



# SCIENCE AND ENVIRONMENT COUNCIL OF SARASOTA COUNTY

## Science and Environment Council of Sarasota County

### Interim Report

## Two-Year Science Curriculum Enhancement Pilot Project

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## I. Executive Summary

“I feel like a scientist!”

9<sup>th</sup> grade Booker High School on-level science student  
participating in SEC's Science Curriculum Enhancement Pilot Project.

In December 2005, representatives of the Science and Environment Council met with Dr. Norris to explore ways to enhance science education in Sarasota County. Dr. Norris challenged SEC member organizations to propose ways to use SEC member resources and facilities to enhance science education, make science real, and teach students about careers in the sciences.

The Science Curriculum Enhancement Pilot Project was developed by SEC members with guidance from school board staff. Its purpose is to enhance science curriculum through community-based science education and inquiry-based activities. The pilot project's aim is to make science “real” for students by:

- showing students how abstract science concepts apply to their community, and
- providing opportunities for students to interact with people who work in the sciences.

Ninth grade was chosen for the pilot year because interest in learning science often declines at this grade level. The Principal and Assistant Principal at Booker High School enthusiastically welcomed the pilot project and helped shape the direction it took. An evaluation firm provided an impartial assessment of the impact of the pilot on students, using a science attitude survey among other tools.

While the evaluation cannot be extrapolated to a larger population, it does show a positive affective impact toward science on students participating in the field trips. Students who attended the field trips demonstrated consistently better attitudes towards science than students in the control or comparison classes. The results are reinforced by the teacher's report that by the end of the six field trips, the students in the field trip group were utilizing her as a mentor and were more willing to interact with her and listen to her advice than students who were in her other classes. The teacher was also of the opinion that the

hands-on interaction in the field-like environment of the field trips provided more stimulation to the students than sitting in a class lab experiencing the same content.

The evidence – both quantitative and qualitative – indicates that field trips increase students' attitude toward and possibly interest in science, and provide a useful pedagogical tool that allows more student interaction with positive role models in the various scientific disciplines. It is apparent from these findings that multiple science-related field trips further develop student engagement and help students develop connections from one trip to the next, as well as between the concepts they are studying in class and the real world. The changes seen in the students who attended the field trips are not mirrored in either the control group (traditional instruction) or the comparison group (SEC-in class presentation). The results are even more compelling in that the comparison group (SEC-in class presentation) consisted of honors students who are traditionally viewed as excelling in science and presumably have a more positive attitude toward science.

In the 2007-08 school year, we will integrate the science activities and field trips developed in Year One into curriculum for Booker High School's SCREAM (Science, Construction, Research, Engineering, Architecture, and Math) Small Learning Community. SCREAM teachers will use the science activities and field trips to enhance other subject areas. We will work with the classroom teachers to use the field trips and science instruction as a culminating activity for cross-disciplinary lessons. Information about careers in the sciences will continue to be an integral part of the pilot. In addition, we will do extensive planning work to determine the best ways to sustain this program long-term and to expand it to additional high schools in Sarasota County.

The Science Curriculum Enhancement Pilot is laying the groundwork for a long-term collaboration between SEC member organizations and Sarasota County Schools. It has the potential to enhance teachers working across the curriculum – specifically to use science to teach other subject areas – and to increase on-level student interest in science and help them prepare for the world of work. This program puts the Sarasota County School District in a leadership role for dynamic science education, in an ever-increasingly competitive world for students regarding science.

## **II. Background**

### **A. A Challenge from Dr. Norris: Enhance Science Education and Understanding of Careers in the Sciences**

In December 2005, representatives of the Science and Environment Council met with Dr. Norris to explore ways to enhance science education in Sarasota County. During the discussions, Lori White, Associate Superintendent, and Sue Puchalla, Science and Health Program Specialist, underscored the importance of providing students with real world science experiences that are integrated in the curriculum and that help students understand opportunities for science-related employment. Dr. Norris challenged SEC to develop a proposal for a pilot project meeting these two criteria. In addition the Task Force recommended the pilot should:

- Focus on on-level students rather than advanced specialized students
- Help “localize” the curriculum
- Help teachers place the science in the student’s “backyards” and at SEC member organizations
- Focus on experiential learning
- Include research and testing, to demonstrate how and if the program we propose makes a difference
- Start on a small scale, grow over time, and involve school board staff and financial resources to develop and sustain long-term

### **B. Developing a Two-Year Pilot**

A Task Force consisting of SEC members and Susan Puchalla presented Dr. Norris with a two-year pilot project. Dr. Norris approved funding for the first part in spring 2007. This Interim Report provides an update on accomplishments to date, and future plans for the Science Curriculum Enhancement Pilot Project.

The purpose of the Science Curriculum Enhancement Pilot Project is to enhance science curriculum through community-based science education and inquiry-based activities. The project’s aim is to make science “real” for students by:

- showing students how abstract science concepts apply to their community, and
- providing opportunities for students to interact with people who work in the sciences.

### **C. Enhancing Classroom Instruction**

On-level 9<sup>th</sup> graders at Booker High School were chosen to pilot the project. The focus of the first pilot year was to develop activities to localize the 9<sup>th</sup> grade textbook, *Glencoe Physical Science with Earth Science* and align with Sunshine State Science Standards.

These activities present concepts explored in the textbook in a Sarasota County context. In-class instruction and field trips allowed students to experience science concepts learned in the classroom in their own community. Information about jobs in the sciences and skills needed to perform those jobs was included. Two criteria were used to select topics for the first pilot year:

- students must master the topic as part of the curriculum, and
- topics are currently being worked on by SEC member organizations.

Ninth grade was chosen for the pilot year because interest in learning science often declines at this grade level. Elementary and middle school science learning usually involves hands-on activities, field trips, and easily applied concepts. Beginning in 9<sup>th</sup> grade, more abstract concepts are typically taught. Outside-the-classroom learning and practical applications of concepts are rare. It is at this point that many on-level students (as opposed to honors or advanced science students) become disinterested in science.

The Principal and Assistant Principal at Booker High School enthusiastically welcomed the pilot project and helped shape the direction it took. They played a key role in assuring its success.

### **D. Field Trip Lessons and Activities at SEC Sites**

#### **Lemur Conservation Foundation**

Taking on the role of anthropology intern, students began an investigation into why lemurs consume soil (a behavior called geophagia and practiced by all primates, including humans). Soil samples were taken on-site and students, working in small groups, chemically tested the samples and drew conclusions. A visit to one of the lemur enclosures to study the primates first-hand concluded the field trip. A staff researcher was on-hand to answer questions.

#### **Sarasota County Urban Forestry Program**

At the beginning of this field trip, students were posed with the question, “What is your ecological footprint?” The group learned about the role of mangroves, estuaries, and trees in nature’s balanced system, as they walked the grounds of Selby Gardens. Thermometers

in-hand, they were able to see how trees moderate ambient temperature. By the end of the tour, students not only knew the impacts humans have on the natural environment, but also ways they could reduce the size and impact of their footprint.

### **Marie Selby Botanical Gardens**

Booker students began their tour of Selby Gardens by learning about the life cycle of poison dart frogs while studying them in a replicated natural environment. Four groups of students each observed a frog's eating habits and recorded the number of fruit flies it consumed. The fruit flies used in the observation were grown by students several weeks prior to the field trip. Students visited several greenhouses and research laboratories to talk with botanists about their areas of specialization. They identified different plant species, studied details of plant segments under a microscope, followed the stages of orchid growth, and pruned plants, among other activities.

### **Crowley Museum and Nature Center**

The 190 acres of wildlife sanctuary at Crowley provided the means for Booker students to investigate five different Florida habitats. Small groups performed scientific fieldwork using soil pH meters, light meters, and thermometers in several different habitats and recorded their findings on data sheets. Back at the Learning Center, they discussed their research and reported to the whole class. Several students commented this was the first time they had ever been "out in the wild."

### **Mote Marine Laboratory and Aquarium**

Students were treated to a behind-the-scenes dolphin training session at the Goldstein Marine Mammal Center on the Mote campus. The Behavioral Husbandry and Rehabilitation Coordinator on staff explained the process and answered a myriad of questions. Using a real-life example of a problem facing Mote staff, students were asked to figure out how to get a stranded 220 pound dolphin onto a truck for transport to the rehabilitation center. Working in small groups, students applied and tested their knowledge of simple machines.

### **G.WIZ Hands-on Science Museum**

In this exploration of electricity, Booker students participated in demonstrations of current, static, and magnetism, then experimented with an electrical device to test their knowledge of basic principles. The remainder of the field trip was spent in the two large

galleries of the museum, where students could interact with a host of exhibits to learn different scientific concepts.

### **E. In-Class Lessons**

Each SEC member organization sent a staff member involved in the field trip to provide instruction at Booker High School for a comparison class. For that class, they provided an in-class lesson covering the same material as that presented on the field trip.

### **F. Evaluation**

Evaluation is an integral part of the Science Curriculum Enhancement Pilot Project. For pilot year one, the SEC hired an independent consulting firm, Consult JEM, to conduct an evaluation of the pilot. Their findings are included in this report.

### **III. SEC's Commitment to the Pilot Project and its Collaborative Approach**

The SEC is a group of non-profit and government organizations that operate or support conservation and science-based facilities. SEC's mission is to promote and advocate science, conservation, and environmental issues in Sarasota County for maintaining and improving quality of life through education, public outreach, demonstration, information gathering and analysis, and special projects. By collaborating on projects, the SEC can offer services and provide educational materials that no one organization can do alone.

Each SEC member organization regularly works with Sarasota County teachers and students, providing resources and educational opportunities that over the years have been a tremendous asset to the School Board. The intention of this pilot project was to look at ways SEC member organizations could collectively enhance science education in ways no one organization can do alone.

## **IV. Research on the Impacts of Field Trips on High School Students**

Concern in the U.S. about generally poor student performance in science and a lack of interest in pursuing careers in the science field has been growing. Curricula that does not include experiential learning and fails to make science relevant to the students' lives, as well as a negative perception of science are often cited as possible reasons. Further research shows a decline in attitudes towards science beginning in the secondary grades (Osborne, 2003).

As a result, it has become prudent for school districts to examine their science curriculum and to look for ways to improve science attitudes as a means of improving science achievement. A recent study by Turpin & Cage (2004) demonstrated that an activity-based approach to science improves secondary students' achievement in science. While numerous high school science classes have a laboratory component, many educators agree that seeing science first hand out in the 'real world' raises the curriculum to a whole new level.

Over the past 30 years, a good deal of research has been conducted on the effect of field trips on students. Most of that research focuses on K-8. In general, the evidence indicates that field trips have a positive impact on students, in both cognitive as well as affective terms. Interestingly, Nazier (1993) found that among science and engineering professors, a field trip was one of the top factors influencing their decision to make science their career.

To date, there has been little research on the impact of field trips on high school students. In light of this, the evaluation being conducted during this pilot phase adds to a lacking body of research. While the statistical information in the Consult JEM 2007 evaluation of this pilot is not definitive, it does show a positive affective impact toward science on students participating in the program. This despite the fact that 9<sup>th</sup> grade is when students tend to loose interest in science. Further study in the second year of the pilot will provide a better understanding of the impact of field trips on ninth graders.

## V. Interim Evaluation: Field Trips Enhance Science Education

Consensus among Booker High science teachers, the assistant principal, SEC educators, and Consult JEM, an independent evaluation firm, was that the first year of the pilot provided experiences that enhanced student interest in science and has the potential to interest students in science careers.

The evaluation, conducted by Consult JEM, utilized a science attitude survey, field notes, and post-trip surveys to assess the pilot's success in improving student attitudes toward science. Three groups of students were evaluated. To provide consistency across the groups, they all had the same teacher, Rosemary Schmidt. One 9<sup>th</sup> grade on-level integrated science class received instruction related to the curriculum via field trips to SEC sites. An honors science class received similar instruction presented by SEC staff, but in the classroom. One on-level class served as the control group and received traditional science instruction.

Results of the Science Attitude Inventory II (SAI II) showed that students who attended the field trips demonstrated consistently better attitudes toward science than students in the control (traditional instruction) or comparison (SEC-in class) conditions, although only the difference between the field trip and comparison groups was statistically significant. This finding was seen on the overall total scale of the SAI II, as well as the composite positive subscale and two individual subscales (5-A and 6-A):

- 5-A: Progress in science requires public support in this age of science; therefore, the public should be made aware of the nature of science and what it attempts to do. The public can understand science and it ultimately benefits from scientific work.
- 6-A: Being a scientist or working in a job requiring scientific knowledge and thinking would be a very interesting and rewarding life's work. I would like to do scientific work.

The statistical results are reinforced by the instructor's report that by the end of the year, the students in the field trip group were utilizing her as a mentor and were more willing to interact with her and listen to her advice than students who were in her other classes. She felt that the students who had the experiences outside of the school environment got to know her better, and the shared experience of the field trips was a method of reaching a different level of interaction with her students. She was also of the opinion that the

hands-on interaction in the field-like environment provided more stimulation to the students than sitting in a class lab experiencing similar content.

Differences were also noted in the field trip students' responses over time on the SEC post-trip surveys. For example, students responded to the surveys given after the first field trip with short single word responses, while later survey responses were more elaborate and related to specific field trip experiences. Additionally, during the later field trips, students were overheard discussing earlier field trips.

The evidence – both quantitative and qualitative – indicates that field trips increase students' attitude toward and possibly interest in science, and provide a useful pedagogical tool that allows more student interaction with positive role models in the various scientific disciplines. It is apparent from these findings that multiple science-related field trips further develop student engagement and help students develop connections from one trip to the next, as well as between the concepts they are studying in class and the real world. The changes seen in the students who attended the field trips are not mirrored in either the control group (traditional instruction) or the comparison group (SEC-in class presentation). The results are even more compelling in that the comparison group (SEC-in class presentation) consisted of honors students who are traditionally viewed as excelling in science and presumably have a more positive attitude toward science.

## **VI. Moving Forward with Year Two: Integrating into a Small Learning Community**

In the 2007-08 school year, we will integrate the science activities and field trips developed in Year One into a Small Learning Community's curriculum. We will work with Booker High School's SCREAM (Science, Construction, Research, Engineering, Architecture, and Math) Small Learning Community and teachers using science activities and field trips to enhance other subject areas. We will work with the classroom teachers to use the field trip and science instruction as a culminating activity for cross-disciplinary lessons. In addition, we will do extensive planning work to determine the best ways to sustain this program long-term.

Booker high school faculty asked us to keep two key components in mind as we develop the second phase of the pilot.

- The priority of the program should remain providing students with an off-campus experience. Changing the environment enhances learning and provides opportunities simply not available in a classroom context.
- Each student should continue to learn in a small focused environment with the kind of individualized attention provided in the first year.

The field trips will be spread out over the entire school year. Field trip topics will coincide with the teacher's in-class lesson topics. This would also allow extra time between field trips to add pre- and post-visit student activities, and to integrate those activities with the teaching of English, Math, History, or Social Studies. SEC will offer ideas to teachers for multidiscipline approaches to their subjects and work with classroom teachers to use the field trip as a culminating activity for cross-discipline studies.

Information about careers in the sciences will continue to be a focus of the pilot project. Helping students understand how other disciplines inform science careers will be included (for instance the importance of English for writing science research reports, or of math for monitoring technical equipment and determining their reliability).

To effectively achieve the planning, scheduling, topic coordination, and in-depth curriculum integration, preparation work begins in August 2007, working with teachers during their annual preparation days in August. Booker has requested we announce the

program to parents at mid-August orientation to ensure critical permission forms are signed.

Evaluation will continue to be an integral part of the pilot project. In addition, as the second phase of this pilot gets started, we will work to determine how to sustain it in the years ahead.

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