

4-H Science Initiative from Inception to Impact:

Methodologies, Lessons Learned, Best Practices and Recommendations

A National Framework Released February 2013 Report developed by Dr. Eddie L. Locklear



NOYCE FOUNDATION

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Introduction

Building on a 110-year history of hands-on science education, 4-H is working to improve the science, engineering, technology and applied math skills of America's youth. The partnership between the Noyce Foundation and 4-H has created a national system that is having a significant impact on improving the STEM (Science, Technology, Engineering and Math) skills of youth in out-of-school settings. 4-H science programs have been shown to increase youth interest, engagement, skills, knowledge and aspirations in STEM education and careers.

This report highlights the development, expansion and sustainability of the national 4-H Science CUT (SET) system. 4-H has provided reports to the Noyce Foundation since the beginning of the Noyce Foundation/4-H Science partnership. Therefore, only the highlights of the work—intended to show how the 4-H Science Initiative was conceived, designed, implemented and sustained—are included in this report. If additional details are needed, the reports provided to the Noyce Foundation are available at National 4-H Council.

4-H: A Brief History

Clearly, 4-H is at a turning point in its history with an extraordinary opportunity to reaffirm its legacy as a leader in hands-on non-formal science, engineering and technology education. Since the 4-H Youth Development Program began in 1902, 4-H youth have been engaged in demonstration projects that bring innovation and understanding of land-grant college and university research to local communities. Understanding and appreciating the role of science, engineering and technology is even more critical as the needs of our society and its workforce change. Now, more than ever, we must ensure that our nation's youth develop the necessary competencies and abilities for the United States to remain competitive in the 21st century. —4-H SET: A Strategic Framework for Progress, May 2007

Since its inception in 1902, the 4-H Youth Development program has created learning opportunities for young people (ages 5–18) to learn about the natural world, technology and their communities. Initially, 4-H used its hands-on learning approach to help youth, and eventually their parents, to become more efficient agricultural producers and homemakers, while balancing agricultural advancement with quality of life and environmental concerns. 4-H connected youth to universities and their research to help them develop agricultural skills and improve leadership and citizenship skills. 4-H became part of the larger United States Department of Agriculture effort to connect citizens to rapidly developing advances in agricultural sciences and technology discovered by the land-grant universities. 4-H youth were often among the first to learn about the new scientific discoveries and related technologies and to apply them in real-world settings through their 4-H projects.

As America grew and the demographics of the population shifted from agrarian to rural non-farm, suburban and urban populations, 4-H expanded to meet the needs of the changing population while continuing to use its signature hands-on learning strategies. Today, 4-H continues to offer a variety of learning opportunities to meet the diverse interests of youth across America. When the need to increase STEM engagement, interests, skills and knowledge among youth was identified as a major need in America, 4-H was in an ideal position to help address this important youth and national need.

4-H serves more than six million young people each year, learning leadership, citizenship, and life skills. National 4-H Council is the private sector, non-profit partner of 4-H National Headquarters located at the National Institute of Food and Agriculture (NIFA) within USDA. 4-H programs are implemented by the 111 land-grant universities and the Cooperative Extension System through their 3,100 local Extension offices across the country.

Executive Summary

Since its inception in 1902, the 4-H Youth Development program has created learning opportunities for young people (ages 5–18) to learn about the natural world, technology, and their communities. When the need to increase STEM (Science, Technology, Engineering and Math) engagement, interests, skills, knowledge and aspirations among youth was identified as a major need in America, 4-H designed a comprehensive system to address this need. 4-H's goal is to engage 1 million new youth in 4-H Science by the end of 2013.

To design the 4-H Science comprehensive system, an effective infrastructure was needed. The National 4-H Science Management Team—consisting of local, state and national 4-H leaders—was organized to guide the development and implementation of 4-H Science. To increase and maintain effective communication with state and local 4-H staff and volunteers, 4-H Science Liaisons from land-grant universities were recruited and trained to assist with the work. Of these, five regional 4-H Science Liaisons were recruited to provide leadership to the liaisons in each of the five Cooperative Extension System regions. Conference calls, webinars and face-to-face meetings were used by the national team and liaisons to design and implement 4-H Science.

Resources used by the national team to develop the 4-H Science initiative included: 1) The 4-H Strategic Framework (Strategic Plan); 2) Land-grant Universities' 4-H Science Plans to Action; 3) The 4-H Science Checklist—used to define a "4-H Science Ready" program; 4) The 4-H Science Logic Model; and 5) two papers ["Science, Engineering and Technology (SET) Programming in the Context of 4-H Youth Development" and "4-H SET (Science, Engineering and Technology) Staff Readiness Survey"].

As the national team designed the 4-H Science initiative, national teams were organized to guide the development of professional development, curriculum, evaluation and research, marketing and communication, fund development, and partnership resources. The teams consisted of internal and external experts in the specific areas and used face-to-face meetings, webinars, conference calls and email to conduct their work.

The Professional Development team conducted national conferences (June 2007 and December 2010) and regional conferences (five in early 2012) to train state and local 4-H staff on the many PD resources developed by the team. The team continues to develop PD resources available via webinars and on the PD website at www.4-h.org.

The Curriculum team developed a rubric/template that was used to develop additional 4-H Science curricula. The rubric is being used by the 4-H System to develop additional curricula. The rubric is also useful for reviewing STEM curricula from other organizations that can be used in 4-H Science. High-quality STEM curricula continue to be a major need for 4-H Science programs.

Executive Summary continued

The Evaluation team developed a plan that: 1) Assessed 4-H staff members' capacity and capability for designing and implementing 4-H Science programs; 2) Determined the success of 4-H Science for increasing youths' interest, engagement, skills, knowledge and aspiration for STEM education and careers; 3) Identified best practices, including frequency, duration and intensity, for offering high quality 4-H Science programs; and 4) Conceived a longitudinal study to compare 4-H Science members with non-4-H youth to assess differences in STEM interest, engagement, skills, knowledge and aspirations.

The Marketing team organized and implemented five 4-H National Youth Science Days (2008–2012) to engage youth in a variety of STEM activities to teach them the fun of STEM. The activities involved a variety of STEM concepts including alternative energy, water conservation and engineering a robot to address environmental issues. The activities were conducted in thousands of communities across America and in other countries. The team developed a variety of marketing fact sheets and web-based tools to support 4-H professionals.

The Partnership team worked with over 30 organizations to develop a collaborative relationship to support 4-H Science. The engagement of partners ranged from sharing resources to involving strategic partners in training, serving as mentors, coaches and leaders of 4-H Science programs.

The Fund Development team developed a variety of fund development resources, including a Fund Development Toolkit with over 250 learning modules, templates and resources to enhance fundraising for 4-H Science. The modules are intended to be a virtual learning environment for 4-H staff and volunteers who have a variety of experience and comfort levels with fund development. The team also presented fund development workshops and resources, offered webinars, training and technical assistance to 4-H staff and volunteers. The team is exploring new business models and revenue streams for curriculum, professional development and other aspects of the 4-H Science initiative.

The teams were successful in achieving the goals and objectives of the 4-H Science Strategic Framework:

- Team members and 4-H Science Liaisons are providing significant leadership to help 4-H staff and volunteers design, implement and secure funding for high-quality 4-H Science programs that meet national STEM standards.
- 4-H faculty and staff are developing needed 4-H Science curricula that meet national standards.
- Evaluation resources of the national team are being widely shared with 4-H and non-4-H groups.
- The evaluation of 4-H Science programs continues to show that 4-H Science is having a positive impact on increasing 4-H youths' interest, engagement, skills, knowledge and aspirations in STEM education and careers.



An Introduction to STEM

The danger exists that Americans may not know enough about science, technology, or mathematics to significantly contribute to, or fully benefit from, the knowledge-based society that is already taking shape around us. (Rising Above the Gathering Storm, Pre-Publication Version, February 2006 Edition, p. 3–24).

The Rising Above the Gathering Storm Report highlighted a significant challenge: America's young people are not prepared with the necessary math, science and workforce skills for the 21st century. With a presence in every county in America and its connection to 111 land-grant universities, 4-H was in a unique position to address this challenge. For this reason, 4-H selected science as one of its three mission mandates. These three focal areas are Science, Healthy Living and Citizenship. Because of the urgent need to advance STEM programs nationally, 4-H SET (4-H Science) was selected as the first mission mandate to receive significant leadership and financial support from National 4-H Headquarters, USDA and National 4-H Council.

What's in a Name? STEM to SET to 4-H Science

Although the term STEM was being used by many organizations, 4-H decided to use the term 4-H SET. This was most appropriate to 4-H because of its historical strength and focus on science, engineering and technology. 4-H did not offer any programs that "directly" impacted math skills. Since 2003, there has been extensive discussion by 4-H and land-grant university leaders regarding the appropriate term for 4-H science work. Some of the leaders felt that 4-H SET was too restrictive and did not communicate the appropriate message of 4-H's impact on STEM education. Therefore, after much discussion among the 4-H National Management Team, national and state 4-H leaders and land-grant university leaders, the term 4-H Science (science, engineering, technology and applied math) was selected as the name of the 4-H STEM work. The terms STEM, SET and Science are used throughout this report due to this evolution of the name.

Defining the 4-H Science Role

National 4-H Headquarters, National 4-H Council, and Extension Committee on Organization and Policy (ECOP) 4-H Task Force rallied around the need to focus more extensively on defining the role of 4-H in the area of science, engineering and technology. 4-H established the Science, Engineering and Technology Work Group (Working Group) in fall 2003, with support from the National 4-H Leadership Trust, to examine the role of science, engineering and technology in 4-H and make recommendations on how to reinvigorate its commitment and sharpen its focus in this area. Led by Dr. Beth Birnstihl, University of Nebraska at Lincoln, and Dr. Bob Horton, The Ohio State University, the Working Group represented a cross-section of the 4-H movement. In January 2004, they conducted an internal audit and environmental scan to identify strengths, weaknesses, opportunities and challenges. The process culminated in a three-day meeting in March 2004 where the group developed a vision statement and framework for reaffirming 4-H's leadership in SET programs. The outcome of the team's work was a preliminary strategic plan and a goal: to engage 1 million new youth in 4-H SET.

Due to the high interest in STEM education in out-of-school settings, National 4-H Council chose 4-H SET as a primary focus for fund development work. The team's work highlighted the need for significant funding to support the development of a national system to design, expand and sustain 4-H SET.

National 4-H Council staff began soliciting donors to support 4-H SET. In 2006, Council staff contacted the Noyce Foundation to explore a potential partnership. Council staff submitted briefing papers, partnership rationale, program ideas, proposals and program strategies that highlighted 4-H strengths in addressing the need for STEM education for youth. This exchange opened a dialogue between the Noyce Foundation and National 4-H Council. For the next few months, National 4-H Council responded to Noyce Foundation questions. On October 4, 2006, the Noyce Foundation and National 4-H Council had a telephone conference to discuss the potential of a partnership. On April 23, 2007, Don Floyd, President and CEO of National 4-H Council, Dr. Eddie Locklear, Council's 4-H SET Leader, and Tanya Blue, Council fundraiser, met with members of the Noyce Foundation Board of Directors in Cambridge, MA to discuss a potential partnership. Following this discussion, the Noyce Foundation decided to fund the development of the infrastructure needed to design, implement and sustain the 4-H SET Initiative.

4-H SET Goal

By 2013, 4-H, a recognized leader in providing hands-on, non-formal learning experiences, will engage one million new youth in a dynamic process of discovery and exploration in science, engineering and technology to prepare them to meet the challenges of the 21st century.

Designing and Implementing 4-H SET

The funding provided by the Noyce Foundation enabled National 4-H Council to secure staff to assist with the design and implementation of 4-H SET. On July 6, 2006, National 4-H Council and National 4-H Headquarter staff met to develop strategies for expanding the 4-H SET work. Don Floyd asked Dr. Eddie Locklear to provide Council leadership for 4-H SET along with National 4-H Program Leaders (NPLs) from 4-H National Headquarters.

Using the preliminary work of the 2004 team, Dr. Locklear and NPLs began designing the 4-H SET work. They reviewed the list of 2004 team members and decided to develop a smaller team to revise and implement the 2004 strategic plan. This new 4-H SET Leadership Team—created in September 2006—consisted of national, state and county 4-H faculty and staff. Over the years, the team has expanded to include additional state and local 4-H professionals and changed its name to the 4-H Science Management Team.

The team developed the "4-H Science, Engineering and Technology: A Strategic Framework for Progress." As a framework, the document was meant to be used as a guide by state and local 4-H staff to design locally appropriate strategic plans. The document was not designed to be the "right" plan for all 4-H programs. The framework outlines 4-H's goals, objectives, strategies, tactics, outcomes and indicators in science, engineering and technology in seven key areas:

- Program Development and Design
- Curriculum

- Professional Development
- Evaluation and Research

- Marketing and Communication
- Funding

• Partnership and Collaborations

This report details accomplishments in each of these seven categories since 2006. Additional details are available on request.

4-H SET Objectives

- Increase youth interest, literacy and engagement in STEM
- Increase the number of youth pursuing post-secondary education in STEM
- Increase the number of youth pursuing STEM careers



4-H SCIENCE RESULTS

LESSONS LEARNED

Since 4-H Science became a key 4-H focus in 2004, 4-H staff leading the work have learned several lessons that have enabled them to achieve success. This section identifies some of the important lessons to be considered as 4-H looks to make changes that are national in scope, scalable and sustainable.

- **Begin with the end in mind!** Be sure that the program vision, goals and objectives are clearly articulated. Conduct environmental scans to ensure the vision and goals are realistic and attainable. Don't be afraid to take risks and develop an innovative and dynamic vision and goal, but spend time with key leaders to explore the capacity and capability of the organization. Don't be afraid to dream big!
- Think comprehensively: establish a strategic plan or framework to guide the work. Consider all aspects of the work to be done and include key work areas. Be sure to include specific goals, objectives, strategies, tactics and outcomes. At the national level, it is impossible to develop a plan that will encompass every conceivable strategy and outcome. However, it is possible to provide a guide to help staff develop specific plans with strategies and outcomes. The 4-H Science Initiative divided work into seven categories: 1) Program Development and Design; 2) Professional Development; 3) Curriculum; 4) Evaluation and Research; 5) Marketing and Communication; 6) Funding; and 7) Partnerships and Collaborations. These components are interrelated, so the national leadership team developed linkages and coordination across the components. Once this framework was developed, it provided guidance and a vision to accomplish the 4-H goal of reaching one million new youth.

- Establish a strong national leadership team. A national leadership team is essential. It should engage well-respected, successful partners from inside the organization who can promote the initiative, as well as external partners who can bring expertise, linkages, resources and recognition to the work. Engage individuals with expertise in program design and development, fund development, evaluation, professional development, curriculum, marketing and communication, and partnership development.
- Establish an infrastructure to ensure state and local leaders can be engaged in the development of the work. To ensure plans developed at the national level are relevant and actually used at the community level, develop a clear communication structure to inspire buy-in at all levels of the organization. Although web-based technologies are valuable, face-to-face interaction helps team members build successful working relationships. The 4-H national team met bi-annually, had monthly conference calls and participated in webinars as appropriate. There was also a regional structure that involved key 4-H leaders from all land-grant universities (4-H Science Liaisons). The 4-H Science Liaisons participated in monthly or bi-monthly conference calls. Regional staff also met in person.
- **Begin with a theory of change.** Begin with (or develop very early) a clear theory of change articulated over a multi-year period. Identify short, intermediate and long-term outcomes and articulate to partners clear expectations for engagement.
- Develop specific committees or teams to implement the plan. Given the complexity of building a national framework to encompass the work occurring in every county in America, the level of specificity needed to be successful cannot be accomplished by one national team.
 4-H created a national leadership team as well as national teams for each major program focus area. It also created ad hoc and short-term committees frequently. When developing the committees, engage a broad array of leaders at many levels from within and outside the organization. The major committees should develop specific Logic Models to guide their work.
- Develop a strong, clear and consistent message about the STEM program. To build momentum and enthusiasm for the initiative, communicate the program vision early and consistently to all stakeholders within the organization. Provide opportunities for feedback as well as processes to integrate it into program development. Conduct public awareness campaigns to ensure parents, donors, political leaders and other external stakeholders are aware and knowledgeable about the program.
- **Plan for sustainability at the outset of the initiative.** To ensure the long-term success of the initiative, create a sustainability plan detailing potential future funding sources.
- Secure commitment of administrative leaders at all levels of the organization. Strong internal administrative partnerships and institutional buy-in are essential for success. The commitment of leaders at all levels helps ensure that the initiative fits unique state and local needs and that it will not be treated as a temporary responsibility.
- Help staff integrate the STEM work into existing work. National leadership must make a concerted effort to provide guidance on how best to integrate SET concepts and instructional techniques into existing programming. This guidance can address ways of offering more and better SET programs in spite of limited budgets, time, staff and volunteer resources.

- Plan for leadership changes and evolution. Develop a plan supported by a well-established framework to avoid stagnation of the national team. A sunset time frame is useful, as is having clear terms for individual appointments. This encourages new ideas and perspectives. Team members should be appointed to support essential functions of programming, but will ultimately work collaboratively. There has to be a balance of stable leadership with dynamic engagement of new partners.
- Develop a succession plan for key leadership staff. Because key leaders help direct the overall initiative, develop a succession plan to replace those who retire, change job assignments or are no longer available to support the initiative. As soon as a key leader plans to leave, take steps to find a replacement.
- Develop strategies to motivate and engage others. If the national leadership does not have line authority over those implementing the program, use positive reinforcement strategies to engage them as partners. Incentives (paid professional development opportunities, short-term contractual work, invitations to serve on national task forces and committees, and grants) and recognition (press releases, awards, involvement in limited access opportunities, special appointments) are great ways to inspire individuals' commitment and engagement.
- Create a formative and summative evaluation strategy to measure the organization's capacity to implement and sustain the STEM work and program impact. Evaluation data are essential for program revisions and adjustment. Determine the organization's capacity and capability to implement and sustain the program at the outset before investing significant resources. Documenting program impact is vital to securing and maintaining donor and partner involvement.
- Develop a well-coordinated and effective professional development plan and delivery system to meet the needs of the population served. Feedback from 4-H science professionals indicated that they have many demands on their time, especially at the local level. A professional development plan that includes process and content skill development is helpful to ensuring consistency and quality of program delivery across a distributive system like 4-H. The plan should be easily accessible; constantly reviewed, updated and maintain; and allow for technical assistance support when needed. Needs assessments can help determine what is most useful for staff and guide the creation of a professional development system. Although all needs cannot be addressed, the plan should include broad topics that apply to most staff and volunteers, such as positive youth development.
- Create a curricula development/access system to ensure high-quality STEM curricula. High-quality STEM curricula is essential for the success of STEM programs at the local level. The curricula should be based on national STEM standards and include positive youth development elements. Regular reviews of STEM standards should be conducted to ensure that the latest information on standards is available and used.
- Create a fund development plan, if needed, to sustain the national leadership and other program infrastructure. Because securing funds for administrative, leadership and management staff is a perpetual challenge, a strategic plan should always include fundraising strategies. As the program expands, develop models to generate funds to sustain this leadership.
- **Patience, patience, patience and more patience.** It takes a long-term commitment to bring about change in a large, distributive, national organization or group. Don't expect immediate outcomes.



- **Obtain multi-year commitments from partners.** A multi-year commitment from donors and other partners helps ensure that the necessary resources will be available to achieve desired outcomes. Without a steady source of funding, it is difficult to hire and keep good people, develop momentum and engage the larger system.
- Invest in both the initiative and the infrastructure of the organization. When a new initiative is funded, everyone in the organization already has a full-time job. The organization is committing all the resources it can into its current work. Investing in additional staff, as well as infrastructure support such as websites and other tools, may be critical to the initiative's success.
- Seek out additional funding and programmatic partners. Donors can be valuable allies in securing support from a broad array of sources. By opening doors to other sources of support, they can help build program sustainability. Because no one organization has all of the STEM expertise and resources it needs, outside STEM partners can provide content experts, STEM curriculum, access to new youth and volunteer audiences and other resources. This helps ensure a dynamic, diversified and comprehensive STEM program.
- Create a climate of openness and trust with donors. Donors wield significant power over grantees, so it is important to have a climate where opinions, ideas and concerns can be shared and discussed in an open dialogue without fear of reprisals.

Research to Discover Best Practices for Local STEM Programs

Although the "Lessons Learned" and "Recommendations" in this report are meant for developing and sustaining an infrastructure for a national STEM program, the following practices are more appropriate for local community program delivery. However, the practices do offer useful insights for national leaders who are designing a STEM framework for local programs.

Not all practices will be best for every STEM program. These practices were identified via a multi-method study of eight promising 4-H science programs across the country." The entire report, *PRIMING THE PIPELINE: Lessons from Promising 4-H Science Programs*, July 2012, is located on www.4-h.org under the Research link, and then the Science link. The list below includes only the practices. Additional details and examples are available in the full report.

Youth Outreach and Recruitment

- Promote recruitment through "word of mouth".
- Invite participants to contribute to the recruiting process.
- Recruit youth through partner organizations and parents.
- Design the application and acceptance process to build the desired participant group profile.
- Design strategies to recruit underrepresented youth.

Staff and Science Volunteers

- Include science experts as site leaders and volunteers.
- Recruit scientists to deliver the science content they know and love.
- Maximize the expertise of youth development staff and volunteers and clarify their roles alongside scientists.
- Cast a wide net when recruiting science experts, then tap the specific expertise needed.
- Recruit scientists through networks and continuously tend to the relationships in those networks.
- Recruit scientist volunteers who work well with youth; consider partnering with K–12 teachers and schools.

Professional Development

- Make it easy to access and use professional development tools and resources.
- Provide guidance to science experts on lesson planning, delivery and youth development.
- Provide guidance to educators and youth development experts on science curricula and technology.

Science Curricula and Pedagogy

- Take advantage of the opportunity to maximize youth-centered delivery.
- Develop student skills and knowledge through experiential learning and real-work application of science.
- Incorporate inquiry in activities.
- Manage a realistic yet productive balance between adaptation and fidelity to an adopted curriculum.
- Enable volunteer science experts to develop their own curriculum, driven by their expertise and passions.
- Develop content targeted toward participant skills and interests.

Youth Development and Attitudes toward Science

- Provide opportunities for the development of positive relationships in a science context.
- Structure science activities to promote the development of life skills.
- Involve youth in their communities through science projects.
- Build opportunities for youth to serve in leadership roles.
- Enable youth to make meaningful choices about what they learn and how they learn it.
- Develop program activities that expose youth to diverse science fields and careers.

Partner Organization and Resources Support

- Draw human resources and science expertise from organizational partnerships.
- Look for low-cost ways for organizations to partner and make substantive contributions.
- Consider deeper partnerships with schools.
- Approach partnership development mindfully and persistently.

Program Evaluation

• Design evaluations to provide data that are useful for securing additional funds, partners, visibility and for guiding continuous program improvement.

Program Sustainability and Scale-Up

- Improve sustainability and replication by codifying and institutionalizing key program features, such as procedures, content, training and partner relationships.
- Plan for sustainability and replication through program and evaluation design.



RECOMMENDATIONS

The following recommendations are collected from program and evaluation reports, feedback from key 4-H Science leaders at the national level, and the observations and experiences of the author.

- Sustain a national infrastructure for the 4-H Science. Given the success of the design in building, implementing and sustaining the 4-H Science work, the structure has proven effective. Secure feedback from 4-H Science leaders and those directly involved in managing the infrastructure to determine what revisions and changes are needed.
- Use the 4-H Science infrastructure design and processes to support the broader 4-H mission areas. As 4-H's other two Mission Mandates become fully operational, national leaders should reshape the current infrastructure to integrate the three mission mandates into one structure. Many of the functions and processes in the 4-H Science structure–professional development, evaluation, curriculum, fund development, partnership development, etc.–are identical, except for the specific content. Streamlining the organization in this way will greatly improve efficiency and minimize the number of staff and resources needed to sustain the infrastructure.
- Identify the factors that affect the implementation of STEM programs and develop strategies to address challenges. For the 4-H system, staff reported that funding and staff resources (including the time required to seek funding) were the top two factors affecting their capacity to promote 4-H Science programming. These two factors affect almost all aspects of 4-H Science implementation. Many individuals report knowing where to seek funding for 4-H Science, but lack the staff time and/or expertise to secure funds.



- Continue offering fund development training and technical assistance to state and county staff and volunteers if resources are available. The Fund Development Toolkit and modules developed by the 4-H Fund Development Team effectively increased state and county fundraising skills. Over time, as staff members become more proficient at fundraising, they will be able to hire program staff, allowing them more time for program planning and management.
- Provide ongoing sustained professional development. Without intensive, on-going, and sustained professional development for staff and volunteers, the 4-H Science initiative will not endure. Solid professional development tools and resources help ensure fidelity to program models, reliable and valid evaluation, and even a basic understanding of the initiative's goals and objectives. In the implementation study of the evaluation team, some staff indicated that they lacked sufficient time to design, offer and attend professional development. For this reason, investing in professional development is critical.
- Build the capacity of the 4-H System to develop, design, review and evaluate 4-H STEM curricula. One of 4-H Science's greatest needs is high-quality STEM curricula. The National 4-H Curriculum committee has made significant changes to how 4-H curriculum is designed, developed and produced. These changes will help increase the availability of STEM curricula. This evolution of the curriculum process should continue and 4-H should stay informed of the changes. 4-H staff and volunteers should be encouraged, and supported with training, technical assistance, tools and strategies, to contribute to this STEM curricula development process. The committee should also expand the use of STEM curricula developed by organizations outside the 4-H system.

- Continue the current mechanisms for peer-to-peer learning and collaborations. Engaging and working with state 4-H Science Liaisons (one person per state to help maintain communication among national, state and local 4-H staff) has been effective. Regional Liaisons (multi-state contacts within the five regions of the Cooperative Extension System) have held regular conference calls to invite state 4-H Science Liaisons to connect. Maintaining local, state, regional and national contacts with a regular, periodic system for communication is important.
- Provide training on evaluation and data collection. In order to accurately assess the progress of the 4-H Science initiative, the data systems that partners use to collect program information need greater uniformity, with clear definitions of key terms used in data collection and evaluation. 4-H should communicate to all programs the type of data to be collected and how it will be collected. 4-H should provide on-going training and technical support to those using the nationally designed evaluation instruments to encourage local programs to use them.
- Maintain systems to encourage input from all staff on program development and design. Since 4-H is a distributive and diverse system, program staff and volunteers at all levels can offer valuable insight. Implementing a system for all staff to offer input on program development is helpful.
- Use innovative strategies to provide resources to staff and volunteers. Since science curricula can be costly, state and county educators should exchange curricular resources among states and counties through online networks.
- Continue to expand engagement of minorities and girls in 4-H Science. Because 4-H Science programs offer informal, out-of-school opportunities for youth to engage in science, 4-H is well positioned to help generate genuine interest, engagement and excitement among minority youth. Continue to seek out best practices for recruiting, engaging and supporting these youth, and share this information among state and county-level leadership.
- Continue to monitor and evaluate the effectiveness of delivery strategies. The 4-H Science Management Team and the other committees that support the 4-H Science initiative have successfully designed and implemented exemplary resources, training and technical support. Given feedback on usage of online resources and participation in webinars—which was reported as low and limited—4-H should continue to monitor how resources, training and technical assistance is provided and find ways to engage a larger percentage of the intended audiences.



THE 4-H SCIENCE PROCESS

1) Program Development and Design

GOAL: Develop and deliver 4-H SET programs that are content and contextually valid to youth in different settings and locations and that meet the needs of youth from diverse backgrounds.

OBJECTIVE: Increase youth knowledge, skills and competencies, and improve youth attitudes regarding science, engineering and technology.

Accomplishments

The 4-H SET Initiative successfully developed, designed and implemented an effective infrastructure to sustain and expand the 4-H SET Initiative. Specific successes include:

- A national leadership team to provide direction and planning
- A national 4-H SET Strategic Framework
- Effective staff and structural support at the regional and state levels
- Expansion of 4-H SET programs to minority youth
- Effective communication system to keep the 4-H system informed
- Significant research and fundamental support pieces to guide the 4-H SET work



4-H SET Management Team and SET Liaisons

Because 4-H is a very decentralized system, involving staff at national, state and county levels, a wide variety of partners, land-grant universities, stakeholders, and 4-H volunteers and youth, it is important to provide an effective, comprehensive infrastructure to ensure local programs receive the resources they need for effective program development and delivery. The national 4-H SET Management Team was created to serve this purpose and to provide overall direction and planning for 4-H SET.

To expand its reach, the team contacted state 4-H offices to identify 4-H SET Liaisons who would serve as the team's link with local 4-H county staff. This input from county 4-H staff and volunteers was vital to ensuring that the framework met local needs and to encouraging local buy-in—a critical ingredient for success. The goal was to recruit a 4-H SET Liaison from all land-grant universities involved in 4-H SET. The SET Management Team continues to have monthly telephone calls and two face-to-face meetings per year to manage all aspects of 4-H SET work.

The SET Management Team consists of 4-H staff that provides national leadership in professional development, curriculum, evaluation, fund development, partnership development and marketing. These leaders worked with internal and external experts to develop the work plan for each category. The team also consisted of five regional 4-H SET Liaisons who helped coordinate communication and program support in the five Cooperative Extension System regions. This ensures that the Management Team is connected to the strategies being used to implement and sustain the 4-H SET Strategic Framework.

The success of 4-H SET helped increase funding for the initiative. National 4-H Council staff worked closely with program staff to develop successful funding proposals that expanded the 4-H SET work at the national, state and local levels. This funding enables Council to hire additional support staff in various Council departments. State and county 4-H programs are hiring more staff with expertise in youth development and STEM.

4-H SET Plans of Action

The SET Management team worked with states to develop 4-H SET Plans of Action (POAs). These plans used the seven categories in the national 4-H SET Strategic Framework to outline the specific state and county STEM programs. In 2008, states began to develop POAs, often in conjunction with county 4-H staff. They revise them annually to reflect changes in their county and state programs. To be eligible for funding from National 4-H Council, all of the following criteria were required to be included in the POA. These criteria helped ensure program quality and sustainability:

- Provide non-formal education programs to diverse youth populations in multiple delivery settings. The national team recommended that land-grant universities develop 4-H SET programs that provided participants at least 50 hours or more of SET participation during their 4-H membership.
- Conduct SET programs that meet the SET definition and are contextually valid.
- Recognize youth as stakeholders and articulate how youth/adult partnerships will be utilized when appropriate.
- Create a well-coordinated on-going professional development plan.
- Adapt the 4-H SET marketing plan template to publicize 4-H SET.
- Create and maintain a funding plan to sustain 4-H SET.
- Use an evaluation process/system to measure youth outcomes—the instruments and system developed by the national evaluation team can be used for this work.
- Develop effective partnerships and collaborations to support the 4-H SET work.
- Leverage existing and new 4-H SET programs to reach new youth.

The national team provided the following **4-H SET definition** for state and local staff and volunteers. 4-H SET is 4-H's response to our nation's concern for improving human capacity and workforce ability in the areas of science, engineering and technology. 4-H SET programs combine non-formal, hands-on and inquiry-based learning with strong youth/adult partnerships in a youth development context to increase literacy and prepare youth to compete in the 21st-century workplace. 4-H SET programs also utilize strong youth/adult partnerships to address content as defined by the **National Education Science Standards** and engage youth in improving SET knowledge, skills and abilities.



Other Resources Used to Design the 4-H SET Initiative

As the SET Management Team began to create the 4-H SET Initiative, they gathered information about the quality of existing 4-H SET curricula, the standards needed for additional curricula, and the readiness of 4-H staff to embrace and deliver high-quality 4-H programs. The Curriculum section of this report details 4-H work to develop a high-quality curricula. Following are core resources used by the national team to design the 4-H SET Initiative.

• Science, Engineering and Technology (SET) Programming in the Context of 4-H Youth **Development**, a report developed by Robert L. Horton, Ph.D., The Ohio State University, and Jeanne Gogolski, M.S., and Carol Warkentien, M.M., Education Projects and Partnerships, LLC.

The SET Management Team commissioned this report in October 2006 to identify an established set of nationally recognized SET standards that 4-H could align with, as well as a set of life-skill outcomes (SET abilities) that could be addressed within the context of 4-H youth development.

SET Management Team and Cooperative Extension professionals used the report to support state and county 4-H staff and volunteers and as a framework for the design, implementation and evaluation of 4-H programs and curriculum materials. Both 4-H and non-4-H professionals were able to download the report on the 4-H SET website. The primary audiences included 4-H SET Liaisons, state program leaders, current and potential partners, the SET Evaluation, PD and Curriculum committees, and other interested organizations and individuals. The paper could also be used by other organizations creating youth development SET curricula.

The paper was submitted for blind peer review in April 2007 and approved for publication in May 2007. Suzanne Le Menestrel, Ph.D., National Program Leader, conducted the blind peer review.

Based on the review of the literature on SET standards, the research team suggested that 4-H adopt the **National Science Education Standards** as the guiding set of principles for its SET curriculum planning and development process. The team also recommended adopting the 4-H SET Abilities model provided in the report. There were 30 SET Abilities recommended, including: build, collaborate, evaluate, hypothesize, interpret and predict. The paper provided valuable insight as the SET Management Team developed and implemented the 4-H SET Plan, as well as in the areas of professional development, curriculum development and evaluation.

• 4-H SET Staff Readiness Survey

This online survey was conducted by Dr. John A. (Tony) Cook and Janet Bowles, Auburn University, from September 2007 through March 2008, in collaboration with eXtension Youth SET for Life CoP and the 4-H SET Management Team. It surveyed Cooperative Extension Service field staff to assess their readiness to provide science, engineering and technology learning in youth programs. The survey obtained information about training, experience, interest, attitude, capacity and ability to deliver SET programs.

The survey was developed in early 2007, tested for content validity during the National 4-H SET Liaison Conference (June 2007), and then finalized in early September 2007. The survey was promoted through 4-H SET Liaisons, state program leaders and NAE4-HA. More than 1,500 4-H staff responded. Because the information could easily be filtered by state or any other data point within the survey, a number of states were able to use data to inform their own state programs. The results of this survey were also valuable as the professional development plan was developed.

2007 Staff Readiness Survey – Key Findings

- An overall positive attitude about providing SET learning for youth
- A general confidence in ability and capacity to provide or adapt to providing learning in science, engineering and technology
- 57% of the respondents had masters degrees (52%) or higher (5%)
- 55% of respondents had an academic background in education
- Majority of respondents were female (approximately 76%)
- High local response: 77% were county-based staff
- 73% of respondents expressed a need for training to effectively implement SET programs

- 47% of staff worked with 4-H for ten years or less, while 53% had worked in 4-H for more than 10 years; of those with more than 10 years, 28% had worked for more than 20 years
- Overall strong abilities in using communications technology in programming
- 4-H staff members strongly connected to the need for 4-H science, engineering and technology programs; 68% reported a strong understanding of the 4-H SET mission
- Overall assessment of subject matter competencies indicated a strong need for training, especially in the areas of physical sciences, earth and space sciences, and engineering

• 4-H Science Checklist

The 4-H Science Checklist helped local staff assess their programs and ensured that 4-H Science programs provided youth with high-quality and consistent experiences. The checklist defined a "Science Ready" experience as a program framed in science concepts and based on science standards, and as one that intentionally targeted the development of science abilities and the 4-H Science Logic Model outcome. Additionally, it advised integrating the Essential Elements and engaging participants in experiential and inquiry-based learning. The checklist also recommended that science programs offer a sustained learning experience that offers youth the opportunity to be engaged in programs with relevant frequency and duration. The checklist was also extremely valuable for the development of the evaluation, curriculum development and professional development plans.

• 4-H Science, Engineering and Technology (SET) Logic Model

Completed in January 2007 by the 4-H SET Management Team, the 4-H SET Logic Model highlighted the key situation, inputs, activities, outputs and outcomes to be addressed in 4-H SET programs. Although the logic model has been refined and updated several times, it has been used to guide the development of plans in all seven categories of the strategic framework.

4-H Science Checklist Questions

 Are you providing science, engineering and technology programs based on National Science Education Standards? Are you providing children and youth opportunities to improve their Science Abilities? Are you providing opportunities for youth to experience and improve in the Essential Elements of Positive Youth Development (mastery, independence, belonging and generosity)? Are learning experiences led by trained, caring adult staff and volunteers acting as mentors, coaches, facilitators and co-learners who operate from a perspective that youth are partners and resources in their own development? 	
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Are learning experiences led by trained, caring adult staff and volunteers acting as mentors, coaches, facilitators and co-learners who operate from a perspective that youth are partners and resources in their own development?	
Are activities led with an experiential approach to learning?	
Are activities using inquiry to foster the natural creativity and curiosity of youth?	
Does your program target one or more of the outcomes on the 4-H Science Logic Model, and have you considered the frequency and duration necessary for youth to accomplish those outcomes?	

SET Benchmarks

As the national team developed the infrastructure and management system for 4-H SET and expanded the partnership with the Noyce Foundation, it established benchmarks for 2009–2013 to guide the work of the teams within the national team. The national team developed specific outcomes in the following areas: curriculum, urban programming, partnerships, fundraising, evaluation, professional development, fund development and enrollment (part of the evaluation work).

Urban Programming

To encourage greater minority youth participation in STEM out-of-school learning, the team focused on increasing awareness in urban communities of 4-H SET programs. To that end, they organized outreach activities and hired additional staff in order to expand 4-H SET to minority communities. Highlights include:

- Presented 4-H SET at Children, Youth Children, Youth and Families at Risk (CYFAR) conference, May 2007
- Presented 4-H SET at Urban Extension Conference, May 2007. National 4-H Council staff met with participants to determine the needs of urban staff and audiences and used these ideas and strategies to develop the plan for 4-H SET in urban communities.
- Presented at the 1890's Extension Administrator Annual Conference (Historically Black Colleges and Universities), June 1997
- Hired additional staff on the 4-H SET Management Team to work primarily with urban youth
- Hired Chad Ripberger, Rutgers University 4-H Educator, as the 4-H SET Urban Programs Director, January 2009

Under Chad's leadership, 4-H has made great strides both in expanding its reach to minority populations and in the development and availability of outstanding programming resources for staff. Key accomplishments include:

- Conducted a survey of 4-H professionals in urban communities, March 2009 to:
 - Determine current level and type of 4-H SET programming
 - Assess perceptions of keys to successful 4-H SET programming
 - Assess perceptions of greatest needs for 4-H SET programming
 - Identify staff interested in serving on the 4-H SET Urban Programming Team
- Presented results of the survey to key leadership groups within 4-H.
- Conducted eight urban 4-H SET pilot sites to advance best practices. Each site had a leadership team of a 4-H professional, community collaborator and two youth. Eight teams received training October 14–16, 2009.
- Organized the 4-H SET in Urban Communities Programming Advisory Team, consisting of external and internal youth development and STEM experts. Goals of the team were to:
 - Review the eight pilot sites
 - Identify and profile promising practices for 4-H SET in urban communities

- Identify strategies to bring successful urban program models to scale
- Develop a promising practices guide for 4-H SET in urban communities
- Design and deliver professional development materials for urban professionals
- Helped establish a new partnership with the United Soybean Board (USB) to expand the urban outreach initiative by conducting biotechnology and ag-science literacy demonstration programs in four urban communities. The new partnership added \$349,255 to 4-H SET work.
- Gave numerous presentations in urban communities, including:
 - DoD/USDA Family Resilience Conference, Chicago, IL, April 27, 2011
 - Urban Extension Conference, Des Moines, IA, May 3-5, 2011
 - NAE4-HA Conference, October 2011
- Offered a series of six monthly 4-H Science Promising Practices webinars through February 2012.
- Developed and distributed the highly successful resource, "4-H Science in Urban Communities Promising Practices Guide." 4-H released the 200-page guide on May 31, 2011. The guide contains promising practices, case studies and resources organized into three main sections: 4-H Science Core Principles and Program Design; Partnerships, Resource Development, Program Growth and Sustainability; and Staffing, Recognition and Marketing.
- The Guide's website contains extensive resources, including downloadable PDFs, highlight videos and links to resources and tools. The guide was distributed through:
 - State Program Leaders
 - 1890 and 1994 Administrators
 - Regional and State 4-H Science Liaisons
 - 4-H Science Management Team
 - 4-H Headquarters and National 4-H Council staff
 - 4-H Science Academy participants
 - 4-H Facebook page
 - 4-H Science Professional Development newsletter
 - National Girls Collaborative Project July 2011 e-newsletter
 - 4-H afterschool webinar for 4-H afterschool contacts
 - NAE4-HA afterschool Task Force members



2 Professional Development

GOAL: Create a well-coordinated system of professional development opportunities to better prepare 4-H volunteers and staff to incorporate science, engineering and technology into 4-H.

OBJECTIVE: Increase the knowledge, skills, competencies and comfort level of 4-H volunteers and staff to offer hands-on, experiential-based 4-H SET learning experiences.

Accomplishments

- Engaged a national 4-H SET Professional Development Team to design and implement a comprehensive 4-H SET plan to train state and local 4-H staff and volunteers
- Initiated webinars and in-person training events (2007 national conference, 2010 national academy, five regional academies in early 2012) to disseminate professional development training and resources
- Established extensive professional development resources, training materials, videos and self-directed training resources on the 4-H website, www.4-h.org, and my4-H.org
- Promoted professional development resources through marketing inside and outside of 4-H

Information from the 4-H SET Readiness Report, Urban Extension conferences, 4-H SET Liaisons and other leaders in the 4-H system indicated a strong need for a holistic, comprehensive and easily accessible professional development (PD) system for 4-H state/county staff and volunteers. Feedback from 4-H staff members and state program leaders also reinforced the need for a PD infrastructure with training and resources.

Highlights of the PD work include:

- Formed a 4-H SET professional development committee in late 2006/early 2007 to design a comprehensive 4-H SET training program.
- Held training for national 4-H SET Liaisons in Lincoln, NE, June 2007. The primary objective of the training was to help liaisons develop knowledge and skills to:
 - Deliver high-quality, interactive SET learning experiences to youth
 - Deliver professional development training to county-based staff
 - Design effective 4-H SET evaluations
 - Recruit 4-H volunteers and partners
 - Increase effectiveness in marketing and fundraising to support state and local 4-H SET programs
 - Create a 4-H State Plan of Action to implement in their states
- Hired Pam Garza, a national professional development expert, in 2008 to work with 4-H National Headquarters staff to develop a comprehensive professional development plan for the entire 4-H System. Pam assumed the leadership for the 4-H SET professional development work. Major accomplishments under Pam's leadership included:
 - Development of a work plan for high-quality learning opportunities, including a system for providing these opportunities.
 - Expansion of the 4-H Professional Development Committee to include internal and external professional development experts and national leaders. This group became the 4-H SET Professional Development Leadership Team.
 - Development of materials and a strategy to implement a national coordinated approach to
 4-H SET PD which included three primary components:
 - Competencies: Identifying the knowledge, skills, attitudes and behaviors necessary to effectively implement 4-H SET. These competencies were tested and used during the curriculum pilot (more on the pilot is included in the curriculum section).
 - o Gauging our Assets: Identifying promising 4-H SET practices.
 - Embedding not Injecting: Identifying strategies to embed the PD plan into the ongoing 4-H work.

- Creation of PD information sessions for 4-H professionals, including:
 - o Web-based interactive meetings.
 - o National Afterschool Association (NAA) Conference, March 12–14, 2008, Ft. Lauderdale, FL.
 - o CYFAR (Children, Youth and Families at Risk) Conference, May 6-9, 2008, San Antonio, TX.
 - o 1890 Land-Grant University Extension Conference, June 8–10, 2008, Memphis, TN.
 - Three CONNECT (web system) meetings for state 4-H SET Liaisons (July, September and November, 2008).
 - o NAE4-HA Conference, September 15–19, 2008, Indianapolis, IN.
 - National Conference on Science and Technology in Out-of-School Time Conference, September 17–19, 2008, Chicago, IL.
 - o CYFAR Conference, May 6, 2010.
 - National Association of Extension 4-H Agents Conference, October 24–28, 2010, Phoenix, AZ.
- Outreach to non-4-H audiences to create awareness of 4-H SET work and contribute to STEM education nationally:
 - Frontiers in Urban Science Exploration: A National Convening meeting, New York Hall of Science, June 3, 2010.
 - Advisory Group: ITEST Convening: "Defining an afterschool Research Agenda," June 9–11, 2010, St. Paul MN.
 - Pam Garza was asked to review proposals submitted to TSAC for CBASS Frontiers in Urban Science Exploration.
 - Pam Garza and Sharon Junge, CA State 4-H Program Leader, served on a panel at the Coalition for Science After School National Conference on Science & Technology in Out-of-School Time, September 22–24, 2010, Los Angeles, CA.
- Hiring of Janet Golden in May 2010 as Manager of 4-H Science Professional Development to help refine and implement the PD plan
- Planning and implementation of the National 4-H Science Leadership Academy



National 4-H Science Leadership Academy

To provide state 4-H staff with the tools, training and technical assistance to effectively launch SET programs, 4-H conducted a national 4-H Science Leadership Academy, December 6–9, 2010 with funding from the Noyce Foundation. The professional development team, National 4-H SET Management Team, 4-H SET Liaisons and other key 4-H leaders developed the academy, which consisted of pre-academy webinars, the face-to-face academy in December, and post-academy webinars. 188 4-H educators representing 43 states/46 land-grant universities attended the academy in December. State and regional planning sessions enabled participants to review, revise and develop their 4-H SET plans of action and participants shared promising practices from their state programs.

Primary Objectives

- Address the needs identified in the Implementation Study (see the evaluation section below for details)
- Offer tracks in fund development curriculum, evaluation and professional development, with opportunities for participants to share 4-H SET promising practices and learn about the 4-H SET marketing efforts
- Assess the specific needs for professional development, technical assistance and resources to support state and local 4-H SET leaders
- Provide high-quality training that equips state 4-H SET leaders to implement sustainable and scalable 4-H SET state Plans of Action
- Provide 4-H SET teams with training tools and technical assistance to develop an individualized fund development plan, identify key donors, create their own funding tools and secure gifts/resources

Highlights

- Distributed a 4-H Science Leadership Academy RFA to the 4-H System on May 11, 2010. The RFA outlined who should attend the academy, provided an overview of the training and required a commitment from participants and land-grant university administrators to use the training and resources to train state and local 4-H staff members.
- Conducted a needs assessment prior to the academy. Based on the assessment, professional development, curriculum, evaluation and fund development were selected as broad topics for the academy. Team leaders and committees were selected to develop the training plans.
- Included professional development, curriculum, evaluation and fund development teams from land-grant universities in the academy, who updated their Science Plans of Action and agreed to implement the revised plan—using resources from the academy—to train local staff and volunteers.
- Conducted a needs assessment with the 181 participants registered to attend the academy; there was a 100% response rate. The assessment enabled the planning teams to finalize their training/ teaching plans.
- Conducted a needs assessment with state 4-H program leaders to determine priorities, which found that:
 - 77% reported they did not have a multi-year program budget for 4-H Science
 - 63% reported a need for developing and implementing the infrastructure to support 4-H Science PD
 - 4-H volunteers in many rural areas have limited access to online resources due to low or no bandwidth
- Covered a variety of 4-H Science topics in pre- and post-academy webinars.
- Hosted teams from more than 80% of land-grant universities with 4-H Science Plans of Action at the 4-H Science Leadership Academy and updated their POAs to include broad fund development goals.
- Awarded 39 \$1,500 and five \$5,000 implementation grants to help states conduct appropriate staff training to achieve their POA goals.

Academy Results

Dr. Mary Arnold at Oregon State University—who was on contract with Council—conducted a follow-up evaluation with academy participants in May 2011 to assess their progress in furthering 4-H Science curriculum, evaluation, PD and fund development. Highlights of the report include:

- 71% of participants reported that the conference prepared them to lead 4-H Science efforts at their LGUs.
- 58% of participants in the evaluation track reported that their evaluation expertise was somewhat to considerably greater.
- 75% of fund development track participants reported using all of the fund development tools provided.

- Over 76% of respondents of the PD track reported teaching others about science inquiry and using science inquiry learning.
- Over 80% of participants utilized the curriculum tools presented at the academy, with most respondents reporting the tools are useful to their work.
- Many of the participants reported insufficient time to devote to their role on the 4-H Science team.

Pam Garza resigned from National 4-H Council in December 2010. Janet Golden, who served as the Manager of PD, was promoted to the position of Assistant Director, 4-H Mission to Market, June 1, 2011. Janet assumed the National 4-H Council PD leadership role. Key accomplishments under Janet's leadership include:

- Creation of an annual schedule of 4-H Science PD opportunities, encompassing the seven major categories of the 4-H SET Strategic Framework.
- Continuation of the development of a comprehensive PD system with input from internal and external PD experts.
- Development of a comprehensive system encompassing web-based and face-to-face training, as requested by 4-H staff and supported by PD research.
- Continuation of the development of resources to support 4-H PD, including:
 - My4-H.org, a socially-enabled online community site developed specifically for
 4-H professionals and volunteers to boost productivity and communication skills
 - Inquiry-Based Learning to Support 4-H Science, launched October 2011
 - 4-H Science Smart: Competency Training Guide, launched September 2011
 - Robotics Training Guide, launched September 2011
 - 4-H Science PD Connection, a bi-monthly newsletter
 - E-Basics Online Training (program evaluation training), launched June 2012
 - 4-H Science Ready Online Training: two online modules in December 2011 and one in spring 2012
 - Biotechnology training with USB grant, completed in December 2012
 - PD Mini Site, launched November 2011
 - 4-H Directory of webinars and upcoming webinars, updated monthly
- Hiring of Ed Bender (on contract) in January 2012 to serve as the 4-H Science Professional Development and Partnership Manager. Ed is a county-based 4-H faculty with state 4-H experience in delivering and teaching 4-H SET.
- Assisting with the design, planning and implementation of 4-H Science Regional Academies.



4-H Science Regional Academies

Feedback from the 4-H system continued to suggest that PD strategies must be offered through a variety of channels. To amplify and extend the learning from the National Science Academy, 4-H initiated Science Regional Academies that encouraged multi-state collaboration and provided in-depth learning opportunities. National Science Academy evaluations indicated that staff wanted more access to hands-on learning in strategies for infusing inquiry into practice, developing revenue plans, effectively using communities of practice and using common evaluation tools and metrics.

- Four regional face-to-face 4-H Regional Science Academies and one "virtual" academy were conducted in early 2012
- A total of 515 people participated; many were county-based faculty
 - 73 participants: Northeast (Mid-Atlantic), State College, PA, January 24-26
 - 228 participants: North Central, St. Louis, MO, February 7-10
 - 100 participants: Western, Davis, CA, March 26-28
 - 78 participants: Southern, Huntsville, AL, April 9-12
 - 36 participants: Northeast (New England), Virtual Academy, April 10–11

Primary Objectives

Help participants:

- Design, implement, evaluate and sustain 4-H Science programs
- Develop strategies to secure funds and other resources to support 4-H Science at the state and local levels
- Assist land-grant universities and counties with developing and refining their 4-H Science plans of action
- Identify training and resources needed to support the 4-H Science Mission Mandate

Results

Dr. Mary Arnold, Oregon State University, evaluated the Regional 4-H Science Academies. Since she had worked with the Management Team to evaluate the national academy, she understood academy goals and objectives and was an efficient and effective evaluator. Key highlights of the report include:

- Attendees completed an online evaluation, which received an 82.9% response rate.
- Respondents assessed pre-academy and post-academy knowledge or skills in a variety of domains. Key findings include:
 - Increase in understanding of why science inquiry is critical to 4-H
 - Ability to train staff to recruit, develop and retain volunteers
 - Ability to develop partnerships to support 4-H Science
- Respondents were asked about personal and organizational readiness to facilitate 4-H Science. The percentages below Agreed or Strongly Agreed:
 - 91.5% had the skills to develop partnerships for 4-H Science
 - 88.4% were ready to facilitate 4-H Science
 - 92.4% felt ready to facilitate 4-H Science
 - 86.9% of land-grant universities were organizationally ready to support 4-H Science
 - 91.8% felt there was a positive environment at their institution for 4-H Science
 - 77.9% felt there was adequate support at their institution for 4-H Science
 - 81.1% prepared to form youth/adult partnerships to support 4-H Science

Next Steps:

- Web-based learning objects: short "just-in-time" and "just-for-me" modules to address training needs in manageable units for busy professionals and volunteers. Modules will be engaging and require participant involvement. Planned modules include:
 - o Why 4-H Science
 - o Science Self-Assessment and Planning Tools
 - o Evaluation Basics
 - o Inquiry-based Learning
 - o Modules developed from archived webinars
- Multi-media resources: from static to dynamic, the 4-H Science PD Team is currently exploring software that will convert existing 4-H Science resources into multi-media presentations
- Teens As Teachers TBD
- 2013 Virtual 4-H Science Academy: offering virtual content delivery while connecting learners with peers. 4-H will conduct an in-depth needs assessment so that blended learning methods can be utilized to address the training needs. 4-H will use results from the national and regional academies and other data to plan the 2013 virtual academy and other aspects of the 4-H Science initiative. Youth development professionals from other organizations will be invited to participate.



3 Curriculum

GOAL: Provide the 4-H system and external groups and organizations with a wide variety of 4-H SET curricula that meet the National Science Education Standards (NSES) and the curricula review process established by National 4-H Headquarters.

OBJECTIVE: Work with 4-H volunteers and staff, land-grant university faculty, SET content experts and other partners to revise and develop 4-H SET curricula that meet content and contextual standards.

Accomplishments

- Developed a multi-year 4-H SET curricula plan, with assistance from STEM curriculum experts from inside and outside the 4-H system
- Developed a 4-H SET rubric/template to ensure that 4-H SET curricula meet National Science Education Standards
- Provided face-to-face and webinar training
- Reviewed, revised and developed 4-H SET curricula
- Upheld as a model for the redesign of the curriculum development and review process led by 4-H National Headquarters, including allowing the review and use of STEM curriculum developed by other organizations
- Used the web as a teaching tool for review of existing 4-H SET curricula and the development of new 4-H SET curricula

When the 4-H SET Working Group began their work in late 2003/early 2004, their priority was to review existing 4-H SET curricula to determine if the curricula met National Science Education Standards. 4-H hired a STEM curricula expert to conduct the review, and state 4-H staff submitted copies of existing 4-H SET curricula. Of the large number of curricula reviewed, only six or seven met the national standards. This discovery clarified the need to develop additional 4-H SET curricula.

Dr. Kathleen Jamison, a leading 4-H curricula expert at Virginia Tech University, joined the national SET Management Team to lead the 4-H SET curriculum development work. Because of Kathleen's exemplary work and the urgent need to develop high-quality SET curricula, National 4-H Council hired her on a two-year contract (2008 – 2009) to lead the work. Key accomplishments under Dr. Jamison's leadership include:

- Organized a 4-H SET Curriculum Committee to develop a multi-year 4-H SET curricula plan.
- Provided 4-H SET curricula training at the first national 4-H SET conference, June 2007, Lincoln, NE.
- Participated in a 4-H Curriculum Summit held June 12 14, 2007 in Washington DC to develop a curriculum development and management system for all 4-H curricula, including 4-H SET curricula.
- Used the research paper developed by Dr. Horton, et al, *SET Programming in the Context of 4-H Youth Development*, as a resource tool to develop the new 4-H SET curricula.
- Developed a 4-H SET curriculum rubric/template consistent with National Science Education Standards to review, develop and revise 4-H SET curricula. This work involved national STEM leaders, internal and external to the 4-H system.
- Completed another scan of 4-H SET curricula using the newly developed rubric to determine if any current curricula met the national standards and the criteria outlined in the rubric—which included additional requirements, like effective youth development concepts. Only a few 4-H SET curricula met these standards. This review identified a few 4-H SET curricula that only required minor or moderate revisions to meet the national standards.
- Curriculum committee members worked with land-grant university staff to revise the curricula.
- In late 2007, the 4-H SET Curriculum Team developed two new 4-H curricula: *Exploring Your Environment,* and *The Power of the Wind.* Cary Sneider, formally of the Lawrence Hall of Science and a consultant with the Noyce Foundation, reviewed the materials, concluding: "The instructional design, teaching methods, and philosophy that underpin the materials are consistent with best practices described in the research synthesis from the National Academy of Science." (Sneider, Cary. 2008. "Review of 4-H Instructional Materials"). The curricula:
 - Were intentionally experiential by design
 - Were conceptually framed in big ideas and standards of science
 - Provided open-ended questioning throughout
 - Connected activities with current relevance to everyday application for youth



- In February 2008, the Curriculum Team conducted an extensive pilot of both curricula. The team created a plan of action and a pilot protocol which was implemented between February and June 2008. Since the pilot involved curriculum, PD and evaluation, the team leaders of the three areas (Dr. Jamison, Jill Walahoski and Pam Garza) assisted with the pilot. The team used Harvard University's "Dimensions of Success: Observation Tool for Assessing STEM Learning in Out-of-School Time" instrument to develop the pilot process. The pilot consisted of three stages:
 - Curricula peer review by content experts and revision prior to testing
 - Select-site observation study
 - O Observation rubrics review
 - Focus groups with youth
 - O Retrospective post-assessment with instructors
 - Youth impact study
- The Curriculum Team institutionalized the 4-H SET curriculum tools and standards to allow the development of additional 4-H SET curricula. These resources were made available via the 4-H website for use by state and local 4-H staff, volunteers and other groups and organizations developing STEM curricula for youth.
- With the establishment of these 4-H SET curricula rubric and guidelines, teams of land-grant faculty and staff and external STEM partners developed additional 4-H SET curricula, including *Butterfly WINGS, There's No New Water, Teaming with Insects, and Robotics: Engineering for Today and Tomorrow.*

4-H hired Tara Wheeler to lead the 4-H SET curriculum work after Dr. Jamison's contract with 4-H finished. Accomplishments under Tara's leadership include:

- Migrated all 4-H curriculum to the 4-H.org domain with upgraded analytics and reporting features
- Upgraded 4-H Directory of materials—which includes high-quality 4-H curricula and professional development materials. 4-H conducted a webinar for staff on the Directory of Materials on February 15, 2011
- Presented national webinars for the new web-based curriculum development system to 4-H staff in 2011
- Created an improved process for developing, testing and disseminating education 4-H resources
- Launched new web-based curriculum development system in March 2012 that included:
 - Web-based tools for 4-H developers/reviewers
 - Branded, easy-to-use templates, grounded in the 4-H educational philosophy
 - An electronic review process of materials, conducted by certified 4-H peer reviewers
- Released updated National 4-H Curriculum Peer Review Course in fall 2012
- Initiated plans for upgrading 4-H Directory of Materials to add the ability for users to rate and comment on materials as well as a seamless upload process for end-users
- Hired Gregg Tabachow in 2012 as project manager for Web-based Curriculum Initiatives



4 Evaluation and Research

GOAL: Establish an evaluation and research system to measure the effectiveness of 4-H SET programs in reaching the 4-H SET goals and objectives.

OBJECTIVES: 1) Increase 4-H staff and volunteers' knowledge, skills and competencies for designing effective evaluation strategies for SET programming (process and outcome); and 2) Design and implement a national long-term research model to compare 4-H youth and non-4-H youth SET outcomes.

Accomplishments

- Designed and used instruments to evaluate the capacity and capability of 4-H professionals to deliver high-quality 4-H Science programs
- Designed and implemented a study to measure the impact of 4-H Science programs on youth engagement, attitudes and knowledge of STEM
- Developed a list of promising/best practices from successful 4-H Science programs
- Developed plans for a longitudinal study to enable 4-H Science programs to be compared to non-4-H STEM programs
- Made survey instruments available to STEM educators inside and outside the 4-H system
- Provided training and technical assistance to 4-H state and county staff

Evaluation is one of the most comprehensive and detailed work areas in the 4-H Science Initiative. Initiated in 2007, the work has evolved to adjust to new information discovered through the evaluation process. This report highlights significant accomplishments in 4-H's evaluation efforts. Additional details are available on the 4-H website (www.4-h.org) and at National 4-H Council.

Dr. Suzanne LeMenestrel, National Program Leader at 4-H National Headquarters, and Jill Walahoski, 4-H Specialist at University of Nebraska at Lincoln (hired in 2008 as the 4-H SET Evaluation Director), lead the 4-H Science evaluation work. Prior to funding from Noyce and the creation of the evaluation plan, Dr. LeMenestrel and Jill had assisted with an evaluation training session at the national 4-H SET roll-out conference in June 2007 in Lincoln, NE. This section highlights the significant accomplishments in 4-H SET evaluation since receiving funding in 2007.

• Established working committees and relationships with consultants:

- SET Evaluation Design Team

The team, which included internal and external evaluators and Noyce Foundation representatives, established the three-tiered approach, the final version of the logic model and the initial draft of indicators. Once a complete plan was established, the team was formally thanked and dissolved.

- SET Evaluation Instrument Design Team

This team established the tools used to measure outcomes of the logic model and assess program implementation for Tier 1. The team consisted of evaluation and SET programming experts, land-grant university staff and outside evaluation agencies. The tools were developed based on substantial review of existing tools and current trends in SET/STEM. The national co-directors worked to ensure that these tools would be reliable and useful for many content areas across the 4-H system.

- SET Evaluation Advisory Committee

Consisting of external experts primarily, this committee provided external critique of the national plans, instrument and reports. The committee was engaged in the development of Tier 2 strategies in 2010.

- Regional Evaluation Liaisons

This team coached participating state/land-grant university sites in securing IRB and facilitated the data collection. They served regionally as a liaison among evaluation leadership, the outside evaluation agency, land-grant university SET Liaisons and county program sites.

External Evaluation Consultants

After considering bids from four evaluation groups, Policy Studies Associates, Inc, (PSA) was selected as the consultant to help implement the evaluation plan. Other consultants were hired on an as-needed basis.

- Developed the 4-H evaluation logic model and assisted with developing the 4-H SET Logic Model, the 4-H Science Checklist and 4-H State Plans of Action.
- Built momentum and capacity for evaluation within the 4-H system with effective, consistent and regular communication to staff through workshops, webinars, conference calls and other methods.
- Helped develop SET 101 training, which provided an essential overview of 4-H SET and lessons on evaluation.



- Worked with Noyce Foundation and other Noyce grantees to develop a list of common indicators that can be used by Noyce grantees to evaluate their STEM programs.
- Worked with National 4-H Council Grant Deliverable group to develop common indicators to evaluate all three Mission Mandates—with plans to further refine the evaluation process for specific programs, such as 4-H Robotics.
- Used feedback from the system to refine, revise and improve evaluation plan.
- Collaborated with other STEM initiatives: PEAR and Dr. Robert Tai.
- Worked with land-grant university and local 4-H faculty and staff to educate staff on use of the checklist to determine if a program is "4-H SET Ready." Only programs determined as "4-H SET Ready" and land-grant universities with 4-H SET Plans of Action (approximately 63) were evaluated.
- Used "4-H SET Ready" programs to ensure reliability and validity of the program data collected from local 4-H SET program sites.
- Developed the three-tiered 4-H SET Evaluation Plan. The primary purpose of the 4-H SET Evaluation Plan was to:
 - Assist state and local 4-H professionals with evaluating their work and achieving their program objectives and outcomes
 - Determine if the goal of reaching 1 million new 4-H members with SET programs within five years is achieved
 - Determine if the 4-H SET objectives from the National 4-H SET Strategic Framework and logic model are achieved

Tier 1 of Evaluation Plan: Implementation and YEAK studies

Implementation Study: The team worked with key 4-H SET leaders to collect data via an online reporting system. The primary objective of the Implementation Study was to 1) determine the capacity and capability of 4-H professionals and the 4-H system to deliver 4-H SET programs; and 2) determine the number of new 4-H SET members joining 4-H. The study was conducted in 2009 and 2010.

2009 Implementation Study Results

- 4-H respondents reported limited or insufficient human and financial resources across all seven areas of the strategic framework. This was reported as the most pressing challenge. With a 75% return rate from state programs, respondents reported limited or insufficient resources for the following:
 - 83% Training staff and volunteers in SET program delivery
 - 83% Hiring staff with SET expertise
 - 78% Promoting (marketing) SET programs
 - 73% Fund development for SET programming
 - 59% Developing new curricula for SET programming
 - 55% Seeking out and implementing partnerships
 - 49% Conducting evaluation of SET programming (staff time and training)
- Staff also reported:
 - Developing partnerships with other land-grant university departments and outside organizations
 - Needing financial and informational support to train staff and volunteers
 - Integrating SET into existing 4-H programs
 - Planning to use some form of SET program evaluation
 - Marketing 4-H Science programs to local schools and within land-grant universities
 - Lacking funds for SET programs

2010 Implementation Study Results:

- Though some states had strong 4-H Science programs prior to 2006, they welcomed the work of the 4-H Mission Mandate and national teams.
- States needed guidance and technical assist for science programs.
- States were providing traditional and new SET programs.
- Staff were not sure how to use 4-H.
- Promising features of 4-H Science programs in states and counties:
 - Youth-centered content delivery
 - Experiential learning



- Real-world applications of science
- Opportunities for youth to contribute to their communities through science
- Use of positive youth development strategies
- A focus on moving youth through the educational pipeline toward STEM careers

YEAK (YOUTH, ENGAGEMENT, ATTITUDES AND KNOWLEDGE SURVEY): The primary purpose of YEAK was to determine if 4-H SET programs increased youth engagement, interest, knowledge, skills and attitude toward STEM. Additionally, it sought to determine if 4-H SET programs affected youths' plans to pursue post-secondary STEM education and a STEM career. The data was collected online and in paper format working with state and county-based 4-H SET leaders.

YEAK Results

The YEAK study was administered twice between 2009 and 2011. Sampling for the third wave of the YEAK Study is underway. Over the past four years, there have been several adjustments to the YEAK data collection process, including developing a more systematic sampling procedure that draws a random sample of national 4-H programs. In the past, convenience sampling had been used. As a result of this change, the survey data are more representative of youth in 4-H Science programs than previous years. This improved the ability to generalize the data to the general population of 4-H Science participants.

Full details of both YEAK reports can be found at www.4-h.org. Major findings include:

- Youth who participate in 4-H Science programs are significantly more likely than their peers to hold positive attitudes about science.
- Participants in high-exposure group (those spending at least one hour per week for five or more months) gave higher ratings to their decision-making, critical thinking and problem solving skills than participants from the low-exposure group.

- High-exposure group participants experienced greater benefits from their 4-H Science programs than did youth with less exposure.
- When youth are given opportunities to practice science-related skills, they are more likely to be enthusiastic about science.
- Planning and intentionality are important parts of delivering high-quality youth science programs and preparing educators.
- When compared to the National Assessment of Educational Progress (NAEP) Science examination, youth in 4-H Science programs were more positive about science than other students in the NAEP sample. For example:
 - 68% of 12th grade 4-H Science youth agreed that they would like to have a science-related job, compared to 37% of 12th grade youth in the national sample (4th and 8th grade youth did not answer this question in the NAEP sample).
 - 4-H Science participants are more confident in their science abilities and are more likely to believe that science is useful.
 - 62% of 4th grade 4-H Science youth agreed that they are good at science, compared to 43% of 4th graders in the national sample.
 - 69% of 4th grade 4-H Science youth agreed that science is useful for solving everyday problems, compared to 40% of 4th graders in the national sample.
 - Comparisons between youth in 4-H Science programs and youth in the NAEP sample from the 8th and 12th grades yielded similar results.

The YEAK survey instrument will be publicly accessible in the fall of 2012 through the CYFERnetSEARCH site, an evaluation capacity-building site sponsored by the National Institute on Food and Agriculture.

Many National 4-H Council grant-funded 4-H Science programs (for example, Cargill, USB and Noyce-funded urban program initiative) used the YEAK survey. 4-H plans to continue to use YEAK to evaluate Council-funded programs. Leaders of the other two 4-H Mission Mandates, Healthy Living and Citizenship, are using YEAK as a model to design their evaluation work. State and county 4-H staff members are also adopting elements of YEAK for their 4-H Science programs.

Tier 1 Enrollment Data

An important component of the Implementation Study was to collect the number of new and existing 4-H youth involved in SET. States use different methods for collecting and reporting 4-H SET programming data. Staff members were asked to only provide enrollment data on programs that met the "4-H SET Ready" standard. Since the inception of the enrollment collection process in 2008, the 4-H SET Evaluation Team has worked with National 4-H Council and state staff to improve the data collection methodology. Currently, approximately 26 states are using **ACCESS** (a web-based system for collecting participant and 4-H program data). The committee and PSA are working with the remaining states to collect enrollment data using the existing systems in the states. Inconsistencies and incomplete state data, and some states' inability to count "new" 4-H members continue to be a challenge for collecting enrollment data. Currently, enrollment data are only being collected from a limited number of states.

Responses to the annual enrollment survey reflecting 4-H enrollments for 2011-12 year, showed:

- Cumulative total of 512,029 new youth in 4-H Science.
- In December 2011, 31 LGUs reported 1.33 million 4-H youth in Science Ready programs; In December 2012, 40 LGUs reported 1.2 million youth in Science Ready programs.
- 44% of respondents in the YEAK 2011 report indicated that this was their first year of 4-H participation, suggesting that 4-H Science programs are successfully engaging new youth.
- The percentage of land-grant universities that could provide comprehensive and complete information is still low. The numbers of new 4-H youth enrolled are underreported.

As of November 29, 2011, 39 out of 63 land-grant universities submitted enrollment surveys with a response rate of 62%. The percentage of land-grant universities that could provide comprehensive and complete information is still low. The numbers of new 4-H youth enrolled are underreported .

Tier 2 of Evaluation Plan

Tier 2 consisted of a case study to collect more sophisticated levels of data at fewer sites with great rigor. The goal was to identify promising/best practices for delivering 4-H SET programs. The purpose of this study was to:

- Provide more in-depth data by examining delivery of the programs, including duration, frequency and intensity
- Assess intermediate-level outcomes
- Highlight successful 4-H Science programming and document the structural features of those programs

After screening 90 nominated programs, evaluators visited eight sites that demonstrated "high-context and high-content" youth development programs with high-quality SET content. They used surveys, structured observations and in-depth interviews with youth, volunteers, parents and paid staff, and reviewed program documents such as policy manuals, training materials, evaluation reports and funding applications. Results from a University of California research project examining the relationship between frequency of non-formal science programming and knowledge, skills and attitudes toward science among youth was also used. The report, *Priming the Pipeline*, includes the findings from the study. These finding are highlighted in the Promising/ Best Practices section later in this report.

Tier 3 of Evaluation Plan

Tier 3 consisted of the creation of a longitudinal case study to document sustained program impact on participants. The goal was to understand how 4-H addresses the non-formal concepts and principles of SET education and to observe changes in participants' behaviors. The primary goal was to understand how sustained 4-H SET program involvement impacts positive youth outcomes including:

- Changes in enrollment patterns related to high school and college SET courses and declared college majors
- Changes in interest and engagement in SET as measured by an instrument developed by investigators Tai and Fan

The co-directors of 4-H Science evaluation contracted with Drs. Robert Tai, Xitao Fan, and Jennie Chiu, University of Virginia to conduct a pilot study that laid the groundwork for the proposed Tier 3 longitudinal study. This pilot study used qualitative methodologies and analysis of programmatic documents to examine local 4-H and non-4-H programs. The pilot was designed to identify program characteristics essential to the success of established youth-based science programs. The evaluation team interviewed and observed FIRST Robotics Competition (FRC) teams across different experience levels, with 4-H and non-4-H affiliation to understand the role of 4-H in the local culture of the individual youth organizations.

Results

- Varying degrees of outcomes within the 4-H and non-4-H FRC teams
- Most apparent variation of outcomes between rookie and veteran teams
- Veteran and some rookie FRC teams benefit from strong relationships with 4-H
- Few rookie FRC teams are unsure of the role 4-H plays in their robotics operations and overall functioning of the team
- Additional study and evaluation of this work is needed

Prior to the development of the 4-H SET committee's work, questions pertaining to youth's interest in science and science careers were added in 2007 to the *Tufts 4-H Study of Positive Youth Development*. This study examined the difference in attitudes and behavior between 4-H and non-4-H youth. Details about the study and full results can be found at www.4-h.org. In sum, the study found that 4-H youth are:

- More likely to participate in SET programs
- Perform better in subjects related to STEM compared to their classmates
- More likely to express an intent to pursue STEM careers



5 Marketing and Communications

GOAL: Create a strong, clear and consistent message about 4-H SET programs that is accepted, embraced and communicated by the Cooperative Extension System, land-grant colleges and universities, and 4-H SET partners.

OBJECTIVE: Increase political, financial and partnership support for 4-H SET programs.

Accomplishments

- Held national press conferences to showcase 4-H Science
- Launched successful public awareness campaign
- Promoted 4-H Science to the 4-H system and land-grant universities' faculty and staff successfully
- Created and distributed fact sheets, press releases templates and other marketing resources for 4-H staff and volunteers
- Held five highly visible and successful 4-H National Youth Science Days
- Increased use of ACCESS, my4-H and www.4-h.org to support 4-H professional development, evaluation and curriculum resources, as well as training and technical support for the 4-H system
- Encouraged more land-grant universities to use ACCESS for program reporting, increasing the ability of 4-H to collect participant data
- Provided training and technical assistance to 4-H staff and volunteers on how to use ACCESS and other web-based resources

4-H recognized the need to build an effective communication strategy to inform the pubic, youth organizations and the 4-H system about the Science Initiative. The Marketing Team at National 4-H Council has worked closely with the 4-H Science Management Team to develop an effective and comprehensive marketing and communication process. Highlights include:

- Hired a Director of Web Marketing to oversee the development of ACCESS, the 4-H website. The site included the creation of the 4-H SET Web Portal for professional youth development training, curriculum downloads and youth development education.
- Developed internal and external messages for 4-H staff, volunteers, programs partners and donors.
- Promoted the five-year SET plan to 4-H program and extension staff through conferences and meetings through:
 - SET fact sheet shared with CES Directors, January 2007
 - SET fact sheet shared with State Program Leaders, April 2007
 - Children, Youth and Families at Risk (CYFAR) conference, May 2007
 - Urban Extension Conference, May 2007
 - 1890's Extension Administrators Annual Conference (Historically Black Colleges and Universities), June 2007
- Developed a strategic public awareness campaign to inform America's policymakers, business leaders and parents of the looming challenge facing America through:
 - 4-H SET Power of Youth Newsletter and Clover Corner News, December 2007.
 - National 4-H SET Launch Event, June 18, 2008. This event was held on Capital Hill with Senator Saxby Chambliss and Congresswoman March Kaptur and included a response to the National Academy of Sciences "Rising Above the Gathering Storm" report.
- Planned and coordinated National Youth Science Days (NYSD) in partnership with corporate and media sponsors. During the event, which is held during National 4-H Week, land-grant university staff design experiments that youth in thousands of local communities can replicate. NYSD themes and titles included:
 - 2008: Helpful Hydrogels
 - O Youth explored new superabsorbent polymers that help conserve water.
 - 2009: Biofuels
 - Youth explored the production of the biofuel ethanol. This experiment helped youth learn about renewable energy sources.
 - 2010: 4-H2O
 - o Participants measured their carbon footprint and learned how to conserve water.
 - 2011: Wired for Wind

- Youth learned how to implement alternatives to traditional energy production and renewable energy.
- 2012: 4-H Eco-Bot Challenge
 - Youth were introduced to engineering concepts as they programed a self-directed robot to clean up a simulated environmental spill.
- Partnered with World Wildlife Fund in support of Earth Hour and Discovery Education 3M Young Scientist Challenge.
- Continually developed and shared new tools with the 4-H System to tell the 4-H Science story.

ACCESS

The ACCESS website is used for data collection, analysis and reporting key 4-H program information. In particular, it is vital to the work of the 4-H SET Evaluation Team. The ACCESS team provides programmatic support and evaluation tools for science-focused staff and volunteers. Currently, the system has resources that help staff determine if a specific program meets the high-quality standards of a "4-H SET Ready" program. The ACCESS team produced video instructions, led webinars and worked with county-level staff to develop 4-H Science Ready programming. These efforts were supported by the science-based communities in my4-H. org. As of July 31, 2012, ACCESS was serving 36 LGUs in 26 states.

A beta roll-out of the ACCESS Event Management module began in July 2012. This module meets a critical need for 4-H customers and may generate new revenue for National 4-H Council to support the ACCESS system.

Features of ACCESS:

- Data Import Module Enhancements
- Club Roster
- Reporting System Performance Improvements
- New and Improved Database Schema
- Code Rewrite
- Platform Upgrade
- Reporting Engine Replacement

4-H.org web site

To support innovative web strategies and tools, 4-H continues to revise the 4-H.org website to include more robust analytics and search engine optimization. 4-H is also redesigning its professional development pages. In 2012, 4-H merged the my4-H website into 4-H.org. The My4-H initiative will remain unchanged. By merging the sites, 4-H will:

- Engage teens as partners to share and rate resources and join discussion forums
- Focus on resources
- More effectively engage the 90,000 visitors each month to the 4-H.org site



6 Funding

GOAL: Use public and private funds at the local, county, state and national levels to support 4-H SET programming.

OBJECTIVE: Increase the capacity of the 4-H System to generate private and public funds to support 4-H SET programming.

Accomplishments

- Worked with the Osborne Group to create the Fund Development Toolkit, which included over 250 learning modules, templates and resources to enhance fundraising for 4-H Science and provided a virtual learning environment for 4-H staff and volunteers with all levels of experience in fundraising
- Offered fund development workshops and resources at the National 4-H Science Leadership Academy and assisted with regional academies as requested
- Offered webinars before and after the national academy to provide fund development training and technical assistance
- Promoted fund development toolkit and resources
- Continued to offer training and technical assistance to build fund development skills and competencies of 4-H staff and volunteers
- Continued to explore new business models and revenue streams for curriculum, professional development and other aspects of the 4-H Science initiative



The National 4-H Council Resource Development Team has raised over \$26 million to support 4-H Science. The 4-H Science Initiative has enabled National 4-H Council to build partnerships with new donors such as USB, OJJDP, Lockheed Martin, Toyota, 3M, JCPenney Afterschool Fund and others interested in STEM education. This expansion of funding has enabled 4-H to develop new 4-H Science programs and curricula and to expand programs such as 4-H Robotics and Tech Wizards.

Jennifer McIver, a member of the Resource Development Team, provided fund development training via webinars and conferences and at the National 4-H Science Leadership Academy and five Regional 4-H Science Academies. Following are some of the significant highlights of the work:

- Hired a consultant firm, The Osborne Group, to create an online training toolkit and curriculum plan for 4-H Science fundraising
- Organized a 4-H Science Fund Development Working Group to design fundraising track at the National 4-H Science Leadership Academy
- Completed an inventory of baseline 4-H Science fundraising goals as outlined in 4-H State Plans of Action
- Conducted needs assessments before and after the National 4-H Science Leadership Academy and used the feedback to design training
- Presented workshops at the national academy for beginners and intermediate/advanced participants to accommodate the diverse skill levels of participants. Results of academy workshops included:
 - An increase of interest in fund development.
 - An increase on several key indicators of participants' level of readiness to lead fund development in support of their 4-H Science Plans of Action.

- At least 75% of national academy participants reported using all of the training and technical assistance provided and that these offerings are appropriate for their needs.
- Assisted regional academies' planners with fund development resources as requested

4-H Science Fund Development Toolkit

4-H launched its Science Fund Development Toolkit in April 2011. Toolkit Modules, which include instructional power point presentations, tools and resources, are meant to be "self-study" guides or teaching series that can be used as a "train-the-trainer" model. Topics include "Creating a Powerful Message," "Major Gift Fundraising," "Effective Foundation Grant Writing" and "Maximizing Corporate Giving." These modules include roadmaps specially designed for key audiences, such as 4-H fundraising professionals, state 4-H program leaders and agents, and board volunteers.

The toolkit offers over 250 learning modules, templates and resources to enhance fundraising for 4-H Science and is intended to be a virtual learning environment for 4-H staff and volunteers with all levels of experience in fundraising. 4-H promoted the Fund Development Toolkit with web-based orientations, a professional development e-newsletter and numerous webinars. Toolkit usage continues to increase and 4-H staff using the materials report increased fundraising skills. 4-H is currently exploring new business models and revenue streams for other components of the Science Initiative, such as curriculum and professional development.

Going forward, 4-H will continue to provide resources to enhance fundraising skills in the field. 4-H continues to conduct assessments to determine the success of 4-H staff's fund development work. This data will be used to offer the technical assistance, resources and support 4-H staff need to achieve their fundraising goals. Based on positive feedback, 4-H will continue to offer webinars and conference calls to provide training and technical support to 4-H staff and volunteers.



7 Partnerships and Collaborations

GOAL: Use public and private funds at the local, county, state and national levels to support 4-H SET programming.

OBJECTIVE: Increase the capacity of the 4-H System to generate private and public funds to support 4-H SET programming.

As the 4-H Science Management Team designed the 4-H Science Initiative, it became very clear that 4-H staff and volunteers did not have the capacity to offer training and leadership in the wide range of STEM categories that would be made available in 4-H Science. For this reason, engaging partners was a priority at the outset of the Science Initiative. To fill the gaps, 4-H sought to create partnerships with external STEM organizations. Criteria used to select partners included having the ability to:

Accomplishments

- More than 30 partners engaged to help attain 4-H's goal of reaching 1 million new youth with SET programing.
- Partners have enabled 4-H Science to access additional youth and volunteers, showcase the 4-H Science Initiative and access STEM experts who serve as mentors, coaches and leaders of 4-H Science work in local communities.
- 4-H Science will continue to explore efficient and effective ways to keep STEM partners engaged with 4-H Science,

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level. For the 4-H Science Initiative to be successful, this development must continue.

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Partnerships are critical to advancing the 4-H Science Initiative and engaging 1 million new 4-H members. One challenge is how to transform national partnerships into real engagement and program impact at state and local levels. To achieve this goal, 4-H is employing a variety of strategies, including a renewed and targeted focus on volunteer recruitment, engagement and retention. 4-H is working to develop innovative strategies to engage volunteers from STEM fields, episodic volunteers and corporate volunteers. Plans include demonstration sites that will create, test and refine tools that can be shared broadly across the 4-H system and with other out-of-school STEM providers. This work is being co-led by Janet Golden, National 4-H Council, and Doug Swanson, 4-H National Headquarters.

In spring 2012, state 4-H Science Liaisons reported new and expanded partnerships. Feedback from the field indicates that the national partnership work is positively affecting partnership development at the county

USA Science & Engineering Festival and Resilience (PEAR)

- volunteers to 4-H Science programs and work closely with 4-H staff to involve their youth participants Science. To date, 4-H has engaged more than 30 groups and organizations as partners at som This number does not include the funding partners and marketing partners. Strategic partners include:
 National Association of Rocketry
- Invite 4-H to present 4-H Science workshops and resources to their national conferences and present their STEM resources to 4-H conferences
 - Assist with fundraising to support 4-H Science
- Cultivating partners is time-consuming work. The level of involvement with partners vary from creating awareness of resources to a more in-depth collaboration. Strategic partners provide coaches, mentors and volunteers to 4-H Science programs and work closely with 4-H staff to involve their youth participants in 4-H Science. To date, 4-H has engaged more than 30 groups and organizations as partners at some level.

Allow members of their organizations to serve on national, state and county 4-H Science committees

- Society of Automotive Engineers
- FIRST Robotics
- Program in Education, Afterschool
- Environmental Systems Research Institute
- Educational Equity Center/Great Science for Girls
- Exploratorium
- Sci Girls
- National Science Teacher Association
- Coalition for Science After School
 - YMCA USA

- Help 4-H access new youth and volunteer audiences
- Provide STEM experts to serve as volunteers to local 4-H Science programs
- Participate on conference calls and webinars
- Assist 4-H Science with developing STEM curricula
- Share their STEM curricula with 4-H



Conclusion

The 4-H Science Management Team and key 4-H science leaders have developed an exemplary and effective system for the development, implementation, evaluation and sustainability of the 4-H Science Initiative. Thousands of leaders within and outside the 4-H system have contributed to this success. The system created to implement and manage this ambitious initiative is impressive. Thanks to these efforts, the 4-H Science Initiative has opened up a world of opportunities for youth by effectively engaging them in hands-on science, engineering and technology projects.

Now that the system is in place, it will continue to grow to meet identified organizational needs. Going forward, the next opportunity will be to fully integrate all Mission Mandates into the system and find creative and dynamic ways to sustain it over the long term. Given its experience and success over the last 110 years and its innovative and adaptive approach, there is great confidence that 4-H will successfully meet the challenge.

Appendix

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Timeline of Events

YEAR	EVENT	MONTH
1902	Beginning of the 4-H Youth Development Program	N/A
2003	The Science and Technology Work Group ("The Working Group") established	N/A
2004	Working Group begins duties	January
2004	Working Group develops a vision statement and framework for reaffirming 4-H's leadership in SET programs	March
2004	Eddie Locklear is hired at National 4-H Council: 4-H Afterschool Director (2004–August 2006) and 4-H SET Director (August 2006–May 2012)	N/A
2006	Discussion of starting a partnership with NOYCE Foundation	N/A
2006	Telephone conference with NOYCE Foundation	October
2006	Meeting of National 4-H Council & National 4-H Headquarters to de- velop 4-H SET strategies	July
2006	SET Leadership Team established (changed name in 2009 to 4-H SET Management Team)	September
2006	Commissioned paper to identify & establish nationally recognized standards in SET that would align with SET abilities and stay within the 4-H Youth Development context	October
2006	4-H SET Professional Development Committee is organized	N/A
2007	Presentation at 1890s Extension Administrator Annual Conference	June
2007	NOYCE Foundation partnership established	April
2007	Science, Engineering and Technology (SET) Programming in the Context of 4-H Youth Development submitted for blind review	April
2007	Science, Engineering and Technology (SET) Programming in the Context of 4-H Youth Development approved for publication	May
2007	SET Staff Readiness Survey tested for content validity at National 4-H SET Liaison Conference	June
2007	SET Staff Readiness Survey Available Online	September– March 2008
2007	Original 4-H SET Logic Model created	January

2007	4-H SET Presentation at Urban Extension Conference	Мау
2007	4-H SET Presentation at the Children, Youth and Families at Risk conference	May
2007	National 4-H SET Liaisons training held	June
2007	2 new 4-H Curricula developed: Exploring Your Environment and The Power of the Wind	N/A
2007	SET fact sheet shared with CES Directors	January
2007	SET fact sheet shared with State Program Leaders	April
2007	SET fact sheet shared at Children, Youth and Families at Risk Conference	May
2007	SET fact sheet shared at Urban Extension Conference	Мау
2007	SET fact sheet shared at 1890s Extension Administrators Annual Conference	June
2008	Developed a 4-H SET curriculum rubric consistent with National Science Education Standards for revision and development of 4-H SET curricula	N/A
2008	Development of Land-grant Universities Plans of Action with States	N/A
2008	Pam Garza is hired as - National Professional Development Expert	N/A
2008	National 4-H SET Launch Event	June
2008	One Million New Scientists, One Million New Ideas campaign announced	N/A
2009	Chad Ripberger contracted as 4-H SET Urban Programs Director	January
2009	Survey conducted of 4-H professionals in urban communities	March
2009	Training for 4-H SET programs in urban communities	October
2010	4-H SET changes name to be recognized as 4-H Science	N/A
2010	Janet Golden is hired as Manager of 4-H Science Professional Development	May
2010	National 4-H Science Academy held	December
2010	Pam Garza resigns	December
2011	4-H Science in Urban Communities Promising Practices Guide is launched	May

2011	Conducted follow-up evaluation with participants of the 4-H Science Leadership Academy	Мау
2011	Janet Golden promoted to Assistant Director, 4-H Mission to Market	June
2011	Launched Using Inquiry-Based Learning to Support 4-H Science	October
2011	Launched 4-H Science Smart: Competency Training Guide	September
2011	Launched Robotics Training Guide	September
2011	Launched Personal Development Mini Site	November
2011	Launched 4-H Science Fund Development Toolkit	April
2012	Launched E-Basics Online Training (Program Evaluation Training)	June
2012	4-H Science Ready Online Training	December
2012	Biotechnology Training with USB grant	December
2012	Ed Bender hired as 4-H Science Professional Development and Partnership Manager	January
2012	Launched web-based curriculum development system	March
2012	Beth Birnstihl is hired as: Director of 4-H Mission to Market	July
2012	Released updated National 4-H Curriculum Peer Review Course	Fall
2012	Eddie Locklear retires	Мау
2012	One Million New Scientists goal reached: one year early	November
2012	Tier 2 of evaluation plan conducted	N/A
2012	Tier 3 of evaluation plan conducted and is on-going	N/A
2007–08	SET Staff Readiness Survey	September- March
2008–10	Development of Tiers 1,2 and 3 evaluation plans and strategies	N/A
2009–10	Conducted Implementation Studies	N/A
2009–11	Conducted 2 YEAK Studies	N/A

ACRONYMS

ACRONYM	DESCRIPTION
CBASS	Collaborative for Building After-School Systems
CES	Cooperative Extension Service
CSREES	Cooperative State Research Education and Extension Service
CYFAR	Children, Youth and Families at Risk
ECOP	Extension Committee on Organization and Policy
FRC	FIRST Robotics Competition
IRB	Institutional Review Board
ITEST	Innovative Technology Experiences for Students and Teachers
LGUs	Land Grant Universities
NAA	National Afterschool Association
NAE4-HA	National Association of Extension 4-H Agents
NAEP	National Assessment of Educational Progress
NPLs	National Program Leaders
NYSD	National Youth Science Day
OJJDP	Office of Juvenile Justice Delinquency Prevention
PD	Professional Development
PEAR	Program in Education, Afterschool and Resilience
POAs	Plans of Action
PSA	Policy Studies Associates, Inc
RAGS	Rising Above the Gathering Storm
RFA	Request for Application
SET	Science, Engineering and Technology
SPL	State 4-H Program Leader
STEM	Science, Technology, Engineering and Mathematics
TASC	The After-School Corporation
TBD	To Be Determined
USB	United Soybean Board
USDA	United States Department of Agriculture
YEAK	Youth, Engagement, Attitudes and Knowledge Survey
YMCA	Young Men Christian Association

PERSONNEL

PERSONNEL	DESCRIPTION	ORGANIZATION
Arnold, Mary (Dr.)	Administered follow-up evaluation with 4-H Science Leadership Academy and Regional 4-H Science Academies participants	Oregon State University
Arnold, Mary (Dr.)	National 4-H SET Leadership Academy and Regional 4-H Science Academies Evaluator	Oregon State University
Bender, Ed	4-H Science Professional Development and Partnership Manager	National 4-H Council
Birnstihl, Beth (Dr.)	Co-Director for the 4-H SET "Working Group"	University of Nebraska at Lincoln
Birnstihl, Beth (Dr.)	National Director, 4-H Mission to Market	National 4-H Council
Blue, Tanya	Fundraiser	National 4-H Council (past)
Bowles, Janet	Worked with Dr. Cook to Conduct 4-H SET Staff Readiness Survey	Auburn University
Bramble, Jill	Chief Development Officer	National 4-H Council
Chiu (Dr.)	Conducted pilot study for proposed Tier 3 longitudinal study	University of Virginia
Cook, John A. (Tony) (Dr.)	Conducted 4-H SET Staff Readiness Survey	Auburn University
Drum, Ron	Account Manager	National 4-H Council
Fan, Xitao	Conducted pilot study for proposed Tier 3 longitudinal study	University of Virginia
Floyd, Don	President/CEO of National 4-H Council	National 4-H Council
Garza, Pam	National professional development expert: helped develop comprehensive professional development plan for the entire 4-H system	National 4-H Council (past); consultant
Gogolski, Jeanne	Assisted with developing the SET Programming in the Context of 4-H Youth Development paper	Education Projects & Partnerships LLC
Golden, Janet	Manager of 4-H Science Professional Development; Co-Leader in Volunteer Recruitment, Engagement and Retention; Asst. 4-H Mission to Market Director (June 2011)	National 4-H Council

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Resources

4-H Directory of Materials: <u>http://www.4-h.org/resource-library/national-directory-materials/</u>

4-H Science Checklist: <u>http://www.4-h.org/search/?q=4-h science checklist</u>

4-H Science in Urban Communities Promising Practices Guide <u>http://urban4hscience.rutgers.edu/</u>

4-H Science Smart: <u>http://www.4-h.org/resource-library/professional-development-learning/science-training-guides-resources/</u>

4-H SET: A Strategic Framework for Progress - available on request

4-H Study of Positive Youth Development <u>http://www.4-h.org/search/?q=4-H Study of Positive Youth Development</u>

ACCESS website: http://www.4-h.org/resource-library/access-4-h-online-enrollment-management-system/

Butterfly WINGS: http://www.4-hmall.org/Product/4-hcurriculum-butterfly/08394.aspx

Implementation Study 2009: http://www.4-h.org/search/?q=implementation study

Implementation Study 2010: http://www.4-h.org/search/?q=implementation study

Inquiry Based Learning to Support 4-H Science: http://www.4-h.org/resource-library/professional-development-learning/science-training-guides-resources/buildingunderstanding/inquiry-based-learning/

NYSD 2008-2012:

http://www.4-h.org/4-h-national-youth-science-day/past-experiments-archives/

Priming The Pipeline – Lessons from Promising 4-H Science Programs <u>http://www.4-h.org/search/?q=priming the pipeline</u>

Review of 4-H Instructional Materials - available on request

Rising Above the Gathering Storm, Pre-Publication Version, p. 3-24

Robotics Training Guide: <u>http://www.4-h.org/resource-library/curriculum/4-h-robotics/facilitator-resources/professional-development/</u>

Science Fund Development Toolkit 2011: http://www.4-h.org/resource-library/professional-development-learning/fund-development-toolkit/

Teaming with Insects: <u>http://www.4-h.org/resource-library/curriculum/4-h-teaming-with-insects/</u>

There's No New Water: <u>http://www.4-h.org/resource-library/curriculum/4-h-theres-no-new-water/</u>

YEAK study 2009: www.4-h.org/About-4-H/Research/2009-YEAK-Report.dwn

YEAK study 2011: www.4-h.org/About-4-H/Research/4-H-2011-YEAK-Report.dwn

