

4.2 THE SOMBRERO MARSH ENVIRONMENTAL EDUCATION PARTNERSHIP: A MODEL FOR BEST PRACTICE IN EARTH SCIENCE EDUCATION

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1. INTRODUCTION

The Outreach Program of the Cooperative Institute for Research in Environmental Sciences (CIRES) supports a wide breadth of water education programs, including K-12 school programs in both English and Spanish, hosting the National Ocean Sciences Bowl, providing classroom kits for scientist use, professional development of secondary and prospective science teachers

(<http://cires.colorado.edu/~k12/earthworks/> and <http://cires.colorado.edu/~k12/nova/>), and providing input for the American Society for Limnology and Oceanography's current foray into K-12 science education outreach. One of our most recent water education endeavors is the Sombrero Marsh Environmental Education Program, which was established by a unique group of partners: the Boulder Valley School District (BVSD), the Thorne Ecological Institute, and the city of Boulder Open Space and Mountain Parks (OSMP) to provide an innovative field-based curriculum for students of the BVSD. CIRES is collaborating with these organizations to develop curriculum that uses students-as-scientists to monitor both the restoration of the marsh and the impact of classroom groups on the newly restored marsh. The goal of the program is to provide a scientifically sound outdoor education experience for every 1st, 4th, and middle school student of BVSD and to promote environmental stewardship.

2. BACKGROUND

Sombrero Marsh, one of a handful of naturally formed saline marshes located along the Front Range of Colorado, is in the process of being restored by OSMP (<http://www.ci.boulder.co.us/openspace/preservation/sombrero.htm>). The wetland, which is fed primarily by groundwater, provides important habitat to migrating waterfowl and is listed as an environmental preservation area by Boulder County. BVSD's Environmental Education Center is located on-site and houses the Thorne Ecological Institute, a non-profit organization that works with BVSD and other area school districts to provide environmental science programs. Dr. Lesley Smith, a specialist in wetland ecology, has been working with the partners to help develop a field-based

curriculum that will generate data that meets district curriculum requirements and can be used by OSMP for their marsh restoration and monitoring program. An important aspect of the curriculum is that it is integrated with the FOSS Program (Full Option Science System), which provides the keystone for BVSD's science curriculum. To date, curriculum has been developed for the 4th grade, using the Structures of Life FOSS module as the basis for the Sombrero Marsh curriculum. The Sombrero Marsh curriculum has been carefully crafted to tie in with district, state and national standards for science, geography, and literacy.

3. PROGRAM COMPONENTS

The components of the Sombrero Marsh Education Program are four-fold. First, teachers must attend professional development classes on the pertinent FOSS module and the marsh curriculum before being allowed to bring their students to the marsh. The classes take place at the Environmental Education Center, and the teachers learn about the ecology of the marsh, as well as how to lead the students through the marsh inquiry program (Figure 1). Second, in preparation for the marsh visit, students



Figure 1. A group of hardy fifth grade BVSD science teachers spend the afternoon learning about the ecology of Sombrero Marsh. When they stepped inside, they learned it was a frigid -24C!

spend 1 - 4 weeks on the FOSS module and the pre-visit activities that include a video about the marsh that was developed by OSMP and observations of native marsh plant seeds and structures. Third, the students spend half a day at

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the marsh conducting scientific inquiry in the field and in the lab (Figure 2), as described below.

Field portion of the curriculum

Upon arrival, half of the school group goes outside and is divided into two groups of about 15 students. The students are lead by an OSMP-approved facilitator (facilitators report to OSMP about potential student impacts on the marsh) to the raised boardwalk that includes wells for sampling groundwater and a bird blind.

Outdoor curriculum activities include:

- Weather observations
- Field observations (sights, smells, sounds)
- Measurement of groundwater depth and water temperature
- Human impacts on marsh
- Ecosystem activities

Through these activities, the students are expected to answer questions, such as:

- *Where is the water?*

The answer is not always obvious drought conditions such as experienced this year, because the marsh is dry for a portion of the year.

- *What is the source of water in the marsh?*
- *Why is the marsh saline?*
- *What are the human impacts on the marsh, and in what way do they affect the marsh?*



Figure 2. With a spectacular view of the Continental Divide in the background and Sombbrero Marsh in the foreground, students are asked to think about the sources of water to the marsh.

Laboratory portion of the curriculum

The other half of the school group remains inside, and they work in two different state-of-the-art teaching labs under the direction of their teachers.

Indoor curriculum activities include:

- Discovery of dispersal mechanisms of native wetland and upland plant seeds
- Mapping of Sombbrero Marsh
- Observation of 4 mystery soils taken from a gradient spanning upland and wetland areas
- Placement of the soils on the map

Through these activities, the students are expected to answer questions, such as:

- *What are some of the structures with which seeds disperse themselves?*
- *Sombbrero Marsh has many stakeholders. Who are they and what role do they play?*
- *What are some of the properties that soil scientists use to describe soils?*
- *Why did you place the mystery soils on the locations on the map that you chose?*

Each student group spends half of their visit in the field and laboratory.

The fourth component of the program is the completion of the post-visit activities that include: calculating the depth below MSL of the groundwater; entering the groundwater temperature and depth on a database to be used by future groups; comparing data with previous data and discussing trends; and determining which seeds germinate on the four different soil types. In addition, there is a literacy element that may include writing a letter to the editor of the local newspaper, writing an environmental impact statement, or enacting a role model scenario with the various stakeholders of the marsh.

4. FUTURE PLANS

Expansion of the Sombbrero Marsh curriculum to the 1st grade was begun in fall 2002. The next step will be the development of the middle school curriculum. Middle school science teachers have indicated that they would like flexibility in terms of which middle school grade groups will visit the marsh. Development of the middle school curriculum, therefore, will encompass 6th – 8th grades and will cover life and Earth sciences, as well as chemistry, because each grade has a different content area emphasis. CIRES Outreach will continue its work with the partners and bring in scientific researchers with expertise in biology, geology and chemistry to help in this endeavor. An NSF GK-12 Fellowship grant has been submitted to

draw graduate students from these fields to work with middle school science teachers in the development of this curriculum. At the high school level, mentors from CIRES will provide guidance to high school students that desire to pursue field investigations for science fair projects or honors theses. Investigations may focus on research projects of CU graduate students, or they may provide data needed to further monitoring of the marsh by OSMP.

In addition to curriculum development, the partners intend to expand the research sites available to BVSD students. Currently, the wet portion of the marsh is off-limits because of its environmental preservation area status. Installation of a constructed wetland at the Environmental Education Center will allow students to collect water, invertebrates, and wetland plants for further investigations. Drawing on expertise from the Thorne Ecological Organization, a bird banding area will also be installed, while OSMP will transplant vegetation from Open Space land to

provide several upland vegetation biomes of Colorado.

5. IMPACT

Pilot testing of the 4th grade curriculum was begun in fall 2001 with 10 teachers and 125 BVSD students in preparation for wider implementation for the 2002/2003 school year. When fully developed, each student of the BVSD (ca. 24,000 students) will participate in the Sombrero Marsh Education Program during their tenure in BVSD schools. Each student will participate in the scientific process, as they collect essential data that will be used to monitor this fragile ecosystem by OSMP. The full implementation of this project will establish a model of a unique partnership that has worked together to create an exemplary Earth science education program. In the future, the partners and CIRES envision transferring this model to other school districts across the country.