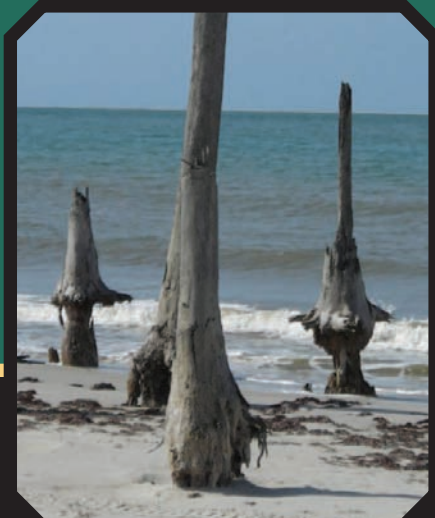
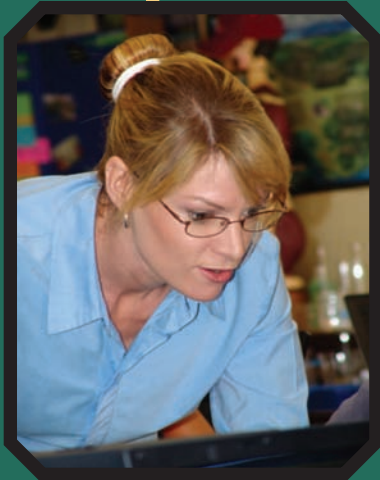




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## Real Science for the Real World

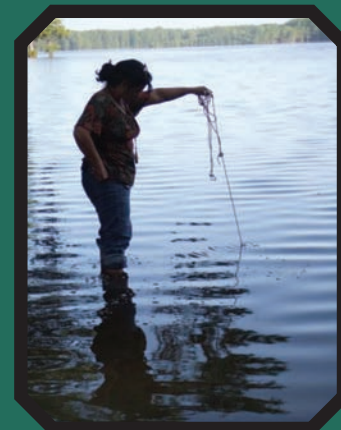
Doing, Learning, & *TEACHING!*



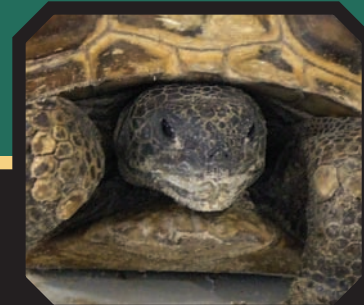
Real Science for the Real World: Doing, Learning, & *TEACHING!*

# Real Science for the Real World

*Doing, Learning,  
& TEACHING!*



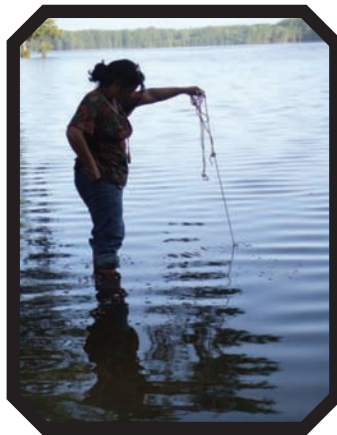
Kate Calvin &  
Penny J. Gilmer  
(Eds.)





# Real Science for the Real World

*Doing, Learning,  
& **TEACHING!***



Kate Calvin &  
Penny J. Gilmer  
(Eds.)





*Panhandle Area  
Educational  
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A free pdf of this monograph can be found at the PAEC Web site until October 1, 2009 at <http://www.paec-sc-iii.org/index.html>, and at Gilmer's web site: <http://www.chem.fsu.edu/~gilmer/>.

PAEC produced an hour long DVD on the Sc:iii program. Four segments are available at <http://www.paec-sc-iii.org/realscience.htm>.

# About PAEC

Strategically located in the center of northwest Florida, the Panhandle Area Educational Consortium (PAEC) is a regional educational service agency owned by its member school districts. Created in 1967 by the school districts of Bay, Calhoun, Franklin, Gulf, Holmes, Jackson, Liberty, Walton and Washington in northwest Florida, PAEC was Florida's first educational cooperative. In July of 1991, Wakulla school district joined the 24-year old organization as the first new member ever admitted. Following an act of the 1994 Legislature, Jefferson and Madison school districts were invited and accepted as new members and Bay school district, due to its size, was no longer eligible to be a member district. However, Bay continues as a very active participating school district. Taylor school district then joined the organization under the same legislative authority in December of 1995. In June 1999, Florida State University Developmental Research School, known today as the Florida State University Schools, Inc., became a member of PAEC, and on July 1, 2001, Gadsden District Schools joined. As of 2008, these school districts comprise the PAEC membership.

In 1994, after successfully serving the region for over 25 years, PAEC embarked upon a yearlong strategic planning initiative *PAEC Strategic Plan Year 2000... and Beyond* to transform the organization for 21st Century needs. Educators and lay people from 11 Panhandle counties formulated a mission statement, a set of beliefs and objectives, internal and external analyses and strategies to set the direction of PAEC. Specific action plans were written on how to accomplish these strategies. The strategies focus on sharing information, mutual understanding, a goals-driven delivery system, technology training, continuous progress and adequate funding. Current services were established as a result of the PAEC Strategic Plan developed in 1994-95 and new or revised services are recommended by appropriate advisory groups for approval by the PAEC Board of Directors at their monthly meetings. In 1995 the name of the Cooperative changed to the Panhandle Area Educational Consortium to better describe its function. In 2001-2002 educators and lay people from across the region revisited the plan in a yearlong process to ensure PAEC continues to align services to customer needs in the 21st Century, renaming the initiative, *PAEC Strategic Plan Year 2005... and Beyond*.

The large array of programs and services include: Curriculum Support Services, Dash~Board 4.0 Student Data System, Florida Diagnostic and Learning Resources System, Instructional Technology Program, FloridaLearns Academy with its electronic Professional Development Center and Florida Educational Channel, Region I Migrant Education Program Services, Printing Services, Clearinghouse for printed materials, Contracted Services, Professional Development Center, Testing Services, Multi-Agency Service Network for Students with Severe Emotional Disturbance, PAEC Research and Development, Program Evaluation, and Accountability Division, and the Florida Learning Alliance, Inc.

PAEC has 14 member school districts and provides selected services to non-member participating school districts across North Florida. PAEC is operated through the Washington County School Board, its District of Record, and the PAEC Board of Directors, comprised of the school superintendents from the member districts. Today PAEC continues under the leadership of the Board of Directors. The key to the organization and its success is that the responsibility for the consortium is placed directly in the hands of the school superintendents.



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Tomorrow

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# Table of Contents

<b>Preface</b>	<b>iii</b>
<b>Table of Contents</b>	<b>iv</b>
<b>Acknowledgments</b>	<b>vi</b>
<b>Foreword</b>	<b>ix</b>

---

<b>Chapter 1</b>	<b>10</b>
<b>Teaching the Nature and Practice of Scientific Inquiry</b>	
Working With Science Teachers in Rural America	
Penny J. Gilmer, Steven Blumsack, Helena Safron, & Kate Calvin	
<b>Chapter 2</b>	<b>24</b>
<b>Schooled by Sharks</b>	
Diving Head First Into Shark Research	
Tiffany Nichols	
<b>Chapter 3</b>	<b>36</b>
<b>Connecting Local Issues to Scientific Inquiry</b>	
Oyster Research and Its Impact on a Teacher	
Margy Callaghan	
<b>Chapter 4</b>	<b>46</b>
<b>CSI: Crawl Site Investigations on St. Vincent Island</b>	
A Teacher's Opportunity to Fulfill a Dream	
Irene Myers	
<b>Chapter 5</b>	<b>60</b>
<b>The Ultimate "Ah-Ha" Moment</b>	
My Experience as a Teacher Mentor	
Amanda Clark	

<b>Chapter 6</b>	<b>72</b>
<b>Joys of Chemical Separation</b> Becoming a Learner Gives Me Empathy for My Students Daphne Hill	
<b>Chapter 7</b>	<b>84</b>
<b>My Summer With the Gopher Tortoises!</b> At Nokuse Plantation I Found Tortoises, Technology, and Fortitude Janice Balentine	
<b>Chapter 8</b>	<b>96</b>
<b>Watershed, Water Quality,</b> What Goes Into a Pilot Education Program? Melissa Rios-Rosier	
<b>Chapter 9</b>	<b>104</b>
<b>Experiencing the Culture of Science</b> Two Teachers' Quest to Experience Science in the Real World Cindy Padgett & Doug Smith	
<b>Chapter 10</b>	<b>122</b>
<b>Administering the <i>Science Collaboration: Immersion, Inquiry, Innovation</i> (Sc:iii) Program</b> Brenda Crouch, Belva Free, & Sharon Mitchell	
<hr/>	
<b>Index</b>	<b>134</b>



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# Foreword

This monograph is the result of multitudes of collaborations, from those involved in obtaining the grant from the State of Florida to the 79 teachers involved in the summer research experience. Involved in this collaboration were eight teacher mentors, at least one scientist at all 30 research sites, our monograph senior editor, Dr. Kate Calvin, our evaluator Helena Safron, administrative assistants at three institutions (Panhandle Area Educational Consortium, Florida State University and University of Florida), other staff from Florida State University, and Dr. Steve Blumsack, who co-managed the FSU part of the program with me.

We had a vision to provide for the teachers some experience in authentic scientific research with scientists in the field. Through the efforts of many individuals, we worked together and achieved our goal. The teachers were challenged by new hands-on tasks. In addition to the science learning, these teachers from rural northwest Florida took two on-line courses that required them to reflect and write about their growing conceptions of the nature and process of science. Through the use of language and direct interactions with scientists, their views on the nature and processes of science changed. Consequently, their ideas about teaching science are in transition, as they return to their classrooms.

For me this past year has reconnected me to K-12 teachers who seek to learn and grow. I thoroughly enjoyed visiting 15 research sites, spanning from Pensacola to Live Oak, Florida and as far south as Perry. This is beautiful, rural Florida. At the sites I too could learn, both from the teachers' growing conceptions and from the scientists who were so pleased to have the teachers with them for the summer.

Our hope is that other states in the US and countries elsewhere will provide scientific research experiences to K-12 teachers and establish collaborative teams that articulate over grade levels (also known as “vertical teaming”). How else can we expect our teachers to teach with inquiry if they have never truly experienced inquiry?

We start the monograph with an overview of the project with some analysis of the teachers' views, especially within the summer research experience. Following this are eight chapters written by teachers, one of whom was a teacher mentor in the Sc:iii program. Finally, our partner, PAEC, has a chapter on administering a project of this size and scope.

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# Chapter 1

## Teaching the Nature and Practice of Scientific Inquiry

Working With Science Teachers in Rural America



# Penny J. Gilmer, Steven Blumsack, Helena Safron & Kate Calvin



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*“We worked very closely with the PAEC team to bring together this experience for the teachers in the rural Florida panhandle.”*

## Reaching Rural Underserved Teachers



*Dr. Penny J. Gilmer*

In the rural communities of the Florida panhandle, the number of K-12 students who understand science and the nature and practice of science is small. Our state requires students to take the Florida Comprehensive Assessment Test (FCAT)<sup>1</sup> a comprehensive, high-stakes test in science in various grade levels (i.e., 5<sup>th</sup>, 8<sup>th</sup>, and 11<sup>th</sup>). Rural school systems often have a large majority of students that score very poorly in the math and science sections of this assessment.

The counties that participated in our program had greater than 40% of their K-12 students on free and reduced lunch; two counties' numbers were as high as 78%. In 2006, our entire state had a low average percentage of students with passing FCAT Science scores: 35% for grade 5, 32% for grade 8, and 27% for grade 11. We applied for grant funding in 2007 and the counties that would participate in our grant had even lower averages of students passing Science in the FCAT than the state averages: 28% at grade 5, 26% at grade 8, and 27% at grade 11. Our lowest performing counties had a range of only 3-10% of students with passing scores.

The high-stakes FCAT is mainly multiple-choice with some questions requiring short or extended responses and does not directly address scientific inquiry. Even with such a simple format, the lack of scientific understanding is imminently clear. Many of the counties only have one elementary school, one middle school, and one high school. Other counties have a combined elementary-middle school or a combined middle-high school. The teachers of these students are isolated from each other, making collaboration and learning of science difficult.

To address these problems, we asked the following research questions:

1. What are the elements that transform our rural K-12 teachers so they can bring real-world knowledge and excitement to their science classrooms?
2. How does articulation across grade levels facilitate teacher learning and their growth in field-based, scientific research experiences?

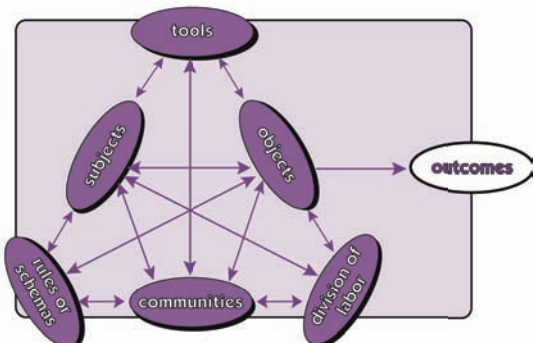


*Dr. Steven Blumsack*

We worked very closely with the PAEC team to bring together this experience for the teachers in the rural Florida panhandle.<sup>2</sup> We received funding for this project from the Panhandle Area Educational Consortium (PAEC) through a grant from the State of Florida for the Math/Science Partnership Program. In addition to this chapter, this monograph includes eight other chapters written by teachers in the program and a chapter written by the PAEC team on the administration of the entire program.

Figure 1. Cultural-historical activity theory (CHAT) model of interactions that influence the subjects' paths to objects and outcomes.

## Theoretical Underpinnings



Our theoretical perspective in the design, management, and evaluation of the graduate courses is cultural-historical activity theory (CHAT).<sup>3</sup> We view all participants' comments and experiences through this lens. With this perspective, the goal of the Sc:iii courses was to facilitate the teachers as the subjects moving to their objects (participating in scientific research) and on to their outcomes (teaching science through inquiry with their students). The four domains that influence the outcomes are tools, communities, division of labor, and rules (Figure 1). These domains can add coherence or contradiction to the flow of the subjects to their objects and outcomes. Reducing the contradictions, adapting the program formatively, and increasing the opportunities for coherence enhanced the teachers' outcomes in the program.

## Designing the Program

We chose to work with grade 3-12 teachers and enroll them as distance learning graduate students at Florida State University, which is in the Florida panhandle. The funded program, entitled *Science Collaboration: Immersion, Inquiry, Innovation (Sc:iii*, pronounced "sigh"), was similar in design to previous successful programs: 1) a large program that had middle school teachers conducting their scientific research in groups near the university (rather than near their schools/homes),<sup>4</sup> and 2) a smaller program enacted with elementary and middle school teachers working with scientists near their schools or homes.<sup>5</sup>

In addition, Dr. Gilmer had worked with teachers wanting to engage in scientific research near their homes for their M.S. degrees, and she teamed teachers from different grade levels for that work. For instance, one team of a community college mathematics teacher and a kindergarten teacher worked two summers together on two different projects. The collaboration across grade levels and



Ms. Helena Safron



Dr. Kate Calvin



*“Science Collaboration: Immersion, Inquiry, Innovation (Sc:iii, pronounced “sigh”), was similar in design to previous successful programs.”*

subject content was powerful, with each teacher providing different pedagogical skills and subject knowledge. Therefore, we wanted to have a much larger program for testing this articulation across grade levels and its influence on a team’s scientific research and the ability to bring authentic inquiry into the classroom. All our teachers in Sc:iii had projects near their homes or schools to facilitate extension of the research with the scientists and the schools after the program finished.

The National Science Education Standards encourage the teaching of science through inquiry<sup>6</sup> and scientific inquiry was a core aspect of the experience we provided for teachers. Crawford has a paper describing new roles for a biology science teacher as he provides scientific inquiry in his classrooms.<sup>7</sup>



*Nobel laureate Harold Kroto talking with Sci:iii teacher LaQuette Cobb, after his presentation to the teachers*

There were several interwoven components to the entire program:

1. In Fall 2007, PAEC offered teachers professional development on several topics designed to enhance their pedagogical skills: *Reading to Make Meaning of Science*, *Writing to Make Meaning of Science*, *Increasing Inquiry in the Science Classroom* and *Effective Questioning*. The teachers also answered the questionnaire, *Views on the Nature of Science*.<sup>8</sup> The teachers answered the same questions in the post-test after the conclusion of the second course in Summer 2008.

2. Throughout the program, we offered various learning opportunities to the teachers. PAEC invited a series of national experts to conduct pedagogical enhancement workshops. Additionally, teachers interacted with six scientists who described their scientific research through a series of seminar presentations. Teachers were provided DVDs of all seminars and several of the workshops, other materials that accompanied the workshops, and classroom supplies. The consortium developed a discussion board that provided a means for early collaboration and interaction. Participants had an opportunity to enroll in a five-day “immersion in science” experience at University of Florida.

All of these activities were crucial in initiating educator reflection into his/her professional practice and enhancing collaboration and collegiality. When the project began, teachers from a particular school district “needed” to sit with each other, and they exhibited a certain degree of wariness at sitting with people from other districts. However, as the teachers attended workshops together and participated in varied small group activities, they demonstrated increased enthusiasm and collaboration.

3. The first graduate class offered in Spring 2008 was a one-credit, on-line course entitled *Nature of Scientific Inquiry*. We used live video streaming (now archived) with Dr. Gilmer, a scientist and scientist educator, and Dr. Steve Blumsack, a mathematician. We discussed sequentially the three books that we thought would prepare the teachers for a scientific research experience in the following summer semester.<sup>9-11</sup> We provided an on-line discussion forum in which the graduate

*“All our teachers in Sc:iii had projects near their homes or schools to facilitate extension of the research with the scientists and the schools after the program finished.”*

student teachers needed to post their own reflection each week, and also respond to another student's post on the same assignment.

4. In Summer 2008 semester we offered a two-credit graduate class entitled *Scientific Research Experience*. The teachers worked for at least 90 hours in the field doing scientific research, plus more time reading and writing reflectively. We organized the teachers into eight sections, three to four teams per section, and approximately two to four teachers per team.

We provided on-site mentoring for the teachers at the research site by the scientist(s) and by a teacher mentor visiting each site at least three times. We hand picked six teachers and two graduate students with scientific research experience to be the teacher mentors and they graded the teachers on their involvement and their on-line reflective posts. Gilmer and Blumsack each visited 15 of the 30 teams during the research experiences, with the goal of providing more connections for the teachers between their research and teaching science. Dr. Calvin also visited the monograph authors and their teams.

5. At the conclusion of the Summer 2008 semester, we had a poster session with more than 30 team posters. Each team had at least one poster that the members defended to the other teachers in the program and to the participating scientists who could attend. In all, we had approximately 100 attendees, with four rounds of poster presentations. The posters were an important component for the teachers to write and reflect on their research, and were an important part of evaluating the Sc:iii program.

In developing this program, we purposefully encouraged the teachers to select their teams so teachers from different grade levels would work together with the same scientist on the same project. In this way, we could foster articulation (also called vertical teaming) across elementary through high school grade levels. Most teacher professional development focuses on teachers of a certain grade level or a certain content subject matter. Our approach was different because we encouraged the articulation across K-12. Due to constraints of geography across our broadly extended rural area (spanning approximately 275 miles east-west and ~75 miles north-south), along with other commitments and interests of the teachers, some teams could not follow this articulation, but many of the teams did.

We also wanted the teachers to have the research experiences near their school/home so that their students would see the real-world applications of the science. Many projects were environmental in nature, such as studying gopher tortoises as indicators of the pine forest uplands, oysters as indicators of the brackish water, mussels as indicators of the freshwater streams, and butterflies and rare plants as indicators of the open fields. Earlier research documented the importance of the research site's proximity to the students' home/school.<sup>5</sup> This enables each

*"In developing this program, we purposefully encouraged the teachers to select their teams so teachers from different grade levels would work together with the same scientist on the same project. In this way, we could foster articulation across elementary through high school grade levels."*



*Teacher mentor Janice Ouimet with FSU Sc:iii Director Penny J. Gilmer, enjoying the ride back to port after a day of monitoring the shark population*



*Helena Safron en route from Indian Pass to St. Vincent Island at sunrise*

*“Because our mode of delivery was distance education using on-line formats, the teachers needed to learn to utilize the Internet and become technologically savvy. The teachers also got to learn about the other participants by reading their posts and commenting on them.”*

teacher’s students to ask science questions related to their lives and local setting. Therefore, the teacher can engage the students in real-world science.

In this paper, we examine if and how the teachers’ ideas on the nature of science change as a result of the 216 hours of professional development, mainly within the two graduate courses that the teachers took for credit. We also use their reflective writing during the scientific research experiences.

## Designing the Evaluation

Each teacher had a term paper due at the end of the scientific research. We wanted each teacher to construct his/her ideas about the experience in writing. An important component of the teachers’ final term paper was a plan to incorporate their insights and experiences into classroom teaching. These plans included a variety of modes including experiments, discussions and focused

observations. For all the written work we had five criteria in the rubric on which to base the teachers’ scores:

1. Accurate relating of current understanding of the science content, using the language of the appropriate discipline
2. Reflecting in relation to your prior learning and/or experiences
3. Writing in good form, without spelling or grammatical errors
4. Citing references (using APA citations), at least some from the Internet
5. Indicating ways of bringing inquiry-based teaching into the K-12 classroom

To change a teacher’s perspective and thinking, we encouraged the teacher to reflect on prior learning and/or experiences in the light of new learning (see Figure 2.1, in reference 12). Because our mode of delivery was distance education using on-line formats, the teachers needed to learn to utilize the Internet and become technologically savvy. The teachers also got to learn about the other participants by reading their posts and commenting on them.

Understanding the relationship of the teachers’ views of experiential learning and the learning of their own students is important. What are the characteristics of the scientific research experience that provide for significant changes in the teachers’ classrooms? Do these changes include both content and pedagogy? Since only 79 teachers participated in the scientific research experience, we can broaden the impact of the program by providing resources for other teachers. Dr. Blumsack plans to compile the teachers’ planned curricula by grade level, context, and nature of the activity in a fashion that provides easy access for other teachers to the description of fundamental activities. The teachers became learners, so they remembered the frustrations and the joys of learning. Through such experiences, teachers became more empathetic toward their students. This development of empathy for the learners is consistent with earlier studies in which pre-service science and mathematics teachers engaged in scientific research.<sup>13</sup>



## Findings and Analysis

### Data From *Views on the Nature of Science* Questionnaire

Regarding the *Views on the Nature of Science* (VNOS) questionnaire, the typical responses at the beginning of the program were naïve and after the summer research the responses were more analytical. We analyzed the data of the nine teachers who are monograph authors and those of a seven teacher comparison group that did not do as well in the first on-line course. We sorted the data from the pre- and post-program survey into nodes of categories of responses.

However, we had problems getting genuine responses to the VNOS, especially at the end of the program, since the teachers had to hand-write their answers, and the responses tended to be very short and not as informative. We learned from this to have another paid day for the teachers to come to do a proper evaluation, rather than trying to fit it at the end of the poster day.

### Data From Teachers' Journals During Scientific Research

Due to the problem of getting authentic data on the VNOS, we decided to sort the data from the three journal responses from the summer research experience. The most informative and genuine data were from the teachers' posts during the semesters in which they took the on-line courses.

The node "thoughts from the field" was especially informative, as the teachers were especially informative, as the teachers were actively learning science in their research experience, asking questions, conducting experiments, and making inferences from their data with the team members and the scientist.

A monograph author, Haley (a pseudonym), wrote about her being able to understand the process of science by being immersed in the laboratory with the scientists and seeing their process of asking questions.

If I had to pick one word to describe the scientists and students I am working with, it would be curiosity. Everything is of interest and one test just leads to the next test or question. I was able to see first-hand how all of science is interwoven and connected. I found myself getting excited over species I once over looked as not interesting or important. Suddenly, everything was interesting and connected to everything in its habitat. I had the book sense to know that fact, but the reality of that concept hit me! I am thinking differently already, about how I view science and the teaching of science in my classroom. (Journal 1, Summer 2008)

*"For these teachers, the genuine nature of science revealed itself, and they are returning to their classrooms prepared to teach their students how to question as opposed to what to learn."*



*Kate Calvin at Nokuse Plantation waiting for a rescued gopher tortoise to show her head*



*“The combination of teachers teaching how to question and providing the local science opportunities is likely to have a significant and far reaching impact on how students view their roles in society.”*

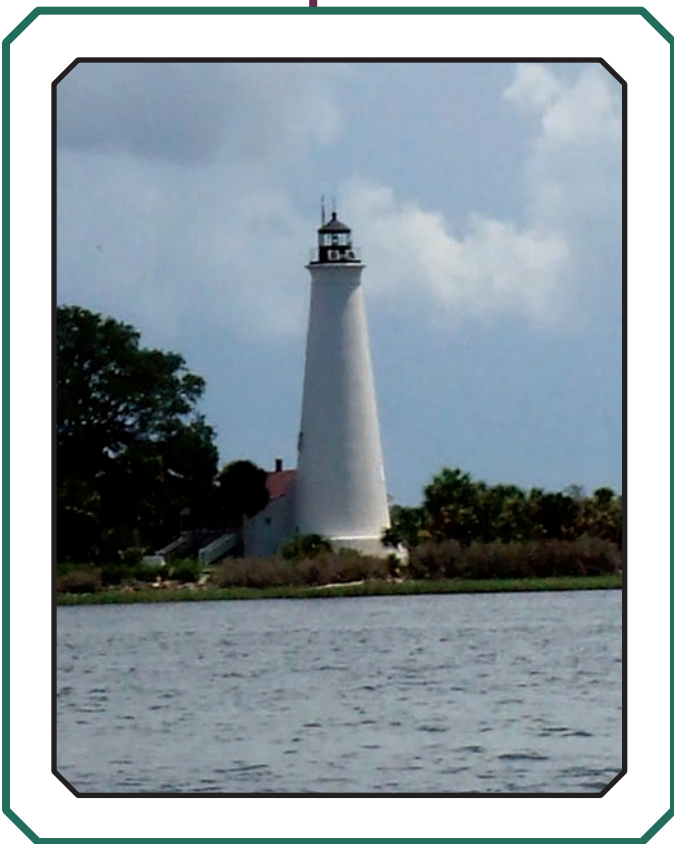
Those teachers in the comparison group grew and learned as well. Yvette had been more reluctant at the start, in part, because her county required her to attend. However, her ideas on nature and the world around her changed rapidly. Yvette told Gilmer, “This is an incredible learning experiment—with each step I learn butterflies and understand why conservation is necessary. We need more opportunities like this one open to teachers.”

In Yvette’s first journal for the summer’s research, she noted:

Later that week I stepped out to get my mail, and there on my doorstep was one of the butterflies we are tracking, the Hoary Edge. I was so excited! Sweeping the back porch, I found a dead Carolina Satyr. I add this because I wonder if my eyes have been closed to a beautiful world around me. Have these butterflies been here all along and I just haven’t noticed? I now am on a quest to find where they are feeding in this area so I can find what species of butterflies I actually have in my neighborhood. (Journal 1, Summer 2008)

The world opened for Yvette, and this was obvious in her remaining posts and in her reflections that she shared on her team’s poster:

This experience brings an entire[ly] new take on our human footprints and is something that I can share with my students. Also, experiencing the process of learning through inquiry has been rewarding and will allow me to instruct my students using an inquiry-based, hands-on approach through inquiry-based centers. This experience as a student of scientific inquiry has given me confidence to let go and just allow learning to occur. (Final poster, Summer 2008)



*St. Mark's lighthouse*

*“The impacts are real, and tying science to their personal lives will illustrate for the students how important a tool science really is in understanding important issues.”*

Yvette now is no longer afraid of questions that students might ask her. She can allow her students to do the experiments to find the answers.

The data from the journals and poster of one monograph author and one in the comparison group provide a glimpse of the rich source of data we have. For this chapter in the monograph we only provide these entries, but the data are enough for a number of research publications.

### **A Welcome Shift in Focus**

From their research, direct experience with science became a tool the teachers can use to be better science teachers. For many of the teachers, the research provided an entirely new way to view the nature of science and to engage students in the learning of science. For these teachers, the genuine nature of science revealed

itself, and they are returning to their classrooms prepared to teach their students how to question as opposed to what to learn. An elementary school teacher said, “I used to put all this pressure on myself to know all these facts. Now I’m not afraid to say, ‘I don’t know, let’s find out.’” The process of discovery is at the heart of science, not the knowledge itself.

Without exception, regardless of grade level, these teachers want to impact their students and inspire excitement about learning and about science. The teachers learned to push themselves to learn. One teacher said to a science reporter who was visiting her team on a shark trip:<sup>14</sup>

This has been the most awesome experience of my whole life, as a teacher. I’m excited about what I’ve learned. I’ve had to go outside of my comfort zone, but then I felt such success after accomplishing things that I never knew. (p. 4)

This same teacher said to Dr. Gilmer that she had always been a “princess” and previously did not touch things that were messy. She had to force herself to become involved. The reporter asked the teacher about ways she might change her teaching for this coming year. She said, “I’m going to push them, because I want them to step out of their comfort zones and experience that same success and just the excitement for the knowledge. It’s just been wonderful. I’ve loved it” (p. 4).<sup>14</sup>

## Articulation in Teams Across Grade Levels

On the value of articulation with the teacher teams, one of the middle school teachers (also a monograph author) who had five teammates because her own team paired with another at the same site, with teachers spanning from 5<sup>th</sup> to 10<sup>th</sup> grade, said:

We bounced ideas off each other and gave elaborate descriptions of how each idea would work. This is the type of discussion that a teacher yearns to hear from students, and it is not achieved by saturating the learner with information but through the power of curiosity and the thrill of solving a real-world problem.

Now we can strive together to bring similar experiences into the classroom more often and continue the tradition from middle school to



*Daphne Hill, left, and Algeletha Mitchell relaxing outside the lab at DOACS*

*“In teacher teams representing different grade levels, the basic desire to excite students about inquiry is akin to a positive feedback loop and the inspiration becomes contagious.”*

high school classes. I believe this is important because a strong support system is needed if we were to successfully implement a new teaching practice. (Cindy, final term paper in CHM 5832)

We conclude that isolated science teachers in rural areas thrive on the stimulation of collaborating with the scientists and their peer teachers. In teacher teams representing different grade levels, the basic desire to excite students about inquiry is akin to a positive feedback loop and the inspiration becomes contagious. These teams are better equipped to carry on inquiry-based traditions from one grade level to the next and help students build upon their critical thinking skills. In the Sc:iii program, some groups fit this articulation model perfectly while others did not.

*“Questions from the teachers arose about ways to bring inquiry into the classroom, and the teacher mentor could speak with experience.”*

## Scientist Mentor's Roles

One of the valuable assets of this program was the participation of the scientists. The scientists generously donated their time and knowledge with the teachers, and the rapport between the scientists and the teachers was excellent. Without exception, the scientists shared their passion for their research with the teachers. The reason this was so successful was because overall, the teachers' enthusiasm for learning matched the scientists' enthusiasm for the research.



*Teacher mentor, Joi Walker*

Having the research sites with all the personnel, equipment, technology, and expertise allowed the teachers to enter a research site and learn a lot in a short period of time. Many of the teachers now have access to Global Positioning System (GPS) units because of their connections to local scientists. Also many of the scientists plan to visit the classrooms of our teachers. For example in 2004 and 2005, Mr. Scott Sweeney, Park Ranger with Falling Waters State Park, mentored a science teacher, Caren Prichard, during two summers of scientific research. Ms. Prichard continued the work on eradicating exotic plant species at the state park by getting her students and the community involved in identifying exotic species. Ms. Prichard wrote a flyer on exotic species that the park gives to visitors to the state park. Mr. Sweeney has visited Prichard's high school chemistry classrooms many times and invited the students to come to the park as a class field trip.

Mr. Sweeney has visited Prichard's high school chemistry classrooms many times and invited the students to come to the park as a class field trip.

In Summer 2008, Mr. Sweeney mentored six of our Sc:iii teachers at Falling Waters State Park and two more at Ponce de Leon State Park. Mr. Sweeney is an example of the ongoing collaborations and teamwork that can develop with the teachers getting involved with scientists in experiential learning in the field, close to their home/schools.

## View From a Teacher Mentor

The Sc:iii teachers learned considerably from their teacher mentors. Questions arose as to ways of bringing inquiry into the classroom, and the teacher mentor could speak with experience. We had six practicing teachers as teacher mentors, plus two current graduate students, one in biochemistry and the other in science



education. The teacher mentor in science education, Joi Walker, also teaches organic chemistry at a community college. Here is Joi's perspective as a teacher mentor:

At the community college we are trying to bring more inquiry into the classrooms and labs. Convincing our colleagues is one barrier, but a significant challenge is getting students to buy into the new system. By the time they reach college students have learned to "do school" a certain way, and they fight change. In my graduate courses we talk about the need to change the way science is taught, but where do we start? [Should that be] in elementary school with young minds that are open to trying new things? In middle and high school where we introduce core science courses? In college science courses, so that we train teachers in inquiry? The answer is all of the above. We have to work at all levels.

She is correct that we need to address the issue of science literacy at all the levels simultaneously.

## Collaboration

All of these facets to the program carry a common thread: collaboration. Collaboration extends in all directions throughout the network of people involved in the project and beyond. However, the most important collaboration that will arise as a result of this program is the collaboration between teacher and student. One Sc:iii teacher described her classroom as being a place in which students can use mistakes as learning tools as opposed to constantly regarding mistakes as "bad." These collaborative views of teaching are likely to engender a higher degree of trust and courage for the teacher to encourage his/her students to do more exploring and questioning. As a result of this program, the teachers have a new view of the classroom in which asking the questions and figuring out ways to find the answers involves team effort and is more important than knowing the answers. Critical thinking, problem-solving skills and innovation are essential for our children to learn and experience in order to become the citizens and leaders of tomorrow.

## Contribution

This Sc:iii program opened an opportunity for some of the teachers to engage in a previously undiscovered mechanism to expand their horizons in teaching and learning. Science is not a subject but a process, and that is a brand new practice and perspective for the Sc:iii teachers. The teachers have learned that science is



*Greenhouse modules team relaxing at the greenhouse after a day in the field*

*"One Sc:iii teacher described her classroom as being a place in which students can use mistakes as learning tools as opposed to constantly regarding mistakes as 'bad'."*



“One of the important contributions that we add to science educational research is the value of articulation across grade levels.”

something that you do, not memorize. The teachers are figuring out the process and ways to bring that experience to their students. The notion of collaborating with their own students reduces the pressure of feeling like they need to know all the science “facts”—now they feel like they can work together with their students to develop the question, find a methodology that works for answering the question, and make discoveries and innovations, which then lead to the next questions.

Jay Dubner is a pioneer in developing programs for urban teachers doing scientific research. He currently has an NSF-funded Research Experience for Teachers program in NYC focused on nanoscale science and engineering.<sup>15</sup> Columbia University’s Summer Research Program for Science Teachers (SRP), founded in 1990, is one of the longest, most stable programs of its kind. SRP is believed to be the first teacher research program to directly link this form of teacher professional development with increased student achievement (personal communication, Jay Dubner, October 3, 2008).

Through this monograph and the video documentary of the monograph authors in the field with their teams, we present these findings to other teachers in the Sc:iii program and also to their school peers and teachers elsewhere, thereby broadening the impact of the program.

One of the important contributions that our results add to science educational research is the value of articulation across grade levels. Utilizing articulation among the various grade levels may enhance other researchers’ programs for practicing science teachers in the teaching and learning of science.

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# Chapter 2

## Schooled By Sharks

Diving Head First Into Shark Research



# Tiffany Nichols

Carr Elementary and Middle School  
Clarksville, Florida



## Biographical Information

### Present Positions

- 7<sup>th</sup> and 8<sup>th</sup> grade general science, Carr Elementary and Middle School, Clarksville, Florida
- Member, Calhoun County Educators Association, Florida Association of Science Teachers, National Science Teachers Association
- National Board Certified
- Graduate master's student in Science Education at Florida State University

### Years Teaching

- 8 years

### Science Background

- Certified in Middle Grades Science Education
- No prior field experience

### Reasons I participated in Sc:iii

I had the opportunity to work in the field, and without hesitation I instantly said yes. I did not know that we would get any graduate credit, which was an unexpected bonus. I love teaching science and am always looking for new opportunities to enrich my own learning. As an undergraduate, I had been an elementary education major with no background in science. At the beginning of my career, I had to get certified to teach middle grades science and absolutely fell in love with science. I want to inspire that same enthusiasm in my students.

### My learning from the Sc:iii program

The most profound insight I had of scientific research was the importance of teamwork and collaboration. Being able to anticipate one another's needs in order for procedures to run smoothly and paying attention, not only to your responsibilities but also to events occurring around you, is vital during research. Scientists have to be aware of any possible outside interferences that limit or influence their data and results.

*“The purpose of this research project is to conduct a fishery-independent survey of the Big Bend region to determine the composition of the coastal shark populations that use the seagrass beds as nursery grounds.”*



## We Need a Bigger Boat for All This Gear!

*"You're gonna need a bigger boat." - Chief Brody (Roy Scheider) in "Jaws," 1975*

I work with teenagers everyday and have learned to "roll with the punches" and adapt quickly to new situations. I was not fully mentally prepared for the journey that lay ahead. I had learned previously that my team would be working with Dr. Dean Grubbs at Florida State University's Coastal and Marine Laboratory conducting shark research, but I really was not sure about the work we would be doing. Would we study shark anatomy? Would we catch

sharks? Would it be just like the documentaries I've seen that show sharks being tagged and released? Dr. Grubbs gave us several articles to read as background for the research that we would be doing and the ongoing debates involved in shark population and conservation studies. In addition to being fantastic windows into the ethics of scientific research, the articles also clarified our research project and provided some understanding of the jargon associated with equipment and sampling procedures.

The seagrass beds in the Gulf of Mexico off the Big Bend region of Florida's coast cover approximately 3,000 square kilometers, or 750,000 acres.<sup>1,2</sup> Seagrass beds are critical primary nursery grounds for marine life, including several

species of coastal sharks. Even though shark surveys exist along the Gulf coast west of Port St. Joe Bay<sup>3</sup> and eastward from Cedar Key, there are no data in the Big Bend region of Florida, from Port St. Joe Bay to Cedar Key. The purpose of this research project is to conduct a fishery-independent survey of the Big Bend region to determine the composition of the coastal shark populations that use the seagrass beds as nursery grounds. Elasmobranch ecologist Dr. Dean Grubbs led our collaborative effort in surveying this region of Florida's coast.

I was thrilled to participate in a project so exciting and could hardly wait to board the boat. We spent the first several days preparing gear for our first set of surveys. Our team consisted of Wendy Guilford, Shannan Romer and me, along with Dr. Grubbs. We spent two days in the blazing hot sun mending the gillnets. The experimental gillnets we used consisted of six panels having stretched mesh sizes ranging



*The FSU Coastal & Marine Laboratory near Panacea, Florida, as seen from the Gulf of Mexico.*

*"We needed a total of 120 gangions, 30 of each hook size, and we made them all, until our fingers ached."*

*Dr. Grubbs handing off a gangion to Tiffany*



from 7.6 cm (3.0 in) to 14.0 cm (5.5 in), in steps of 1.27 cm (0.5 in). Each panel was 30.5 m in length and 3.1 m deep during fishing. Webbing for all panels is clear #28 monofilament nylon. This monstrosity was about three meters high, a total of 186 meters long, and had holes torn in it the size of truck tires from the previous outing. (In each set, the gillnet is cut in order to free the animals.) Having such large holes, this gillnet would not catch many sharks. Facetiously, I asked Dr. Grubbs if it would be easier just to buy new nets. Laughing, he replied, “Probably.” As teachers, we are all very aware of the difficulties with funding and making do with the available equipment. To mend gillnets, you basically recreate the net pattern by weaving monofilament through whatever is left of the net. It was very tedious work, but since the task did not require a tremendous amount of focus, we had a good opportunity for our team and Dr. Grubbs to get to know each other and learn about this gear we were preparing. Typically, the National Marine Fishery Service (NMFS) uses a 186 m long gillnet for sampling small coastal shark species along the Florida Panhandle.<sup>3</sup> The use of gillnets is highly controversial due to the high mortality rate of the catch,<sup>4</sup> but in order for this survey to include data comparable to other surveys along the Gulf coast, we used gillnets for part of our study.

Once we repaired the gillnets I asked myself, “Now can we get on the boat?” Not yet. In addition to the gillnet, we needed to prepare a longline for use as a second measure of shark relative abundance. We wanted to compare catch composition, bycatch and shark mortality rates between gillnets and longlines. The longline is constructed of a ~2 km main line of 6.4 mm tarred nylon that is anchored on each end and lies horizontally on the bottom. Three-meter long branch lines, or gangions (pronounced “ganjuns”), are clipped to the main line at 20 m intervals. Gangions consist of a stainless steel tuna clip with an 8/0 stainless steel swivel attached to 2.5 m of 150 or 400 kg monofilament followed by an 8/0 swivel, 1.5 m of 1.8 mm or 2.1 mm stainless aircraft cable, and terminated by a 10/0, 12/0, 14/0, or 16/0 circle hook. We needed a total of 120 gangions, 30 of each hook size, and we made them all, until our fingers ached. Constructing the gangions was rather like putting together a puzzle. I was amazed at the way my teammates and I naturally and easily fell into an assembly line. We became an efficient gangion-making machine. We spent the next few days putting the finishing touches on our longline rig. We coiled the 2 km of tarred line into containers, tied and labeled buoys, and drew measurement lines on a special measuring trough for the sharks. I could feel it coming; we would board the boat soon!

## Excitement and Delay: A Teacher Learns From Mistakes

During the massive amounts of gear preparation, I started to wonder what we would discover once we were out on the water. I had never done anything like this before.

*“I may have learned more from this one mistake than from anything else during this experience. It opened my eyes to the close connection between every step of the process.”*



*Gear assembled by the shark team*



*Dr. Grubbs, left, and Shannan, right, set the gillnet.*

*“With biological surveys of this nature, some death is expected. However, we did everything we could to lower the mortality rate.”*

*Tiffany, left, and Wendy, right, help set the longline.*



Here is a basic description of the procedure we followed: One set of data collection includes setting out the gillnet and marking the location with a GPS. Setting the gillnet requires approximately 10 minutes. Once the net is anchored, we mark a new location for the longline. The longline requires anywhere from 30 to 45 minutes to set and all hands on deck are needed to bait hooks and prevent the 3 m gangions from becoming entangled. Soak time is the amount of time the gear remains in the water. Initially, we thought soak times of over an hour would be needed but after the second day, we minimized our soak times.

We arrived at the laboratory before sunrise to load our gear. As we headed into the Gulf for the first time to the anchor location to set the gillnet, Dr. Grubbs asked us to start cutting the bait. The bait was bycatch from another expedition, mostly Spanish mackerel. We cut one hundred pieces of varied sizes for the different sized hooks. It was quite disgusting and I understood the reason Dr. Grubbs told us to wear clothes that we did not mind ruining. After

we set the gillnet, we headed to another location to set longline. Then the fast paced work began. I baited hooks, along with Wendy, while Shannan unclipped the hooks and passed them to Dr. Grubbs. He kept a steady pace, attaching gangions every 20 m. Once 25 hooks of a particular size were secured, he attached a buoy to the line. If cutting the bait was a nasty ordeal, baiting the hooks was far worse. Blood and other vile particles were running down my arms and legs... and it was only 9:30 in the morning! Just

as I developed a rhythm to my fish baiting technique, a major problem sprang up out of nowhere. One of the main line sections I had coiled became horribly tangled. I had accidentally placed a coiled section in its container upside down. The mass of line was so entangled that Dr. Grubbs had to cut it and replace it with another section. I took full responsibility and felt terrible about it. I could tell he was annoyed by my mistake, but he did not get angry or say anything. The mishap put us behind schedule, which meant going home late and greater mortality of the fish in the gillnet. I may have learned



more from this one mistake than from anything else during this experience. It opened my eyes to the close connection between every step of the process. Management of the gear is incredibly important. Every single time we handled gear we had to think about the consequences that could occur later.

## In Life and Death: Scenes You Never See in Documentaries

Everyday was a new adventure, filled with new discoveries and new experiences. A serious surprise to me though, was the mortality rate of the sharks. Our first two days out, it seemed we caught more sharks dead than alive. Atlantic sharpnose sharks dominated the catch. This is an extremely abundant small coastal species, however, it is also a very active species. Due to its high metabolic demands, mortality rates are very high in this species. Although our overall mortalities were much lower than commercial or recreational fisheries and we were not catching any threatened or endangered fish, this still was not good. With biological surveys of this nature, some death is expected. However, we did everything we could to lower the mortality rate. Dr. Grubbs told us we would have to lower our soak time, which meant there would be no break between setting and hauling in the gear—it would be non-stop work. We eliminated mistakes like the one I made with the coiled rope. Wendy and I baited hooks faster and we each became more skilled and efficient with each of our jobs. As a result of our efforts, the number of successfully tagged and released sharks increased by 4%, which may not seem like much, but it matters.

We were drenched in seawater, stinging our skin, while we reeled in 2 km of tarred nylon. Our shoulders ached with the weight of the wet rope as we coiled as fast as humanly possible in order to maintain Dr. Grubbs's pace. We smiled the entire time because we wanted to learn, no matter the challenge. There was an immediate rapport among the four of us that made all of the hot, tiring time in the field seem less like "work." We all seemed



*"As a result of our efforts, the number of successfully tagged and released sharks increased by 4%, which may not seem like much, but it matters."*

*Above and below, Dr. Grubbs catches, tags and releases a robust shark*



*"We smiled the entire time because we wanted to learn, no matter the challenge. There was an immediate rapport among the four of us that made all of the hot, tiring time in the field seem less like 'work'."*



*“At the end of the day we smelled awful and disgusting things covered us from the neck down, but we would gladly do it again and again.”*

to naturally gravitate to tasks that were comfortable to us and stepped forward to do the best job possible. I volunteered to record all the data from our catch, which kept me very alert! I also had the job of keeping the taggers loaded and ready to go whenever Dr. Grubbs needed them. We cut bait, coiled wet, dirty rope, assisted in hauling in gear, cleaned the boat, and even drove the boat. At the end of the day we smelled awful and disgusting things covered us from the neck down, but we would gladly do it again and again. On the way home we talked about going faster, being more particular with the gear and paying more attention to everything going on so we could anticipate problems and prevent them. We did all of that intentionally; it wasn't just a coincidence. We became like a well-oiled machine and I think Dr. Grubbs was even impressed with our teamwork.

We all had personal milestones: Shannan scraped her leg on a shark's dermal denticles while she assisted Dr. Grubbs in measuring a thrashing 236 cm long nurse shark. She was so proud of her “shark burn” that I took a picture of it.

Wendy is a 44-year old mother of two adult children. She has never been a risk taker and to be with her as she stepped out of her comfort zone and faced new challenges was very special. It created a bond that we will always share. As for me, I wanted to learn everything I could about these apex predators. Also, I had never been so close to sharks before!

We, especially Dr. Grubbs, respect all of these creatures and we waste nothing. Bycatch becomes bait or is released. We release tagged sharks for future study and we bring the sharks that die back to the laboratory for dissection. The dissections reveal valuable information regarding shark physiology and feeding behavior. Dr. Grubbs enters this information into his overall database for later use or to share with colleagues. Students get to do dissections on the sharks for educational purposes.

*Dr. Grubbs uses the trough to measure the length of each small shark.*



*Dr. Grubbs tags the shark's dorsal fin with help from a student volunteer.*

Not only did dissections serve as demonstrations for middle school visitors to the Marine Laboratory, they provided us with teaching aids. One example was six complete sets of jaws (two for each of us). I cleaned them all and by the time they were ready for us to take



to our classrooms, I was able to identify four shark species by their fascinating teeth. Another incredible discovery, and by far the most thrilling for me, was a pregnant female bonnethead. Bonnetheads are the smallest species of the *Sphyrnidae* (hammerhead) family.<sup>5</sup> Unlike male sharks, whose maturity can be visually determined by examining external appendages on the

pelvic fins, maturity in female sharks is difficult to determine without dissection. Bonnetheads have an advanced reproductive tract consisting of paired uteri. After mating, they can store sperm for up to four months before actual fertilization of eggs occurs. The gestation period is approximately four to five months and this particular female was mid-term, with five pups in each uterus for a total of ten pups. She was most likely seeking shelter in the seagrass beds to pup, or give live birth. Each pup had its own yolk sac placenta and umbilical cord. The mother supplies histotroph (similar to milk) to the pups through the umbilicus. My team and I measured each of the ten pups and we also collected their DNA for later studies. The umbilicus of each bonnethead pup had many frilly protrusions along its length. It is believed that the mother supplies the pups with additional nourishment through these “villi” (D. Grubbs, personal communication September 2, 2008). This particular reproductive mode happened to be one of the last that Dr. Grubbs needed to photograph for his lectures on shark development and physiology. In addition, we each got to take a preserved pup for use in our classrooms, an important gift from nature and a much-appreciated teaching aid from Dr. Grubbs.



*“Another incredible discovery, and by far the most thrilling for me, was a pregnant female bonnethead.”*

*Shannan helps Dr. Grubbs measure the length of a healthy nurse shark.*

## The Data Tell the Story

During our 90 hours of field research, my team and I spent approximately 40 hours on the boat with the sharks. My team completed a total of nine gillnet and longline sets, catching a total of 253 sharks. Our survey data show that the species composition of coastal sharks inhabiting the seagrass beds and adjacent sandy flats is as follows:

Nearly two-thirds, 63%, of our total catch consisted of *Rhizoprionodon terraenovae*, or Atlantic sharpnose sharks, with 52% of them -being either juveniles or young-of-year (newborns). The other half of the Atlantic sharpnose catch consisted mostly of mature males.

Sixteen percent of our total catch consisted of *Sphyrna tiburo* or bonnetheads and 95% of these were female. Estimates based upon body length indicated that the ratio of mature:immature females was approximately 1:1. The males were immature.



*A pregnant sphyrno tiburo, or “bonnet-head” shark with 10 pups. Dissections like these provide valuable scientific information.*



*Tiffany meticulously keeps up with all the data collection.*

*“I will never again teach scientific processes as a simple series of steps. Since returning to my classroom, I have provided my students with multiple opportunities to learn through discovery, just as I did.”*

*Two sharks caught on a longline being taken back to the laboratory for dissection.*

Eleven percent of our total catch was *Carcharhinus acronotus*, blacknose sharks and 74% of them were mature males and females; one male had mating scars indicative of group courtship. The last 9% of our catch was *Carcharhinus limbatus*, blacktip sharks, with 63% of these either juveniles or young-of-year.

These data show the following trends: 1) Atlantic sharpnose shark is the most abundant species present in the area surveyed. 2) The seagrass beds in this area appear to serve as mating grounds and/or nurseries for the Atlantic sharpnose, bonnethead, blacknose and blacktip species. 3) These data also indicate the likelihood that this region of the Gulf of Mexico is an essential fish habitat for these species.

Our survey data indicate that the gillnet produced 54% bycatch and the longline produced 27% bycatch, which means that the gillnet method had approximately twice the bycatch mortality of the longline method. The shark mortality for the two methods differs less, with the gillnet method being 5% higher than longline. The difference in selectivity between the two catch methods was the most important finding. It is indicated first by the 2:1 bycatch ratio for gillnet: longline. However, the selectivity extends to sharks species as well. The gillnets were highly efficient in capturing Atlantic sharpnose and bonnethead sharks but had very low catchability for other species. While four total shark species were captured in the gillnets, 98.4% were bonnetheads and Atlantic sharpnose. Six shark species were captured on longlines, including three species that were absent from the gillnets (bull shark, great hammerhead, nurse shark). Atlantic sharpnose sharks were the most common species captured on longline (~60%). Bonnethead sharks were completely absent from the longline catch. Blacknose and blacktip sharks were 21% and 16% of the longline sharks catch, respectively. These two species combined were only 1.4% of the shark catch in gillnets. We do not yet know the reasons for the difference in shark selectivity with the different methods of catch.



The survey data as well as life history data will be provided to the National Marine Fisheries Service’s Highly Migratory Species Division, for use in stock assessments for the species we caught and in delineating essential fish habitats (EFHs) of these species. The EFH, as defined by the Sustainable Fisheries Act<sup>6</sup> enacted in 1996, include those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.

While these data indicate the likelihood of certain findings, our sample size is far too small to make any scientifically relevant conclusions until Dr. Grubbs finishes



additional surveys. We felt privileged to have helped initiate this important project.

## Teaching Like a True Scientist: Science Is Everywhere

My research began with curiosity. As a student, I did not have any preconceived notions about the species of shark we would catch or the reasons they were here. It was truly amazing to discover the trends that the data revealed. I will never again teach scientific processes as a simple series of steps. Since returning to my classroom, I have provided my students with multiple opportunities to learn through discovery, just as I did. I use my shark jaws to guide students as they question differences between species and identify the species based on dentition records. My students venture outside the classroom to collect samples of insects and return to the classroom to identify and classify their samples. I am witnessing higher interest and understanding of scientific concepts than in any previous year.

Initially, I had reservations about spending my entire summer immersed in scientific research, but I do not regret one second of my time spent in the field. The Sc:iii program<sup>7</sup> showed me the value of collaboration between colleagues that share common goals. I opened myself up to a new experience that took me outside of my comfort zone and put me in the place of my students.

I think about science education in a new way that is realistic and born out of experience. I want my students to feel exactly the same way. I want to take them outside the confines of a four-walled classroom and guide them to the realization that science is not just another class written on their schedule or a word on the cover of their textbook. So many children lack the vital life experience necessary to understand scientific concepts. Children cannot understand the interactions among organisms in an ecosystem without observing those relationships anymore than they could understand riding a bicycle if they had never seen one.

Science is life, and science is everywhere. I want to provide opportunities for my students to discover concepts and draw conclusions from observations. I want them to feel secure enough to make the mistakes necessary for true learning to take place. Most importantly, I want them to learn that everyone has valuable ideas and that they can learn so much from one another if they set



*The Shark Team heads out for a day in the Gulf of Mexico. Left to right, Tiffany, Shannon, and Wendy*

*“While these data indicate the likelihood of certain findings, our sample size is far too small to make any scientifically relevant conclusions until Dr. Grubbs finishes additional surveys.”*



*Tiffany collects data while keeping taggers ready for Dr. Grubbs*

*“I think about science education in a new way that is realistic and born out of experience.”*



*“So many children lack the vital life experience necessary to understand scientific concepts.”*

*The Shark Team  
From left, Tiffany Nichols, Dr. Dean Grubbs, Wendy Guilford and Shannan Romer*

aside personality differences and open themselves up to new experiences and work together for common goals. Unfortunately, learning from others is the most difficult lesson to teach. Cooperative attitudes toward learning together and openness to other people’s ideas are invaluable. Had any one of the four of us been difficult or quick to complain, it would have made this experience much less meaningful. Professionally, it has been the most meaningful project I have ever done. Personally, this experience has inspired a deeper love of Florida’s natural resources and an appreciation for a beautiful predator that is greatly misunderstood.



*“Professionally, it has been the most meaningful project I have ever done. Personally, this experience has inspired a deeper love of Florida’s natural resources and an appreciation for a beautiful predator that is greatly misunderstood.”*

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# Chapter 3

## Connecting Local Issues to Scientific Inquiry

Oyster Research and Its Impact on a Teacher



**Margy Callaghan**  
**Riversink Elementary School**  
 Crawfordville, Florida



**Biographical Information**

<p><b>Present Positions</b></p> <ul style="list-style-type: none"> <li>• 4<sup>th</sup> grade teacher, Wakulla County</li> <li>• National Board Certified</li> <li>• 2001 Hawks Rise Elementary Teacher of the Year, Leon County Finalist</li> <li>• 2002 Leon County Elementary Science Teacher of the Year</li> <li>• Member of Delta Kappa Gamma Society International</li> <li>• Member Air Force Association</li> <li>• 4-H Classroom Leader</li> </ul>	<p><b>Reasons I participated in Sc:iii</b></p> <p>I wanted to bring new ideas and resources back to my school. I also wanted to learn first hand about the marine research that was taking place in my area and bring that knowledge back in practical, hands-on ways for my students.</p>
<p><b>Years Teaching</b></p> <ul style="list-style-type: none"> <li>• 1 year in middle school</li> <li>• 15 years in elementary school</li> </ul> <p><b>Science Background</b></p> <ul style="list-style-type: none"> <li>• Trained as a Harvard-Smithsonian SEDNett Inquiry-Based Teacher and Trainer 2004</li> <li>• Summer participant in Research Experiences for Teachers Program, FSU High Magnetic Lab 2005</li> </ul>	<p><b>My learning from the Sc:iii program</b></p> <p>Most importantly, I experienced the work and the life of a scientist in the field. I found out that real science is not just a one time experiment attached to text readings and definitions, but an ongoing process of questions, tests, background research and data collection. An extra bonus was the deeper understanding I gained from my marine research and its impact on my coastal region.</p>

*“At the end of each day, I sit out in my woods to watch the owls, deer and bats come out for night-time activity. I feel so privileged to be a ‘watcher’ in their habitat.”*

**Surrounding Myself With Science, Then and Now**

I am always looking for opportunities to learn more about science. I first got hooked as a child. I attended a summer camp that had a full-time botanist on staff and while other kids were swimming and making crafts, I was in the woods



*“My county is home to many local fisherman, crabbers and oystermen and many of my students have been out on boats helping their dad since they were five or six years old.”*

*Oysters with growth on their shells. Arrow indicates an oyster drill.*

with the nature group, identifying plants and watching the animal life that lives on the camp’s beautiful three lakes. I have never stopped being attracted to the science around me, from looking for fossils by day to the wonder and majesty I see at night while gazing through my telescope. At the end of each day, I sit out



in my woods to watch the owls, deer and bats come out for nighttime activity. I feel so privileged to be a “watcher” in their habitat. It is that same love of the natural world I want to instill and inspire in the students I teach. Although this was not my first inquiry experience, it was unique and inspiring on many levels. The nuggets I took away have given me a new lens to look at teaching life science.

## Struggling to Make It in the Forgotten Coast



*A scallop in its shell*

I live in an area of Florida called “the forgotten coast.” The fact that tourists forget it is the reason I love to live here! Nature abounds, unobstructed by big hotels and tourist attractions, and endless traffic. Instead, we have quiet beaches to inspect, lazy rivers for kayaking and beautiful wildlife to investigate and appreciate. However, outside forces are threatening this pristine area. My county is home to many local fisherman, crabbers and oystermen and many of my students have been out on boats helping their dad since they were five or six years old. They know things are slowing down and that the catch is getting harder to find. They also know that the water is changing, getting saltier and dirtier. Because of this area’s unique natural beauty and its delicate balance with human interaction, I wanted to learn more about the scientists

doing the research. The FSU Coastal and Marine Laboratory (FSUCML) seemed liked a perfect research site to learn more about inquiry and the characteristics that effective scientists possess.

## Water Wars! The Background of My Research

*“Georgia, Alabama and Florida all compete for water from a shrinking Lake Lanier in northeastern Georgia, which empties into the Chattahoochee River.”*

Georgia, Alabama and Florida compete for water from a shrinking Lake Lanier in northeastern Georgia, which empties into the Chattahoochee River.<sup>1</sup> After years of drought and rising water needs in the rapidly growing and populated Atlanta area, the water level in the lake continues to drop at an alarming rate, pushing the state of Georgia to dam the lake and restrict the fresh water flow downstream. Downstream, a nuclear power plant in Alabama needs the water to power much of its home and industrial electricity. Both states also need the water for their agriculture, especially during drought conditions. As the river continues to make its way south, a new threat is introduced. The river flows into Florida and the

Apalachicola River, impacting the very existence of much of the marine life in the Apalachicola Bay. Here, my summer research takes place.

## Scope of the Work

The first key to wisdom is assiduous and frequent questioning, for by doubting we come to inquiry, and by inquiry we arrive at truth. -Peter Abelard<sup>2</sup>

The fundamental question of our research involved the effect of salinity on Dermo disease transmission and disease-related mortality in Apalachicola Bay oysters. In their habitat, oysters were dying from both Dermo disease and predation by oyster drill snails and other marine predators. The protozoan parasite *Perkinsus marinus* causes Dermo disease, which is more prevalent in higher salinities. Due to the reduction of fresh water coming the Apalachicola River from Georgia, the salinity in Apalachicola Bay had increased, and Dermo disease was on the rise. Dr. Laura Petes was establishing evidence and collecting data to determine the relationship between higher salinity and oyster mortality.<sup>3</sup>

Upon our arrival at the FSUCML, the experiment was already two weeks underway. Fortunately, we were there for the bulk of the research study and at the end of the experiment. From the first day we arrived my teammate Russell and I were put to work. I was not aware of the manpower involved in conducting scientific research.

Dr. Petes and a team of helpers had gone on a boat to Apalachicola Bay to hand pick the oysters that would be used in the experiment. The bay's ecosystem supports 90% of Florida's commercial oyster industry. For our experiment, 16 tanks were set up in a small climate controlled laboratory trailer. We divided the tanks equally, and each set of four had a different salinity rate (in part per thousand): 9 ppt, 17 ppt, 25 ppt, or 33 ppt. Each tank had 20 oysters, with 10 large and 10 small. We observed the oysters and documented their health in the different salinities over time.

## Who Asks the Questions, Anyway?

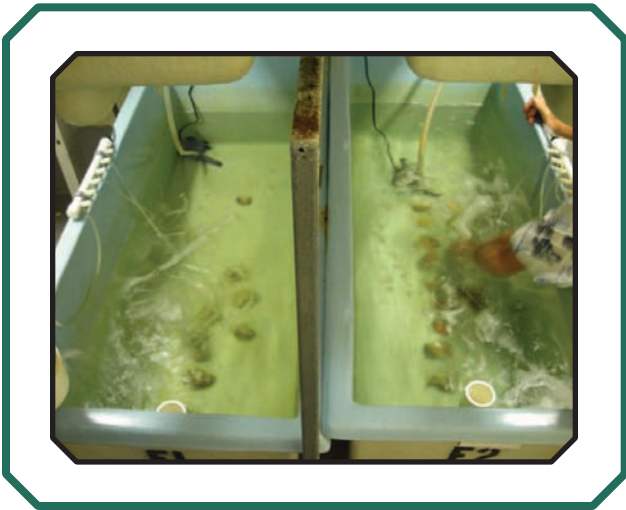
Concurrently, two undergraduate students conducted experiments with oysters using their *own* scientific inquiry and experiments. With guidance from Dr. Petes, these students set up their own methodology and addressed their own questions. This gave me the idea to do the same thing with my students. I wanted to think of ways to engage my students' curiosity and thinking. Up to this point, I was always the one giving them the questions and experiments. Things will be different this coming year.



*Russell and Margy in front of the FSU Coastal & Marine Laboratory*



*The Oyster Team From left, Russell Herron, Dr. Laura Petes, and Margy Callaghan*



Oyster tanks

*“The fundamental question of our research involved the effect that salinity had on Dermo disease transmission and disease-related mortality in Apalachicola Bay oysters.”*

*Dr. Petes shows Margy the oyster’s organs.*

*“From start to finish, Dr. Petes asked us questions, gently corrected our misconceptions, encouraged our ideas, and allowed us to be an active part of her work.”*

## Teaching the Teacher

From the first day we arrived, we felt a welcomed part of the team. I recall my first impression of Dr. Laura Petes. After giving us the “50 cent tour” of the laboratory facility and the experiment, we walked outside to see the oyster tanks. She suddenly jumped back and exclaimed, “Oh wow, look at that!” At our feet on the sidewalk, two green lizards were fighting, both jaws in death grips around each other’s neck. As they grappled and twisted and flipped each other over and over, she stopped the tour and we all watched in fascination. For about five minutes, Dr. Petes watched intently and commented on which lizard might win and the possible causes for their fight. She demonstrated a very important characteristic of any great scientist, curiosity! One of the other scientists ran and got a camera. The lizards were totally unaffected by their human audience of scientists and teachers. From that moment, I knew we had picked the right scientist and place to be this summer!

We have a hunger of the mind, which asks for knowledge of all around us, and the more we gain, the more is our desire; the more we see, the more we are capable of seeing. -Maria Mitchel<sup>2</sup>



From start to finish, Dr. Petes asked us questions, gently corrected our misconceptions, encouraged our ideas, and allowed us to be an active part of her work. I was taken with her attention to detail, her problem solving abilities, organizational skills, and her commitment to the natural environment at large. She also had the ability to see the multiple sides of the work

in which she was involved. While she was deeply focused on the peril of the oyster, she also had care and concern for the hundreds of oyster harvesters and their livelihood in the Gulf. But most importantly, I noticed and appreciated her sense of curiosity and wonder. Each new answer only pointed to another question, one that would hopefully establish the next experiment. Dr. Petes taught me to think and act like a scientist through her example, professionalism, and commitment to her field. She was teaching a teacher without knowing it. For her, it was just a way of life.

## Science Is More Than One Random Test

Although the experiment was already set up before we arrived, we were always in a “do it better” mode. Precision and accuracy of data observations and



documentation were always our focus. Each day we would check the tanks for dead oysters. We did this process carefully, day after day, as we had to pick up the oyster, look to see if the shell was gaped and if not, gently place the numbered oyster exactly back in its place. I hesitate to call the oyster a he or she, for I learned that all oysters are males at the beginning of their lives. After they grow to a larger size, they will probably become a female. They are called “sequential hermaphrodites;” they have the ability to be both sexes, but not at the same time. As I picked up the oysters, I was always sad to see the ones that had died overnight from the deadly Dermo disease. We would take the dead one out because the disease could spread after the oyster gaped, contaminating the other oysters in the tank. The dead oysters were not replaced, but we kept and documented size and weight of the shells.

Daily, we gave the oysters liquid algae to eat. We turned off the water filters for four hours while the oysters fed. Oysters feed by pumping water and algae in and out of their shell. This is also the way oysters filter seawater, sometimes as much as a liter an hour! They are a filtering system for other sea life, another important reason their survival is so crucial. We were instructed to be very careful not to let the feeding device touch anything, so as to not introduce any other contaminants. We also changed the water in each tank each week, always returning it to one of the four salinities: 9 ppt, 17 ppt, 25 ppt, or 33 ppt.

## Oysters Have Feelings Too

Although an oyster can neither move nor defend itself, oysters have squirted me with water. I will never forget the first time this happened. It took me totally by surprise! Russell and I were down in the lower laboratory among the extra oysters kept for other experiments with snail drills. We walked by a cluster of about a dozen oysters, and one of them shot me in the arm with several soft squirts of water. Oysters do not have eyes.<sup>4</sup> They do, however, have a sensor that detects shadows coming their way and will promptly close their shell. The oyster must have “seen” the shadow I cast, and let me know I was in its area. Maybe it was just tired of being picked up and examined and that was its way of letting me know!

## Science Is Not All “Swimming With the Dolphins”

The final day of the experiment had arrived and we were each assigned a specific task. Russell was the oyster runner, and he brought us the oysters, tank by tank. One undergraduate student was the oyster shucker. She measured the oyster,

*“Each new answer only pointed to another question, one that would hopefully establish the next experiment.”*



*Russell and Margy examine the oysters.*

*“I hesitate to call the oyster a he or she, for I learned that all oysters are males at the beginning of their lives. After they grow to a larger size, they probably will become a female.”*



*An oyster removed from its shell*

*“Although an oyster can neither move nor defend itself, oysters have squirted me with water. I will never forget the first time this happened.”*



removed the tissue and placed the shell and tissue in separate weigh boats. The shell to tissue mass ratio is an indicator of oyster health. Dr. Petes weighed the samples and reported the mass values to the other student responsible for documenting the results for further study and analysis. Russell rubber-banded the shells together and stored them. Dr. Petes carried the tissue to the fume hood to

dissect and preserve them in formalin for

histological analysis. Histology involving slicing the tissue very thin and dying it for examination under a microscope is an expensive process and only some of the tissue will be analyzed.<sup>5</sup> The rest would have to wait until funding became available. My job was to label and number all of the containers to match the numbers on the oysters. Once I made a mistake and had to start again. This taught

me the importance of being *very* methodical. The process ran like clockwork, and soon we were finished with the experiment.

Then it was time for Dr. Petes to analyze the data, and for the rest of us, it was time to scrub out the tanks, organize the laboratory, and prepare for the next experiments.

## **We Finally Get to Go Out on the Boat!**

Our final day in the summer research program was spent on the boat collecting oyster samples for the next set of experiments. The day on the water was an exhilarating last chapter in a life changing experience! I had a hard time sleeping the night beforehand, anticipating the last day and the boat ride to the Bay. The day itself was perfect, mild temperatures in the 80's with a few clouds that graced the open blue sky. We helped with an ongoing experiment for some of the other scientists.

As several of the scientists lifted up the bags of oysters and checked them for growth, I scrubbed off the algae that had grown on the bags and the oysters themselves. It was

interesting to see the way everyone came together and got the job done. Russell tonged for the new oysters.<sup>6</sup> All around us were oystermen, doing exactly the same thing and I hoped that our work helped to ensure theirs. As we headed back to the laboratory, the trip seemed too short. I was really sad that this experience was at an end. My view and understanding of oysters and our shared environment will never be the same. It was a glorious way to end my summer Sc:iii research.

## **Results and Conclusions**

The oyster mortalities were directly proportional to salinity and mortality percentages among the tanks varied linearly (Figure 1).

*Russell collects oysters for analysis*

*“The day on the water was an exhilarating last chapter in a life changing experience!”*



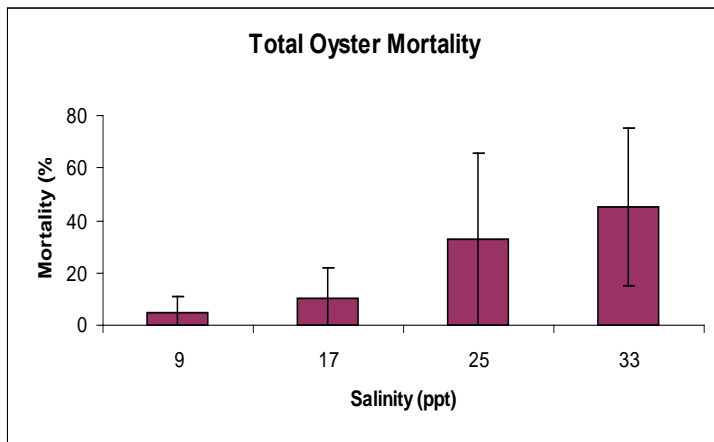


Fig 2 Salinity and Mortality of Oysters

These results point to the conclusion that the lack of fresh water to the Apalachicola bay estuaries is indeed contributing to the rise in oyster mortality rates. River management groups upstream could use this information for making water usage decisions.

## Bringing It All Back to My Classroom

Although I have had many inquiry experiences in the areas of earth and space science, through *this* experience, I realized that I rarely had any on-going work in the life sciences, especially as they relate to my own community and local marine life. The Sc:iii program has not only given me the opportunity to work with my scientist but also enabled me to learn from the other teachers. As I read their postings online, I am motivated to try things with local butterflies, plants, animals, insects and fresh water testing. It has been wonderful sharing ideas with other science teachers. As an added bonus, I have become part of a science network of teachers. This experience has opened the door for opportunities to share and collaborate with fellow teachers on new ideas. This year, the teachers who worked with water quality testing have set up a time to bring a guest speaker who will share their findings with my class on local fresh water issues. Other opportunities for the students are in the works as well.



*Russell rubber bands the oyster shells.*

*"The Sc:iii program has not only given me the opportunity to work with my scientist but also enabled me to learn from the other teachers."*

*Oysters shells ready for storage*

*"As an added bonus, I have become part of a science network of teachers."*

It is time to get the science tools out of my closet, and into the hand of my students. I have set up a science corner that will host ongoing experiments in different phases. Students will have the opportunity to ask their own questions

*Oysters to be weighed and dissected.*

*“It is time to get the science tools out of my closet, and into the hand of my students.”*



and organize their own experiments in our own mini science laboratory. Students will post questions, do research, take measurements and keep an on-going data log. Too often, elementary school students do not have enough experience with metric measurements. By conducting long-term experiments with daily metric measurements, my students will have opportunities to apply facts from their books to real life

situations. I have already set up an aquarium housing oysters we collected the last day on the boat. Students will be able to observe, test water salinity with a hydrometer, document growth, and directly experience some of the marine life that lives right outside their backyard.

I believe that science needs to be a partnership between scientists and schools. Each year we have a weeklong event called “Project Learning Tree.” Dr. Petes has promised to come and be a part of that week. As my students use their senses to experience the science in their backyard, they will become more environmentally aware of their world.

## Reflections...

My research has made a lasting impact on the way I view science and the way I teach science. In the past, I gave my students an experiment, often right from the science book and felt I had done “hands-on science.” Now I realize science is an ongoing process of investigation, questions and data collection. Real science is not just a single experiment, but also a series of methodical tests. Each answered question leads to the *next* question, often involving getting one’s hands dirty, with careful handling of the experiment and tedious collection of data. As a participant and not just a bystander, I was invested in our experiments. My goal is to have all my students involved in inquiry and have on-going experiments.

I have gained a new insight on just how my students feel as learners. As a teacher, I have the role of being the one in charge, the expert. This summer, my role was reversed and I was the learner. I am glad to have been reminded of what it is like to be the learner. I sometimes found myself making mistakes or having misconceptions about what I thought was factual, just like my students. It was not always easy to be in the learner’s seat! This experience gave me a deeper understanding and empathy for how most of my students feel. I am renewed in

*Dr. Petes dissects the oysters.*

*“Now I realize science is an ongoing process of investigation, questions and data collection.”*



my belief to keep a balance between the experience of inquiry and the guidance of factual content materials. My students need a blend of both, and a constant stream of encouragement and affirmation.

The cooperation and collegiality among the people who worked at the FSU Coastal Marine Laboratory were remarkable. Often different groups of scientists, university students, and teachers interacted with each other, and generated ideas to organize and streamline experiments and data. Problem solving took on a new meaning because we brainstormed and thought through every procedure. There was no manual or textbook with a protocol for the experiment. With that in mind, another goal this year will be to encourage my students to work in groups and share their scientific results with each other and the entire class. I will provide more opportunities for them to talk about science with each other. I also will provide a reflection journal. As they talk about science, do real science with on-going experiments, reflect and share their experience, I hope my students will come to love science the way I do.

High quality science teaching is all about making connections to each student's world, offering students hands-on experiments that students control, not just the teacher. As I model personal enthusiasm, curiosity and wonder, my vision is that those qualities will filter down to my students and become a permanent way for them to view the world and experience real science.

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Margy labels sample jars.

*"I am renewed in my belief to keep a balance between the experience of inquiry and the guidance of factual content materials. My students need a blend of both, and a constant stream of encouragement and affirmation."*

# Chapter 4

## CSI: Crawl Site Investigations on St. Vincent Island

A Teacher's Opportunity to Fulfill a Dream



# Irene Myers

W.R. Tolar K-8 School

Bristol, FL



## Biographical Information

### Present Positions

- 8<sup>th</sup> grade science teacher at W.R. Tolar Middle School

### Years Teaching

- 3 years in middle school

### Science Background

- Biology
- Chemistry
- Anatomy & Physiology
- Ornithology & Mammalogy
- Stream Study (field experience)

### Reasons I participated in Sc:iii

I participated in Sc:iii for the opportunity to gain knowledge and field experience to enrich my teaching abilities in the classroom. The idea of working side by side with scientists in the field was so exciting because I love science and am always searching for ways to bring real life applications into the classroom. Sc:iii presented an opportunity not just to read about science but also totally to immerse oneself in the discipline.

### My learning from the Sc:iii program

The total immersion gave way to a deeper understanding of the research and a clearer view of a scientist's work on a daily basis. The knowledge gained allowed me to develop better lesson plans for my students, so that they could have similar immersion experiences through inquiry learning in the classroom.

I feel energized by the experience to make my classroom a place in which students learn by hands-on experiences and become inspired to always ask "Why?" and then challenge my students to find the answers. The journey to finding the answers provides the learning; the answers themselves are just the closing remarks of the journey.

*"The journey to finding the answers provides the learning; the answers themselves are just the closing remarks of the journey."*



## Understanding the Basics of Beach Investigation

### An Episode of CSI Without a Crime

Looking back over my experiences at St. Vincent Wildlife Refuge I am amazed at the wealth of knowledge and experience the employees and volunteers shared with our team of teachers. Established in 1968 as the St. Vincent National Wildlife Refuge (SVNWR),<sup>1</sup> St. Vincent Island comprises 12,300 acres with five freshwater

lakes covering over 600 acres. The western tip of the island is approximately one-quarter mile south of Indian Pass, Florida. The Apalachicola Bay surrounds the northern shores, with the Gulf of Mexico on the south shores.

The refuge is supervised by a staff of five, with Monica Harris as the SVNWR Manager. Budget constraints require the SVNWR staff to rely heavily on volunteers to assist with monitoring the beach during sea turtle nesting season in the summer and tracking the red wolves year round. Our research team included two other science teachers (Kammy Mann and Laura Quisenberry) and me. I focused on monitoring the sea turtle nests on the southern shores of the island and bridging the connections between inquiry in field research and inquiry in the classroom.

The sea turtle nesting research project for SVNWR is part of an ongoing project conducted annually from mid-May through the end of September by the U.S. Fish & Wildlife Service (USF&WS).<sup>2</sup> On average, the staff documents 30 nests each year on the beaches of the St. Vincent Island.<sup>3</sup> The purpose of the research is to monitor sea turtle nesting sites, protect the sites from destruction by predation, check for weather and water damage, and determine the hatchling success rate. Specific questions addressed in the field research include:

- What impact do the red wolf and feral hog populations have on the depredation rate of the sea turtle nests?
- What role does the sea turtle play in the ecological balance of St. Vincent Island?



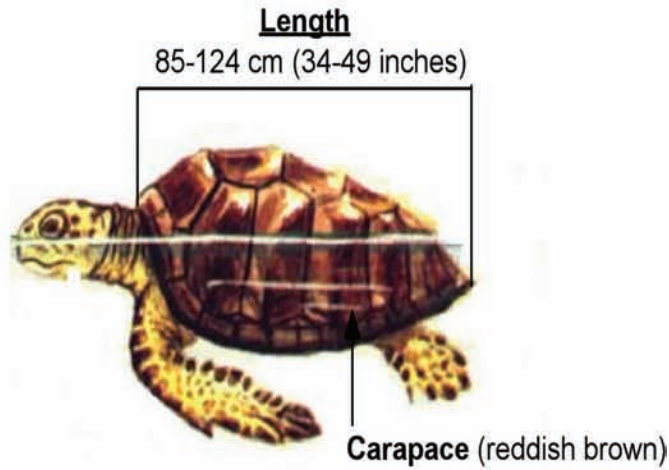
*The southern shoreline of St. Vincent Island*



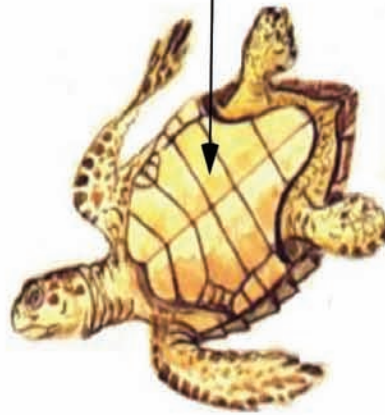
*The St. Vincent Island Team  
From left, Kammy Mann, Irene Myers and Laura Quisenberry*

# A

- Diet**  
 Horseshoe crabs  
 Crabs  
 Mollusks  
 Clams  
 Sea snails  
 Sea pens  
 Jellyfish



**Plastron (yellowish brown)**



- Feeding** < 61 m (200 ft)  
**Depth** Estuaries  
 & Along the continental shelf  
**Location** Open ocean

**Mass** 80-200 kg (176-440 lbs)

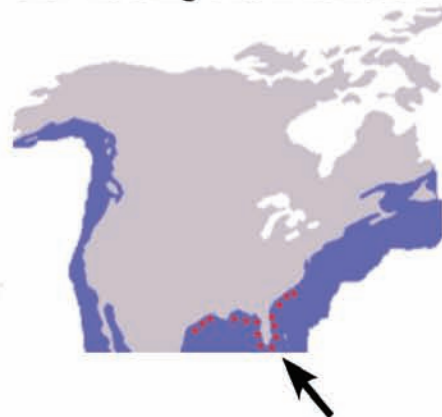
Figure 1. Distinguishing features, and range of the loggerhead sea turtle. A. Physical and behavioral traits common to loggerheads. B. World wide range, left, and U.S. nesting site distribution, right. Red asterisks indicate common nesting site locations. ([http://commons.wikimedia.org/wiki/Caretta\\_caretta](http://commons.wikimedia.org/wiki/Caretta_caretta))

# B

**World-wide Range**



**U.S. Nesting Site Distribution**





*Irene prepares for the day.*

The most common sea turtle nests on St. Vincent Island are those of the loggerhead turtle (*Caretta caretta*). Figure 1A shows several distinguishing features of the loggerhead turtle and Figure 1B shows the world wide range and U.S. nesting site distribution. The U.S. Federal government has listed the loggerhead as endangered worldwide. In this country, the loggerhead's nesting areas are divided among four states: Florida (91%), South Carolina (6.5%), Georgia (1.5%), and North Carolina (1%). Florida beaches account for one third of the world's total population of loggerheads.<sup>4</sup> The procedure for nest monitoring is as follows:<sup>5</sup>

Every morning at 6:45 a team comprised of SVNWR employees and volunteers meets at the government landing at Indian Pass, Florida to take the short quarter mile boat ride to St. Vincent Island. We conduct nest surveys for the best results early in the morning because the sun is low on the horizon, allowing us to view the turtle crawls easily in the sand. The majority of sea turtle nesting occurs at night, so early surveying is essential before the wind covers or distorts the crawls.



*Turtle tracks entering the beach, left, and returning to the sea, right*

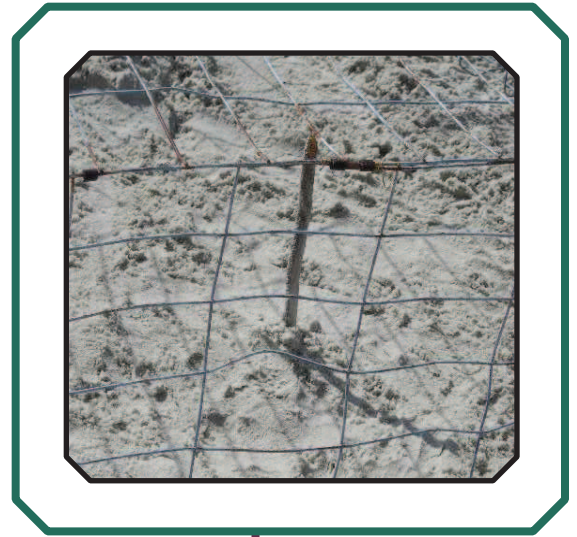
The team members drive the Polaris all-terrain vehicle along the beach on the Gulf side to survey for sea turtle crawls. Nesting surveyors count and identify "crawls," which are the marks left in the sand by sea turtles that have come onshore to nest.<sup>5</sup> Once the team discovers a crawl, the first step is to establish an overview of the crawl by evaluating the sea turtle's entry and exit paths. Next, we identify the species of sea turtle by the crawl patterns (i.e., loggerhead, green, kemp, or leatherback sea turtles). Each species of turtle has a distinct crawl pattern. We evaluate the site to determine the secondary body pit, sand spray and location of the egg chamber. These observations provide clues to determining if the crawl resulted in a nest or a false crawl. A false crawl means the sea turtle returned to the water without laying her eggs. We predict the location of the potential egg chamber in the nest then gently remove the sand

using only our hands to uncover the eggs. We find the egg chamber, replace the sand, mark the egg chamber with a small stick standing upright and cover the nest with a 4-foot by 4-foot wire cage to prevent small game predation. We document the nest on the data log sheet as a confirmed nest (CN) and place a marker stake with the coded information and a National Fish and Wildlife Turtle Nesting sign three feet from the center of the egg chamber. Island staff and volunteers check all nests daily for any signs of disturbance.

That first day, I was excited and eager to begin my fieldwork with the sea turtles. We rode the beach in search of sea turtle tracks and signs of nesting. I was on the edge of my seat observing the diverse wildlife on the beach as I closely scanned



the beach for the sea turtle tracks. Then, in front of us was our first crawl! I listened closely to Monica as she used the signs left behind by the turtle to decipher the mystery before us. She invited me to work alongside her and I had to analyze the overall picture, then break down piece by piece the events of the preceding night, including each step the sea turtle took as she left the water and entered the beach to lay her eggs. First, I started analyzing the flipper tracks to determine the sea turtle's entry and exit. Next, I photographed the undisturbed crawl site, wrote down its GPS coordinates, then summed up the rest of the site through a series of questions regarding the sand spray, secondary body pit, and predicting the location of the egg chamber. I found myself using all the predicting, analyzing and observing skills I am forever reminding my students to use. The crawl site was like an episode of the television show "CSI", without a crime. To unlock the mystery, I considered everything a clue and I was hooked! The grand finale was using my hands only to gently dig into the sand to find the egg chamber! There the eggs were, like little white ping-pong balls. I was speechless in total awe! I was allowed to hold an egg gently in my hands for a brief moment. That moment is one I will treasure for a lifetime. We solved the mystery and replaced the sand the way we found it along with the protective wire cage to ward off predators and a sign to mark the nest. We continued the day combing the beach for additional nests and observing nature in this pristine environment.

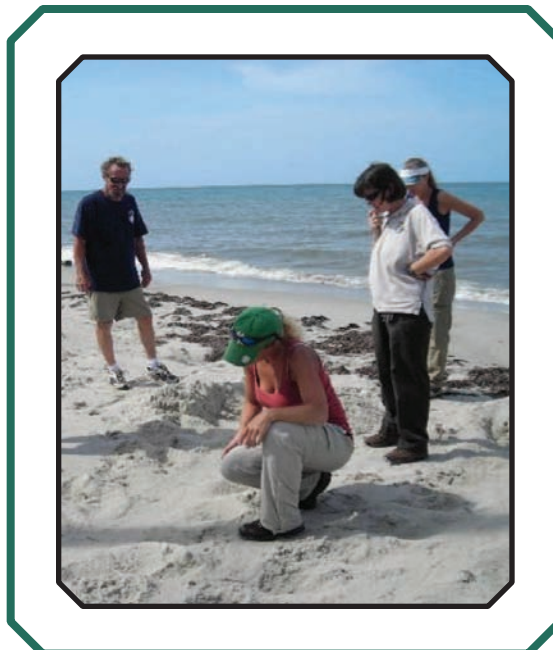


*The nest is marked with an upright stick and protected with a cage.*

## No Pain, No Gain

### The Glamorous Aspects of Field Research

After such a perfect start, I welcomed each new adventure. We greeted the rising sun at Indian Pass and I contemplated the possibilities of the day. What amazing displays of nature did the island have in store for us today? To my disappointment I did not find any sea turtle crawls at first, however I was amazed to find one half of a red canoe, which had washed on shore along with a wide range of rubber gloves, plastic bottles and empty motor oil containers. Later, we came across our first new crawl of the day! I was so excited but also sad because the nest was only about 15 feet from the water's edge and risked flooding from the ocean during the incubation period. We observed the crawl marks for entry and exit paths, evaluated the body pits and possible location of the egg chamber.



*"I found myself using all the predicting, analyzing and observing skills I am forever reminding my students to use."*

*In the foreground, Irene and Wildlife Manager Monica Harris, right, analyze turtle tracks while volunteer Bob Sutton and fellow teacher Kammy Mann look on.*

*“The crawl site was like an episode of the television show ‘CSI’, without a crime.”*

*Digging for turtle eggs, clockwise from lower left: Monica Harris, Dr. Penny Gilmer, Kammy and Irene*



Then we photographed the site and recorded the GPS coordinates and nest description. Finally it was time to dig for the eggs and we gently removed the sand with our fingers. We observed ghost crab holes and Monica warned us to be careful. As we dug I was so excited about the potential for eggs that I was not worried about the crabs. Oh, big mistake! All of a sudden I felt a pinch and quickly pulled my hand from the hole in the sand. To my surprise, a 4-5” ghost crab had attached itself to the end of my finger! I flung my hand

*“The grand finale was using my hands only to gently dig into the sand to find the egg chamber!”*

and off he sailed and scurried away. I returned back to the task at hand and we confirmed the nest, replaced the sand, placed the protective cage and hammered the nest marker into the sand.

After a short break we were assigned to our next adventure, cleaning a hiking trail. We picked up palm fronds, pine limbs and other debris scattered along the trail. The mosquitoes were plentiful and feasted on us as we worked our way through the trail. We saw a black snake basking on the trail and heard alligators bellowing and entering the water as the trail meandered through the edge of the salt marsh. As the trail continued we saw muddy upturned earth from the feral hogs and wolf scat (dung) filled with coarse pig hair. We followed the trail and decided to hike toward the landing while waiting for our ride. We felt it was smarter to keep moving than become lunch for the swarms of mosquitoes. Upon arriving at the landing, we were hot, sweaty, dirty and thirsty, since we had run out of water several hours ago. I decided to take a quick dip in the bay to rinse off the grime from the afternoon’s adventures. I removed my hiking boots and waded to only about 10” in the murky salt water. The water was warm but with the gulf breeze, it quickly gave relief to the heat. I sat down dipped my head in the water to cool off. I should have stopped but didn’t. I dipped backwards again right onto a



*The egg chamber!*

jellyfish! OUCH! Up I jumped and headed to shore, but after about two steps I landed on an oyster shell in the murky water and cut my foot! I could not believe my bad luck. Not wanting to draw attention to my misfortune, I tried to downplay my mishap. However, word spread quickly, and a few band-aids later I was on my way to the boat. On our boat ride to the mainland I spoke the words no one should say: “This day could not get any worse!” Well, it did. As Laura and I tried to leave



the landing, our vehicle became stuck in the sand! All we could do was laugh! We evaluated our predicament and through teamwork and creativity we were able to get back to solid ground. Finally, we were on our way home to a hot shower and clean clothes!

## Enjoying the Sunset

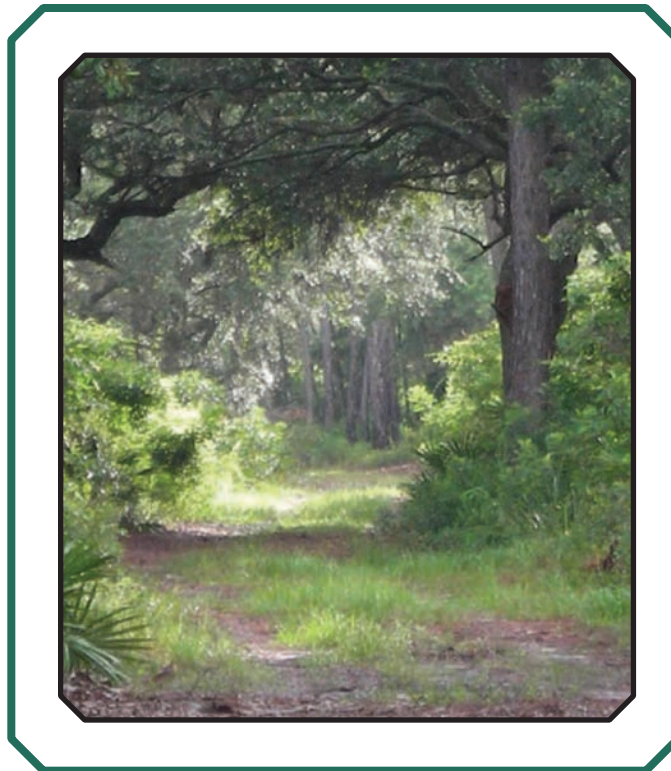
### Our Final Day in the Field

We loaded the Polaris and headed down the beach.

Bob, another volunteer called the “turtle man,” drove me just east of the point. I walked the point looking for crawls and observed the abundance of nesting shore birds in the early morning light, such a peaceful and glorious way to begin your workday. I joined two volunteers and rode the Polaris looking for turtle crawls on the beach. We filled up garbage bags with trash, which had washed up on the shore. We actually collected a medium sized television and an old large computer monitor—both had washed ashore during the night. I was amazed at the large amount of household trash, as we traveled down the beach. The most interesting object was a metal canister about 8” in length, silver and orange in color with Russian writing.

While picking up the trash off the beach, I realized this would be a valuable lesson to bring back to the classroom. How does the dumping of trash from boats landing into our Gulf affect the refuge? Students could research the water currents and the reasons that the trash accumulates on St. Vincent, as well as the dangers of the materials being dumped into the Gulf on the area’s aquatic life and wildlife on the refuge. Seeing all the trash reminded me of the poster in the SVNWR office illustrating that sea turtles mistake plastic grocery bags for jellyfish and eat the plastic bags.

This is a community awareness activity on recycling, limiting plastic bag use and their proper disposal, which the students could easily begin in our community. Making the students aware of the problem and challenging them to find ways to help solve the problem is a great way to bring inquiry to the classroom. In the end, we found four crawls that day, with three being confirmed nests—a record-tying day! It was a great way to finish this inspiring experience!



*Early morning on a St. Vincent road*

*“The mosquitoes were plentiful and feasted on us as we worked our way through the trail. We saw a black snake basking on the trail and heard alligators bellowing and entering the water as the trail meandered through the edge of the salt marsh.”*



*Irene pounds the nest marker into the nearby sand while Dr. Gilmer watches.*



## Results—Tying Into the BIG PICTURE

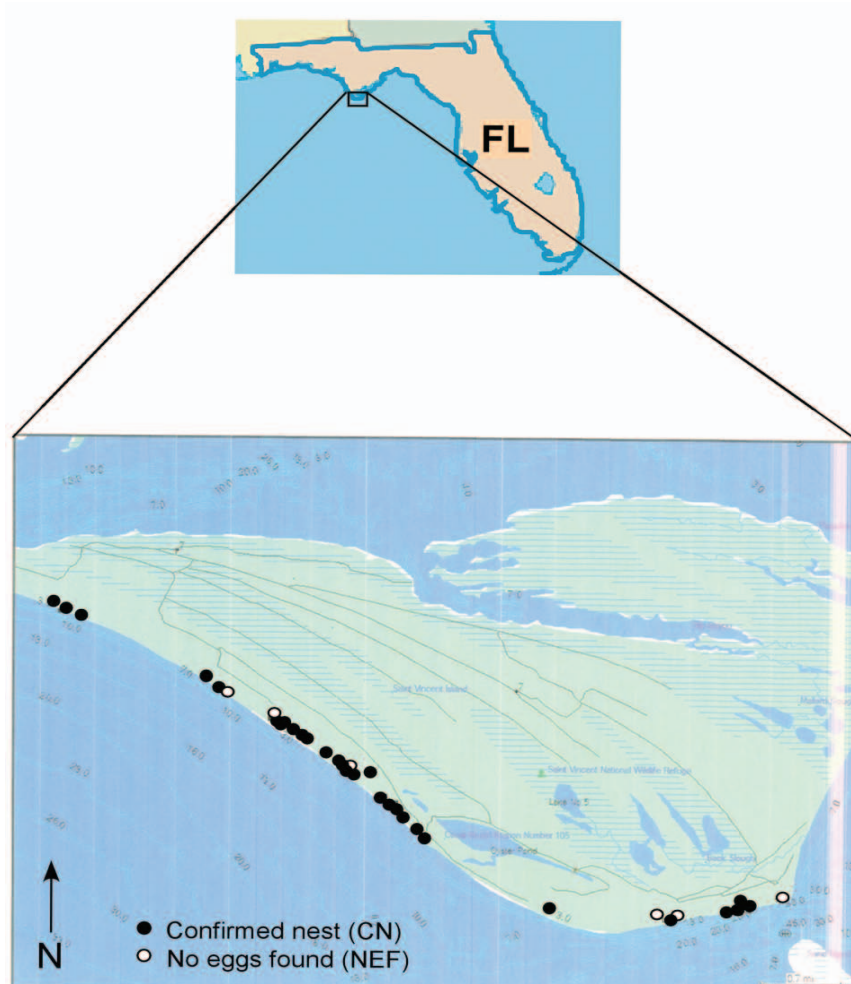
Although I did not monitor this step in the turtle life cycle, the eggs hatch after 46-65 days of incubation, with 35-180 eggs per nest.<sup>6</sup> As of July 15, 2008, no turtle eggs had hatched, but after the hatchlings enter the sea, the staff members evaluate the nest for hatchling success rates. The team excavates the nest, estimates successful hatchlings from remaining shells and examines unhatched eggs and the stage of development of the sea turtle embryos. The team documents all information on a data log sheet provided by the SVNWR. The data log sheets provided an easy reference for verifying nest location and condition.

*Fresh water lake on St. Vincent Island*

Figure 2 shows a map labeled for confirmed nests and false crawls for the 2008-nesting season through July 10<sup>th</sup>, 2008. The solid black boxes represent the 37 confirmed nests (CN) and the white boxes represent the six nest sites with no eggs found (NEF).

*“I will take back to the classroom the importance of being open to new experiences in the field and adapting to learning in new situations outside of your own comfort zone.”*

*Figure 2. Turtle nesting site distribution on St. Vincent Island.*



Thom Lewis, SVNWR biologist, compiled all hog depredation to sea turtle nests on St. Vincent NWR data from 2002-2007.<sup>3</sup> Table 1 compares the results of the data I helped collect this year with the data from the previous six years.

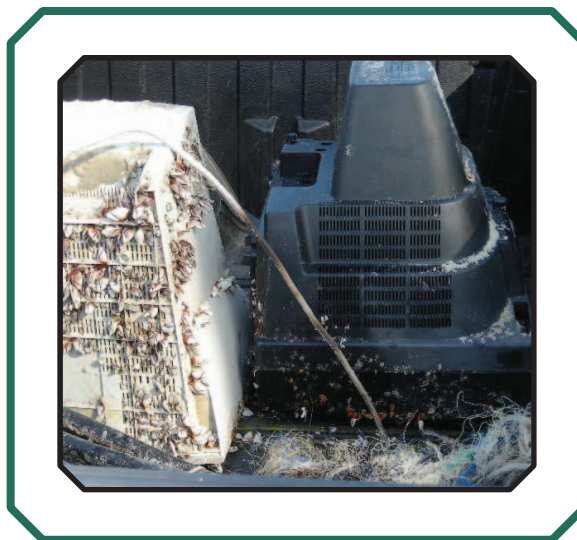
Table 1  
Hog Depredation to Sea Turtle Nests on St. Vincent NWR 2002-2008

Year	Total Nests	Nest suffering hog depredation	% nests lost to hogs
2002	21	2	14
2003	43	4	9
2004	41	5	12
2005	19	3	16
2006	38	7	18
2007	46	23	50
2008*	37	2	5

\* Confirmed nests as of July 10, 2008 SVNWR data log sheets.

The depredation rate is lower (5%) this year, which Monica Harris predicted due to the hunting season opened to remove the feral hogs over the winter months and successful breeding habits of the red wolves, a predator for the hogs. This year, 2008, will include the fourth consecutive successful litter of red wolf pups from the elder mating pair on St. Vincent Island. The wolves are natural predators of the feral hogs and raccoons, which both feed on the sea turtle eggs. The sea turtles impact on the ecosystem continues, as Gulko and Eckert state:

Female sea turtles can carry both nutrients and energy from foraging areas hundreds or even thousands of miles away, where it is later deposited as eggs in the nest she leaves behind on the sandy shore. The energy and nutrients now represented by the developing embryos, amniotic fluids, and eggs shell can follow a number of paths that will end up exiting the immediate habitat as either hatchlings entering the ocean or through the actions of predators. At the other end of the spectrum, energy and nutrients can also remain in the habitat through localized food web and end up incorporated into predators,



*“I was amazed at the large amount of household trash, as we traveled down the beach.”*

*“Making the students aware of the problem and challenging them to find ways to help solve the problem is a great way to bring inquiry to the classroom.”*

*Computer and television monitors washed up on the turtle nesting shore.*



*“The students will be required to complete a basic training sea turtle camp to prepare them for their missions. Through station rotations students will complete inquiry labs and research investigations to prompt their curiosity and challenge them to earn their right to a mission.”*

*A sea turtle U-turn (false crawl)*

detritivores, and decomposers, which in turn may redeposit such energy and nutrients into the primary producers, the beach vegetation, resulting in increased plant growth and dune stabilization.<sup>7</sup> (p. 128)



The continued placement of protective cages over the nest, the annual primitive hunting of feral hogs and small game, along with the natural prey/predator relationship of the red wolf pack with the feral hogs and small game will aid in preserving the ecological balance necessary for sea turtles to continue successfully nesting on the beaches of St. Vincent Island.

## Bringing Research & Inquiry to the Classroom

Through the knowledge and experiences gained from the field research I am designing a scientific inquiry unit called “CSI” (Crawl Site Investigation) for my eighth grade classroom. I have downloaded the digital pictures of the crawls

from this year and am working on acquiring photographs from previous years to utilize as part of this project. The students will learn about the life cycle and ecological importance of the sea turtle to SVNWR through scientific inquiry. I will introduce the unit by posing the questions, “What is St. Vincent National Wildlife Refuge, and why do the sea turtles nest there? What evidence does nature provide to prove sea turtles nest on St. Vincent Island?”

The students will be given time to research and explore possible answers in the computer laboratory for one class period and homework, then present their findings in a five minute oral presentation, along with a written one page paper on their proposed

answers to the questions. Next, I will assign CSI badges and clipboards to small teams (2-3 students). The students will be required to complete a basic training sea turtle camp to prepare them for their missions. Through station rotations students will complete inquiry labs and research investigations to prompt their curiosity and challenge them to earn their right to a mission. The stations will include such labs as “What is GPS?” “Why sea turtles?,” “Lights on, Lights



*Turtle tracks*



off!,” and “Who am I?” Once the students complete the stations over several class periods, the student teams will earn their mission. Then I will give each team a packet, which contains photographs, GPS coordinates, a map of the island and their mission objective. The mission provides an experience similar to discovering a crawl. The students will be required to observe the crawl and analyze the data, record their results on a data log sheet, and create a field report supporting their conclusions. The students will also be required to identify the crawl entry and exit paths, whether the crawl resulted in a nest or a false crawl and determine the species of turtle. The students will plot the nest on a classroom map to share all nesting locations. All students will share their data and use the information to make conclusions about current activity and predictions about future nesting activities. The students will review all data to conclude the most common areas for nesting, predation and water damage. Also, the students will be given the data from the last few years to make predictions on future changes in sea turtle nesting at St. Vincent.

Data analyzing, mapping, creating charts and graphs, researching, reading, investigating, predicting, summarizing and inquiring allow this to be an integrated unit with endless possibilities, which inspires students to become involved in the scientific world in their communities.

Each class will adopt a sea turtle through the Caribbean Conservation Corporation Adopt-A-Turtle Program<sup>8</sup> and monitor its travels via the Internet. Also, the hazards of human littering and pollution of beaches and waters will be addressed to inspire student action in their communities.

I will take back to the classroom the importance of being open to new experiences in the field and adapting to learning in new situations outside of your own comfort zone. Everything is not in a nice neat little package in nature; you have to get dirty and sweaty sometimes to experience nature at its best.

## New Beginnings

The field research experience at St. Vincent has reinforced the importance of teaching students independent and critical thinking, teamwork, and observation and providing them the opportunity to realize their abilities to impact nature. The true experience of scientific inquiry is something I hope to give my students by providing real world applications of science. In the process, students will expand their knowledge and build confidence in their own scientific abilities. I feel invigorated from this field research and renewed in my fundamental inspiration for teaching science. I am flooded with new ideas for lesson plans, community projects and field trips to actively involve my students in science everyday.

*“The field research experience at St. Vincent has reinforced the importance of teaching students independent and critical thinking, teamwork, and observation and providing them the opportunity to realize their abilities to impact nature.”*



*Irene holds a lightning wench in one hand and its case in the other hand. The lightning wench is the only left-handed conch in Florida.*

*“I feel invigorated from this field research and renewed in my fundamental inspiration for teaching science.”*



The sea turtles at St. Vincent are magnificent peaceful creatures of the water. The mature females return to the beaches of their birth, year after year, to lay their eggs as their ancestors did. The research has shown a decrease in nest destruction as the result of feral hog hunts and a healthy red wolf pack.<sup>3</sup> Someone asked Archie Carr, a pioneer of sea turtle conservation, the reason he was so interested in turtles for all his life. He offered a simple response: “I just liked the look on their faces. There is an old, wise, sort of durable, aboriginal look about turtles that fascinates people.”<sup>9</sup> (p. 2)

Loggerhead sea turtle  
 ([http://en.wikipedia.org/wiki/Image:Loggerhead\\_Sea\\_Turtle.jpg](http://en.wikipedia.org/wiki/Image:Loggerhead_Sea_Turtle.jpg))

*“In 2004 I happened upon a sea turtle while snorkeling and I have been fascinated with these creatures ever since. This research experience will have a positive impact on my teaching for years to come.”*

I agree with Archie Carr. In 2004 I happened upon a sea turtle while snorkeling in Hanauma Bay in Hawaii. I was mesmerized by its grace and peacefulness as the sea turtle glided through the ocean, and I have been fascinated with these creatures ever since. This research experience will have a positive impact on my teaching for years to come.

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<sup>9</sup>Davis, F. R. (2007). *The man who saved sea turtles: Archie Carr and the origins of conservation biology*. Oxford: Oxford University Press.



# Chapter 5

## The Ultimate “Ah-Ha” Moment My Experience as a Teacher Mentor



**Amanda Clark**  
**Cottondale High School**  
 Cottondale, FL



**Biographical Information**

*Present Positions*

- High school science teacher of biology, anatomy & physiology, chemistry, and physics
- Member, Florida Association of Science Teachers (FAST) and National Science Teachers Association (NSTA)
- 2007 Cottondale High School Teacher of the Year
- Graduate doctoral student in Science Education at Florida State University
- Cottondale High School's Science Department Chairperson, 2006-present.

*Years Teaching*

- 3.5 years high school

*Science Background*

- 2 years research assistant, FSU Department of Psychology with Dr. Fred Stephan, studying circadian rhythms
- 3 years laboratory assistant, FSU Department of Psychology, with Dr. Charles Ouimet, studying Alzheimer's disease, selective serotonin reuptake inhibitors in juvenile rats
- 3 years biologist, FSU Department of Biology with Dr. Bryant Chase, studying familial hypertrophic cardiomyopathy

*Reasons I participated in Sc:iii*

As a science teacher, I had searched for years for professional development courses regarding science teaching and had no success. This realization coupled with my graduate courses in science education fostered an idea for a thesis project. I was interested in documenting the benefits of authentic science research for pre-service teachers. By becoming a mentor on this Sc:iii project, I got hands-on interactions with practicing teachers immersed in science research.

*My learning from the Sc:iii program*

Watching the teachers transform from teacher to researcher was remarkable. I felt humbled watching the teachers churn out ideas to use at their schools. At the start I gathered professional reactions from each teacher's experience. In the end, however, I realized that I gained a vast amount of pedagogical information for my own classroom. I learned from these seasoned teachers better ways to incorporate my research experience in the classroom. I gained knowledge about scientific endeavors in the community that will benefit my students in the classroom and in life. I watched doors open between local scientists and teachers. A feeling of mutualism grew between these teachers and scientists, each gaining lifelong partnerships.

*"I watched doors open between local scientists and teachers. A feeling of mutualism grew between these teachers and scientists, each gaining lifelong partnerships."*



## A Teacher Learns From Scratch

*“Was I using my science and teaching backgrounds properly? This question ate at me, ironically, while the many redbugs fed on my Deep Woods Off ®-soaked skin in the summer heat.”*

My role in the Science Collaboration: Immersion, Inquiry, Innovation (Sc:iii)<sup>1</sup> grant was different from the other teachers who were in the program. I was one of eight teacher mentors and had the responsibility of visiting each of my three teams 3-4 times and grading those teachers on their participation and their written posts on BlackBoard.

I did scientific research in Spring of 2008 so I could be a teacher mentor in Summer of 2008. I have written about both sets of experiences in Spring 2008 and Summer 2008.

I went from quiet days in the laboratory, talking with graduate students and conducting animal research, to five preparations for teaching high school in six periods per school day. I thrived on the chaos of my schedule, glad to be able to offer my students a variety of science content. I enjoyed telling the students stories of my research days, especially about extracting pig hearts. I held their attention with clever anecdotes and stories. I was good at the last minute, thinking on my feet, problem-solving techniques needed in my teaching laboratories. Yet, I started questioning my teaching abilities as I immersed myself into my summer mentoring experiences in the Sc:iii program.<sup>1</sup> Was I using my science and teaching backgrounds properly? This question ate at me, ironically, while the many redbugs fed on my Deep Woods Off ®-soaked skin in the summer heat.

To prepare for this summer, in the preceding Spring semester I conducted a research project to learn about identifying exotic versus indigenous plants at Florida Caverns State Park near Marianna, Florida. I learned so much, even after spending so much energy feeling inadequate and aggravated. This background equipped me well to be a teacher mentor.

In my orientation, park managers and I discussed the goals of the project from their viewpoint and mine. We also discussed scheduling and identifying

invasive plant species in specific locations of the park. I received background information on importing exotic plants and the theories on their entry into the park. I found this really informative and thoroughly enjoyed each member of the research team. Each person had ideas for me and offered me help. I was really nervous



*A fawn camouflages itself beneath some palmetto branches at Florida Caverns State Park*

*Sapium sebiferum, “Chinese tallow” (<http://aquat1.ifas.ufl.edu/images/sapseb/dsc03659.jpg>)*





because they were calling out the plant names, and I could not even spell them. I was hiding my notes, thinking I had spelled “Nandina” incorrectly, which I had!

My job was to obtain global positioning system (GPS) coordinates for any of the four exotic plants they mentioned: *Nandina domestica*, *Ligustrum sinense*, *Sapium sebiferum*, and *Lygodium japonicum*. We had decided that I would only search a certain area of the park and should avoid the floodplains. On my first day, Park Ranger Mark Ludlow took me on a fascinating tour of the entire park.

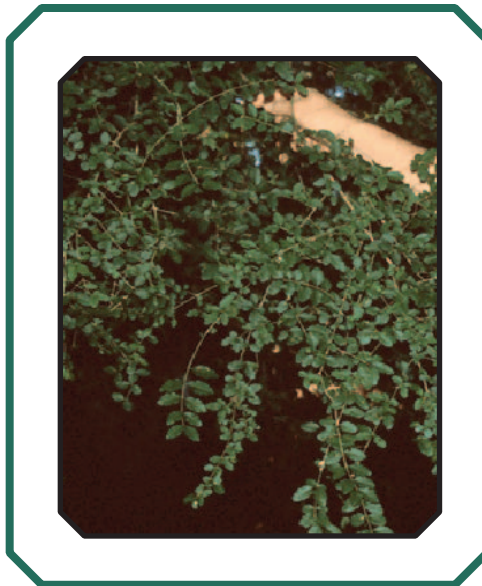
I scribbled extensive notes, consisting of combinations to locks through the park, locations of particular exotic plants from the past, and roads that I could access. As he and I walked through areas of the park, he pointed out the species of exotic plants, and later he quizzed me on a few. I was nervous but got one right. I was also able to keep a few plant samples so I could study them later.

That Saturday, my father was in town so we went to the park together. I showed him “my” areas, and we hiked around and tested my powers of observation. I was not very good at identifying the indigenous plants in the area. I needed to learn more about my plants! My father and I spent several hours together getting to know the land and ruling out the plant species I do not need to locate. Most exotic plants are evergreens and since my research started in early Spring before new growth, I could see the exotics more easily. However, full Spring came quickly, and then I had a harder time identifying the plants as time progressed.

## From Defeat Comes Victory

In my first real attempt at identifying plants on my own, I hiked through the area called Muddy Waters. I am embarrassed to report that I spent about 1.5 hours recording GPS latitude and longitude values for a *non-invasive* plant. I thought it was wisteria (not on my list, but was mentioned in orientation). I realized this after I went to my car for a lunch break. I looked at my binder and saw that I had made the mistake.

As for the rest of the day, I went further down the trail and then veered to the right on another path. I went deep into the woods, off the path and just started walking. I decided to narrow down the search and look for just one plant. I was originally trying to find all four at one time and it was too stressful. I had hiked for a while and then I found a GIANT Nandina bush! I was so excited. I pulled out my log sheets and my GPS machine only to find that the batteries were *dead*. I was so mad! I then decided to mark the bush with a big pile of moss. As I started hiking out of the area, I started noticing more and more Nandina,



*Ligustrum sinense*,  
“Chinese privet”  
(<http://aquat1.ifas.ufl.edu/node/231>)

“Since I did not have the GPS, I drew a map. My little map was crazy and the park staff laughed at it, saying only I could follow that map.”



*Nandina domestica*,  
“Nandina”  
(<http://aquat1.ifas.ufl.edu/node/281>)

*Lygodium japonicum*,  
"Japanese climbing  
fern"  
(<http://aquat1.ifas.ufl.edu/images/lygjap/lygjap4.jpg>)



*"The floods brought out a large number of mosquitoes and snakes were running. Snakes do not bother me and anyone living in this rural part of Florida gets accustomed to them and knows ways to avoid them."*



*Rhexia virginica*,  
"Virginia meadow  
beauty"

big ones, immature ones, and all sizes. I had found a huge area of Nandina! Since I did not have the GPS, I drew a map of landmarks to find my way back, after I had gotten new batteries. My little map was crazy and the park staff laughed at it, saying only I could follow that map. But I marked everything and the number of steps I took each time until I got to another unique land point. I came out

of the trail, and since it was late in the day, I had to go home. While the park manager was looking at the samples I had gathered from my mapped area, I showed him some cards I had made as field aids for the plants, and the park actually wanted a set! I felt very proud. He also said I had identified the Nandina correctly.

A few days later I used my crude map to retrace my steps through Muddy Waters, up through the ridge directly to Indian Cove, located behind the area I call "Fern Valley." That time I had rechargeable batteries in the GPS, plus I went and bought backup batteries to keep in my backpack. I traveled to the top of the ridge again and though my map proved to be too crude, I found one of the landmark points I had drawn on my paper! I followed that and found the Nandina plant I had marked with a piece of moss. From there I gathered GPS locations on all the plants I located. I also took various pictures, which required quite a few hours because I had to hike back to my original location. I had gone through two cans of bug spray because after the floods, the mosquitoes were awful! I was lucky that they never seemed attracted to me, but they were terrible in the park. I had to spray every 15 minutes.

Filling out the park's "Sample Exotic Species Survey Forms" got too cumbersome for each new exotic. I dropped my clipboard and it broke. This became an issue while I was up on the ridge in dense forest. I started keeping records on one sheet, so as not to lose the other ones by dropping them. Funny, the way fieldwork is different once the laboratory bench is gone! Each time I went to Marianna Caverns State Park to hike, I brought my MP3 player but never used it—the park was too beautiful to ruin the sound of nature with that music. Plus, I liked to listen for snakes crawling. The floods brought out a large number of mosquitoes and snakes were running. Snakes do not bother me and anyone living in this rural part of Florida gets accustomed to them and knows ways to avoid them.

I was very excited to have a set of high school students interested in the Caverns Project. First, I had them duplicate my binder (not a simple task). Next, they had to read all the information I had and then we would research the plants. I told them to narrow down the search to two types of plants. Based on information from the Caverns Biologist, wind patterns, seed dispersal characteristics and other

features, they would hypothesize the potential locations for particular exotic plants. I wanted them to have the experience, formulate a hypothesis and utilize the scientific method.

In the classroom, prior research experiences prepared me to teach students, but not in the way it should have. I was able to trouble shoot laboratory snafus, but was I relating this knowledge to my students and to the teachers I was mentoring?

Without a doubt, my field experience had given me a solid background for these summer work sites, yet I wondered, was I truly passing on my research questioning abilities, or was I just using the knowledge to make myself feel more confident in my teaching role? Experience is wonderful but keeping your learning to yourself benefits no one. These were the questions I asked myself as I worked with these teachers as their mentor.

## My “Ah-Ha!” Moments

### It Is All in Your Way of Telling the Story

I was the teacher mentor for three teams of teachers in the 2008 Sc:iii program.<sup>1</sup> The Mussels and Plants team collected data on the freshwater mussels in a stream that emerged from the earth and then submerged one quarter of a mile later. How did the mussels get there? How long had they been there? It was in this stream, submerged in the cold waters of Sugar Mill Creek within the Marianna Caverns State Park and digging for freshwater mussels that I heard myself asking the teachers, “How do you think you will use this experience in your classroom?” I listened to the fabulous ideas regarding conservation, ecosystems, species identification, and the importance of preserving species.

I heard myself reminding the teachers to see and use this experience as a whole, reminding them to talk with their students about methodologies of data collection, scientific questioning, the scientific process and procedures utilized across the disciplines. For example, this team had to be careful to limit variables in order to obtain accurate conclusions—this applies to all experimentation, not just in their study. We ended the conversation by discussing the reasons we became easily distracted—we can easily get caught up in such fascinating research that we forget the original research question and our purpose for doing the research in the first place: to

*“Experience is wonderful but keeping your learning to yourself benefits no one.”*



*Amanda admiring the urn shaped seed pods of a “Virginia meadow beauty”*

*“We can easily get caught up in such fascinating research that we forget the original research question and our purpose for doing the research in the first place.”*



*Threatened mussel in Sugar Mill Spring*





*Common mussels in Sugar Mill Spring*

*“No matter the amount of background you have, your methods of relaying the lesson are critical to your students getting full use of their experiences.”*

*Amanda times a field experiment while Melba Adkins, right, records data.*

*“So often our students have the misconception that scientist are unapproachable.”*

experience real science first hand so that we can become better science teachers. At this moment I realized I was guilty of exactly that—losing sight of the “big picture.” I was instantly reminded of a quote a friend sent me: “Mentor and coach others whenever you can. Your teaching will deepen your own learning.” (p. 1) Mentoring the practicing teachers helped to highlight some serious flaws in *my* teaching. No matter the amount of background you have, your methods of relaying the lesson are critical to your students getting full use of their experiences.

## Scientists Are People Too

One thing that left me in a state of awe this past summer was the relationships among scientists and teachers. So often our students have the misconception that scientists are unapproachable. They imagine a person with glasses, lab coat, a large vocabulary and who works in a lab with test tubes. I assume childhood cartoons and books ingrain this image in our minds. Little do the students know that scientists come in many varieties! Just this summer I worked with various types of scientists, including biologists, environmentalists, and technicians. Their fields of expertise may be different, but these scientists exhibit similarities in their scientific principles and their passion for science. I also observed the scientists’ communication skills and their ability to work well with each teacher, including me. The scientists treated the teachers as equals—

the teachers’ opinions mattered, their learning was critical to the scientist, and their suggestions came into the research design. It was an awesome display of partnership and community. Many of the teachers felt amazed at the relationship they had formed with their scientists, such as Sandy Pursifull with the U.S. Fish and Wildlife Service. She was wading and crawling in the creek with the teachers and me, looking for the mussels too.



As a teacher mentor I had three teams to visit, so I was not able to be at all meetings of each team, yet those times I could attend, I felt welcomed and was part of the team, as though I had been doing

the research for years. I created many

contacts with the scientists that will benefit my students. Mostly, I left with the desire to convince my students that scientists are PEOPLE, people just like you and me!

## Science Is Right Here, Right Now!

Lastly, in the “Ah-Ha” department I realized the vast number of science projects occurring in my community! I thought I had been well informed about projects in my region but was not. The types of projects I saw this summer left a lasting impression on me as a scientist, teacher and person. To use an ant colony as a metaphor for the science in my region, I felt like a person standing over an ant colony and seeing only a pile of dirt above ground. After taking the time to explore the whole colony that was *really* was underneath that pile of dirt, I saw the intricate tunnels that interconnected and led to specific areas built by hard-working scientists for one purpose. This program enabled me to explore further into this community’s science research and see many wonderful projects first-hand.

In particular, through the second of my Sc:iii<sup>1</sup> teams, I became aware of many science career opportunities available to high school graduates in my rural county. The Florida Department of Transportation (DOT) offers such careers. The majority of students in my school district go into vocational programs, and this was important information for my students. I met “good ‘ol boys” that started working for DOT after high school, and after years of experience, DOT training and certifications, they had become skilled science technicians or fully titled scientists. DOT employment means a state job with retirement and health insurance benefits, all crucial in today’s economy. Most of my students think you have to go to college to work in the sciences, and therefore they avoid my class. Now, I can enlighten them and even have some DOT personnel talk to my students. I was completely unaware of these opportunities for my students in the science world!! This is just one of many examples of career opportunities. All of these projects serve a larger purpose for our region and are performed by talented, professional scientists working in *this* region of the Florida panhandle.

I saw some of my teachers have the same kind of “Ah-Ha” moment about other available science resources in our area. With one of my other teams, the Soil Survey group, we realized that soil, a basic component of any landscape (not to mention that it is outside and FREE) could provide excellent opportunities for teaching science to our students!

## Did You Know That Scientists Are Funny?

### What Little Red Plate?

While my third Sc:iii<sup>1</sup> team did its fieldwork, Rob, their scientist, needed a battery powered metric scale, and I let him borrow mine. A few days later, I got a



*Dr. Penny J. Gilmer, left, discusses field experiments with teachers Miranda Rehberg, Sally Sims, and Melba Adkins*

*“Many of the teachers felt amazed at the relationship they had formed with their scientists.”*



*Amanda and scientist Vivian Negron-Ortiz listen as the team discusses the next survey destination*





This image of a DOT project illustrates some of the many areas that DOT researches, from engineering to materials science and environmental issues.

“The types of projects I saw this summer left a lasting impression on me as a scientist, teacher and person.”

The US Department of Agriculture Natural Resource Conservation Service conducts soil surveys for purposes ranging from agriculture to emergency management planning. (<http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>)

message that stated the scale behaved funny and needed calibrating. I arrived at the field site and the team tried to calibrate the scale but it gave an unusual reading. Rob and the team asked me to look at it before they gave up. Since the scale was mine, I felt like I let them down. I took a look at the scale and happened to see a red plate under the silver weighing plate. I pulled the red plate out and then the scale worked fine. The red plate was the stabilizer to keep the scale safe while being stored in the box. They all felt silly and joked with me about it for weeks, especially Rob!

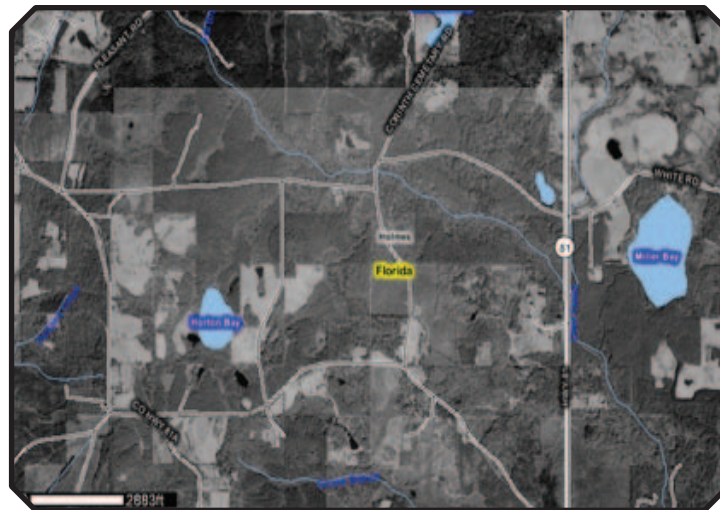
## In the Woods Without a Compass

The Mussels and Plants team had two parts to their project, and the teachers spent some days at the Apalachicola Forest looking for rare and endangered plants. Our U.S. Forestry guide was wonderful. She had teamed up with our botanist, Vivian Negrón-Ortiz with the U.S. Fish and Wildlife Service, to help us locate *Macbridea alba* “White birds in a nest,” a rare plant that only grows in the southern central panhandle of Florida.<sup>3</sup> She showed us different habitats and the way one habitat slowly sloped down into another. She showed us the rare plants in-flower and post-flower and taught us the other plants that synchronized growth timing with *Macbridea alba*. In order to get to our last survey area, we had to trek around washed-out trails and into areas with no distinct paths. Everything looked the same to us. We thought we were doing well to avoid the water, and our guide was several meters ahead. We were chatting and watching for our guide more than local landmarks. Finally, as we caught up to her, she showed us the plant populations we wanted to count with Vivian. However, before we knew it, in one breath she said, “You all remember how to get out, right? Okay, bye.” We all looked at each other in a sort of bewildered way. We knew she had to leave early, but she also left *fast!* In the end, we were fine. We counted several hundred

plants and used our collective senses of direction to get back to our vehicles.

“Oh Look, a Water Snake.”

In Sugar Mill Creek, the Mussels and Plants team was collecting fish and we





came to a log. We had passed this spot twice already, as the log lay across the stream and we had to crawl underneath it while digging for mussels an hour earlier. Anyway, we went under the log again and the scientist was the last to go. As he did so, he politely said, “Oh look, a water snake.” Well, that was the wrong thing to say because a member of our team is terrified of snakes. She hit that bank quicker than a hummingbird flapping its wings! “Where?” the other teacher and I asked. It was exactly in the spot we had just crawled under and placed our hands. “JOY,” I thought. The real humor in this story is not the darting of our teacher to safe ground, but the fact that the scientist, a skilled and knowledgeable biologist, simply said, “Oh look, a water snake.” Anyone reading this needs to understand that in this part of Florida, “water snakes” in creeks means poisonous water moccasins. The calmness in his voice and tact in his movements said it all. It got even better, because we stayed right there and collected our fish and then slowly walked down river. We stayed away from the log after that. As for our speedy teammate, she walked on the bank alongside us and refused to enter the water again!



*Macbridea alba,  
“White birds in a nest”*

## Reflection

I am so grateful for my experiences with the Sc:iii teams over this past summer. Overall, I feel I have gained from Sc:iii<sup>1</sup>, a sense of renewal in my profession of teaching, an awakening that I am not alone, and confidence in my abilities to educate my students using scientific inquiry.



*Teachers hike along  
a washed out trail to  
survey the area*

Teaching that begins with questions is both a moral and a pedagogical choice.

A teacher teaches with questions because she or he believes that it is a better way to teach, and a better way to be a teacher. Yet to succeed at this, the questions must be real



*The “Mussels and  
Plants” team making  
field observations of  
rare plants. From left,  
Sally Sims, Miranda  
Rehberg and Melba  
Adkins*



questions: questions that puzzle, confuse, and interest.<sup>4</sup>  
(p. 1)

The opportunity to work with teachers of varied grade levels made it crystal clear that the coursework in the elementary schools is truly the educational foundation for building math and science knowledge for our middle school and high school students. Remember soil! A simple tool, although the simplicity is only in its obtainment. Soil itself provides exercises in biology, chemistry, physics and more. Keeping the “scientific language the same” is really important! Based upon their home addresses, our students follow a selected path from elementary school, to middle school and to high school (i.e., students from

The “Mussels and Plants” team conducts a visual and tactile search for mussel species in Sugar Mill Spring inside the Florida Caverns State Park, Marianna, Florida. This work studied the effectiveness of a less invasive method for DNA collection from bivalve species.

various small elementary schools trickle into a few prescribed, larger middle schools that then trickle into even fewer high schools for the county. Some counties only have one middle-high school). If the teachers within this school continuum work together rather than in isolation, they could develop one common scientific vocabulary



Amanda points to some rare plants growing along a state road

and methodology for teaching. This vocabulary and methodology would reduce confusion and be a common thread that the students could utilize as they develop educationally. This kind of collaboration between grades and schools will enable teachers to work as a team to create *lifelong* science learners, not just grade level science learners.

Most importantly, actually meeting the science teachers for the grade levels below and above your own is really beneficial. Usually we have no time, place or chance for these types of meetings to occur. This summer made these meetings happen and we inspired each other with new ideas. We often focus only on our own schools, but we are, in fact, a team of teachers that for 13 years impacts students in many ways, and we should all work together to maximize our students’ ability to understand and appreciate their world.

## References

- <sup>1</sup> Panhandle Area Educational Consortium (2008). Science Collaboration: Immersion, Inquiry, Innovation (Sc:iii). Retrieved September 13, 2008, from <http://www.paec-sc-iii.org/index.html>
- <sup>2</sup> Colan, L. J. (2001). Teaching. Retrieved September 13, 2008, from [http://www.quoteland.com/author.asp?AUTHOR\\_ID=2411](http://www.quoteland.com/author.asp?AUTHOR_ID=2411)
- <sup>3</sup> Florida Natural Areas Inventory (FNAI) (n.d.). Field Guide to the Rare Plants and Animals of Florida Online. Retrieved September 17, 2008, from [http://www.fnai.org/FieldGuide/pdf/Macbridea\\_alba.PDF](http://www.fnai.org/FieldGuide/pdf/Macbridea_alba.PDF)
- <sup>4</sup> Burbles, N. C. (2001). Teaching. Retrieved September 13, 2008, from [http://www.quoteland.com/author.asp?AUTHOR\\_ID=1780](http://www.quoteland.com/author.asp?AUTHOR_ID=1780)

*“Overall, I feel I have gained from Sc:iii, a sense of renewal in my profession of teaching, an awakening that I am not alone, and confidence in my abilities to educate my students using scientific inquiry.”*



# Chapter 6

## Joys of Chemical Separation

Becoming a Learner Gives Me Empathy for My Students



## Daphne M. Hill

Jefferson County Middle High School  
Monticello, FL



### Biographical Information

<p><b>Present Positions</b></p> <ul style="list-style-type: none"><li>• Middle/High school biology, Jefferson County Middle/High School</li><li>• Member: National Science Teacher Association, National Education Association, Phi Delta Kappa, Florida Teacher Association</li><li>• Master Degree – Alcorn State University</li><li>• Jefferson County Middle/High School Science Department Chairperson, 2006-present</li></ul>	<p><b>Reasons I participated in Sc:iii</b></p> <p>As an educator, I teach students the theories and practices used by scientists. Since the majority of my students are from underrepresented populations in science, I felt this opportunity would enable me to become reacquainted with scientific research and improve my skills in introducing science to my students. When asked to identify careers in science, students most often mention chemists or biologists, the most commonly known scientists. They rarely describe other careers in science because they are not familiar with other science professionals. I hope my experience in Sc:iii will trigger students' interest in science.</p>
<p><b>Years Teaching</b></p> <ul style="list-style-type: none"><li>• 8 years middle school</li><li>• 8 years high school</li></ul> <p><b>Science Background</b></p> <ul style="list-style-type: none"><li>• TRUE (True Research Update Experience) Program, University of Florida</li><li>• Laboratory scientist, State of Louisiana Laboratory, Prenatal Screening</li><li>• American Society of Cell Biology Fellowship, FSU Department of Biology with Dr. Laura Keller</li><li>• Biology, AP Environmental Science, Environmental Science, Integrated Science</li></ul>	<p><b>My learning in the Sc:iii program</b></p> <p>I have expanded my knowledge of scientific inquiry by participating in the Sc:iii program. I recognize the importance of involving my students in inquiry, but in the past have had difficulties incorporating inquiry directly into their learning. From my summer experience, I have acquired the skills needed in scientific inquiry. With these skills, I am able to generate questions, perform experiments, produce results, and collect data that will lead to other interesting questions. In order to think like a scientist, a student needs certain skills, such as observing, making inferences, collecting data, predicting, analyzing data, recording, drawing conclusions, asking questions, and communicating. I used these skills repeatedly as I worked on my research experiments this summer.</p>

*"I never imagined that I would learn so much!"*

## Being the “New Kid”

*“I have acquired new empathy for my students, and I can now honestly acknowledge their position.”*

On July 7, 2008, as part of the Sc:iii program<sup>1</sup> for practicing science teachers, my experience as an analytical chemist began. I never imagined that I would learn so much! As a teacher, the opportunity to experience being a learner is rare, and this summer granted me that opportunity. I “walked a mile in my students’ shoes” and realized that comprehending foreign concepts is not always easy. Nothing is wrong with having to visit information several times to attain clarity and understanding. I have acquired new empathy for my students, and I can now honestly acknowledge their position. As a student myself this summer, I realized that in order to understand unfamiliar information, reviewing resources beyond those presented in the learning setting is critical. After first entering the

laboratory and becoming familiar with the language

of the analytical chemistry,<sup>2</sup> I had to visit several websites to help me gain a better understanding of the laboratory’s routine. Thank goodness for resources such as the Internet and professional journals! After reading journal articles about similar procedures, I began to start putting things into perspective. During the summer, I wrote of my learning:

I am not saying that I have the information down pat, but I am closer to understanding “what” and “why!” Now I can ask questions and integrate the information. If my students would practice going beyond the classroom, understanding concepts would not be so difficult for them!

I worked and learned in the Chemical

Residue Laboratory at the Florida Department of

Agriculture and Consumer Services.<sup>3</sup> This laboratory has the task of analyzing a wide variety of food products for trace amounts of pesticides, antibiotics, and other chemical contaminants. My specific task was to acquire an understanding of the chemical and instrumental techniques involved. My teammate, fellow science teacher Algeletha Mitchell, and I followed all of the processes required to extract, purify, measure, and report pesticide concentrations in food products at a level of parts per million (ppm). Our primary focus was hands-on analysis of samples for various chemical compounds. This process involved extraction of residues from fruits and vegetables with chemical solvents and analysis of these samples using coupled liquid chromatography/mass spectrometry (LC/MS). Preliminary knowledge included an accurate grasp on the definition of a pesticide. The US Environmental Protection Agency<sup>4</sup> describes, “What is a Pesticide?”:

A pesticide is any substance or mixture of substances intended for: preventing, destroying, repelling, or mitigating any pest. Though often misunderstood to refer only to insecticides, the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests. Under United States law, a pesticide is also any substance or mixture

*Algeletha, left and Daphne, right, compare notes*

*“As a student myself this summer, I realized that in order to understand unfamiliar information, reviewing resources beyond those presented in the learning setting is critical.”*

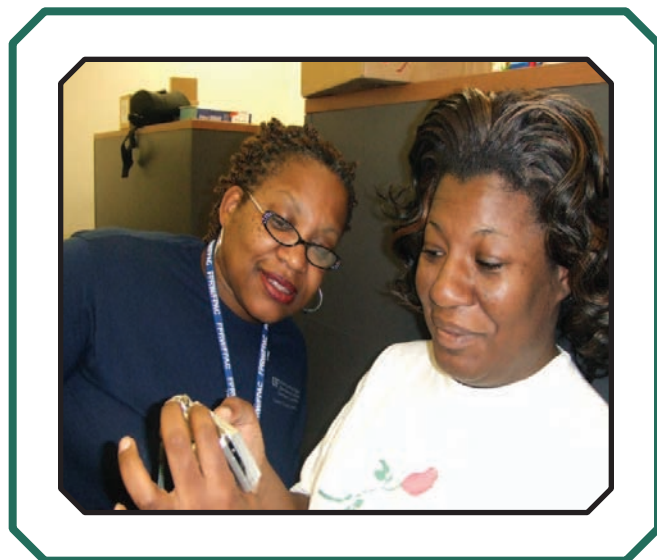




of substances intended for use as a plant regulator, defoliant, or desiccant.<sup>5</sup> (p. 1)

During the first week I learned about mass spectrometry as it relates to liquid chromatography and gas chromatography. Our mentoring scientists, Walter Hammack, Donna Kilpatrick, and the other chemists, were instrumental in teaching me the operation of the laboratory. While researching the topic, I found this interesting definition of a mass spectrometrists:

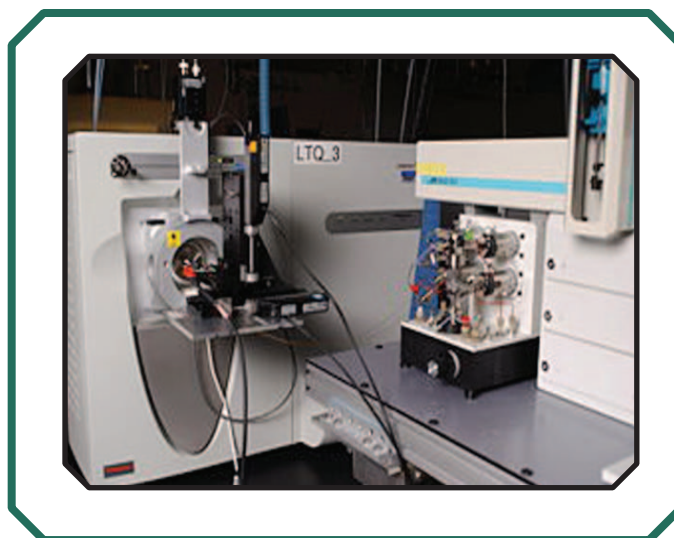
A mass spectrometrists is someone who figures out what something is by smashing it with a hammer and looking at the pieces.<sup>6</sup> (p. 1)



*Daphne, left and Algeletha, right, look at pictures of their lab*

Liquid chromatography is a method of chemical separation that involves passage of a liquid mobile phase through a solid stationary phase and relies on chemical interactions to resolve mixtures into pure compounds.<sup>7</sup> To separate a small amount of sample, one mixes the sample with the solvent and injects it onto the top of a column densely packed with small particles (i.e., the stationary phase). More of the solvent mobile phase flows through the column continuously to carry the sample from the top to the bottom of the column. During passage through the column, the components of the sample partition back and forth between the two phases, and small energy differences in the chemical interactions of the sample components with the mobile and stationary phases slow the passage of some solutes more than others and lead to their separation.

In principle, as the separated solutes come off the liquid chromatography column, they go directly into the mass spectrometer, which produces a mass spectrum scaled to the intensity of response for all peaks in a scan. A mass spectrum can show the fragmentation pattern of a molecule if the scan is of the product ions, and this information enables the identification of an analyte.<sup>8-10</sup> This LC/MS coupled instrument is amazing because it is capable of separating compounds into the smallest of ions. Prior to my arrival, I could not imagine a process capable of receiving a whole compound, breaking down that compound and then separating it into its most basic ions! There was so much information and so many processes going on for one purpose.



*“Liquid chromatography is a method of chemical separation that involves passage of a liquid mobile phase through a solid stationary phase and relies on chemical interactions to resolve mixtures into pure compounds.”*

*LC/MS apparatus  
(<http://en.wikipedia.org/wiki/LC/MS>)*

## Our Project and Purpose

*“How do the data compare between the well-established more manual method versus a new more automated method?”*

I acquired knowledge piece by piece, making the connections. The connections made it possible for me to collaborate with Algeletha to generate our major research question, the driving force of our research:

What is the compatibility of LC/MS pesticide data from food samples using Chemical Residue (CR) Method 260 versus CR Method 242?

The rationale for asking this question is that CR Method 242 is older, has a proven record of accuracy and precision but relies upon human technique, is labor intensive and time consuming. Conversely, CR Method 260 proposes greater speed and more automation.

Other questions surfaced as we embraced scientific inquiry: (1) What type of pesticides will be found in the samples? (2) What will be the quantity of the compounds found in each sample? (3) Will there be a difference between the compounds found in the chemists' samples using CR Method 242, compared to ours using CR Method 260, and in what amounts?

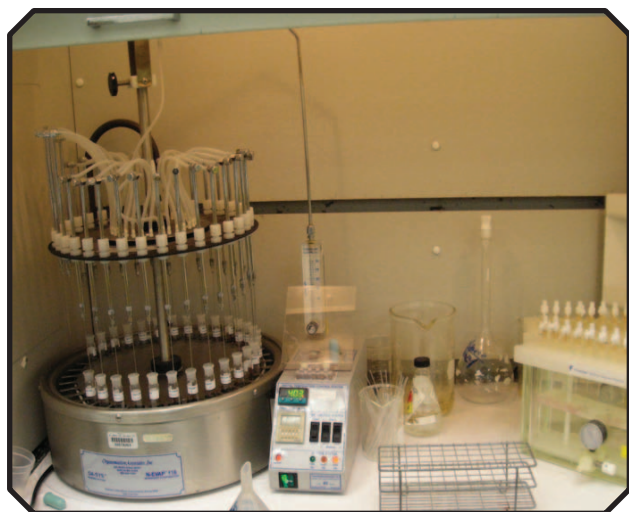
In order to provide an answer to these questions, I used the following standard operating procedure

(SOP) with duplicate samples of pears, bananas, papayas, and grapes. These were the same samples previously used by the chemists as part of the State Regulatory Program (SRP). Like a former pre-service science teacher who worked in the same Chemical Pesticide Laboratory,<sup>11</sup> Algeletha and I also analyzed Algeletha's orange from the groves in Lake Wells, Florida. This extraction was not included in our investigation, but we thought it would be interesting to determine the pesticides in it.

## Analytical Methodologies

Before proceeding with sample extraction, we labeled the sample bottles and vials and put them in order to prevent any sample misidentification.

- Prepare sample: weigh two sets, 15 g for each test sample of pears, bananas, papayas, and grapes in a 50 mL centrifuge tube (These are the matrix samples; “matrix” refers to the components of a sample other than the target analytes)
- Prepare a reagent blank with 15 mL of deionized water into 50 mL centrifuge tube (Blanks contain solvent only. Measuring the blank establishes the background reading for the solvent, subtracted from the sample data, to get the reading from the matrix and analyte particles.)



*Sample extraction equipment used in the manual technique, CR Method 242*

*“Educators face two fundamental obstacles: 1) Many of our students have negative preconceptions about science and scientists and 2) These topics are so foreign to students that they have a hard time relating and feel little or no interest in science.”*

- Prepare matrix blank: 15 g of spinach in a 50 mL centrifuge tube
- Prepare matrix spike: 15 g of spinach in 50 mL centrifuge tube plus 60 uL of liquid chromatography spike #2 mix (known analytes) and 60 uL of the gas chromatography spike #2 mix (known analytes). (A “spike” is a sample containing known components and a known concentration of analytes. Prepared in advance by Donna, the senior chemist)
- Add 50 uL of control/standards to all test samples and spike. (Controls prepared in advance by Donna)

As I observed the sample preparation, I asked myself the rationale for using the older CR Method 242 if the CR Method 260 were likely to be faster for extracting pesticides from fruit and vegetables. I concluded that continuing to use an older, proven method is probably a good way to compare effectiveness. I asked laboratory personnel this question, and I was happy to find that their answer was similar to my conclusion. I asked Walter whether CR Method 242 would be eliminated from the SOP file? He replied that more tests would be needed before any SOP could be eliminated.

I treated the samples alternately with organic solvents and salts and after shaking them vigorously, I centrifuged the samples to separate the polar components from the non-polar components containing the pesticides. The instrument utilized for analysis was a LC/MS/MS system. The samples were injected into the HPLC (high performance liquid chromatograph) and the procedure continued in conjunction with the quadrupole tandem mass spectrometer or “triple quad,” which measures (isolates) the mass of each pesticide, fragments the molecule to produce a “fingerprint” and then records the trace of the fingerprint as a peak that we can then compare to known standards to confirm identity and quantity. The sample processing continued until the next day. The mass spectrometer interpreted one sample per 30 minutes and recorded the data automatically. I identified the analytes, based on their column retention times and their mass spectrum analyses. The retention time of a solute is the time elapsed between the time of injection of a solute and the time that most of the solute eluted off the column. The analytes are identified based on their retention times in the liquid chromatograph and characteristic fragmentation patterns (“fingerprints”) in the mass spectrometer relative to a standard. The area of each peak is then compared to the area of corresponding standard peak to determine the concentration of the analyte in the sample. Our instruments operated in a mode known as multiple reaction monitoring (MRM) to monitor known product ions, typically two, per compound. The presence of these product ions in a sample and standard, the ratio of these ions matching in both the sample and standard, and the matching retention times for the sample and standard, all form the complete identification/confirmation of the analytes in question.



*Algeletha, right, applies sample to a column as Daphne looks on*



*Daphne, left and Algeletha wait while samples flow through the preparatory columns*



## Results and Conclusions

Upon the completion of the LC/MS for the samples, I collected the data. Of all the pesticide compounds screened, I detected the six compounds shown in Table 1:

TABLE 1

Name	Use
Thiabendazole	To control mold, blight, and other fungally-caused diseases in fruits and vegetables
Imazalil	Fungicide to control wide range of fungi on fruit
Pyrimethanil	Fungicide
Azoxystrobin	Fungicide
Boscalid	Fungicide
Pyraclostrobin	Fungicide

*"I can remember times during class that students used colored markers or paints to complete an assignment. For whatever reason, water got on the paper and the resulting watermark fascinated them because they saw the different colors that made up the particular color that got wet. They were intrigued and curious!"*

Table 2 displays the results of both methodologies:

TABLE 2

Pesticide Level (ppm)				
Teacher Data using CR Method 260				
	Pear	Bananas	Papayas	Grapes
Thiabendazole	1.1	0.28	0.50	
Imazalil		0.23		
Pyrimethanil	0.25			
Azoxystrobin			0.30	
Boscalid				0.22
Pyraclostrobin				0.11
Original Data (Chemist) using CR Method 242				
	Pear	Bananas	Papayas	Grapes
Thiabendazole	0.38	0.16	0.30	
Imazalil		0.22		
Pyrimethanil	0.22			
Azoxystrobin			0.30	
Boscalid				0.22
Pyraclostrobin				0.083

As indicated in Table 2, the results of the two methods are very similar but for some reason, especially for the pear and banana samples, the values in the teacher set of data using CR Method 260 are larger than those by the chemist using CR Method 242. A factor that might have caused an increased amount of residue concentration is poor stirring of the samples. Higher concentration can occur in certain portions of the sample while proper stirring would produce greater sample homogeneity. Thiabendazole appears in three of the four fruits, while each of the other pesticides was only present in one fruit. Regarding our own orange sample that was tested identically as these, it was interesting to find out that it did contain two pesticides tested, dinotefuran (0.7 ppm) and carbaryl (1.3 ppm).

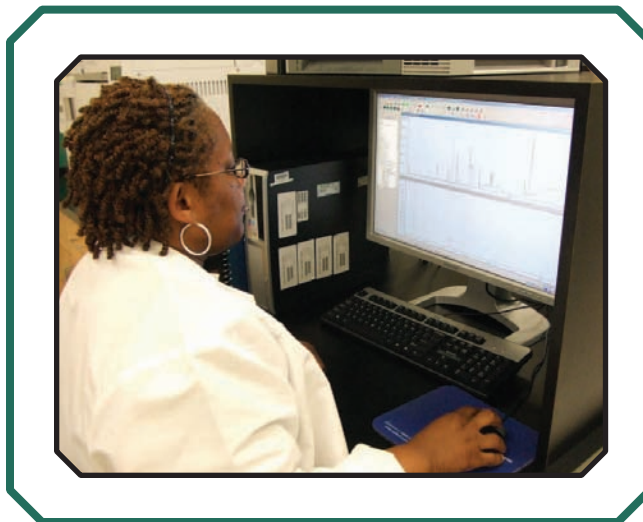


*Comparing samples eluted from the preparatory column.*

In conclusion, for the investigated set, 100% of the eluted pesticide compounds were detected at levels less than or equal to the state tolerance expectancy of 2.0 ppm. The results show that the data from both methods are very compatible. The high level of compatibility between the two data sets is good because using CR Method 260 would lower the required personnel time, decrease the volumes of solvents used and reduce the requirements for glassware (CR Method 242 requires several 50 mL beakers). I was very happy to see that our results were very similar to the chemists' results.

## Bridges Between Real Science and the Classroom

Whenever the opportunity presents itself for educators to exchange roles from teacher to learner, implementation of the experiences into the classroom is of major importance. The students I teach are different; therefore, we need to take into consideration concerns about their learning styles. A learning style is a student's way of responding to the context of learning.



*"Students would also be allowed to design an experiment, which is an excellent activity for them to think and act like a scientist."*

*Daphne analyzes her data from the automated technique, CR Method 260*

Learning styles are defined as those "educational conditions under which a student is most likely to learn." Thus, learning styles are not really concerned with "what" learners learn, but rather "how" they prefer to learn.<sup>12</sup> (p. 15)



Left to right, Daphne, Dr. Gilmer, and Algeletha

*“In order for them to experience similar involvement in chemical separation experiments, they need to experience hands-on activities like the ones I enjoyed this summer. Two activities include 1) Grape Soda Column Chromatography, and 2) Chromatography of Food Colors.”*

in science. To dismiss the typical stereotypes and increase students’ interest in science, we have to provide content on science careers and present science and scientists in a different light.

As I brainstormed over other ways I could incorporate my lessons into my classroom, I thought of more activities that I could use to provide my students with the concepts of spectrometry and chromatography. First, it would be significant for them to know the definition of these two terms. Once they understand that the objective is to separate molecules, I would expose them to specific activities based on their grade level. I can remember times during class that students used colored markers or paints to complete an assignment. For whatever reason, water got on the paper and the resulting watermark fascinated them because they saw the different colors that made up the particular color that got wet. They were intrigued and curious! Using a similar structured activity, students can relate this to the concept of molecules being separated. I think using examples like this would provide them a background to understand the processes of liquid and gas chromatography. One specific activity that comes to mind is Extraction of Chloroplast Pigments for Chromatography and Chromatography of Chloroplasts Pigments (taken from BSC 1010 Laboratory Manual – by the Biology Faculty, Florida A & M University). Other possible activities would include; M & M chromatography, tie dying, separation of oil/water/food coloring. Some helpful websites for teaching mass spectrometry and chromatography include Understanding Chemistry<sup>14</sup> and NASA Jet Propulsion Laboratory.<sup>15</sup>

As I searched the Internet, I found interesting activities that could be used in my classroom. I feel that students should understand my involvement in the Chemical Residue Laboratory. In order to for them to experience similar involvement in chemical separation experiments, they need to experience hands-on activities like the ones I enjoyed this summer. Two activities include 1) Grape Soda Column Chromatography,<sup>16</sup> and 2) Chromatography of Food Colors.<sup>17</sup>

These two activities take the approach of teaching students from the standpoint of separating mixtures of compounds. I think this is a wonderful approach because students will get to understand the basics of separating components of mixtures. Students would also be allowed to design an experiment, which is an excellent activity for them to think and act like a scientist. To prepare, students would get involved with the activities in Thirteen Ed On-line<sup>18</sup> experiments. Once students

Once the teacher determines the learning styles of the students, the method of lesson delivery becomes the challenge.<sup>13</sup> Educators realize that scientific inquiry is an excellent method for inspiring interest in science and experimental methods. However, we face two fundamental obstacles: 1) Many of our students have negative preconceptions about science and scientists and 2) These topics are so foreign to students that they have a hard time relating and feel little or no interest



become familiar with the concept of designing an experiment, I would give them a scenario for applying their scientific inquiry.

Another activity I would use is to allow students to “Role Play a Scientist.” Students would assume the role of scientist by getting involved in exploring a variety of resources to obtain information on a scientist of their choice. They would submit a one-page abstract, highlighting important ideas and facts about this scientist. They would prepare and make presentations (5-8 minutes) on the scientist’s achievements, contributions, etc., using visuals and costumes to enhance the presentation.

I want my students to make vivid comparisons in science using metaphors. This relationship would give them an appreciation of science and allow them to see the relevance. This relevance would help them get involved, and get hooked on science. Lightman states:

Metaphor is critical to science. Metaphor in science serves not just as a pedagogical device, like the cosmic balloon, but also as an aid to scientific discovery. In doing science, even though words or equations are used with the intention of having precise meanings, it is almost impossible not to reason by physical analogy, not to form mental pictures, not to imagine balls bouncing and pendulums swinging. Metaphor is part of the process of science.<sup>19</sup> (pp. 49-50)

Encouraging my students to use metaphors might get them more excited about science.

I am extremely ecstatic and thankful to have had the opportunity to experience research as a scientist. I have become empowered with strategies needed to involve my students with scientific inquiry. The ideas are so enormous in my head that I wonder if I am going to be able to implement them in my classroom. I am grateful for the many resources from the personnel in the Chemical Residue Laboratory. My school and the personnel of the Chemical Residue Laboratory plan to collaborate in the future; the scientists expressed a willingness to visit my school as guest speakers, demonstrate science activities based on their work, and arrange tours of the laboratory. I have learned considerably and look forward to my students getting deep into scientific INQUIRY, in which they think and express themselves like scientists!

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<sup>1</sup> *Science collaboration: Immersion, inquiry, innovation* (Sc:iii) (2008). Retrieved September 14, 2008, from <http://www.paec-sc-iii.org/index.html>

*“They would prepare and make presentations (5-8 minutes) on the scientist’s achievements, contributions, etc., using visuals and costumes to enhance the presentation.”*



*Daphne at her desk*

*“I am extremely ecstatic and thankful to have had the opportunity to experience research as a scientist.”*

*"I have learned considerably and look forward to my students getting deep into scientific INQUIRY, in which they think and express themselves like scientists!"*

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# Chapter 7

**My Summer With the Gopher Tortoises!**  
At Nokuse Plantation I Found Tortoises, Technology, and  
Fortitude



**Janice C. Balentine**  
**Freeport Middle School**  
 Freeport, Florida



**Biographical Information**

<p><b>Present Positions</b></p> <ul style="list-style-type: none"> <li>• 7<sup>th</sup> grade science teacher, Freeport Middle School, Freeport, FL</li> <li>• Boys basketball bookkeeper, Freeport High School, 13 years</li> <li>• Girls softball bookkeeper, Freeport High School, 2 years</li> <li>• Girls basketball bookkeeper, Freeport Middle School, 2 years</li> <li>• Graduated from University of West Florida, with President and Dean Honors, 1999</li> </ul>	<p><b>Reasons I participated in Sc:iii</b></p> <p>I was selected and felt it would be a great opportunity for my students to learn about science through my experience and real-life situations. What better way to learn than at the right-hand of a “real” scientist!</p>
<p><b>Years Teaching</b></p> <ul style="list-style-type: none"> <li>• 4.5 years Freeport Middle School, Freeport, FL (7<sup>th</sup> Grade Science Teacher)</li> <li>• 5.5 years Rosenwald Middle School, Panama City, FL (4 years Science, 1 year all subjects, 5 year Academy 6, 7, and 8 grades combined)</li> <li>• 4 years Freeport Elementary School, Freeport, FL (Student teaching, Para-professional)</li> </ul> <p><b>Science Background</b></p> <ul style="list-style-type: none"> <li>• General science</li> <li>• Scientific inquiry</li> </ul>	<p><b>My learning from the Sc:iii program</b></p> <p>I obtained vital skills and experiences that could only occur through real hands-on inquiry. I was amazed at how excited I could get about real science and want to have my students see my enthusiasm and be able to experience some of their own. The Sc:iii program was a life-changing experience.</p>

*“What better way to learn than at the right-hand of a ‘real’ scientist!”*

*“I have to admit, I did not know the spills and thrills that were in store for me in summer 2008.”*

**Translocated Gopher Tortoise Population Research**

**I Found My Niche**

I have to admit, I did not know the spills and thrills that were in store for me in summer 2008. I had agreed to be part of the Sc:iii program,<sup>1</sup> offered jointly by Florida State University and the Panhandle Area Educational Consortium. The

*“The days were LONG, I was hot and sweaty, I got three non-venomous snakebites, I nearly over-heated, and I got blisters.”*

days were LONG, I was hot and sweaty, I got three non-venomous snakebites, I nearly over-heated, and I got blisters. However, I also saw so many beautiful plants and animals! Our team even collected a dried plant specimen book for our students. Best of all, I relocated my first gopher tortoises, and I tracked and observed the tortoises with the web-camera.

I worked with a team of two other science teachers, Judy Kennington and Pamela Cuchens, at Nokuse Plantation,<sup>2</sup> a research site that protects gopher tortoises from being buried alive by developers building new houses and industrial sites in eastern and central Florida.<sup>2</sup> (Nokuse is pronounced “nuh-GO-see.”) The scientists at Nokuse Plantation test different methods to encourage the gopher tortoises to stay at the plantation rather than try to walk the 500 or so miles from the panhandle of Florida back to their old burrows.

Our research questions pertained to maximizing site fidelity. We maximize “site fidelity” if more than 23% of the gopher tortoises remain

within the boundaries of an enclosure after the fencing is removed. Our specific questions included:

- 1) What is the minimum land requirement for translocated gopher tortoises (*Gopherus polyphemus*)?
- 2) How long must the fencing remain in place for stable colonies to be established?<sup>3</sup>

The rationale for asking these questions involves the threatened status of the gopher tortoise. The number of gopher tortoises is falling, but we need more data to know the extent of the decrease due to habitat destruction, urbanization, increased vehicular traffic, fire suppression, planting of dense stands of sand pines, and the increased introduction of exotic plant species.<sup>4</sup> Other factors contributing to their decline in numbers include overharvesting of tortoise meat and the tortoises’ delayed sexual maturity and spatial isolation.<sup>3</sup>

We typically relocate gopher tortoises to pens of different sizes. However, Nokuse staff experimented by relocating five gopher tortoises to an unenclosed region. These relocation procedures are referred to as soft release (in an enclosure) and hard release (no enclosure). Surrounding each pen is a “1-m tall, Georgia DOT-approved HD black, polypropylene silt fence double-stapled to oak stakes<sup>3</sup>” (p. 4). Based on their behavior after soft-release, we categorize gopher tortoises as “dispersers” or “non-dispersers.” “Dispersers” move to a pen’s fence line from



#### *The Nokuse Tortoise Team*

*From left, Biologist Bob Walker, Judy Kennington, Pamela Cuchens, Janice Balentine and Teacher Mentor Linda Kitner*

*“Our research questions pertained to maximizing site fidelity. We maximize ‘site fidelity’ if more than 23% of the gopher tortoises remain within the boundaries of an enclosure after the fencing is removed.”*



the center release area without establishing a burrow (i.e., without the fence they would have left the pen or site). Conversely, “non-dispersers” establish burrows within the site enclosure.

We determine site fidelity by comparing the number of non-dispersers to the number of dispersers. We hypothesize that time frames of nine to twelve months are required for stable colonies to be established.<sup>3</sup>

## Incidental Take: A Permit to Bury Gopher Tortoises Alive

Participating in this research gave me a real purpose. For the first time in my life I felt like I was doing something truly scientifically important.

The largest threat to the gopher tortoise is habitat loss resulting from land development. In 1991 the state of Florida established an “incidental take” policy<sup>5</sup> whereby land developers could pay a fee to a state fund designated for purchasing gopher tortoise conservation lands and then receive state permission to bury the tortoises on their development site.<sup>2</sup> The rationale for the policy was that the purchase of conservation lands offset the destruction of existing gopher tortoise colonies on the sites. In 2007, the state of Florida changed this policy<sup>5</sup> and developers now are required to either move the tortoises to relocation lands off their development site or create an on-site conservation area, both of which would be expensive. Nokuse Plantation accepts gopher tortoises relocated under the new policy and retrieves gopher tortoises, at no cost to the developer, from sites with permits obtained before the policy change. Fines for infractions range from \$200 up \$4,000 for each tortoise immediately impacted by disregard of the new policy.<sup>6</sup>



*“Participating in this research gave me a real purpose. For the first time in my life I felt like I was doing something truly scientifically important.”*

*The gopher tortoise*

## The Work Begins

Our first delivery of hand-dug gopher tortoises from Clermont Crossing, Lake County, Florida arrived at Nokuse Plantation via cargo van. Before we began processing the new arrivals, our scientist, Bob Walker, told our team to speak softly, handle them very carefully and avoid anything that might stress them any more than they already were from the digging and transport. I was very surprised that Bob let us start working with the gopher tortoises right away! I was expecting to observe at first and take notes. He was a great safety net for us because we felt very comfortable asking him if we were unsure about anything.

*“The largest threat to the gopher tortoise is habitat loss resulting from land development.”*



*From left, Pam, Teacher Mentor Linda Kitner, and Judy measure a new arrival.*

My personal observation of the first gopher tortoise was that the back feet are a miniature version of elephant feet while the front feet have claws and are shaped like flippers. We measured all new arrivals using forestry-regulation calipers and we recorded all length measurements in millimeters. With the calipers we measured the dimensions of the carapace (top shell) and plastron (bottom shell), a process that also enabled us to determine the sex of the tortoises. In males, the plastron is concave while in females the plastron is nearly flat. Minimum adult carapace length for males is 180 mm and for females, 220 mm. (B. Walker, personal communication, 9/20/08) We measured the mass using a digital scale by placing the gopher tortoise on his/her back.

Next we did a visual examination of the gopher tortoise's entire body for evidence of age, health and any injury. The shell has sections called scutes, made of bone and keratin (like our fingernails). With age, the gopher tortoise adds layers called annuli around the scute's edges like a tree trunk adds rings. Many believe that one can count the annuli to determine the age of a gopher tortoise, just like a dendrologist would count rings in a tree trunk. Counting scute annuli is not

always valid for two reasons: 1) As a gopher tortoise matures, the shell wears down and annuli cannot be correctly counted; 2) Counting annuli can be relatively accurate up to 18-20 years. After that, they generally grow at a slower rate and the annuli are too close to decipher. We make notations of any pulling injuries because the gopher tortoise was and may be still eaten for its meat, although it is illegal and a felony to do so. During the Great Depression, people referred to gopher tortoises as 'Hoover's chicken.' The injuries to the tortoise occur as people try to pull it out of the burrow and the tortoise resists with all its might. I have first-hand knowledge, after handling them that tortoises are very strong!



*A rescued gopher tortoise goes for a walk.*

We examine for gopher tortoise ticks and any other visible signs of injury. It turns out that tortoise ticks look much like ticks found on other animals like dogs. We leave the ticks in place to avoid creating an open sore. Eventually, a tick engorged with blood simply falls off the tortoise. We document any other damage on the tortoise relocation sheet and back up our observations with drawings or digital pictures. We assign each relocated gopher tortoise an identification number and mark it with small drill holes in the edge of the shell for future identification. During the marking process, some shells bleed so we use a medicinal "liquid Band-Aid" called NuSkin® to cover the site. We



attach transmitters to the shells with epoxy putty to enable tracking with telemetry.

In the first shipment were two young tortoises estimated to be two to three years old by observing their size, looking at the annuli, and using good old fashioned estimating. While maturing, juveniles are especially susceptible to attack from predatory animals. Just as a child has a soft spot on the top of its head, a tortoise has a soft shell. These young tortoises had no obvious signs of injury from attack. Nokuse Plantation does not mark the babies with drill holes or put transmitters on their shells.

Gopher tortoise eggs were in this first shipment, but five of them rolled downhill during retrieval because the excavators did not see them at first. Rotated eggs such as these may not hatch. The excavators found other eggs at the site and carefully removed to keep them in exactly the same position.

After processing all the gopher tortoises, we returned them into their Rubbermaid containers, filled with approximately 1-2" of fresh, cool water, allowing them to soak overnight for hydration. The baby tortoises were not soaked overnight because of the risk of drowning. They were soaked for a shorter time prior to release.

## Relocation Day

### A Rite of Passage

We arrived at the plantation at dawn and started the day by emptying the gopher tortoises and the water out of the containers. We reloaded the gopher tortoises into other containers with lids and put them on a small flatbed trailer for the ride to the relocation site. As we rode to the release point in the early morning light, I thought about everything I had read about gopher tortoises and ecosystems.



*Gopher tortoise containers ready for transport*

*"The gopher tortoise burrows provide protection from predators, extreme temperatures, fire and dehydration. They also protect or serve as home to 350-400 other species."*



*A Nokuse Plantation road after a cloud burst*

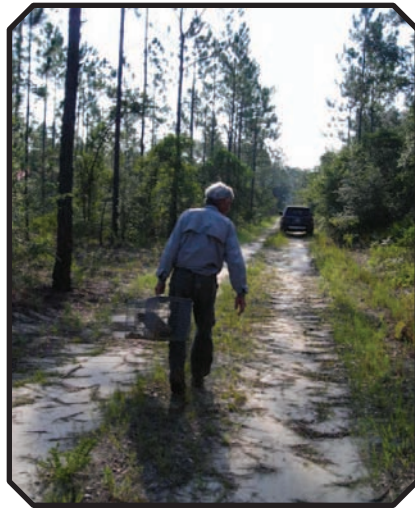




*An active burrow*

*“During a fire, many species use the same burrow at the same time; they will not prey on each other during the fire. However, after the fire, they return to their normal predator/prey relationships.”*

*Biologist Bob Walker carries a rescued gopher tortoise that escaped from an enclosure.*



The gopher tortoise (*Gopherus polyphemus*) is medium-sized and can range in size from 9 - 11” long. Their color is dark brown, tan, or gray. The range of the gopher tortoise covers six southeastern US states including Florida, which hosts the largest population. All 67 Florida counties have documented gopher tortoise habitats. Gopher tortoises have a population density that can be up to four gopher tortoises per acre.<sup>2</sup> They inherit burrows from previous generations and can maintain as many as 8-10 burrows each!<sup>7</sup> The gopher tortoise burrows provide protection from predators, extreme temperatures, fire and dehydration. They also protect or serve as home to 350-400 other species, including the pine snake, the indigo snake, and the gopher frog! During a fire, many species use the

same burrow at the same time; they will not prey on each other during the fire. However, after the fire, they return to their normal predator/prey relationships.<sup>8</sup>

These essential multi-purpose burrows earn the gopher tortoise the distinction of being a “keystone species,” which means that without the gopher tortoises, many other creatures would not survive and their ecosystem would change dramatically.<sup>8</sup>

Gopher tortoises have a long lifespan lasting over 40 years. Male gopher tortoises reach sexual maturity “as early as 15 years...., but it generally occurs at 20 to 25 years for females<sup>8</sup>” (pp. 17-18).

Generally, when the gopher tortoise has a carapace length of ~190 mm, the animal can breed. A gopher tortoise that is in the 190 mm range and is not showing any male characteristics would be considered a subadult female. The female gopher tortoises are larger when full grown, so the females are generally larger when sexually mature. Breeding season is usually March through October, and females bury clutches containing an average of 5-9 eggs in or near the sandy apron of the main burrow. The incubation period is usually 80-100 days. During incubation and through their first years of life, gopher tortoises are extremely susceptible to predators.<sup>8</sup> Only one out of every seven eggs results in an adult tortoise.<sup>8</sup>

Gopher tortoises are vegetarians and their diet consists usually wiregrass, legumes, and fruits. Gopher tortoises do not venture far from their burrows to find food. Overall, their movements depend on the forest ground cover.<sup>3</sup>



*Janice holding the snake*

The goal for gopher tortoise conservationists is to “restore and maintain secure, viable populations throughout the species’ current ranges in Florida”<sup>4</sup> (p. 8).

Officials and scientists are quick to point out that realizing this goal is going to be slow and will take many years because the tortoise is a slow growing, long living animal.<sup>3,4</sup> Future efforts include monitoring for the following factors: tortoise relocation effectiveness, prescribed forest burns, specific tortoise response to Longleaf Pines plantings, impact of herbicides, the impact of exotic plants and wildlife, and long-term effects of disease.

The sun had barely come up when Bob Walker noticed a red rat snake about 4.5 feet long crossing the road. He slammed the vehicle to a stop and jumped out with us close on his heels. I am terrified of snakes. I avoid snakes to the extreme of hurting myself to avoid them, and my first question was, “Is it poisonous?” It was not, so I was brave enough to venture a little closer. I was interested because the rest of my team was in such admiration of the snake, and I did not want to be a wimp. My teammates suggested that I touch the snake somewhere far from its head.

They said the scales were dry, not slimy. During this time, Bob had been holding the snake, and my teammates encouraged me to hold it. “No way!” I said. After repeated prodding, I asked, “What will it feel like if the snake bites me?” They told me it would feel like a needle stick or a briar prick. I was very nervous but I finally decided to try to hold it, and Bob handed me the snake. As I reached my hands out to take it, I

was shaking so much you could see it quite clearly. I couldn’t believe it! I was holding a snake, and it was an awesome experience! Then the snake bit me. It had its mouth wrapped around my left forearm! Everyone expected me to drop or throw the snake, but instead I continued to hold onto it, smile, and simply state, “Look, the snake is biting me, and it doesn’t hurt.” Bob held the snake until it let go of my arm and he took control of it again. Everyone was right because the bite was not bad at all. It felt like a needle stick that didn’t last very long. In fact, I have had briar pricks that hurt much more than this. I had endured my first snakebite and not panicked or fainted! As quickly as all of that happened, I began to think it was not real, and I asked if I could try to hold it again. I was just beginning to explore the length of the snake, and it bit me again—TWICE—and I kept my composure through it all! Bob took the snake back, and we decided that both the snake and I had had enough excitement for one morning. Bob placed the snake on a tree trunk and it climbed upward. I was fine as we cleaned



*One of Janice’s snake bites*

*“Everyone expected me to drop or throw the snake, but instead I continued to hold onto it, smile, and simply state, ‘Look, the snake is biting me, and it doesn’t hurt.’”*



*Bob Walker, left, and Janice, right, search for a burrow for the rescued tortoise.*

*“These essential multi-purpose burrows earn the gopher tortoise the distinction of being a “key-stone species,” which means that without the gopher tortoises, many other creatures would not survive and their ecosystem would change dramatically.”*



*"I learned that gopher tortoises have very unique responses to what we would consider the same relocation experiences."*

my snake bites. For someone so afraid of snakes, this event was huge, amazing. I felt as if I had finally come of age or fulfilled a rite of passage.

All this action in a matter of a few minutes, and we had not released the first gopher tortoise yet. We climbed back into the vehicle and proceeded to the release site. To release the tortoises, each of us carried one and walked until we found a burrow. We placed the tortoise on the apron of the burrow facing the entrance.

Some just stayed on the apron, and we gave them a gentle nudge, while others walked right inside. If one stopped in the entrance, we gently pulled on the back edge of the shell to see whether that would encourage movement into the burrow but the gopher tortoises dug their feet into the sand and did not want to budge in either direction. We then walked along the fence line checking for other tortoises or new burrows. We also mended the fence as needed to maintain the enclosure.

This was the pattern of our research. We relocated baby gopher tortoises in the same manner, and we buried eggs in a burrow's sandy apron. To track the gopher tortoises, our methods included live-trapping, personal observations,

telemetry at radio frequencies

matching the tortoises' transmitters, marking burrows with flags and documenting burrow locations with a Global Positioning System (GPS), and recording any remains of tortoise shells. I learned that gopher tortoises have very unique responses to what we would consider the same relocation experiences. Some appeared quite resilient by the way they readily walked around and went from burrow to burrow after

their release. Others were obviously

disturbed by the events. One gopher tortoise, number 56, completely avoided her old burrow after staff replaced her transmitter. She found another burrow and did not emerge for close to three weeks and staff began to wonder if she was ill. (After more observation, they determined that she was not ill.) How do these animals perceive the actions we do to them and how can we reduce potential stressors? Also, gopher tortoises appear very social; from our tracking data, we know that they share burrows and move from one burrow to another. How well do these animals know their neighbors and neighborhood? With each new question my appreciation for gopher tortoises grew.



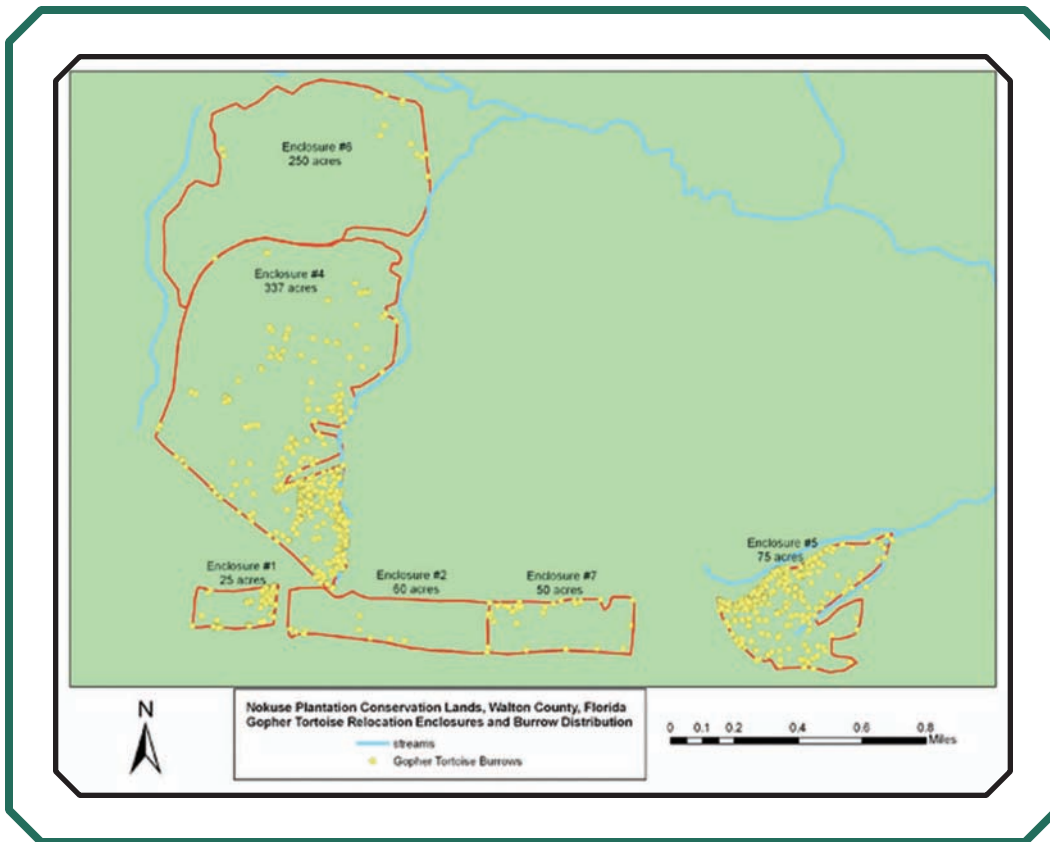
*The gopher tortoise is going ...*

*... going ...*

*... gone into its new burrow!*







*“Gopher tortoises appear very social; from our tracking data, we know that they share burrows and move from one burrow to another. How well do these animals know their neighbors and neighborhood? With each new question my appreciation for gopher tortoises grew.”*

*Diagram of Nokuse Plantation gopher tortoise enclosures*

Each day I enjoyed new and beautiful discoveries. I realized as the days passed that I had changed as the result of meeting that snake. I was not as nervous and skittish about things, and I felt free to explore and learn more. In all, we relocated 45 tortoises and tracked 60 others. We also collected 75 specimens for our dried plant book.

## Results

### Building New Neighborhoods

Due to the gopher tortoise’s low reproductive rate, it will take a minimum of three years to collect sufficient data to determine minimum land requirements and site fidelity. Our current data show that only 10% of the soft-released gopher tortoises dispersed after the silt fencing was removed from two pens, 60-75 acres each. In contrast, based upon compared migration distances, the typical dispersal rate for gopher tortoises that were hard-released is 77%. Presently, Nokuse has several enclosures still in place. Nokuse Plantation staff will continue to collect data as more gopher tortoises arrive and after the staff members remove fencing from other enclosures.



*“The gopher tortoise rotated all the way in the burrow and looked straight back at the camera! It is this type of adventure I want to share with my students and have them feel that same excitement that I felt.”*

*Janice looks inside the tortoise camera’s viewer.*

*“I have already pitched the idea of adding a web link to Nokuse’s web-site for students to “meet” the tortoises. Students can learn about a specific tortoise, their adventures, their movements, and so on. Finally, I want to set up a link that classrooms can use to Adopt-A-Tortoise.”*

*Janice, left, and Bob Walker, right, use the tortoise camera to see inside burrows.*

*“Thanks to Nokuse Plantation, Bob Walker, the gopher tortoises and that snake, I am a braver person and a better teacher. If I had the chance to do it all again, I absolutely would!”*

## Educational Inspirations!

On our last day’s adventure we viewed two gopher tortoises in their burrows! I felt like a five year-old as I watched the screen and saw each gopher tortoise. Then one moved! And moved again—this time the gopher tortoise rotated all the way in the burrow and looked straight back at the camera! It is this type of adventure I want to share with my students and have them feel that same excitement that I felt.

Throughout our time at Nokuse Plantation, my teammates and I collaboratively worked on ideas we want to take back into our classrooms. We all want to set up a wetland area in a plastic pool and incorporate native plants. I plan to do a themed unit on the gopher tortoise.



For teaching classification, I will provide pictures of gopher tortoises instead of cartoon pictures. I want my students to experience nature the way I did by taking my students on field trips to Nokuse Plantation on days gopher tortoises arrive and taking the children through part of the Florida Trail. My teammates and I want our students to participate in web-based blogs about nature and gopher tortoises. We want our students to participate as pen pals with each other. I have already pitched the idea of adding a web link to Nokuse’s website for students to “meet” the tortoises. Students can learn about a specific

tortoise, their adventures, their movements, and so on. Finally, I want to set up a link that classrooms can use to Adopt-A-Tortoise.

## Final Reflections

The time I spent at Nokuse Plantation changed my life. I learned so much and saw so many things I had only heard about before this. I have a deep appreciation and respect for these gopher tortoises and their role in the ecosystem. Thanks to Nokuse Plantation, Bob Walker, the gopher tortoises and that snake, I am a braver person and a better teacher. If I had the chance to do it all again, I absolutely would!

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# Chapter 8

**Watershed, Water Quality...**  
What Goes Into a Pilot Education Program?



**Melissa Rios-Rosier**  
**Wakulla Middle School**  
 Crawfordville, Florida



**Biographical Information**

<p><i>Present Positions</i></p> <ul style="list-style-type: none"> <li>6<sup>th</sup> ESE teacher, Wakulla Middle School</li> </ul> <p><i>Years Teaching</i></p> <ul style="list-style-type: none"> <li>5 in middle school</li> </ul>	<p><i>Reasons I participated in Sc:iii</i></p> <p>I wanted to enhance my science knowledge and create connections that will help me become a more successful teacher.</p>
<p><i>Science Background</i></p> <ul style="list-style-type: none"> <li>Biology classes as an undergraduate</li> <li>No prior field experience</li> </ul>	<p><i>My learning from the Sc:iii program</i></p> <p>I learned that we need to allow our students to be creative and encourage them to ask questions instead of looking for immediate answers. Our students need feel comfortable trying to figure out the process instead of concentrating on the outcome.</p>

*“In 1994 my pediatrician diagnosed my one month old daughter with acquired methemoglobinemia<sup>1</sup> or “blue baby syndrome,” caused by the oxidation of iron by excess nitrate in the drinking water.”*

**Healthy Water Hits Home**

My prior knowledge about water and water quality monitoring was very limited. In 1994 my pediatrician diagnosed my daughter when she was just one month old with acquired methemoglobinemia<sup>1</sup> or “blue baby syndrome,” caused by the oxidation of iron by excess nitrate in the drinking water. The oxidized iron cannot carry the oxygen molecules within hemoglobin in her red blood cells, so the cells do not receive enough oxygen, making the baby look blue.



*The Pilot Education Program Team  
 Front row, Cassie Burnham, left, and Melissa Rios-Rosier, right. Back row, DEP scientist Kristy Butgereit, left, and Diane Driggers, right.*



*“At the start of this project I never imagined that my family and I had been affected by the quality or lack of quality water monitoring.”*



*Melissa tests for pH.*

*“I knew little of the natural resources, and I had no knowledge about the Wakulla watershed.”*

*Field testing kits. At most sites, testing involved wading into the water to obtain samples from various depths.*

*“In an effort to share this information with students, the state environmental agency began developing a water quality-monitoring program for the 7th graders. This was our project.”*

At the start of this project I never imagined that my family and I had been affected by the quality or lack of quality water monitoring. I quickly became aware that the presence of nitrates in the water and vegetables that we used for my daughter’s food may have caused her illness. The impact of knowing that my daughter almost died, possibly due to nitrates in the water and vegetables, put water quality monitoring high on my list of priorities. I am now very aware of the importance of speaking to students about natural resources, water quality and, most of all, teaching the requisites of healthy water. The Project WET International Foundation<sup>2</sup> published a field monitoring guide for “healthy water healthy people,” relevant to my growing interests in this area.

## Starting From Square One

As I began my field experience, the only things I knew about my upcoming experience was 1) water is a natural resource, 2) Wakulla Springs is the center of a debate about the decline of water quality, and 3) the future of the Springs is of great concern to the residents of Wakulla County. I knew little of the natural resources, and I had no knowledge about the Wakulla watershed.

I had neither positive nor negative feelings; my only hesitation was that I did not consider myself to have a strong science background—but this was the main reason to take part in this experience. I did know that citizens expressed great concern in Wakulla and Leon counties about the condition of our watershed and its connection to Wakulla Springs.<sup>3</sup> I also understood the importance of educating people about the causes underlying the deterioration of our water quality and measures to improve these conditions. In an effort

to share this information with students from Wakulla County, the Florida Department of Environmental Protection/Office of Environmental Education (OEE) began developing a water quality-monitoring program for the 7<sup>th</sup> graders at Riversprings Middle School. This was our project. The research involved testing the water quality at various sites in Leon and Wakulla counties using specific parameters developed for Learning in Florida’s Environment (LIFE) Program

by the Florida Department of

Environmental Protection.<sup>4</sup> Our main goal was to locate two appropriate and safe sites for 7th grade students’ field experiences.

My first day in the field at Wakulla Springs was also my first visit to this state park. Initially, I felt a bit uncomfortable because it seemed like the scientists





spoke some foreign language. Nevertheless, I made a commitment to the program, and I knew I would understand and enjoy this soon enough. We worked with three scientists who are very knowledgeable and extremely enthusiastic about education and water quality who want to share all they know about science. As soon as they all started to discuss and debate among themselves, it became very obvious that they didn't share the same opinions but they did share the same love for science and research.

## What Is Water Quality?

To be able to help the Riversprings teachers with their water quality-monitoring program, we first need to have an understanding of the measures of water quality. Water quality is the biological, physical and chemical quality of water as it compares to standards set by US agencies. For example, one of many factors that determine water quality for water to be drinkable is the pH. Drinkable water is also clear and is free of nutrients. Some pollutants in the water are visible but others are not, which creates a need to test for other parameters. As the days passed, I began to discover that I was going to learn more about science than I had previously imagined. One of our jobs was to determine the parameters that the students will measure. We also established the required time, the best location and other essential components for a successful experience. We were quickly introduced to the equipment and began to test water for dissolved oxygen. As a group, we thought that these would have been the only parameters, but the teachers at Riversprings (myself included) had a strong desire to measure the amount of nitrates in the water. We decided that because our goal was to help the students, we needed to seriously consider testing for nitrates.

We traveled to Lake Munson, Ames Sink, Wakulla Springs, McBride Slough, and Leon Sinks (Natural Bridge and Hammock Sink), all part of the Florida watershed and geology in the panhandle of Florida.<sup>5</sup> At each site we evaluated the site for safety, ADA accommodations, bus accessibility, travel time, access to a safe area for water sampling, availability of an area such as a pavilion, picnic tables and/or a bathroom for use as a makeshift laboratory bench to safely test parameters. We tested for parameters that indicate water quality: dissolved oxygen content, nitrate-nitrogen content, phosphate content, pH, temperature (air and water), conductivity, salinity, and transparency. We recorded all the results for these parameters at each site as well as made qualitative observations such as Karst features (i.e., elements of the landscape formed by flowing or pooling



*Cassie Burnham tests for nitrates.*

*“Water quality is the biological, physical and chemical quality of water as it compares to standards set by U.S. agencies.”*



*Melissa tests for dissolved oxygen at Lake Munson.*

*“As the days passed, I began to discover that I was going to learn more about science than I had previously imagined.”*



Collecting specimen samples at Wakulla Springs. From left, Melissa, DEP scientist Jessica Petronis, Cassie Burnham, and behind the pillar, DEP scientist Emily Peffer.

“In order to really know the health quality of the water, we needed to assess the macroinvertebrate population in the water. The presence of certain macroinvertebrates indicates the overall health of water bodies.”

Analyzing benthic macroinvertebrate populations in the spring watershed provides indicators of water quality.

water), weather conditions, cloud cover, color of water, type of water (surface or ground), along with GPS measurements of longitude and latitude.

## Pushing Boundaries → New Ideas

In one of our early days in the field, we learned the elements of our watershed, point and non-point sources of pollution, nitrification cycles and methods of testing for dissolved oxygen and nitrates. This was a very enjoyable day but I felt pushed with my physical and mental boundaries. For this day at Wakulla Springs, Emily Peffer and Jessica Petronis from the Florida Department of Environmental Protection, Bureau of Standards and Special Projects joined us. They were great at explaining that in order to really know the health of the water, we needed to assess the macroinvertebrate population in the water. The presence of certain macroinvertebrates indicates the health of bodies of water.<sup>6</sup> We collected samples from the different habitats for example: sand,

leaves, vegetation, snags (submerged trees or branches), and rocks. This particular testing method is called the *Stream Conditioned Index*. Jessica and Emily explained that ecological communities evolve in response to physical, chemical and bio-geographic processes. On that morning we collected samples and used a magnifying glass to analyze and identify the specimens. Our scientist, Kristy Butgereit, gave us a sheet with different names and pictures of various macro-invertebrates. While Cassie and I sat down to look at our samples, all I could think of was that my 6<sup>th</sup> and 7<sup>th</sup> graders would have a wonderful time collecting these samples. I thought the activity we were doing would be great for them. The abundance and types of organisms we see at Wakulla Springs enables us to know whether or not we are taking care of our resources—such a straightforward correlation, and one the students could see with their own eyes. We could begin to discuss ways in which we could all help and inform our families about the importance of conserving the Springs. This was one of the best days in the field.



Another of our field experiences was a visit to the City of Tallahassee Wastewater Treatment Facility. Dave Worley was our tour guide. While he provided us with some helpful information, I realized that his and my attitudes toward spray fields and their effects on Wakulla Springs were polar opposites.



I may have misunderstood, but I got the impression that he believed the only reason the city stopped fertilizing the crops that the city grew in the spray fields was because the *Friends of Wakulla Spring* sued the City of Tallahassee (and not because there was a negative impact by such activities on the Spring). I am sure that he believes that the measures taken by the city are good enough to protect our Springs. I was happy to have seen the treatment facility—it is much better that the city provides some treatment for the water than having no treatment. As we toured the facility I thought it would be great to take my students to see the different “pools” of water as they moved from one section to the next. I also thought that my students would enjoy a tour of the spray fields and be thinking of ways to improve the condition of Wakulla Springs. They could brainstorm, “What can we do at the spray fields to improve the situation?”



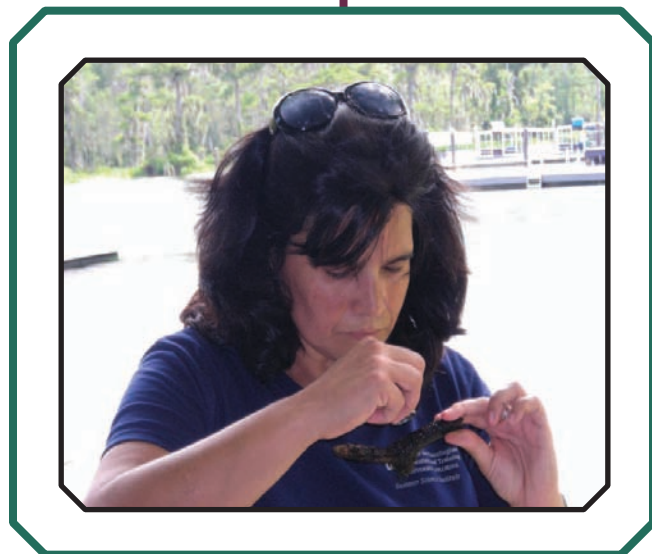
*“On that morning we collected samples and used a magnifying glass to analyze and identify the specimens.”*

*Above and below, Melissa identifies specimens from Wakulla Springs. Many specimens cannot be seen without a magnifying glass.*

## Paradigm Shift

Over the course of our work, I realized that our research question did allow me to learn science through inquiry. In order to put this program together we had to learn about springsheds, watersheds, pollution, parameters and other terms that I would not have ever understood, had I not taken part in this project. I had some wonderful, enriching experiences this summer. I learned about rivers, streams, different parameters, pollution, and most importantly, the impact of humans (positive or negative) on the conditions of our waters. As a child I lived by the ocean and that is really all I knew, but this summer I actually made connections between all those bodies of water and their relationships with each other. For a scientist, this seems obvious, but for me it wasn't because I had bits and pieces of knowledge with no connections. As of today, I can say that I am beginning to understand those relationships and humans' effects on various bodies of water.

As I complete this experience I look forward to the upcoming year and all the new knowledge and experiences I want to share with my students. I have been forced to learn science in a new way, instead of going into books and readings I have had the opportunity to work in the field, ask questions and work through them before determining the answer that we all agree is best. This type of learning, reasoning and inquiry makes teaching with inquiry much easier



*“Over the course of our work, I realized that our research question did allow me to learn science through inquiry.”*





*The scenery at Ames Sink. Like most sites in this study, Ames Sink is beautiful but shows signs of deteriorating water quality. The pink spots on the cypress trees are eggs from an invasive species of apple snail.*

*Eggs from the South American Island Apple Snail on a cypress knee. This animal threatens native species via rapid reproduction, competition, and aquatic plant eradication. It has few predators in Florida. (<http://www.dep.state.fl.us/central/Home/Watershed/snails/Snails.htm>)*

develop, understand, appreciate, and encourage the curiosity and inquisitiveness that our students bring to the classroom. On the day we were at St. Marks Wildlife Refuge we talked about the tide and the relationship with the moon. I thought about an entire thematic unit on the moon. I told Cassie and Diane that we could read a book about the moon during Reading. During Science we could discuss the moon and its effects on the tides, and we could write about our learning during Language Arts. In Math, we could graph any changes. This is just the beginning of a thematic unit.

After participating in the Sc:iii program,<sup>7</sup> I think that I have not only changed the way I will teach but, more importantly,



to incorporate in the classroom. I do believe that this experience has taught me many things, the most important being that students need to feel the experience and be able to come up with questions and not necessarily *answers*.

## Inspiration for the Classroom

As an Exceptional Student Education (ESE) teacher in the state of Florida, I plan to incorporate inquiry in our day-to-day lessons. I think children are naturally curious, and we need to

I have changed the way I approach life in general. I am more apt to ask questions and less likely to expect a quick answer. I have also discovered that inquiry is not about the great lesson plans that take many hours or days to develop, with elaborate experiments and hands-on activities. Instead, inquiry is more about enticing the students and creating an environment that is flexible and safe, an environment that allows the student to make mistakes and learn from them. I would like to create a classroom in which students would approach their mistakes as a point of reference instead of as a failure.

We did not think of the great open plains, the beautiful rolling hills, and winding streams with tangled growth as “wild.” Only to the white man was nature a “wilderness” and only to him was the land “infested” with “wild” animals and “savage” people. To us it was tame. Earth was bountiful and we were surrounded with the blessings of the Great Mystery.

Chief Luther Standing Bear of the Ogala band of Sioux<sup>8</sup>

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Melissa recording the phosphate and nitrate data



# Chapter 9

## Experiencing the Culture of Science

Two Teachers' Quest to Experience Science in the Real World





**Cindy Padgett**  
**Roulhac Middle School**  
 Chipley, FL

**Douglas Smith**  
**Vernon Middle School**  
 Vernon, FL



**Biographical Information**

<p><b>Cindy Padgett</b></p> <p><i>Present Positions</i></p> <ul style="list-style-type: none"> <li>6<sup>th</sup> grade science teacher, Roulhac Middle School, Chipley, FL</li> </ul> <p><i>Years Teaching</i></p> <ul style="list-style-type: none"> <li>13 years in middle school</li> </ul> <p><i>Science Background</i></p> <ul style="list-style-type: none"> <li>Currently completing graduate work at Florida State University</li> </ul>	<p><i>Reasons I participated in Sc:iii</i></p> <p>I participated in this program because it offered numerous opportunities for me to connect with scientists in various fields and ultimately complete my own scientific fieldwork.</p> <hr/> <p><i>My learning from the Sc:iii program</i></p> <p>I learned to question and troubleshoot during an investigative experience. As a result of this experience, my colleagues and I were able to articulate with one another about our educational goals for using inquiry in the classroom. The impact of these experiences was such that I truly felt like a real scientist!</p>
<p><b>Douglas Smith</b></p> <p><i>Present Positions</i></p> <ul style="list-style-type: none"> <li>5<sup>th</sup> grade science teacher, Vernon Middle School, Vernon, FL</li> <li>Member, National Science Teachers Association</li> <li>Member, National Education Association</li> <li>Member, Florida Farm Bureau</li> </ul> <p><i>Years Teaching</i></p> <ul style="list-style-type: none"> <li>1st year in middle school</li> </ul> <p><i>Science Background</i></p> <ul style="list-style-type: none"> <li>Basic Earth Science</li> <li>Astronomy Course</li> <li>Elementary Science Courses</li> </ul>	<p><i>Reasons I participated in Sc:iii</i></p> <p>I, being a first year teacher, sought more science content knowledge. I also wanted to work with veteran science teachers. This was a great way to get exercise both physically and mentally over the summer. The thrill of doing actual scientific field work was a big draw.</p> <hr/> <p><i>My learning from the Sc:iii program</i></p> <p>I learned to take a research question and use the inquiry method to address/produce a valid answer to that question. During my field experience I gained an understanding of methods 'real' scientists use to solve problems, collect data, interpret data and share with colleagues.</p>

*“Classroom science is full of facts that are usually memorized by the learner, but lacks any relevance necessary to understand its usefulness.”*

## Introduction

Both Cindy and Doug participated at the same research site with four other practicing teachers at Falling Waters State Park in Chipley, FL and their team represented the 5<sup>th</sup> through 10<sup>th</sup> grades. Since these two practicing teachers worked together so extensively, this chapter became a conversation between the two of them, as they collaborated in the field and as they will continue to do in their classrooms within the same county.

## Classroom Science: A Teacher's Worst Fear

Cindy: It is important that I understand the way actual scientists think and conduct their work in the field. In the classroom this focus can be lost and a separate realm of science is created—"classroom science." Classroom science is full of facts that are usually memorized by the learner, but lacks any relevance necessary to understand its usefulness. Students typically dread classroom science and many teachers unconsciously perpetuate it. Whether from pressures like the Florida Comprehensive Assessment Test<sup>1</sup> and school grades or other factors such as childhood poverty and lack of parental support, many teachers look in the mirror one day and realize that their worst fears have come true. This was the case for me. However, I found my way of escape from this low place. The Panhandle Area Educational Consortium (PAEC) and Florida State University (FSU) introduced me to the concept of teaching science by using inquiry and their Sci:iii program<sup>2</sup> enabled me to complete an exhilarating science fieldwork project at Falling Waters State Park (FWSP) in Chipley.

*The Falling Waters State Park Team relaxes after a day of field work. Front row from left: Teacher mentor Caren Prichard, Cindy Padgett, Greta Draayom and Lenora James. Middle row: Doug Smith and Park Service Specialist Scott Sweeney. Back row: Rodney Hubbs and Johnny Booth.*



*Invasive species like Lygodium japonicum, "Japanese climbing fern," destroy native habitats.*

## Collaboration: A Teacher's Dream

Cindy: This opportunity allowed me to finally work with my peers in a setting that fosters inquiry and necessitates communication. We were finally working together instead of working in our own rooms in separate buildings teaching different grade levels. I was excited about this because I hoped we could incorporate more inquiry-based lessons into our current teaching AND in a continuum across our grade levels. I have always been too intimidated to implement this teaching style on my own.

The park is within five miles of our school site and very familiar to our student population. Its location is also close enough for planned field trips and implementation of environmental class projects. We met with our supervising scientist, Park Service Specialist Scott Sweeney, and we were asked to investigate two areas of interest. The first was evaluation of the exotic plant removal plan currently in place at FWSP and to determine its effectiveness.

Doug: Exotic species are those plants or animals that are not native to Florida, but were introduced as a result of human-related activities. In the 1920s a commercial nursery on this land introduced many exotic plant species from Eastern Asia, before FWSP was established. That nursery brought in non-native plants such as Japanese climbing fern (*Lygodium japonicum*), Chinese privet (*Ligustrum sinense*), Chinese tallow (*Sapium sebiferum*), and mimosa tree (or silk tree) (*Albizia julibrissin*). These exotic species<sup>3-5</sup> choke out the native plants that are part of the park's habitat and food chain. The plan calls for removal by prescribed fire every three years, the use of herbicides and prompt removal of all exotic saplings.

Cindy: The second area to investigate was whether a viable gopher tortoise population resides at FWSP. The rationale for these investigations stems from attempts to retain features of "real" Florida in the state parks, as presented in the park's brochure.<sup>6</sup> The appeal to the public is the invitation to enjoy and interact with native Florida. Therefore, it is crucial that foreign species do not upset the natural balance of the native ecosystem.

## Preconceptions

### Exotic Plants

Cindy: I did not realize the detrimental effects of exotics on the "real" Florida before my fieldwork. In the park the exotics seemed to be under control, and I was not convinced that the problem was as big as our scientist was implying. Learning about exotics allowed me to increase my knowledge of native plants, which was more limited than I realized.

Doug: Being a non-Floridian, I had no idea about exotic plants in Florida and the effect on native plants and habitats. The exotic species removal plan educated me on the need to eradicate these invaders. The presence of exotic plants adversely affects the long leaf pine forest. The exotics can grow freely in the park without any species of animals eating them. Most exotics shade and out-compete many other species and, once established, are very difficult to remove.

### Gopher Tortoises

Cindy: I was unaware of the dangers faced by the gopher tortoise populations. My father works as a safety inspector for a natural gas pipeline company. In his line of work he has dealt with the gopher tortoises and the legal issues of safely removing them during the construction process. His experiences influenced his perspective, and thereby influenced me. As a result, I entered this research project with

*"We were asked to investigate two areas of interest. The first was evaluation of the exotic plant removal plan currently in place at FWSP and to determine its effectiveness."*



*Longleaf pine forest four months after a controlled burn*

*"I did not realize the detrimental effects of exotics on the 'real' Florida before my fieldwork."*



*Another invasive species, *Albizia julibrissin*, "mimosa tree" or "silk tree" (<http://www.fast-growing-trees.com/Mimosa.htm>)*



*“I knew nothing about gopher tortoises, which heightened my excitement for collecting data about them.”*

my father’s misconceptions that gopher tortoises were plentiful. However, Mr. Sweeney was not convinced that there was an adequate gopher tortoise population in the park despite several gopher tortoise sightings.

Doug: I knew nothing about gopher tortoises, which heightened my excitement for collecting data about them. All I knew was that there had never been a formal survey of the gopher tortoise population done before in the park. I soon realized that was just as important as the removal of the exotics.



*Herbicides used to remove invasive exotic plants.*

*“Weak solutions are used because they do not damage the plant’s vasculature as fast, enabling the herbicide to reach the roots.”*

*Johnny Booth, left, and Doug with herbicide-sprayed Japanese climbing fern*

## Teachers’ Voices From the Field

### Exotic Plants

Cindy: We surveyed the landscape to determine which species of exotic species were present in each land tract. Altogether we found the same four exotic species Doug mentioned earlier. The first was Japanese climbing fern, with delicate lacy leaves that are a pretty shade of green. It creeps along the ground and wraps around anything in an effort to climb toward the sky.<sup>3</sup> If left unattended, it will completely cover everything with a frilly canopy.<sup>4</sup> This species propagates via rhizomes and spores on the back of its leaves.<sup>3</sup> The second species was Chinese privet or Chinese ligustrum. It is classified as a shrub and, if left alone, grows close together forming an impenetrable thicket<sup>4</sup> that can grow in diameter to a 2-3 inch tree. Thus privet is often difficult to eradicate. The third exotic is Chinese tallow or “popcorn” tree. This species seems to thrive everywhere.<sup>4</sup> We identified it in hilly areas, low-lying drainage areas and along creek beds. It aggressively grows back from the stump unless it is chemically treated. The last exotic is the mimosa tree or silk tree.<sup>5</sup> This tree is called “mimosa tree” because its foliage resembles plants in the distantly related genus, *Mimosa*.<sup>7</sup> This tree has a memorable pink fluffy bloom and delicate compound leaves that close at night. The tree’s fragrant bloom and its reputation as a fast-growing tree attract landowners to purchase or maintain them instead of removing them from their properties.<sup>8</sup>



### Methodology for Exotic Plant Removal

Doug: Mr. Sweeney advised us that due to the size of the park and the amount of available labor, it would be best if we all worked together as one big team on both projects. At first I was disappointed, thinking that I would now be ‘weeding’ the park and not becoming the gopher tortoise expert that I knew I could be. That feeling soon changed.

Cindy: The methods of removing exotic plants depend on the structures of the plants themselves.

Doug: The Japanese climbing fern got foliar spraying with Rodeo®. The woody plants got the ‘hack & squirt’ treatment: cut down the plant and squirt Garlon® on the stump. At first I was apprehensive about handling the chemicals because my wife is five months pregnant, and I want to have more healthy children, but I did some research on my own and found some additional information that gave me piece of mind about the safety of the herbicides.

Cindy: I felt intimidated mixing the chemicals after reading the labels on the herbicides. To treat the Japanese climbing fern we mixed a solution of 3% glyphosate or (Rodeo®). Rodeo® is similar to the more familiar chemical, Round-Up®; however, Rodeo® is the preferred chemical for our work because it is safer to apply in areas that have potential to drain into local waters, such as ponds, rivers, and aquifers. This weak solution is applied directly to the foliage of the plant, gets absorbed and slowly infiltrates the root system. Weak solutions are used because they do not damage the plant’s vasculature as fast, enabling the herbicide to reach the roots. To treat the woody exotic species like tallow, popcorn and mimosa, we mixed an 18% solution of triclophyr or (Garlon 4®) with Kinetic®, a sticking agent, to hold the poison on the plant longer. First, the woody stem is cut and then the stump is sprayed generously with the Garlon 4® solution. Sometimes small saws are necessary to cut through the plant’s stem.

Doug: Field Day Two—D-Day: At 0800 we met at the park’s workshop and herbicide shed. The squad prepped for the invasion of the exotic plants. The team mixed four gallons of 3% Rodeo®, which was divided between a 3-gallon backpack sprayer and a one gallon hand sprayer. A small 32 oz bottle of Garlon® was prepared for any woody plants like Privet. I felt badly about being dubious of the chemicals, I chose to be the flagman. My job was to flag the plants with a small orange flag for identification and location of the exotics.

The team moved out to Area A. We were at 15-20 yard intervals so that we could methodically cover the area. Initially, I had trouble identifying the plants, but one only needs to train one’s eye to see the features of the plants and almost immediately one sees a lot of those plants, like the road trip game I played as a kid, trying to pick out all the Volkswagens and then noticing more and more VWs everywhere.

Voices shouted as the enemy was discovered. “I got one over here!”, “There’s a whole bunch!” or the infamous “Here’s a scad of the stuff!” The armed squad members immediately responded to the scout’s cries. The sounds of pump handles and the nozzles filled the hot morning. Smells of pine needles and herbicides filled the battlefield. From the looks of



*Japanese climbing fern often requires multiple herbicide treatments for successful eradication*

*“Usually, treatment is reapplied a week later. This second treatment is more effective because the surviving plants are easier to see through the brown mass successfully destroyed in the first spraying.”*



*Drymarchon corais couperi, “Eastern indigo snake” is one species that may utilize the gopher tortoise’s burrow. ([www.baysoundings.com/fall03/tortoise.html](http://www.baysoundings.com/fall03/tortoise.html))*

*“The gopher tortoise gets the distinction as a keystone species because its burrow serves as a sort of community safe house” for some 300 to 400 other species.”*



*Rana areolata aesopus, “Gopher frog” frequently uses the gopher tortoise’s burrow as its home. (www.baysoundings.com/fall03/tortoise.html)*

*“Careless construction reduces available lands, blocks foraging paths, buries burrows and makes the keystone species disappear.”*

*Podomys floridanus, “Florida mouse” or “gopher mouse” also lives in the gopher tortoise’s burrow. (www.baysoundings.com/fall03/tortoise.html)*

the scattered entrenched enemy positions I knew it would be a long day, perhaps ‘longest day’ for our team. “The Longest Day” is a World War II movie about the D-Day invasion of Normandy. A good quote from that movie for this day was said by Robert Mitchum as Brigadier General Norman Cota: “Only two kinds of (exotics) are gonna stay in this area; those that are dead and those that are gonna die.”

We marked with orange flags three bunker locations, or plots, so we could find them days later and check for evidence of our strikes. The plots were labeled A, B, and C. Photographs were taken for the “Intelligence Department” (Mr. Sweeney) to review.

Cindy: In other words, we began first by walking land tracts that were labeled and mapped according to the currently used prescribed burn plan. We picked a land tract and walked it in a line and treated exotics as we canvassed the tract. Exotics were identified, treated, photographed and tallied on a record sheet provided by the park ranger.

Doug: Field Day Three—D-Day plus three: We returned to the battlefield to check on the results of our efforts. According to our Intelligence Department, Plots A and B needed to be re-sprayed.

Cindy: Usually, treatment is reapplied a week later. This second treatment is more effective because the surviving plants are easier to see through the brown mass successfully destroyed in the first spraying.

Doug: Later in day three the team located 15 gopher tortoise burrows.

## Gopher Tortoises: The Keystone Species of the Long-Leaf Pine Forest... but Does Man Care?

Cindy: The gopher tortoise gets the distinction as a keystone species because its “burrow serves as a sort of community safe house” for some 300 to 400 other species.<sup>9</sup> Animals like northern bobwhites or rabbits may use the burrow to escape from predators such as hawks and foxes. Vertebrates and arthropods also depend on the burrows for survival. For these animals, gopher tortoise burrows provide protection from abiotic elements like the sun, fire, and extreme temperatures.

Without the security of the burrows many of these animals would not survive. Once again I am faced with the realization of the delicacy of an ecosystem and its inhabitants.



Doug: The gopher tortoise is a *Species of Special Concern*, as listed by the Florida Fish and Wildlife Conservation Commission<sup>10</sup> and the Gopher Tortoise Conservation Initiative,<sup>11</sup> meaning that



state laws protect them. It is illegal to touch or move a gopher tortoise. Man is a potential predator, as well as large dogs and coyotes. The main threat to the gopher tortoise is man with a bulldozer. The humans encroach on the gopher tortoise's habitats, building new homes, malls, and roads on the lands that were once the gopher tortoise's home. Careless construction reduces available lands, blocks foraging paths, buries burrows and makes the keystone species disappear.

Gopher tortoises play a major role in their environment. Besides providing their burrows, gopher tortoises aid in spreading seeds of flora/plants throughout the habitat in their droppings. These new native plants in turn grow, provide food, and shelter in return to other co-inhabitants that share the land with the gopher tortoises.

Gopher tortoises are herbivores, and depend on healthy vegetation. The need for our team to remove non-native plants became apparent once I learned that the invasive plants grow thick and block the sun. The exotic plants stop the native wiregrass and Bracken fern from growing. Those native plant species provide a staple source of food for the gopher tortoise.

Cindy: Gopher tortoises can be found in habitats such as longleaf pines, turkey oak sand hills, pine flatwoods, pine savannahs, coastal dunes, barrier islands and oak scrubs.<sup>12</sup> There are two conditions that are necessary for the burrow location; the burrow mouth must receive sun part of each day, and the burrow must be constructed in soils that drain well to prevent flooding. The shape of the burrow hole is arched, like the gopher tortoises themselves; holes that are round do not belong to gopher tortoises. The width of the opening indicates the length of gopher tortoise that built it, much like the measurement of our bodies along our arms from fingertip to fingertip indicates our height. Gopher tortoises may dig more than one tunnel and move from one to another at different times of the year based on the supply of food available. During the times that a burrow is unoccupied, juvenile gopher tortoises may make it their home.

### Methodology for Burrow Identification and Study—Innovation at Its Finest!

Cindy: Armed with the land tract maps, we systematically formed a walking line to search for burrows. We identified burrows by the characteristic sandy apron, or mounded area surrounding the entrance, and classified them as active, inactive or abandoned. If an apron is fresh, the sand is slightly disturbed but is clear of leaf litter around the mouth of the burrow. It means the burrow is active.



*“If an apron is fresh, the sand is slightly disturbed but is clear of leaf litter around the mouth of the burrow. Active burrows are the easiest to identify because of their clean apron.”*

*An active burrow. Fresh sand spray and a clean entrance indicate a current resident*

*“Another interesting discovery was the distribution of burrows: in tract B, which consists of a large hillside, we saw that our orange burrow tags went up the hillside in a line!”*



*Measuring the gopher tortoise's carapace*

*Prototype of home made tortoise camera*



*“We discovered that the tunnels were not always straight holes into the ground, but holes with many twists and turns to the right or left.”*

appearance, and documented each burrow’s location using a Global Positioning System (GPS) unit. Another interesting discovery was the distribution of burrows: in tract B, which consists of a large hillside, we saw that our orange burrow tags went up the hillside in a line!

Doug: Field Day Four: The team continued the gopher tortoise reconnaissance in area A. We flagged, plotted measurements and GPS coordinates for six new burrows (#16-21) and the heat continued to beat us down. During a much needed water break, Mr. Sweeney approached the team, and he was holding a live male

gopher tortoise, providing us an opportunity to learn about the “plastron,” or belly side of the gopher tortoise’s shell. Male plastrons are concave and female plastrons are perfectly flat. We recorded the measurements of his shell and his burrow, and the burrow’s location.



*The Falling Waters State Park team prepares their hand made tortoise camera equipment for use*

Cindy: While these findings were interesting, they involved observation of only the burrow exteriors and we wanted to see the burrows on the inside as well. We decided to build a camera system to view the burrow’s interior and its inhabitants. I purchased an inexpensive Phillips® PC camera designed for web video chats and two 20-foot booster cables to connect the camera to a laptop

computer. I also purchased two flashlights and fixed them to the head of the camera. The camera assembly involved constructing a PVC® head for protection and wrapping the computer cables with a flexible core to provide stability and guide it down the burrow. After assembly, we tested the apparatus on an active gopher tortoise burrow. We discovered that the tunnels were not always straight holes into the ground, but holes with many twists and turns to the right or left. This discovery explained part of our difficulty in maneuvering the camera through the tunnel system. The camera head also would pack dirt in front of the lenses and bury the camera in the dirt instead of continuing through the hole. To solve this problem we added an attachment to the bottom of the camera to act as a slide and



reduce the friction of the dirt. At the time, the only materials we had available were the odd supplies in our vehicles.

Doug: The whole team began to brainstorm about ways to modify the camera. We used the scientific method and trial and error.

Cindy: We cut a plastic Solo® plate and pieced together the attachment with duct tape. We laughed because the situation reminded us of the television show MacGyver. This modification was not successful so we removed the plastic plate and taped a Tupperware® lid in its place. The rigid plastic lid was more supportive than the thin plastic plate; the lid also had a rigid lip around the edge that allowed it to glide over the dirt floor of the tunnel, but we still had problems keeping the camera in the upright position and scooping dirt within the tunnel. After much thought and discussion among team members we added a second Tupperware® lid to the camera system. Now, the camera's position was not an issue and the scooping up of additional sand was dramatically reduced.

Doug: Field Day Five—Gopher Tortoise Cam: The day started just as any ordinary day. I volunteered to be the one to introduce the cam into a burrow and I sat on the pine needle covered ground. I groaned and sweated in the morning heat. Chiggers were everywhere, and I was advised to dust garden sulfur on my boots, socks, pant legs and arms to prevent the impending doom of itchiness. I complied, though I had never used the smelly yellow dust before and my manly pride was too much to use an organic insecticide. Pride goeth before a fall, and fall I did.

Seeing no gopher tortoise in that burrow, we moved onto Area B. While walking along the trail I began to get light-headed and I became queasy. I started to feel fatigued. What was happening to me? Johnny was the first one to notice my situation: "Doug, you don't look so good, are you OK?" I came back with, "Nope." The one word reply caused quite a stir with the team as I gradually knelt down on one knee for a break.

After a quick drink of cool water, I popped back up, only to sense a colossal throbbing at the back of my head. I looked down at my sweaty arms and noticed a red rash. I also noticed the yellow powder in the sweaty creases of my elbows. Sulfur-Sulfa- hmm. I am allergic to Penicillin and Sulfa drugs. Could this be a reaction to the Sulfur dust or was this some form of espionage? I went home, stripped, threw on some swim trunks and leaped into our pool. Following my decontamination I dressed and picked up some sandwiches for my teammates continuing the gopher tortoise quest in the heat. During lunch we discussed allergies and what could have possibly happened. How could simple garden



*Johnny Booth searches for a burrow entrance*

*"The whole team began to brainstorm about ways to modify the camera. We used the scientific method and trial and error."*



*INNOVATION! The working version of the home made tortoise camera*





*Dead Japanese climbing fern*

*“In one case, the camera was tapping on something hard and it took a few moments before we saw clearly that we were tapping a gopher tortoise on its shell!”*

sulfur dust cause a reaction? Further research on my part led to a better understanding that I had an allergic response to the garden sulfur dust. My being allergic to Penicillin and Sulfa drugs may have contributed to my hypersensitivity, not a fellow teammate trying to kill me.

Field Day Six—Gopher Tortoise cam, third time is a charm: The team revisited Area B and probed three burrows, which yielded two active burrows that we documented with photographic evidence. Enough science talk, the camera WE designed worked! We got great pictures of two live gopher tortoises in their burrows. The team cheered and jumped for joy—we became real scientists that day! Not only that, but on Days 5 and 6 we found a total of 24 burrows (#22-45)!

Cindy: Our camera was fully functional and we were actually able to view active burrows! In one case, the camera was tapping on something hard and it took a few moments before we saw clearly that we were tapping a gopher tortoise on its shell! A realization that we did not make until later was that our camera system ended up looking like a blue gopher tortoise. The two lids attached together around the camera head formed a shell-like structure that mimicked the carapace (top) and the plastron (bottom) of the gopher tortoise. We all had a good laugh about our ingenuity; we had unwittingly managed to learn about nature by mimicking its superior design.



*The Falling Waters State Park Team heads out for a day of field work. From Left, Greta Draayom, Rodney Hubbs, Cindy, Doug, Johnny Booth, and Lenora James*

## Teachers' Wrap-Up of Research

Doug: Field Day Seven: Exhaustion is the word of the day. Area A's Rodeo® application was rechecked and documented. The first burrows (1-15) found in Area A were finally plotted via GPS thanks to fresh batteries; I wish changeable batteries were made for people too. Ten new burrows were located in Area A during the recheck (#46-55).

Friday the 13<sup>th</sup> was not a bad day; no injuries to the team. Three small holes/burrows were discovered and measured only 3" x 4". Evidence of a juvenile gopher tortoise adds to the validity of a viable population. Later, Rodney discovered a live juvenile gopher tortoise! The baby was measured and released. A team member noted that the juvenile was much more colorful than the adults. I guess with age we all lose some color.

Field Day Eight: The team checked the climbing fern plots A, B, and C. We photographed and recorded plants—brown, wilted, deceased and no sign of recovery. The invasion was complete and the enemy was finally defeated here.

Our team continued through Zone A to monitor the gopher tortoise burrows. It rained during the last two days and the park got 1½ to 2 ½” of the wet stuff. At least five gopher burrows seemed to be ‘washed out.’ Do the burrows flood? Teammate Cindy advised that gopher tortoises dig the burrows at a 30° angle with a kind of ‘water trap.’ That made me think of the Viet Cong tunneling strategies during the war.



*An abandoned burrow. Note the vegetation growing at the entrance*

## Results

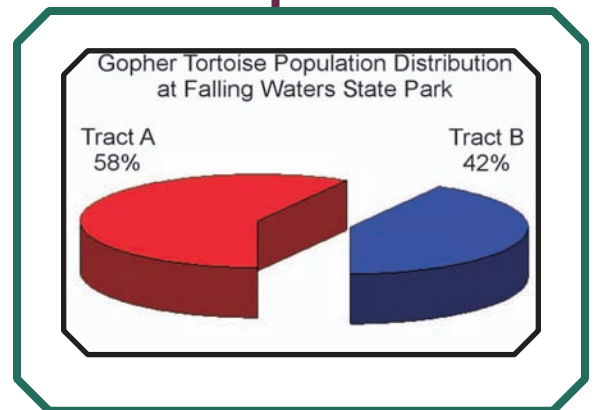
### Exotic Plants

Cindy: According to our data, we eradicated a total of 2,300 Japanese climbing ferns, 15 Chinese privet, three Chinese tallow trees and no mimosa trees. These data clearly show that the Japanese climbing fern was the most abundant exotic plant species at FWSP. The small numbers of woody exotics suggest that the herbicide management plan is working effectively at the park. However, outside the 168-acre park and along its borders, Chinese privet, tallow and mimosa can be seen thriving in vast numbers. These areas owned by private landowners are not currently managed for exotic removal and therefore resemble a tropical forest rather than the native upland pine forest or hardwood hammocks that comprise the “real” Florida. The vast quantities of exotics that exist immediately outside the park are evidence of the excellent job the park personnel are doing. Unfortunately for Mr. Sweeney, the task of exotic removal at Falling Waters State Park will be a constant battle. Although the management plan is currently effective, he knows the future of the park depends on the ability of park personnel to educate the public about the growing problem.

*“The vast quantities of exotics that exist immediately outside the park are evidence of the excellent job the park personnel are doing.”*

### Gopher Tortoises

Cindy: We documented a total of 55 gopher tortoise burrows at FWSP on both land tracts, A and B. Tract A consists of 55 acres of upland pines with a vast number of potential forage species. In this tract the gopher tortoise has various types of wiregrass, peas (milk and butterfly), blackberry, dwarf blueberry, seagrape, similax, bracken fern, and peppergrass to eat. Of the 55 burrows 32 were located in this land section. The most interesting observation we made here was the sighting of a juvenile gopher tortoise and several juvenile burrows. In addition, we found an adult gopher tortoise foraging on the planted centipede grass alongside the black top road. The park ranger pointed out that the grass strip lures the gopher tortoise out of the forest to forage and places it in danger of being struck by vehicles heading to the pavilion. Tract B consists of 45 acres with similar forage material that is sparse. In this area, we found 23 gopher tortoise burrows, and this was the location that we discovered the linear pattern of the burrows going



*Gopher tortoise population survey results*



*A juvenile gopher tortoise*

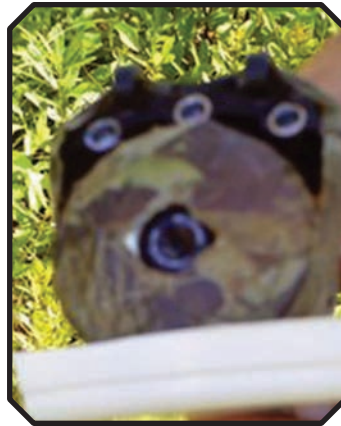
*“Due to the difficulty of locating the burrows under the foliage, it is reasonable to believe that the gopher tortoise population could be larger.”*

*First adaptation to the home made tortoise camera*

up the hillside. Determining the number of gopher tortoises mystified us. Gopher tortoises are very social creatures and can use several burrows, which makes estimating gopher tortoise populations from the number of burrows difficult. Biologists use two different formulae in order to calculate the number of gopher tortoises.<sup>12</sup> One method calculates the projected number of gopher tortoises by adding the number of active, inactive and abandoned burrows, and multiplying the sum by 0.67. Our raw data showed 37 active burrows, 17 inactive burrows and one abandoned burrow. Using this method, we calculated an approximation of 37 gopher tortoises in FWSP. The second method takes the total number of all gopher tortoise burrows and divides

by two. Using our data, this method would yield an estimate of 28 gopher tortoises. Another interesting figure states that the gopher tortoise carrying capacity is approximately 1-3 gopher tortoises per acre.<sup>9</sup> Based on this information, land tract A could carry 55-165 gopher tortoises and land tract B could carry 45-135 gopher tortoises. This information makes me question the total number of gopher tortoise burrows found. I wonder if our observations were affected by our fatigue, underdeveloped observational skills and lack of manpower.

Doug: Other evidence of a viable gopher tortoise population includes the various burrow entrance sizes that indicate a varied adult population plus the sighting of a juvenile gopher tortoise in land tract A. Due to the difficulty of locating the burrows under the foliage, it is reasonable to believe that the gopher tortoise



population could be larger. It would be great to continue this research by monitoring the current and future burrows. Perhaps we can utilize some of our students to facilitate this continuing research need.

## Connections Between Exotic Plants and Gopher Tortoises

Cindy: One of the most frustrating concepts for me to grasp during the summer fieldwork was the interconnectedness of an ecosystem.

For example, a small change in one area of the ecosystem can influence or determine the future of the entire system. This was the topic of many discussions as we walked through the park with Mr. Sweeney. We discussed questions like this one: If exotics like Japanese climbing fern are left to propagate, will they take over? Yes. Over time the fern will form a massive canopy that will smother out native species by decreasing the amount of light and growing room on the forest floor. Animal species like the gopher tortoise that feed on these native plants will not survive. The thick fern canopy would also impede the gopher tortoise from maneuvering through the forest and force it to seek food



and shelter elsewhere. This seemingly small change results in a shaded canopy region that provides a more suitable habitat for woody plants like oaks and sweet gum trees to thrive. Unlike the evergreen pines, these deciduous trees drop large leaves that accumulate on the forest floor in a thick layer. Ironically, this leaf layer does not burn as efficiently as the native forbs and grasses of the upland pine forest. As a result, natural fires that normally occur in spring to stimulate grasses and forbs to flower and release their seeds are now suppressed and no pot ash from burned plants rich with phosphorous, nitrogen, and other nutrients is available for new plant growth.<sup>9</sup> It was discussions like these that helped me understand the degradation of Florida's native habitat.

## Conclusions

Cindy: As I reflect on the amount of knowledge that I learned this summer I was reminded that I did not have to write and memorize 25 vocabulary words, complete section review questions and ace a chapter test to learn. So how did I manage to be so productive at a time normally set aside for sunbathing and sipping cool drinks at the poolside? Four simple words can explain: collaboration, immersion, inquiry, and innovation. Although these words sound simple enough, the concept behind them is colossal.

Curiosity inspired us to assemble our gopher tortoise camera and I distinctly remember feeling a huge sense of pride in the construction of my prototype camera. I could not wait until we tested it in a real burrow. In the field it did not take long to experience the aggravations of failure as the PVC® head buried itself in the dirt instead of continuing through the tunnel. However, the challenge brought out the best in us. We bounced ideas off each other and gave elaborate descriptions of each idea and potentials for success. This is the type of discussion a teacher yearns to hear from students, and it is not achieved by saturating the learner in information, but through the power of curiosity and the thrill of solving a real world problem. This experience driven by our curiosity was innovation in action! This participation by my peers was wonderful because it gave us an opportunity to experience first hand the give and take our students deserve to experience in our classrooms on a daily basis. Now we can strive together to bring similar experiences into the classroom more often and continue the tradition vertically from middle school to high school classes. I believe this is important because a strong support system is needed if we were to successfully implement a new teaching practice. I am confident that as a collective science team spanning 5<sup>th</sup>-10<sup>th</sup> grades, we will be successful with inquiry-based lessons.



*"It would be great to continue this re-search by monitoring the current and future burrows."*

*Yard stick invention by the Falling Waters State Park Team for measuring burrow entrances. Doug demonstrates its use, note the pink rubber band serving as the "hinge."*

*"I did not have to write and memorize 25 vocabulary words, complete section review questions and ace a chapter test to learn."*

*“The field experience has taught me to think like a scientist and to ask why, how, when, where.”*

Doug: “Make and Take” is a term used to describe an activity that teachers do at the end of an in-service or seminar. Teachers complete a hands-on project or lesson before leaving. They physically *make* the product from the lesson and *take* it back to their classrooms. This summer project has filled my basket full of knowledge and ideas to take back to the classroom. The field experience has taught me to think like a scientist and to ask why, how, when, where. Mr. Sweeney gave us the research question and turned us loose, with no direct instruction. Through inquiry the team developed a strategy for locating and documenting the gopher tortoise population.



*The team’s method of visualizing tortoises with their camera.*

*“During our project, our team had many discussions during our snack breaks that established the groundwork for a collaborative network.”*

I plan to take back to my classroom the simple information about exotic plants taking over Florida’s habitats. I did not have any knowledge about the problem, and I am sure my 5<sup>th</sup> graders do not as well.

## Educational Implications

Doug: Group work is a challenge for the classroom teacher and many teachers avoid using it. Most think that only the student’s social skills would be enhanced by group work. I used to feel that way. Reflecting back on my prior experiences with group work, I recall there being an unequal distribution of labor and skills. I experienced this not only in grade school but also at the university level. It always seemed like one person in the group did most of the work.

Our team was not that way at all. We were a great group of people! We were a heterogeneous crowd. There were three women and three men. The six of us teachers represented the 5<sup>th</sup> grade through the 10<sup>th</sup> grade, and we all worked very well together. There was a natural leader, a data collector, an ‘out of the box thinker,’ a raw labor person, and a caring nurturer. Jobs were not assigned, we as team members each stepped up and did the jobs that needed to be done.

Cindy: During our project, our team had many discussions during our snack breaks that established the groundwork for a collaborative network that would provide crucial support for one another in the coming year for creating an inquiry-based curriculum that continues from one grade to the next. I will use the learning cycle format to introduce a problem-based lesson regarding land use and the gopher tortoise to help students improve their inquiry skills:

**Invitation:** A letter from the superintendent’s office will be read to the class describing the purchase of a 100-acre land tract to build a new school. However, the letter reveals that during the groundbreaking ceremonies several gopher tortoise burrows were discovered. As a result of these unexpected discoveries the school board and superintendent will have a public meeting to inform the public and discuss solutions on the matter.

**Exploration:** Students will discuss both the needs of the gopher tortoise and a new school. Students will brainstorm to generate a KWL chart including

important questions that school board members might consider in solving this problem. (KWL<sup>13</sup> stands for “What do you **K**now? What do you **W**ant to know? What have you **L**earned? These questions are used to help steer and monitor student learning.)

**Concept Introduction:** Students will work in groups to explore the issue of land management practices in conjunction with the identification of a threatened species. Students will also research the gopher tortoise and determine the factors that result in its threatened status. Information will be shared in a classroom forum. The following website will provide students with the background information about gopher tortoises and legal management practices: [www.ashtonbiodiversity.org](http://www.ashtonbiodiversity.org)

**Application:** Students will devise a plan to meet both the needs of the local school district and maintain a viable population of gopher tortoises on the same property. Students will present their plans to a fictitious superintendent and panel of school board members. (Guest actors will be invited into the classroom for this event).

Doug: During this research experience, I learned about the word, “**articulation.**” I had never heard the word spoken in the educational field. The word **articulation** means to work as a team in sharing ideals, strategies, and course curricula over various grade levels, often between different levels of schooling. We science teachers did exactly that this summer. Several from the team are going to be doing the same articulation during our pre-service seminars. We will have a vertical planning session so that we can work as a whole unit and not just a grade level. This **articulation** will benefit the students by not re-teaching the material the teacher taught the year before, but adding to the students’ scaffolding of science content.

My method will be inquiry based. I will cut six plant samples (i.e., stems with leaves). Three of those samples would be plants that are indigenous to Florida, and three would be non-native plants. The plants will be in Ziploc® bags. There will be six sets of all plants. The students will work in groups. There will be plant identification books and picture/info sheets printed from the Florida Exotic Pest Plant Council’s booklet<sup>4</sup> accessed from their website.

I will make sure that any information about the exotics and their harmful ways will be blacked out. This info will be presented to the students later. I want the students to identify each plant using the resources. The students will classify/ID the plants by their colors/features, leaf patterns, etc. Classification is an important scientific skill for students to learn. Cards at the group stations will have questions the students need to answer. For example, “Have you seen these plants before? Where?” “Do you think the plants are a food crop plant?” “How do you think these plants interact with Florida’s habitat?”



*Three members of the Falling Waters State Park Team at the park’s 73’ waterfall, the highest in Florida. From left, Lenora James, Cindy and Greta Draayom*

*“We will have a vertical planning session so that we can work as a whole unit and not just a grade level. This articulation will benefit the students by not re-teaching the material the teacher taught the year before, but adding to the students’ scaffolding of science content.”*





*Greta and Doug measure a burrow the "old fashioned" way*

*"One of the most exciting aspects of the gopher tortoise research project was the fact that these magnificent animals actually exist in my local park."*

*Park Service Specialist Scott Sweeney*

*"Another wonderful outcome of this experience was the opportunity to collaborate with Mr. Sweeney at FWSP."*

## Plans for the Future

Cindy: One of the most exciting aspects of the gopher tortoise research project was the fact that these magnificent animals actually exist in my local park. I have visited Falling Waters State Park for 20 years and never thought about the land species that comprise the upland pine community. However, by participating in field research at the park this summer I have not only learned about the presence of a gopher tortoise population, but that they are the keystone species. Now I can use this opportunity to teach my students to recognize and appreciate the gopher tortoise and its importance to the native upland pine community. Another wonderful outcome of this experience was the opportunity to collaborate with Mr.



Sweeney at FWSP. Mr. Sweeney was thrilled about having six volunteers at the park; in fact, he was like a fisherman with a new reel. We were mesmerized by his passion for his work and asked for practical ways we could make this learning experience involve our students. We now have plans to establish a summer science immersion program at FWSP in cooperation with Mr. Sweeney for students to experience the true culture of science for themselves.

Doug: As a teacher I have begun to understand the influence I can have on my students. I have the ability to directly affect 40 students, and they can affect their parents, friends, grandparents and neighbors. My students need to know about the exotics growing in their backyards and the ways those plants affect Florida's native habitats. Those native habitats that are affected can have a dire affect on native

After the students explore and classify the plants I will add to their knowledge base. I will show a set of photos of the Japanese climbing fern taken from FWSP. The first slide will be a close-up shot, just leaves, next a pulled back shot of a single plant, next a lot 'mess' or patch of climbing fern. A slide asking the question, "Where do you think these plants are?" will be followed with the FWSP sign and "Right in our backyard!!" Then the class will discuss the effects of exotic plants.

Another way for me to incorporate my summer experience into my classroom is to use GPS units with the class. I can teach the coordinate grid system, X-axis, Y-axis and also latitude and longitude. An outside activity will be conducted using plastic turtles, snakes, and other animals for students to plot on graph paper. I can relate my fieldwork directly to the children through cross-curricular lessons in mathematics and science. I cannot wait until the new school year to implement my ideas.

animal species like the gopher tortoise. I have become a steward of the land, and I will impart that on my students for years to come.

What's in your backyard?

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*"I have become a steward of the land, and I will impart that on my students for years to come."*

# Chapter 10

## ***Administering the Science Collaboration: Immersion, Inquiry, Innovation (Sc:iii) Program***





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*“By collaborating with our partners, we capitalized on the strengths of the consortium while maximizing the benefits for the teachers in PAEC-participating districts in the panhandle of Florida.”*

**Organizing the Math/Science Partnership Project**

In June 2007, the State of Florida awarded a Mathematics and Science Partnership grant entitled *Science Collaboration: Immersion, Inquiry, Innovation* to the Panhandle Area Educational Consortium (PAEC). Florida State University (FSU) received a subcontract from PAEC and underwrote the development of this monograph, *Real Science for the Real World: Doing, Learning and TEACHING!* Dr. Penny J. Gilmer, Principal Investigator for the Florida State University subcontract of the Science program and Dr. Kate Calvin, Postdoctoral Fellow, had the vision and determination to edit, assemble and publish this monograph.

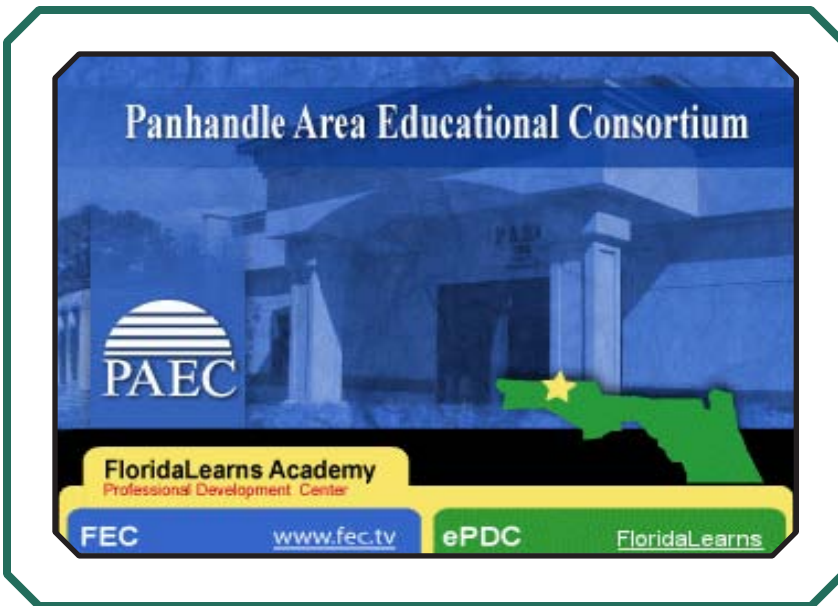
Although these monograph chapters, written by participating teachers, focus on the summer field experiences with a scientist, the PAEC project staff and administrators considered it important to share details about the entire project, so readers might fully appreciate the scope and magnitude of the project’s activities. In this chapter, project developers, Brenda Crouch, Belva Free, and Sharon Mitchell describe the project rationale, outline major project activities and share their reflections, regarding the project journey. By collaborating with our partners, we capitalized on the strengths of the consortium while maximizing the benefits for the teachers in PAEC-participating districts in the panhandle of Florida.



*Brenda Crouch and Belva Free (at Nokuse Plantation)*



*Sharon Mitchell on Poster Day*



The program's name, *Science Collaboration: Immersion, Inquiry, Innovation*, characterizes its purpose and parallels the milestones of the participants' experiences. From the program's inception to these final stages of completion, collaboration has been the key word. Collaboration began with substantial discussion among the project creators regarding each aspect of the project, from large scale priorities to the minutiae of details and has remained ongoing and far-reaching over the program's entire time span.

## Setting Project Goals

*"Collaboration began with substantial discussion among the project creators regarding each aspect of the project."*

As the search for university Science, Technology, Engineering, Math (STEM) faculty partners began, we kept hearing two names: Dr. Penny J. Gilmer, Professor of Chemistry and Biochemistry at FSU and Dr. Mary Jo Koroly, Director of the University of Florida (UF) Center for Precollegiate Education and Training and a faculty member in the UF College of Medicine Department of Biochemistry and Molecular Biology. Both women are passionate about working with science teachers and offered suggestions that were invaluable in the overall project design and implementation. Gilmer was instrumental in helping frame the project goals, based on her prior experiences with smaller, similar projects.<sup>1,2</sup> Those goals included:

1. Science teachers will experience research at the elbow of a scientist, becoming both scientist and science educator. This allows teachers to bring relevant, inquiry experiences into the science classroom—those that afford students opportunities to become and think like scientists, deepen content knowledge, enable them to make meaning of their experiences and express their knowledge in a variety of ways.
2. Teachers will be actively engaged in collaborative networks, including those occurring between teacher team and research scientist, teachers and scientists from universities, agencies and industry, and networks with other teachers from different grade spans and schools, to help students become increasingly literate in science and ultimately, make a positive difference in student achievement in science.
3. Teachers will effectively implement inquiry experiences in their classrooms so that students will experience the relations, richness, recursion and rigor that are natural and integral aspects of inquiry science.

*"Science teachers will experience research at the elbow of a scientist, becoming both scientist and science educator."*

From inception, the planning team recognized that achievement of the project's ambitious, overarching goals could not be met with a single activity; instead,

we decided to provide a variety of activities targeting specific goals. Effecting professional growth and subsequent positive change in teacher practice would require a series of carefully orchestrated events, taking place over a period of time. Therefore, with that in mind, we planned activities falling into four major categories and spanning the course of a year. Those categories were: 1) enhancing pedagogy, 2) promoting awareness of scientific work and understanding its relevance, 3) reflecting and writing about their experiences in a course to prepare them for their scientific work and following semester's field experiences and 4) conducting scientific work. The organization of the next section reflects these four goals.

## Providing Opportunities for Teacher Learning

### Enhancing Pedagogy

PAEC provided a series of four workshops focused on pedagogy to: 1) effect critical and meaningful reflection by project participants regarding specific aspects of their existing practice, 2) update pedagogical skills and provide research-based strategies to foster more frequent incorporation of student inquiry activities, conducted at higher levels, 3) examine existing classroom questioning practices while boosting the number of classroom questions and activities that fall into the highest categories of Webb's Depth of Knowledge,<sup>3</sup> 4) increase use of research-proven literacy strategies to heighten and enrich learners' access to and understanding of science content. To make travel more convenient for teacher participants, who were from locations ranging from the westernmost part of Escambia County to the easternmost point of Madison County in the Florida panhandle, a distance of about 275 miles, PAEC conducted the four workshops in four regional locations.

### Promoting Awareness of Scientific Work and Understanding Its Relevance

Additionally, PAEC offered a three-part workshop series entitled *Seminars in Emerging Science* and a weeklong summer immersion experience at UF to help participants become increasingly aware of cutting-edge scientific research and understand the relevance of the work. The seminar series gave teachers an opportunity to hear presentations delivered by seven STEM faculty members and/or researchers addressing a variety of scientific topics. Following each presentation was a question and answer period—a time when teachers could interact informally with each presenter. Participation not only increased awareness of cutting-edge scientific research taking place in a variety of scientific disciplines, but also each presenter explained the rationale for the research and its potential impact, so teachers would gain insight into the research's relevance.

Dr. Mary Jo Koroly from UF's Center for Precollegiate Education and Training led the week-long summer immersion experience on the UF campus. This was

*"Participation not only increased awareness of cutting-edge scientific research taking place in a variety of scientific disciplines, but also each presenter explained the rationale for the research and its potential impact, so teachers would gain insight into the research's relevance."*



*Belva Free at Nokuse Plantation greets Roscoe at research site*

*"Each group experienced a unique curriculum designed to best meet their specific needs."*



*“Gilmer and Blumsack directed the activities of the course, with one of them visiting each team of teachers in the field at least once.”*

a fast-paced week, during which the university opened its doors wide to the teachers. We separated teacher participants into two groups, middle school and high school teachers. Each group experienced a unique curriculum designed to best meet their specific needs. Teachers re-lived their college days as they experienced dormitory life, soaked up lectures from many of the university’s distinguished STEM faculty members, employed modern research methods, used equipment to conduct activities appropriate for use in their classrooms, learned about academic and industrial career choices available to students, and participated on local field trips. Topics addressed included those particularly relevant to Florida, and focused on conserving and restoring the state’s environment through awareness, new technologies, entomology, biotechnology, and emerging pathogens.



*Belva Free (on left) and Brenda Crouch hold gopher tortoise while scientist, Bob Walker, numbers the carapace.*

*“The teacher mentor’s role was to offer assistance and guidance for teachers throughout the course and to serve as a point of contact between the scientists and FSU faculty.”*

## Reflecting and Writing About Their Experiences

In Spring 2008, Gilmer organized a one-credit, on-line graduate course entitled *Nature of Scientific Inquiry* to prepare the 118 teachers for the summer’s foray into the real world of scientific work. During the course, teachers had weekly reading assignments from *A Sense of the Mysterious*,<sup>4</sup> *Serendipity: Accidental Discoveries in Science*,<sup>5</sup> and *On Being a Scientist: Responsible Conduct in Research*.<sup>6</sup> As part of the course, we provided an hour-long weekly program, Web cast from the Global Education Outreach in Science, Engineering and Technology (GEOSSET) website,<sup>7</sup> for required viewing. Gilmer and retired FSU Professor of Mathematics, Dr. Steven Blumsack, discussed topics relevant to each week’s reading assignment. This course prepared teachers for the upcoming inquiry experiences during the summer semester and the reflective writing requirements which they learned was a critical aspect of both semesters of the FSU coursework.

## Conducting Scientific Work

Finally, the teachers themselves became scientists! From a list of 40 pre-arranged choices, each teacher team had a choice for its summer work site based on the teachers’ interests and their location, for a 90-hour field experience. Gilmer and Blumsack offered the second on-line FSU course, worth two semester hours of graduate credit, for the teachers’ authentic scientific work. Gilmer and Blumsack directed the activities of the course, with one of them visiting each team of teachers in the field at least once. FSU also provided a leadership team of eight teacher mentors, all of whom had completed a similar research experience while earning their graduate degrees. Each teacher mentor led 3-4 teams and was responsible to visit each team at its field location a minimum of three times. The teacher mentor’s role was to offer assistance and guidance for teachers throughout the course and to serve as a point of contact between the scientists and FSU faculty.

To foster reflection on the field experiences in research, Gilmer required the teachers to individually discuss specific aspects of their field experiences on the FSU BlackBoard course site and submit a scientific paper on their work. The

teachers were also required to produce a team poster about their collective project for presentation at the teachers' own unique symposium and summer finale, Sc:iii Poster Day. For most participants, the high point of the project experience was the field work done with their teams and their scientist.

## Collaborating at Many Levels

Developing innovative collaborations was a major requirement of the funding priority addressed by the *Sc:iii* Project proposal. Careful planning underpinned all project interactions to make the intended goal of increased collaboration on multiple levels a reality. During the recruitment process, school districts, PAEC and FSU grouped the teachers from participating districts into vertical teams, comprised of elementary, middle school and high school teachers within each district's feeder patterns. Vertical teaming involves articulation among teachers of different grade levels.

These vertical teams of teachers worked together on a daily basis in the field with a scientist. The major intended outcome was for meaningful dialogue among teachers to occur – dialogue essential for identifying, discussing and building on the strengths and rectifying possible weaknesses in the science program at each level. Additionally, because high school teachers are typically more knowledgeable about science content, a bonus outcome we expected was for elementary and middle school teachers to become comfortable enough to rely upon their high school colleagues as valuable content resources during subsequent school years. Meanwhile, the elementary and middle school teachers brought more expertise in learning and pedagogy to the teams.

Discussion boards were also an important component of the collaboration-building process. Their use was begun on the *Sc:iii* program Website, with participants being encouraged to post responses to specific topics and later integral to the FSU graduate courses with responses being required. Over the course of the year, such reflections resulted in a significant number of interactions among project participants.

Initially, PAEC project staff members noted that teacher participants tended to band together by district, school, and subject. During the workshop series, which focused on pedagogy, another level of collaboration “forced” teachers to separate from their district peers and group with teachers having similar grade level and content assignments from neighboring districts. Some participants complained during workshops when they were seated with teachers from other districts according to grade and content area. Gradually, however, participants became more comfortable with each other and as the school year progressed, teachers began to express excitement and appreciation for the opportunity to interact with



*Brenda Crouch (left) and Dr. Penny J. Gilmer collaborating on Poster Day*

*“During the recruitment process, school districts, PAEC and FSU grouped the teachers from participating districts into vertical teams, comprised of elementary, middle school and high school teachers within each district’s feeder patterns.”*



*Sc:iii teachers (left to right) Debbie Drake, Trudy Beaver and Alicia Brown wore hats to go with Dr. Gilmer’s (far right)*



*Dr. Charles Ouimet at PAEC after speaking at Seminar in Emerging Science, entitled, "Why Do Nerve Cells Die, and What Can Be Done About It?"*

*"Teachers learned that scientists are always eager to share details about their work, and like themselves, are not all-knowing."*

*Prototype of tortoise camera*

peers, sharing management tips and lesson ideas. Inter-district collaboration continued and became more comfortable with the weeklong immersion into science at UF, as teachers traveled to "camp" together on a bus, lived in campus dormitories, ate together and experienced workshops grouped with other middle or high school teachers. The week's collaboration reached its highest point at UF when a group of teachers got together and arranged a cookout for everyone on the final evening in Gainesville. By summer's end, participants from locations across the consortium knew each other. At Sci:iii Poster Day, teachers from adjacent districts shared their experiences and heard other teams presenting their learning. Teachers promised to work together to develop projects for students that would result in poster presentations similar to those they had completed.

Collaborative interactions between teachers and university STEM faculty took place on a variety of levels. Initially, these interactions occurred during the series of *Seminars in Emerging Science* lectures. The UF immersion experience provided a number of meaningful opportunities for participant and STEM faculty collaboration, both formally and informally. Teacher and STEM faculty interactions also took place frequently and with a nice level of comfort at the research sites. One teacher said of Gilmer, "We just love her! She is the real deal!" and another teacher said of Blumsack, "Oh, he [Blumsack] can visit us anytime! We interacted with him on physics in the SOAR program." Others exchanged contact information with UF faculty members who offered workshops during the immersion experience. Some scientists made pledges to visit classrooms and to loan scientific equipment to the teachers.

Important scientist-teacher relationships resulted from the collaborative interactions that took place during the field experiences. Scientists, who were initially hesitant about taking a team of teachers, reported valuing the experience and being willing to participate in a similar venture again. Teachers learned that scientists are always eager to share details about their work, and like themselves, are not all-knowing. In most cases, the



teachers reported plans to continue the relationship with their scientist on some level. For some, the work will continue on a voluntary basis during the school year and ensuing summers, as time permits. Others plan to engage their students, in some measure, in the same scientific work, while being guided by their scientist. To generate student enthusiasm for science, many teachers have already made plans to invite their scientist and other people they met in the field to visit their classroom and share interesting, pertinent information and then connect that information to the students' lives.



## Innovating

Were there resulting innovations? Absolutely! Two conversations, overheard by project staff while visiting teachers in the field, immediately come to mind. One took place with the team that conducted a gopher tortoise survey at Falling Waters State Park. After discovering a burrow that had all the signs of being inhabited, the team wanted to be able to “see” down into the burrow. The group did not have a commercial tortoise cam but, after brainstorming, designed one. It included a small digital camera, a light source taped on the end of a strong wire cable, and USB cord. The team plugged the USB port into a laptop, cut plastic picnic plates into semi-circles to serve as a sled of sorts for the camera, and inserted the cable through a length of pool cleaning hose to guide the “tortoise cam.” The innovation worked!

Furthermore, the teacher team conducting oyster research at the FSU Coastal and Marine Lab expressed amazement at the number of exchanges among members of the research staff regarding “how” to set up an experiment. They described one particular conversation by staff about the need to obtain filtration systems for the oyster tanks in the study. Because commercial systems are extremely costly, the scientists determined a way to engineer their own much more affordable system employing readily available materials.

## Planning and Implementing Project Logistics

Project logistics, planning, and implementation schedules became exclusive priorities on the part of the PAEC project manager and support staff. Over the course of the year, the project staff members worked daily, including nights and weekends, to plan for and achieve the hoped-for outcomes. Innumerable activities, requisite for the project’s success took place behind the scenes.

### Teachers Registered and Engaged as Graduate Students

The project team also encountered challenges along the way! Those deemed most significant by project staff were the teachers’ admission to FSU as special graduate students, registration of participants for the initial FSU graduate course, and securing the summer work sites. The task of getting 120 teachers from locations across Florida’s rural Panhandle admitted as special graduate students and registered for a class at FSU was monumental. However, after many weeks of persistence, determination, patience, and help from Christin Foster, Gilmer’s administrative assistant, we finally accomplished the task.

Once teachers were admitted to FSU and registered for the course, some experienced delays in their ability to access course content via FSU’s online BlackBoard system. PAEC project staff served as the intermediary between the teachers and the university until we could resolve each of the issues. Many of the teachers in these groups reported feeling overwhelmed and grew discouraged, as they were “behind” in class work/participation before getting underway. However, once we overcame these initial hurdles, the number of issues seemed to decrease and teachers began to gain comfort with the entire process.



*“However, once we overcame these initial hurdles, the number of issues seemed to decrease and teachers began to gain comfort with the entire process.”*



*“Not only did we have to locate willing scientists, but also summer work sites had to be in proximity to teachers, so travel to and from the site could take place in a reasonable amount of time.”*

## Scientist Mentors

Much of the project's success hinged on finding work sites with a scientist willing to allow a team of teachers to work at his/her side for 90 hours. Not only did we have to locate willing scientists, but also summer work sites had to be in proximity to teachers, so travel to and from the site could take place in a reasonable amount of time. At the project's onset, we believed that scientists within the state park system would provide a significant number of opportunities for teachers, as several rangers had previously expressed

willingness to take a team. With parks

facing summer budget cuts, many of the parks had to decline taking teachers, so the PAEC project manager called one agency after another, with many dead ends. However, many whom we contacted graciously offered their services and provided the name of someone else who might also be willing to help with the teachers. Approximately ten weeks after beginning the search for sites, a sufficient number of scientists had expressed willingness to participate and we halted the search with 40 research sites identified. In retrospect, the PAEC project manager could not have asked for a more cooperative and extremely knowledgeable group of scientists.

### Deliverables...

The Sc:iii program also funded development of a number of deliverables in addition to this monograph. They included a two-part science literacy series with programs, *Reading to Make Meaning of Science* and *Writing to Make Meaning of Science*, and a four-part series, *Seminars in Emerging Science*, all of which PAEC videotaped and produced. PAEC broadcast both series through the Florida Education Channel, which is available at 9418 on DISH Network; 61.5 satellite, and via selected district-based delivery systems and various cable providers. We made these videos available as DVDs from the FloridaLearns Clearinghouse at PAEC and also Web-stream them from the Sc:iii program Web site<sup>8</sup> for as long as PAEC maintains the site. We also offer online courses that support and extend the video content of both series through the PAEC electronic Professional Development Connections (ePDC).<sup>9</sup>

We documented the summer activities of participants by videotaping the teachers for a documentary, entitled *Real Science for the Real World* with a series of ten short vignettes, the *Teacher as Scientists Series*. *Real Science for the Real World* will be broadcast on the Florida Education Channel, *Teachers as Scientists* vignettes will be available as Podcasts, and both will be Web-streamed from the Sc:iii program Website.<sup>8</sup>



*Mussels and Plants team members, Melba Adkins and Miranda Rehberg (in brown shirts) with Lisa Schofield (directing videotaping) and Charles Walker, videographer, with scientist Sandy Pursifull, (on far right) all looking at mussels experiment*

*"We documented the summer activities of participants by videotaping the teachers for a documentary, entitled Real Science for the Real World with a series of ten short vignettes, the Teacher as Scientists Series."*

# Learning

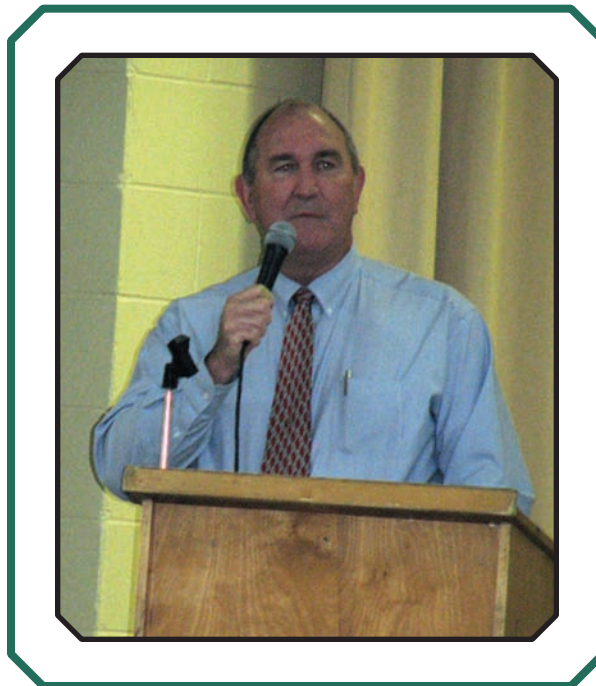
## Teacher Learning

Throughout the project, participants learned! Those completing all of the professional development workshops and accompanying online evaluation activities were eligible to receive 166 hours of professional development credit. For those who also attended the UF immersion week, that number increased to 216 hours.

In addition, teachers became graduate students and, for a number of teachers, this was the first time being a university student since graduating from undergraduate school. Many reported experiencing pressure and fear of “not knowing” an answer or failing to measure up. However, as participants completed challenging assignments and met the high expectations of Gilmer and Blumsack, they told of gaining confidence and becoming increasingly empowered in this new role. They also pledged to be more understanding and empathetic of their students. Many teachers enhanced their technology skills as they learned to navigate through a graduate course in the online world, add comments to a discussion board, draft documents and send them as attachments, and use e-mail for academic purposes. Others came to know firsthand the benefits of teamwork, from camaraderie and collaboration, to the satisfaction of shared success. Most teachers reported feeling re-invigorated and eager to get back to school, once again enthusiastic about “doing” science in their classrooms.

The opportunity for teachers to become scientists was the best part of all! Chigger bites became battle scars, and tales of spiders, snakes and getting down and dirty grew bigger as they were retold. Watching teachers in the field doing science was immeasurably exciting and rewarding for project personnel and scientists, alike!

According to one teacher who completed the project successfully, “I’m very satisfied, because the experience left me with much more knowledge, as well as more confidence in myself.” Another shared, “This experience has been incredible! The research I did... impacted me on a personal level. Because of this experience, I will now teach...with true passion and authentic knowledge...that I gained through inquiry-based experiences.” While yet another stated, “My participation in the Sc:iii program this summer has been the capstone experience in my career



*“As participants completed challenging assignments and met the high expectations of Gilmer and Blumsack, they told of gaining confidence and becoming increasingly empowered in this new role.”*

*Tony Anderson,  
Sciii Projector  
Administrator, PAEC*





*Brenda Crouch,  
Consultant,  
FloridaLearns  
Academy, PAEC*

as a science teacher. I have participated in a genuine learning community. The program has enhanced my passion for science.” For the PAEC project team, this positive and empowering feedback from the teachers is the highest possible compliment!

## PAEC Staff Learning

Teachers weren’t the only ones who learned; PAEC project staff members also experienced many opportunities to grow professionally. Reflecting back on the experience, some of our lessons learned included: 1) Finding great partners who can be counted on to do what they say they will do! We had excellent partners who made project work predictable and much less stressful by being pleasant, cooperative, timely and hardworking. 2) Doing as much

recruiting for teachers in person as possible. Although all project requirements may be spelled out in detail, we found it critical that those who sign on for the project fully understand the commitment required to successfully complete the project. 3) Securing the name of at least one person in the university admissions office with authority to make decisions, if you plan to enroll 120 people in a major university. For the project manager, that

person and invaluable partner was Leah M. Paul, Assistant Director of Admissions at FSU! 4) Expecting attrition and not taking it personally when participants drop out. This initiative began with 120 teachers and ended with 79 full participants. It should be recognized that a number of participants came with responsibilities for elderly parents, small children, family members who became ill, too many school-related duties beyond the normal day, health issues, heavy student loads and unexpected circumstances. 5) Being kind and understanding always! We made many new friends. 6) Expecting hundreds of e-mails and replying promptly.



If someone takes the time to ask a question,

she/he is concerned. 7) Planning to spend hours on the telephone, especially while recruiting scientists. Don’t give up; if one cannot help, he or she may know someone who can. Most will be extremely helpful. 8) Carefully planning and organizing each aspect of the project, because even though it consumes a lot of time initially, we avoided last-minute crises and made each event more enjoyable. 9) Being very familiar with the budget and the rationale underlying each item. 10) Not being afraid of failure, but working harder than ever. The PAEC project staff discovered that making a good thing happen can be one of the most rewarding experiences, ever.

*Brenda Helms,  
Secretary to Brenda  
Crouch*

*“Teachers weren’t the only ones who learned; PAEC project staff members also experienced many opportunities to grow professionally.”*

Sc:iii Program Project Administrator was Tony Anderson, Administrator, Instructional Services and the Sc:iii Project Manager was Brenda Crouch, Consultant, FloridaLearns Academy, both from PAEC. Brenda Helms was the secretary to the consultant, Brenda Crouch. She did all of the paperwork with the teachers, including the teachers' pay in the field, travel reimbursements, district substitute reimbursements, and maintained a myriad of project documents.

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# Index

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## A

Ames Sink 99, 102  
Apalachicola Bay 40, 43, 48, 139  
Apalachicola, forest 68  
Articulation 12-15, 19-22, 119, 126

## B

Blackboard Web site 126, 129

## C

Camera, tortoise 93-94, 112-113, 116-117, 128  
Carapace 88, 90, 111, 114, 126  
Carr, Archie 58-59  
Climbing fern, Japanese (plant) 64, 106-109, 114-116, 120  
Crawls, of turtles 50-51, 54-56  
Cultural-historical activity theory (CHAT) 13

## D

Depredation 55  
Dermo disease 39-41

## E

Enclosure, for tortoises 86-87, 90, 92-93

## F

Falling Waters State Park 20, 106, 112, 114-115, 117, 119-120, 128-129  
Florida Caverns State Park 62, 70  
Florida Department of Agriculture & Consumer Services 74  
Florida Department of Environmental Protection 98, 100  
Florida Education Channel 130  
Florida Fish and Wildlife Conservation Commission 110  
Florida LIFE program 98  
Florida State University (FSU) 13, 15, 26, 38-39, 45, 85, 106, 123-124,  
126-127, 129-130, 132  
Fungicide 74, 78

## G

GEOSET 126  
GPS (global positioning system) 20, 28, 51-52, 56-57, 62-64, 92, 112, 114,  
120  
Gulf of Mexico 26, 32-33, 48



## H

Hog, feral 48, 52, 55-56, 58  
Hoover's chicken 88

## I

Ion fragments (from mass spec) 75, 77

## K

Karst features 99  
Keystone species 90-91, 110-111, 120  
Koroly, Mary Jo 124-125  
Kroto, Harold 14

## L

Liquid chromatography 74-75, 77

## M

Macbridea alba (plant) 68-69  
Mass spectroscopy 74-75, 77, 80  
Mimosa (plants) 107-109, 115  
Mobile phase 75  
Mussels, freshwater 15, 65-66, 68-70, 130

## N

Nandina (plant) 62-64  
Nature of Scientific Inquiry 14, 126  
Nesting, sea turtles 48-50, 53-57  
Nitrates 97-100, 103  
Nokuse Plantation 17, 84, 86-87, 89, 93-94, 123, 125

## O

Ouimet, Charles 61, 128  
Oxygen, dissolved 97, 99-100  
Oyster 15, 36, 38-44, 52, 129  
Oyster drill snails 39  
Oyster mortality 39, 43

## P

Panhandle Area Educational Consortium (PAEC) 11-12, 14, 85, 106, 123, 125, 127-132  
Partnership, Math/Science 12, 123  
Pedagogy, enhancing 14, 16, 61, 69, 81, 125, 127  
Permit, incidental take 87  
Pesticide 74-79  
Pilot Education Program 97  
Plants, exotic species 20, 62-64, 86, 91, 106-109, 111, 115-116, 118, 120

Plants, invasive 62-63, 70, 102, 108, 111  
Plastron 88, 112, 114  
Privet, Chinese (plant) 63, 107-109, 115

## R

Relocation, of gopher tortoises 86-89, 91-92  
Residue 74, 76, 79-81

## S

Salinity 39-40, 42-44, 99  
Scientific Research Experiences 12, 14-16  
Sea turtles 48-51, 53-58  
Seminars in Emerging Science 125, 128, 130  
Separation, chemical 72, 75, 80  
Silk tree (plant) 107-108  
Site fidelity 86-97, 93  
Snake, water (water moccasin) 68-69, 86, 90, 109, 120  
Soil analysis 67-68, 70  
Spray field 100-101  
Springshed 101  
St. Vincent Wildlife Refuge 48, 56  
Sugar Mill Creek 65-66, 68, 70

## T

Tallow, Chinese (plant) 62, 107-109, 115  
Telemetry 89, 92  
Tortoise, gopher 15, 17, 84-86, 88-94, 107-108, 110-121, 126, 128-129  
Turtle, loggerhead 49-50, 58

## U

University of Florida (UF) 14, 73, 124-125, 127-128, 130-131  
US Fish & Wildlife Service 48, 50, 68  
US Forestry Service 68

## V

Vertical teaming 15, 119, 126-127  
Views on the Nature of Science (VNOS questionnaire) 14, 17

## W

Wakulla Springs 98-101  
Water wars 38  
Watershed 96, 98-102  
Webb's Depth of Knowledge 125  
Wiregrass 90, 111, 115  
Wolf, red 48, 52, 55-56, 58

