

The Department of Energy's  
Academies Creating Teacher Scientists  
at Brookhaven National Laboratory

## The Role of the National Laboratory in Improving Secondary Science Education



One of ten national laboratories overseen and primarily funded by the Office of Science of the U.S. Department of Energy (DOE), Brookhaven National Laboratory conducts research in the physical, biomedical, and environmental sciences, as well as in energy technologies and national security. Brookhaven Lab also builds and operates major scientific facilities available to university, industry and government researchers. Brookhaven is operated and managed for DOE's Office of Science by Brookhaven Science Associates, a limited-liability company founded by Stony Brook University, the largest academic user of Laboratory facilities, and Battelle, a nonprofit, applied science and technology organization.



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National laboratories are making an important contribution to the science education system by engaging teachers in authentic research activities.



## Opening Remarks

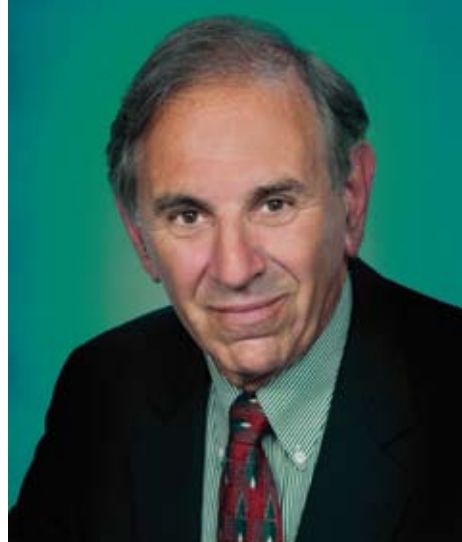
While the role of science, technology, engineering, and mathematics (STEM) teachers in our education system is obvious, their role in our economic and national security system is less so. Our nation relies upon innovation and creativity applied in a way that generates new technologies for industry, health care, and the protection of our national assets and citizens. Often, it is our science teachers who generate the excitement that leads students to pursue science careers. While academia provides these teachers with the tools to educate, the rigors of a science and technology curriculum, coupled with the requisite teaching courses, often limit teacher exposure to an authentic research environment. As the single largest funding agency for the physical sciences, the US Department of Energy's (DOE) Office of Science plays an important role in filling this void. For STEM teachers, the DOE Academies Creating Teacher Scientists program (ACTS) bridges the worlds of research and education. The ACTS program at Brookhaven National Laboratory (BNL), one of several across the country, exemplifies the value of this program for participating teachers. Outcomes of the work at BNL as evidenced by the balance of this report, include the following:

- Teachers have developed long-term relationships with the Laboratory through participation in ongoing research, and this experience has both built enthusiasm for and enriched the content knowledge of the participants.
- Teachers have modified the way they teach and are more likely to engage students in authentic research and include more inquiry-based activities.
- Teachers have reported their students are more interested in becoming involved in science through classes, extra-curricular clubs, and community involvement.
- Teachers have established leadership roles within their peer groups, both in their own districts and in the broader teaching community.

National laboratories are making an important contribution to the science education system by engaging teachers in authentic research activities, maintaining durable relationships with the teachers, sharing the tools and intellectual capabilities of a federal research agency, and taking the added step of engaging their students as well. These experiences, set in a scientifically rich environment, distinguish the DOE ACTS program.



Ken White  
Manager, Office of Educational Programs  
Brookhaven National Laboratory



Being “plugged in” to a national laboratory like BNL has provided DOE ACTS teachers with access to a rich and continuing source of information and scientific expertise.

## Preface

In 2005, the National Academies published *Rising above the Gathering Storm*. In that report, which addresses the challenge of increasing America’s talent pool by improving K-12 science and mathematics education, the authors stated that “laying a foundation for a scientifically literate workforce begins with developing outstanding K-12 teachers in science and mathematics.” They went on to say that “simply stated, teachers are the key to improving student performance.” Subsequently, the Department of Energy’s Academies Creating Teacher Scientists (DOE ACTS) program was developed to address this challenge. While many science and mathematics teachers have a fairly good content background, they have not had the opportunity to participate in authentic research projects. Through the DOE ACTS program, national laboratories like Brookhaven National Laboratory enable teachers to participate in significant research projects with world-class scientists.

It is the intent of this program that active research activities will reshape the way teachers conduct their own classes so that they will transmit the excitement and nature of research to their own students.

The broad goals of the DOE ACTS program include, among others:

- enhance teacher knowledge and skills within their discipline;
- develop leadership skills for teachers in the science and math community;
- integrate inquiry skills into the science and math curriculum; and
- increase the level of enthusiasm and excitement for science in both teachers and their students.



The summer 2006 DOE ACTS teachers with Mel Morris (back row, left), Program Manager, and Ken White, OEP Manager (back row, right) gather for their annual group photo at Brookhaven National Laboratory.

As you read through the individual teacher surveys in this report, you will quickly discover overwhelming evidence that these goals have been achieved. Teachers are developing new courses, conducting workshops for their peers, evaluating and revising ways in which they teach to include inquiry-based, authentic research activities, and becoming very excited about the nature of teaching science. Additionally, teachers are forming lasting relationships with their scientific mentors as well as the Office of Educational Programs at Brookhaven National Laboratory.

You will also note in the surveys the positive results these teachers are having on their students. In spite of the fact that this is a fairly new program, there are students who, having been excited by their teachers, are going on to college for degrees in environmental science, while others, still in high school, have enrolled in new electives that the DOE ACTS teachers have developed, joined new after school science clubs and begun their own research projects.

Being “plugged in” to a national laboratory like BNL has provided DOE ACTS teachers with access to a rich and continuing source of information and scientific expertise that will benefit them and their students over the years.

*Melvyn Morris*

Melvyn Morris, EdD  
Program Manager, DOE ACTS  
Brookhaven National Laboratory





The summer 2007 DOE ACTS teachers and Mel Morris (far right), Program Manager, gather for their annual group photo at Brookhaven National Laboratory.

## The DOE ACTS Program produces the intended results:

**73%**

have assumed new leadership roles within their school or district

**100%**

created new curriculum units

**47%**

created new courses after their DOE ACTS experience

**40%**

have given presentations, some at national conferences

**20%**

have been awarded grants or applied for them

**53%**

have completed additional certification requirements

## The Department of Energy's Academies Creating Teacher Scientists (DOE ACTS) at Brookhaven National Laboratory

### Program Synopsis

This program provides a six-week special training and research summer experience for in-service science, mathematics, and technology teachers. Participating teachers receive a stipend, housing allowance, and travel expenses.

During six weeks at Brookhaven National Laboratory, program participants:

- are matched with world-renowned scientists who serve as mentors;
- are trained to use advanced scientific instruments;
- attend seminars and lectures on scientific inquiry and recent discoveries;
- complete a research project;
- develop professional and technical communication skills; and
- work with a master teacher to develop educational modules and a professional development plan.

Teachers are asked to continue to work with their mentors throughout the academic year via email. Participating teachers are eligible to receive mini-grants for projects to be carried out in their schools and funds to attend and present at professional conferences. Teachers who successfully complete the program are eligible to participate in successive years for a total of three years.



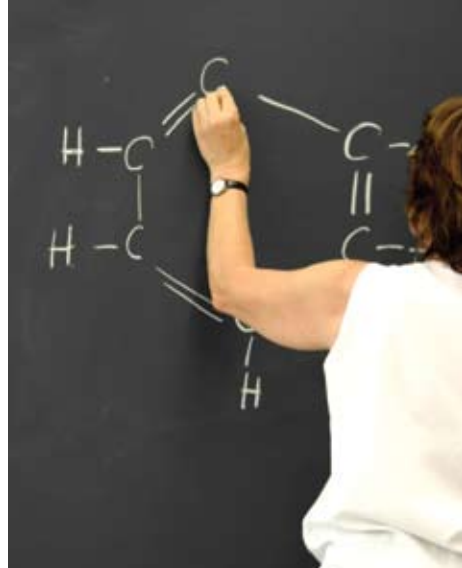
## Program Overview

Brookhaven National Laboratory (BNL), one of ten national laboratories overseen and primarily funded by the Office of Science of the U.S. Department of Energy (DOE), conducts multi-disciplinary research in the physical, biomedical, and environmental sciences, as well as in energy technologies and national security. Brookhaven Lab also builds and operates major scientific facilities available to university, industry, and government researchers. Examples include the National Synchrotron Light Source (NSLS), the Relativistic Heavy Ion Collider (RHIC), the Alternating Gradient Synchrotron, The Center for Functional Nanomaterials, a facility for Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI), and a Scanning Transmission Electron Microscope. These facilities and the supporting laboratories are staffed by world-class researchers, both as BNL employees and visiting scientists, who are highly supportive of the BNL science education mission.

In addition to its facilities and staff resources, BNL is located on a 5,300-acre site with great biodiversity and a natural resource management group that is intimately involved in research activities and educational initiatives. The other supporting infrastructure at BNL includes dormitories, housing, a cafeteria and after-hours restaurant, a credit union, post office, gymnasium, rental car facility, and many other quality-of-life facilities and functions for visiting DOE ACTS teachers.

The rich research environment and an experienced staff within the BNL Office of Educational Programs (OEP), the organization that manages the DOE ACTS program, complement the physical resources at BNL. The OEP staff includes experienced science educators who manage and operate science education programs at every level from kindergarten through graduate school. Almost 38,000 students, teachers, and university faculty participated in BNL science education programs this past year. Many of the science education programs have been in place for several decades and have served as models for some of the current DOE Office of Workforce Development for Teachers and Scientists programs. The OEP staff continues to work collaboratively with BNL scientists and researchers to implement the DOE ACTS program by creating opportunities for teachers to interface with student interns, other teachers, pre-service teachers, and with university faculty while they participate in BNL's DOE ACTS program.





## Program Goals

The overarching purpose of the program seeks to improve students' science and mathematics performance in the classroom by impacting middle and high school teachers. This impact is both direct and indirect: students' performance is directly influenced by their teachers' successful participation in the BNL DOE ACTS program, and indirectly, as the participating teachers take on leadership roles within their own spheres of influence such as their respective school districts or local teacher associations.

The success of the teacher participation is achieved through long-term, mentor-intensive professional development and scientific research or research-like opportunities at BNL. The specific goals of the DOE ACTS program at BNL are as follows:

- Transfer teacher research experiences to the classroom through increased understanding of content knowledge for those subjects taught, particularly math and science.
- Augment state and local curriculum development efforts by increasing the content knowledge in science and mathematics of participating teachers through exposure to the national laboratory system's facilities and intellectual resources through research-intensive experiences.
- Provide guidance and opportunities – through professional development and relationships with BNL researchers – to become leaders and agents of positive change in their respective educational communities.
- Raise student achievement in math and science, and increase the number of students pursuing careers in science, technological, and engineering disciplines.

Achieving these goals is expected to result in the following program outcomes:

- Increased science and math content knowledge for teachers
- Increased instrumental/lab/inquiry skills for teachers
- Leadership in the science teacher community
- Increased professional development of teachers through targeted actions based on professional development plans
- Increased student achievement in science and mathematics
- Improved teacher attitudes and enthusiasm about science
- Increased collaborations between teachers, students, and scientific communities
- Assessment improvement leading to a cycle of continuous personal improvement

## Program Structure

The DOE ACTS program at BNL provides a six-week special training and research summer experience for in-service science, mathematics, and technology teachers at the Laboratory. Participating teachers receive a stipend, housing allowance, and travel expenses.

During six weeks at Brookhaven National Laboratory, program participants:

- are matched with world-renowned scientists who serve as mentors;
- are trained to use advanced scientific instruments;
- attend seminars and lectures on scientific inquiry and recent discoveries;
- complete a research project;
- develop professional and technical communication skills; and
- work with a master teacher to develop educational modules and a professional development plan.

Teachers continue to work with their mentors throughout the academic year via email. Participating teachers are eligible to receive mini-grants for projects to be carried out in their schools, and funds to attend and present at professional conferences.

Teachers who successfully complete the program are eligible to participate in successive years for a total of three years.

Teachers also complete the following deliverables:

- Content Knowledge Assessment
- Professional Development Plan
- Professional Practice Inventory
- Enhanced Electronic Portfolio
- Weekly reports to the DOE ACTS Program Manager
- Conference attendance and equipment requests
- Annual report of program impact on instruction to the DOE ACTS program manager
- Fall and spring academic year participation in group discussions either in person or via the internet through videoconferencing
- Student performance assessments on an annual basis





With increased hands-on field oriented research a better relationship between teachers and their students is established, one that leads to better and more authentic learning experiences. This interactive involvement has improved the quality of the research since students understand that they have a higher level of accountability for the data they collect.







### Professional Outcomes

I have helped develop the new environmental course that is being offered for the first time at the high school this year.

As I continue to work toward getting all of the schools in the district involved in the Open Space Stewardship program (OSSP), I am currently attempting to set up in-service courses to train elementary and middle school teachers so that they can incorporate OSSP's environmental projects and lessons into their curriculums.

As a result of my involvement in the BNL ACTS program, my teaching is now geared to real-world applications of the science I teach. It has also been a pleasure to collaborate with like-minded professionals. This has forced me to stay abreast of current teaching practices and technologies. I have experienced tremendous professional growth that I believe I would not have experienced without this program.

I applied for a grant through US Fish and Wildlife Service last year, but I did not receive the grant. This year I have applied for a grant through the South Country Education Foundation. The grant would pay for BNL to visit our school and perform labs with our chemistry students.

This program should be expanded in order to allow more teachers the opportunity to experience authentic research. I believe this program gives insight into the importance of connecting the science you are teaching to real world applications. During my first few years of teaching, I found that very little if any collaboration took place. This program has shown me the importance of sharing information and the dramatic improvement that can occur in teaching as a result.

### Student Outcomes

Last year one of my research students received second place in the LISEF competition for her work on phragmites.

## Ann Ballester

Teacher

### School District

South Country School District  
Bellport High School  
Brookhaven, NY

### Major

Chiropractic

### Degrees

Bachelor of Science  
Doctor of Chiropractic

### Certification

New York: Biology, Chemistry, 7-12  
General Science

### Recent Courses Taught

Chemistry  
Biology  
Research  
Forensics

### ACTS Participation

2007

### BNL Mentor

Timothy Green (Environmental and Waste Management Services Division)

### Projects and Collaborations

Field Study of the American Burying Beetle

Population Study of Tiger Beetles

Students in ACTS teachers' classes are researching environmental topics and sharing their results with others using the web site ([www.greenossp.org](http://www.greenossp.org)) and database maintained by the Open Space Stewardship Program sponsored by the Brookhaven National Laboratory's Office of Educational Programs.





## Professional Outcomes

I have incorporated an environmental health component into my Environmental Science course. Students use La Motte kits to quantify dissolved oxygen, nitrogen, phosphate, and other parameters to assess soil and water health. The skills used in this component were first taught to me at the Open Space Stewardship Program (OSSP) at BNL. The Open Space Stewardship Program at BNL trains teachers to incorporate aspects of environmental science and stewardship into their curriculum.

Based on lessons from the OSSP workshop, I have created an Environmental Science elective. The students perform soil and water testing, as well as bioassays for toxicology studies. These lessons came directly from the OSSP lesson plan binder.

Some of the research projects being considered for the upcoming school year include: macro invertebrate studies of various locations in the Peconic River, continuing studies of the school's pond, DNA studies of damselflies, and wetland delineation.

I am working closely with a colleague who is developing a research class. I am the Science Club advisor.

This program has given me the time to incorporate more hands-on learning into my teaching. It has widened my network of science education professionals and made me more knowledgeable of programs, internships, and projects for my students.

## Student Outcomes

Students are more confident and more structured when doing research.

My students were recognized for their environmental research of the school's pond area at this past May's OSSP reception.

## Linda Dowd

Secondary School Science Teacher

### School District

Riverhead Central School District  
Riverhead High School  
Riverhead, NY

### Major

Biology

### Degrees

Master of Science, Science Education  
Bachelor of Science, Biology  
Associate of Science, Environmental Health

### Certification

New York: Biology, Chemistry, Earth Science

### Recent Course Taught

Earth Science

### ACTS Participation

2007, 2008

### BNL Mentor

Timothy Green (Environmental and Waste Management Services Division)

### Projects and Collaborations

Population Study of Tiger Beetles

Wetland Delineation Study



## Professional Outcomes

While working with Keith Jones, I also developed a curriculum for teachers that would have used Manhasset Bay as an out-of-classroom learning environment. Teachers would attend a workshop where they would learn about various activities they could complete at the Bay, as well as what equipment to use and how to use it. This was never taught, but Keith still has it for his own reference.

I have also created an environmental awareness unit for my own classroom based on my experiences with Keith Jones at Manhasset Bay. Students now look more closely at the surrounding environment and evaluate their community's stewardship as well as their own as they complete the unit. Students then come up with solutions on how to improve their stewardship within their community.

## Brian W. Foster

Secondary School Science Teacher

### School District

Patchogue-Medford UFSD  
Saxton Middle School  
Patchogue, NY

### Majors

Adolescence Education  
Earth Science

### Degrees

Bachelor of Science  
Master of Science

### Certification

New York: Earth Science 7—12, General  
Science Extension

My experiences in the third year have helped me to create even more activities for my curriculum. I developed a unit plan that takes curriculum content and helps to make it more meaningful for students through authentic research. This unit plan has students get out into the field and collect their own samples and run tests on their samples. Students make discoveries about their own area, which is pretty cool. The unit plan developed is also in line with the Open Space Stewardship Program (OSSP), which will help me to share my students' data with the rest of Long Island and the world.

Being able to view how science is conducted at BNL each and every day has changed my own methods towards labs in my own classroom. It is apparent how open-ended the research is here at BNL. I attempt to model this open-endedness by creating labs and activities that are more inquiry-based and do not have a predetermined outcome every time.

I have kept in contact with Keith Jones about his project over the previous two years. He has also included me on a list-serve that discusses his project with other professionals who are interested in it as well. We have discussed using web-casts to have my students watch him analyze some of his bivalves or sediment from a contaminated bay or canal.



I also hope to remain in contact with Jeff Fitts. His research is very interesting to me, and I know it would be very interesting to my students as well.

The BNL ACTS program has helped me evolve as a teacher. Instead of running through the curriculum, just to cover it, I now am able to create more meaningful experiences for my students that still cover the curriculum knowledge. This has allowed me to convey to my students that there is more to science than just what you learn in your seat, as well as the notion that science is found everywhere around them. Also, when students are up and moving and/or outside in the field, there is a better relationship between the teacher and his/her class. I feel that when this true relationship is established is when learning will occur at its best.

### Student Outcomes

Because of my research and the BNL experiences that I discuss with my students, more of them have expressed an interest in joining my school district's science research course.

### Recent Courses Taught

Earth Science Regents Review Course  
Earth Science (Honors)  
Earth Science (Regents)  
General Science (Grade 8)

### ACTS Participation

2006, 2007, 2008

### BNL Mentors

Keith Jones (Environmental Sciences)  
Jeff Fitts (Environmental Sciences)

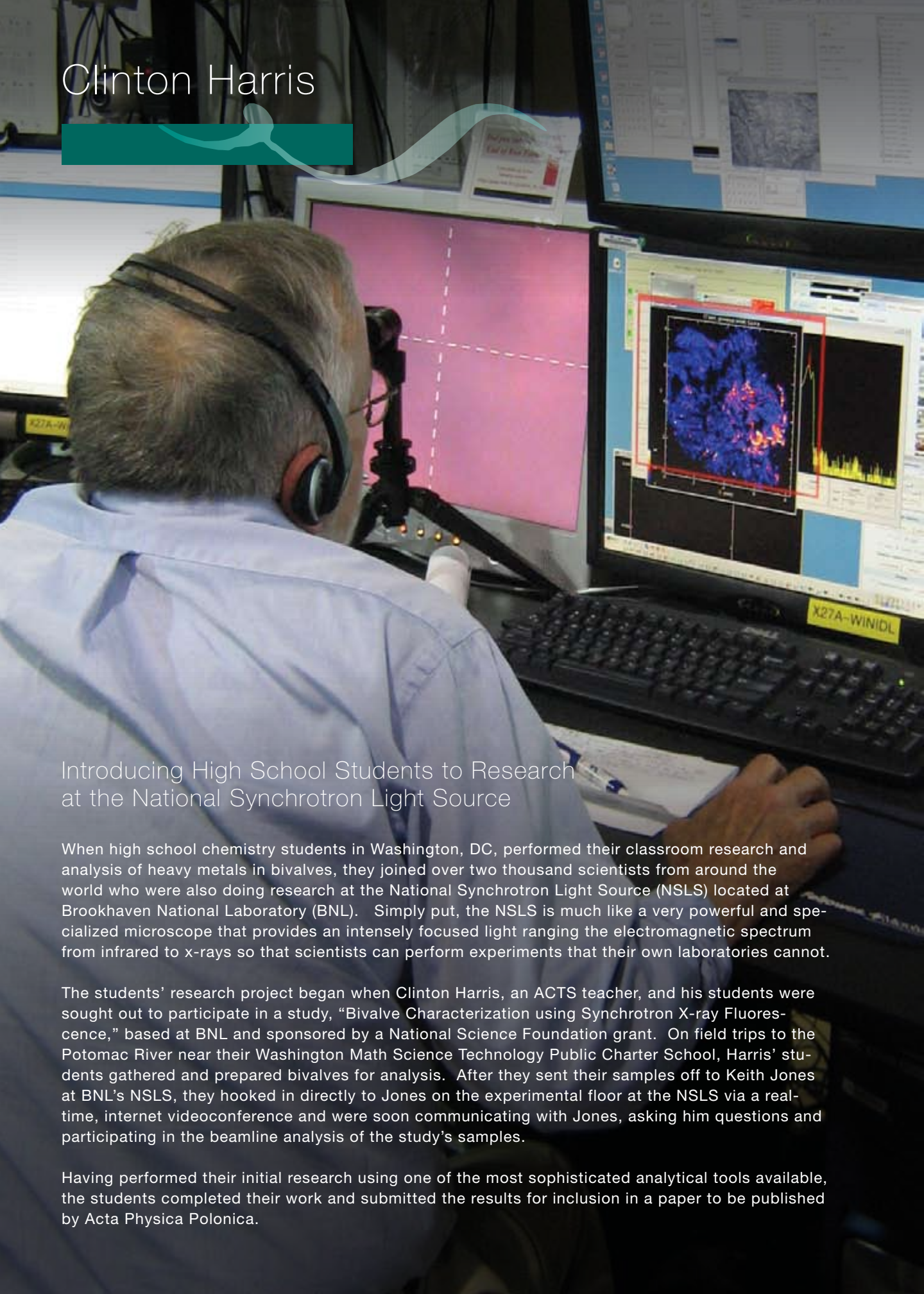
### Projects and Collaborations

"Manhasset Bay Research: Developing a Research Plan"

"Manhasset Bay Research: Examining a Marine Environment Using Bivalves and the National Synchrotron Light Source at Brookhaven National Laboratory"

"The Fate and Transport of Palladium Nanoparticles in Sand-sized Sediment on Long Island"



A photograph of Clinton Harris, a man with grey hair wearing a light blue shirt and a headset, sitting at a desk with multiple computer monitors. The background shows a control room or laboratory setting with various screens and equipment. A teal decorative graphic is overlaid on the top left of the image.

# Clinton Harris

## Introducing High School Students to Research at the National Synchrotron Light Source

When high school chemistry students in Washington, DC, performed their classroom research and analysis of heavy metals in bivalves, they joined over two thousand scientists from around the world who were also doing research at the National Synchrotron Light Source (NSLS) located at Brookhaven National Laboratory (BNL). Simply put, the NSLS is much like a very powerful and specialized microscope that provides an intensely focused light ranging the electromagnetic spectrum from infrared to x-rays so that scientists can perform experiments that their own laboratories cannot.

The students' research project began when Clinton Harris, an ACTS teacher, and his students were sought out to participate in a study, "Bivalve Characterization using Synchrotron X-ray Fluorescence," based at BNL and sponsored by a National Science Foundation grant. On field trips to the Potomac River near their Washington Math Science Technology Public Charter School, Harris' students gathered and prepared bivalves for analysis. After they sent their samples off to Keith Jones at BNL's NSLS, they hooked in directly to Jones on the experimental floor at the NSLS via a real-time, internet videoconference and were soon communicating with Jones, asking him questions and participating in the beamline analysis of the study's samples.

Having performed their initial research using one of the most sophisticated analytical tools available, the students completed their work and submitted the results for inclusion in a paper to be published by Acta Physica Polonica.



# Stephen Wefer and Michael Vacariello

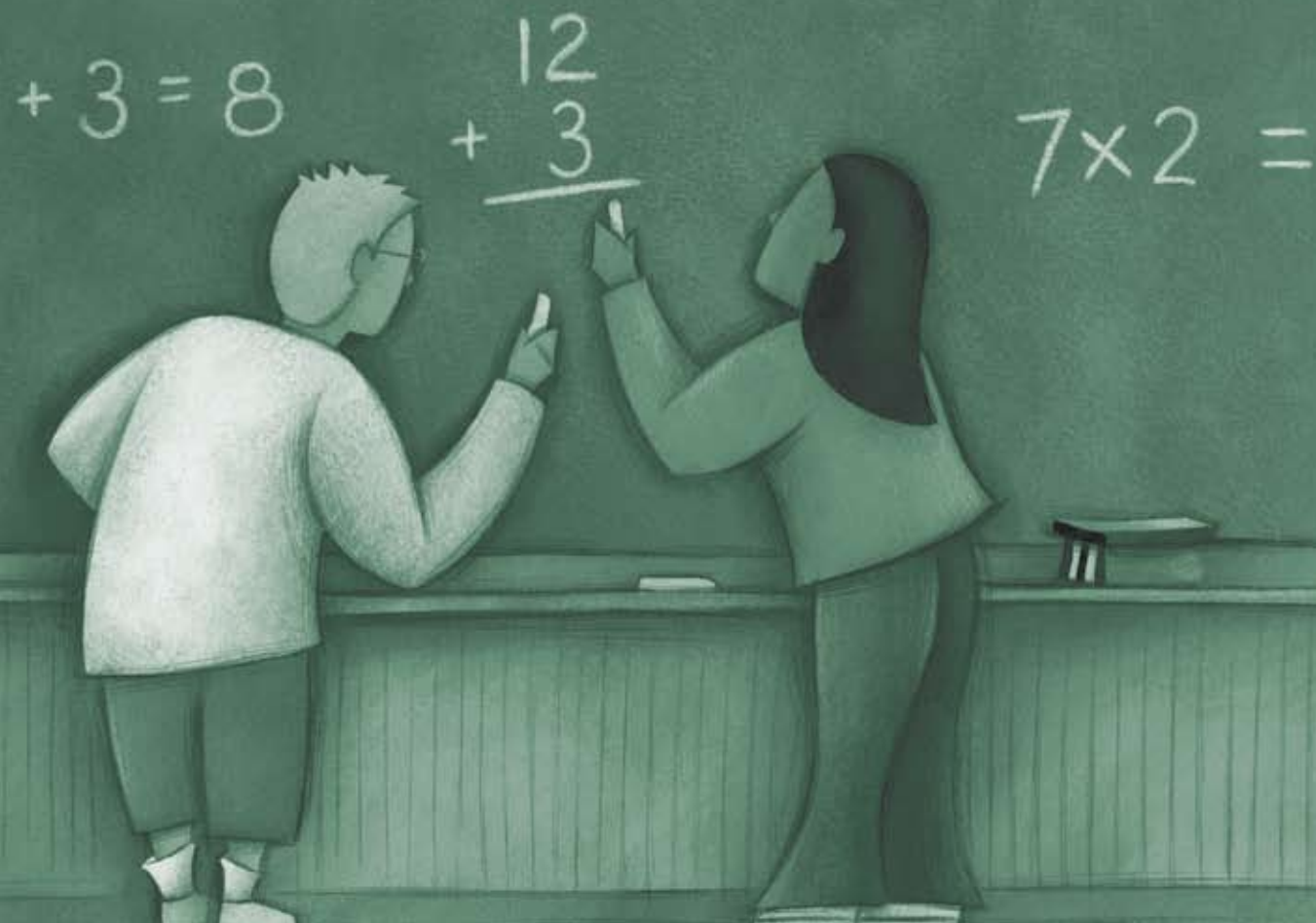


## Leveraging a BNL Partnership

In his third year as an ACTS teacher, Stephen Wefer worked alongside one of his own Sachem High School East students at BNL. Excited by the experience of doing research at BNL, the student, William Marsiglia, quickly signed up to participate in the Office of Educational Programs (OEP) High School Research Program (HSRP) and was mentored by Peter Thanos, Medical Department. During his second summer at BNL, Marsiglia worked on a meta-analysis of immunohistochemistry procedures – a technique used to localize proteins in tissue using antibodies.

When Marsiglia started classes again, he became a student in a research class taught by Michael Vacariello, another ACTS teacher from Sachem High School East. The following summer, assisted by an Arthritis Foundation Summer Fellowship, Marsiglia returned to BNL to conduct research on inflammation with guidance from Thanos. Of the six researchers who received the \$2,000 fellowship this year, Marsiglia was the only high school student. Marsiglia's research grant funded work that focused on how blocking a specific brain receptor is responsible for neuro-inflammation impacts and the expression of dopamine receptors. While the summer fellowship has ended, Marsiglia, now a high school senior, continues to conduct his research at BNL alongside Peter Thanos.

ACTS teachers are seeing increased interest and participation in newly formed or existing after school science clubs and science research classes.







## Professional Outcomes

By including the integration of science and technology into my lessons, I have changed the way that I teach various math concepts, including two lines cut by a transversal and the conversion of fractions, decimals, and percents.

Working with the Office of Educational Programs and a BNL researcher, I developed a middle school gifted math program held at BNL.

## Student Outcomes

I have noticed that the students are more interested. Instead of “drill and kill” lessons, students are able to participate in their own learning, and become more involved and responsible.

It is more evident that the students are excited to participate in hands-on activities, especially in mathematics. They enjoy the student-centered, inquiry-based lessons that allow them to become responsible for their own learning.

My students participated in the DOE Regional Middle School Science Bowl.

## Eileen Gurski

Math Teacher

### School District

Georgetown IDS  
Tippit Middle School  
Georgetown, TX

### Major

Mathematics

### Degrees

Bachelor of Arts  
Master of Arts

### Certification

New York: Mathematics 7-12, Special  
Education K-12  
Texas: Mathematics 4-12

### Recent Courses Taught

PreAlgebra  
Algebra  
Math 8

### ACTS Participation

2005, 2006, 2007

### BNL Mentors

Mike Sivitz (Physics)  
Carol Scarlett (Physics)

### Projects and Collaborations

Simulating Neutron Emissions

Using Magnets in a Math Curriculum

Angle Measurement via the Propagation  
of Light



In the summer of 2008, DOE ACTS teacher Clinton Harris presented a series of chemistry seminars based on BNL research to students attending sessions of the Minority High School Apprenticeship Program (MHSAP), the Community Summer Science Program (CSSP), and Dowling College's Gaining Early Awareness and Readiness for Undergraduate Programs (GEAR UP) at Brookhaven National Laboratory.



## Professional Outcomes

The new Nuclear Chemistry course I introduced helps to illustrate the advances that nuclear chemistry has brought forth not only for energy purposes and military uses, but also for science and medical uses. I also added course modules for an Environmental Chemistry course.

The experience here has allowed me to increase my own understanding through practical lab experiences that are relevant to everyday life.

The ACTS experience has aided in providing a better rationale for why the study or subject is being discussed.

## Student Outcomes

Students are more willing to do research on a topic than simply take the words of a textbook or lecture at face value.

Brought students from Washington Math Science Technology Public Charter High School to BNL to experience a National Laboratory.

As part of a National Science Foundation-funded research grant, my students gathered bivalve samples from the Potomac River, prepared the samples for study, and then forwarded them to Keith Jones at BNL's National Synchrotron Light Source (NSLS). Using a live video connection, my students and Keith Jones conducted research involving the presence of heavy metals in the samples. The results ("Bivalve Characterization using Synchrotron Micro X-ray Fluorescence") from the analyses performed at NSLS in collaboration with my students, students and teachers from Long Island, and BNL scientists are to be published in 2009 by the *Acta Physica Polonica*.

## Clinton Harris

Secondary School Chemistry Teacher

### School District

Washington, D. C.  
Washington Math Science Technology  
Public Charter High School  
Washington, DC

### Majors

Chemical Engineering  
Secondary Science Education

### Degrees

Master of Science, Science Education  
Bachelor of Science, Biology  
AS, Environmental Health

### Recent Courses Taught

General Chemistry  
Advanced Placement Chemistry  
Nuclear Chemistry

### ACTS Participation

2006, 2007, 2008

### BNL Mentors


Richard Ferrieri (Nuclear Chemistry  
Summer School)  
A. J Francis, Cleve Dodge, Keith Jones  
(Environmental Sciences)

### Projects and Collaborations

BNL Nuclear Chemistry Summer School  
High School Nuclear Chemistry Curriculum and Course

"S.E.E.E. Gowanus Canal Sediment  
Restoration and Cleanup, Analysis of  
Heavy Metals"





ACTS teachers find innovative ways to incorporate field-based science experiences. They often restructure the demands of existing curricular units to provide room for hands-on, field-based research.



### Professional Outcomes

My biology curriculum includes an ecology unit where all of the work I have done at BNL is useful. I also taught Science Research and geared the class towards environmental science.

Many local newspaper articles were written, and I was named Teacher of the Year 2007-2008 for the high school.

I love being at BNL. I enjoyed my experiences there immensely. I had fun while I was learning. I went through all of the processes I ask my own students to go through in their research. I am a good example of what they are also doing. I had first-hand experience about real bench research and I take these experiences with me when I teach. I now expect more from my students based on what I did.

BNL needs to keep this program for teachers. It was two of the best summers I have had as a teacher. I learned so much, and my students are benefitting from that.

### Student Outcomes

I am the environmental person in my district; and so, anything environmental comes my way. One of my students was asked to present to the Southampton Village Board about his findings on the pond he is researching.

## Maria Metzger

Teacher

### School District

Southampton Union Free School District

### Majors

Physical Therapy  
Biology

### Degrees

Masters in Physical Therapy  
Masters in Teaching  
Bachelor of Science, Biology  
Bachelor of Health Science

### Recent Courses Taught

Living Environment, Regents  
Science Research

### ACTS Participation

2006, 2007

### BNL Mentors

Timothy Green (Environmental and Waste Management Services Division)  
Murty Kambhampati (Southern University at New Orleans)

### Projects and Collaborations

My first year study compared the biomass, health, and chlorophyll content of healthy versus defoliated black oak leaves due to gypsy moth infestation.

The second year study included identifying, tagging, and releasing the different species of Tiger Beetles at BNL. Population estimates were created using a program called NOREMARK.



Amy Meyer, an ACTS teacher and Open Space Stewardship Program workshop leader, has received a \$10,000 The Nature of Learning Grant from the US Fish and Wildlife Service that will allow her students to monitor the Wertheim National Wildlife Refuge and post the results of their research and stewardship through the BNL OEP-sponsored Open Space Stewardship Program and its web site.







## Amy Lynn Meyer

Teacher

### Professional Outcomes

Awarded a \$10,000 The Nature of Learning Grant provided by the United States Fish and Wildlife Service.

One of two lead teachers for the Open Space Stewardship Program, including the Annual OSSP Summer Teacher Workshop (3 years).

The experience has given me a more discovery-based approach to teaching. Rather than through passive classroom lectures, students now discover and acquire information through inquiry-based activities.

### Student Outcomes

As part of the US Fish and Wildlife Service's The Nature of Learning Grant, students will have done the following:

- Students will develop a sense of civic responsibility as they become an integral part of stewardship of the Wertheim National Wildlife Refuge within their own community. Students will assess the environmental issues that are affecting the wildlife in their community and they will be given the opportunity to contribute to conservation, protection, preservation, and restoration of the natural environment.
- Students will demonstrate scientific protocol, analytical techniques, and data collection and analysis skills. Students will have increased exposure to real world science and thus develop skills needed for careers in science and technology and post-secondary education.
- Students will support a meaningful scientific endeavor by collecting and providing important scientific data to the Wertheim Refuge to enhance stewardship, management decisions, and identify the need for further study.
- Students will conduct, present, and collaborate with others doing independent scientific research. They will report their data to the Open Space Stewardship Program managed by Brookhaven National Laboratory and publish their findings when possible.

### School District

William Floyd School District  
William Floyd High School  
Mastic Beach, NY

### Major

Natural Sciences

### Degrees

Bachelor of Arts, Natural Sciences  
Master of Science, Environmental Studies  
Advanced Certificate Educational Administration

### Certification

New York: Science 6-12, Physics,  
Earth Science, Biology, School Building  
Leader, School District Leader

### Recent Courses Taught

Living Environment, Regents  
Earth Science, Regents  
Physics, Regents

### ACTS Participation

2005, 2006, 2007

### BNL Mentor

Timothy Green (Environmental and Waste  
Management Services Division)

### Projects and Collaborations

BNL Pond Limnology

"OSSP: Formulating the Open Space  
Stewardship Program"

"OSSP: Teacher Leadership Course for  
OSSP Program Implementation"



## Professional Outcomes

For many years prior to my experience at BNL, I used ArcView data files other researchers had collected that were applicable to the curriculum topics my students and I were working on. For example, if we were learning about volcanoes, I had the students analyze a dataset and layers of volcano data files collected by various agencies and researchers. This worked out well to create correlations between the tectonic plate boundaries and volcano eruption frequencies. However, after being at BNL, I became more comfortable with student data collection. I realized that the students would have a greater understanding of the scientific process if they themselves were collecting more of their own data whether in the field or in the classroom. We now take this data and display it on Google earth, using Excel. Our goal is to take all data that is tied to geographical locations and display it as accurately as layers in an ArcView GIS.

## Michele A. Miller

Fifth Grade Teacher

### School District

Middle Country Central School District  
Eugene Auer Memorial Elementary  
School  
Lake Grove, NY

### Majors

Psychology/Staff Development and  
Administration

### Degrees

Bachelor of Arts, Psychology  
Master of Arts, Education

### Certification

NYS Permanent Certification, N-6  
Permanent SDA in Staff Development  
and Administration

I have worked within the OSSP program to investigate the presence of a mutated segment of the eastern gray squirrel population that has appeared in our local community. We created a research project that involved taking population counts and sightings of the black squirrel. We also collected data on their nests. We connected all the tallies and sightings to a place with GPS and displayed these sightings on Google earth maps.

The *NY Daily News*, *The New York Times*, *Newsday*, and News 12 covered our research project on the black squirrel. ABC News also filmed segments of our investigation for later use. Students received a proclamation for their research from State Assemblyman Steven Englebright. My principal has nominated me for a national teaching award, and I have also received the ASSET teacher of the year award.

Ariana Breisch, a BNL scientist, accompanied us on many of the OSSP field research outings. She steered our research on the melanism mutation in the eastern gray squirrel in the right direction and asked key questions that led to more significant levels of inquiry. BNL OSSP Program Director Mel Morris also attended our technology conference and asked students questions that spurred more research on the black squirrel. He was always avail-

able to the teachers as a resource for new programs, products, and information on the topic we were working on. We directed many media questions to Mel for additional comments or information on the program itself.

This year was very exciting, but also challenging. I expanded the OSSP program within my school and involved another fifth grade teacher in the program. Next year, the entire grade level will be participating on some level with field research.

As a member of the District Science Committee, I am helping to choose a new science curriculum that has more hands-on opportunities for science research and experimentation. I have also taught in-service classes that utilize the smart board as an interactive tool in the science curriculum. I ordered materials for the entire grade level that would allow for more experimentation within the classroom. I also developed a relationship with our district public relations agency to alert them to our study for increased media coverage.

Working at BNL, I realized the value of cutting-edge equipment. Student understanding increases when they can have repetitive experiences using accurate and state-of-the-art materials. For example, I used part of my equipment grant money to get a digital gram scale that allowed students to weigh objects to the hundredth of a gram. Practice with this equipment not only gave them a better sense of what a gram was like relative to their world, it also gave them a better number sense of the place values to the hundredth place. They knew they were close to the next gram when they got to .99 in the tenths and hundredths place. This was authentic learning at its best.

I want to thank the DOE for this opportunity. I am passionate about empowering students to use their skills to not only investigate the world, but to change it in positive ways. As a result of this training, I was able to reach out to the community and involve them in our student research project. After working with my students and the research tools they had developed for their own classroom project, many people in our town, Lake Grove, indicated

*(continued on next page)*

## Recent Course Taught

Fifth Grade

## Related Work Experience

Technology Integrator and Staff Developer

## ACTS Participation

2006, 2008

## BNL Mentor

Terence Sullivan (Environmental Research and Technology Division)

## Projects and Collaborations

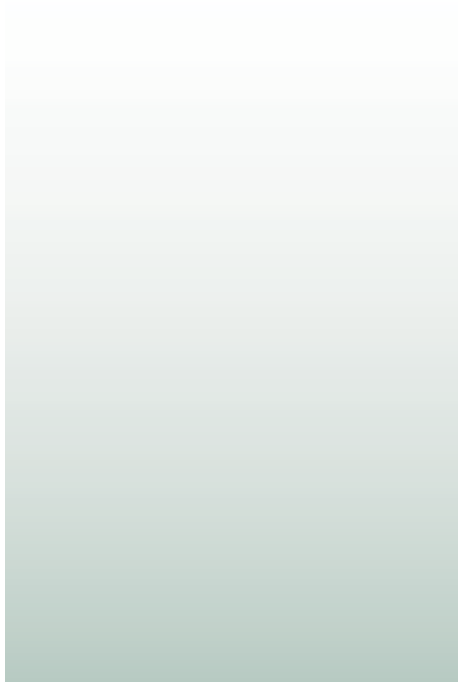
"Environmental Sampling for Mercury to Assess Deposition from Coal-fired Electric Generating Plants"

"Analysis and Database Development of Manufacturer Data on Human Portable Radiation Detectors (hprds)"

"End-user Analysis of DecernsSDSS (MCDA) – A Multi-criteria Decision Analysis Tool"







## Michele A. Miller

Fifth Grade Teacher

*(continued from previous page)*

they would like to take a more active role in investigating the world around them.

OSSP also instills in the students a sense of civic pride for the community they live in and the open spaces that remain there. The OSSP program uncovers the hidden treasures in the environment that are inconspicuous to students at first glance, but become increasingly evident and valued as the year progresses.

The first summer at the DOE exposed me to a research study and the process of scientific investigation. DOE ACTS gave us the tools to conduct these investigations using probes, instruments, soil and water testing kits, and the skills to guide students through this process. After I utilized these methodologies with my students, they themselves started focusing on issues such as maintaining control groups, being clear that there were only two variables, and accurately labeling data so that the results were being attributed to the right specimen.

### Student Outcomes

Students' data collection and recording has improved because they have higher levels of accountability for this data. When we return from the field, we compare data that students are collecting in the same GPS waypoint. This way we can see if there were any outliers in the dataset. The students are careful to record the data because they need to have it to enter in their spreadsheet.

My students participated in a research project on the melanistic mutation of the eastern gray squirrel, also known as the black squirrel. They were studying trends in their population and clustering. We were taking data on temperature, time of day, and acorn liter to see if there were any correlations between this data and population size.

My students presented their research in the OSSP at the Annual BOCES Celebration of Technology Fair in January of 2008.

## Inquiry-Based Research and an Aha! Moment

Michele Miller's fifth-grade students started out on a field trip to conduct field research on the environmental health of a nature preserve near their school and serendipitously discovered a population of black squirrels that should have been gray.

Michele, already in the middle of her three-year ACTS internship at BNL, quickly reached out to BNL's OEP and its ACTS mentors to help her formulate the protocols needed to explore this phenomenon. She and her students soon developed their own research tool, collected data and, using a GPS locator, posted their work to the web using Google Earth maps. Along the way, these fifth graders could also now explain melanistic mutations to their parents. Interest in the project grew beyond Michele's classroom to include the active involvement of people throughout the school's town of Lake Grove. Soon, community members were mailing in data collection sheets developed by the students and posting sightings to an e-board at the school's web site. *The New York Times* also featured this research in an article. Michele's natural enthusiasm for this authentic research has led to the adoption of field research activities by the entire grade level at her elementary school.





An ACTS teacher expanded an Open Space Stewardship Program within her school by first including one other grade level teacher in a field research project. Next year, an entire grade level will be participating in field research.





## Professional Outcomes

Incorporating new technologies for the students to bring with them into the field has changed our ecology unit. The students study surrounding ecosystems by measuring data and making connections to that data and the organisms living within their environment.

One of three teachers leading an OSSP Summer Workshop

Awarded a Proclamation from the Suffolk County Legislature for work organizing the OSSP Summer Workshops.

I gave a presentation at 2006 NSTA Regional Convention, Baltimore, MD.

## Student Outcomes

The students conduct research projects based on the environmental work studied at BNL. These projects are presented to parents during the district Science Fair, as well as at the BNL Open Space Stewardship Symposium.

The students have shown a greater understanding of the research that scientists conduct. They are showing greater interest in scientific fields after being exposed to newer technologies and actual scientific methods they themselves practice, rather than ones they only learn from reading a textbook.

By bringing new technology into the district and newer ideas for curriculum that I share with all other teachers within my department, all students, rather than just my own, have been exposed to the materials brought in from the DOE ACTS program.

## Laura Opitz

Science Teacher

### School District

Miller Place School District  
North Country Middle School  
Miller Place, NY

### Major

Biology

### Degrees

Bachelor of Arts, Biology  
Master of Arts, Liberal Sciences

### Recent Courses Taught

7th Grade General Science  
8th Grade General Science

### Related Work Experience

QA Chemist at Estee Lauder Labs

### ACTS Participation

2005, 2006

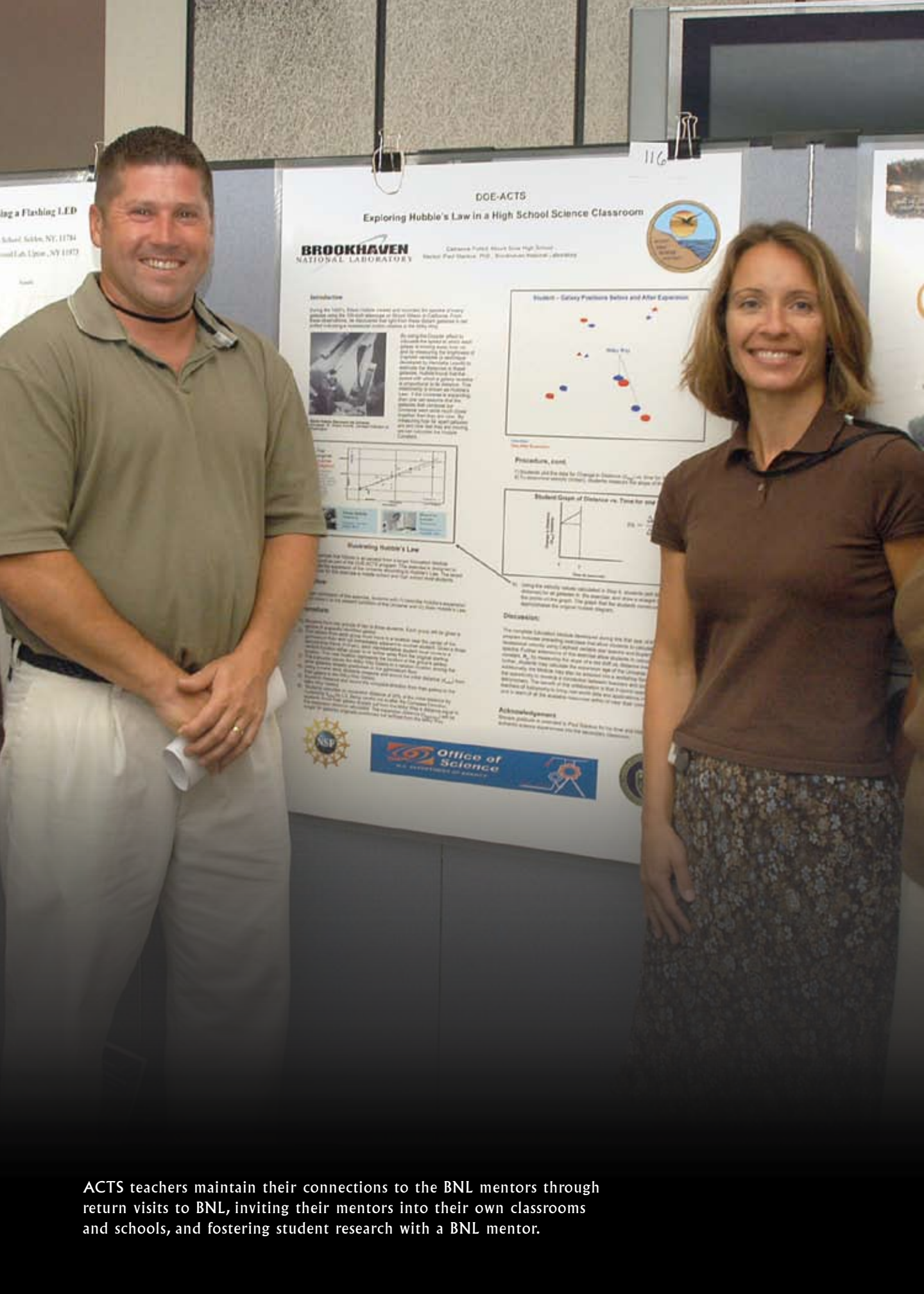
### BNL Mentor

Timothy Green (Environmental and Waste Management Services Division)

### Projects and Collaborations

"A Study of the Eastern Tiger Salamander Habitats at Brookhaven National Laboratory"

"Implementing the Open Space Stewardship Program and Teacher Workshops"



DOE-ACTS  
Exploring Hubble's Law in a High School Science Classroom

**BROOKHAVEN**  
NATIONAL LABORATORY

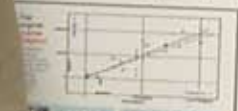
Catherine Pineda, Mount Saint High School  
Robert Paul Slavicek, PhD, Brookhaven National Laboratory

**Introduction**

Using the Hubble Space Telescope (HST) and records of galaxies in many groups along the Hubble sequence, we have observed the relationship between distance and redshift. We have also observed that galaxies in our local neighborhood are moving away from us at a rate proportional to their distance from us.



By using the Hubble Space Telescope (HST) and records of galaxies in many groups along the Hubble sequence, we have observed the relationship between distance and redshift. We have also observed that galaxies in our local neighborhood are moving away from us at a rate proportional to their distance from us.



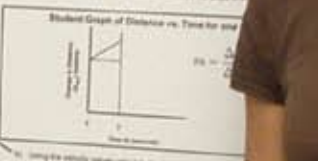
**Measuring Hubble's Law**

Hubble's Law states that the distance to a galaxy is proportional to its redshift. The Hubble constant,  $H_0$ , is the proportionality constant between distance and redshift. The Hubble constant is measured in kilometers per second per megaparsec (km/s/Mpc).

The Hubble constant is measured in kilometers per second per megaparsec (km/s/Mpc). The Hubble constant is measured in kilometers per second per megaparsec (km/s/Mpc). The Hubble constant is measured in kilometers per second per megaparsec (km/s/Mpc).



**Procedure, cont.**



**Discussion**

The complete Hubble's Law is derived during the first part of the program. Students are given a list of galaxies and their distances. They are then given a list of galaxies and their redshifts. They are then given a list of galaxies and their distances and redshifts. They are then given a list of galaxies and their distances and redshifts.

**Acknowledgements**

We thank the DOE-ACTS program for providing the opportunity for this project. We also thank the Brookhaven National Laboratory for providing the facilities for this project.

ACTS teachers maintain their connections to the BNL mentors through return visits to BNL, inviting their mentors into their own classrooms and schools, and fostering student research with a BNL mentor.

## Professional Outcomes

Prior to my first year at DOE-ACTS, I developed a senior-year Astronomy elective course. The course was designed as a mid-level elective option for science-oriented seniors. My first summer in the ACTS program focused on developing more course materials to supplement my existing program.

From my second year experience, my co-teacher and I developed three new lab activities for the Earth Science course. Two of the labs relate to the density of Earth materials and the third lab measures the porosity and permeability of Earth materials. The inspiration to develop these labs came as a result of our fieldwork with Jeff Fitts.

Although I have not completed my ACTS residency, I have maintained contact with the Education Department throughout the school year, and have established collaborative relationships with other educators at BNL. Outside of ACTS, I arranged for a science lab lesson at my high school through the Office of Educational Programs. The educator taught a lab developed by BNL educators titled Gene Transfer and Genetic Engineering to a group of thirty students during an after-school science program.

I think my experience in this program, thus far, has made me look at education and my approach to teaching science with a more critical eye. At this point, I think I am better able to discriminate among lessons that truly add educational value versus those that, while a whole lot of fun to do, may not necessarily advance student's knowledge. From my second year experience, I polished some lab skills that I had not used in many years. I believe this will benefit me in my classroom as far as teaching students to be more mindful of their own lab work and note taking skills.

## Student Outcomes

Along with a co-teacher, we have developed a new science club at Mt. Sinai that is designed to broaden the high school student's science experience. On a near-monthly basis, the students, approximately thirty, participate in a lab exercise at any one of four locations: BNL, SUNY Stony Brook, Cold Spring Harbor Labs, or Mt. Sinai High School. The labs span the range of science and engineering disciplines including physics, biology, chemistry, geology, and engineering.

## Catherine Pohlott

Secondary School Science Teacher

### School District

Mt. Sinai School District  
Mt. Sinai High School  
Mt. Sinai, NY

### Majors

Geology  
Geography

### Degrees

Bachelor of Arts, Biology  
Master of Arts, Liberal Sciences

### Certification

New York: General Science, Earth Science

### Recent Courses Taught

Earth Science  
Astronomy

### ACTS Participation

2007, 2008

### BNL Mentors

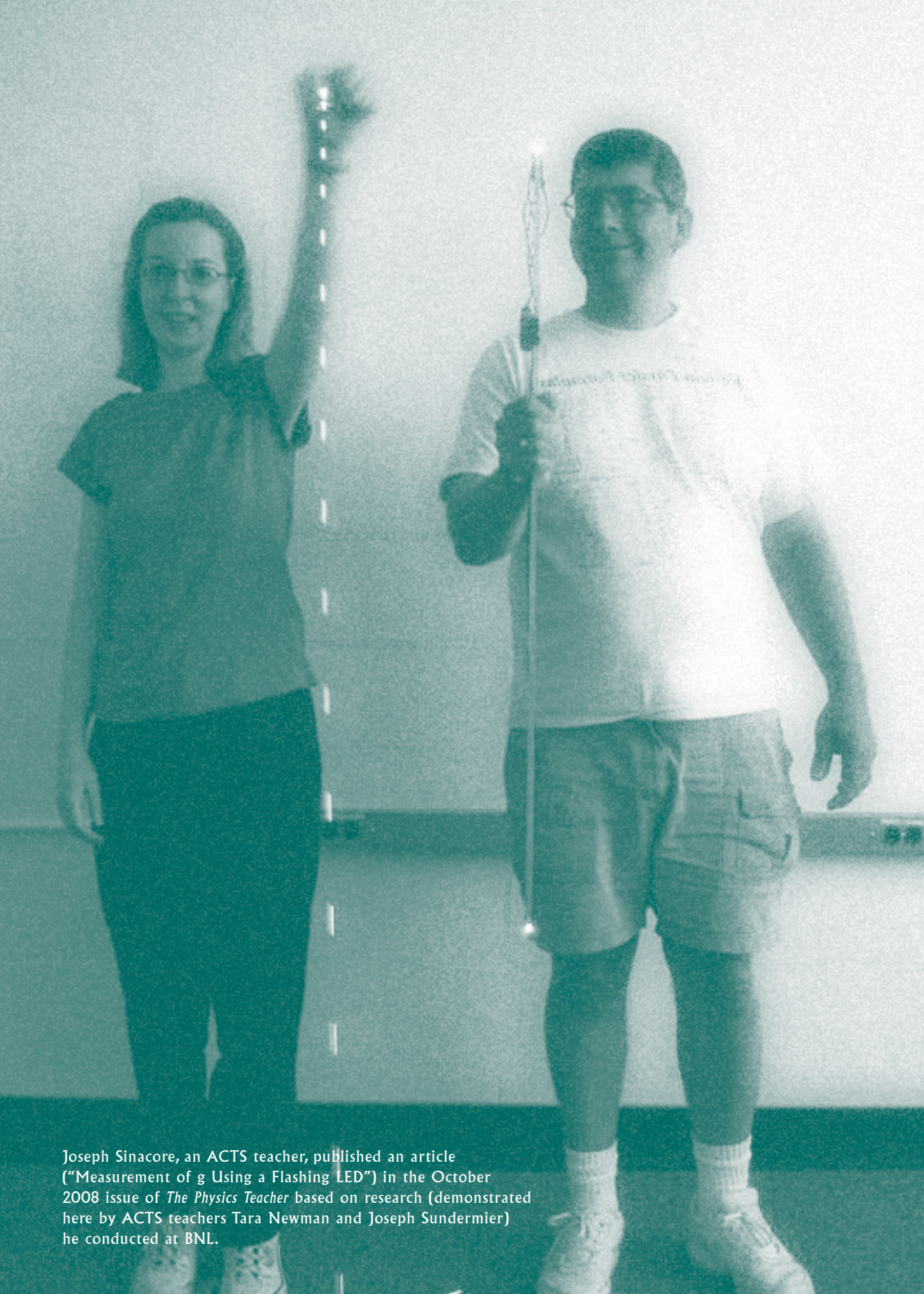
Paul Stankus (Physics)  
Jeff Fitts (Environmental Sciences)

### Projects and Collaborations

"Exploring Hubble's Law"

"Soil Characterization of Surface and Near-surface Sediments"





Joseph Sinacore, an ACTS teacher, published an article (“Measurement of  $g$  Using a Flashing LED”) in the October 2008 issue of *The Physics Teacher* based on research (demonstrated here by ACTS teachers Tara Newman and Joseph Sundermier) he conducted at BNL.

## Professional Outcomes

My experience in the DOE ACTS program has been different from that of my colleagues in the program. The typical participant spends the summer doing “hard” science research. Instead, I have been involved in physics education research. Since my mentor is deeply committed to improving physics education, I have had the opportunity to explore novel ways of presenting and demonstrating some of the physics covered in my classes. During my first summer, I helped design a new free fall lab using a flashing LED.

I am excited to announce that an article (“Measurement of  $g$  Using a Flashing LED”) describing the device and our experimental design has just been published in October 2008 issue of *The Physics Teacher*. Physics teachers across the country may use this experiment to engage their students in simple and inexpensive experiments that provide an accurate verification of the acceleration due to gravity.

Throughout the remainder of my time in the program, I hope to continue improving and updating traditional physics experiments in order to enhance and facilitate my students’ understanding of physics.

## Student Outcomes

Our experiment turned out to be very successful. The students enjoyed using digital cameras and computers to record and analyze data. I’ve now added a Microsoft Excel tutorial as a required part of my honors physics course. This powerful data analysis tool has become an integral part of our lab activities. Honestly, I was surprised to learn that most juniors and seniors have no familiarity with Excel. I hope that mastering it will also be an asset for my students in the future.

## Joseph Sinacore

Secondary School Physics Teacher

### School District

Middle Country Central Schools  
Newfield High School  
Selden, NY

### Major

Physics

### Degree

Master of Arts

### Certification

New York Permanent: Physics 7-12

### Recent Courses Taught

Physics Honors  
AP Physics

### ACTS Participation

2007, 2008

### BNL Mentor

Helio Takai (Physics)

### Projects and Collaborations

Flashing LED

Magnetic Pendulum and Telephone Pickup





## Caroline Singler

Secondary School Science Teacher

### School District

Lincoln-Sudbury School District  
Lincoln-Sudbury Regional High School  
Sudbury, MA

### Major

Geology

### Degrees

Bachelor of Science  
Master of Science

### Certification

Massachusetts: Earth Science 9-12

### Recent Courses Taught

Earth Science  
Practical Physical Science  
Aquatic Biology  
Environmental Science

### Professional Outcomes

This year I am preparing to implement a new environmental unit in my Earth Science classes that is based on the education module I developed during my first year at ACTS. I spent last year trying to streamline my Earth Science curriculum with the hope of freeing up time in the schedule to add this new unit.

Not specifically related to my work at BNL, but inspired by my desire to try new things and get my students out of the classroom, I am working with another Earth Science teacher to construct a dinosaur trackway in a parking lot at our school. We will use this for a series of lessons about observation and inference and scientific measurement and calculations in our introductory unit this year. This hands-on experience will replace paper activities that we typically used for this purpose.

I currently have no opportunity to develop new courses since most of our electives were cut due to budget constraints. My hope is to eventually teach Environmental Science again and make it a field-based course that incorporates concepts that I learned at BNL from the Open Space Stewardship Program, from my fieldwork, and from the courses I am taking using my professional development funds. I am selecting courses that are specifically geared towards field-based activities that can be incorporated into high school science classes.

My school is not big on formal "leadership" roles. I am a member of a couple of committees in the Science Department. I meet regularly with other Earth Science teachers to discuss how we teach different topics and collaborate on new activities or new spins on old activities. One of my colleagues actually commented to me during the last school year that she noticed that I was more outspoken and assertive at meetings. I don't know whether my BNL experience contributed directly to this, but I think it gives me more confidence to speak my mind, particularly regarding how (and why) we teach Earth Science, and how we assess our students. My hope is that as I try out new activities with my classes, I will be able to get other Earth Science teachers interested in doing them with their classes, too.



My participation in the BNL ACTS program has rejuvenated my interest in doing more field-based science with my classes. That is something that I wanted to do since I started teaching. In my early years, I focused more on figuring out how to teach and mastering the Earth Science curriculum, and I was not really ready to take a lot of risks and try new things. Now I have better ideas about ways to incorporate field studies into my courses without radically changing the scope of my curriculum, and I have some extra resources I can use to purchase equipment to conduct those activities. I think the BNL ACTS program has given me the confidence to try things and see what works rather than not trying something because I am afraid it won't work. I am also more aware of the different resources that are available to help me plan new activities.

Inspired by my BNL experience, I am taking courses to improve my knowledge of subject areas that are peripheral to those that I teach, but will help me better understand the connections between Earth Science and other sciences. I want to have a better sense of what my students will be expected to learn in subsequent science courses, especially Biology and Chemistry, and I hope to be able to prepare them better for those courses.

### **Related Work Experience**

Seven years as a geologist for an environmental consulting firm performing remedial investigations of hazardous waste sites in NY, NJ, PA, MD, MI, and VA.

### **ACTS Participation**

2007, 2008

### **BNL Mentor**

Timothy Green (Environmental and Waste Management Services Division)

### **Projects and Collaborations**

Wetland Delineation Study

"Influence of Physical Factors on Occurrence and Distribution of Tiger Beetles at Brookhaven National Laboratory"

"Using NOREMARK to Estimate Populations of Tiger Beetles at Brookhaven National Laboratory"

"A Comparison of Efficacies of Pitfall Trapping to Netting of Tiger Beetles"

"Has the American burying beetle (*Nicrophorus americanus*) been extirpated from Brookhaven National Laboratory?"





## ACTS and Empowering Leadership

It started with a river that ran through both communities.

Having spent the first year of their ACTS internship at Brookhaven National Laboratory (BNL) learning the protocols and techniques needed to develop baseline limnology data for vernal pools, Amy Meyer and Ivan Suarez started their second year internship by realizing that they could apply what they had learned to develop a curriculum unit that featured field research techniques to study the water quality of the Carmans River, the river that ran through both of their school districts on Long Island.

After a few conversations with Mel Morris and Ken White, from BNL's Office of Educational Programs (OEP), it didn't take everyone too long to realize that this collaboration between two teachers in neighboring districts could be the basis for a larger collaboration between school districts across Long Island. After all, the open ocean and sheltered bays, the tracts of open land and dense pine barrens, the rivers, streams, ponds, marshes, and lakes of Long Island offered an array of opportunities for field research. Additionally, the US Fish and Wildlife Service, the New York State Department of Environmental Conservation, the Long Island Pine Barrens Commission, the Suffolk County Department of Parks and Recreation, among others, were already committed to preserving and maintaining the natural resources of Long Island. What these elements now needed was the catalyst to bring all of the pieces—science research, education, nature, and conser-



# Amy Meyer, Ivan Suarez, and Laura Opitz



vationists—together. The DOE ACTS program offered a natural way for teachers to create authentic research activities focusing on the environmental health of the students' own communities through partnerships with local and state agencies committed to the environment, or as it is now known: The Open Space Stewardship Program (OSSP).

Amy and Ivan, along with another ACTS intern, Laura Opitz, spent the remainder of their ACTS internship working with their BNL mentor, Timothy Green, developing the activities and scientific protocols needed to conduct field research that was based on sound scientific research principles. Their work led to them creating and leading the first OSSP Summer Workshop for teachers. Subsequent to completing their ACTS internship, Amy and Ivan have continued to serve as leaders of the OSSP Summer Workshop for teachers sponsored by BNL through the OEP.

Their enthusiasm for this project and the constant support of the OEP for this program has seen it grow from the initial work of Amy, Ivan, and Laura to a program that now involves nearly one hundred teachers in thirty schools and over one thousand of their students in authentic environmental research.

And it all started with a river.





## Ivan Suarez

Science Teacher

### School District

Longwood Central School District  
Longwood High School  
Middle Island, NY

### Majors

Chemistry  
Biology

### Degrees

Bachelor of Science, Chemistry, Biological Sciences  
Master of Science, Secondary Education

### Certification

New York: Biology, Chemistry; Administrative Certification pending internship completion 10/28/08

### Recent Courses Taught

Chemistry  
AP Environmental Sciences  
Biology  
Marine Science  
Human Ecology  
Meteorology

### Professional Outcomes

I now include soil and water analysis in my Chemistry and AP Environmental Science classes. I have also had students collect and identify aquatic macroinvertebrates from the Carmans River in my Human Ecology and Environmental Science classes as a means of assessing water quality in the river.

The Open Space Stewardship Course at Longwood High School is a direct product of my experience at BNL. Every technique I have learned from Dr. Green as well as those I have learned from the courses I took with the ACTS grant money are implemented in this course.

I have also started the AP Environmental Science Course at Longwood High School.

I have been teaching the Open Space Stewardship Course to teachers for the past three summers. This course is designed to teach educators the protocols they need to gather field data with their students. I have also taught a high school chemistry course at BNL for Scott Bronson and the Center for Environmental Molecular Sciences (CEMS) at BNL.

I am in the process of developing an instructional DVD focusing on the science protocols that are taught in the Open Space Stewardship Program. Dr. Timothy Green (Environmental and Waste Management Services Division) has secured a grant from the National Grid Foundation to videotape and produce a not-for-profit DVD for teachers to get teachers involved with field studies.

I am now a mentor for several teachers in my school district who have taken my course and are involved with field studies with their students.

These BNL ACTS experiences have had a dramatic impact on my life. I am constantly looking for areas in my curriculum to incorporate field research ideas. I am now active in changes in my community and have attended and presented my ideas at Town Hall meetings. The courses I have taken with the grant money from the ACTS

## ACTS Participation

2003, 2004, 2005

### BNL Mentor

Timothy Green (Environmental and Waste Management Services Division)

### Projects and Collaborations

2003: Pond Limnology

Using an EPA water sampling protocol, I developed baseline limnology data for man-made and natural vernal ponds at BNL and also worked with other summer research students to capture and identify dragonflies and damselflies, to track turtles, and to check traps and cover-boards for endangered tiger salamanders.

2004: Pond Limnology

Using similar techniques to gather our second year of pond chemistry data, I worked with Dr. Rita Hegeveick from North Carolina A & T. In this second year, my summer program partner and I also developed a unit plan that would include the field research techniques we were learning at BNL.

2005: Open Space Stewardship Program

This summer an ACTS colleague and I developed scientific field research protocols we incorporated into an OSSP teacher workshop course we were implementing at BNL.

program have had a major influence on my teaching and my enthusiasm for science in my classroom.

For me, this was the single best experience I have had in my teaching career. I have achieved exactly what this program was designed for. I learned new science techniques, developed programs, and taught what I learned to other teachers. Because of the ACTS program and the people at BNL, I have networked and developed relationships with the entire Office of Educational Programs at BNL, members of the Department of Environmental Conservation, the Fish and Wildlife Management Services, the Suffolk County Parks Department, local community conservation groups, Town Board Members as well as research scientists. All because of the ACTS program and the folks at BNL. We all have developed a mutual support structure that has been a critical part of my educational career. I would recommend that this very important program continue to support and encourage science teachers grow in their chosen profession. Thank you for the opportunity to be part of ACTS program.

### Student Outcomes

My experiences at BNL have influenced my students. Many of my students over the last three years have taken a serious academic interest in studying science.

The greatest influence this experience has had is reflected in how my students present their research. They have developed and improved communication and presentation skills. Their lab reports are now of professional quality and the poster and PowerPoint presentations are impressive.

Because of the ACTS program at BNL, I have opened doors for some of my students to experience the educational programs BNL offers.

My AP Environmental class inspired three of my students to attend Stony Brook Southampton College for environmental studies.



The purchase of cutting edge equipment for a classroom and an entire school has allowed for authentic learning experiences. For example, students in an elementary school classroom now work with a digital scale that reinforces through authentic research the value of decimal places in their data collection.







## Professional Outcomes

I have included the use of muons in the section on modern physics.

The DOE ACTS program allowed me to form lasting relationships with other teachers and scientists at BNL. This has influenced my teaching in many ways.

I gave presentations at the NSTA Conference in California and the AAPT Conference in Baltimore.

## Student Outcomes

Student research continues to be more authentic.

## Joseph Sundermier

Physics Teacher

### School District

Deer Park School District  
Deer Park High School  
Deer Park, NY

### Majors

Biology  
Math Education

### Degrees

Associate of Science  
Bachelor of Science  
Master of Science

### Certification

New York: Biology, Chemistry, Physics,  
and Mathematics

### Recent Courses Taught

AP Physics  
Regents Physics

### Related Work Experience

Computer programming in RPG II

### ACTS Participation

2004, 2005, 2006

### BNL Mentor

Helio Takai

### Projects and Collaborations

"MARIACHI: Looking for Ultra High  
Energy Cosmic Rays Above Long Island"



Michael Vaccariello, an ACTS teacher, from Sachem High School East, and his students continue to participate in the BNL sponsored MARIACHI Project to study cosmic rays. He has installed cosmic ray scintillators in his school's research classroom and sends his results to the BNL MARIACHI Project for inclusion in their study.



## Michael Vacariello, PhD

Secondary School Science Research  
Teacher

### Professional Outcomes

Summer one enabled me to help students develop physics-based independent research projects. In addition to the cosmic ray research, students developed projects on Brownian Motion and the Curie Effect.

I brought Particle Physics to the High School Research Laboratory. We now have cosmic ray scintillators networked in the research room as part of the BNL MARIA-CHE Experiment to study Cosmic Rays.

Dr. Helio Takai has helped as a science advisor for both my students and me. He is currently mentoring two of my Senior Research Students. Last May, Dr. Takai was the keynote speaker at the Sachem High School East Science Research Symposium. He is a vital resource for any research student that wants to pursue physics-based research.

The most valuable thing about DOE-ACTS is the connections that I make with scientists. Last summer, I was able to connect with a very supportive Particle Physicist. This summer, my students and I are getting help from Dr. John Dunn. With his guidance and expertise, I will be able to incorporate Molecular Biology Research into my High School Research Program.

### Student Outcomes

One student earned first place in the physics category at the New York State Science and Engineering- Andromeda Science Fair.

My students have better access to scientific expertise as a result of my experiences in the Physics Department at BNL.

As a result of my involvement in physics last summer, I had five students participate in the MARIACHI Workshop for Cosmic Ray Research, a one-week course at Stony Brook University.

### School District

Sachem Central School District  
Sachem High School East  
Farmingville, NY

### Majors

Biology  
Secondary Science Education  
Pathology

### Degrees

Bachelor of Science  
Master of Science  
Doctor of Philosophy

### Certification

New York Secondary Science: Biology,  
Chemistry, Physics, General Science

### Recent Courses Taught

Science Research (9, 10, 11, 12)

### Related Work Experience

Lab Tech, Research Tech, PhD Graduate  
Student, Post-Doc

### ACTS Participation

2007, 2008

### BNL Mentors

Helio Takai (Physics)  
John Dunn (Biology)

### Projects and Collaborations

"DOE ACTS: Bridging the Gap—Bringing  
Physics to the High School Research  
Classroom"

"PCR-Based Analysis of Human Patho-  
gens in Amblyomma and Ixodes Ticks  
at Brookhaven National Laboratory"



Stephen Wefer, a Sachem High School East science teacher, was awarded a \$10,000 Toyota Tapestry Grant to incorporate Bioinformatics into his genetics classroom.





## Stephen Wefer

Science Teacher

### Professional Outcomes

I was awarded a \$10,000 Toyota Tapestry Grant to incorporate Bioinformatics into my genetics classroom. As a result of this award, my colleagues now seek me out for help with writing their own grants.

I am currently writing a manuscript on International Brain Awareness Week in the Secondary Schools.

I still maintain contact with Dr. Thanos on a regular basis. Additionally, I stay connected with the staff at the BNL OEP. For example, we are planning videoconferencing sessions this year. Furthermore, this past summer I worked at BNL's Science Learning Center to develop science lessons and to teach elementary students science as a member of their staff.

In other words, even through my DOE ACTS program has expired, I am still very much connected with Brookhaven National Laboratory in a long lasting relationship.

### Student Outcomes

One of my Sachem students (an HSRP participant) worked along my side me during my third year while I was a DOE ACTS participant and as a result, he is now working independently in the Thanos Lab at BNL throughout the year. He received the "Arthritis Foundation Fellowship," a \$2,000 grant, to continue his research at BNL.

My students are more aware of what happens in the real world of science rather than just learning about topics in a text book.

### School District

Sachem School District  
Sachem High School East  
Farmingville, NY

### Majors

Biology  
Genetics

### Degrees

Bachelor of Science  
Master of Science  
Doctor of Philosophy

### Certification

Secondary Biology

### Recent Courses Taught

Advanced Placement Biology  
Genetics  
Living Environment

### ACTS Participation

2005, 2006, 2007

### BNL Mentor

Dr. Peter Thanos

### Projects and Collaborations

The Brain Awareness Week Unit, a result of my collaboration with Dr. Peter Thanos, enabled me to bring neuroscience into the classroom. I attended the Society for Neuroscience conferences to glean ideas for incorporating neuroscience in education.

Sachem East became the only high school in NYS to celebrate Brain Awareness Week.



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Office of Educational Programs

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Workforce of the Future*