Project Smart Team Action Report Form

Using Common Core Learning Standards & Data to Improve Student Achievement

Teacher(s)/School: James Hefti / Pulaski Senior High School

SUNY Oswego faculty member: Sue Witmer

Teacher Participant Names: James Hefti

Project or Team Name: High School Biology Participation in Citizen Science Programs

Please answer the following questions:

Action: Describe your CCLS project. Which CCLS standards will you target?

My Biology classes at Pulaski High School are making connections with the Common Core Learning Standards through participation in citizen science programs. For those whom are not familiar with what citizen science is it is public participation in scientific research conducted, in whole or in part, by amateur or non-professional scientists. "You don't have to work in a laboratory or wear a white coat to be a scientist. In fact, you don't even have to have any formal training. Average citizens are getting involved in the scientific process every day by participating in citizen science, a movement in which volunteers are helping professional scientists collect and analyze data." (http://money.howstuffworks.com/economics/volunteer/information/citizen-science.htm)

High school student participation in citizen science makes sense because students get an opportunity to apply what they have learned, become exposed to large-scale research and get involved with projects that they can continue on with after Biology class and the school year is over.

The citizen science programs that the Pulaski Biology students will be involved with are the World Water Monitoring Challenge (WWMC) and the Cornell Lab of Ornithology citizen science programs eBird and Project FeederWatch. Through the World Water Monitoring Challenge Pulaski students will be learning about some environmental testing protocols and performing water quality analyses on local bodies of water. Through the Cornell programs students will be learning about birds and the environmental issues affecting them and the conservation efforts taking place to protect them.

The Common Core Learning Standards that my citizen science project addressed follow:

Academic Level - MST1.C.SI2: Commencement

Performance Indicator - MST1.C.SI2A:
Students devise ways of making observations to test proposed explanations.

Major Understandings - 2.1a:
Design and/or carry out experiments, using scientific methodology to test proposed calculations
Major Understandings - 2.1a:
Design an experiment to investigate the relationship between physical phenomena

Performance Indicator - MST1.C.SI2B:
Students refine their research ideas through library investigations, including electronic information retrieval and reviews of the literature, and through peer feedback obtained from review and discussion.

Major Understandings - 2.2a:
Use library investigations, retrieved information, and literature reviews to improve the experimental design of an experiment
Major Understandings - 2.2a:
Development of a research plan involves researching background information and understanding the major concepts in the area being investigated. Recommendations for methodologies, use of technologies, proper equipment, and safety precautions should also be included.

Performance Indicator - MST1.C.SI2C:
Students develop and present proposals including formal hypotheses to test explanations, e.g., predict what should be observed under specific conditions if the explanation is true.

Major Understandings - 2.3a:
Develop research proposals in the form of "if X is true and a particular test Y is done, then prediction Z will occur"
Major Understandings - 2.3c:
Development of a research plan for testing a hypothesis requires planning to avoid bias (e.g., repeated trials, large sample size, and objective data-collection techniques).
Major Understandings - 2.3b:
Hypotheses are widely used in science for determining what data to collect and as a guide for interpreting the data.
Major Understandings - 2.3a:
Hypotheses are predictions based upon both research and observation.

Performance Indicator - MST1.C.SI2D:
Students carry out a research plan for testing explanations, including selecting and developing techniques, acquiring and building apparatus, and recording observations as necessary. (Note: This could apply to many activities from simple investigations to long-term projects.)

Major Understandings - 2.4a:
Test sediment properties and the rate of deposition
Major Understandings - 2.4a:
Determine safety procedures to accompany a research plan

Rationale: Fully state your **rationale** for the project. Why is this work important?

The potential in citizen science is that participation allows students to apply what they are learning about in class and be a part of large-scale research projects. Researchers from Cornell University studying the impact of citizen science programs on achievement have stated that "Participating in a citizen-science project helps advance scientific discovery, enhances your personal discoveries… and contributes to better understanding…" (http://www.allaboutbirds.org/page.aspx?pid=1162).

Inclusion of citizen science projects in high school science will enhance my students' biology experience for the following reasons:

- Increased relevance of course content
- Increased number of nonfiction reading opportunities (protocols and handbooks) to be completed outside of class
- Increased opportunities to utilize and expand technology skills
- Increased exposure to potential careers in science
- Increased need for high quality communications – both verbal and written
- Increased opportunities for students to stay involved with course content out of the classroom and beyond the school timeline
- Increased motivation to engage with biology course content

Responsibilities/Timeline: Identify a series of **action steps** you will take to complete your project. Next to each step, identify person(s) **responsible** for carrying out that task. For each step also identify your **timeline** (during what month(s) you plan to complete each step).

In order for my students' participation in citizen science project to be successful I needed to complete the following steps on or around the dates listed:

1. Identified relevant curricular places to include activities for each of these projects *(September – J. Hefti).*
2. Made decisions about lessons in my existing program that could be substituted or enhanced with citizen science *(September – J. Hefti).*
3. Trained myself in important citizen science protocol to follow and became proficient with project specific technological skills *(October – J. Hefti).*
4. Identified science infrastructure needs to participate in citizen science projects and procured equipment *(October-November – J. Hefti).*
5. Became adept at the use of project specific equipment and developed a plan for training students on the proper utilization of said materials *(December – J. Hefti).*
6. Amended unit plans to include desired activities (Dec*ember – J. Hefti).*

7. Delivered instruction on projects *(January-May – J. Hefti).*
    - **Mid-January:** biology students learned about ornithology, the branch of biology that focuses on the study of birds.
    - **Early February:** students learned how to use probewear to collect data.
    - **Mid-February:** set up accounts and entered initial eBird observations.
    - **Late February:** students continued to learn how to use probewear to make detailed measurements.
    - **March:** students monitored bird behavior and did some projects on local bird species.
    - **April:** students performed environmental testing (including water quality sampling in the Salmon River) and continued on with their bird studies.
    - **May:** students wrapped up their bird investigations, explored potential careers in biology and the environment and researched other citizen science programs with which they might want to get involved.

Evaluation: What **data** will you collect that shows the impact of your project on student achievement of CCLS? How will you document student learning? Teacher learning?

In order to document the impact of my project on student achievement pre-test and post-tests were administered for each citizen science program for which we participated. The results from these allowed me to discern the prior knowledge that students possessed regarding citizen science programs and the level of intended learning to result from project activities.

Student learning will be documented by the changes observed as a result of actual participation in citizen science. It makes sense to assume that any differences in survey results and opinions observed in post-test responses will be the result of the experiences gained while participating in citizen science. Pre-tests and post-tests will be given for What is Citizen Science, eBird, Project FeederWatch and the World Water Monitoring Challenge. A follow-up survey will also be given to inquire about students' attitudes and their feelings about participating in these projects.

Teacher learning will be documented by examining two examples of change: the volume of alterations in the learning activities schedule and the changing emphasis on literacy instruction. A large number of changes represents a significant amount of learning – in order to modify plans a teacher must be knowledgeable about the new concepts, skills and techniques for which instruction will take place. The emphasis on literacy is not new to science education, but the need to be intentional in planning and for teachers to select activities that lend themselves to providing students opportunities to utilize high quality communication skills is a definite change.

Resources: What resources will you need for this project? What costs, if any, will be incurred? What are possible sources of funding for needed resources?

To upgrade environmental testing equipment for the World Water Monitoring Challenge I purchased a Vernier LabQuest 2 standalone interface for collecting data. It has a high-resolution touch screen that makes it easy and intuitive to collect, analyze and share data from experiments. It also has wireless connectivity that simultaneously allows an entire classroom of laptop users to analyze data that were collected with any of the 70 or so available sensors.

For the Cornell Lab of Ornithology citizen science programs I needed to obtain bird-watching equipment. I purchased three pairs of binoculars for viewing birds (and other forms of wildlife), a bird feeder and bird feed and bird identification books and posters. Project FeederWatch required a nominal registration fee.

Funding for all of these supplies and equipment was provided by Entergy for Project SMART. There were expenses that were beyond my school's annual equipment budget so I am thankful for the support I was provided. Now that I have procured a data logger I will most likely be able to purchase different sensors each year through my school's budget to create a versatile repertoire of probes to be used for future data collection.

Analysis of Data on Teacher Learning: We examined our reflections on the 6 shifts, and CCLS and found the following: (Support each claim with examples/evidence)

I found that implementing change as outlined in the Common Core Learning Standards can be much easier to do when you have a mission upon which to rally. Our mission was citizen science… since the programs in which we participated required a great deal of new skills and attainment of new vocabulary, we rallied around nonfiction reading, technical writing (and reporting) and verbal communication.

Some of the nonfiction readings performed by students included overviews of bird species, instructions for performing bird counts, instructions for reporting bird counts, a handbook for how-to attract birds and maintain their habitats, blog posts about water monitoring experiences, information sheets about water quality indicators, a scenario regarding a true story of water pollution, water quality reports and other readings.

As for technical writing we created detailed reports of observations following standard protocols associated with each of our citizen science programs. Project FeedWatch has a detailed series of observations to be submitted electronically; students must be pin-point accurate in their reporting of else they run the risk of sharing invalid data that could skew professional ornithologists' projects.

To participate in eBird students also need to practice technical writing. Observations need to be recorded a certain way and again should be submitted electronically. The World Water Monitoring Challenge required data entry online and encouraged individuals or groups to upload a blog post that described the water monitoring experience. I required each student to write their own blog post of our experiences and then had students peer-edit one of their classmates blog posts. Based on classroom voting results we uploaded the blog post students felt was the most outstanding to represent our experiences with citizen science programs.

Our participation in citizen science programs also entailed working on verbal communication skills. Besides the standard "make eye contact" and "project your voice" public speaking skills that were emphasized, students were also instructed on how to plan out an oral report for efficiency and clarity.

While there were times when students were required to step out of their comfort zone of simply reading results, most students enjoyed the opportunity to present findings in a safe and supportive classroom environment. Much progress was made between January and May and the communication component of the CCLS was definitely as much of a highlight to this project as learning about birds or water quality testing.

Analysis of Data on Student Learning: We examined _______________ and found _________________ (Give examples/evidence for each claim).

I examined students' opinions regarding water conservation and found out that students participating in the World Water Monitoring Challenge were four times more likely to conserve precious water resources than students that did not get involved with water quality testing. Survey results indicated that students highly regarded water conservation. Given the fact that the only difference between the instructional program of the student population surveyed was that half the students took part in a citizen science program that entailed learning about water quality indicators and then performing environmental assessments, it can be deduced that the impact of participation is what contributed to students' desire to care for aquatic ecosystems and reduce water consumption.

My feeling is that students took an interest in preserving water resources because they tested water quality at several locations and realized that water quality is not the same everywhere. Participation contributed to understanding and where there is understanding there will likely be concern. At a ratio of 4:1 I would say that students that have become involved with large-scale research projects are clearly more concerned about water issues.

I examined students' willingness to protect and/or improve habitats for birds and found that students whom made observations and submitted their findings to eBird or Project FeederWatch were five times more likely to want to be good environmental stewards than students whom did not participate in Cornell Lab of Ornithology citizen science programs. In Project FeederWatch students observed birds visiting a feeder outside our biology classroom and developed a connection with them as they saw certain species from day to day. As a result of submitting data to eBird students were able to build long-term checklists of species encountered and this generated interest in adding to lists as often as possible.

The conversations students had focusing on birds often included empathy for birds and making sure that the feeder had enough food for all visitors. As a result of these experiences I believe students wanted to do more. They wanted to put up feeders so that they could continue to make observations and learn more about birds. Students wanted to take care of the birds and their habitats at a ratio of 5:1 for participants compared to non-participants. Again, survey results clearly indicate that participation in citizen science generates valuable outcomes.

I examined students' attitudes toward getting involved with other citizen science programs and found that students whom participated in eBird, Project FeederWatch and the World Water Monitoring Challenge as biology students in my classes were ten times more likely to seek out a program that they could be a part of even if it was not affiliated with an instructional activity at school than students whom did not participate. My students indicated that they wanted to continue on with citizen science programs which I feel speaks very well of their experiences!

The ratio of 10:1 is a bold statement that citizen science is an effective teaching tool that creates a high level of motivation. The unconventional instruction that occurs by participating in citizen science seems to be a welcomed divergence from the normal classroom routine. Data collection, data entry, sharing – all of these aspects of citizen science allowed students to apply what they learned from traditional classroom instruction, but I am most impressed by the fact that students want to find other programs in which they can make observations and then submit their findings.

Opinions of Citizen Science Non-Participants

Citizen Science Opinions	1	2	3	4	5	6	7	8	9	10
Strongly disagree	11	2	4	7	9	2	5	7	8	2
Disagree	13	7	5	3	10	1	4	7	7	10
Neutral	16	37	32	28	22	31	8	26	21	34
Agree	4	0	3	10	3	6	16	4	4	1
Strongly agree	6	4	6	2	6	10	17	6	10	3

Opinions of Citizen Science Non-Participants

Citizen Science Opinions	1	2	3	4	5	6	7	8	9	10
% Positive response	20.0	8.0	18.0	24.0	18.0	32.0	66.0	20.0	28.0	24.0
% Indifferent response	32.0	74.0	64.0	56.0	44.0	62.0	16.0	52.0	42.0	68.0
% Negative response	48.0	18.0	18.0	20.0	38.0	6.0	18.0	28.0	30.0	8.0

Pre-Test Results

Citizen Science Opinions	1	2	3	4	5	6	7	8	9	10
Strongly disagree	1	5	8	10	4	3	12	14	4	10
Disagree	0	3	4	12	3	3	6	5	3	12
Neutral	34	16	24	4	21	30	12	2	5	7
Agree	3	10	4	14	7	6	5	3	6	11
Strongly agree	3	9	3	3	8	1	8	19	25	3

Citizen Science Attitudes & Aptitudes	1	2	3	4	5	6	7	8	9	10
Strongly disagree	30	28	21	32	40	29	32	22	21	30
Disagree	5	3	12	3	3	10	4	10	6	10
Neutral	5	3	3	0	0	4	4	2	1	0
Agree	1	5	5	4	0	0	2	6	5	3
Strongly agree	2	4	2	4	0	0	1	3	10	0

eBird Attitudes & Aptitudes	1	2	3	4	5	6	7	8	9	10
Strongly disagree	29	22	34	43	40	29	13	8	12	2
Disagree	8	21	8	0	3	11	11	2	1	7
Neutral	1	0	0	0	0	3	5	32	15	2
Agree	2	0	0	0	0	0	7	0	6	4
Strongly agree	2	0	1	0	0	0	7	1	9	28

Project FeederWatch Attitudes & Aptitudes	1	2	3	4	5	6	7	8	9	10
Strongly disagree	10	32	40	24	43	30	43	12	30	21
Disagree	12	3	3	8	0	3	0	16	5	2
Neutral	3	4	0	2	0	3	0	4	4	11
Agree	9	4	0	3	0	5	0	10	4	6
Strongly agree	9	0	0	6	0	2	0	1	0	3

World Water Monitoring Challenge Attitudes & Aptitudes	1	2	3	4	5	6	7	8	9	10
Strongly disagree	0	35	28	35	35	2	1	1	20	6
Disagree	7	5	7	8	6	2	4	0	1	5
Neutral	7	3	3	0	2	39	28	3	20	18
Agree	6	0	3	0	0	0	10	4	2	10
Strongly agree	5	0	2	0	0	0	0	35	0	4

Pre-Test Results

Citizen Science Opinions	1	2	3	4	5	6	7	8	9	10
% Positive response	14.0	44.2	16.3	39.5	34.9	16.3	30.2	51.2	72.1	32.6
% Indifferent response	82.9	39.2	55.8	9.3	48.8	64.8	27.4	4.7	11.6	16.3
% Negative response	2.3	18.6	27.9	51.2	16.3	14.0	41.9	44.2	16.3	51.2

Aptitudes	1	2	3	4	5	6	7	8	9	10
% Positive response	7.0	20.9	16.3	18.6	0.0	0.0	7.0	20.9	34.9	7.0
% Indifferent response	11.6	7.0	7.0	0.0	0.0	9.3	9.3	4.7	2.3	0.0
% Negative response	81.4	72.1	76.7	81.4	100.0	90.7	83.7	74.4	62.8	93.0

eBird Attitudes & Aptitudes	1	2	3	4	5	6	7	8	9	10
% Positive response	9.3	0.0	2.3	0.0	0.0	0.0	32.6	2.3	34.9	7.0
% Indifferent response	2.3	0.0	0.0	0.0	0.0	7.0	11.6	74.4	34.9	4.7
% Negative response	86.0	100.0	97.7	100.0	100.0	93.0	55.8	23.3	30.2	20.9

Project FeederWatch Attitudes & Aptitudes	1	2	3	4	5	6	7	8	9	10
% Positive response	41.9	9.3	0.0	20.9	0.0	16.3	0.0	25.6	9.3	20.9
% Indifferent response	7.0	9.3	0.0	4.7	0.0	7.0	0.0	9.3	9.3	25.6
% Negative response	51.2	81.4	100.0	74.4	100.0	76.7	100.0	65.1	81.4	53.5

World Water Monitoring Challenge Attitudes & Aptitudes	1	2	3	4	5	6	7	8	9	10
% Positive response	25.6	0.0	11.6	0.0	0.0	0.0	23.3	90.7	4.7	32.6
% Indifferent response	16.3	7.0	7.0	0.0	4.7	90.7	65.1	7.0	46.5	41.9
% Negative response	16.3	93.0	81.4	100.0	95.3	9.3	11.6	2.3	48.8	25.6

Post-Test Results

Citizen Science Opinions	1	2	3	4	5	6	7	8	9	10
Strongly disagree	3	20	8	9	1	4	10	3	9	4
Disagree	2	8	27	10	5	2	2	2	10	6
Neutral	2	1	0	0	1	1	4	3	8	0
Agree	22	11	4	1	4	1	7	11	5	3
Strongly agree	14	3	4	23	32	35	20	24	11	30

Citizen Science Attitudes & Aptitudes	1	2	3	4	5	6	7	8	9	10
Strongly disagree	4	0	0	3	6	8	7	5	9	4
Disagree	6	0	2	3	5	3	4	2	6	10
Neutral	2	0	3	2	5	4	10	12	9	6
Agree	20	3	10	10	13	12	10	10	9	11
Strongly agree	11	40	28	25	14	16	12	14	10	12

eBird Attitudes & Aptitudes	1	2	3	4	5	6	7	8	9	10
Strongly disagree	0	6	5	6	7	3	2	2	3	1
Disagree	0	5	10	2	6	8	3	1	3	0
Neutral	0	2	10	1	12	7	4	4	1	0
Agree	3	9	2	9	3	11	4	10	13	7
Strongly agree	40	21	15	24	15	14	30	26	23	35

Project FeederWatch Attitudes & Aptitudes	1	2	3	4	5	6	7	8	9	10
Strongly disagree	6	3	6	6	10	8	6	4	6	10
Disagree	3	1	2	2	12	9	8	3	4	3
Neutral	2	0	8	4	4	3	5	3	11	3
Agree	10	3	9	11	10	10	14	20	10	4
Strongly agree	22	36	18	20	7	13	10	13	12	23

World Water Monitoring Challenge Attitudes & Aptitudes	1	2	3	4	5	6	7	8	9	10
Strongly disagree	0	0	4	2	5	3	8	0	20	1
Disagree	2	0	10	0	5	3	20	0	8	0
Neutral	0	0	7	10	15	3	10	0	5	10
Agree	7	3	12	7	12	0	4	3	6	4
Strongly agree	34	40	10	24	6	34	1	40	4	28

Post-Test Results

Citizen Science Opinions	1	2	3	4	5	6	7	8	9	10
% Positive response	83.7	32.6	18.6	55.8	83.7	83.7	62.8	81.4	37.2	76.7
% Indifferent response	4.7	2.3	0.0	0.0	2.3	2.3	9.3	7.0	18.6	0.0
% Negative response	11.6	65.1	81.4	44.2	14.0	14.0	27.9	11.6	44.2	23.3

Citizen Science Attitudes & Aptitudes	1	2	3	4	5	6	7	8	9	10
% Positive response	72.1	100.0	88.4	81.4	62.8	65.1	51.2	55.8	44.2	53.5
% Indifferent response	4.7	0.0	7.0	4.7	11.6	9.3	23.3	27.9	20.9	14.0
% Negative response	23.3	0.0	4.7	14.0	25.6	25.6	25.6	16.3	34.9	32.6

eBird Attitudes & Aptitudes	1	2	3	4	5	6	7	8	9	10
% Positive response	100.0	69.8	39.5	76.7	41.9	58.1	79.1	83.7	83.7	97.7
% Indifferent response	0.0	4.7	23.3	2.3	27.9	16.3	9.3	9.3	2.3	0.0
% Negative response	0.0	25.6	34.9	18.6	30.2	25.6	11.6	7.0	14.0	2.3

Aptitudes	1	2	3	4	5	6	7	8	9	10
% Positive response	74.4	90.7	62.8	72.1	39.5	53.5	55.8	76.7	51.2	62.8
% Indifferent response	4.7	0.0	18.6	9.3	9.3	7.0	11.6	7.0	25.6	7.0
% Negative response	20.9	9.3	18.6	18.6	51.2	39.5	32.6	16.3	23.3	30.2

World Water Monitoring Challenge Attitudes & Aptitudes	1	2	3	4	5	6	7	8	9	10
% Positive response	95.3	100.0	51.2	72.1	41.9	79.1	11.6	100.0	23.3	74.4
% Indifferent response	0.0	0.0	16.3	23.3	34.9	7.0	23.3	0.0	11.6	23.3
% Negative response	4.7	0.0	32.6	4.7	23.3	14.0	65.1	0.0	65.1	2.3

2012-2013 Reflection
James Hefti
SUNY Oswego / Project SMART / Entergy

The main focus of my SUNY Oswego / Project SMART / Entergy project was to find out if participation in citizen science projects with high school biology students would increase interest, motivation and learning. My feeling is that participation will result in greater interest and a higher motivation-level amongst participating students. If interest and motivation increase I also feel that increased achievement is inevitable. I identified three citizen science programs that I felt would make outstanding first citizen science experiences for high school students. In order to determine whether or not participation could actually assist with those intangible benefits to the biology education of predominantly fourteen and fifteen year old children I implemented the project with roughly half of my 93 students.

This project began in September and was finalized in May. The actual classroom instruction for it did not begin until November, but in total students participated in activities that fall under the umbrella of this project for close to 20 periods during the 2012-13 academic year. I teach four sections of biology with an average population of just over 23 students per class. They have a 44-minute class every day and then each group meets for an additional period every other day that runs consecutively with their regular class period. In terms of impact on education that means that roughly 46 students were involved in 40,480 instructional minutes toward completion of this project! This number is fairly conservative considering it does not include out-of-class reading time or other self-guided activities.

The three citizen science programs in which Pulaski High School biology students participated were eBird, Project FeederWatch and the World Water Monitoring Challenge. The first two are ornithology projects administered by Cornell University. The third is a world-wide water quality testing program sponsored by the Water Environment Federation and the International Water Association. One of the reasons I selected these programs was that they fit into my existing curriculum well and did not require me to restructure my units in terms of making sure that I addressed certain state standards by certain times of the year. More importantly, I selected these programs because I envisioned students finding enjoyment in participating in them. I simply felt that students would like learning about biology through collecting and reporting data for these large-scale research projects.

The Cornell Lab of Ornithology runs eBird. For an overview of what this program is and its purpose, please refer to the following caption taken from the eBird website (http://ebird.org/content/ebird/).

> **A real-time, online checklist program, eBird has revolutionized the way that the birding community reports and accesses information about birds. Launched in 2002 by the Cornell Lab of Ornithology and National Audubon Society, eBird provides rich data sources for basic information on bird abundance and distribution at a variety of spatial and temporal scales.**
>
> **eBird's goal is to maximize the utility and accessibility of the vast numbers of bird observations made each year by recreational and professional bird watchers. It is amassing one of the largest and fastest growing biodiversity data resources in existence. For example, in March 2012, participants reported more than 3.1 million bird observations across North America!**

The observations of each participant join those of others in an international network of eBird users. eBird then shares these observations with a global community of educators, land managers, ornithologists, and conservation biologists. In time these data will become the foundation for a better understanding of bird distribution across the western hemisphere and beyond.

Project FeederWatch is also an entity of citizen science conducted by the Cornell Lab of Ornithology. Again, a caption that explains the scope of this program is reported (http://www.birds.cornell.edu/pfw/index.html .

Project FeederWatch is a winter-long survey of birds that visit feeders at backyards, nature centers, community areas, and other locales in North America. FeederWatchers periodically count the birds they see at their feeders from November through early April and send their counts to Project FeederWatch. FeederWatch data help scientists track broad scale movements of winter bird populations and long-term trends in bird distribution and abundance.

The following caption taken from the organization's homepage (http://www.worldwatermonitoringday.org/default.aspx) explains the purpose of this program and describes the charge for participants.

World Water Monitoring Challenge™ is an international education and outreach program that builds public awareness and involvement in protecting water resources around the world by engaging citizens to conduct basic monitoring of their local water bodies.

In 2012, approximately 250,000 visits were made by participants to monitoring sites in 66 countries. We challenge you to test the quality of your waterways, share your findings, and protect our most precious resource!

In order to participate in these projects with large groups in a fairly efficient manner I had to upgrade the infrastructure of my science classroom. This entailed purchasing new equipment and items through the Entergy grant. It took much effort to spend money wisely and since one of the items to be purchased was highly technical I wanted to make sure that I got the right piece of equipment for my project needs and future science activities. I chose to purchase a data logger and probewear and reviewing option and generating price quotes was a challenge. I also was able to procure bird-watching materials for my classroom including three pairs of binoculars, a bird feeder and feed to stock it. I am very fortunate to have had the opportunity to obtain these items. They enhanced the classroom experience for my current students and will continue to do so for many years to come!

I have learned a great deal from this experience. I had previously participated in both Project FeederWatch and eBird before, but when you teach about something you are required to learn the ins and outs of that topic. So I had to go through both of these citizen science programs afresh as if I was learning about them for the first time. This time I had to pay attention to places where students could end up sidetracked. I had to learn how to troubleshoot each program. My knowledge of what you can do with each of these programs has deepened tremendously.

A very cool outcome of participating in Project FeederWatch is that I have been working with a student whom has a hard time with school on keeping the feeder clean and stocked. This has been a great experience for me; judging by how the student responds when we take care of the feeder (and thus the birds) I believe my student shares my sentiments. I have learned that just spending a few minutes away from the academic classroom setting with a student – but engaged in content – can have a major positive impact on a student's attitudes and aptitudes. I enjoyed the conversations I had with my students while performing simple maintenance tasks, but I really feel that it took the citizen science program for me to spend the time.

I learned that a regular schedule of outdoor activities can bring about some major positive feelings about class amongst children. When students knew they were going to be out of the classroom for activities overall behavior management became easier. Students wanted to be outside so badly, they did not want anything to interfere with the respective class's ability to get out! It gave me a break from the routine I have developed and that was refreshing. With the success of my project I am more apt to try other programs and step out of the classroom a bit more. With increased emphases on testing and APPR and all it seems like that is not in line with the intended changes we are to make to our teaching programs. I feel as though these changes will enhance the classroom atmosphere to the point where a regular schedule of outdoor (or out-of-the-classroom) activities will increase productivity toward evaluations and achievement.

As the World Water Monitoring Challenge was new to me that certainly qualifies as something about which I learned. I learned about water quality indicators and water quality levels form locations all over the world. I learned how to collect, analyze and submit data. In order to make measurements I had to learn how to use the data logger and probewear. All of these actions were brand new to me.

Participation in the water quality monitoring citizen science program allowed me to discover the state of water chemistry for several local bodies of water. I am very proud to have been involved with testing these places because I feel that knowledge is wasted if it does not get applied. I have always been interested in environmental assessment, but this project gave me an opportunity to hone my measurement skills and apply knowledge – to put it to good use so that water affairs could be evaluated and if there were significant problems they could hopefully be abated before they become unmanageable. This is the application of understanding and by doing so we are working for the environment and being a part of a solution rather than the part of a problem.

My students definitely learned a lot as a result of their biology experience that included citizen science. Obviously they learned how to participate in the three citizen science programs. That is the tangible learning upon which I will not focus right here. Instead I would rather focus on the benefits of learning about careers and employable skills, the communications instruction, the technology benefits, the increased engagement and relevant dialogue that resulted from enjoying what you are doing.

I believe students learned about several careers that they might or might not want to look into as they get older and grow intellectually. One of our activities was to research jobs that include skills that you might use in citizen science programs. The variety of search results was impressive and there is a possibility that some students end up pursuing the careers about which they learned.

Reporting results for most citizen science programs typically involves some type of standard protocol. It was rewarding to see the growth in students from setting up accounts to entering simple data at first and then maximizing their experiences to the point where they became advanced participants by the end. In order to make this progress students had to learn how to make observations efficiently, utilize technology to enter data and often report back to the class about their observations or what they learned. These are skills that go beyond the standard high school biology curriculum. These are skills that contribute to lifelong learning and once again, the decision to focus on citizen science programs made all of these revelations possible since I never need to sacrifice content for instruction pertaining to my project.

I believe I was able to weave in the project during different units of instruction and stay on a schedule successfully. One of my strengths as an instructional planner is that I can do just that. On the other hand I am not the greatest "diverge from the regularly planned schedule" style of teacher. In fact, the skill of knowing when to take advantage of meaningful opportunities to stray off course has been a weakness of mine. Because of this project I have learned how important that can be and how beneficial that can be to student learning. In the past I have always followed a very structured sequence of learning activities and was never that willing to take the non-linear pathway.

These citizen science programs have required that I explore the teachable moment more and perhaps re-design a lesson (sometimes at short notice) to make connections between high school biology curriculum and what we are observing. This is an area of important improvement for me because, as previously mentioned, in the past I would not. It is just that I wanted to take advantage of the potential of citizen science with my classes and try something new.

The most successful aspect of citizen science based learning was that for the first time in my 12-year teaching career students truly applied their understanding. Teachers have toiled to fill kids' brains for years and years. The essence of education, however, should not be to simply "pass on the smarts." Teachers should be the students' learning partners. By teaching through citizen science we can do just that. We become equals in the data sharing process and because of the collaborative nature of citizen science we become experts in program trouble-shooting and redirecting to certain stages of the learning cycle.

It's hard to state what did not work well since I feel the project was so successful. In my fall 2012 preliminary action report I referred extensively to the GLOBE Science citizen's programs. I had good intentions of becoming certified through GLOBE and then following GLOBE protocols and submitting observations to their international data bank. The problem with getting involved with GLOBE is that there are strict training requirements and not many training sites. It might be needless to say, but in case it isn't, I was not able to become GLOBE certified this year. I am hoping that I will be for next year, even though it won't be part of my future project, I still have lofty goals to get my school involved with GLOBE.

I was able to make contact with Dr. Todd Ellis, a geoscientist at SUNY Oneonta. He is unofficially New York State's GLOBE expert. I was able to persuade him to do a series of trainings in Syracuse this summer so the outlook for getting certified is promising. I additionally was able to find out about an e-training certification program that starts this fall for some of the more advanced GLOBE protocols, so between Dr. Ellis's training and the e-certification program I will hopefully be able to build the necessary credentials to make this happen for next year.

In order to generate data to determine the impact of my participation in citizen science project on student attitudes and aptitudes I created a series of pre-tests and post-tests. The pre-test and the post-test are essentially the same and use the Likert statistical scale to inquire about students' feelings. In a Likert scale respondents circle (or in the case of my assessment instruments shade) the level at which they agree with a statement pertaining to what you want to find out. For example, if I wanted to survey my classes to find out if they had ever participated in a citizen science project using the Likert scale I might include the statement, "I have participated in citizen science programs before" on my assessment tool. Students would record their responses on a continuum of levels in which they agree with that statement ranging from strongly disagree to disagree to neutral to agree to strongly agree. Data were pooled as positive responses (in agreement with the statement), neutral (or indifferent to the statement) and negative response (in disagreement with the statement). Those groupings were then converted to percentages.

The pre-test / post-test system is ideal for discerning the impact of an instructional program because if you complete a survey prior to instruction and then complete the same one sometime later following a specialized instructional sequence you can assume that any differences in attitudes and aptitudes arose as a result of the learning that occurred. I believe this to be an appropriate statistical measurement system for reliably finding out how students grew as a result of my project. Additionally, I gave a simplified form of the concluding survey to students that did not actually participate in citizen science programs. This allowed me to compare results to a group whose education lacked the powerful experiences that my experimental group had the benefit of gaining.

The five pre-test / post-test survey instruments completed by students include one about citizen science attitudes and aptitudes, one specifically about eBird attitudes and aptitudes, one about Project FeederWatch, one about the World Water Monitoring Challenge and the final one was about citizen science opinions. I was able to determine how much growth occurred in the most important aspects of each of these banks of learning experiences. For each one I made ten unique statements and again, requested that students share the level at which they agreed or disagreed with the statement.

The results from my survey series that I am most proud of came from my concluding post-test cross-referenced with the survey that I gave my control group – the students that were exposed to citizen science programs but did not participate in any. I feel these results epitomize what went right with my project and feel that the inquiry focus of citizen science holds the power to increase students' motivation levels to extend and apply classroom learning.

It was determined that participating in the World Water Monitoring Challenge resulted in students that were four times more likely to conserve water and preserve water resources than students who did not participate. 81.4% of my participating students either agreed or agreed strongly that "Water conservation is more important to me now." That rate is only 20.0% for non-participants. I find that to be great news for the future of aquatic resources and now the challenge is to include instruction that teaches students what to do about it.

It was found that 83.7% of my eBird and Project FeederWatch participants agreed with the statement that, "I am more likely to care for birds' habitats after learning about ornithology" in a positive way. Compare that to only 18.0% for non-participants and we find that students are 4.65 times more likely to be ecological good stewards for birds. This creates a ratio of close to five to one. Since birds are often important indicator species for the health of many different types of ecosystems I think it would be a good thing if we could foster a few more bird lovers through our instructional strategies.

The third finding that illustrates the success of this project serves as a bit of encouragement for expanding citizen science opportunities. You can think of this statistic as a testimonial. If you are writing a glowing review of a product you purchased then it can be assumed that you liked that product and would probably continue to purchase that product long into the future since you liked it. The final statistic I am going to share is that students agreed or agreed strongly that "I would participate in a citizen science program outside of class if I found one that interested me" 1043% more than non-participating students. The numbers say it all – 76.7% positive responses for participants and a lowly 8.0% for others. In other words for approximately every 10 participants that wanted to do more citizen science there was only one student that did not participate in class that was interested in getting involved. I would have to say that's quite the positive review and a strong (and clear) statement by students indicating that they want their education to include more of these style of instructional programs.

From an anecdotal standpoint I can confidently state that the "outside the box" nature of citizen science learning improved classroom behavior. Any activities that required outdoor observations and data collection resulted in easy classroom management. Students were highly motivated to participate and were not willing to take risks with behavior that might force them to stay indoors or not get to do what the rest of the group was doing.

I was also quite pleased with the inquisitive nature of students while participating in the open-ended activities that the citizen science projects entailed. We often had to come up with ideas on the fly; whereas a vast majority of my students typically rely on me to help them figure out the connection between X and Y, while doing several citizen science activities I noticed students either being more self-sufficient or at the least being more apt to ponder issues themselves. That is an unexpected outcome that I feel is outstanding. I wish more of my learning activities had that same result!

Some of the professional development that occurred for my project included training directly from the Cornell Lab of Ornithology director of outreach. She shared with me an eBird training PowerPoint that I used with my classes and now have good intentions to share with community members interested in sharing bird observations online. The outreach director advised me on how to lead "bird walks" and manage large numbers of observations in the field for later uploading.

I was fortunate to obtain a copy of Pathways to the Common Core by Lucy Calkins and read that for further professional development. It allayed many of my fears and I even learned that I am not a curmudgeon of change. My high school principal was quite impressed that I was well-versed in Common Core issues – especially since I am a Biology teacher. I explained to him that we all have to be on the same wavelength regarding the Common Core, and that we need to work together regardless of discipline. Teaching effective communication skills is not just the job of ELA teachers, it is for all teachers. If we are all hoping our students will use proper speaking, reading and writing skills in our classes and be more effective communicators when they proceed to whatever comes next for them, then we had all better do our part to teach these valuable skills. I shared my Pathways book and explained that you will not find a more comprehensive yet concise overview of the Common Core.

I am now working with the other members of our high school science department to extend our grasp of data logger / probewear instruction. Although time has been limited, we have gotten together to explore options with the new equipment and attempted to find new ways to incorporate into our existing programs. Our collective desire to expand the use of these technologies and the successes experienced thus far has not gone unnoticed by our administration because they have shown a desire to financially support future endeavors with said technology. We have been approved for three summer curriculum work days to develop labs that utilize our new equipment so hopefully by next fall we will have a plethora of activities planned to enhance instruction with high tech lab ware.