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How to do a Science Fair Project and provide hands on learning outside of the classroom: An inquiry based activity to teach all the skills and techniques required to do independent research project

SJA served as a pilot for the Coastal Roots program in 1999, and for more than a decade, my students have been active participants. This program is headed by Dr. Pam Blanchard at LSU. Today, Louisiana students in second grade through high school take part in the program by establishing wetland plant nurseries at their schools. Students grow native plant seedlings to plant in a coastal habitat restoration project in a nursery at school. In the spring and fall of 2007, 708 students and 110 adults/chaperones participated in 16 restoration plantings, transplanting 2,929 seedlings and 6,230 grass plugs. Since 2001, there have been 88 restoration planting trips and 28,726 plants grown and transplanted at restoration sites. This has involved 3,454 students in restoration planting trips.

Inquiry-based lesson plans are developed to be used in conjunction with the nursery on the school grounds. This is lesson 5 in that series. It is an inquiry-based activity that teaches experimental design, data collection, graphical representation of results and statistical analysis of the data. Many technical and processing skills are developed through this project that are also utilized in science fair process.

In December, the students plant the trees in their coastal habitat site. This is therefore a service learning project, also. Each year the students return to the site to plant new trees and can observe the growth of the previously grown trees. If the trees are tagged they can collect data on these trees also.

Saving the Sportsman's Paradise

Grade level: 9-12

Subject Area: Biology, Environmental Science, Math. Researching the hackberry, southern bald cypress, southern wax myrtle, black mangrove and red mulberry trees which help to prevent coastal erosion and designing experiments to determine the best methods of growing the trees.

Duration: Six 45-minute periods

Materials list: Resources such as magazine articles, newspapers, books and the internet that have information on the trees and coastal erosion.

Ray Leach Single Cell Cone-tainer System
Seeds
Planting media
Large tub or container
Permanent markers
Tray labels
Water
Vermiculate

National Science Education Standards:

TEACHING STANDARD B:

Teachers of science guide and facilitate learning. In doing this, teachers

- Focus and support inquiries while interacting with students.
- Orchestrate discourse among students about scientific ideas.
- Challenge students to accept and share responsibility for their own learning.

- Recognize and respond to student diversity and encourage all students to participate fully in science learning.
- Encourage and model the skills of scientific inquiry, as well as the curiosity, openness to new ideas and data, and skepticism that characterize science.

TEACHING STANDARDS

SI-H-A2, SI-H-B4

References used:

1. America's Vanishing Treasure. Gautreaux, Craig. Barataria-Terrebonne National Estuary Program.
2. Cothron, Julia. Giese, Ronald. Rezba, ARichard. Students and Research: Practical Strategies for Science Classrooms and Competitions. Kendall/Hunt Publishing Company, 1993
3. Haunted Waters, Fragile Lands. Pitre, Glen. Barataria-Terrebonne National Estuary Program.
4. LaMer. Louisiana Sea Grant College. 4 April. 2003 <http://www.lamer.lsu.edu>
5. Portrait of an Estuary. Csaffrey, Rex and Breuax, Janis. LSU Ag Center.
6. Rescuing the Treasure. Pitre, Glen. Barataria-Terrebonne National Estuary Program.
7. Saving Our Good Earth: A Call to Action. Barataria- Terrebonne Estuarine System Characterization Report

Focus/Overview: Students will evaluate websites, cite sources and make note cards on information regarding the trees that may help stop erosion. The students will research the tree with which they will be working and planting to prevent coastal erosion as part of the Coastal Roots program and the independent variable of choice. The students will also design an experiment to determine the effects of pH, salinity, fertilizer type and amount, bacteria, earthworms or hormones on the trees. Both quantitative and qualitative data will be recorded for two months. This is followed by graphical representation and statistical analysis of the data. The students will jointly conclude the best conditions under which to grow their respective trees.

Background information:

This series of activities is designed to help students acquire the skills needed to research, design and conduct an experiment. "Student experiments are the very kind of inquiry learning proposed by the National Science Education Standards Project." (Cothron, Giese, Rezba, p.vii.) Students will use their web page evaluation techniques previously learned in lesson two. They will learn to properly make notecards and bibliography cards. Students will implement an original experimental design based on the trees which are used to help prevent coastal erosion.

Through making the notecards as stated in *Students in Research*, students will learn to identify critical information and use an approved format for the documentation. "They will learn the four types of information: general sources scientific research, technical manuals and procedures and interviews with community leaders." (Cothron, Giese, Rezba) Students will also learn to use library resources and questions to create and refine ideas for experimentation. They will discover library and community resources appropriate for use in science projects.

Basic information on the above trees can be found at

Southern bald cypress:

http://www.lamer.lsu.edu/projects/coastalroots/pdf/Learning_about_baldcypress.pdf

Southern wax myrtle:

http://www.lamer.lsu.edu/projects/coastalroots/pdf/Learning_about_waxmyrtle.pdf

Black mangrove:

<http://www.lamer.lsu.edu/projects/coastalroots/blackmangrove.htm>

Red Mulberry:

<http://www.lamer.lsu.edu/projects/coastalroots/redmulberry.htm>

Hackberry:

<http://www.lamer.lsu.edu/projects/coastalroots/hackberry.htm>

Objectives:

1. The students will be able to design experiments of their own using available resources and will understand that such experimentation becomes a responsibility.
2. The students will be able to differentiate between the product of science and the process of science.
3. The students will be able to list and explain the steps in the Scientific Method.
4. The students will be able to name and explain the four parts of an experiment.
5. The students will be able to identify a control in an experiment and to explain the relationship between a control and an experiment.
6. The students will be able to define and identify an independent variable and a dependent variable.
7. The students will learn to gather information from an experiment and use it to draw a conclusion.
8. The students will learn to formulate a hypothesis, to make observations, to collect and organize data, to manipulate variables, and to draw conclusions.

Procedure:

Attention grabber:

Show the students maps of the coast of Louisiana as it was and as it is now. Give an introduction.

Two weeks prior: Give the students a timeline with due dates and the rubric for each step. These should include dates and rubric for notecards, bibliography cards, the purpose and hypothesis of the investigation, the background information, the procedure, data tables and graphs, data analysis and the conclusion.

Discuss the proper **format** for preparing notecards and bibliography cards. Discuss how to avoid plagiarizing and the rules regarding plagiarism. Show the students how to document within a paper. (**1 class period**)

1. **Class 1 (1 class period)**

1. Divide the students into groups of four.
2. Assign each group the tree to be researched and an independent variable to test. Allow them to pick from a hat.
3. Students will make notecards and bibliography cards using the proper format on the research material.
4. The research should include the following:
 - a. Characteristics of the assigned tree
Size, description of foliage, geographic range, fruit, seed
 - b. Niche of tree
Nutrients needed, climate conditions, reproduction
 - c. Concerns
Environmental value, part it plays in coastal roots project, plans for perpetuation of the species.
 - d. Coastal erosion
 - e. Background research on the requirements of plant growth
 - e. Background research on the independent variable to be used in the experiment.

5. Allow the teams to brainstorm and research the rest of class.

Give the students two weeks to do the research as homework as they have previously done class activities on these skills.

Two weeks later

Class 2 – allow each group to ***brainstorm*** as to possible investigations that would be appropriate for the assigned tree.

Provide the students with a list of questions such as

What nutrients does the tree need to grow?

What conditions are best for growing?

What kind of soil should the trees be planted in?

How do the seeds need to be planted?

How often do they need to be watered?

What can affect the plants' growth?

How are the seeds germinated?

Based on the above, what ***one factor*** should be changed (identify the independent variable)? What can be tested?

What can be measured or observed? Identify the dependent variable(s).

Identify a control group and the constant factors.

Class 3

1. To help students narrow the choice, provide a second list of questions such as materials are usually a limiting factor.

What materials are needed?

How much will they cost?

Where will they be purchased?

Provide a rating sheet of excellent, good, fair and poor to rate the materials (need to work on this). This will determine what is economically feasible to perform the experiment.

Students will then decide on ways to vary the materials and rate them as excellent, good, fair, poor.

Students will narrow the investigation based on available materials and the variations of the investigation.

2. To narrow the topic further: Students will evaluate the creativity of the project.

Class 4:

1. Each team will design an experiment testing their variable. The experiment will have a purpose, hypothesis, materials, procedure and method of data collection.
2. The procedure will be approved by the teacher

Class5:

The students will plants the seeds according to the directions set forth at the LaMer website. http://www.lamer.lsu.edu/projects/coastalroots/pdf/Planting_Seed_Trays.pdf . They will then continue with the procedure they designed.

Class 6:

The students will design tables in which to collect both the quantitative and qualitative data. Teams will discuss with the rest of the class each investigation.

This will be approved by the teacher.

At the beginning of each period, students will collect data and enter into a data table for a period of two months. This should only take about 5 minutes each day.

At the end of the two months, students will generate graphs from the data. They will also calculate mean, median, mode, variance, standard deviation, and do the appropriate inferential statistic. Each team will present its findings to the class.

Note: Be sure to monitor topic selection so that each group does a different investigation.

Possible extension:

1. Each group will write a research paper in APA format of the investigation.
2. Each team will write up the investigation as a lab report.
3. Each group will prepare a power point presentation of their tree and the investigation.