers in their science *learning logs* (view literacy strategy descriptions). Remind students to complete topic-related *vocabulary cards* (view literacy strategy descriptions) including *risk*, *perception*, and *probability*.

As a concluding activity (and assessment), students are to complete the EnviroTacklebox™ "Lesson 2 Activity: *How Risky Is It?"* (Teacher instructions are available via
http://www.lpb.org/education/classroom/itv/envirotacklebox/teacherguide/module1/trsklsn2.htm
and the student worksheet is available at
http://www.lpb.org/education/classroom/itv/envirotacklebox/teacherguide/module1/trsklsn2f.htm.

In this activity, students will be given an opportunity to look at physical recreation and sports activities to determine how risky an activity is and what teenagers can do to prevent injury to themselves, their teammates, or opponents. (If Project Learning Tree™ module *Exploring Environmental Issues: Focus on Risk*, is available, Activity 2 –Part C, *Environmental Risks* and *Special Topics-Taking Action: Reducing Risk in Your School or Community* are comparable but more sophisticated exercises.)

Activity 2: Water Quality (SI GLEs: 6, 7, 10, 15: SE GLEs: 12, 15, 19, 26, 27)

Materials List:

per student - science learning log, vocabulary cards;

per class - water quality test kits/meters (such as O_2, CO_2, pH), sampling tools such as nets and collection jars, disposable gloves, safety goggles, lab aprons, hand soap, paper towels

Note: Identify potential pollutants and safety issues before taking students to collection sites or having them test water samples. Provide students with basic water quality monitoring mechanisms and procedures (and have them identify and discuss safety measures) before they participate in the water quality monitoring activities. Hands should be washed prior to and after testing. Instruct students in appropriate disposal of the water samples and of used gloves.

This activity will take several days to complete. If it is possible to participate in local water quality monitoring programs, this activity should be an on-going project. Contact the local Cooperative Extension Service office about local programs. In addition, a list of volunteer monitoring programs is available at *EPA Monitoring and Assessing Water Quality*
http://yosemite.epa.gov/water/volmon.nsf/vst?openview&startkey=Louisiana&expandview.

Introduce the topic of *water quality* by assigning text reading materials relevant to water pollution and water quality monitoring. Remind students to complete *vocabulary cards* (view literacy strategy descriptions) for topic-related terms including *pollution, point-source pollution, nonpoint-source pollution, eutrophication,* and *thermal pollution*. To ensure accuracy in card construction as well as in content, invite student volunteers to recreate their cards on the board, as a computer graphic, or as an overhead transparency.

Students should also be given time to review the cards with a partner in preparation for quizzes and other class activities.

Instruct students to identify major sources of aquatic pollution in Louisiana and to make inferences about the potential effects of a variety of aquatic pollutants on local wildlife and the hydrosphere within their science *learning logs* (view literacy strategy descriptions). Local/state information can be accessed from the following:

- *EPA Water- Louisiana* includes links to a variety of water quality-related resources www.epa.gov/water/states/la.html
- Louisiana DEQ-Water Quality Educational Resources http://www.deq.louisiana.gov/portal/Default.aspx?tabid=2470
- Louisiana *Adopt Your Watershed* http://yosemite.epa.gov/water/adopt.nsf/by+state?SearchView&Query=Louisiana

Next, provide students with basic water quality monitoring mechanisms and procedures and have them identify and discuss safety measures before they participate in water quality monitoring activities. *Healthy Water Healthy People™: Water Quality Education Guide*, www.healthywater.org/resourcesED.html#qmonitoring, and most textbook resources provide instruction on both water quality tests/techniques and on the use of biological indicators (such as macro-organisms) in determining water quality. Test kits are available through science supply catalogs.

After each data collection experience, students should share their findings with the class and, based upon their collected observations, offer inferences relating local water quality to both environmental accountability and sustainability issues.

Depending upon the available resources, water quality monitoring can be accomplished by

- Taking a short field trip to a local stream or body of water and collecting water samples or by having students bring in samples of water from local bodies of water and conducting water quality tests on the samples. If available, calculators and calculator-based ™laboratory probes could be used to integrate technology for water quality tests.
- Having students participate in watershed monitoring projects. The projects have students collect and organize environmental data, analyze the data, and communicate their findings. Some groups have students present their work during symposia on area water quality.
- The exercise, *Water Fit For a Bug: Macroinvertebrate Sampling for Evaluating Water* Quality, developed by the Louisiana Department of Environmental Quality, can be completed within 2-3 hours. It can be completed outdoors or indoors with pre-collection of water samples by the teacher. http://www.deq.louisiana.gov/portal/Portals/0/planning/WATERBUG.DOC
- Using water quality monitoring activities available from text resources, biological supply houses, and *Healthy Water Healthy People™: Water Quality Education Guide, Project WET™,* or *Field Trip in a Box: Focusing on Science Process Skills through a Real World Simulation* (LA Tech University CATALYST Program).

At the conclusion of their water testing program, have students share their findings and state conclusions they have reached relating local water quality to environmental accountability and sustainability. This could be accomplished through participation in a symposium during a school "Science Night", during a PTA meeting, or via presentations to a local environmental organization or to other science classes.

Additional Water Quality resources include the following:

- DVD and VHS copies of the popular 1/2 hour television program, about storm water run- off and watersheds -- *After the Storm* (Feb.,2004) -- co-produced by EPA and The Weather Channel™ are available at no charge. Brochures, fact sheets, and "what you can do" recommendations are also available: http://www.epa.gov/weatherchannel
- Louisiana *Adopt Your Watershed* list can be found at http://yosemite.epa.gov/water/adopt.nsf/by+state?SearchView&Query=Louisiana Some of the groups also have a speakers bureau and/or educational programs.

Activity 3: Air Quality (SI GLEs: 5, 6, 9, 12, 15; SE GLEs: 6, 20, 21, 25, 26, 28) **(**Assessment of this activity also includes **SI GLE 4**. Refer to Activity 3 Activity Specific Assessments.)

Materials List:

per teacher/class - EPA *Air Pollution:* "What do you Know?" lesson, large copy of the Air Quality Index, Real-time data materials

per pair of students - EPA *AIR NOW: Quality of Air Means Quality of Life"* fact sheets

per student - vocabulary cards

Introduce the topic of *air quality* by assigning students appropriate teacher-selected text materials and engaging them in a discussion of questions about what they know and what they want to know about air pollution. (The EPA *Air Pollution: What's the Solution?* project's "What do you Know?" lesson lists numerous appropriate question prompts at http://www.k12science.org/curriculum/airproj/genknow.html). Familiarize students with the Air Quality Index (AQI) and distinguish among the five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide.

Provide individual copies or post a large copy of the Air Quality Index and discuss its use (available in most texts and at http://airnow.gov/index.cfm?action=static.aqi). Engage students in discussions comparing and contrasting air quality in different locations (utilize Louisiana locations, if possible) or differences noted in one location at different times of day or in different seasons. Have them speculate causes for differences noted. If possible, provide students with real-time images or data instead of

information/images from the textbook alone. Real-time data engages students, and also brings a "real" and relevant connection to the content. Real-time data can be obtained and forecasts can be accessed from several sources including by following the links on http://airnow.gov/index.cfm?action=static.background. When using any form of technology, especially the Internet and Real-Time Data, it is essential to have a back-up plan in case of technology failures.

Using student input as a guide to their need, select, download, and print copies of the EPA *AIR NOW: Quality of Air Means Quality of Life"* fact sheets found at http://airnow.gov/index.cfm?action=jump.jump_youcando. Assign each pair or small group of students one air quality "tip" sheet. Tell them that they will be summarizing a fact sheet and using it to create a public service announcement to educate the general public about their assigned "tip." As students unskilled in summarizing tend to say too much or too little in their summaries, take this opportunity to introduce them to a technique of extracting essential ideas or "*gisting.*" *GISTing* (view literacy strategy descriptions) is an excellent strategy for helping students paraphrase and summarize essential information. Select one of the fact sheets and model the *GISTing* strategy with the class prior to placing them in groups. Refer to the attached sample gist of a paragraph from the "Don't Top off Your Gas Tank!" fact sheet.

It's best to start the summarizing process with relatively short paragraphs that are easily understood. Then, establish a limited number of spaces to represent the total number of words in the gist, say fifteen or so. Students then read the first sentence of the paragraph and, using only the spaces allowed, write a statement in those spaces capturing the essential information of the sentence. Have the students then read the second sentence of the paragraph and, using the information from the first and second sentences, rewrite their gist statement by combining information from the first sentence with information from the second. Again, the students' revised gist statement should be no more than the allotted number of spaces. This process continues with the remaining sentences of the paragraph. As students read each succeeding sentence, they should rework their gist statement by accommodating any new information, while not using any more than the allotted number of spaces. Finally, students should share their gists for comment and critique. (Here, in the form of their public service announcements.) Remind the class that the announcement is to be accurate; they should incorporate the entire fact sheet and be concise. After reading the assigned fact sheet and preparing their announcement, each group will present to the class.

Sample: Writing a Gist with Maximum of 15 spaces (words)

Paragraph from: *Quality of Air Means Quality of Life* fact sheet, "Don't Top off Your Gas Tank!"

"Topping-off the gas tank can result in your paying for gasoline that is fed back into the station's tanks because your gas tank is full**.** The gas nozzle automatically clicks off when your gas tank is full. In areas of ozone non-attainment, gas station pumps are equipped with vapor recovery systems that feed back gas vapors into their tanks to prevent vapors

from escaping into the air and contributing to air pollution. Any additional gas you try to pump into your tank may be drawn into the vapor line and fed back into the station's storage tanks."

Gist statements for the sample paragraph

Sentence 1: Topping off can result in paying for gas fed back into station's tanks.

Sentences 1 and 2: Stop pumping when nozzle clicks off to prevent gas being fed back to station's tank.

Sentences 1-3: Topping off feeds gas vapor back to station's tank and into the air.

Gist of the paragraph: Topping off contributes to gas feed-back into station's tank and to air pollution.

After several gisting activities using this approach, guide students in constructing summaries without having to gist each sentence of a paragraph. It is more important that students recognize that the gisting process is a mental one and not necessarily a written one. Eventually, it will be possible for students to prepare overall gists for sections of text by combining essential information from summary statements made from several paragraphs.

As air quality vocabulary terms are introduced, have students complete *vocabulary cards* (view literacy strategy descriptions). Terms should include but not be limited to *particle (particulate) pollution, ozone, VOC (volatile organic compounds), NO_x (nitrogen oxides), temperature inversions, smog, AQI, carbon monoxide*. Provide students with an opportunity to review, discuss, and modify the cards, as well.

Additional air pollution resources, including indoor air quality activities, are available through the EPA and the Environmental Literacy Council. The AIRNow: Air Quality Movie Link (http://airnow.gov/index.cfm?action=movie.main) provides flash animations and on-line movies related to ozone and particulate air pollution. If class computer access is available, Air Info Now (www.airinfonow.com/html/activities.html) offers on-line games, experiments and "Actions You Can Take to Reduce Air Pollution". These include effects of air pollution on the lungs and CO-City, an interactive animation that lets students set certain parameters. Students can then find out how and why CO levels change in response to their actions.

At the conclusion of this activity ask students to cite evidence that investigations are conducted for many different reasons (relating their reasons to examples from this activity).

Activity 4: Relationship between Carbon Dioxide and Global Climate Change (SI GLEs: 11, 13; SE GLEs: 6, 12, 19, 23, 26, 28; ESS GLEs: 1, 10)

Materials List:

per teacher - the Union of Concerned Scientists' publications: *Confronting Climate Change in the Gulf Coast – Curriculum Guide, Confronting Climate Change in the Gulf Coast Region: Prospects for Sustaining Our Ecological Heritage Report*

per student - pages 21-23 of *Confronting Climate Change in the Gulf Coast Report*

per group - Climate Change Impacts on Ecosystems Worksheet (*Confronting Climate Change in the Gulf Coast-Curriculum Guide* p.63-65); per class - Access to recent newspapers and magazines, copies of Ch. 2 and 3 of *Confronting Climate Change in the Gulf Coast Report*, access to books, magazine articles, and Internet for student research

While developed before the hurricanes of 2005, the Union of Concerned Scientists' publications: *Confronting Climate Change in the Gulf Coast – Curriculum Guide* (www.ucsusa.org/assets/documents/global_warming/UCS_gulf__curriculum.pdf) and the report upon which it is based (*Confronting Climate Change in the Gulf Coast Region: Prospects for Sustaining Our Ecological Heritage* (http://www.ucsusa.org/gulf/gcchallengereport.html), provide resources that are of long-term relevance. The report website also includes links to Louisiana specific materials, and the curriculum guide includes Louisiana-specific supplements.

Introduce the topic of global climate change by assigning relevant text reading materials. After discussing the basic concepts, students are to research newspaper and magazine articles to identify current (or recent) topics related to global warming/global climate change. Inform students that they will be summarizing the articles they identify. Include a review of the *gisting* (view literacy strategy descriptions) strategy as part of the exercise procedures. (Reminder: *Gisting* instructions are included in this Unit within Activity 3) The article summaries should include the following:

- The bibliographical information (article title, author, publication title, date of publication, and page number[s])
- The focus of the article. (What's the issue? How does it relate to Louisiana?)
- Does the article present several perspectives, or is there a bias?
- What interest groups, government agencies, organizations, and/or communities are involved, and what is at stake for each?
- Are new research findings included? If so, how do they alter previous knowledge of the issue?

Have students record their summaries within their notebooks and present their summaries to their classmates in the form of round-table discussions. Recent articles on global climate change can generally be accessed from newspaper and magazine archives and via web pages by doing a keyword search for "global warming" or "global climate change."

(Website links for Louisiana newspapers can be found at http://www.newslink.org/lanews.html.)

Through text readings and teacher-lead discussion, introduce the concept of *greenhouse emissions*. Include discussion of the basic processes underlying the greenhouse effect, the relationship of "natural" greenhouse emissions to climate, and issues related to increases in greenhouse emissions as a result of human activities. If computers with internet access are available, have students estimate their personal "carbon footprints" through the use of a climate calculator such as the one found at http://go.ucsusa.org/calculator.html.

Distribute a copy of pages 21-23 of *Confronting Climate Change in the Gulf Coast* to each student. Ask them to read the material as homework and to answer the discussion questions. (Questions are listed in the Teaching Strategies section of the *Confronting Climate Change in the Gulf Coast-Curriculum Guide* - Activity 6.)

Assign students to small, cooperative groups. Ask the student groups to imagine that they are wildlife managers in charge of protecting a species from negative consequences of climate changes in the Gulf. Distribute copies of "Worksheet: Climate Change Impacts on Ecosystems" (pages 63- 66 of *Confronting Climate Change in the Gulf Coast-Curriculum Guide*) to each group; assign each group a single species or local ecosystem to research. Ask each group to answer the problems and to create a technology-enhanced presentation that incorporates a verbal component and visuals (such as photos, videos, and/ or graphic organizers such as those available through programs such as Inspiration™). Remind students that while their report is to be creative, accuracy is most important.
After each group has presented, conduct a question-and-answer session to insure that the assigned problems have been accurately and completely reported.

Note: Chapters 2 and 3 of the *Confronting Climate Change in the Gulf Coast Report* and the websites listed at the end of this unit should be included in research resources available for student use.

Activity 5: Hazardous Wastes (SI GLEs: 5, 7; SE GLEs: 20, 21, 22, 25, 26)
(Activity-Specific Assessment includes **SI GLEs: 14 and 16.)**

Materials List:

per teacher - EPA *Super Fund for Students and Teachers: Defining Hazardous Waste Materials*, EPA *Waste-Where Does It Come From? Where Does It Go?*, EPA *Making Decisions About Hazardous Waste Cleanup*

per class - map of the community, assorted markers

per student - *Analysis of Alternatives for Cleaning Up Flowing Railroad Site; Fact Flash* handout 1, vocabulary cards; per group - Character Background information *Fact Flash* handouts 2 and 4

Download and print a copy of the EPA *Super Fund for Students and Teachers: Defining Hazardous Waste Materials* (www.epa.gov/superfund/students/clas_act/haz-ed/def_hazw.htm). Use the Background and Procedure sections in introducing the concept of hazardous waste to the class. Begin the exercise by asking students to define hazardous substance and inviting them to share their answers with the class. After discussing the definition, discuss the characteristics of hazardous substances with them. Students should prepare *vocabulary card*s (view literacy strategy descriptions) for the terms discussed (*hazardous substance*, *corrosive*, *toxic*, *ignitable*, and *reactive*). Ask students to list and discuss some types of hazardous substances found in their homes and community. Then, distribute copies of the *Fact Flash 1: Hazardous Substances and Hazardous Waste* for students to read, possibly as homework. Record the exercise questions (Procedure Step 6) on the board. Assign students to small groups. Explain that they will have about 20 minutes to discuss the problems within their groups and will then participate in a class-wide discussion. After the discussion period, have students share their concerns and opinions with the class.

Following this discussion, students are to complete EPA *Super Fund for Students and Teachers:* "Waste: Where Does It Come From? Where Does It Go?" exercises. (www.epa.gov/superfund/students/clas_act/haz-ed/act01.htm). Hang a large map of the local community (or state) on the classroom wall. As they complete the exercise, students will discuss and indicate locations of local landfills, recycling centers, incinerators, and hazardous waste facilities on the map. Utilize the exercise background and procedures in providing prompts and in guiding the class through this exercise.

As an authentic assessment of the hazardous waste exercises, students are to complete *EPA Super Fund for Students and Teachers: Making Decisions about Hazardous Waste Cleanup*, www.epa.gov/superfund/students/clas_act/haz-ed/act09.htm. In this exercise, the students assume roles and act out a situation that illustrates the process of decision making during clean-up of a Superfund site. Explain to students that they will be participating in a role-playing exercise in which they will assume they live in the hypothetical area of a Superfund site. They will participate in a community meeting held to discuss views about the site clean-up options under construction. Divide the class into nine teams. Assign one team to represent each of the "players" in the scenario. Distribute copies of the *Analysis of Alternatives for Cleaning Up Flowing Railroad Site* to each student. Fact Flashes 2 and 4 (background info) and the *Character Background* should be distributed to each group. (Both are available via links on the website.) Tell students that each team is to research its role, choose a group member to be the actor in the class presentation, and participate in an analysis of the decision-making process. Utilize the exercise background and procedures in guiding the class through this exercise.

Activity 6: Government and the Environment (SI GLE: 7; SE GLEs: 21, 22, 23, 25, 26)

Materials List:

per teacher - EPA *Super Fund for Students and Teachers: Federal and State Laws on Hazardous Waste*

per student - EPA Student Handout, *Federal and State Laws on Hazardous Waste*, *Fact Flash 2* (see Activity 5)

Download and print EPA *Super Fund for Students and Teachers: Federal and State Laws on Hazardous Waste*, www.epa.gov/superfund/students/clas_act/haz-ed/act12.htm. In this simulation exercise, students become familiar with how legislation on hazardous waste is developed, enacted, implemented, and enforced. Students also gain an understanding of how hazardous waste clean-up laws are enacted and intended to function by creating a statute and set of regulations that parallel the issues covered by the Superfund.

Distribute the EPA Student Handout, *Federal and State Laws on Hazardous Waste* to each student. Assign students to read this document and to review *Fact Flash 2* (previously distributed in Activity 5). Assign them to record answers to the Student Handout questions in their *science learning logs* (view literacy strategy descriptions). Briefly review the concerns raised in the handout and the questions that students must answer when they are devising their program. Divide the class into small, collaborative groups.

Utilize the simulation exercise background and procedures in guiding the class through this activity. Remind students that each group member should express his/her opinion on the issues and that if the group can not reach a consensus on an answer, they should move on, considering the next problem(s) in terms of alternative positions suggested by group members. During the last 10 minutes of the period, each group outlines the program it has decided upon, lists the features of the program, and records the consensus response to each question. On the following day, conduct a round-table discussion. Be sure that each group discusses its program and states (and defends) its position on the issues. Discussion of how education and collaboration can affect the prevention and control of hazardous materials should also be included in the activity summation.

If *Project WILD ™*materials are available, *Know Your Legislation: What's in It for Wildlife?* provides a similar activity with a wildlife focus. *Project Learning Tree* lesson, *There Ought to be a Law*, provides students an opportunity to select the environmental issue under consideration.

Sample Assessments

General Guidelines

Assessment techniques should include drawings/illustrations/models, laboratory investigations with reports, and laboratory practicals (problem-solving and performance-based assessments), group discussion and journaling (reflective assessment), and paper-and-pencil tests (traditional summative assessments).

- Students should be monitored throughout the work on all activities via teacher observation of their work and lab notebook entries.
- All student-developed products should be evaluated as the unit continues.
- Student investigations should be evaluated with a rubric.
- For some multiple-choice items on written tests, ask students to write a justification for their chosen response.

General Assessments

- Student groups will set up information booths at school or during a community celebration of Earth Day. They can collect and distribute the information previously gathered about an environmental issue or results of a monitoring study.
- The students will work in small groups to prepare a display/model and to make a presentation on their pollution research. Rubrics should be used to evaluate each group's report.
- The students should compose essays that relate the impact that personal choices have upon environmental quality and make recommendations for solutions for the future.

Activity-Specific Assessments

- Activity 2: Students are to participate in a lab practicum in which they analyze water quality of a specific water sample and draw conclusions with regard to environmental quality of the source.

- Activity 3: Using an experimental design format, students will create their own ground-level ozone investigation. Using a teacher-developed format or the materials found via the ozone lessons link from http://www.k12science.org/curriculum/airproj/genopenaqi.html, students will determine if there is ground level ozone present in your area.

- Activity 5: Students should cite and research emerging technologies associated with hazardous waste disposal and/or clean-up and use the rules of

evidence listed in GLE-SI-H-16 to analyze reports or research on these technologies. Students then assume roles and act out a situation that illustrates the process of decision making during clean-up of a Superfund site by completing EPA *Super Fund for Students and Teachers: Making Decisions about Hazardous Waste Cleanup*, www.epa.gov/superfund/students/clas_act/haz-ed/act09.htm.

Resources

- **Global Change and Louisiana**

  Louisiana Public Square's Climate Change and Louisiana: The Heat Is On
  http://www.lpb.org/programs/LApublicsquare/topic.cfm?MonthofEvent=03&YearofEvent=2007
  Comprehensive look at global warming issues as they relate to Louisiana

  Louisiana Sea Grant's Climate Change: What Will It Mean For Louisiana's Coastal Fisheries?
  http://www.seagrantfish.lsu.edu/pdfs/coast&sea/ClimateChange.pdf
  Global warming history and its effects on Louisiana ecosystems