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Integrating horticulture biology and coastal environmental issues into the Middle School Science Curriculum

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INTEGRATING HORTICULTURE BIOLOGY AND COASTAL ENVIRONMENTAL ISSUES INTO THE MIDDLE SCHOOL SCIENCE CURRICULUM

A Thesis

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Master of Science

In

The Department of Horticulture

By
Kathryn Lauren Karsh
B.S., Louisiana State University, 2003
May, 2005
This thesis is dedicated to Mr. Stephen Karsh

His love for nature and all her creatures inspires me to want to share the enthusiasm he has with all people.
Acknowledgements

I would like to thank Dr. Edward Bush for supporting and encouraging me to do my best work on this thesis project. I will forever be grateful for his devotion of time and thought into this project as well as his friendship. I would also like to acknowledge my committee members Dr. Pamela Blanchard and Dr. Janice Hinson who encouraged and supported all efforts towards this project. To the Coastal Roots teachers, Mr. Jim Giambrone, Mrs. Mary Levron, Mrs. Valarie Stewart, Mrs. Sylvia Beard, Mrs. Ashley Vicknair, and Mrs. Gauthier and all students who participated in the horticulture lessons, thank you for generously giving up your school time to help me with my project. You were an essential part in the success of the thesis. Thank you to Dr. Bush, Dr. Owings, and Dr. Wilson for always giving me a positive outlook on life. Thanks to Dr. Bill Carney, Mr. Robert Mirabello, Dr. Charlie Johnson, and Dr. Don LaBonte for aiding with supplies, lab space, and knowledge. I cannot thank enough the staff of Louisiana Sea Grant College Program, Dianne Lindstedt, and Rachael Somers for support and creative ideas incorporated into the project. A special thank-you is also given to Chris Goodson, without whom the preparation for all lesson plans and assistance teaching the lessons to students would never have run as smoothly. Thanks to Mrs. Sandra Good who provided her graphic design skills for all the lesson labels. Thanks to Mr. Robert Mirabello who encouraged furthering my education and proposed the idea of Coastal Roots to me. Thanks to Dr. Lynn LaMotte for providing his statistical knowledge and skills. Thank you Dexter, for helping me grade endless amounts of papers, tallying and recording data, and photographing the students. Your encouragement and love cannot be replaced. Finally, the most thanks goes to my parents Ken and Marlys Karsh for providing love,
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Abstract

Louisiana is losing nearly 34 square miles of coastal land each year. Scientists predict by 2050 one-third of Louisiana’s coast land will disappear (LaCoast, 2004). Many restoration projects have begun to counteract the severe land loss. Scientists use restoration methods such as vegetative plantings, sedimentary and freshwater diversions, and hydrologic projects to prevent land loss. Coastal Roots, a school-based nursery stewardship project for upper elementary to high school students coordinated by Louisiana Sea Grant College Program and LSU AgCenter, helps students understand the land loss crisis and gives them a constructive way to help restore the damaged coastal habitats by providing student-grown plants for vegetative plantings. Because of the critical role that horticulture practices play in raising seedlings into mature transplants, eight standards-based horticulture lessons were created and taught in middle school classrooms at four schools over a period of two years. Ultimately, these eight lessons will (1) provide the science content and skills students need in order to be able to grow healthy seedlings, and (2) increase students’ awareness and concern about coastal land loss issues facing the citizens of Louisiana. The eight middle school science lesson plans were created to meet specific Louisiana Grade-Level Expectations for 463 students in 4 schools. Pre and Post-tests were given to each participating class (six grade through nine) in addition to the Children’s Attitude Towards the Environment Scale (CATES). Additional pre- and post-tests were given to selected classes not participating in the program. The evaluations tested both short and long-term memory on material contained in the lesson plans. The data was analyzed by school, gender, treatment, and grade level. Results for both 2003 And 2004 general science knowledge increased an average of
greater than 20%. Long and short-term memory test indicated individual higher scores for
the students who were instructed in this program compared to the control students. The
Children’s Attitude Towards the Environment Scale or CATES indicated a significant
increase in environmental awareness in participating students.
Chapter 1

Introduction
1.1 Environmental Education

Studies have shown that introducing environmental education not only raises science scores but other subject scores as well (Wakefield, 2001). Despite this claim, the introduction of less popular environmental topics, such as horticulture, to the classroom curriculum is rare. Teachers who do not have sufficient background in an area such as horticulture are less likely to use it as a tool for teaching students. Using educational workshops to train teachers in horticulture would be a valuable asset for achieving curriculum integration in the classroom (Clark, 1994). Some teachers also feel less-popular environmental topics such as horticulture cannot be used because they are not age-specific towards the grade level in which they teach (Lane and Fritz, 2000). Coastal Roots, an educational program created by Louisiana Sea Grant College Program at Louisiana State University was initiated in 1999 to introduce information on Louisiana’s wetland loss to elementary through high school students. Coastal Roots also focuses on fostering environmental stewardship among students by combining nursery management and coastal environmental awareness into a hands-on program. Participating schools are provided with seeds and soil for students to grow native Louisiana wetland plants in their school nursery. Once the seeds mature into young trees, the students go on a field trip to plant the seedlings in an eroding wetland area. The project goals are as follows: (1) to produce wetland plants that students can use for the field trip, (2) to provide students with information on wetland loss, (3) to construct a plant nursery on school grounds, (4) and to provide on-going environmental education projects to student.

After four years, the school nurseries were operating, but the educational goals were not being adequately met. Coastal Roots provided an effective field experience
through the nursery project but lacked the in-classroom teaching component. Developing lesson plans with horticulture and environmental issues as the main focus would provide hands-on activities for students and complete the original goals of the Coastal Roots program. We hope that the constant exposure to environmental science through a set of horticulture and coastal lesson plans given to students will increase student’s science grades. Middle school students test scores should increase because they are given a local topic to study. The eight lessons have relevance to the lives of Louisiana middle school students and are based on hands-on activities stimulating an interest in students. Each lesson is divided into three or four activities so that the attention of the students is never lost. The average attention span of a student in middle school is twelve minutes. Exposure to the environment should also increase environmental stewardship in students (Waliczek and Zajicek, 1999).

The eight lesson plans formulated in this thesis will form the backbone of the Coastal Roots in-class education program. Each lesson plan meets specific Louisiana Grade-Level Expectations (GLE’s), making these lessons applicable to the current science curriculum for grades five to eight. Students gain increased insight from hands-on activities in comparison to a basic lecture class. If adding lessons that allow students to work outside and in a lab situation, promote better science grades and healthier environmental attitudes, then this project is certainly justifiable. The Coastal Roots program will reach its original goal to distribute on-going activities and information to students about the interaction of horticulture science on wetland loss. Students will share information they learn in school with peers and parents spreading what they have learned to the general public. In addition, teaching the students about environmental problems
south Louisiana faces and methods of slowing land loss; students will become a
knowledgeable coastal restoration volunteer base. Introducing students at an early age to
environmental stewardship enables educators to reach children at an influential age when
we can teach them to become environmentally responsible citizens.

1.2 Wetland Loss

Currently, Louisiana is losing one acre of wetlands every thirty minutes and
approximately twenty-five to thirty square miles per year (EPA, 2004). Louisiana can not
afford to lose wetlands, as this particular ecosystem provides more than one billion
dollars in the seafood industry annually (USGS, 2004). Wetlands not only provide the
state with annual revenue but also flood protection from hurricanes, habitat for wildlife,
places of rest for migrating waterfowl, and water quality maintenance (LaCoast, 2004).

The land loss is due to a number of factors, namely subsidence or a gradual
sinking of the land, dams blocking the natural flow and sediment deposits of the
Mississippi River, and canals dredged throughout the coastal marsh to allow for the
drilling of oil. The need for wetland restoration in Louisiana is immense. Louisiana’s
wetlands serve as an excellent place for students of all ages to learn about wetland plants
and provide much needed restoration services. Most people in south Louisiana encounter
the wetlands daily. Our program will teach horticulture biology and coastal
environmental issues using the surrounding wetlands.

There are few agencies in Louisiana developing curriculums using our
disappearing wetlands as the main educational focus. Excellent examples of current
educational wetland programs are Louisiana Wetland Educational Coalition (LaWEC)
providing educational tools for teachers on the internet. The Jason Project is another
exemplary team that is developing educational program for teachers combining science education with the topic of wetland loss in Louisiana.

Horticulture plays a huge role in saving the wetlands and is therefore integrated into the Coastal Roots program. In order to save our wetlands we need to prevent erosion from occurring. Plants are an effective measure against erosion because their roots hold valuable soil in its place. In order to establish a large number of healthy plants in a school-based nursery, basic horticulture science is necessary. Teaming horticulturalists with wetland specialists we can assist students in raising healthy restoration plants and assist in delivering these plants to areas in Louisiana experiencing widespread erosion.

Eight horticulture-coastal lessons were developed and pilot tested for two years in four schools across south Louisiana. A treatment group receiving the horticulture-coastal lessons and a control group who did not participate in the horticulture-coastal lessons were chosen at each school. Although the control group did not receive the horticulture-coastal lessons, they were given both pre and post-horticulture tests as well as the CATES survey to establish a control student population. The control and treatment classes should have received the same basic science lessons as all eight of the horticulture-coastal lessons were based upon the state regulated educational standards. Because the state of Louisiana requires certain subject matter to be taught at certain grade-levels the control and treatment classes should have received the same information in class; the difference lies within the material used to teach the educational standards. Chapters 2 through 9 contain the detailed lessons developed for this thesis.
1.3 Grade Level Expectations

State educational standards have a long history. Beginning in 1957 the United States felt the need to increase its current number of scientist, through a long series of teacher lead council meetings, a number of state educational standards have been developed and modified. Benchmark for Science Literacy was published in 1993 to develop minimum goals for students at second, fifth, eighth, and twelfth grades. In 1989 the Curriculum and Evaluation Standards for School Mathematics was developed by the National Council of Teachers of Mathematics. A national set of science education standards which were published in 1995. Louisiana published its own state science standards based on the National Science Education Standards in 1997. The Louisiana Grade-Level Expectations published in 2004, (LA Department of Education, 2004) break down the science standards into grade-specific expectations. The Grade-Level Expectations or GLE’s provide guidance to public school teachers to create educational curriculum. The GLE’s are categorized by grade and subject. Within each grade-level the subjects are then split again into sub-categories. For example, science at the seventh grade-level is categorized into six sub-sections. The six sub-sections are Physical science, Life science, Reproduction and Heredity, Populations and Ecosystems, Adaptations of Organisms, and Science and the Environment. In all, there are forty-three different GLE’s that fall into these six sub-headings under seventh grade science; two additional sub-headings cover topics concerning inquiry. Because the state strictly enforces the usage of the GLE’s, science teachers are restricted in the topics that they can choose to focus on. Taking into consideration the GLE’s and the goals of the Coastal Roots program, the horticulture-coastal lesson plans were developed to provide on-going environmental
activities in accordance with state educational standards. The set of eight horticulture-coastal lessons targets twenty-six individual GLE’s at the fifth to eighth grade science levels. Because so many GLE’s are taught within the horticulture-coastal lessons, science teachers are able to focus their attention on planning curriculum to support the other GLE’s. If the GLE’s covered in the horticulture-coastal lessons will also be addressed by the science teacher, he or she can use the lessons as introductory or follow-up activities. Students will have a better grasp on science topics if they are introduced to the ideas several times.

1.4 Lesson Development

Horticulture revolves around a set of main principals. In any given horticulture class, topics such as photosynthesis, pollination, soil science, binomial nomenclature, and others will be highlighted by the instructor. Because students within the Coastal Roots program needed to know how to grow better native plants they too needed to learn these important horticulture concepts. In addition to horticulture basics, the lessons needed to incorporate Louisiana land loss prevention and the Louisiana Grade-Level Expectations.

After reviewing the science standards taught at grades five to eight, we incorporated the science standards into our horticulture lessons. Each lesson taught incorporated at least two benchmarks as well as provide students with general plant science. As the lessons were taught, Louisiana native wetland plants were introduced to students as example plants for the lesson. To connect the lessons into the Coastal Roots project we linked several horticulture topics with wetland loss. The following table pairs each lesson with its main objective and the connection to coastal restoration.
Table 1 Significance of Horticulture Lessons to Wetland Restoration

<table>
<thead>
<tr>
<th>Title</th>
<th>Main Objective</th>
<th>Connection to Restoration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Identification</td>
<td>Identify plants and learn how to write their scientific names</td>
<td>Students learn to identify the plants they are growing for restoration</td>
</tr>
<tr>
<td>Wetland Habitats</td>
<td>Focus on the adaptation of native plants to the habitats in which they live</td>
<td>Students learn what environments are best suited for their native plants</td>
</tr>
<tr>
<td>Photosynthesis</td>
<td>Focus on the basic process of photosynthesis</td>
<td>Students learn the importance of sun, water, and carbon dioxide to their native plants growth</td>
</tr>
<tr>
<td>Composting</td>
<td>Focus on the proper ingredients and methods for building a compost pile</td>
<td>The finished compost product was used to transplant second year native plants in student nurseries</td>
</tr>
<tr>
<td>Pollination</td>
<td>Focus on the reproductive structures of plants</td>
<td>Students learn how their native plants will continue to populate themselves</td>
</tr>
<tr>
<td>Plant Genetics</td>
<td>Focus on the environments role on plants phenotypes and genotypes</td>
<td>Students learn that the environment in which a plant lives can effect how well it will or will not grow</td>
</tr>
<tr>
<td>Wetland Soils and Media Characteristics</td>
<td>Focus on a plants role in preventing soil loss and how to identify different wetland soils</td>
<td>Students learn that plants are essential to creating and maintaining a healthy wetland</td>
</tr>
<tr>
<td>Global Warming and the Greenhouse Effect</td>
<td>Focus on the positive and negative impacts of global warming on Louisiana wetlands</td>
<td>Students learn the significance and role of human interaction with Louisiana’s wetlands</td>
</tr>
</tbody>
</table>

1.5 Gender

Gender plays a significant role in science. A common stereotype is men are better at science than women. Many sociologists have studied this issue and are trying to trace the origin of when women begin to lose interest in science. Are men truly superior to women in science fields, or is it that women lose interest in science somewhere along their educational path? Most studies indicate that women are subconsciously taught that
they are not supposed to be interested in science. A number of papers try and pin point the explanations for females disinterest in science. Otto (1991) mentioned that many studies pay attention to “explanations for women not entering the science fields and have focused on (a) disparity in cognitive abilities, (b) personality characteristics, (c) attitudes towards science, (d) differences between in-school and out-of-school experiences, and (e) gender differences in math preparation”. Studies like Otto’s and others such as Boone (1997) set out to discover why females are losing interest in science. Boone found through a survey of both Chinese eighth grade boys and girls that there were not extreme differences in science attitudes of the two sexes however there was a difference in the intensity of the answers given by the differing sexes. Girls tended to strongly agree or disagree with statements about science whereas boys just agreed or disagreed. He felt girls were more passionate in their attitudes and the classroom environment may have had an effect on their answers. More importantly is the fact that females are losing interest in science and are therefore performing inferior in science than males.

The Third International Mathematics and Science Study (TIMSS) is a multinational survey of student achievement in mathematics and science. TIMSS is a test given to third, fourth, seventh and eighth grade students. Thirty-eight countries participated in this survey in 1999 (TIMSS, 1999). “International assessments Organisation for Economic Cooperation and Development (OECD) countries demonstrate that boys outperform girls at the grade eight level by an average of 5 points in mathematics and 18 points in science” (Raptis, 2003). The averages came from the TIMSS test given in 1999.
Because women only encompass eight percent of the total employed engineers, thirty-six percent of mathematical and computer scientists, and twenty-seven percent of chemists it is important to test for gender differences and find solutions to close the gap, thus making science gender-free, or indiscriminate, towards women (White, 1992). The goal of the horticulture-coastal lessons is not to determine why females are losing interests in science but develop science activities that close the gender gap. Following the conclusions of the lessons we hope to identify science activities that promote elevated science grades, stewardship of the environment, and a non-gender biased program that uniformly supports the learning capacity of male and female students.
Chapter 2

Lesson 1 Teacher’s Lesson Plan and Student Material for Identifying Plants and Plant Parts
2.1 Introduction and Teacher’s Guide for the Lesson

This chapter incorporates both the lesson plan used by the teacher and all student material needed to complete this lesson. The main objectives of this lesson were for students to learn to identify the different categories of plants and then to properly classify them.

Focus/Overview
The plant id lesson teaches students some of the most fundamental topics in horticulture. Targeted areas are: simple plant id, plant structures and functions, classifying plants, and the rules for binomial nomenclature.

Learning Objective(s)
The learner will be able to:
- Use a simple dichotomous key.
- List in order, the scientific ranks for classifying a plant.
- Know basic structures and functions of plant morphology.
- Know the rules for writing the scientific name of a plant.
- Know the definition of horticulture.

Louisiana Grade Level Expectations
5: GLE-22 Develop and use a simple dichotomous key to classify common plants and animals (LS-M-C1)

7: GLE-4 Compare functions of plant cell structures (LS-M-A2)

7: GLE-23 Classify organisms based on structural characteristics, using a dichotomous key (LS-M-C1)

Materials List
- Card set A
- Tap root (Carrot)
- Bulb (Caladium)
- Ariel roots (pothos ivy)
- Parasite (Dodder or mistletoe)
- Stolon (St. Augustine Grass)
- Corm (gladiolus)
- Rhizome (Iris)
- Tuber (Irish potato)
- Lateral roots (petunias, pansy’s any common annual plant in the plastic container)
- Epiphytes (Spanish Moss)
- Red and white oak dowels (approximately 3 inches long and 3/4 inch diameter)
- Bubbles
- Small plastic cups

**Background Information**
For the “What type of plant is it?” section it would be helpful for the teacher to identify each card using the dichotomous key before the lesson. The What type of plant is it activity may spark many questions from students that the instructor would find easy to answer if he or she identifies the cards using the dichotomous key before doing this activity with students in order to more clearly understand the student’s questions. Allow students to be silly when writing the phonetic devices. Outlandish sentences often results in the student’s remembering the order of the ranks. The more eccentric the saying, the easier it is for students to remember. Have students share their sayings with the whole class. This section works best when students work in a group. This way, shy students will not feel so confronted when sharing with the class. After a few students have shared their phonetic devises with the class, ask for one more volunteer. This volunteer should read his statement out loud, and then read each word in the sentence while the rest of the class shouts out the rank that corresponds to the silly word.

Instructions for writing the scientific name of a plant:
1. Always capitalize the Genus
2. Never capitalize the species
3. The entire name should be underlined or written in italics, but never both.
4. Example: Cypress tree = *Taxodium distichum*  
   or *Taxodium distichium*

   The instructor should familiarize his or herself with all of the different root structures of the plants. Have students hold opposite pairs of roots (ex: tap root vs. lateral roots, what are the differences? Corms verse bulbs and rhizomes, any differences?) This activity works well when you let the students eat, dissect, and hold all of the different roots.

   Point out the different sizes of the xylem and phloem vessels. Emphasis the fact that they have different functions (Xylem carries water, phloem carries food.) Remember all trees are not created equal. The vessels in the red oak dowels are open
therefore bubbles can be made. The vessels in the white oak dowels are plugged so bubbles cannot be made.

**Advance Preparation**
1. Divide students into groups.
2. Pass out all supplies to each group.

**Procedure 2.2 Lesson 1A Dichotomous Key**
3. Divide students into groups for this entire lesson.
4. Hand each group two cards to identify using the dichotomous key
5. Read out loud the instructions.
6. Have students share their findings with the class.
7. If students identify the cards quickly; allow groups to exchange cards.

**Procedure 2.3 Lesson 1B Plant Classification**
8. Have students read the silly saying “King David Calls Out For Good Spaghetti” that refers to the classification system. Now let students work together in groups to create their own sayings. Each word must start with the same letter as one of the ranks.
9. Students should share their silly sayings with the class.
10. Ask the question “Why do scientist care about the ranks?” (Answer: Scientist use the last three ranks to classify plants, Family, Genus- the plants “first name,” and Species- the plants “second name.”)
11. Practice writing the scientific name of a plant. Give students a few examples and have them write them on their papers or on the board (Magnolia – *Magnolia grandiflora*, Azalea bush, *Rhododendron spp.*)

**Procedure 2.4 Lesson 1C Plant Structures**
12. Give each group two or three of the plant roots. Allow students to match their plant parts with the pictures on the handout. Have students pass along the plant structures once they have identified them.
13. The following questions will help initiate student discussion; Does anyone have a root you can eat? There are two plants that look like roots but aren’t. What are these two plants? (ANS: Epiphyte: Spanish moss a plant that is dependent on another plant for support. It is not a vine, but it does not hurt the host plant. Parapse: Dodder or mistletoe, this plant depends on another plant for support and food, it destroys the host plant. Parasites are also not vines.)
14. Next, ask the transition question- why are roots so important? Students should give answers similar to the following examples: Roots take up water. Roots support the plants, etc.
15. Finally, explain that even though the roots take up water and nutrients for the plant, the water and nutrients must travel throughout the rest of the plant. How
do water and nutrients travel throughout the plant? (ANS: XYLEM and PHLOEM.)

Procedure 2.5 Lesson 1D Plant Conductive Tissue

16. Each group should have a set of dowels, one for each student and a couple of cups with bubble liquid on the tables.
17. The worksheet has a diagram of the phloem and xylem paths. Ask students to trace with their fingers or a pencil the paths of the xylem and phloem. Take note of the size of the vessels. Ask which vessel carries what. i.e. xylem- water, phloem- food (glucose).
18. Have students dip the dowels into the bubbles and then blow on the other end. Can the students determine which dowels are red and which are white? Explain that they are making the bubbles travel through the wood just as water and glucose travel throughout the tree.

Blackline Master(s)
1. Student handout
2. Card set A (Can be used several times if you laminate these cards)

Assessment
Plant Id quiz (L1), and questions 1, 3, 4, and 5 on the pre and post-test relate to this lesson.

Resources


What is Horticulture???

Horticulture is the science and art of cultivating, processing, and marketing fruits, vegetables, trees, shrubs, and other landscape plants.

Why is it important that we learn about Horticulture?

Louisiana has a very large number of wetlands, where many plants grow. Right now much of our wetlands are disappearing. Without wetlands many animals would not have a home. In order to restore wetlands we are going to need everyone’s help. This includes you! So let’s begin to learn about plants so we can help save Louisiana’s wetlands.

Eroding wetlands in Louisiana. Photographs by K. Karsh

2.2 Lesson 1A Dichotomous Key (Activity from WOW! Wonders of Wetlands)

Lesson 1A -Dichotomous Key

- Using the Key-Study the plant picture in front of you.
- Circle the correct YES or NO answers.
- Follow the directions until you successfully key the plant.
- Did you key the plant correctly?
What Type of Plant Is It?

This is a practice key that will help you use a dichotomous (di-KOT-uh-muss) key. The word dichotomy means “division into two.” A dichotomous key divides the task of identifying something into a series of questions that are based on physical features. Each set of questions offers opposing answers to choose from. As you make choices and eliminate others, you eventually find out the name of the mystery item. Use this key to identify the plants on the cards.

1. Are stems or other parts of the plant woody and rigid like a tree?
   Yes…………………………………….Go to 2.
   No…………………………………….Go to 6.

2. Is the plant growing above the ground but leaning on other plants?
   Yes…………………………………….It is a VINE.
   No…………………………………….Go to 3.

3. Is the plant growing above the ground and standing on its own?
   Yes…………………………………….Go to 4.

4. Is the plant 20 feet tall or taller?
   Yes…………………………………….It is a TREE.
   No…………………………………….Go to 5.

5. Does the plant have more than one main stem?
   Yes…………………………………….It is a SHRUB.
   No…………………………………….It is a sapling (young) TREE.
6. Is the plant a soft (herbaceous) plant like grass?

Yes……………………………………...Go to 7.
No……………………………………...Start Over.

7. Is the plant growing in open water that is always there, such as a pond, lake, or permanent stream?

Yes……………………………………...Go to 8.
No……………………………………...Go to 10.

8. Is the plant growing completely underwater, freely floating on the surface, or does it have floating leaves?

Yes……………………………………...It is an AQUATIC PLANT.
No……………………………………...Go to 10.

9. Is the plant growing with roots and part of the stem under water, but the rest sticking up above the surface?

Yes……………………………………...It is an EMERGENT PLANT.
No……………………………………...Go to 10.

10. Is the plant growing in soil that is saturated, wet, spongy, or appears to have been wet at one time (remember that wetlands are not always covered by water)?

Yes……………………………………... It is an EMERGENT PLANT.

This activity is directly from WOW! : The Wonders of Wetlands
(Card Set A Revised from WOW! Wonders of Wetlands)

Figure 1 Card Set A
Figure 2 Card Set A
Figure 3 Card Set A
2.3 Lesson 1B Plant Classification

Lesson 1B -Plant Classification

• We need to devise a pneumonic devise to remember the order of the classification ranks. i.e. King David Called Out For Good Spaghetti.

King=Kingdom; David=Division; Called=Class; Out=Order; For=Family; Good=Genus; Spaghetti=Species.

Example: Corn

| Kingdom: | Plantae          |
| Division: | Magnoliophyta    |
| Class:    | Liliopsida       |
| Order:    | Cyperales        |
| Family:   | Poaceae          |
| Genus:    | Zea              |
| Species:  | Mays             |

As a group, write two sayings that help you remember the order.

1. _____________________________________________________
2. _____________________________________________________

• People have first and last names, and so do plants. Let’s practice using the Scientific names. I.e. Genus and Species.

_Sunflower-Helianthus annus_ or _Helianthus annus_

• Which is the genus and species?

**RULES FOR WRITING PLANT NAMES!**

• Remember to **CAPITALIZE** the first letter of the Genus and keep the species all **LOWERCASE**.

• Either **underline** the entire scientific name, or write it in italics.

This activity was developed by Miss Kiki Karsh and Dr. Edward Bush.
2.4 Lesson 1C Plant Structures

Plant Morphology & Structures

- Look at the sample plants in your group. What type of plant or plant structure is it?

Tap root  Lateral root  Tuber

Rhizome  Bulb  Corm

Stolon  Epiphytes  Aerial Roots

Parasite

Worksheet by: Miss Kiki Karsh and Dr. Edward Bush
2.5 Lesson 1D Plant Conductive Tissue

Lesson 1D Plant Conductive Tissues:

- Which tissue transports food and water? (Xylem-water and Phloem-food).

Figure provided by Dr. Michael Arnold at Texas A and M University
Dip your stem into the soapy solution, blow into the opposite end, and see if you can make bubbles? (Hint: All trees are not created equally!).

Can you blow bubbles with a tree? Yes or no?

Experiment based upon the Virginia Tech Wood Magic show.

St. Louis King of France students blowing bubbles through oak dowels. Photo by E. Bush
Chapter 3

Lesson 2 Teacher’s Lesson Plan and Student Material for Wetland Habitats
3.1 Introduction and Teacher’s Guide for the Lesson

This chapter incorporates both the teacher’s lesson plan as well as the student material need to complete the lesson. The main objective of the Wetland Habitats lesson was for students to focus on the different wetland habitats here in Louisiana and then to learn how the plants adapt to their surroundings.

Wetland Habitats

Focus/Overview
This lesson focuses on wetland habitats. It is important for students to understand that the habitat in which a plant lives influences how the plant will grow and look. Students will learn different adaptations of plants living in wetland habitats. Students will also design the ultimate wetland plant and designate a specific wetland habitat in which the plant will live. Students will cover thirteen different wetland habitats.

Learning Objective(s)
The learner will
- Learn the definition of a habitat
- Use a flow chart to identify 13 unknown habitats
- Identify unknown wetland plants using a dichotomous key
- Be able to describe some common adaptations of wetland plants

Louisiana Grade Level Expectations
5: GLE-22 Develop and use a simple dichotomous key to classify common plants and animals (LS-M-C1)

5: GLE-26 Identify and describe ecosystems of local importance (LS-M-C3)

5: GLE-29 Describe adaptations of plants and animals that enable them to thrive in local and other natural environments (LS-M-D1)
7: GLE-23 Classify organisms based on structural characteristics, using a dichotomous key (LS-M-C1)

7: GLE-28 Differentiate between ecosystem components of habitat and niche (LS-M-C4)

**Materials List**
- Student handout
- Card set B
- Card set C
- Crayons

**Background Information**
Before beginning this activity with the class; look over all habitats and identify them using the flowchart. Some habitats are difficult to discern. A useful hint for identifying habitats is, if the paragraph on the card says the word ‘tidal’ then the habitat is a tidal environment. If the card never mentions the word ‘tidal’, then the habitat is not a tidal environment.

**Advance Preparation**
1. Divide class into groups of about 4.
2. Each group should have at least two cards from set B
3. Each group should have at least two cards from set C
4. Each student should have his or her own crayons

**Procedure for 3.2 Lesson 2A Habitat Flow Chart**

1. Ask students what a habitat is. Have them give a few examples. Afterwards ask what a niche is. (Hint: Something funny to say to students, “No… I didn’t say itch I said niche!”) Most students will give incorrect answers. Have students read the definition of a niche off the worksheet. Then have students give examples of niches in habitats. Use the habitats students previously gave as examples to see if they understand what niches are. The students will focus the remainder of time on habitats not niches.
2. Have students open to the Habitat flow chart in their handout. Point out the start circle.
3. Explain that after reading the information on the habitat cards and looking at the picture on the card, the students should then refer to the flow chart. To answer the flow chart, start at the Start circle and read the question directly below it. Based on the answer follow the arrows until they reach the name of their habitat, on the right hand side of the flow chart.
4. Students may want to use highlighters to trace their path and write the number of the card next to the correct habitat name on the right side of the flow chart.
5. Have students read out loud what their habitat card says and tell the class what kind of habitat it is.
6. Once a habitat is named, pass the card to the next group. Identify as many habitats as you can.
Procedure for 3.3 Lesson 2B Plant Profiles

7. Students should open the handout to the dichotomous key. Assure students that this is similar to the key they used in the first lesson. However, this time they will find out not only what type of plant they have but the scientific name as well.
8. Tell the students to look at the picture of the plant, and then read the plant’s description. Based on the plant card, use the dichotomous key to find the plant’s scientific name.
9. If time permits, allow students to trade cards to identify as many plants as they can.
10. Have the groups stand and describe their wetland plants to the class.
11. Hint on figuring out specific cards: (Cattails have wide leaves not grass-like).

Procedure for 3.4 Lesson 2C The Ultimate Wetland Plant

12. Have students open their handouts to the wetland plant adaptation page. (Worksheet D).
13. Students should read out loud the different adaptations of wetlands plants.
14. Using at least 3 of these adaptations, each student is to create the ultimate wetlands plant on (Worksheet E).
15. The students are to identify which wetland habitat their ultimate wetland plant will grow in (Worksheet B). Students should then give the wetland plant a scientific name. Students can be as silly as they like with the names as long as they use the binomial nomenclature rules of writing a plants scientific name. (Genus species or Genus species)

Blackline Master(s)
1. Card set B
2. Card set C
3. Student handout

Assessment
Wetland Habitats quiz (L2), and questions 7, 9, 17, and 27 on the pre and post test relate to this lesson.

Resources
WOW! The Wonders of Wetlands. Environmental Concern.
Lesson 2A -Habitat Flow Chart

Do you know what a **Habitat** is?
A habitat is the area or environment where an organism lives.
A good example of a habitat is a swamp.

So now that we know what a habitat is… What is a **Niche**?
A niche is a particular area within a habitat occupied by an organism. A good example of a niche within a swamp is a range of cattails. Cattails are a wetland plant. Certain ducks may nest in swamps specifically the cattails or a niche within a habitat.

Let’s practice identifying different wetland habitats!

Read habitat description on picture cards (Card Set B) and refer to Worksheet B to identify each habitat.

To use the flow chart (Worksheet B), simply follow the following directions:

1. Begin at the start and answer questions following the sequence of arrows.
2. What habitat do you have? Write the name of the habitat.
3. Be prepared to tell your classmates about the wetland habitat you identified.

Flow chart developed by WOW: Wonders of Wetlands
1. During storms, the waves push grains of sand into ever-changing patterns. During low tide the animals that live among the sand grains feel the summer heat or the winter cold. Shore birds search along the water's edge for these animals and for bits of food that wash in from the water. No plants grow here.

2. Scrubby, low-growing thickets of shrubs grow here, in places that may have started out as wet meadows. You might find these places near the coast, or where lakes, streams, rivers, marshes, and forested swamps overflow. They are not always covered with water. This type of wetland offers good habitat for fish, reptiles, amphibians, and many other animals.
In the shallow borders of ponds, lakes, rivers, and streams, where there is good light and the water has little salt, underwater plants and plants with floating leaves grow. Some of these plants are valuable food for many kinds of waterfowl including ducks, geese, and swans. All make places for little fish and other animals to live and feed. These plants slow water movement and protect the soil on shores and banks from erosion.

Depressions in the ground may fill with rain and ground water and stay wet for several days or weeks. Landowners often mow or plow around these spots to avoid getting tractor wheels stuck in the soft ground. On spring evenings, these puddles seem alive with the high-pitched calls of spring peepers (tiny frogs) looking for mates among the rushes and sedges that grow here. In the heat of the summer, these places usually dry up.
5. Fine particles of dirt make mud when they settle out of the water. Where the water is very shallow, the muddy bottom is uncovered at low tide. While this area may not look like home to many animals, and few or no plants grow here, lots of creatures live down in the mud. Watch for hungry shore birds searching for them in the mud.

6. Tall grasses and other kinds of plants grow up out of the water. The water contains little or no salt, but the push of incoming tides is strong enough to raise the water level in the river. The ground is sometimes flooded and sometimes dry or exposed. The plants provide food and places to hide for many kinds of animals including fish, invertebrates, muskrats, and lots of birds.
7. Where trees grow in low-lying areas, the ground may hold water for part of the year. In the spring, many beautiful wildflowers grow here, and frogs and salamanders find wet places to lay their eggs.

8. In salty bays or at the ocean's edge, two kinds of plants may grow under the shallow water. They can only live where it is shallow because they are rooted on the bottom and need light to make food. The plants are eaten by many animals, and many of them find safe places to live among the plants. These plants protect the shore and reduce the muddiness of the water by slowing the waves.
Old lakes and other low areas that fill with rainwater sometimes accumulate layers of partially decayed plants called peat. At first glance these places might look dry, but their moss-covered floors actually hold a good deal of fresh water just below the surface. The ground here feels very spongy. Some shrubs and evergreen trees also grow above the sphagnum moss. In these unusual conditions, many unique, beautiful, and rare plants and animals can be found.

Along the shore where the water is salty, tall grasses grow out of the water. Tides move in and out, but some places are flooded only during storms and very high tides. When the tough plants here die, they break down in the water to form little particles called detritus. Many animals eat detritus by filtering it out of the water.
3.3 Lesson 2B Plant Profiles

Lesson 2B - Plant Profiles

· Each group will be given an unknown plant card to identify (From Card set C). On each card there is a picture and a description of the plant. Use this card along with (Worksheet C) to correctly identify your plant.

· Identify the unknown plant and write its name using the correct scientific format (Hint: Capitalize the Genus and underline both Genus and species).

· Be prepared to describe your plant to the class.

Activity developed by Miss Kiki Karsh and Dr. Edward Bush

St. Louis King of France student is presenting his wetland plant to the class. Photo by E. Bush
Name this Plant

**Family:** Umbelliferae
**USDA Zones:** 3-10

**Identification:**

**Flower:** The small white flowers have 5 regular parts and grow in branching clusters. They bloom in early spring and fall.

**Foliage:** Leaves are round in appearance and one to two inches long. They are attached vertically to the stem on small petioles. Leaves have several lobes.

**Fruit:** Appear on the stem, they are smaller than the leaves, and form umbels.

**Trunk:** Small perennial plant with creeping stems.

This plant grows on the coast and its seeds provide food for ducks and birds. Nutria eats the plant. Only one type is not eaten by wildlife. Some people say you can eat the foliage raw or cooked.

**Sources**


Name this Plant

Family: Salicaceae
USDA Zones: 4-10

Identification:

Flower: Spring blooming tree (May to June). Dioecious. Yellow-green in color. Located on catkins that are one to three inches long. Flowers look like caterpillars.

Foliage: Alternate and simple leaves that are three to six inches long and one-eighth to three-fourths of an inch wide. Lanceolate shape. Margins are slightly toothed and the top and bottom sides are shiny. They have earlier new growth than other trees.

Fruit: Small cone-like structure that contains many cottony seeds. Needs a moist place to germinate before it dies, which happens quickly. Mature June to July and split at this time.

Trunk: Heavily ridged dark colored bark. Branches fall off easily, however they will root quickly (if not dead) so a great way to propagate this plant.

This tree is native to North America; they like to grow along rivers, lakes and ponds. They prefer full sunlight and wet soils but can tolerate some dry conditions. Very fast growth. It has an upright form that is considered a medium size tree. The branches gracefully “weep” downwards giving the tree a soft look.

Fun Facts

- Only lives from fifteen to twenty years
- Branches constantly fall off.
- Tree will die is soil covers the roots formed on the trunk.
- Keep away from drainage pipes
Name this Plant

Family: *Typhaceae*
Zones: 4-10

**Identification:**

**Flower:** At the end of the stem a long brown spike that is similar in shape to a cigar or hotdog. This can be eaten if boiled.

**Foliage:** Narrow, upright and four to six feet long.

**Fruit:** A fluff contains the seeds.

**Trunk:** A grass-like perennial herb that grows from rhizomes

There are many species of this plant that provide excellent habitat and food for wildlife such as nutria and muskrats. This plant grows in freshwater and intermediate marsh in Louisiana. Some species can even grow on beaches and in the bay.

**Fun Facts**

- Water fowl love to live in areas populated with this plant.

**Sources**


Reed, Daniel. 2001. Wildflowers of the Southeastern United States

http://2bnthewild.com/plants/H230.htm
Name this plant

Family:  *Salviniaceae*
Zones: 3-10

**Identification:**

**Foliage:** Two leaves grow from each node. They are oval shaped with a heart shaped base. The tips are either notched or rounded. A third leaf is under the water that separates into filaments. Shorter leaves lie flat on the waters surface while longer leaves stretch out and stick up vertically. Leaves can be anywhere from 0.4 to 2 cm in length. New growth is green, whereas mature leaves turn brown. White stiff hairs cover the leaf surface making a water repellent coat. Long light brown hairs are on the bottom side of the leaf.

**Fruit:** No fruit is present. This plant is considered sterile. However, on larger plants sporocarps are formed. They are sacs that encase smaller sacs which hold microscopic spores. The spores are about one millimeter in size.

**Trunk:** None. A floating fern, with root-like structures referred to as fronds.

This non-native plant is one of only ten species in the world all of which do not naturally grow in the United States. It is found in water with high organic content.

**Fun Facts**

- Only outlawed in Louisiana and Texas. Not on any other invasive species plant list for other states.

**Sources**


Name this Plant

Family: Taxodiaceae  
USDA Zones: 5-10

Identification:

Flower: Flowers in summer and fall. Flower appears as long hanging cones at the ends of branches. It produces pollen which is purple in color.

Foliage: Alternate foliage appears soft and feathery. The individual leaf is tiny, only measuring one and a half to three fourths of an inch long and one sixteenth of an inch wide. Foliage changes color in fall appearing rusty brown.

Fruit: A seed bearing cone. Also changes color from green to purple in the late summer and fall.

Trunk: Straight trunk reddish-brown in color with a fibrous bark and horizontal branches. One main trunk.

These trees are native to North America. They can live near or in water, but seedlings cannot be successfully started in standing water. Full sunlight is necessary. This tree grows rapidly in the first years of growth. It grows pyramidal in form at an average height of 50 to 70 feet. The spread is around 30 feet. Scale is a noted problem in the spring.

Fun Facts

- The state tree of Louisiana
- Swollen basal trunk commonly called knees grow around the base when tree is located in a moist environment.

Sources
Name this Plant

**Family:** Verbenaceae  
**Zones:** 9-10

**Identification:**

**Flower:** The flowers are tubular and small blooming from spring into early summer. They are white with four petals and about a half of an inch wide. They appear in clusters.

**Foliage:** Opposite, simple leaves are smooth and leathery. They are shiny above with a grayish pubescent below. They have lateral veins. Their size ranges from one to three and a fourth inches long.

**Fruit:** The fruit capsule is somewhat hairy and light green. It is one to two inches long.

**Trunk:** Dark and scaly bark with an inner reddish bark. Older bark grey to black. There are distinct nodes on the twigs.

This tree is an evergreen tropical. It can be found in salt marshes and flats, and estuarine waters. It can reach eighty feet tall. This tree is so common that there are special swamps with only this one tree in them.

**Fun Facts**

- Ashes from the tree can be added to water and is useful as a soap substitute.
- The flowers are a good source of honey.
- The wood is considered weak.
- Smoke from this tree burning makes a good smudge that keeps mosquitoes away.

**Sources**


[http://www.hort.purdue.edu/newcrop/duke_energy/Avicennia_germinans.html#Uses](http://www.hort.purdue.edu/newcrop/duke_energy/Avicennia_germinans.html#Uses)
Name this Plant

Family: Juncaceae
Zones: 3-10

Identification:

Flower: Subtle green to brown flowers bloom in cluster of two to eight. They grow from just above the middle of the stem. Flowers March to October.

Foliage: Very stiff and sharp foliage. The leaves are grass-like and are evergreen. They are olive brown to grey in color.

Fruit: The fruit capsules have three sides. These are almost a fifth of an inch long. The seeds inside are ribbed.

Trunk: Unbranched linear stem. The bottom portion is red. This is a perennial grass. This plant grows in very wet areas that are sometimes covered by water.

Fun Facts

• This grass grows in areas of thick mud build-up. It can withstand high tide flooding.

Sources


USGS. 2001. Gulf of Mexico Tidal Wetlands
Name this Plant

Family: Rubiaceae
USDA Zones: 5-9

Identification:

Flower: Summer blooming (June and July) round creamy white flower that is one to two inches in diameter. The stamen is prominent and it is very fragrant. The flowers cluster at the end of a slender 1 to 2 inch stalk.

Foliage: Opposite to whorled simple foliage. Leaves are in groups of three and two to seven inches long with smooth margins. The top portion of the leaf is dark green and shiny, whereas the bottom half is dull. The depressed veins are prominent.

Fruit: Tiny hard balls in clusters along the stems. The fruit is sometimes called “nuttlets.” They are one fourth of an inch long and mature anywhere from August to November. These are still prominent when foliage is fallen, thus this is a deciduous plant. The color is reddish brown.

Trunk: The bark is thin and smooth on young stems. As plant matures the bark becomes scaly. Twigs are dark red-brown in color and have elongated lenticels. Look for D or U shaped leaf scars. There is more than one main stem on this plant.

This plant is native to Asia, Africa, and North America. It grows in full sun to part shade marshy areas. The form is upright but irregular. It is considered a medium deciduous shrub to a small tree. It has average growth is eight feet tall and ten feet wide but can reach heights of twenty-five feet. Often found along rivers and lake edges.

Fun Facts

- Deer like to eat the foliage.
- This plant attracts bees … be careful!
- Insects love to eat the leaves. However it is not necessary to spray insecticides.

Sources
Name this Plant

Family: *Caprifoliareae*
USDA Zones: 4-10

Identification:

**Flower:** Prominent flowers bloom in June and July. They are small and clustered about ten inches across milky white in color.

**Foliage:** Opposite pinately compound leaves. Normally have five to seven leaflets with coarse toothed margins. Leaves can range from oval to lanceolate shape. Prominent lenticels are found on old woody canes and on twigs. The leaves are deciduous.

**Fruit:** Fruit appears with the flowers. The berries are shiny and color ranges from purple to black. Fruit matures in July through September.

**Trunk:** Very short trunks (More than one main trunk) with few stems. The bark is smooth and brown but with age it becomes rough. Buds appear red brown in color and pointed.

This semi-woody shrub can also become a small tree. It is fast growing in soils ranging from very wet to somewhat dry. It grows best in full sun and wet soils. Its form is upright with an umbrella like canopy. Propagation is possible through seeds, cuttings, and root suckers.

**Fun Facts**

- Only certain fruits can be eaten. Some species are poisonous!
- People use berries in wine and jelly
- Wildlife also enjoys the fruit. Look at fence lines where songbirds have helped the spreading of this seed.

**Sources**

[http://www.cnr.vt.edu/dendro/dendrology/syllabus/sacandensis.htm](http://www.cnr.vt.edu/dendro/dendrology/syllabus/sacandensis.htm)
Name this Plant

Family: Malvaceae
Zones: 8-10

Identification

Flower: Colors range from rose and pink to white. It is about one and a half inches across in diameter. It blooms from August through October.

Foliage: Grayish velvety leaves with somewhat serrated margins.

Trunk: An herbaceous plant. The main stem can grow three to five feet tall.

A native to Europe this plant was originally brought to the United States for medicinal purposes. It is found in salt marsh areas.

Fun Facts

- The roots are the original source of …HINT: A sticky treat we use at campfires.
- Used to heal upset stomachs and sore throats.

Sources

Name this Plant

Family: *Pontederiaceae*
USDA Zones: 3-8

Identification:

**Flower:** Erect spikes contain blue to sometimes white flowers. There are six parts to the flower and each spike contains small petals that have two yellow spots on them. The tubular flowers have three united upper lobes and three separated lower lobes. The spike can reach six inches long. Most are three to four inches long. Blooms June to October.

**Foliage:** Single leaf per flowering stem however other basal leaves occur. They are alternate and can grow to ten inches long and six inches wide with lanceolate shaped leaves, but with a wider base and very shiny.

**Trunk:** A perennial herb started from a rhizome roots grow in muddy flats underneath water.

A native plant to the United States grows one to three feet tall in fresh marshlands, shallow ponds and lakes. Rhizomes and stems are eaten by nutria and ducks enjoy the seeds. This plant usually grows in small clumps.

Sources

**Name This Plant**

**Family:** *Gramineae (Poaceae)*  
**Zones:** 3-10

**Identification:**

**Flower:** The flower is a panicle with five to thirty alternate spikes that are two to four inches long. These have even smaller spikelets attached to them. The flower can be seen June to October.

**Foliage:** Leaves are sixteen inches long and a half an inch wide. They are smooth and pointed at the end but also slightly rolled inward just at the end of the leaf. The margins are smooth and hairy.

**Trunk:** A perennial grass with hollow stems. Stems are fat and spongy at the base. There are two form of this plant a tall form and a short form. HINT: This plant grows half underwater and half above water!

**Fun Facts**

- Native on the Atlantic coast of the US but an invasive non native on the pacific coast of the US.
- Snow geese love this plant.

**Sources**


Name this Plant

Family: *Myricaceae*
USDA Zones: 7-10

Identification:

**Flower:** Blooms in spring, not very prominent. Flowers are brown. Male and female flowers are on separate plants.

**Foliage:** Leaves are alternate and simple. They have tiny dots on both the top and bottom sides. The tip is pointed and margins are entirely or half toothed. Crush the leaves, they have a strong scent! The branches are hairy.

**Fruit:** Female plants produce a white wax over two-sixteenths of an inch nutlets. These are clustered along the stem and are round in shape. They smell like bayberries when crushed.

**Trunk:** An evergreen plant. There is more than one main trunk.

This is a native shrub. It can grow anywhere from thickets to prairies and swamplands. However, it is found on the east coast and all throughout the Gulf States. It has a fast growth rate and can usually be found after land is disturbed. Propagate it by seeds, cuttings, and root cuttings.

**Fun Facts**
- Wildlife eats the berries, including many species of birds.
- Early settlers used the wax from the berries to make candles.
- Plants keep fleas away.
- A cutting in a drawer will keep cockroaches away.
- Some people use it to make duck blinds for hunting.

**Sources**

Dichotomous Key

Do you remember using a dichotomous key in the first lesson to identify the different types of plants? Today, we are going to key out the different types of plants and their common and scientific names! Start at number 1 and answer the questions until you discover the name of your plant. Good luck!

1. Are stems or other parts of the plant woody and rigid like a tree?
   Yes…………………………………….Go to 2.
   No…………………………………….Go to 6.

2. Is the plant growing above the ground but leaning on other plants?
   Yes…………………………………….It is a VINE.
   No…………………………………….Go to 3.

3. Is the plant growing above the ground and standing on its own?
   Yes…………………………………….Go to 4.

4. Is the plant 20 feet tall or taller?
   Yes…………………………………….It is a TREE. (Go to #13)
   No……………………………………..Go to 5.

5. Does the plant have more than one main stem?
   Yes…………………………………….It is a SHRUB. (Go to #16)
   No……………………………………..It is a sapling (young) TREE.

6. Is the plant a soft (herbaceous) plant like grass?
   Yes……………………………………..Go to 7.
   No……………………………………..Start over.
7. Is the plant growing in open water that is always there, such as a pond, lake, or
permanent stream?

Yes…………………………………………Go to 8.
No………………………………………….Go to 10.

8. Is the plant growing completely underwater, freely floating on the surface, or does it have floating leaves?

Yes………………………………………..It is an AQUATIC PLANT.  (Go to #11)
No………………………………………..Go to 10.

9. Is the plant growing with roots and part of the stem under water, but the rest sticking up above the surface?

Yes……………………………………….It is an EMERGENT PLANT. (Go to #22)
No…………………………………………. Go to 10.

10. Is the plant growing in soil that is saturated, wet, spongy, or appears to have been wet at one time (remember that wetlands are not always covered by water)?

Yes……………………………………….It is an EMERGENT PLANT. (Go to #19)

11. Are leaves one to two inches long?

Yes………………………………………. Go to 12
No……………………………………….. Go to 15

12. Are leaves kidney shaped?

Yes………………………………………. It is Water pennywort (Hydrocotyle spp.)
No……………………………………….. Go to 15
13. Are the leaves on your tree Alternate or Opposite?

Opposite……………………………………. Go to 14
Alternate…………………………………. Go to 17

14. Is the fruit on your tree hairy and light green?

Yes………………………………. It is a Black Mangrove (Avicennia germinans L.)
No………………………………… Go to 17.

15. Are leaves .4 to 2 cm in length and oval shaped?

Yes…………………………………… It is Water fern (Salvinia minima)

16. Does your shrub bloom in the spring with brown flowers?

Yes……………………………………. It is a Wax Myrtle (Myrica cerifera)
No…………………………………… Go to 18.

17. Is the alternate foliage tiny (1/2 to ¾ of an inch long and 1/16 of an inch wide) or bigger (3 to 6 inches long and 1/8 to ¾ of an inch wide?)

Tiny…………………………………….. It is a Bald Cypress (Taxodium distichum)
Bigger…………………………………… It is a Black Willow (Salix nigra)
18. Your shrub probably blooms in June or July. But, is the fruit a tiny hard ball red to brown in color, or bright and shiny purple to black berries?

Hard ball. It is a **Buttonbush (Cephalanthus occidentalis)**

Berries. It is an **Elderberry (Sambucus Canadensis)**

19. Are the leaves on your emergent plant grass-like or broader (wide)?

Grass-like. Go to 20.

Wide. Go to 21.

20. Are the stems of your emergent grass plant hollow?

Yes. It is **Smooth cordgrass (Spartina alterniflora)**

No, (but the bottom of the stem is red). It is **Black needlerush (Juncus roemerianus)**

21. Does your emergent grass plant have pink or white flowers?

Yes. It is **Marshmallow (Althaea officinalis)**

No. Opps, start again!

22. Does your emergent plant have a flower that looks like a hotdog?

Yes. It is a **Cattail (Typha spp.)**

No. Go to 23.

23. Does your emergent plant have blue to white flowers with two yellow spots?

Yes. It is **Pickerelweed (Pontederia cordata)**

No. Start over at # 8.

Dichotomous key modified from WOW: Wonders of Wetlands
3.4 Lesson 2C-The Ultimate Wetland Plant

Lesson 2C-The Ultimate Wetland Plant!

- Have individual students read out loud the different plant adaptations wetland plants use to survive in their specific habitats (Worksheet D). This sheet contains the knowledge you will need for this lesson.

- Using Worksheet E create your very own wetland plant using at least three of the adaptations that you have previously learned.

Tips: Make sure to name your plant with a common and scientific name. (HINT: Genus species)

List the specific wetland your plant lives in. (CLUE: look at the first activity we did today (Refer back to Worksheet B)!

Example of a student worksheet provided by K. Karsh

Lesson developed by Miss. Kiki Karsh and Dr. Edward Bush
(Worksheet D)

Wetland Plant Adaptations

- Certain wetland plants, like Cattails have air spaces or AERENCHYMA CELLS in their leaves and roots to allow oxygen to move through the plant and into its roots!

- Mangrove and Willow trees have ADVENTITIOUS ROOTS (stick up above the water level) with LENTICELS (tiny holes in roots to allow oxygen to enter.)

- Black mangroves have PNEUMATOPHORES (air roots) that are exposed to air during low tide.

- CYPRESS KNEES are cone shaped structures that emerge from the root system of a cypress tree. They stick out above the water. Scientists are unsure of their purpose but think the knees help support the soil for the plant to grow in, or might help collect oxygen for the tree. However, neither of these has been proven yet. Many plants that cannot withstand flooding drop their seeds on cypress knees to germinate above the water level.

- HYPERTROPHY when an organ of a plant becomes bigger, but the number of cells does not increase. It doesn’t really grow but extends as if you were to stretch your arm to reach across a table.

- Black Willow and American Elm trees have SEEDS that can germinate below water!

- Some trees produce FLOATING SEEDS that are useful for the plant to spread its population over a large area.

- The Grey Mangrove has special SALT GLANDS located in the leaves that do not allow salt in salt water to enter the plant. Only freshwater moves freely inside the tree.

- The Water Hyacinth can float on water without being attached to the bottom by roots. It has AIR-FILLED HOLLOW LEAF STALKS that allow the plant to float.

Worksheet developed by Miss. Kiki Karsh and Dr. Edward Bush
The Ultimate Wetland Plant!

1. What wetland habitat does your plant live in?
   _____________________

2. What are the common and Scientific names of your wetland plant?
   _____________________  _____________________

Worksheet developed by Miss. Kiki Karsh and Dr. Edward Bush
Chapter 4

Lesson 3 Teacher’s Lesson Plan and Student Material for Photosynthesis
4.1 Introduction and Teacher’s Guide for the Lesson

This chapter incorporates both the teacher’s lesson plan as well as the student materials needed to complete the Photosynthesis lesson. The main objective of this lesson was to teach students the basic process of photosynthesis and the role of photosynthesis in plant development.

**Photosynthesis**

**Focus/Overview**
Photosynthesis is fundamental to learning how plants function and grow. This lesson will provide students with the opportunity to see photosynthesis in action, extract the different pigments from leaves, and get growers experience by doing a small scientific experiment. Students will learn to collect data and analyze it through graphs.

**Learning Objective(s)**
The learner will be able to:
- Learn the basic process of photosynthesis.
- Learn the different pigments found in leaves and the colors associated with those pigments.
- Learn that plants are a very important component to our health because they provide us with oxygen and eliminate some of the carbon dioxide in the air.

**Louisiana Grade Level Expectations**
5: GLE-19 Describe the processes of photosynthesis and respiration in green plants (LS-M-A4)
7: GLE- 7 Construct a word equation that illustrates the processes of photosynthesis and respiration (LS-M-A4)

**Materials List**
- Baking pan (Cake pan) filled with hot water (1 or 2 depending on how many students in the class)
- Isoproprenol (1 bottle)
- Leaves from plants that change colors in the fall. Tallow, Maple, Gingko, and Red bud trees are good

**Grade Level**
5, 7

**Duration**
The lesson will last one hour if instructor is well prepared. If not this lesson can be taught in two class periods

**Subject Area**
Life Science

**Setting**
Classroom with a sunny windowsill, and closet or empty drawer space

**Vocabulary**
Photosynthesis, Pigments, Chlorophyll, Xanthophyll, Carotenes, Anthocynins
species to use for this project. Collect enough leaves so that each student may have half a small Dixie cup full
- Spoons (1 for each student)
- Coffee filters cut into strips (1 for each student)
- Small/short plastic cups (Dixie cups: 1 for each student)
- Light source with a grow bulb
- Extension cord
- 5mL syringes (1 for each student)
- Straws (1 for each student)
- New growth from weed leaves (Any weeds with soft leaves will work: 1 leaf per student)
- Baking soda (1 box)
- Test tube holder
- Film canisters (1 for each student)
- 1 gallon of water
- Pre-grown plants (One grown in the dark one grown in the light)
- Corn and bean seeds (enough to grow 2 plants for each group. Take into consideration seed germination rates)
- Soil (enough to fill small pots for each group)
- Small pots or paper cups with holes punched in the bottom (2 per group)
- Crayons
- Student Handout

**Background Information**
Photosynthesis is an important horticulture topic students should focus on.
Photosynthesis is the ability of a plant to make its own food. Plants are the only living organisms that can produce their own food without the aid of any other living thing.
A few hints for this lesson:
- Plant seeds only as deep into the pots as they are wide. Corn and bean seeds tend to be small.
- Use a regular desk lamp (without a shade) and obtain a grow bulb from any Wal Mart. These bulbs become very hot. Be careful.
- When growing your plants previous to the lesson notice the plants in the dark are taller and have little to no color. This is because of the lack of sunlight. Without sunlight chlorophyll cannot be processed so the plant will not turn green. The plants are taller because they are stretching towards any light source.
- The plants in the sunlight should be healthy, greener, and shorter than plants grown in the dark.
- When extracting pigments from plants it is very hard to get all colors to come forth from the leaves, especially when doing so in such a simple manner. Make a rainbow plant ahead of time so that students can see that all colors are in a plant even though it looks completely green (See rainbow plant instructions.)
- Pigments in leaves give color to the leaf throughout the year.
  1. Chlorophyll is green
2. Xanthophyll is yellow
3. Anthocynins are purple and red
4. Carotenes are orange

**Advance Preparation**

1. At least two weeks before teaching this lesson grow your own set of light and dark plants to show the students.
2. Gather all leaves and weeds before the class begins
3. The class should be divided into groups
4. Make a rainbow plant. Here are the instructions: 1. Gather red and orange petals from flowers, green leaves from trees, and a yellow bell pepper. 2. Crush all ingredients in an herb bowl until it looks completely green. 3. Put all ingredients into a glass jar with a lid. 4. Add isopropenol to the jar until it completely covers the ingredients. Stir and combine until the ingredients look like a milkshake. 5. Heat the jar in a water bath or in a pan full of hot water for thirty minutes to an hour. 6. Place a coffee filter strip into the jar. Allow the pigments to travel up the filter strip. (Add isopropenol if needed). Your results should show green, yellow, orange, and red coming from the mixture. Store in the refrigerator until time to do the experiment. It must be stored in a dark place.
5. Put baking soda (just enough to cover the bottom of film can) and fill the canisters with water ahead of time.

**Procedure for 4.2 Lesson 3A How Many Colors are in a Leaf?**

1. Ask the class if anyone knows what photosynthesis is.
2. Have the class read out loud the formula for photosynthesis.
3. Do they know what CO₂ and H₂O are?
4. Have the students color in the pigment boxes with the appropriate crayon color.
5. Show students the rainbow plant mixture. Ask them if they have ever noticed that the leaves change colors in the fall. Ask for a raise of hands. Who believes the colors are there all year round even though we cannot see them, and then ask who believes that they are only there in the fall when the leaves turn colors? Tell them the results will be seen in the “experiment”
6. “Experiment” Allow students to dip a filter strip into the mixture.
7. Tell them to place the strip with the color side down on their desk. It helps if they rest it against a book so it is at a slight angle.
8. They should see the different colors appear throughout the lesson (Yes the colors are in the leaf year round.)
9. Now students will extract chlorophyll from the leaves provided.
10. Tell students to take the leaves marked pigment extraction and chop are tear them up in their small plastic cup.
11. Using their spoons have the students continue to tear and grind the leaves as you add rubbing alcohol to each jar.
12. Tell students they are going to extract pigment from their leaves.
13. Each student should write his or her name on a filter strip and place one end in the mixture with the other end hanging over the side of the cup.
14. Have all students place their cups in a pan with hot water. Hint place cups in pan before adding hot water to prevent the cups from floating.
15. Near the end of class have students take their filter strips and tape them to a piece of paper. As the alcohol evaporates they will see different colors (probably green and yellow)

Procedure for 4.3 Lesson 3B Do plants need sunlight to grow?

16. Ask students if they think plants need sunlight to grow? (Answer: Yes. Will plants grow without sunlight? Yes.) Do seeds need sunlight to germinate? (Some do, some do not.)
17. Tell students to open their handouts to the page that states “Do plants need sunlight to grow.” Read and follow directions with students on planting their seeds.
18. Explain that each group will grow 2 plants. One plant in the dark, the other in a sunny place. Label all pots with group name and either sun plant or dark plant.
19. Students will record data for three weeks measuring the height of each plant in centimeters. Do this on worksheet F
20. After three weeks, students should graph their plants growth on worksheet G. Make graphing the plant growth a competition. Give an incentive of your choice to the group with the best graphs.

Procedure for 4.4 Lesson 3C Producing Oxygen through Photosynthesis

21. Have students open the page that states “Producing oxygen through photosynthesis.” Students will now conduct a short experiment to see photosynthesis occur. Of course we can’t actually see photosynthesis or the plant making its own food but we can see the product of photosynthesis. (Follow instructions in student handout.) Hint: What is a by-product of photosynthesis? (Oxygen)
22. Have students take their straws and punch four holes in the weed leaves. Keep these ‘disks’ in one piece. Put the disks into the syringe.
23. Draw 5mL of water and baking soda from the film canister into the syringe.
24. Create a vacuum.
25. Flip the syringe tip side down. Pull the syringe, and then remove your finger from the tip. Leaf disks should sink. (Try to get at least three disks to sink.)
26. Put all syringes in the test tube holder under the grow bulb.
27. Have a student keep time. As the leaves absorb the sunlight they produce food or make photosynthesis. The leaves take the CO₂ (Baking soda) out of the water process it with the sunlight and make oxygen (hence the leaves float.)
28. Record the time it takes for the leaf disks to float.
29. Ask the students to explain why the leaves are floating. Then ask students how humans and plants interact during photosynthesis. (Answer. Humans breathe in
O₂ and out CO₂; Trees take in CO₂ and produce O₂. Without O₂ we would not survive.)

30. Ask students to unscramble the words! (Hint: All words relate to photosynthesis)

**Blackline Master(s)**
1. Student handout
2. Answer sheet to word scramble

**Assessment**
Photosynthesis quiz and questions 11, 15, 19, and 25 refer to the photosynthesis lesson on the pre and post test.

**Resources**


4.2 Lesson 3A How Many Colors Are in a Leaf?

Lesson 3A-How Many Colors are in a Leaf?

- This project will help us understand why leaves change colors in the fall.

- Chlorophyll is what gives leaves their green color. When chlorophyll and sunlight combine, a plant can make its own food! The general equation for photosynthesis is: \[6 \text{CO}_2 + 12 \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O} + 6\text{O}_2\]

- When the days get shorter in the winter, less sunlight is available to plants, and the temperature is cooler, the chlorophyll begins to break down and the green color fades away.

- Now that the chlorophyll is broken down, we can see other pigments! The leaves appear yellow, orange, and red!

**COLOR THE PIGMENT BOXES!**

- GREEN – CHLOROPHYLL

- YELLOW – XANTHOPHYLL

- ORANGE - CAROTENS

- RED AND PURPLE – ANTHOCYNINS

Worksheet developed by Miss. Kiki Karsh and Dr. Edward Bush
Now we are going to extract the different pigments out of leaves!

1. Your group has been given 2 to 3 leaves. Tear them up into very small pieces and put them into the small jars.

2. Add enough rubbing alcohol to each jar to cover the leaves. Using you plastic spoon, chop and grind the leaves in the alcohol.

3. Cover the jars very loosely with lids. Place jars into the shallow tray with warm water.

4. Keep jars in warm water for at least a half-hour, until the alcohol has become colored (the darker the better). Twirl each jar gently every five minutes or so. Replace hot water if it cools off.

5. Place coffee filter paper strip into each jar so that one end of the strip is in the alcohol and the other is taped to the outside of the jar.

6. The alcohol will travel up the paper bringing the different pigments with it. As the alcohol evaporates you should be able to see the different colors of pigments in your leaf.

7. Remove strips of paper tape them to a sheet of paper and let them dry.

Activity modified from Science Made Simple

Chromatography paper used to extract pigments. Photo by K. Karsh
4.3 Lesson 3B Do Plants Need Sunlight to Grow?

Lesson 3B-Do Plants Need Sunlight to Grow?

- Have you ever used the scientific method? This class project will help you understand what happens to plants that grow with sunlight and without sunlight.

Do you think the plants that grow in the dark will be taller or shorter than the plants grown in the sunlight?

**Circle your answer!**

Coastal Roots Student drawing depicting plants grown in light and dark environments
Here is how we will apply the Scientific Method to our study!

Question:  
Does light affect the germination of bean seeds?

Hypothesis:  
Light is necessary (not necessary) for the bean seeds to germinate.  
(Underline your guess for the hypothesis)

Materials:  
Soil, paper cups, bean seeds, a dark area, a sunny area, water, paper towels.

Procedure:  
Plant seeds ¼ of an inch into the soil. Place 4 paper cups with three bean seeds in a dark cabinet. Place 4 paper cups with three bean seeds on a sunny window sill. Water all seeds with the same amount of water once a day, or when the soil feels dry. Measure the growth of the plants once a week for four weeks. Make sure the inside of your classroom is around 70-75°F.

Data:  
Fill in the chart showing growth (Worksheet F and Worksheet G)

Results:  
Explain your graph in two or three sentences.

Conclusion:  
Write why you think the plants grew like they did. Example: Why are the plants in the sun taller or shorter than the plants in the shade?  
Now as a class prepare your pots!

1. Poke a hole in the bottom of the pot for drainage.
2. Line the paper cup with a paper towel.
3. Add soil
4. Place seeds on top of soil
5. Add a little more soil
6. Sprinkle water over soil
7. Place half of your paper cups in the dark area, and half in the sunny area.
8. After one week remove your pots and compare the growth of the plants in the sunny area to the growth of the plants in the dark area.
9. MEASURE THE HEIGHT.

10. Measure the height of each plant once a week for three weeks (Worksheet F).

11. Fill in the graphs (Worksheet G).

Activity developed by Miss. Kiki Karsh and Dr. Edward Bush

Plants grown in the light and dark from St. James Science and Math Academy photo provided by K. Karsh
School Name__________________________________________

During the next three weeks you and your classmates should measure the height of your plants both in the sun and in a dark area. Measure the height in centimeters. Your results will be compared with other Coastal Roots Schools!

Sunlight Experiment Data

<table>
<thead>
<tr>
<th>Plant</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunny A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sunny B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dark A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dark B</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Worksheet developed by Miss. Kiki Karsh and Dr. Edward Bush
Worksheet developed by Miss. Kiki Karsh and Dr. Edward Bush
4.4 Lesson 3C Producing Oxygen Through Photosynthesis

Lesson 3C-Producing Oxygen Through Photosynthesis (Activity from Wisconsin Fast Plants)

1. Make sure your group has all materials required for this experiment.

   **Materials**
   - Three or four day old cotyledons
   - Baking soda
   - Small straw
   - 35 mm film can
   - 5 ml syringe

2. Use just enough baking soda to barely cover the bottom of the film can. If you use too much baking soda bubbling will occur. We do not want this to happen because the leaf disks will stick together.

3. Add a drop of liquid detergent to the film can. This will help reduce static.

4. Instructions and pictures can be found on Worksheet H.

**Tips**: Remember that photosynthesis is dependent on light. For your initial experiments you may want to have the disks rise quickly (3-5 minutes). This will require that your syringes be several centimeters from the light bank lights or in direct sunlight.
Photosynthesis and Respiration

7. Place the syringe narrow end up about 5 cm from the light bank lights, or in bright sunlight. Record the time. Tap the syringe with your finger every 20-30 seconds to dislodge the floating discs.

8. As leaf discs photosynthesize and produce oxygen, they will float to the top. Record the time at which each disc floats.

9. After all discs float, put syringe in a dark room or cover the syringe partly. The leaf discs will sink as they respire and consume oxygen.

10. Record the time at which each disc sinks.

Worksheet developed by Wisconsin Fast Plants
Observing Photosynthesis Worksheet

Start time

Time disc 1 floats

Time disc 2 floats

Time disc 3 floats

Time disc 4 floats

© 1991 Wisconsin Fast Plants, University of Wisconsin-Madison, College of Agricultural and Life Sciences Department of Plant Pathology, 1630 Linden Drive, Madison, WI 53706 1-800-462-7417 wfp@fastplants.cals.wisc.edu

St. James Science and Math Academy student participating in photosynthesis experiment photo by K. Karsh
(Worksheet J)

4.5 Lesson 3D Word Scramble

JUST FOR FUN!!!

Write the unscrambled word next to the scrambled word!

Word Scramble!!!

Trawe  _______
Afle    _______
Rnege   _______
Ernago  _______
Mutana  _______
Loscuge _______
Gnlituhs _______
Holopryclh _______

Word scramble created by Science Made Simple
Chapter 5

Lesson 4 Teacher’s Lesson Plan and Student Materials Composting
5.1 Introduction and Teacher’s Guide for the Lesson

This chapter incorporates both the teacher’s lesson plan as well as the student materials needed to complete the lesson. The main objectives of the Composting lesson are for students to learn the proper materials to use in a compost pile and what to do with the finished product.

Compost

Focus/Overview
The composting project is a valuable lesson focusing on both scientific horticulture and environmental stewardship. The compost project will teach students an easy way to eliminate some of the waste that is dumped into our landfills daily. It also gives students a great background in basic soil science. The project will not only serve as a hands-on project for students but economically benefit the Coastal Roots program by eliminating the need to buy some of the necessary gardening soil each year.

Learning Objective(s)
The learner will
- Learn how a compost pile works.
- Build a compost pile which they will monitor over the course of the year.
- Learn the best methods of composting.
- Engage in an environmentally friendly project.

Louisiana Grade Level Expectations
6: GLE-42 Determine if energy types are renewable or non-renewable (SE-M-A6)

6: GLE-45 Describe methods for sustaining renewable resources (SE-M-A6)

6: GLE-46 Identify ways people can reuse, recycle, and reduce the use of resources to improve and protect the quality of life. (SE-M-A6)

Materials List
- Student Handout
- University of Mississippi Compost Video
- LSU Ag Center Compost Handout
- Weekly data log
- Compost bin
- Pitch fork
- Thermometer
- pH indicator slips
- Copy of pH indicator color chart
- Empty pot with drainage holes and a saucer
- Leaves, grass clippings, hay, and food scraps.
- Fertilizer
- Starch peanuts

**Background Information**
Before teaching this lesson, watch the compost video from the University of Mississippi. Be able to guide students through the initial process of building a compost pile. Use the layering method. For each layer of (soil, leaves, grass, and food scraps) add one cup of general fertilizer and add water. Start building the next layer (soil, leaves, grass, and food scraps) again add one cup of fertilizer and water. Repeat this until the bin is at least ¾’s full. Larger piles will compost faster. Compost works through heat energy. As microorganisms break down food, they give off energy in the form of heat. This is why the pile heats up. Temperatures can reach 150 degrees. If the pile becomes too hot use a shovel to flip the ingredients over providing air to the middle of the pile. If pile becomes too dry, add water. Use the squeeze test. Take a handful of compost squeeze in your hand and let compost fall back into pile. Do you see water droplets? If yes do not add water, if no, add water. To monitor pH simply fill pot with compost then add water, collect the leachate in the saucer. Place pH strip in leachate, allow strip to sit for one minute. Remove strip and compare the colors with the color chart. The best match indicates the pH of the compost. As compost matures it should become more acidic in nature. (Acid 0-6, 7 neutral, basic 8-14) Compost will heat up as microorganisms eat more and more. The pile will shrink to about 1/3rd of its original size. Once temperatures and PHs have settled, take a small sample to the lab for testing. Use the compost to transplant second year plants. Do not plant seeds directly in compost! Do not add dairy, meat, or any feces to the compost pile. Read in the LSU Ag Center handout the acceptable things to add. Remember to monitor and record weekly compost measurements.

**Advance Preparation**
1. Build the compost bin. (See instructions in the student handout)
2. Gather leaves, grass clippings, and food scraps prior to the project.
3. If a water source is not near the compost bin, have buckets of water near the pile for students to use.

**Procedure 5.2 Lesson 4A Composting**
1. Watch the compost video from the University of Mississippi.
2. Guide students in a short discussion (5-7 minutes) on the importance of composting.
3. Have students read out loud the student handout.
4. Show students the thermometer they will be using. Point out the diagram of where to measure temperature from. Remind students that they will have to take the average of all three temperatures to get the overall temperature of the compost pile.
5. Show the students the pH scale. Pass around the pH color chart and the pH strips. On the blackboard explain with a diagram how to take pH measurement to the students.
6. Explain the squeeze test to students.
7. Open the LSU Ag Center Compost handout.
8. Have students focus on what can and cannot be composted. (Let students give ideas of what they’d like to compost. Are materials students want to compost safe or not? Discuss this as a class.)
9. Go outside and build your pile according to the techniques shown in the video. (Layering, leaves, grass, fertilizer, water, soil, repeat… repeat…)
10. Come back into the classroom; explain that each week students are in charge of checking and monitoring the compost pile. Students are required to fill out the class weekly compost chart.
11. Keep the chart, pH strips and color chart, thermometer, etc., all in the same spot so they won’t be lost.

**Blackline Master(s)**
1. LSU Ag Center Compost handouts
2. Student Handouts
3. Weekly compost chart (Worksheet L)

**Assessment**
Compost Quiz and Questions 16, 18, 20, and 23 on the pre and post test refer to this lesson.

**Resources**
Digital Seed. 1999. Wire mesh composting bin. (20/06/03).
http://www.digisalseed.com/composter/bins/wirebin.html

LSU Ag Center. 2003. Backyard composting. (20/06/03).
http://www.lsuagcenter.com/subjects/compost/backyard_composting.asp

http://compost.css.cornell.edu/Composting_homepage.html
5.2 Lesson 4A Composting

Lesson 4A-Composting

Today we will learn how to compost our waste products and why we need to monitor certain variables of the compost.

First we will watch an 8 minute video from Mississippi State University explaining how to compost.

We will now review the different variables we will monitor in our own compost piles.

- **Temperature**: Temperature is important because it tells us that the compost is working. The microorganisms in the soil give off heat energy as they break down the different waste products.

- To take the temperature of your compost, stick the thermometer into the compost in three different areas. Then take the average of these three areas. This is the average temperature of your compost. Make sure to stick the thermometer in different depths into the compost!

Illustration provided by K. Karsh

- **pH**: pH is a great indicator of the decomposition process. Microorganisms in the soil like slightly acidic to neutral conditions (pH 5.5 to 8.0) As the composting matures the pH range will become more neutralized and fall into the range from (pH 6.0 to 8.0)

<table>
<thead>
<tr>
<th>Acid</th>
<th>Neutral</th>
<th>Alkaline</th>
</tr>
</thead>
</table>

Illustration provided by K. Karsh
The **pH scale** runs from (0----------------7----------------14)

- To accurately measure the pH of the compost, put the pH indicator slip into the compost pile. Remove it and wait one minute. The indicator slip will start to turn several colors. Now match the color the pH slip turns to the colors on the pH color chart. When your slip matches the color scheme on the pH color chart, it will tell you what the pH level of your compost is. Write down the pH level.

- **Moisture**-Microbes need moisture to survive just like people do! The compost moisture content should be 50 to 60 percent.

- To measure the moisture content, simply grab a handful of the compost material. Squeeze it in your hand.

- Does the compost feel wet? Are there any tiny water droplets left on your hand when you drop the compost?
  - **YES**- YOU HAVE ENOUGH WATER!
  - **NO**- ADD WATER TO YOUR COMPOST!

- If there is not enough moisture the compost will not decompose.

- If there is too much moisture there will be a foul smell to the compost, the decomposition rate will slow down, and nutrients will be leached.

Now, let’s review the handout from the LSU Ag Center!

(Worksheet K)
Worksheet K can be found on the internet using the LSU agriculture web site. The address is
http://www.lsuagcenter.com/Communications/pdfs_bak/pub2610Acompost.pdf
Last, we will build our compost pile. You will find your class compost container outside near the can yard. When you are instructed we will go outside and build our pile! Remember to use techniques we have discussed and techniques the video recommends.

Student illustration of the compost pile. Picture provided by K. Karsh

To make your own compost bin simply follow the easy instructions.

**Materials**

1. (2) four foot 2”x4” pieces of wood.
2. (2) large hook and eye latches
3. 8 to 10 feet of four foot wide sturdy poultry wire.
4. (200) Poultry nails
5. Drill and drill bit
6. Hammer
7. Wire cutters

**Procedure**

1. Lay flat the poultry wire. Use a chair or a sturdy object to hold one end down while you work the other end.

2. Place one 2”x4” underneath the edge of the wire.
3. Using the poultry nails hammer the wire to the 2”x4”. Make sure that the length of the wire does not exceed the 2”x4”. If it does, students make get caught on or cut by the sharp edge. Trim any sharp points off after securely fastening the wire to wood.

4. Repeat step 3 on opposite side.

5. Now you should have the frame of the compost bin. Stand the bin up, and gently shape into a circular form.

6. Approximately four inches from the top of the 2”x4” use your drill to install the first hook and eye set. Make sure to install the hook and eye set so that it faces the outside of the compost bin.

7. Repeat step 6 at approximately 24 inches from the top.

Your compost bin is now ready to use!

Remember to monitor all aspects of composting we discussed (Temperature, pH, moisture content, and any extras you add to your bin.

Use Worksheet L to record your findings.

To learn more about composting visit this school’s website!
http://compost.css.cornell.edu/Composting_homepage.html
(Worksheet L)

Weekly Compost Chart

School Name: _______________________________

<table>
<thead>
<tr>
<th>DATE</th>
<th>TEMPERATURE</th>
<th>pH</th>
<th>MOISTURE</th>
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Worksheet developed by Miss. Kiki Karsh and Dr. Edward Bush
Chapter 6

Lesson 5 Teacher’s Lesson Plan and Student Material for Pollination
6.1 Introduction and Teacher’s Guide for the Lesson

This chapter incorporates the teacher’s lesson plan with all student material needed to complete this lesson. The main objectives of the Pollination lesson plan are for students to learn the reproductive structures of a flower and how and why pollination occurs.

Focus/Overview
The pollination lesson connects plant science to the life of a middle school student. Pollination affects allergies and the food that we eat. Middle school students tend to like food and anything relating to sneezing. This lesson focuses on the importance of pollination to the survival of flowers and foods.

Learning Objective(s)
The learner will
- Become familiar with the different structures of a flower.
- Monitor school pollen counts and compare their findings with the local published pollen counts.
- Learn several methods in which plants are pollinated.
- Participate in activities that show the importance of pollination and pollinators.

Louisiana Grade Level Expectations
5: GLE-29 Describe adaptations of plants and animals that enable them to thrive in local and other natural environments (LS-M-D1)

7: GLE-9 Relate structural features of organs to their function in major systems (LS-M-A5)
Materials List
Provide a list of supplies necessary to conduct the activity.
- Instructional sheet
- Hand Lenses
- Plastic knives
- Rulers
- Tape
- Hibiscus flowers
- 3 by 5 index cards (Stakes)
- Black markers
- Crayons
- Rain gauge
- Bucket with water

Background Information
In order for students to understand and be able to differentiate the different flower parts use flowers with obvious traits such as hibiscus flowers or lilies. Keep flowers in a bucket of water until time to use them. Flowers are best if picked or bought the morning of the lesson.

Advance Preparation
1. Tape enough 3”x 5” index cards to small wooden stakes for each student to have one. This will serve as a pollen catcher.
2. Gather either hibiscus or lilies for students to dissect.
3. Have crayons and other art supplies available for students use.
4. Bring in the local paper or use the website provided to determine the local pollen counts. Students should be able to look up this information.

Procedure 6.2 Lesson 5A Flower Investigation
1. Start a discussion with students about flowers. How many different shapes of flowers are there? (tubular, round, big, small, like a trumpet) Why are there so many shapes? (Easy access for pollinators, a bird with a curved or very long beak, a proboscis on a butterfly, the fuzziness of a honey bee). Can you think of anything else that might attract pollinators to flowers? (Color, size, smell)
2. Start the project by dissecting the flowers with the students. Allow enough time for student to thoroughly take the flowers apart and see most of the parts of a flower.
3. Students should look at the illustration of the flower and try to find the same parts on the flower they are dissecting.
4. Have students fill out (Worksheet M) The Detective report. They are supposed to be trying to figure out how this flower is pollinated and what attractive qualities it has that pollinators like.
5. Hint: a great flower to use is the hibiscus, or lilies from a florist.
Procedure 6.3 Lesson 5B Pollination Cards

6. Ask students if they know what pollen is. Next ask for a raise of hands, does anyone have allergies? If so, these people will be the monitors of the project.

7. The students will make pollen catchers. They are to draw a 1 by 1 cm square with a black marker in the middle of the 3x5 index card. Color in the square. Each student will have a certain day of the week. (i.e. 5- Monday students, 5 Tuesday…. ) students are to place a piece of double sided tape over the black square.

8. On your designated day of the week. Place your pollen catcher outside, either at the end of the school day or the next morning count the number of pollen grains on the piece of tape. This number represents the pollen count for the day.

9. Take an average of all pollen grains on each card for each day. Record this average on Worksheet N. Also record the local pollen count and temperature outside from the internet site, or your newspaper every day of the project. You also want to note if there was any rain. The class has been provided with a rain gauge, so students should write the number of inches in the gauge each day.

10. Students should notice a similar trend between the published pollen counts and their own. Of course the numbers won’t be the same. As the published pollen count rises so should the school pollen count, similarly if the published count decreases so should the schools counts.

11. The students with allergies can tell the class if they sneezed more or less on certain days. Do their sneezes follow the pollen trend?

Procedure 6.4 Lesson 5C Bee Free BBQ

12. Make-believe with students that all honeybees are extinct. Ask students if they think this would be a problem.

13. Have a student read out loud the list of foods that need the honeybee to pollinate them in order to exist.

14. Students can work together in groups or alone but must create a menu for the class without using any of the listed foods.

15. Have students share their ideas.

Procedure 6.5 Lesson 5D Design Your Own Flower

16. Students need to work in pairs for this activity.

17. The student handout has a list of questions for each partner to ask the other. Students are to design a flower based on what their partner likes.

18. The object of this activity is to be as creative as you can and design a flower that your partner would be apt to pollinate. Use crayons and other art supplies.

19. Share flowers with the class.

Blackline Master(s)
1. Student Handout; includes worksheets (M, N, O)
Assessment
The Pollination quiz and questions 6, 10, 22, and 29 on the pre and post test are designed for this lesson.

Resources
American Academy of Allergy Asthma and Immunology. (2/5/04).
http://www.aaaai.org/

Cahill M.C. 2003. Plant Pollination (15/07/03).
http://school.discovery.com/lessonplans/programs/plantpollination/

http://www.csdl.tamu.edu/FLORA/201Manhart/repro/repro.1/repro1.html

Smithsonian Education. 2003. Plants and animals partners in pollination. (16/07/03)
http://www.smithsonianeducation.org/educators/lesson_plans/partners_in_pollination/intro_2.html

The Weather Underground Inc. (2/03/04)
http://www.wunderground.com/
Today we are going to learn all about how flowers are pollinated. Flowers have special structures to enable pollination to occur. You will each be given a flower. Become a plant detective and figure out what each structure’s function is!

- Carefully dissect the flower with the plastic knife given to you.
- Find the flower parts that are in the diagram. (Ill. 1)
- Record the parts of the flower you were able to identify and hypothesis as to what you think the function of each flower part is. (Worksheet M).

(A Complete Angiosperm Flower)

Flower diagram provided by Dr. J. Manhart. Texas A and M University
Detective Report

Name of flower you are dissecting:

What is the average height and width of your flower?

What color is your flower?

What does your flower smell like?

Record the flower parts you were able to identify here.

<table>
<thead>
<tr>
<th>Flower Part</th>
<th>How many parts present!</th>
<th>What do you think its function is?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

Activity modified from School Discovery
6.3 Lesson 5B Pollination Cards

Lesson 5B – Pollination Cards (Activity idea from American Academy of Allergy Asthma and Immunology)

Pollen is the fine yellow powder attached to the Anthers (Male flower parts) on a flower. Pollen is carried from one plant to another to help the plant reproduce. Some individuals are allergic to certain types of pollen causing an allergic reaction. People with allergies can check the local newspaper and weather channel for pollen counts.

Today we will make pollen cards. Officially, scientists measure pollen counts in a cubic meter area. We will use much smaller areas to check our pollen count.

- Take your “3x5” index card, ruler, and black marker. Draw a 1x1 cm square in the middle of your index card. Fill in the square with black marker.

Illustration created by K. Karsh

- (THIS IS THE AREA YOU WILL BE COUNTING POLLEN IN!)

- Completely cover the black square with double sided tape or fold the tape to have the sticky side both up and down on the index card.

- Each day place one pollen catcher outside in a protected area. The pollen catcher can be exposed to wind but NOT RAIN!

- So our pollen catcher won’t blow away in the wind. There is a stake attached to the index card. The stake is provided so we can tape the stake to a pole under an awing or breezeway.
Each day place a new pollen card outside for five days. Divide the class into 5 day groups (i.e. M T W Th F). Record the following information on data (Worksheet N):

A. Date
B. Temperature outside
C. Weather conditions
D. Published pollen count (see website)
E. Your pollen count

To figure out your pollen count, use the hand lens supplied to estimate the number of pollen grains on the black square.

To figure out the published pollen count check your local newspaper or visit this web site: [http://www.wunderground.com/US/MI/hamburg.html](http://www.wunderground.com/US/MI/hamburg.html)

HINT: This activity is really fun if students with allergies monitor the project. Students can record the number of times they sneezed each day that pollen is being caught by the class. Did you sneeze more on high pollen count days?
Tips on using the underground website are below.

*The top left hand corner of this web page has a rainbow.

*Next to the rainbow is a blank spot where it says “\textbf{type the name of the city state and or zip code and find out the local weather.}”

*Scroll about half way down the page until it says “\textbf{CURRENT CONDITIONS}”

*This contains a lot of information about the weather in your city.

*Next, click on the link that says \textbf{local info from pollen.com}.
When you click on this link your pollen counts will appear for the next four days.

\begin{itemize}
  \item At the end of the week, compare your pollen counts to the official pollen count. The numbers will be different because of the methods we use to record the pollen counts. However, the trend should be the same, higher pollen days will have more pollen grains on your card. Days with reported low pollen counts should have less pollen on your card.
  \item Complete the Pollen Count worksheet and give it to the instructor next time he or she comes to visit.
\end{itemize}
## Pollen Counts!

**School Name:** ______________________

<table>
<thead>
<tr>
<th>Date</th>
<th>Temperature</th>
<th>Weather conditions (Precipitation)</th>
<th>Published Pollen Count (Internet or local paper)</th>
<th>Your Pollen Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day 2</td>
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<td>Day 3</td>
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<td>Day 4</td>
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<tr>
<td>Day 5</td>
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</tbody>
</table>

Activity modified from DiscoverySchool.com
6.4 Lesson 5C Bee Free BBQ

Lesson 5C- Bee Free BBQ

If animal pollinators were to become extinct, especially the honey bee then this list of food would not be available for us to eat!

List of Extinct Foods!

<table>
<thead>
<tr>
<th>Vanilla</th>
<th>Oranges</th>
<th>Sugar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lemons</td>
<td>Onions</td>
<td>Almonds</td>
</tr>
<tr>
<td>Limes</td>
<td>Cucumbers</td>
<td>Watermelon</td>
</tr>
<tr>
<td>Mustard seed</td>
<td>Lettuce</td>
<td>Apples</td>
</tr>
<tr>
<td>Cacao bean</td>
<td>Potatoes</td>
<td>Tomatoes</td>
</tr>
</tbody>
</table>

Pollination by animals and insects is very important. We must be kind to these insects that help us out daily!

- This year we will have an annual BBQ with your classmates.
- Unfortunately, the honey bee population has gone extinct and because of this, many of your favorite foods no longer exist!
- Your job is to create a Menu for your entire class and all your friends. But! You cannot use any of the foods that are listed because they are no longer pollinated and therefore, no longer available! (Worksheet O)

Activity modified from Discovery School
Design your menu in the space below!

Menu designed by K. Karsh
6.5 Lesson 5D Design Your Own Flower

Lesson 5D- Design Your Own Flower (Activity modified from Discovery School)

Now it’s your turn to create a special flower pollinated by your friend.

- You and your partner will ask each other the list of questions provided to you.
- Next design a flower your partner would like to pollinate!
- Remember to give your flower a proper scientific name!

**Genus species** or *Genus species*

(List of Questions for your partner)

What is your favorite color? ______________________

What is your favorite shape? ______________________

What smells good to you? ________________________

What is your favorite food? ______________________
Now design the flower below!

Scientific Name ____________  _____________

This lesson was created by Ms. Kiki Karsh and Dr. Edward Bush of LSU Ag Center and Louisiana Sea Grant College Program with some borrowed materials from Discovery School.
Chapter 7

Lesson 6 Teacher’s Lesson Plan and Student Material for Plant Genetics
7.1 Introduction and Teacher’s Guide for the Lesson

This chapter incorporates the teacher lesson plan with all student material needed to teach the Plant Genetics lesson. The main objectives of Plant Genetics are for students to learn the differences in phenotypes and genotypes, dominant and recessive traits and how the environment plays a role into the development of a plant.

Focus/Overview
Genetics is a difficult subject to teach to middle school students. However using example stories and visual aids, genetics becomes a fun lesson. Students will pretend they are tourists and notice the differences between mangrove seeds in southern Louisiana and northern Louisiana. Students have the opportunity to show their understanding of traits by creating their own plant and a Punnett square to go along.

Learning Objective(s)
The learner will
- Learn the difference between genotypes and phenotypes as well as factors that influence the genetics of plants.
- Learn what dominant and recessive traits are.
- Create a Punnett Square, and study the experiments of Gregory Mendel.

Louisiana Grade Level Expectations
7: GLE-19 Apply the basic laws of Mendelian genetics to solve simple monohybrid crosses, using a Punnett square (LS-M-B3)

7: GLE-20 Explain the differences among the inheritance of dominant, recessive, and incomplete dominant traits (LS-M-B3).

7: GLE-32 Describe changes that can occur in various ecosystems and relate the changes to the ability of an organism to survive (LS-M-D2).
7: GLE-34 Explain how environmental factors impact survival of a population (LS-M-D2).

**Materials List**
- Live sample of a mangrove tree
- Brassica rapa plants cabbage plants only 10 days old. (hairy and non-hairy, purple and non-purple stems)
- Tomato or cucumber plants (Plants for prizes …must have pubescent)
- Construction paper
- Hand Lenses
- Poster Size Punnett Square
- Review Game Questions
- Teacher Evaluations
- Instructional Sheets

**Background Information**
It is very helpful to search the internet before teaching this lesson to research Gregory Mendel. He was the founding father of modern genetics. Mendel, cross pollinated peas in search for different varieties. He hoped to be able to pollinate peas in order to get specific traits he desired, such as grey, green, wrinkled, smooth, small, large, etc. Try to relate dominate and recessive traits of plants to traits of humans. For example, talk about the dominant and recessive trait of humans. Brown eyes are dominant blue are recessive. Some students might have brothers and sister with different eye colors from themselves. Talk about how this might happen. Then relate it to plants. Use the pubescent or how hairy a plant is, to describe a phenotype or an observable trait. (Hair is a phenotype of a plant). Explain that phenotypes are regulated by the environment, whereas, genotypes are determined by the plants genes. Even though a plant has certain genotypes, it may not look like what the genes tell a plant to look like. For example, a plant has the genotype to be 60 feet tall but because of the extremely cold environment, the plant only grows to be 30 feet tall. The phenotype is different than the genotype.

**Advance Preparation**
Provide a list of supplies necessary to conduct the activity.
1. Grow Brassica rapa plants from seed in a sunny windowsill. You can order these from Carolina Biological supply. They are called ‘fast plants.’ There are two varieties you will need for this lesson, both hairy and non-hairy. When you order it might also say something about the plants having purple or non-purple stems this is not as important as the hair. Instructions come with the seeds
2. Grow tomato, cucumber, sunflower or any other plants with pubescent available for the students as well.
3. Use a poster board to create an example of a Punnett square for the students. The square on the left has two parents the top row and the first column each have both a dominant and recessive trait. The square on the right has two parents one with both dominant traits and the other with both recessive traits. How do their offspring differ? P can stand for purple flowers while y can
stand for yellow flowers the lower case y is the recessive trait and the uppercase P is the dominant trait. Parent plants are in bold font.

Example:

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<th>P</th>
<th>y</th>
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</thead>
<tbody>
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<td>PP</td>
<td>Py</td>
</tr>
<tr>
<td>Y</td>
<td>Py</td>
<td>yy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>P</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>yP</td>
<td>yP</td>
</tr>
<tr>
<td>Y</td>
<td>yP</td>
<td>yP</td>
</tr>
</tbody>
</table>

Procedure 7.2 Lesson 6A Hairy’s Inheritance

1. Have students take turns reading the student handout. As questions arise discuss what some students answers might be.
2. Use a live mangrove tree or a picture of a mangrove tree to remind students what pneumataphors are. This also provides a good visual aid for the tourist story.
3. When it is time to look at the cabbage plants (Brassica rapa) explain to students that they are going to count the number of hairs on the plant and record their observations on the blackboard.
4. Decide as a class where the students will count the hairs, (i.e. underneath the first leaf, along the stem, etc.)
5. After students count their hairs using the hand lenses, have them draw what the plant looks like in the appropriate blank space and label the area in which they counted hairs.
6. Students should make tally marks on the chalkboard in the square marked with the number of hairs they counted.
7. All students should copy down the class data from the board. Have students make a histogram or any type of graph representing the class data in the student handout. An x and y axis are provided in the student handout.
8. Again discuss question found in the handout.

Procedure 7.3 Lesson 6B Dominant and Recessive Traits

9. Discuss who Gregory Mendel was.
10. Talk about dominant and recessive traits on people.
11. Have students create a plant with one dominant and one recessive trait. In one box they are to draw the plant demonstrating the dominant trait in the adjacent box the students are to draw the same plant only now demonstrating the recessive trait.
12. After students have created their plants they should make a Punnett square representing the dominant and recessive traits.
13. Show the poster size Punnett square to the class so they can see how to construct it. Task them to make a tic-tac-toe with no X's or O’s. Now they should fill in the tic-tac-toe. The upper left box remains empty the middle and right upper boxes are one parent and the first column middle and bottom boxes are another parent. Inside are the four offspring. Explain your Punnett square, and then have them draw their own Punnett Squares for the plants they just created.

**Procedure 7.4 Lesson 6C Coastal Roots Review Game**

14. Read out loud the instructions for the game.
15. Divide the class into two teams. Ask for one student to be the scorekeeper.
16. Each team will have a representative from the team at the front of the classroom for each question.
17. The team with the most points wins the tomato or cucumber plants.

**Blackline Master(s)**
1. Student Handout
2. Coastal Roots quiz game.

**Assessment**
The Genetics quiz and questions 2, 8, 24, and 32 on the pre and post test are directly related to this lesson plan.

**Resources**

Anonymous. (n.d.) Dominant gene inheritance. (21/06/03).

Kendrick, B. 1996. Pea soup; the story of Mendel. (22/06/03).
[http://www.sonic.net/~nbs/projects/anthro201/](http://www.sonic.net/~nbs/projects/anthro201/)

University of Wisconsin. 2003. Hairy’s inheritance, getting a handle on variation. (16/06/03) [http://www.fastplants.org/pdf/genetics/hair_inheritance.pdf](http://www.fastplants.org/pdf/genetics/hair_inheritance.pdf)
Lesson 6A- “Hairy’s” Inheritance

- Do you know the difference between phenotypes and genotypes? Let’s learn today by participating in a fun activity.

- Just like people, plants inherit certain traits.

- Some of us have blue eyes and some brown eyes. Some people are tall and some people are short. These are examples of traits.

This Smurf has blue skin. This is one of his traits!

- We all have genes that determine how we are going to grow and develop. Plants have genes too.

A **Genotype** is the genetic code or blueprint of a plant. It’s DNA!

A **Phenotype** is what the plant actually looks like.

Phenotypes are dependent on the **ENVIRONMENT**. Genotypes are **not**.
Let’s look at a Coastal plant as an example of Phenotypes and Genotypes. Remember learning about the Black Mangrove (*Avicennia germinans*)? Here is a picture.

![Photo provided by K. Karsh](image)

Black mangroves like to live in flooded places. They prefer full sunshine and moderate temperatures. Black mangroves are also salt tolerant and can live in brackish waters.

- Let’s pretend we are tourists visiting the Louisiana coast. We absolutely love the black mangrove tree and want them to grow in our backyard. So we pick a few hundred seeds and take them home with us.

- We are now home in Alexandria, La. (Northwest of Baton Rouge) and we have planted the mangroves. Some seeds actually germinate, but our climate is colder than the coast. Mangroves do not tolerate freezing temperatures. Plus our backyard has little water available, because we live on top of a small hill. To make matters worse, our backyard has many tall pine trees, which shade our yard.
How will our mangrove look if planted in Alexandria?

Remember these facts:

- Mangroves typically grow 20 feet tall.
- Mangroves usually have pneumataphors for roots since they are submerged in water. (Look at the picture)
- Mangroves have many spreading branches.

Will the mangroves living in this Alexandria backyard have different phenotypes than mangroves living on the coast?

If yes, what will the Alexandria mangrove phenotypes look like? (Give three characteristics)

1. ____________________  2. ____________________

3. ____________________

- Will the genotypes of the coast and Alexandria mangroves be the same?

  YES or NO?
  (CIRCLE ONE)

- Why do the Alexandria mangrove trees display different phenotypes than the Louisiana mangrove trees?
• Let’s look at our cabbage plants. (*Brassica rapa*)

• Each group should have two plants on their table.

• The hairs on your plant represent the plants phenotype or an **observable trait** of the plant.

(Scientists are currently running experiments to determine why some plants are hairy and some are not. Very little is known right now.)

1. Look at your cabbage plant. Determine what parts of the plant are hairy. You must also decide where you will count the hairs on your plant. (HINT: Try counting hairs along the edge of the first leaf.)

2. Draw a sketch of your cabbage plant below and label the area you will count the hairs on. (Everyone in the class should count hairs in the same area!)

3. Each person in the group should count the number of hairs they see in the chosen area of the plant.

• Put a piece of construction paper behind the part of the plant that you are counting the hairs. This will help you see the hairs.

• Use your provided hand lens for a better view of the hairs.

RECORD THE NUMBER OF HAIRS YOU COUNTED HERE _____!
On the blackboard there will be columns labeled with numbers. When you have completed counting the hairs on your plant, walk to the front of the room and mark the column with the number of hairs. For example, the blackboard will look like this.

<table>
<thead>
<tr>
<th>Number of hairs</th>
<th>0-5</th>
<th>6-10</th>
<th>11-15</th>
<th>16-20</th>
<th>21-25</th>
<th>26-30</th>
<th>31-35</th>
<th>36-40</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>//</td>
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<td>///</td>
<td>///</td>
<td>/</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Each mark represents one group!

Students at Montegut Middle School counting hairs on cabbage plants, photo provided by K. Karsh
Now create a histogram with your class data!

- The Horizontal axis (X) is the number of hairs counted.
- The Vertical axis (Y) is number of groups.

Graph developed by Miss. Kiki Karsh and Dr. Edward Bush

- Did you notice one of your plants had a lot of hairs and the other did not?
- Do you think hairiness is an inherited trait determined by genes?
- Do you think all fast plants (*Brassica rapa*) have the same genes? Maybe, the phenotypes of the two plants determined that one plant would be hairy and the other plant would not be hairy because of the environment?
- If we cross-pollinated the plants in your class do you think we could create a SUPER HAIRY PLANT?
• Which plants would we need to cross-pollinate to obtain a very hairy plant?

Circle your answer.

A. The two plants with the least amount of hair.

B. The two plants with the most hair.

C. One plant with a little hair and another plant with a lot of hair?
Lesson 6B- Dominant and Recessive Traits

Have you ever heard of Gregory Mendel? (Father of Modern Genetics) He was a very famous botanist who cross-pollinated pea plants. He noticed they had many different traits (wrinkled, smooth, gray, green, yellow, inflated, constricted, tall, short, etc.) Mendel knew some traits were dominant and others were recessive. Mendel used Punnett Squares to determine which trait would result when cross-pollinating the different peas.

- Dominant traits usually mask recessive traits.
- A good example of a dominant trait and a recessive trait in people is eye color.
- Chances are if you have a mother with blue eyes and a father with brown eyes you will have Brown Eyes.
- Brown eyes are the dominant trait. Of course there are always exceptions to this rule!

Plants have dominant and recessive traits just like humans.
It is your job to create a plant with one dominant and one recessive trait. Be as creative as you want! Draw a picture of your plant showing the dominant trait in one box and the recessive trait in the other box!

<table>
<thead>
<tr>
<th>Dominant Trait</th>
<th>Recessive Trait</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Symbol for the Dominant Trait _______.  
Symbol for the Recessive Trait _______.

Worksheet developed by Miss. Kiki Karsh and Dr. Edward Bush
In the space below create a Punnett Square for your plant. Look at the board for help.

Activity created by Miss. Kiki Karsh and Dr. Edward Bush
7.4 Lesson 6C Coastal Roots Review Game

**Lesson 6C- Coastal Roots Review Game** (Developed by Miss. Kiki Karsh and Dr. Edward Bush)

The class will divide into two equal halves.

Rules for the game!

1. Only one team member at a time should be in the front of the classroom.

2. The first team to hit the desk will have a chance to answer the question after it has been read.

3. If both teams get the question wrong, teammates can help the representative with the answer.

4. One point is given to the team who gets the correct answer first.

5. After all questions have been answered the team with the most points wins.

GOOD LUCK!

Students participating in Coastal Roots Review Game, photo provided by E. Bush

The following list of questions refers to the Coastal Roots review game.
Questions and Answers for the Coastal Roots Review Game

1. What is Horticulture?
ANS: The science and art of cultivating, processing, and marketing fruits, vegetables, trees and shrubs.

2. What is the correct method of writing a plant's scientific name?
ANS: Underline both the genus and species, or italicize. The genus is capitalized and the species lowercase.

3. What does the xylem transport in a plant?
ANS: Water

4. What does the Phloem transport in a plant?
ANS: Food, sugar, nutrients.

5. There are seven ranks when classifying a plant in the scientific classification. Say them in order.
ANS: Kingdom, division, class, order, family, genus, species.

6. Give me a pneumonic devise to remember the order of the seven classification ranks?
ANS King David called out for good spaghetti.

7. The pH scale runs from what number to what number?
ANS: 0-14

8. During photosynthesis a plant makes what?
ANS: Food

9. What is so important about saving Louisiana’s wetlands?
ANS: We need to restore the vanishing wetlands to ensure that all the wetland plants and animals have a place to live, as well as a place for us to play, fish, and hunt. Also, the wetlands protect the mainland from big storms like hurricanes.

10. Name two wetland habitats
Ans: Mud flat, swamp, marsh, stream bed, pond, open water, etc.
11. Name 3 things that are monitored in compost
ANS: pH, Temperature, moisture

12. What size of container is best for composting?
ANS: Large at least 3'x3'x3'

13. What pigment gives leaves their green color?
ANS: Chlorophyll

14. What pigment gives leaves their orange color?
ANS: Carotens

15. Are the different colors present in a leaf all year long or only in the fall?
ANS: All year long

16. Plants take in _______ and give off _________.
ANS: Carbon dioxide, oxygen.

17. If all plants in an ecosystem were killed would the ecosystem stay alive or die and why?
ANS: Die- because animals and humans are dependent upon plants for their survival.

18. As plant material decomposes it gives off energy in the form of Light, Heat or solar energy?
ANS: Heat

19. What does a leaf need for photosynthesis to occur?
ANS: CO₂, Sunlight, and Water

20. Which of the following plant traits is not inherited?
   Flower color, fruit type, leaf shape, insect damage?
ANS: Insect damage

21. What kind of plant grows half in water and half out of water?
ANS: Emergent

22. What kind of plant grows completely underwater?
ANS: Aquatic
23. Plants play an important role in soil erosion because their roots _____?
   ANS: Hold the soil in place.

24. A genotype is affected by the plants _______?
   ANS: GENES

25. Name one adaptation of wetland plants that help them survive in wetland habitats
   ANS: above ground roots, hollow stems, salt glands, etc.

26. Why should we plant coastal plants in Louisiana?
   ANS: To keep the soil from eroding

27. Who is the father of modern genetics?
   ANS: Gregory Mendel

28. Give me the correct names of female plant parts.
   ANS: Stigma, style, ovary

29. What part of a plant affects people’s allergies?
   ANS: Pollen

30. Name a food that needs to be pollinated in order to exist.
   ANS: Coco bean chocolate, tomatoes, potatoes, melons, etc.

31. EXTRA POINTS: Ask me a question about anything we have learned this year and see if I know the correct answer!!!

This lesson was created by Ms. Kiki Karsh and Dr. Edward Bush of LSU Ag Center and Louisiana Sea Grant College Program.
Chapter 8

Lesson 7 Teacher’s Lesson Plan and Student Material for Wetland Soils and Media
8.1 Introduction and Teacher’s Guide for the Lesson

This chapter incorporates the teacher’s lesson plan with all student material needed to complete the lesson. The main objectives of the Wetlands soils and Media lesson are to teach students the role plants play in holding soil together in the wetlands; teach students basic soil identification practices; and help students understand the differences between soil that is bought or used in greenhouses verses native soil.

Wetland Soils

Focus/Overview
This lesson focuses on soils, a very important topic in horticulture. Start by teaching the students about regular soil horticulturist’s use in nurseries, greenhouses, etc. Next, students will focus on wetland soils. Students learn why plants are important to wetlands and how to identify the different types of soils using a number of methods.

Learning Objective(s)
The student will be able to
- Distinguish between a healthy and non-healthy wetland, and the importance of plants to wetlands.
- Learn what media is.
- Learn the techniques to identify the different types of soils.

Louisiana Grade Level Expectations
8: GLE-52 Describe the relationship between plant type and soil compatibility (SE-M-A9).

8: GLE-53 Distinguish among several examples of erosion (e.g. stream bank, topsoil, coastal) and describe common preventative measures (SE-M-A10)

Materials List
- bag of media

Grade Level
7

Duration
1 hr class period
About 30 minute’s preparation

Setting
The classroom and an area outside near a ditch, or low spot to dig at least four holes.

Vocabulary
Media, Perlite, Vermiculite, Pine Bark, Osmocote, Peat moss
- bag of pine bark
- bag of sand
- bag of osmocote
- bag of vermiculite
- bag of perlite
- bag of peat moss
- two jars
- sediment and water for each jar
- doormat
- wood
- 2 crawfish plates or shallow pans
- shovel
- rulers
- 2 jugs of water
- instruction sheets
- color charts laminated

**Background Information**

Media is a soil-less soil that horticulturalist use to plant their nursery crops. Media contains no native soil. See student handout for list of media components. There are hundreds of thousands of different soil types all over the world. We can distinguish soil type by taking soil samples and testing them. The Munsell book which is a widely used book among agronomists is used to identify soils by their color. While we cannot distinguish a soil completely by its color we can narrow our choices down with color, soil particle size, and texture combined.

**Advance Preparation**

Provide a list of supplies necessary to conduct the activity.

1. Dig at least four holes outside in a low-lying area or ditch. This is where students will sample soil.
2. Have a bowl of media or soil handy.
3. Collect samples of all media components and put them in unlabeled plastic bags.
4. Have at least two or three gallons of water in jugs

**Procedure 8.2 Lesson 7A What is Dirt (Soil)?**

1. Start a discussion. Ask students if they know what dirt is. Then ask if they have ever heard of soil-less soil. Tell them they are going to learn the correct vocabulary horticulturalists use, that dirt is no longer dirt. Read the handout with students on the differences between dirt, soil, and media.
2. Pass around the bags of media components ask if students can match the bags to the pictures in the handout. Allow students to feel and smell the different components.
3. Explain that soil in the greenhouse is very different from soil outside. There really is no soil involved at all!
Procedure 8.3 Lesson 7B Runoff Race

4. Ask for four volunteers (1- holds the door mat, 1- holds the piece of wood, 2 shake the jars of water and sediment and pour them onto the “wetlands”)
5. The doormat represents the healthy wetland full of plants, and the wood represents the unhealthy wetland with no plants. (Why might there be no plants? Dredging for oil salt water intrusion, airboats, chemicals etc., what would have caused this erosion?)
6. Each of these wetlands leads to a lake (crawfish plate). What lake would the students rather swim in, fish swim in? Deer drink from? Has the most and least pollution? Etc.
7. Have students pour jars of sediment onto the doormat and wood at the same time. Look at the differences in the wetlands discuss as a group.
8. Make sure the wood and the doormat are at relatively the same angles.
9. Ask students what might be done to prevent erosion in our wetlands in the future.

Procedure 8.4 Lesson 7C Wetland Soil Identification

10. Previous to the class starting have four holes at least a foot in diameter dug in a low-lying area outside of the classroom.
11. Start by showing the class color copies of the Munsell chart (In identification book for soils) ask them if they have ever seen soils in those particular colors. Tell the students they can create their own Munsell chart by using the colors labeled above the boxes out of a box of Crayola sixty-four crayons.
12. Explain that when they go outside they will test the color of the soil. Do this by taking a small pinch of soil from the side of the hole at the designated depth. The pinch should be at least three inches in diameter. Hold the pinch in the sunlight out of any shadows. Place it next to the different colors on the chart and determine the shade of the soil.
13. Next, explain to students how they will test the texture of the soil. Does anyone know what texture is? Have them rub the pinch of soil between their fingers and describe how it feels. Students can use words listed on page 64 of the student handouts. But they also need to follow the flow chart on page 66 each time they test the texture of the soil.
14. Students also need to know how to describe the soil particles. Use the text on page 64 to describe the pinch of soil at each designated depth.
15. Then tell the students at each depth they are also to record if they see anything else in the soil such as roots, sticks, bugs, or trash etc.
16. All of this information is to be recorded on page 65 of the student handout in the Soils Data Chart. REMEMBER… Always test the color of the pinch first to get the true color of the soil before taking any other measurements.
17. Hint: Demonstrate all techniques necessary to test soil at the holes while the students are watching. They will ask you how to test texture, color, etc several times if you do not demonstrate.
Blackline Master(s)
1. Student Handout
2. Munsell color charts

Assessment
The wetland soils quiz (L7) and questions 12, 21, 26, and 28 on the pre and post test relate to this lesson.

Resources
http://www.allencountyindiana.org/NR/rdonlyres/eu4bnlcewrw7sc5nhdlofkorgzh56labgpbadcoa3r53cyv6f dbsdyodw2atwbnuo5jwyotere2mak/ach4.pdf

Plant Science second edition. Prentice-Hall.

WOW! The Wonders of Wetlands. Environmental Concern.

National Gardening editors. 2004. Building soil 101. (12/03/04)
http://www.garden.org/articles/scripts/articles.taf?id=1354
Lesson 7A – What is Dirt (Soil)?

Almost everyone knows what dirt is. Some people say it smells good, some people say it smells bad. Horticulturists say that “dirt is under your fingernails and soil is what we grow plants in.” Soil can feel sticky, dry, clumpy, gritty, or slick, this is better known as texture. Horticulturist use special soil. We call this Media! Media is a combination of many components to make the most optimum soil for planting seeds and plants. Media contains no actual native soil! It is referred to as “soil-less media” Did you know that certain media is better than others for specific plants?
Look at the samples of components horticulturists mix to create media. (All media component photographs provided by K. Karsh)

 пенетратор

➤ See if you can match each bag with its correct name.

### PINE BARK

![Pine Bark Image]

Pine Bark makes up the bulk of the media. It looks like small pieces of wood.

### OSMOCOTE

![Osmocote Image]

Osmocote is a slow release fertilizer. It looks like little balls.

### SAND

![Sand Image]

Sand gives the media weight. It is light brown and gritty.

### VERMICULITE

![Vermiculite Image]

Vermiculite gives the media drainage and pore space. It has small gold flecks in it.
Perlite gives the media pore space. It looks like small pieces of white Styrofoam.

Peat Moss gives the media water holding capacity. It is brown and spongy. Peat holds up to 20 times its weight in water.

Wetland soils are different from the media horticulturist use to grow greenhouse crops in.

In our next activity we will look at native soil!

Lesson developed by Miss. Kiki Karsh and Dr. Edward Bush
Lesson 7B - Runoff Race

Now we know that there are many different types of soil and wetland soils. But why are they so important to us?

Wetlands are protective barriers to the mainland.

Wetland plants keep native soil in its place, which in turn slows erosion.

Wetland plants help settle heavy soil particles out and clean the water.

Wetlands slow down water runoff which can flood towns. The wetlands become a place for all the water to go.

Now we will begin the activity!

- Shake up the jars of sediment. Illustration provided by K. Karsh
- Watch how the sediment settles in the jars.
- Why might muddy water be harmful to the wildlife in wetlands?
- Wetland plants can slow the flow of water by just being in the way.
- The door mat represents a healthy wetland full of plants. The slab of wood represents an unhealthy wetland with no plants.
We need four volunteers. Two students will pour the jars of water and sediment onto the healthy and not healthy wetlands. The other two volunteers will hold the healthy and not healthy wetlands at a 60 degree angle resting in a lake (crawfish dish).

At the exact same time, both students pour all of the contents of the jars of water and sediments onto the wetlands.

As the sediment runs across both wetlands and into the lakes, observe the differences between both lakes (shallow crawfish dish).

- Which do you think will produce the fastest runoff?
- Is it better to have fast runoff or slow runoff? Which lake (pan) appears to be cleaner?

Lesson developed by WOW! Wonders of Wetlands

St. James Science and Math Academy students participating in erosion experiment. Photo provided by D. Fontenot
Lesson 7C- Wetland Soil Identification

Remember how we have keyed out plants in past lessons with a dichotomous key? Now we will key out soil types, only this time we are going to create our own key. The key we are making is a simplified version of the Munsell book. Agronomists use this book to help identify soil types. One farm may have 3 to 6 different soil types, whereas in the United States there are tens of thousands of soil types and all over the world there are hundreds of thousands of different types of soils. (Boger, 2003).

First we need to look at the wetland soils color chart. (Worksheet P)

- We have colored in the chart using Crayola Colors® from the 64 color box. You can do this again at home by using the colors shown on the chart! Must use Crayola brand!

- Every time you see the word (light) on the chart, do not press heavily with that particular crayon.

St. James Science and Math Academy students testing soil color. Photo provided by D. Fontenot
Chart modified from WOW! Wonders of Wetlands
2. After looking at the soils color chart, we will go outside and test the soil in the hole that was previously dug. When we are outside the note-taker in each group should record information on the Soils Data Chart provided (Worksheet Q).

Remember:

- You may see other colors and minerals within the matrix of the soil. These colorful streaks may represent different minerals in the soil.

- RED, ORANGE, AND YELLOW might be iron in the soil.

- BLACK STREAKS may represent manganese, but it also might be organic matter.

- These spots of color are good indicators of seasonal wetland soils.

- **DO NOT USE THESE SPOTS OF COLOR TO KEY OUT YOUR SOIL TYPE**

St. James Science and Math Academy students testing soil. Photo provided by D. Fontenot
Record the words or phrases that apply to each soil sample in the chart on Worksheet Q.

**Texture/Moisture:** Rub the soil between your fingers. Choose words that describe how it feels.
- Dry, moist, wet, very wet, or drippy
- Falls apart, sticks together, sticky (sticks to fingers)
- Feels like clay (easily molded into shapes)
- Slippery, oozes (extrudes between fingers when you squeeze it)

**Soil particles:** Draw the size and shape of the particles. What is the sample made of?
- Sand (feels gritty)
- Minerals (tiny bits of rock)
- Clay (like cat litter mixed with water)
- Silt (like flour or powder; slippery when wet)
- Pebbles or small gravel
- Organic matter (bits of leaves, twigs, bark, etc.)

**Color:** Use color chart

**Other features or creatures:** What does the soil smell like? List or describe any rocks, dead plants, or other non-living materials in the soil. List or describe any living things such as worms, roots, or insects. Do you see any roots with “rusty” red or orange soil around them?

Worksheet modified from WOW! Wonders of Wetlands
(Worksheet Q)

**Soils Data Chart**—modified from WOW! Wonders of Wetlands

<table>
<thead>
<tr>
<th>DEPTH FROM SOIL SURFACE</th>
<th>TEXTURE/ MOISTURE (How it feels)</th>
<th>SOIL PARTICLES (Describe or Identify them)</th>
<th>COLOR # (Use color chart)</th>
<th>OTHER FEATURES OR CREATURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 INCHES</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>4 INCHES</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>6 INCHES</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>12 INCHES</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>18 INCHES</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
</tbody>
</table>

In order to correctly complete the texture and moisture boxes, refer to the Key to Soil Texture by Feel on Worksheet R.
Key to Soil Texture by Feel

START

Place approximately 2 teaspoons of soil in your palm. Add water by drops and knead the soil until it feels like moist putty.

Does soil remain in a ball when squeezed?
Yes
No

Does soil make a weak ribbon less than two inches long before it breaks?
Yes
No

Does soil feel very gritty?
Yes
No

Is the soil really neither gritty nor smooth?
Yes
No

Does the soil feel very smooth?
Yes

Add dry soil to soak up water.

Is soil too wet?
Yes
No

SAND

Is soil too dry?
Yes
No

Place ball of soil between thumb and forefinger. Gently push the soil with thumb, squeezing it upward into a ribbon. Form a ribbon of uniform thickness and width (1/8 inch). Allow the ribbon to extend over forefinger until it breaks from its own weight. Does the soil form a ribbon more than one inch long?

Leamy

Sandy

Silty

Lean

Loamy

Sand

Does soil make a weak ribbon two to three inches long before it breaks?
Yes
No

Does soil make a medium ribbon two to three inches long before it breaks?
Yes
No

Does soil make a strong ribbon three inches or longer before it breaks?
Yes

Wet a small pinch of soil in palm until it is very wet. Rub soil around with your finger.

Sandy

Sandy

Sandy

Silty

Silty

Leamy

Lean

Leamy

Lean

Leamy

Leamy

Worksheet modified from WOW! Wonders of Wetlands

This lesson was designed by Ms. Kiki Karsh and Dr. Edward Bush of LSU Ag Center and Louisiana Sea Grant College Program. Some material was borrowed from the WOW: Wonders of Wetlands textbook.
Chapter 9

Lesson 8 Teacher’s Lesson Plan and Student Material for Global Warming
9.1 Introduction and Teacher’s Guide for the Lesson

This chapter incorporates the teacher’s lesson plan along with all student materials needed to complete the lesson. The main objectives of the Global Warming lesson are for students to learn how and why global warming occurs, then to discuss the positive and negative impacts global warming causes on Louisiana wetlands.

Global Warming and the Greenhouse Effect

Focus/Overview
This lesson focuses on the positive and negative impacts of global warming on wetlands, plants, and some animals. Students create a simulated greenhouse effect and measure changes in temperature. They also play a game making informative decisions based on environmental protection of wetlands and natural habitats.

Learning Objective(s)
The learner will be able to
- Discuss positive and negative effects of global warming on the environment.
- Learn how people add greenhouse gases to the atmosphere
- Learn what greenhouse gases are
- Speak about the numerous ways they can help restore the wetlands in Louisiana.

Louisiana Grade Level Expectations
7: GLE- 35 Identify resources humans derive from ecosystems (SE-M-A1)

7: GLE- 36 Distinguish essential roles played by biotic and abiotic components in various ecosystems (SE-M-A1)

Grade Level
7

Duration
1 hr class period
About 30 minute’s preparation

Setting
The classroom and an area outside with plenty of sunlight

Vocabulary
- Greenhouse Effect
- Global Warming
- Climate
- Nitrous oxide
- Carbon Dioxide
- Methane
7: GLE- 43 Identify and analyze the environmental impacts of humans’ use of technology (e.g. energy production, agriculture, transportation, human habitation (SE-M-A8)

8: GLE- 51 Analyze the consequences of human activities on global Earth systems (SE-M-A4)

Materials List
- Thermometers (2 per group)
- Jars (one per group)
- Hydropoly game board (1 per group)
- Sand glass (1 per group)
- Game pieces (6 per group)
- Dice (1 die per group)
- Decision cards (1 set per group)
- Instructional sheet
- STM questions
- Teacher evaluation
- Stop watch

Background Information
Before teaching this lesson look at websites or newspaper articles on global warming to get an idea of the multitude of things that the Earth’s rising temperature will affect besides an increase in heat. (Things to look for: migration patterns, overall- sea level rise, melting of glaciers, etc.) Thermometers that work best to simulate the greenhouse effect are outdoor thermometers. Use small six-inch thermometers that are easy to read. It is best if degrees Celsius are labeled. Students should record temperature changes in degrees Celsius as scientists in the real world do. One of the greenhouse gasses is Carbon Dioxide that comes from us breathing out after we breathe in oxygen, car emissions, and factory emissions. Nitrous oxide is also a greenhouse gas it is used in racing car engines to speed up cars, and it is also the laughing gas that surgeons and dentist use. Nitrous oxide is released from factories that burning fossil fuels. Another source of nitrous oxide is agricultural practices such as using fertilizer and burning crop residues. Methane is the third greenhouse gas we will discuss. Methane is released from the anaerobic decomposition of dead plants and animals in the marsh, known as marsh gas. Methane is also released when coal is burned. Methane can be released from cows. Cows make up about 20% of the methane in our atmosphere as they respire. Methane emerges when a cow BURPS!

Advance Preparation
5. Find articles on global warming to show students
6. Make sure each group has one jar or fish bowls work well too, two thermometers, a pencil, game board, game pieces, sand glass, dice, and decision-making cards.
Procedure 8.5 Lesson 8A Global Warming and the Greenhouse Effect

18. Start a discussion. Ask students if they know what global warming is, or if they know what the greenhouse effect is.
19. Have different students read out loud each of the definitions for Greenhouse Effect, Greenhouse gases, Climate change, and Global warming. When reading about the greenhouse gases describe each gas to the students and ask them if they know where these gases come from. If they do not, tell them (See background information).
20. Next, students will write down three impacts of global warming on the Earth. In each of their separate groups they can read the Major Changes Due to Global Warming list. These can be used in the three examples they write down. Have girls pay attention to the fact that rising temperatures and shorter winter seasons will cause more bugs to appear in the summer. Tell boys to pay attention to the fact that global warming is a major cause of waterfowl decline. The duck limits may lessen in hunting because of global warming.
21. Have students share their findings with the whole class.

Procedure 8.6 Lesson 8B Simulate the Greenhouse Effect

22. Ask students if they have ever read the temperature off of a thermometer. Show them the thermometers and tell them how to correctly read the temperature using degrees Celsius.
23. Read the instructions for simulating the greenhouse effect before going outside
24. Designate someone as the timekeeper for the class.
25. Have each group stand around their jar and two thermometers in a very sunny area. The timekeeper will call time out loud once after three minutes for the initial reading of the two thermometers, then students place a jar over one. Then for the next ten minutes at each minute the timekeeper calls time and students record both temperatures from each thermometer on the chart on page 73 of the student handout.
26. Once this activity is finished, go inside. Was there any difference between the covered verses non-covered thermometer? Did any groups have their thermometers on the sidewalk instead of the grass how did that affect temperature? Were any clouds present; was there a strong wind, what time of year is it? Have students determine what external factors might have influenced the differences between the two thermometers.
27. Read out loud with students the different ways they can contribute to global warming on page 74 of the student handout.

Procedure 8.7 Lesson 8C Hydropoly

28. Finally, read the instructions for the game “Hydropoly.” It is almost like “Monopoly.” Let students play until class time runs out. They are making environmental decisions.
**Blackline Master(s)**
These are worksheets that teachers can copy for students to complete the lesson/activity. Provide a blank copy as well as an answer key copy.

- Student Handout
  - Hydropoly game board
  - Decision making cards

**Assessment**
The global warming quiz (L8) and questions13, 14, 30, and 31 on the pre and post-test relate to this lesson.

**Resources**

CBS News: Breath Mints for Cows (5/08/04)

  [http://www.co2science.org/subject/n/summaries/nfixherbaceous.htm](http://www.co2science.org/subject/n/summaries/nfixherbaceous.htm)


Pawelski N. 1997. Global warming could sink coastal areas. (12/03/04).


The Franklin Institute Online. (n.d.) The greenhouse effect in a jar. (14/07/03).

Lesson 8A: Global Warming and the Greenhouse Effect

Have you ever heard of global warming and the greenhouse effect? Today we are going to simulate the greenhouse effect and discuss how it can negatively impact our world.

First we need to learn a few new terms to help us understand why the Earth is heating up.

**Greenhouse effect:**

- Greenhouse gases warm the Earth by trapping solar energy in the atmosphere like a glass covered greenhouse on a sunny day.

**Greenhouse gases:** These gases are carbon dioxide (CO$_2$), nitrous oxide (N$_2$O), and methane (CH$_4$). Greenhouse gases in the Earth’s atmosphere allow light to enter. The sunlight then heats the Earth’s surface. Without the greenhouse gases, Earth’s temperature would be about 60 °F colder! However large increases of greenhouse gases into the atmosphere can be harmful for the Earth. If too many greenhouse gases are present in our atmosphere several environmental changes could happen.

1. A rise in global temperature (1°F warmer for the last 100 years, up to an 11°F change by 2100).
2. Earlier spring times (earlier budding of leaves and flowers.)
3. Melting of glaciers leading to a rise in sea level which will make our wetlands disappear.
4. Higher risks of extreme weather such as hurricanes and flooding. (Cold spells would still occur in winter, but heat waves would be more common.)
5. Many more respiratory diseases will occur in people living in urban areas.
**Climate change:**

Climate is the long-term average of a region's weather events combined together. i.e. The annual quantity of precipitation may increase or decrease. (Scientists think rain would come in short, quick bursts, for instance one place may receive more than 2 inches in one day, which can lead to flooding)

**Global warming:**

The greenhouse effect works by allowing sunlight to enter the Earth's atmosphere (the air we breathe). As sunlight hits the land and water on the surface of the Earth it is absorbed thus heating the land. A portion of the heat energy is reflected back into space, but a portion of that energy is trapped by greenhouse gases. As a horticulturalist, would you think global warming would negatively or positively impact the Earth?

Having earlier spring times and warmer weather should make us happy because then our flowers bloom longer and we can grow tropical plants in colder climates. Think about it, wouldn’t it be nice to grow a banana tree in Colorado? So what’s the big deal?

In your groups try and come up with at least three negative impacts global warming will have on plants, animals, and wetlands. (Hint: Think of migratory birds (ducks), sea turtles, butterflies, and the impacts of plants flowering too early)

1. _________________________________________

2. _________________________________________

3. _________________________________________

(Worksheet developed by K. Karsh)
Let’s do a project that simulates the greenhouse effect!

1. Each group will be given two thermometers. Place both thermometers in the sun.

2. Now place a jar over one of your thermometers. This data will be recorded as covered, and the other as uncovered.

3. After three minutes record the temperature readings of each thermometer in the correct column on the data sheet on the next page in the INITIAL TEMPERATURE blanks.

4. For every 10 minutes record the readings of both thermometers on the data sheet (Worksheet S).

Which thermometer will register the higher temperature?

Circle:

Covered or Uncovered

Why?

St. Louis King of France student participating in a greenhouse effect simulation project.

Photo provided by D. Lindstedt

This lesson was modified from the Franklin Institute Online
**Temperature Data Sheet** (Modified from the Franklin Institute Online)
Initial temperature of uncovered thermometer _______ (After 3 min.)
Initial temperature of covered thermometer ________ (After 3 min.)

<table>
<thead>
<tr>
<th>Minutes After Initial Measurement</th>
<th>Uncovered Thermometer</th>
<th>Covered Thermometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>__________</td>
<td>__________</td>
</tr>
<tr>
<td>2</td>
<td>__________</td>
<td>__________</td>
</tr>
<tr>
<td>3</td>
<td>__________</td>
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<tr>
<td>4</td>
<td>__________</td>
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<tr>
<td>5</td>
<td>__________</td>
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<tr>
<td>6</td>
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<td>7</td>
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<td>__________</td>
<td>__________</td>
</tr>
<tr>
<td>9</td>
<td>__________</td>
<td>__________</td>
</tr>
<tr>
<td>10</td>
<td>__________</td>
<td>__________</td>
</tr>
</tbody>
</table>
How are people contributing to global warming?

We add greenhouse gases to our atmosphere every time we do the following things…

- Watch TV
- Wash clothes
- Turn on a light
- Microwave our food
- Ride in a car
- Listen to the radio
- Use the AC
- Use the dishwasher
- Use a hairdryer

All of these things cause us to use electricity. Look at the following diagram.

1. Plants remove CO$_2$ from the air.
2. When the plants died, they were buried in the Earth.
3. After millions of years their remains turned into coal and oil.
4. People mine the Earth for coal and oil, which are called “fossil fuels”.
5. When fossil fuels burn they release CO$_2$ and other greenhouse gases into the air.

Diagram and words provided by the United States Environmental Protection Agency
Lesson 8B- Hydropoly (Reprinted with permission from WOW textbook)

How environmentally friendly are you?? All year long we have learned about plants and wetlands. Now it’s your turn to play a game. The more environmentally friendly you are, the greater your chance at winning the game.

Here’s how to play Hydropoly!

1. Each player gets a game piece. Put your game piece on the start block.

2. Role the dice, the player with the highest number goes first.

3. Now role the dice. Move the number of spaces that the dice indicates.

4. If the player lands on a blank space his/her turn is over.

5. If the player lands on a roll again space, then he/she will roll again and move the number of spaces the dice indicates.

6. If the player lands on a LOSE YOUR TURN space then the next time around that player is skipped.
7. If the player lands on a Decision Card space. Then he or she must pick up the first card in the pile. An opponent will then read the top portion of the card out loud. Do not read the consequences portion. The player is given only two minutes to make a decision. The card will indicate how many spaces forward or backwards the player gets to move. Then it is the next players turn.

8. You can only reach the winners space by rolling the exact number on the dice. For example if the player is three spaces away and rolls a four he or she cannot move at all. They are stuck until their next turn.

Students at St. James Science and Math Academy playing Hydropoly; photos provided by K. Karsh

This lesson plan was created by Ms. Kiki Karsh and Dr. Edward Bush of LSU Ag Center and Louisiana Sea Grant College Program. Some material was borrowed from WOW: Wonders of Wetlands.
Chapter 10

Materials and Methods
10.1 Year 1-2003 Methods

Participants

The four schools chosen to participate in this program were Montegut Middle School (Montegut, LA. Terrebone Parish), Pierre Part Middle School (Pierre Part, LA. Assumption Parish), St. James Science and Math Academy (Vacherie, LA. Assumption Parish), and St. Louis King of France (Baton Rouge, LA. East Baton Rouge Parish). All schools were previous participants in the Coastal Roots program established by Louisiana Sea Grant College Program and the LSU AgCenter. Students in grades sixth through ninth participated in this project. A participating class (treatment group) and non-participating class (control group) were chosen from each school. The treatment and control class for each grade level were chosen from the same school, i.e. Montegut Middle School represented sixth grade students; Pierre Part Middle School represented seventh grade students; St. James Science and Math Academy represented both seventh grade and ninth grade students; St. Louis King of France represented eighth grade students. The treatment and control groups at each school were taught science class by the same instructor. In all 275 students test scores were used in our final data collection for year one.

Lesson Descriptions

Eight science lessons were taught by Ms. Kiki Karsh only to the treatment students at the participating schools. Each science lesson was taught during the scheduled science period lasting approximately one hour. Every lesson was divided into three or four smaller activities representing the overall theme of the lesson. The sub-lessons
ranged from fifteen to twenty minutes each. All lessons topics were chosen based upon the Louisiana Science Grade-Level Expectations at the middle school level.

**Testing Methods**

A 30 question pre-horticulture test (Appendix A.11) and a 25 question pre-Children’s Attitudes Towards the Environment Survey CATES (Musser, 1994) were given to both treatment and control classes prior to the lessons being taught. The CATES was designed by Dr.’s Musser and Malkus. The test is a survey designed to measure the environmental attitudes of students (Appendix A.12). The pre-tests were given to evaluate student’s level of science knowledge and environmental stewardship prior to the lessons.

After each lesson was taught a four question short-term memory (STM) quiz was given to the treatment class only (Appendix A.3-A.10). The four question short term memory quiz represented how well the students understood the taught material after the lesson. Each quiz was four questions long and multi choice, fill in the blank, and true or false questions. This quiz would later be compared with individual questions off of the post-horticulture test to determine if students were able to retain the taught information in both their long and short term memory.

After all lessons were taught a 30 question post-horticulture test was given to both treatment and control students. The 25 question post-CATES survey was also given after all lessons were taught to both treatment and control students.

**Statistical Analysis**

Pre- and post-horticulture tests for the first year of study were compared statistically using a paired t–test and an analysis of variance (ANOVA). Using both the
paired t-test and the ANOVA, differences were analyzed by school, gender, treatment, and grade-level. The post-horticulture test score was analyzed using an ANOVA and paired t-test against each individual STM quiz given at the completion of each lesson. Statistically comparing the STM quizzes and questions from the post-horticulture test enabled us to compare the student’s ability to retain the taught information in their short and long-term memory banks. The CATES was statistically analyzed using an ANOVA.

10.2 Year 2-2004 Methods

Participants

The same schools from 2003, Montegut Middle, Pierre Part Middle, St. James Science and Math Academy, and St. Louis King of France participated in 2004. After collecting data from the first year the results indicated that the lessons were best suited to students in sixth and seventh grades. Montegut Middle represented sixth grade. Pierre Part Middle, St. Louis King of France, and St. James Science and Math Academy all represented seventh grade students. Two treatment and two control classes were selected from St. James Science and Math Academy. Therefore a total of four classes were used from St. James Science and Math Academy. We chose to teach two treatment classes at St. James because two science teachers at that school were willing to participate in our program in Year 2. Treatment and control classes were chosen at each school. Treatment and control classes were taught by the same science instructor. Because one of the St. James treatment classes participated in only half of the lessons we chose to disregard that classes data. The treatment class at St. James attending only half of the lessons would skew the overall data for the treatment group. In all 188 students test scores were used in our final data collection for year two.
Lesson Descriptions

Lessons were modified from Year 1. Teachers turned in evaluation sheets on each lesson after it was taught in Year 1. Based on suggestions made by teachers and Year 1 test results, slight modifications were made to the methods used to teach lessons. Other changes in the lessons involved correlating the Louisiana Grade-Level Expectations to each lesson. The lesson topics remained the same as well as the lesson activities. The lessons included in this thesis are the revised lessons.

Testing Methods

The pre-horticulture test from Year 1 was modified for Year 2. Test modifications were made based on the modifications made to the lessons. The pre-horticulture test in Year 2 consisted of 32 questions (Appendix A.13). Each individual lesson was represented by four questions on the pre and post-horticulture test. The pre-horticulture test and pre-CATES survey were administered to all treatment and control classes before the lessons were taught. No changes were made to the CATES survey in Year 2 (Appendix A.12). The STM quizzes were given after each lesson to treatment classes only. Modifications to the 2004 STM quizzes were made based on revised lessons. Each STM quiz now consists of four multiple choice questions. Each question has a possible of four correct answers. Whereas the old STM quizzes may have been true or false or fill-in the blank, the new STM quizzes each had a possible of four answers to chose from. Now each question had a 25% chance of being answered correctly if the student guessed, whereas the year before students may have had a 50% chance of getting the correct answer if guessing. The questions on the STM quizzes are the same questions on the pre and post-horticulture test (Appendix A.14-A.21). The 32 question post-horticulture test
was administered to both treatment and control classes after all lessons had been taught. Scores from the STM quizzes were compared to individual questions on the post-horticulture test. Individual questions on the post-horticulture test represent the long-term memory LTM of the treatment students. The post-CATES was also administered to both treatment and control students after the lessons were taught.

**Statistical Analysis**

Pre- and post-horticulture tests were statistically analyzed using a paired t-test and an analysis of variance, or AVOVA as completed in the first year. The second year test scores will not be compared to the first year test scores. As mentioned previously, lessons and tests were altered for the second year of study after gaining better insight as to how students in this age range learn. The STM and LTM scores were compared using both paired t-tests and ANOVA’s. The CATES survey was statistically analyzed using an ANOVA.
Chapter 11

Results
11.1 Results: Year 1-2003

After analyzing the pre and post-horticulture test scores we found significant improvements in test scores for students who participated in the program (treatment group) verses students who did not participate (control group). When the program began, the treatment students and control student’s horticulture pre-tests scores varied on average of 0.34 points, the treatment group was slightly higher but not significantly higher. After comparing overall scores between treatment students and control students in the post-horticulture test we saw an average of 6.7 point difference, the treatment group being statistically higher (Table 1). Although we did not statistically analyze the difference between the treatment students pre and post scores we did see an average increase of 11 points. This is similar to an increase in one letter grade for middle school students.

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Pre-Test</td>
</tr>
<tr>
<td>Post-Test</td>
</tr>
</tbody>
</table>

Means within each row having different letters are significantly different. (Means are % out of 100%)
Z Mean score on general horticulture test. (n=275.)
N.S. =Not significant; ** Significant at p ≤ 0.01.

Each question on the pre-horticulture and post-horticulture test pertained to a specific lesson. After comparing the individual questions pertaining to each lesson, we
were able to identify individual lessons the students improved upon from the pre- to post-horticulture tests. Significant improvements were found for lessons one, three, four, seven, and the total score (T-score) on the post-test. The lesson differences found between the pre- and post-horticulture tests were obtained comparing the treatment and control groups. Lessons one, three, and four were significant at \( p \leq 0.05 \). Lesson seven and T-score were significant at \( p \leq 0.01 \) (TABLE 2). There were no significant differences found in gender, grade-level, or school.

**TABLE 2. Results of the Individual Lessons on the General Horticulture Test in 2003.**

<table>
<thead>
<tr>
<th>Students (Post-test)</th>
<th>Lesson</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>T-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
<td>34^a^</td>
<td>54^a^</td>
<td>56^a^</td>
<td>31^a^</td>
<td>25^a^</td>
<td>60^a^</td>
<td>40^a^</td>
<td>43^a^</td>
<td>41^a^</td>
</tr>
<tr>
<td>Treatment</td>
<td></td>
<td>42^b^</td>
<td>50^a^</td>
<td>63^b^</td>
<td>37^b^</td>
<td>27^a^</td>
<td>66^a^</td>
<td>51^b^</td>
<td>45^a^</td>
<td>47^b^</td>
</tr>
<tr>
<td>Significance</td>
<td></td>
<td>* N.S.</td>
<td>*</td>
<td>*</td>
<td>N.S.</td>
<td>N.S.</td>
<td>**</td>
<td>N.S.</td>
<td>**</td>
<td></td>
</tr>
</tbody>
</table>

Means within each column having different letters are significantly different.

\( ^z \) Mean score on long term memory test (n=275.)

N.S. = Not significant; * Significant at \( p \leq 0.05 \); ** Significant at \( p \leq 0.01 \).

Significant differences between short term memory (STM) and long term memory (LTM) at \( p \leq 0.0001 \) were found for every lesson, including the total score except for lesson six. The STM tests had higher scores than the LTM tests (Figure 1). Again, STM scores are the small quizzes given immediately after the lesson was taught. LTM scores for this test are the sets of individual questions on the post-horticulture test that relate to each lesson.
Figure 1. Short and Long Term Memory Averages in 2003. N.S. = Not significant; **** Significant at $p \leq 0.0001$ (n=275).

We choose to use an ANOVA statistical test to measure differences in the environmental attitudes of students. We found no significant differences in the scores of pre- and post-CATES between the treatment and control groups. However, one significant difference occurred at Pierre Part Middle, where females scored significantly higher than males in one class. Otherwise, differences in gender, grade-level, and treatment had no significant influences.

11.2 Discussion: Year 1-2003

TABLE 1 indicates that students who participate in the horticultural-coastal lessons significantly improved their overall scores on the post-horticulture test as compared to the students who did not participate. Because the pre- and post-
horticulture tests reflect Grade Level Expectations or GLE’s, we have determined that the treatment groups better understand the main science concepts involved in these lessons taught at the middle school level after participating in the horticulture-coastal lessons. Each lesson re-introduced or taught for the first time GLE’s that students are required to learn at specific grade levels. Therefore, participating students graduate from middle school better equipped with the knowledge that the state requires students to posses as they move to the next grade level.

When we analyzed individual specific questions relating to each lesson on the pre- and post-horticulture test for both the treatment and control students test scores, we discovered that in lessons one, three, four, seven, and the total score; the treatment group significantly exceeded the control group. This finding is important as it indicates that specific lessons are effective methods to teach horticulture to young students. Mentioned previously, each lesson is geared towards grade specific educational benchmarks or GLE’s that the state of Louisiana requires all public school teachers to use as a guide for their curriculum. Results indicate the horticultural-coastal lessons prove to be good curriculum sources for teachers who need science curriculum based upon the GLE’s.

We found no statistical difference in school or gender. The lessons serve as a non-gender biased source of science lessons. This is important because females tend to lose interest in science. The fact that there were no statistical differences between male and female students supports our lessons.

Significant differences in STM and LTM data (Figure 1) show higher scores on the STM quizzes with the exception for lesson number six. The STM quizzes were
given immediately after each lesson was taught. The post-horticulture test was given at the end of the school year, almost a complete year after some of the lessons had been taught. It is understandable that students would score slightly higher on the STM quizzes. However, the LTM scores for each lesson should have been higher. The one exception was lesson number six or “Plant Genetics”. We hypothesized that the two scores LTM and STM would be similar for each lesson and that there would be no difference in the short-term and long-term memory of students. In order to resolve this problem we modified all lessons and tests for use in the second year of study (2004 school year). Each lesson was critiqued by the participating class teachers. Using the teacher’s suggestions in addition to revising the teaching strategies used in lesson six, we modified the lessons to serve as better indicators of student knowledge. Short-term memory quiz questions and questions on the post-horticulture test were not the exact same questions. However, the two sets of questions did characterize the same basic material. In addition, STM quiz questions had multiple methods for answering each question such as fill in the blank, multi-choice, true or false, and short answer; the LTM or post-horticulture test questions were strictly multiple choice. Although questions on the post-horticulture test were all multiple choice, each question had anywhere from two to four choices that could be the correct answer. Our newly modified STM and LTM tests have four questions geared towards each lesson. The STM quizzes consist of four questions each. The LTM or entire post-horticulture test contains thirty-two questions. The questions on the STM quizzes are the exact same questions on the LTM test. The questions are all multi-choice and have exactly four possible answer choices. These changes make the second year tests (2004 school year)
a much more quantifiable and reliable set of tests enabling us to determine differences in short-term and long-term memory.

The CATES data shows no significant differences between treatment and control groups in this project. It also shows no significant differences in female and male students with the exception of female students at Pierre Part Middle School. Female students scored significantly higher than male students at Pierre Part. This finding warranted the use of this scale again in the second year of study (2004 school year). All treatment students should have equally high attitudes towards the environment after the program. Nevertheless, when females excel in scientific areas, researchers must give particular attention to these results as female students tend to lose interest in math and science (Hatchell, 1998). All students tended to score high in the pre- and post-CATES leading to the conclusion that students in this study are fond of the environment and care about its protection. We believe if our sample size had been slightly larger we might have found significant differences in post-CATES scores.

11.3 Results: Year 2-2004

Statistical differences were found between the treatment and control groups on the post-horticulture tests. Table 3 represents each school individually. There was a very significant difference between treatment and control post-horticulture test scores found at each school favoring the treatment group. Only Montegut Middle School showed a slight significant difference on the pre-horticulture test between treatment and control groups, in favor of the treatment group (Table 3).
<table>
<thead>
<tr>
<th>School</th>
<th>Pre-test Treatment</th>
<th>Pre-test Control</th>
<th>Significance</th>
<th>Post-test Treatment</th>
<th>Post-test Control</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mont</td>
<td>37.2a</td>
<td>28.2b</td>
<td>**</td>
<td>65.3a</td>
<td>30.6b</td>
<td>****</td>
</tr>
<tr>
<td>PP</td>
<td>42.5a</td>
<td>37.7a</td>
<td>N.S.</td>
<td>57.2a</td>
<td>32.6b</td>
<td>****</td>
</tr>
<tr>
<td>SLKF</td>
<td>44.8a</td>
<td>38.2a</td>
<td>N.S.</td>
<td>69.5a</td>
<td>43.4b</td>
<td>****</td>
</tr>
<tr>
<td>SMA</td>
<td>37.8a</td>
<td>33.7a</td>
<td>N.S.</td>
<td>60.1a</td>
<td>45.3b</td>
<td>***</td>
</tr>
</tbody>
</table>

Means within each row having different letters are significantly different. N.S. = Not significant; **** Significant at p ≤0.0001; *** Significant at p≤ 0.001; ** Significant at p≤ 0.01 (n=188).

The post-horticulture test consisted of thirty-two questions. Eight lessons were taught throughout the school year. Four questions on the post-horticulture test related to each lesson. Using an ANOVA test we compared the average score of each set of four questions for both treatment and control groups. The treatment group shows a large statistical increase at p≤0.0001 when compared with the control group for every lesson (Table 4).

<table>
<thead>
<tr>
<th>Student</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control</strong></td>
<td>43b²</td>
<td>40b</td>
<td>47b</td>
<td>31b</td>
<td>54b</td>
<td>42b</td>
<td>41b</td>
<td>23b</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td>59a</td>
<td>69a</td>
<td>64a</td>
<td>56a</td>
<td>75a</td>
<td>62a</td>
<td>66a</td>
<td>49a</td>
</tr>
<tr>
<td><strong>Significance</strong></td>
<td>****</td>
<td>****</td>
<td>****</td>
<td>****</td>
<td>****</td>
<td>****</td>
<td>****</td>
<td>****</td>
</tr>
</tbody>
</table>

Means within each column having different letters are significantly different.

²Mean score on long-term memory test (n=188.)

N.S. = Not significant; **** Significant at p ≤ 0.0001.

Significant differences were found for every lesson with the exception of lessons 6 and 7 when comparing STM and LTM. Short-term memory averages came from the quizzes given immediately after each lesson. LTM averages came from questions related to individual lessons on the post-horticulture test (Table 5). Results shown are for the treatment group only.

### TABLE 5. Short-Term and Long-Term Memory Scores in 2004 Overall Schools.

<table>
<thead>
<tr>
<th>Memory</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STM</strong></td>
<td>84.7²</td>
<td>77.1</td>
<td>84.4</td>
<td>68.8</td>
<td>84.1</td>
<td>65.4</td>
<td>70.2</td>
<td>74.0</td>
</tr>
<tr>
<td><strong>LTM</strong></td>
<td>58.7</td>
<td>69.4</td>
<td>64.1</td>
<td>56.3</td>
<td>74.7</td>
<td>68.2</td>
<td>65.6</td>
<td>48.8</td>
</tr>
<tr>
<td><strong>Significance</strong></td>
<td>****</td>
<td>***</td>
<td>****</td>
<td>****</td>
<td>****</td>
<td>N.S.</td>
<td>N.S.</td>
<td>****</td>
</tr>
</tbody>
</table>

N.S. = Not significant; **** Significant at p ≤ 0.0001; *** Significant at p ≤ 0.001

Means combined overall schools (STM n=76; LTM n=76).
Unlike the first year of study, in the second year there were statistical
differences in student attitude towards the environment. The scale used to test
environmental attitude was the same as the first year, the CATES. Using an ANOVA
and paired t-test we analyzed for differences between the control and treatment
groups. The treatment group showed a significant increase in environmental
stewardship over the control group on the CATES post-test (Table 6).

**TABLE 6. Results of the Children’s Attitudes Towards the Environment Scale in 2004.**

<table>
<thead>
<tr>
<th>Test time</th>
<th>Control</th>
<th>Treatment</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-CATES</td>
<td>2.53aZ</td>
<td>2.61a</td>
<td>N.S.</td>
</tr>
<tr>
<td>Post-CATES</td>
<td>2.50a</td>
<td>2.78b</td>
<td>****</td>
</tr>
</tbody>
</table>

Means within each row having different letters are significantly different.
Z Mean score on CATES (n=188.)
N.S. = Not significant; **** Significant at p \( \leq 0.0001. \)

**11.4 Discussion: Year 2-2004**

As a whole the revised horticulture lessons far exceeded results gained in the
first year of study (2003-2004 school year). Throughout the first year of study (2003-
2004 school year), teacher comments were collected for each lesson. The teachers
were asked to give their professional suggestions for improving each individual
lesson. Lessons were modified according to teacher suggestions. Other modifications
of lessons resulted from our own statistical data. The first year (2003-2004 school
year) results revealed a significant improvement of the treatment group in lessons 1, 3,
4, and 7. We looked at the methods used to teach these specific lessons and applied
them to the other lessons. Statistical analysis of data from year 1 indicated that lesson
6 (Plant Genetics) was the only lesson with no statistical difference between the long-term and short-term memory. Based on this finding the Year 2 lessons were modified according to lesson six, as we would desire all student long-term memory to be equal to student’s short-term memory.

Highly significant improvements in student’s knowledge of horticulture concepts were found on the post-horticulture test for each school. The treatment class in each school improved their overall test scores at $p \leq 0.0001$ (Table 3). Results indicate that our modified lessons and tests improved the overall horticulture knowledge of students. The post-horticulture test scores show an average increase of 25 points between control and treatment students. An increase of 10 points on a regular school test result in a higher letter grade, i.e. 70 to an 80 equals a C to a B. Because the treatment group scored on average 25 points higher than the control groups on the post-horticulture test this suggests that the treatment group would be at least two letter grades above the control group. The modifications of lessons did not change any of the GLE’s used in Year 1 from GLE’s used in Year 2. This suggests that these lessons are excellent tools for teaching state-guided science curriculum.

Analyzing the data by lesson, we saw significant improvements in the treatment student’s horticulture knowledge for every lesson in the Year 2 at a significance of $p \leq 0.0001$. The overall test score improvements indicate that students learned the main concepts taught throughout the lessons. The statistics showing improvements for the treatment class in every lesson implies that each lesson improves student knowledge in specific areas (Table 4).
Improvements on lessons from Year 1 to Year 2 were made to decrease difference between students STM and LTM. In Year 1 the only lesson indicating no significant difference was lesson 6. However, in Year 2 there were no significant differences in both lesson 6 and lesson 7. Differences between years may have resulted from improvements in lessons.

First year statistical results showed no improvements for either the treatment or control groups on the Children’s Attitude Towards the Environment Scale, or CATES. However in the second year the CATES was again administered and analyzed by grade, sex, treatment, and school. Statistical significances were found for treatment only. Our treatment group showed a significant increase in environmental stewardship by $p \leq 0.0001$ over the control group in the post-CATES. There were no significant differences found in the pre-CATES between control and treatment groups. Increases in environmental stewardship and attitudes may be attributed to the hands-on experiences the treatment students had with coastal plants, horticulture and environmental issues. Increases in the treatment groups post-CATES score may also have resulted from the modified lessons in 2004. Also in our second year of testing statistical variability was reduced by assigning individual student identification numbers.
Chapter 12

Conclusions
Students who participated in the “Integrating Horticulture Science and Coastal Issues into the Middle School Science Curriculum Program” scored higher on the horticulture based tests than students who did not participate. Results from the pre- and post-horticulture tests indicated no significant differences between the treatment and control groups at the time of pre-test in Year 1. The post-test scores of treatment students were significantly higher than the scores of control students in both Year 1 and Year 2. The horticulture lessons were geared towards Louisiana Grade-Level Expectations. Treatment students receiving higher scores than control students on the post-test indicates students who participate in this program are better taught the state regulated Grade-Level Expectations than non-participating students.

We analyzed short-term memory (STM) and long-term memory (LTM) of students participating in this program. Plant Genetics (Lesson 6), indicated no differences in STM and LTM scores for treatment students in Year 1. No differences between STM and LTM indicated a deeper understanding of this lesson. So based on the results we modified methods used to teach the students so that in the second year all lessons would be similar to Lesson 6. After modifications in lesson plans were made, we found that there were no significant differences between LTM and STM in lessons 6 and 7 in Year 2. Students were able to retain the information taught in both lessons 6 and 7 from the time the lesson was taught until the post-test was administered. In Year 1 students began this program in September and finished in May. In Year 2 students began the program in August and finished in December.

Environmental stewardship was also analyzed in this program. In Year 1 we found no significant improvements in environmental stewardship in treatment or control
students, with the exception of female students scoring significantly higher than male students in one school. Because we found this one significant difference we used the Children’s Attitudes Towards the Environment Scale (CATES) again in Year 2. In Year 2, there were no differences in treatment and control students on the pre-CATES, but the post-CATES results indicated a highly significant difference between control and treatment students favoring the treatment students. Results from this scale indicate that the hands-on activities used in the program gave student the opportunity to interact with the environment thus raising their environmental awareness.

Statistical analysis were done comparing school, gender and grade level. We found no significant differences within the different variables. We hypothesized that there would not likely be any differences between schools because all students live in Louisiana and all schools had dynamic science teachers. However, we were surprised to find that there were no significant differences between the genders. Researchers have recently paid attention to the large gap between female and male science scores. Females are not only scoring lower on standardized science tests but also less likely to enter fields related to science. We were pleased that our statistical analysis showed no differences among the sexes. Our program consists of non-gender biased material that equally improves the science-knowledge of both male and female students. Most importantly, the lessons used in “Integrating Horticulture Biology and Coastal Issues into the Middle School Science Curriculum Program” increased horticulture-science knowledge and environmental attitudes of treatment students.
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### A.1 School Demographics for Participating Schools in 2003

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<tr>
<th>School</th>
<th>Address</th>
<th>Enrollment</th>
<th>Student : teacher</th>
<th>Type</th>
<th>District</th>
<th>Teachers Name</th>
<th>Grade Level</th>
<th># of control students</th>
<th># of treatment students</th>
<th>% on free or reduced lunch</th>
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<tbody>
<tr>
<td>Montegut Middle</td>
<td>138 Dolphin St. Montegut, La. 70632</td>
<td>650</td>
<td>16.3</td>
<td>Public</td>
<td>Terrebonne Parish School Board</td>
<td>Mrs. Mary LeVron</td>
<td>6th</td>
<td>51</td>
<td>27</td>
<td>60%</td>
</tr>
<tr>
<td>Pierre Part Middle School</td>
<td>3321 Highway 70, Pierre Part, La. 70359</td>
<td>370</td>
<td>14.2</td>
<td>Public</td>
<td>Assumption Parish School Board</td>
<td>Mr. John Giambrone</td>
<td>7th</td>
<td>43 (8th)</td>
<td>22 (7th)</td>
<td>64%</td>
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<tr>
<td>St. James Science and Math Academy</td>
<td>3125 Valcour Ave, Vacherie, La. 70952</td>
<td>278</td>
<td>18.1</td>
<td>Public</td>
<td>St. James Parish School Board</td>
<td>Mrs. Valerie Stewart (9th), Mrs. Sylvia Beard (7th), Mrs. Morrill (7th-9th)</td>
<td>7th and 9th</td>
<td>17 (7th)</td>
<td>15 (6th)</td>
<td>65%</td>
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<tr>
<td>St. Louis King of France</td>
<td>2311 S. Sherwood Forest Blvd, Baton Rouge, La. 70808</td>
<td>390</td>
<td>16.1</td>
<td>Private (Roman Catholic)</td>
<td>National Catholic Educational Association (NCEA)</td>
<td>Mrs. Linda Gauthier</td>
<td>8th</td>
<td>22</td>
<td>23</td>
<td>0%</td>
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### A.2 School Demographics for Participating Schools in 2004

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<th>School</th>
<th>Address</th>
<th>Enrollment</th>
<th>Student : teacher</th>
<th>Type</th>
<th>District</th>
<th>Teachers Name</th>
<th>Grade Level</th>
<th># of control students</th>
<th># of treatment students</th>
<th>% on free or reduced lunch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Montegut Middle</td>
<td>138 Delphin St. Montegut, La. 70632</td>
<td>650</td>
<td>16.3</td>
<td>Public</td>
<td>Terrebonne Parish School Board</td>
<td>Mrs. Mary Leventon</td>
<td>6th</td>
<td>25</td>
<td>22</td>
<td>60%</td>
</tr>
<tr>
<td>Pierre Part Middle School</td>
<td>3321 Highway 70 Pierre Part, La. 70339</td>
<td>370</td>
<td>14.2</td>
<td>Public</td>
<td>Assumption Parish School Board</td>
<td>Mr. John Giambrone</td>
<td>7th</td>
<td>24</td>
<td>28</td>
<td>64%</td>
</tr>
<tr>
<td>St. James Science and Math Academy</td>
<td>3125 Valeur Amie Street Vacherie, La. 70090</td>
<td>278</td>
<td>18.1</td>
<td>Public</td>
<td>St. James Parish School Board</td>
<td>Mrs. Sylvia Beard (7th), Ms. Vicknair (7th Control)</td>
<td>7th</td>
<td>34</td>
<td>15 applicable</td>
<td>31</td>
</tr>
<tr>
<td>St. Louis King of France</td>
<td>2311 S. Sherwood Forest Baton Rouge, La. 70808</td>
<td>390</td>
<td>16.1</td>
<td>Private (Roman Catholic)</td>
<td>National Catholic Educational Association (NCEA)</td>
<td>Mrs. Linda Gauthier</td>
<td>7th</td>
<td>27</td>
<td>17</td>
<td>0%</td>
</tr>
</tbody>
</table>
Appendix B Student Tests Year 1


School Name ______________________

1. Which rank is missing? _______________
   Kingdom, Division, Class, Order, Genus, Species

2. Is this the correct way to write the scientific name of a plant?
   Helianthus Annus
   Circle    YES   or    NO

3. Is an Irish Potato a tuber?  Circle YES or NO.

Prepared by Miss Kiki Karsh and Dr. Edward Bush.

School Name __________________________

1. Name one adaptation of a wetland plant that helps it survive in its unique environment.  

_______________________________________________________________

2. What is a habitat?

A. An area where a plant can normally be found.  
B. The area where a plant cannot survive.

Prepared by Miss Kiki Karsh and Dr. Edward Bush.

School Name: ____________________________________________________

Circle one

I am Male Female

1. What gives leaves their green color?
   A. Chlorophyll
   B. Xanthophyll
   C. Carotens

2. A leaf needs SUNLIGHT, CARBON DIOXIDE, and WATER for photosynthesis to occur. Photosynthesis is the process by which a plant makes its own food. TRUE or False?
   Circle your answer!
   TRUE FALSE

Prepared by Miss Kiki Karsh and Dr. Edward Bush.

School Name: ______________________________________

Circle the correct answer!

I am Male Female

1. Microorganisms in the soil break down food scraps, leaves, paper, etc. When they decompose different materials what form of energy is given off?
   A. Chemical
   B. Heat
   C. Nuclear

2. Name 1 thing other than the temperature that you must monitor while composting?
   ____________________________________________

3. Your compost will decompose faster if you use a ____________ container.
   A. Smaller (1'x1'x1’)
   B. Larger (3'x3'x3’)

Prepared by Miss Kiki Karsh and Dr. Edward Bush.

School Name: _______________________________

Circle the correct answer!

I am Male Female

1. What are the correct names of the female flowers parts?
   A. Anther and filament
   B. Stigma, style, and ovary
   C. Petal

2. Pollen affects people’s ________?
   A. Allergies
   B. Height
   C. Hair color

3. Name one way a plant can be pollinated?

4. Name one food that must be pollinated in order to exist?

Prepared by Miss Kiki Karsh and Dr. Edward Bush.

School Name: _______________________________

Circle one:

I am MALE FEMALE

1. A genotype is the genetic code or DNA of a plant. The phenotype is what the plant actually looks like. What is the MOST influential factor on a plant's phenotype?

   A. The amount of hairs on a plant
   B. The plant's ability to flower
   C. The environment

2. Circle true or false for this statement.

   A plant's Dominant trait will usually mask the plant's Recessive traits.

   TRUE FALSE

Prepared by Miss Kiki Karsh and Dr. Edward Bush.

School Name ______________________________

Circle One!

I am Male Female

1. What is media?
   a. A wetland plant
   b. “Soil less” dirt
   c. Fertilizer

2. Name one reason why plants are important to wetlands?

3. What is the Munsell Color Book?
   a. A book about wetland plants
   b. A book about wetland animals
   c. A book about soils

Prepared by Miss Kiki Karsh and Dr. Edward Bush.

School Name: __________________________________

Circle One

I am:   Male         Female

1. As greenhouse gases trap heat, what happens to the Earth’s atmosphere?

__________________________________________________________________________

2. Give one example of how people add greenhouse gases to the Earth’s atmosphere.

__________________________________________________________________________

3. Tell me why you think it is important to protect Louisiana’s wetlands.

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

Prepared by Miss Kiki Karsh and Dr. Edward Bush.

General Horticulture Test

School Name ______________________

1. What is Horticulture?
   A. The study of forestry
   B. A science and art of cultivating, processing, and marketing fruits, vegetables and trees/shrubs.
   C. Vegetable production
   D. Large fields of plants

2. What is Morphology?
   A. The internal structure of a plant
   B. The external structure of a plant
   C. The way a plant develops
   D. A plant mutation

3. Circle the correct order for scientific classification.
   A. Kingdom, Phylum, Class, Order, Family, Genus, Species
   B. Kingdom, Phylum, Order, Family, Genus, Class, Species
   C. Kingdom, Order, Family, Phylum, Genus, Class, Species
   D. Kingdom, Species, Order, Family, Phylum, Genus, Class

4. Which do you do when writing a scientific name of a plant?
   A. Underline the genus and species
   B. Capitalized the Genus
   C. Italicize both genus and species if you do not underline
   D. All of the above

5. What does the xylem transport?
   A. Water
   B. Food
   C. Sunlight
   D. Chlorophyll

6. What is the function of a sepal?
   A. The seed coat
   B. Makes pollen
   C. Attracts insects
   D. The initial green leaves that cover the flower
7. Pollen is found on the?
   A. Style
   B. Ovary
   C. Anther

8. Adding lime to soil makes it more ________?
   A. Acidic
   B. Basic

9. The pH scale runs from
   A. 0-7
   B. 1-14
   C. 0-14
   D. 0-16

10. A weed is?
    A. Any plant where it is not supposed to be
    B. Only dandelions
    C. Only grass
    D. None of the above

11. The process of photosynthesis produces?
    A. Water for the plant
    B. Food for the plant
    C. Chlorophyll for the plant.

12. What is media?
    A. Soil
    B. Fertilizer
    C. Pesticides
    D. All of the above

13. What are plants with male and female flowers on separate plants called?
    A. Dioecious
    B. Monoecious
    C. Cultivar
    D. Mutated

14. What is the loss of water through plants stomata?
    A. Respiration
    B. Transpiration
15. Which part of the plant contains chlorophyll?
   A. Vacuole
   B. Cell wall
   C. Chloroplast
   D. Cytoplasm

16. Monocots have how many cotyledons?
   A. 1
   B. 4
   C. 2
   D. 7

17. What is a leaf margin?
   A. The parallel lines inside the leaf
   B. The stem that attaches the leaf to the branch
   C. The outer edge of the leaf blade
   D. The hairy underside of the leaf

18. Fruit comes from which part of the plant?
   A. Petals
   B. Flower
   C. Stem
   D. Root

19. Plants are important because they take in__________ and give off__________.
   A. Oxygen, carbon dioxide
   B. Carbon dioxide, oxygen
   C. Ozone, carbon dioxide

20. What causes water vapor to condense?
   A. Decrease in temperature
   B. Increase in temperature
   C. Precipitation from the clouds
   D. Rise in air pressure

21. Soil with a large percentage of sand in it will feel
   B. Gritty
   C. Slick
   D. Crumbly
   E. Soggy
22. An ecosystem is an environment in which many organisms (animals and plants) interact with each other in the same environment. What do you think would happen if all the plants in it were killed?
A. The ecosystem would stay the same
B. The ecosystem would not survive
C. The ecosystem would survive
D. None of the above would happen

23. As plant material is decomposed through composting, it gives off energy in the form of __________?
A. Light energy
B. Heat energy
C. Food energy
D. Solar energy

24. Which of the following plant traits is not inherited?
A. Flower color
B. Fruit type
C. Leaf shape
D. Insect damage

25. **Abiotic** is a __________ part of the ecosystem, and **biotic** is a _________ part of the ecosystem?
A. Living, non-living
B. Non-living, living
C. Aquatic, land organism
D. Land organism, aquatic

26. Plants play an important role in soil erosion because their roots
A. Channel rainwater away from the plant
B. Hold the soil in place
C. Create a trench for rainwater
D. Dry the soil around the plant

27. Genotype is affected by a plants _______?
A. Genes
B. Environment
C. Available water
D. Available fertilizer

28. What is the Munsell book?
A. A plant identification book
B. Weather forecasting book
C. Soil identification book
D. Turf grass identification book
29. Why should we use native rather than non-native plants in our landscapes?
   A. Extra irrigation is not necessary
   B. They are adapted to the climate
   C. They will not invade or overtake other plants
   D. All of the above

30. Tree leaves change color in the fall. We can see the green chlorophyll in the summer. Are the other colors red, yellow, and purple also present in the summer even if people cannot see them?
   A. True
   B. False

Prepared by Miss Kiki Karsh and Dr. Edward Bush.

Over Name _____________________________

1. Some people like to leave water running while they brush their teeth. 
   1  2
   Other people always turn water off while they brush their teeth. 
   3  4

2. Some students use both sides of the paper when they draw or write.
   1  2
   Other students use only one side of the paper when they draw or write.
   3  4

3. Some people think we should throw away things when we are done with them.
   1  2
   Other people think we should recycle things.
   3  4

4. Some people think dams on rivers are bad because they hurt plants and animals.
   1  2
   Other people think dams on rivers are good because they prevent floods.
   3  4

5. Some people like to bring home plants or animals they find outside.
   1  2
   Other people like to look at plants or bugs outside but they never bring them home.
   3  4

6. Some people don’t like to make bird feeders or bird houses.
   1  2
   Other people like to make bird feeders or bird houses.
   3  4

7. Some people think outdoor lights should be turned off at night because they use electricity.
   1  2
   Other people think outdoor lights should be left on at night because they keep us safer.
   3  4

8. Some people think humans are more important than animals.
   1  2
   Other people think people and animals are equally important.
   3  4
9. Some people are concerned about the rainforest.
   \[ \begin{array}{ll}
   1 & 2 \\
   \end{array} \]

10. Some people think we should build more landfills to hold our garbage.
   \[ \begin{array}{ll}
   1 & 2 \\
   \end{array} \]

11. Some people like visiting national parks.
   \[ \begin{array}{ll}
   1 & 2 \\
   \end{array} \]

12. Some people don’t worry about animals becoming extinct.
   \[ \begin{array}{ll}
   1 & 2 \\
   \end{array} \]

13. Some people throw away things when they are done with them.
   \[ \begin{array}{ll}
   1 & 2 \\
   \end{array} \]

14. Some people think we should use chemicals and fertilizers in our gardens.
   \[ \begin{array}{ll}
   1 & 2 \\
   \end{array} \]

15. Some people pick up trash and throw it away.
   \[ \begin{array}{ll}
   1 & 2 \\
   \end{array} \]

16. Some people don’t sort out their trash.
   \[ \begin{array}{ll}
   1 & 2 \\
   \end{array} \]

17. Some people like to live where there are lots of plants and animals.
   \[ \begin{array}{ll}
   1 & 2 \\
   \end{array} \]

18. Some people touch or catch wild animals.
   \[ \begin{array}{ll}
   1 & 2 \\
   \end{array} \]

Other people aren’t concerned about the rainforest.
\[ \begin{array}{ll}
3 & 4 \\
\end{array} \]

Other people think we should find other ways to deal with garbage.
\[ \begin{array}{ll}
3 & 4 \\
\end{array} \]

Other people don’t like to go to national parks.
\[ \begin{array}{ll}
3 & 4 \\
\end{array} \]

Other people worry about animals becoming extinct.
\[ \begin{array}{ll}
3 & 4 \\
\end{array} \]

Other people reuse things or give them to other people to use.
\[ \begin{array}{ll}
3 & 4 \\
\end{array} \]

Other people think we shouldn’t use chemicals and fertilizers in our gardens.
\[ \begin{array}{ll}
3 & 4 \\
\end{array} \]

Other people don’t like to pick up smelly trash.
\[ \begin{array}{ll}
3 & 4 \\
\end{array} \]

Other people sort their trash and recycle it.
\[ \begin{array}{ll}
3 & 4 \\
\end{array} \]

Other people like to live where there are lots of people.
\[ \begin{array}{ll}
3 & 4 \\
\end{array} \]

Other people never touch or catch animals they find outside.
\[ \begin{array}{ll}
3 & 4 \\
\end{array} \]
19. Some people don’t like to carpool because they don’t like being crowded in the car.

1 2

Other people like to carpool even if it is a little crowded.

3 4

20. Some people are excited about solar energy.

1 2

Other people don’t care about solar energy.

3 4

21. Some people believe they should be able to live wherever they want.

1 2

Other people believe they should be careful not to destroy animal’s homes.

3 4

22. Some people worry about air pollution.

1 2

Other people don’t worry about air pollution.

3 4

23. Some people think we should be able to hunt all wild animals.

1 2

Other people think that animals need protection.

3 4

24. Some people turn off the lights when they leave.

1 2

Other people leave the lights on.

3 4
25. Some people get their Parents to drive them places They want to go
1 2

Other people ride their bikes or walk when they can
3 4
Appendix C Student Tests Year 2


General Horticulture Test

School Name____________________ Student # ________

1. What is Horticulture?
   A. The study of forestry
   B. A science and art of cultivating, processing, and marketing fruits, vegetables and trees/shrubs.
   C. Vegetable production
   D. Large fields of plants

2. A plant’s dominant trait ____________ a plant’s recessive trait?
   A. Masks (Covers)
   B. Is hidden by
   C. Helps
   D. Gives color to

3. Circle the correct order for scientific classification.
   A. Kingdom, Phylum, Class, Order, Family, Genus, Species
   B. Kingdom, Phylum, Order, Family, Genus, Class, Species
   C. Kingdom, Order, Family, Phylum, Genus, Class, Species
   D. Kingdom, Species, Order, Family, Phylum, Genus, Class

4. Which do you do when writing a scientific name of a plant?
   A. Underline the genus and species
   B. Capitalized the Genus
   C. Italicize both genus and species if you do not underline
   D. All of the above

5. What does the xylem transport?
   A. Water
   B. Food
   C. Sunlight
   D. Chlorophyll
6. What are the correct names of the MALE flower parts?
   A. Petal
   B. Anther and filament
   C. Stigma, style, and ovary
   D. Leaves

7. If a plant grows partially under water and partially above water; it is what kind of wetland plant?
   A. Shrub
   B. Tree
   C. Aquatic
   D. Emergent

8. What is a plant's phenotype most affected by?
   A. The environment
   B. The place you bought the seeds
   C. The size of the flowers on the plant
   D. The shape of the leaves

9. Pneumatophors are what part of a wetland plant?
   A. The roots that stick up above the water
   B. Floating leaves
   C. Seeds
   D. Flowers

10. Which food exists because it is pollinated by bees?
    A. Tomatoes
    B. Mustard
    C. Potatoes
    D. All of the above

11. The process of photosynthesis produces?
    A. Water for the plant
    B. Food for the plant
    C. Chlorophyll for the plant.
    D. Oxygen in the leaves.
12. What is media?
A. “Soil less” dirt
B. A wetland plant
C. Pesticides
D. All of the above

13. As a greenhouse gasses increase, what happens to the Earth’s atmosphere?
A. The atmosphere heats up
B. The atmosphere cools down
C. The atmosphere becomes humid
D. None of the above

14. The greenhouse gases are?
A. Carbon dioxide (CO₂)
B. Carbon dioxide (CO₂), Methane (CH₄), and Nitrous Oxide (N₂O)
C. Carbon dioxide (CO₂) and Methane (CH₄)
D. Only Nitrous Oxide (N₂O)

15. Which pigment gives leaves their orange color?
A. Chlorophyll
B. Xanthophyll
C. Carotenes
D. Anthocynins

16. Circle the only thing you do NOT monitor in a compost pile.
A. pH
B. color
C. Temperature
D. Water

17. What is a Habitat?
A. The place an animal or plant lives in
B. The places animals and plants do not live in
C. Only caves
D. None of the above
18. Microorganisms in the soil break down food scraps, leaves, paper, etc. When they decompose different materials what form of energy is given off?
   A. Chemical
   B. Solar
   C. Heat
   D. Nuclear

19. Plants are important because they take in__________ and give off__________.
   A. Oxygen, carbon dioxide
   B. Carbon dioxide, oxygen
   C. Ozone, carbon dioxide
   D. Oxygen, Ozone

20. A compost piles decomposes fastest when the pile is?
   A. Large
   B. Small
   C. Facing the north
   D. Put in the shade

21. Soil with a large percentage of sand in it will feel
   A. Gritty
   B. Smooth
   C. Neither gritty nor smooth
   D. Soggy

22. Pollen affects peoples?
   A. Hair color
   B. Height
   C. Weight
   D. Allergies

23. The pH scale runs between which numbers?
   A. 1-16
   B. 0-20
   C. 0-14
   D. 1-7
24. Which of the following plant traits is not inherited?
A. Flower color  
B. Fruit type  
C. Leaf shape  
D. Insect damage  

25. A leaf needs ________, sunlight, and carbon dioxide for photosynthesis to occur?  
   (HINT: Photosynthesis is when a plant makes its own food.)
A. Oxygen  
B. Soil  
C. Water  
D. Pollen  

26. Plants play an important role in soil erosion because their roots
   A. Channel rainwater away from the plant  
   B. Hold the soil in place  
   C. Create a trench for rainwater  
   D. Dry the soil around the plant  

27. Hypertrophy is when a plant ____________?  
   A. Displays its dominant gene  
   B. Takes in sunlight to make food  
   C. Stretches above water to get air  
   D. Develops floating seeds  

28. What is the Munsell book?
   A. A plant identification book  
   B. Weather forecasting book  
   C. Soil identification book  
   D. Turf grass identification book  

29. A plant can be pollinated by what?
   A. Wind  
   B. Animals  
   C. People  
   D. All of the above
30. Which situation is NOT a way Louisiana’s wetlands can be harmed by global warming?
   A. Melting of the polar ice caps that will eventually flood coastal wetlands
   B. Salt water will move into fresh water and kill fresh water plants and fish.
   C. Waterfowl will migrate at the wrong time of year.
   D. A rise in temperature will allow more marsh grasses and wetland plants to grow faster and larger.

31. People add greenhouse gases to the Earths atmosphere by:
   A. Jogging
   B. Watching TV
   C. Blowing bubbles
   D. Coloring in a book

32. Who is the “Father of Modern Genetics?”
   A. Carolus Linnaeus
   B. Charles Darwin
   C. Gregory Mendel
   D. Liberty Hyde Bailey Jr.

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School Name___________________ Student # _______

1. What is the correct order for ranking a plant?
   A. Kingdom, Division, Class, Order, Family, Genus, Species
   B. Kingdom, Division, Order, Family, Genus, Species, Class
   C. Kingdom, Order, Division, Family, Genus, Species, Class
   D. Kingdom, Species, Division, Family, Genus, Order, Class

2. Which is the correct way to write a scientific name?
   A. Helianthus Annus
   B. *Helianthus Annus*
   C. Helianthus annus
   D. helianthus Annus

3. What does Xylem transport?
   A. Food
   B. Water
   C. Air
   D. Carbon Dioxide

4. What is Horticulture?
   A. The study of forestry
   B. A science and art of cultivating, processing, and marketing fruits, vegetables and trees/shrubs.
   C. Vegetable production
   D. Large fields of plants

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1. Circle the adaptation of a wetland plant that helps it survive in its unique environment.
   A. Above ground roots
   B. Hollow stalks
   C. Salt glands
   D. All of the above

2. What is a habitat?
   A. An area where a plant can normally be found.
   B. The area where a plant cannot survive.
   C. Only trees
   D. Only wetlands

3. Pneumatophors are what part of a wetland plant?
   A. The roots that stick up above the water
   B. Floating leaves
   C. Seeds
   D. Flowers

4. If a plant grows completely under water, meaning its whole life cycle happens submerged in water; it is what kind of plant.
   A. Emergent
   B. Shrub
   C. Tree
   D. Aquatic

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1. What gives leaves their green color?
   A. Chlorophyll
   B. Xanthophylls
   C. Anthocynins
   D. Carotenes

2. A leaf needs SUNLIGHT, __________, and WATER for photosynthesis to occur.
   A. Oxygen
   B. Carbon dioxide
   C. Pollen
   D. Soil

3. The process of photosynthesis produces ________?
   A. Water for the plant
   B. Pigments in the plant
   C. Food for the plant
   D. Insect repellent for the plant

4. Plants are important because they take in __________ and give off __________?
   A. Oxygen, Carbon Dioxide
   B. Ozone, Oxygen
   C. Carbon Dioxide, Ozone
   D. Carbon Dioxide, Oxygen

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1. Microorganisms in the soil break down food scraps, leaves, paper, etc. When they decompose different materials what form of energy is given off?
   A. Chemical
   B. Heat
   C. Solar
   D. Nuclear

2. Which item is NOT monitored in composting?
   A. Temperature
   B. Moisture
   C. pH
   D. Weight

3. Your compost will decompose fastest if you use a ___________ container.
   A. Smaller (1'x1'x1')
   B. Larger (3'x3'x3')
   C. Square
   D. Circle

4. The pH scale runs between which numbers?
   A. 0-7
   B. 1-16
   C. 0-14
   D. 1-20

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1. What are the correct names of the female flowers parts?
   A. Anther and filament
   B. Stigma, style, and ovary
   C. Petals
   D. Sepals

2. Pollen affects people’s ________?
   A. Allergies
   B. Height
   C. Weight
   D. Hair color

3. A plant can be pollinated by?
   A. Wind
   B. Water
   C. Insects
   D. All of the above

4. Which food does not need to be pollinated in order to exist?
   A. Potatoes
   B. Milk
   C. Mustard
   D. Chocolate

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School Name _________________________ Student # __________

1. A genotype is the genetic code or DNA of a plant. The phenotype is what the plant actually looks like. What is the MOST influential factor on a plant's phenotype?
   
   A. The size of the flowers on the plant
   B. The plant's ability to flower
   C. The environment
   D. The shape of a leaf

2. Dominant traits ________ the recessive traits of plants?
   
   A. Are hidden by
   B. Mask or cover
   C. Give color to
   D. Are more important than

3. Which of the following plant traits is not inherited?
   
   A. Color
   B. Shape of the leaves
   C. Type of flowers
   D. Insect damage

4. Who is the “Father of modern genetics?”
   
   A. Carolus Linnaeus
   B. Charles Darwin
   C. Gregory Mendel
   D. Liberty Hyde Bailey Jr.

Prepared by Miss Kiki Karsh and Dr. Edward Bush.

School Name ________________________ Student # ________

1. What is media?
   A. A wetland plant
   B. “Soil-less” dirt
   C. Pesticides for the plant
   D. A way to water plants

2. Why are plants important to wetlands?
   A. They hold the soil in place
   B. They give shelter and food to wetland animals
   C. Only A
   D. Both A and B

3. What is the Munsell Book?
   A. A book about wetland plants
   B. A book about soil
   C. A book about wetland animals
   D. A book about wetland insects

4. Soil with a large percentage of sand in it will feel
   A. Gritty
   B. Smooth
   C. Neither smooth nor gritty
   D. Slimy

Prepared by Miss Kiki Karsh and Dr. Edward Bush.

School Name ______________________ Student # ___________

1. As greenhouse gases increase, what happens to the Earth’s atmosphere?
   A. It cools down
   B. It heats up
   C. It becomes humid
   D. It dries up

2. Circle the example of how people add greenhouse gases to the Earth’s atmosphere.
   A. People jog
   B. People use electricity
   C. People play the piano
   D. People grow a garden

3. Tell me why you think it is important to protect Louisiana’s wetlands.
   A. To save Louisiana from eroding
   B. To protect alligators and other wetlands creatures from losing their homes
   C. To protect endangered plants
   D. All of the above

4. The greenhouse gases are?
   A. Carbon dioxide (CO₂)
   B. Carbon dioxide (CO₂), Methane (CH₄), and Nitrous Oxide (N₂O)
   C. Carbon dioxide (CO₂) and Methane (CH₄)
   D. Only Nitrous Oxide (N₂O)

Prepared by Miss Kiki Karsh and Dr. Edward Bush.
Appendix D Permission Forms

A.22. Student Permission Form.

Student Assent Form

I, ________________________________, agree to let my answers on horticulture tests, and environmental surveys be used for the sole purpose of the study conducted by Kathryn Karsh from Louisiana State University. I understand my grades on these tests will remain anonymous. My teacher will not see the results, nor will the scores reflect any grades I receive in my classes. I can stop participating in this project at any time without getting into trouble.

Student’s Signature ______________________________ Age ______ Date ________

Prepared by Miss Kiki Karsh and Dr. Edward Bush.
A.23. Parental Permission Form

**Parental Permission Form**

<table>
<thead>
<tr>
<th>Project Title:</th>
<th>Integrating Plant Biology and Coastal Environmental Issues into Middle School Curriculum to Evaluate Change in Knowledge and Attitude of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Sites:</td>
<td>Montegut Middle School, Pierre Part Middle School, and St. James Math and Science Academy, and St. Louis King of France School.</td>
</tr>
<tr>
<td>Investigator:</td>
<td>Kathryn Karsh is the principal investigator and is available for questions using the following contact information: Kathryn Karsh Louisiana State University- Horticulture and Sea Grant departments (225) 578-1558</td>
</tr>
<tr>
<td>Purpose of the Study:</td>
<td>To gather statistical and qualitative data on the effects of additional horticulture lessons into the Coastal Roots program. In particular I am looking at the change in knowledge and attitude towards the environment in middle school students. The lessons will be given on a monthly basis.</td>
</tr>
<tr>
<td>Inclusion Criteria:</td>
<td>Students in the selected science classrooms at the participating middle schools.</td>
</tr>
<tr>
<td>Study Description:</td>
<td>At the beginning and end of the school year the students will be given two pre and posttest: one on general horticulture knowledge and the other on environmental attitude. From October through the next eight months the students will be given monthly lessons on general horticulture. All lessons will have some Coastal restoration value to them. Students will also be planting different coastal plants to use when they restore part of Louisiana’s wetlands. I and at times LSU student volunteers will teach the lesson plans. None of the tests given to participating students will be graded by the school science teacher or even seen by the school’s science teacher.</td>
</tr>
<tr>
<td>Benefits:</td>
<td>Students will be able to participate in a Coastal restoration Project. The students will gain general horticulture and environmental knowledge.</td>
</tr>
<tr>
<td>Risks:</td>
<td>There are no known risks.</td>
</tr>
</tbody>
</table>
Right to Refuse: Participation in this study is voluntary, and a child will become part of the study only if both child and parent agree to the child’s participation. At any time either the child may withdraw from the study or the child’s parent may withdraw the child from the study without penalty or loss of any benefit of which they might otherwise be entitled.

Privacy: Results of the study will be published, but no names or identifying information will be included for publication. Subject identity will remain confidential unless law requires disclosure. Photographs may be taken of students participating in activities for research presentations, but no names or identifying information will accompany the photographs.

Financial Info: There is no cost for participation in the study, nor is there any compensation to the subjects for participation.

Parent’s Signature__________________________   Date_____________

or

The parent/ Guardian has indicated to me that he/she is unable to read. I certify that I have read this consent form to the parent/ guardian and explained that by completing the signature line above he/she has given permission for the child to participate in the study.

Signature of Reader _______________________   Date_____________

Name of Student: ___________________________________________

Prepared by Miss Kiki Karsh and Dr. Edward Bush.
A.24. Teacher Permission Form.

Teacher Assent Form

I, ________________________________, agree to let my answers to the General Survey for Coastal Roots Teachers be used for the sole purpose of the study being conducted by Kathryn Karsh from Louisiana State University. I understand my answers will be anonymous. Any data that is published and reported will have numbered codes, not my personal name.

Signature ____________________________ Date__________

Prepared by Miss Kiki Karsh and Dr. Edward Bush.
Vita

Kathryn Lauren Karsh was born in Fort Worth, Texas, in 1981 to Kenneth and Marlys Karsh. After graduating high school she began her undergraduate work in both psychology and horticulture at Louisiana State University located in Baton Rouge, Louisiana. She obtained her Bachelor of Science degree in May of 2003. August of 2003, she began graduate studies at Louisiana State University, under the direction of Dr. Edward Bush. At the spring commencement she will be awarded the Master of Science degree in the field of horticulture.