



NOAA
Climate Stewards
Education Project

2015-16 Stewardship Evaluation Report

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Executive Summary

Stewardship Project Summaries

- A direct outcome of Climate Stewards is to increase participation in active environmental stewardship. During the 2015-16 school year, 18 climate steward projects were conducted with 13 Climate Stewards completing final reports detailing their efforts from the year.
- The projects ranged from reducing waste and energy usage in schools, building school gardens, replanting mangroves and dune restoration, and educating communities about the effects of climate change locally.
- The projects worked with dozens to hundreds and even over a thousand students at different times in after school settings, as school-wide projects, with their communities, and with parents and families.
- It is estimated that nearly 10,000 students, families, and adults were involved in this year's climate stewardship projects.
- Impacted students ranged in age from middle school through high school
- Projects were local (serving a particular class or after school club), school wide (affecting an entire school), or community wide (reaching beyond the walls of the school out into the community).
- Climate Stewards report they plan continue their projects into the future either in their current form or adapting them as needs change or building on past efforts.

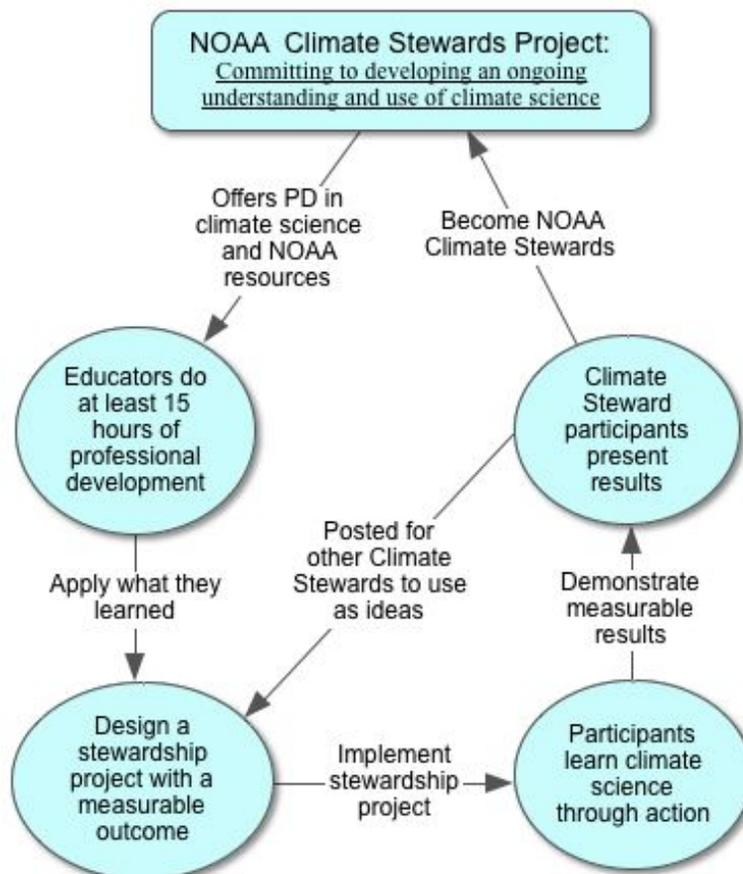
I. Background and Purpose of the Project

Overview

Climate is an ideal interdisciplinary theme for learning about the scientific process and the ways in which humans affect and are affected by the Earth's systems. Climate change will bring economic and environmental challenges as well as opportunities, and citizens who have an understanding of climate science will be better prepared to respond to both.

I. A. Background

The **Climate Stewards Education Project (CSEP)** provides opportunities for local, state, and regional educators to work with NOAA in responding to environmental challenges and inspire our youth to pursue careers in science, technology, engineering, and mathematics (STEM). CSEP brings NOAA science and education efforts together in a cohesive plan to provide educational opportunities and rewards for environmental stewardship actions. Environmental stewardship actions include things like Climate Stewards educating themselves and others, as well as working within their communities to reduce their carbon footprints or develop plans to “go green.” The diagram below provides an overview of NOAA Climate Stewards Project.



I. B. Goals and Objectives

Goal 1. Provide educators with sustained professional development, STEM and geography-based teaching and collaborative tools, digital content resources and compelling NOAA contextual-based teaching applications that align with national standards for targeted content areas. Multiple e-learning professional development tools, Web-based seminars, conference symposia, online classes, and workshops will engage participating educators in order to:

- Provide deeper content understanding and/or competence and confidence in teaching climate/climate change science.
- Strengthen the use of problem-based learning and the inquiry process with scientifically up-to-date education and data resources, and provide support for designing implementing, and evaluating a stewardship project.
- Learn real world and practical applications and careers of climate/climate change science, technology, engineering, and mathematics, and geography from NOAA, other Federal Agency, and non-Federal partner scientists, researchers, and educators.
- Learn how to use technology tools and data Web sites to support classroom and field investigations.
- Use field-based, hands-on experiences at NOAA, other Federal, State and Local field sites, protected areas, or natural places.

Goal 2. Educators will develop Stewardship Project plans that will accomplish one or more of the following:

- Infuse knowledge of climate/climate change science and related STEM careers into formal and informal educational venues.
- Develop a local community project involving students and/or the public in hands-on climate stewardship actions.
- Plan special events in their school, community, or organization to promote and encourage participation in climate stewardship and green action.
- Engage in problem-based learning and active investigations.
- Learn about and/or use local natural areas and special places.
- Highlight and promote STEM careers, and give students experience in career-related roles through their stewardship projects.

Project Outcomes

Direct Outcomes for CSEP Participants

- Increase the **content knowledge** in climate/climate change-related STEM.
- Increase the **use of NOAA, and NOAA Partner data resources.**
- Increase **participation in active environmental stewardship.**
- Intend to continue environmental stewardship activities in the future.

Indirect Outcomes for CSEP Stewardship Project Participants through the CSEP Participants

- Increase participation in **active environmental stewardship.**
- Increase **awareness of careers** in STEM related to climate/climate change science.

- **Apply climate/climate change science STEM** concepts and skills in meaningful ways in a stewardship project.
- Engender **intention to continue** environmental stewardship activities in the future.

I. C. Logic Model for the Overall NOAA Climate Stewards Education Project

CSEP brings together components of several successful NOAA projects to build a comprehensive educator professional development and student experience package. Elements from the NOAA Climate Portal, NOAA/ASTC Community Conversations on Climate series, U.S. Global Change Research Project’s Interagency Education Working Group, NOAA WaterWays Pilot Project, ONMS Ocean Guardians, Padilla Bay NERR Climate Stewards, and NERRS Teacher on the Estuary provide proven strategies to engage educators, students, and the public.

Guiding principles include:

- Providing multiple opportunities for professional development to all participating educators. Formal and informal educators will be offered access to educational resources and professional development opportunities at the local and national level through a variety of channels including online and face-to-face methods.
- Supporting educators/participants through electronic communities of learning/practice as they infuse new knowledge and strategies into the classroom/workplace.
- Using distance learning avenues to increase the availability of professional development and student engagement opportunities.
- Actively involving students in place-based experiences and problem solving to increase knowledge retention and their interest in STEM.
- Expecting educators and students to present investigation results from CSEP opportunities to local stakeholders and share best practices with educators new to the project.

The **inputs, outputs and outcomes** for the CSEP and for participant stewardship project are shown in the logic model below. Increased content knowledge applied in a stewardship project directly affects knowledge, attitudes, and behaviors about climate change.

Inputs	Activities	Outputs	Outcomes
Educators - Informal & Formal (K-16) NOAA CSEP Resources (ongoing projects, mini-grants, travel stipends,	Advertise, review applications, accept educators Provide and/or point to PD opportunities aligned with the 8 climate literacy principles Maintain virtual workspace for educators with resources, guidelines, individual pages, and discussions Arrange external evaluation	PD opportunities archived Stewardship project plans, results, and effects on participants Additional resources from participants	<u>Direct Outcomes for Climate Stewards</u> * Increase the content knowledge in climate/climate change-related STEM * Increase the use of NOAA, and NOAA Partner data resources. * Increase participation in active environmental stewardship * Intend to continue environmental stewardship activities in the future

best practices)	NOAA CS coordinator prepares stewardship guidelines, reviews plans, provides feedback, awards mini-grants and travel stipends, and provides ongoing support for implementation of stewardship plans	Partner involvement (local and NOAA+)	<u>Indirect Outcomes for Climate Stewardship Project Participants through the Climate Stewards</u>
Efforts by other Federal agencies		Effects on project participants	* Increase participation in active environmental stewardship
Examples of Stewardship Projects	Climate Stewards design and implement stewardship projects and evaluate the effects on participants		* Increase awareness of career STEM related to climate/climate change science
Community Organizations involved in similar efforts	Regional leaders facilitate discussion among CS on regional issues, and offer support and resources to CS as available.		* Apply climate/climate change science STEM concepts and skills in meaningful ways in a stewardship project
Regional structure			* Engender intention to continue environmental stewardship activities in the future

II. Evaluation Design and Methods

The Climate Stewards Education Project (CSEP) is a national endeavor managed by NOAA that responds to NOAA’s education goals and strategies as set forth in the NOAA’s Education Strategic Plan 2009-2029. This evaluation effort examined whether the CSEP increased the environmental and climate literacy of its participants and increased the number and impact of climate stewardship activities that resulted from the selected group of formal and informal educators who did stewardship projects.

III. Findings

III.A. Stewardship Project Summaries

A direct outcome of Climate Stewards is to increase participation in active environmental stewardship. During the 2015-16 school year, eighteen climate stewards did projects. They are summarized here. The projects ranged from reducing waste and energy usage in schools, building school gardens, replanting mangroves and dune restoration, and educating communities about the effects of climate change in their area. The projects worked with dozens to hundreds and even over a thousand students at different times in after school settings, as school-wide projects, with their community, and with parents and families.

III.B. Participants

Climate Steward	Project Name	Hours of Involvement	Audience Numbers
Sandra Bennett	Reduce, Reuse, Recycle School Materials to Reduce the Carbon Footprint	32-week program with ongoing efforts	300 directly involved students and 4 teachers 1100 affected students
Chris Schmitz	Polar Bear Challenge Part II		758 Elementary Students, 28 teachers from 28 schools
Karen Temple-Beamish	Children Capturing Carbon		8 th – 12 th grade 690 Students; 350 Community volunteers; 200 adults
Nancy Gifford	Reducing and Recycling Plastic Water Bottles	45 Minutes each day for 3 months = 67.5 hours	23 Middle school students
Nancy Bourgeois	Green Homes and Energy Conservation	Students working on projects as part of classes	High school students in Maryland
Renee Fudala	Feed Forward Project	Ongoing as part of STEM Academy	All 7 th grade students
Kristin Hoss	Youth Environmental Alliance: Mangrove restoration with community, corporate, city, scout and school volunteers!	6 days or presentations - >48 hours	2 Schools (1 MS and 1 HS) 3 Programs 220 People
Angela Huntmer	Turtle Bay Resort Dune Restoration	Removed 100 sq/m of invasive species and planted 500 plants and 800 grass starters	45 3 rd grade students and 15 adults
Teresa Mendez-Quigley	Severe Weather, Climate Change & Seniors' Health: Promoting Climate Education to Protect Senior Citizens During Severe Weather Events	10 Presentations for 1 hour each plus developing the lesson and travel	6 Senior Center 10 Programs 279 Seniors
Ali Neugebauer	Increasing Carbon Sinks in an Urban Environment	After-school program	15-20 MS Students

Janice Novello	Caring for God's Creation Contest		26 School entries from Pre-K through 10 th grade
Kathleen Rocco	Climate Compost Project	Daily participation from each school	14 schools (HS, MS, and ES) participated with a total of 6,453 students
Carlie Trott	Engaging Key Stakeholders in Climate: A Photovoice Project for Youth-Based Participatory Climate Action	1 hour/week at three schools; 175 hours of volunteer time	55 Elementary students with 30-48 attending each week

Educators Not Completing Final Reports

- Terry Atkinson: St. Paul's Green Machine
- Victoria Gorman: 2nd Annual Medford Science Summit
- Roy Lander: Offsetting Carbon Dioxide with Reusable Plastic Bags
- Joanne Logan: Soil Stewards
- Catherine Osman: An Outdoor Classroom

II.B. Project Descriptions

Nancy Gifford - Reducing and Recycling Plastic Water Bottles

Starting at the beginning of the 2015 school year, 23 middle school students embarked on a community wide program to help their school learn to use reusable water bottles and reduce the amount of plastic they disposed of daily. It was believed that through education and the installation of a water-bottle filling station with a filter, they could reduce their school community's dependence on disposable, plastic water bottles. Investigating the costs associated with bottled water, consulting with town officials, and looking at their school community's usage, the students developed their project while learning about hydrology, chemistry, and marketing careers and how to best make a successful presentation. The students collected data from a number of sources as part of their campaign including collecting bottle caps, calculating their school's carbon footprint from the bottled water, conducting a blind taste test of different waters including that from the school water fountains, and interviewed other students on their beliefs about the school's water. They determined that students were avoiding the school fountains because the water is warm and had a chlorine flavor to it. Many students in the school also thought that the water was unsafe to drink because of the chlorine flavor. The students in the group decided that a slide show and skit were the best ways to present what they had learned to the school audience. They worked together to create a slideshow and skit that was presented to the school in December of 2015.

By Nancy's own account, the project was "wildly successful." The presentation by the students generated school-wide excitement around having a water bottle filling station. The cafeteria tried to block the placement of the filling station from outside the cafeteria because it would cut into their sales of water, but the project moved forward. Unfortunately, because of the old plumbing in the building, the installation was delayed until June. They were only able to install one station

and even that went over the grant budget. The students submitted a summary of their project to the NEED Youth Awards Program and were awarded “State Junior Rookie of the Year” Award. In June, they were issued a citation from the Commonwealth of Massachusetts. Their State Representative, Sarah Peake, presented the awards during a ceremony at the school. They also received certificates and plaques from the Cape Light Compact for their work in environmental education. Ben and Jerry’s donated ice cream and the Cape Cod Chronicle wrote a nice article about the student’s project. At the ceremony, Ms. Peake, talked about a proposed deposit law that is in the works for the state. As of September 27, the counter on the filling station reports that they have saved over 1700 plastic water bottles in about four weeks of school. Within their project, the students were able to educate their school community and create partnerships with their town water department, the Cape Light Compact, and NEED.

Teresa Mendez-Quigley - Severe Weather, Climate Change & Seniors’ Health: Promoting Climate Education to Protect Senior Citizens During Severe Weather Events

As Philadelphia becomes hotter and wetter due to climate change, the most affected populations must prepare for the associated effects. It is believed that severe weather is more likely to affect senior citizens due to age-related existing health problems, extreme weather related illnesses, and limited resources and abilities to deal with these changes. As such, there is a need to ensure that seniors not only survive severe weather events related to climate change, but that they thrive in their own communities. After reaching out to 18 senior centers in the Philadelphia area, six senior centers were willing to have Teresa present her program to their senior populations. Each senior center was scheduled for a presentation from November 2015 to March 2016. The presentation included the following elements: An overview of what climate change is and how weather is affected, including what fossil fuels and greenhouse gases are. Teresa used NOAA, Climate & Urban Systems Partnership (CUSP), Environmental Protection Agency (EPA), Centers for Disease Control & Prevention (CDC) materials and resources, and local news coverage as well as historical data on Katrina and Superstorm Sandy and their effects on seniors in her presentations.

All seniors, including those who arrived late, received a Taking Action booklet, a printed color sheet of the neighborhood map of the senior center location they attended, and a green satin ribbon with a safety pin. Participants were then invited to take a healthy snack. A set of pre- and post-test surveys, with corresponding numbers, were distributed to each participant. No identifying information (e.g., name, address, etc.) were collected. Pre-tests were in golden yellow and post-tests were printed on orange paper. Pre-test surveys were distributed at nine (9) of the ten (10) programs. One senior center did not use tables for seniors to write on, which made it impossible to complete the pre- and post-tests. To encourage completion of the pre- and post-tests, each senior received a free raffle ticket for each completed form – up to two (2) tickets each – to enter to win a Safety Tube at the end of the program. Each tube had a whistle, emergency blanket, 12-hour light stick, water pouch, and procedural mask.

Seniors, due to their longevity, can recall cooler nights in previous decades, and understand that the City has gotten hotter. At the start of each presentation, seniors were asked to raise their hands if they have heard of climate change. Nearly all at each site indicated that they had. Most (93%) also believe climate change is happening. Given that the scientific literature has shown that seniors exposed to extreme heat or extreme cold are at higher risk of suffering a heart attack,

the participants were able to identify with the health concerns related to severe weather. The seniors were overwhelmingly eager for this information. Many thanked Teresa and applauded at the end of each program. The goal was to educate at least 150 senior citizens at six (6) senior centers in Philadelphia. A total of 279 seniors participated in the program at ten (10) senior centers throughout Philadelphia. There were 170 surveys returned. Overall, the seniors showed increases in their ability to correctly answer questions related to climate change and how it may affect them. When asked them to raise their hands if they had learned at least one thing, that they would be able to use something they learned, and that they planned to use something they learned. The majority raised their hands each time. Over 90% of participants indicated an intent to change as measured by hand count.

Kristin Hoss - Youth Environmental Alliance: Mangrove restoration with community, corporate, city, scout and school volunteers!

Ocean acidification has been called the "evil twin of global warming" and "the other CO² problem," a problem that through education and increased awareness and action can be mitigated or slowed. Through the use of a program called "CO² Calamity," middle and high school students/teachers/parents/volunteers learned how their everyday choices lead to Ocean acidification and Climate change and then through discussion and action, learned how they can alter the current course of climate history for the better. The program included an in-school interactive hands-on science model demonstrating anthropogenic impacts on ocean acidification and experimental protocols to test multiple hypothetical solutions. Students then worked, hands-on, at a coastal habitat and/or mangrove restoration to take action outside of their homes. Throughout the program, students see ways that their everyday choices impact their lives the environment while becoming active stewards and helping to restore local mangrove/beach systems.

Two schools were involved in this program; Millennium Middle School and South Plantation High School. On multiple dates and additional follow-up dates, the program was offered at the two schools for a total of more than 220 people including students and adults. A number of NOAA resources were included in the program and shared with the students such as the Coral Reef Conservation Center, The Office of Habitat Restoration website, and the Office of Coastal Management. There was also a career focus to the effort focusing on restoration ecology, marine ecology, chemistry, and climate change. Students had the opportunity to work closely with scientists and environmental leaders in the community. The project was also part of the City of Ft. Lauderdale's Proclaimed Annual Mangrove Awareness Day done in partnership with YEA and Millennium Middle School. For both grade levels, knowledge gain averaged 30% from pretest to post program education regarding CO². These particular students did better on the pretest than expected because they were STEM students as well as students who attend a magnet school, so the normal knowledge gain we see was skewed slightly lower. Students still learned some new concepts from a different perspective, the perspective of CO² sequestration and storage and ocean acidification. Millennium Middle School grew out 150 mangrove propagules for planting at Bill Keith Park, and supplied 50 mangroves that were about three feet tall. South Plantation High School planted approximately 10 small red mangrove trees and 20 red mangrove propagules and 20 black propagules. They also removed invasive exotic plants and replaced them with 169 other native coastal plants, inclusive of seedlings and one to 3-gallon sizes, that surrounded the mangrove area.

Based on the findings from the program, Kristin summarized that the students were excited to learn that they could do something immediately to change their carbon footprint, that they will continue to reduce their energy usage, and that the teachers felt the program was very worthwhile and impactful on the students. Beyond the 220 people participating directly in the program, it also had a real impact on improving the environment including 7500 square feet of mangrove habitat and 19,000 square feet of coastal habitat restored.

Ali Neugebauer – Increasing Carbon Sinks in an Urban Environment

Working on three different projects throughout the year with 15-20 middle school students in an afterschool program, Mr. Neugebauer helped the students see the impact of small changes on their energy usage and their community. At the outset, Ali was primarily interested in increasing the number of carbon sinks in their urban environment while helping the students gain awareness of climate change through the school's green campaign. It was believed that through their increased awareness and actions, they could reduce the amount of energy the school used and increase the carbon sinks in their area.

During the first few weeks of the afterschool club, the students learned about climate change and carbon sinks using NOAA online resources. After learning about climate change, the students turned their focus to what they could do to mitigate their impact. Their first project was to get teachers to turn off their lights while teaching to help reduce energy usage. In total, they helped the school have 1057 hours of light free teaching. Their second project involved using Kill-A-Watt meters throughout the school and in their homes. On an ongoing basis, students monitored their household electricity usage and looked for ways to help reduce it. One surprising thing they found was the electrical usage of electronics that were not "on" or actively charging – called "vampire" usage." The students final project of the year was a school garden – developing a carbon sink. With the help of parents and community volunteers, they were able to build raised garden beds and plant successful gardens that lasted through the summer months. Throughout the year, the students in the club were exposed to a number of different climate related issues by way of field trips, including the New England Aquarium and MIT. One student commented that she was surprised to learn that there were other science careers besides being a doctor.. Students were engaged throughout the program, worked hard and collaboratively, and were able to get other students excited and involved. Students reported taking what they had learned and using it in their own homes and sharing it with others. At the end of the year, 87% of the students reported being more aware of issues of climate change and 68% reported they plan to continue to practice the energy saving techniques they started.

Angela Huntmer – Turtle Bay Resort Dune Restoration

It was hypothesized that by removing invasive species from the dunes and planting native plants, it would increase habitat for animals and plants and help reduce beach erosion. Lessons were developed and implemented to introduce climate change, the native flora and fauna of the target site and how changes in climate will affect the plants and animals.

There three hands-on experiments were used to explore the issues. The students had a work day where they hiked out to the worksite and removed invasive plants from the target area getting some hands-on, eyes-on lessons on native plants. The students planted native plants and hiked back to the school bus. On a second workday, they collected data on the survivability of the plants and weed cover before removal and reflected on the impact.

A number of NOAA resources were used to develop lessons and the help the students learn about climate change, invasive species, and habitats. The course was developed to become part of the school curriculum on Service Learning. Resources included data sets, graphing examples, maps and images, and online readings. During the project, a total of 100 square meters of invasive plants (190 kilos) were removed. Five hundred plants (6 inch pots) and 800 grass starters were planted and 110 kilos of trash and marine debris removed. The data collected on the condition of the newly cleared and planted area was shared with Fish and Wildlife professionals. It was reported that collaborating teachers, students and parents all increased their understanding of climate change and some of the impacts of climate change on the coasts. Participants also learned about the plants and animals living on the coasts and the impacts they face with increased storm action. The 45 student participants and 15 adults were all very proud of their achievements – removing the invasive plants (down to bare sand) and planting the native plants that had been specially grown for this project. All participants are ready to share and participate again next year. All feedback during the planning and implementation phases was very positive.

Nancy Bourgeois – Heating and Cooling in Maryland

Believing that students who are knowledgeable in climate science will understand the importance of energy conservation and take steps to decrease their own energy use, Nancy developed a program in which students investigated ways to decrease their energy needs and in doing so, decrease their use of greenhouse gas emitting fossil fuels. Aspects of the project included:

1. A student pre-survey on climate change, energy conservation and student opinions and knowledge of the issues completed early in the project
2. Students received intensive instruction the various ways renewable and nonrenewable energy works to power our lives
3. Students surveyed the school building with infrared thermometers to determine where energy was being lost and to assess the insulating value of various building materials
4. Students took kilowatt readings on home appliances to see which appliances use the most energy and have begun to design energy conservation plans for their homes
5. Small dog houses were assembled for use as the base of student designed, energy efficient homes
6. Students analyzed all of their data from the school building survey, green home design and construction and home energy use surveys to design an energy saving plan for their homes,
7. After completing all of the activities for the energy efficiency project, students were given a post activity survey to determine if they understood energy conservation and the importance it plays in global climate change.
8. Students presented their building designs and rationale based on research and data collection both at home and at school to several other science classes.

After their experience, the students were post-tested. The data support the original hypothesis that students who are knowledgeable in climate science will understand the importance of energy conservation and take steps to decrease their own energy use. Their post- test assessment showed improvement in all questions relating to climate science and energy conservation.

Data Collection Analysis and Results

The pre/post assessment student survey indicated:

- Pre - nearly 100% of students surveyed believe that the earth is warming due to the activities of humans
- Pre - 96% of students know that carbon dioxide and methane are greenhouse gases, but only 14% know that ozone is also one
- Pre - 43% of students don't think that burning coal is a cause of global warming; Post - almost 100% of students know that coal releases greenhouse gases
- 21% are unclear about how the conservation of energy can help to reduce greenhouse gases.
- Pre - 43% of students surveyed don't understand the role of insulation; 93% of students understand the role of insulation
- Pre - 64% think that green construction is expensive; Post 79% of students understand that there are inexpensive ways to insulate homes
- Pre - 61% of student surveyed believe that the hole in the ozone layer contributes to global warming; Post - 32%
- Post - Nearly 100% of students think it is important to conserve energy and understand the role insulation plays in energy conservation

Stewardship project participants (project students and other students who saw the dog house projects) showed growth in the areas of knowledge of the climate issue, actions to reduce greenhouse gas emissions, and attitudes toward energy conservation and sustainable living in general. Unit testing on the topic evaluated knowledge of climate issues. It was also assessed during presentations of the finished project. The project showed firsthand the energy savings that insulation can afford and how it related to a decrease in greenhouse gas emissions. The calculations that the students did based on home energy audits really hit home the energy savings that a few simple changes can bring. Many students commented that they were excited to implement their conservation plans at home.

Kathleen Rocco – Climate Compost Project

Kathleen's hypothesis was that the Climate Compost Project would decrease the amount of organics being buried in a landfill by at least 1,000 pounds per school. By providing compost training, equipment, education and resources, a school can sustain a food scrap compost program and change attitudes about composting and climate change. Fourteen schools were recruited with some educators coordinating the Climate Compost Project for multiple buildings. The coordinators were trained and given the equipment for initiating food scrap composting during lunch and snack times in October of 2015. Compost bins were installed shortly after training. Most schools started collecting food scraps in November 2015. To help the students and teachers better understand the process, two tours were organized for educators and students to see two different compost systems and learn from compost professionals. Conference calls were also held in December and March to discuss any issues, share information and provide support to coordinators.

Resources from more than ten sources with multiple lesson plans were provided on Google drive to allow educators to teach about composting, sustainability and climate on their own. Educators were provided several activities regarding climate, compost and sustainability for use in their classroom from a variety of activity books/curriculums: Facing the Future, Wildlife and Wildland Toolkit, Project Learning Tree, Population Connect, Windows on Waste, Waste in Place, Quest for Less, and Composting in the Classroom: Science Inquiry for High School Students. The training resource list includes additional websites, activities, links to videos and news stories that referenced NOAA partners and other content experts. Several coordinators and the garden club students from one school met greenhouse manager/sustainable farmer. She taught about building, maintaining and harvesting a compost pile. The students, parents and garden coordinator enjoyed the tour and were interested in an ongoing relationship with the farmer. Some of the schools met an environmental science educator and her presentations were well received. One high school met with the District's Planner to discuss compost and other waste reduction statistics.

Two schools exceeded the 1,000 pounds project goal. The rest did not. Two schools were close to making the goal. One school only collected snack waste, which did not include food scraps from lunch. The total pounds collected was 7,902 pounds for the schools, which was half as much as we estimated. Some statements had significant changes in student's attitudes after the Climate Compost Project was completed. There was a twenty-five percent increase of students that understood climate change is damaging the planet. A twenty-six percent increase in knowing what climate change causes like sea level rise and stronger storms. More students are now worried about how climate change will affect their life by 31% increase. There was a forty-one percent increase in understanding that composting organics helps combat climate change. More students understand keeping food and yard waste out a landfill is another way to slow down changes to climate by an increase of twenty-seven percent. Twenty percent increase occurred with students who agreed that organics in a landfill create methane gas. It was concluded that multiple bin systems or larger compost systems would be needed to capture all acceptable food waste scraps that are currently being generated at a large school. Coordinators are necessary to maintain the project and students will continually need to be educated on what can go into the bins, benefits, and how composting mitigates greenhouse gas emissions.

Karen Temple-Beamish – Children Capturing Carbon

It was believed that by teaching water-conserving and carbon-capturing food production, the *Children Capturing Carbon project*, an outgrowth of the Desert Oasis Teaching (DOT) Garden, would help the students to become stewards of the land and improve their awareness of environmental issues related to soil health and food production. Everything that Karen teaches related to climate change and so the project was a natural extension of what she is already doing in the classroom. Their work began by consulting with a local organic farmer to get a better understanding of irrigation and soils. Then Karen and a smaller group of students attended the Quivera Conference on land restoration and learned about the fundamental of soils and their care. The students then set up transects and plots of different site locations where the soils were analyzed for their quality. After determining the quality of the soils at different locations, a water diversion and capture system was devised, capturing water from the building

roof and storing it in 1500 gallon cisterns. The tested soils were then composted and left to become more sustaining.

As part of their efforts, the students attended conferences, developed websites, worked in environmental clubs, and studied the topic in their classes. Students also had the opportunity to present what they had learned to younger students at the Natural History Museum. The 10th – 12th graders will continue the work by studying the impacts of climate change on polar systems and report their findings through ARC GIS using Story Map. Karen and her classes continue to learn and teach new techniques to other students and the community. They were ultimately successful in enhancing the organic content of the treated soils by 4% overall. A number of NOAA and related climate change resources were utilized throughout the year to enhance the students' learning, expose them to a greater variety of topics associated with climate change, and to act as resources for them in their work with the soils. A career focus was integrated throughout the program as well with scientists presenting to the students on water resources, water conservation, soil and climate, and national energy concerns.

Karen concludes that the DOT Garden and all that it encompassed was a vital, vibrant and effective teaching space, that team work, perseverance and community involvement are the hallmarks of their success, and that students are reporting that their favorite part of this science class is garden day. Additional evidence for the impact of the project on her students comes from their blogs, which are full of personal accounts of their experiences and their impact. There have been many challenges faced and the students have learned to face them and collaboratively overcome them.

Carlie Trott – Engaging Key Stakeholders in Climate: A Photovoice Project for Youth-Led Participatory Climate Action

It was hypothesized that, through their participation in *Science, Camera, Action's!* (SCA) hands-on, interactive science activities, photovoice process, and translation of knowledge to action, youth will demonstrate enhanced climate change knowledge, improved climate change-related attitudes, and increased engagement in small-scale, everyday sustainable behaviors.

Additionally, it is expected that SCA participation will benefit youth by enhancing their science engagement. It is further expected that youth-initiated family action plans, as part of SCA's Carbon Footprint Contest, will contribute to active climate change mitigation practices at the household level. Finally, a key goal of SCA is to empower youths' sense of agency by supporting them in their efforts to carry out a collaborative climate change action project.

SCA was a fifteen-week program that combined hands-on, interactive climate change education with photovoice methodology to empower youth to act as agents of sustainable change within their families and communities. Participants were 55 youth (ages 10 to 12) across three Boys and Girls Club sites in Northern Colorado. SCA's *Science* component used interactive activities to demonstrate the interrelationships between Earth's changing climate, ecosystems, and sustainable actions within communities. Photovoice, SCA's *Camera* component, was used to explore youths' climate change perspectives and to identify opportunities for their active engagement. Finally, SCA's *Action* component aimed to cultivate youth potential as agents of

change in their families and communities through the development and implementation of youth-led action projects. Action projects included local policy advocacy, a tree-planting campaign, a photo gallery opening, development of a website, and the establishment of a Boys and Girls Club community garden. The SCA program encompassed diverse and complementary techniques, framed by the ‘Head, Heart, and Hands’ model for sustainability education, and guided by photovoice methodology for purposes of science learning, community-based inquiry and connection, and youth-led participatory action.

In the final six weeks of the program, participants, as decision-makers and co-researchers, engaged in photovoice with the goal of translating knowledge into action. After reflecting on themes derived from previous weeks’ photovoice sessions, youth engaged in a brainstorming and consensus process to formulate a plan for collaborative climate change action specific to their shared interests and goals. The process of deciding on youth-led projects was open-ended, but limited in terms of focus (i.e., climate change), time (i.e., five weeks), and funds (i.e., \$500 or less). The role of the SCA research team was to assist youth in translating their ideas into concrete action and to support youth as agents of change within their families and communities. In the framework of ‘Heads, Hearts, Hands,’ both action projects promoted youths’ active engagement (“Hands”) with learned concepts through everyday practices and innovative projects.

A combination of survey and focus group methods were used to evaluate SCA program impacts. Surveys were administered to youth before and after their participation in SCA. To address this study’s first research question, which aimed to assess the impact of SCA on youths’ climate change knowledge, attitudes, and behaviors, a diverse and complementary set of pre-existing scales were included in pre- and post-program surveys. A total of 14 items were used to assess youths’ general perceptions of, and knowledge about climate change. Students reported significant changes in their perception of and knowledge about climate change. Students also showed significant increases in the amount they were thinking about climate change and believing that it was a significant issue to be addressed. Student responses were also positively correlated with the ideas of conservation, connections to nature, developing a new ecological paradigm, and acting responsibly towards the environment. Lastly, students showed significant changes in their interest in a STEM-related career and the likelihood that they would pursue one in the future.

Renee Fudala – STEM Academy School Garden: Mitigating Greenhouse Gases

The Climate Science issue addressed was to establish a school garden (Feed Forward Project), which actively engages all students in learning about the causes, impact and mitigation of carbon dioxide emissions both locally and globally. Students closely explored the role that terrestrial plants have in sinking greenhouse gas emissions. STEM Academy students had comprehensive project-based lessons to further understand what the garden accomplished in mitigating the greenhouse gases in our environment. Once the project was funded, they began by establishing their school garden with a wide variety of vegetables, strawberries, and pollinator plant species. Plans are in place now for expanding the garden in the coming year.

Once the garden was established, the students, utilizing NOAA resources, learned about dynamic Earth processes, carbon emissions, global climate change, and carbon sequestration. Additionally, students in the STEM Academy participated in a career fair highlighting careers in STEM where they learned from professionals while participating in hands-on activities. As part of the garden monitoring, students gathered information about carbon dioxide levels and correlated them with the number of plants and their sizes to help determine the amount of carbon being sequestered by them throughout the year. Through the process of studying the greenhouse environment, the students were exposed to a number of complex scientific ideas and showed positive changes in their understanding.

By her own report, the impact of the project on the students has been “tremendous.” Renee reports that the students loved working in and exploring the garden, that they were always willing and enthusiastic to spend science class counting plants, conducting studies, and analyzing the environmental data. Renee reports that her original hypothesis was confirmed – the garden is impacting the students in many positive ways. She notes that there were many challenges along the way, but that the outcomes are well worth it. The students in the Environmental Awareness Club presented their findings to the Sandwich School Committee, the Science Advisory Board, and the PTO. The feedback from these presentations was very positive and helped the group gain additional support for the garden program.

Chris Schmitz – Polar Bear Challenge Part II

Building on the Polar Bear Challenge, Chris developed a 300-page curriculum and teacher workshop used the Polar Bear Challenge (PBC) as the action piece for the curriculum. The curriculum and workshop were designed to help the teachers incorporate science, technology, engineering and math (STEM) skills into their curriculum and help their students make a difference in reducing carbon emissions in the schools and in their home lives. This expansion helped them to meet the Utah State Science Standards, while at the same time, providing activities that engaged their students in STEM activities. By participating in the activities, the students became better stewards of the planet.

To help educators have access to the materials, a website was developed as a way to share and inform. As part of participating in the program, the educators were asked to administer pre and post-tests to their students. A total of 38 teachers administered the pre-test with only five having their students complete the post test. Student tests were collected by their teachers and sent to Chris for scoring and recording. All students and teachers who participated in the Challenge were recognized with a certificate of participation but only those teachers who completed both the pre- and post-test with their students were eligible for prizes. A large number of NOAA and climate change related resources were used in the program materials and by the participating teachers. Careers in STEM were not a focus of the workshop primarily because the students were elementary aged. According to Chris, “By providing teachers with a positive way to address climate change: i.e. being better stewards of the environment to benefit both people and polar bears, they were willing not only to attend the workshop but also to use the materials and information in the classroom. This was a huge step for many of them because the topic of Climate Change in Utah is a political hot button. The 28 teachers who participated in the

Challenge all were moved to take action and make a difference, even if they did not complete all 21 days or have their students take the post test.”

Teachers were asked to submit a final wrap-up of their projects and fill out an evaluation regarding the teacher workshop. Results from the teacher workshops indicated that the workshop addressed standards, provided teachers with enough resources and information to feel confident about addressing the subject in their classrooms.

Janice Novello – Care of God’s Creation Contest

The fundamental question that Janice worked from was, “How might each of us, as Catholics in the Diocese of Venice, share in the care of God’s gift of our Earth so that the children of God in the future will also be able to enjoy and benefit from our environment by participating in a recycling project to make an impact in mitigating Climate Change in the Future?” A total of 26 entries were received for the Care for God’s Creation Contest. The winners of the school contests were then sent to the Diocese of Venice who chose the overall winning entry for each grade division. Grades pre-K through 8 and Grade 10 were represented. May 25, 2016 found the large conference room totally filled with many people standing. The winning students from each participating school attended with their parents, relatives, friends, teachers and principals. The program included an overview of the hypothesis and examples of how NOAA resources were implemented to help the students find real life ways to help mitigate climate change through implementing plans and activities to develop new habits.

Over the 2016 summer the newly organized STREAM (Science Technology Religion Engineering Arts Mathematics) Team continued to meet at Mote Marine in Sarasota to receive professional training in the scientific method and data collection using marine biology and oceanography. Teachers put these new skills into practice by volunteering, for at least one week each, and to model class management for the summer interns from University of Southern Florida. The STREAM team continues to meet and has decided that the coming year will be focused on engineering allowing them to expand the students’ measurement/data collection and recording skills. November 2016 will be the start of the next contest.

Sandra Bennet - Reduce, Reuse, Recycle School Materials to Reduce the Carbon Footprint

The stated goal of the project was, “Through involvement of many students in increased recycling and waste reduction initiatives at the school, there will be increased student awareness that even small changes can result in big differences in the environment.” *The desired outcome of this project was to decrease energy use in the school as well as improve the recycling efforts.* Reduction of waste in the school overall was also a target as well as involving as many students as possible in the project or to impact them through seeing the project being carried out. During the project, records were kept of the pounds of paper recycled and the impacts on local landfills calculated. To collect the paper, two bins were distributed to all classrooms: one for paper and the other for plastic bottles and cans. Students made posters to identify the use for each can. Materials were collected every Friday, weighed, sorted to remove those items that might be best used for paper making (colored paper, newspapers for drying, etc.) Each class involved was given a hallway or two that they collected from each week so that they could deal with any issues that might come up. The bags of cans and bottles were counted as they were collected. Students

were also involved in paper making activities in hopes of expanding their understanding of the concepts associated with recycling.

This project involved well over 300 students directly; four teachers actively with the students but all teachers and staff were involved in the recycling itself. Several clubs assisted involved more students: ecology club, chemistry club, and art students. Community members involved included management from Target, Lowe's, and Martin's stores who assisted with carts and bag collections. The school population is slightly over 1100 and every single student was a part of this project through the awareness of the recycle bins in the classroom, talks by the Ecology students, and seeing the collection being carried out, posters, and paper products made by those involved directly. In all, a total of 6400kg of paper/cardboard, 8000 plastic bottles, and 3200 cans were collected and kept out of landfills.

IV. Conclusions

2016 Climate Stewardship Projects engaged audiences in a wide and meaningful array of topics associated with climate change such as reducing waste and energy usage in schools, building school gardens, replanting mangroves and dune restoration, and educating communities about the effects of climate change in their area. The projects involved over 10,000 students at different times in after school settings, as schoolwide projects, with their communities, parents and families. The following summarizes the findings from the reports by direct and indirect outcomes related to the climate stewards projects.

Project Outcomes

Direct Outcomes for CSEP Participants

- Increase the **content knowledge** in climate/climate change-related STEM.
 - As part of the stewardship projects students were learning about climate change from resources and as part of their classes and embedded within the projects themselves.
 - All projects showed increases in student understanding.
- Increase the **use of NOAA, and NOAA Partner data resources**.
 - All of the climate stewards completing final reports indicated they had used NOAA resources used as part of the stewardship project efforts.
 - All final reports listed numerous NOAA and NOAA partner resources incorporated into the stewardship projects and classroom lessons.
- Increase **participation in active environmental stewardship**.
 - Thousands of students and adults participated directly or indirectly in this year's stewardship projects.
 - Direct participants actively worked within their schools and communities to help clean up the environment, restore natural areas, improve their schools, and conserve and reduce energy usage and waste.

- Intend to continue environmental stewardship activities in the future.
 - Most climate stewards described their plans for continuing their stewardship efforts beyond this year.
 - Most of the plans were able to describe sustainability efforts they have taken to ensure the project continues into the future.

Indirect Outcomes for CSEP Stewardship Project Participants through the CSEP Participants

- Increase participation in **active environmental stewardship**.
 - All of the climate stewardship projects contained a hands-on component or focused primarily on hands-on activities.
 - Students were active participants throughout their projects, working alongside scientists, community members, and fellow students.
 - Students actively engaged the public and family members in their efforts to help increase the understanding of climate change.

- Increase **awareness of careers** in STEM related to climate/climate change science.
 - Climate Stewards were aware of the importance of including STEM related career information and exposure into the stewardship projects.
 - Climate Stewards described in their final reports the efforts they had undertaken to increase career awareness for their students including having scientists speak to their classes, visiting the workplaces of professionals, and working directly with STEM professionals in the field.

- **Apply climate/climate change science STEM** concepts and skills in meaningful ways in a stewardship project.
 - Climate Stewards were able to develop projects that built student understanding of climate science through classroom learning and hands-on practice.
 - Learning by doing, students participated in meaningful purposeful projects designed to improve their environment, community, and themselves.

- Engender **intention to continue** environmental stewardship activities in the future.
 - Stewardship projects were designed to both help improve the environment where the students live and play and inspire them to continue their stewardship work and look for new ways they can make a difference through personal action.
 - In one case, students were asked directly if they intended to continue to be stewards of the environment and all of the students reported they they would.