THE 4-H SCIENCE INITIATIVE:
Summary Observations from an Evaluation

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In 2006, 4-H National Headquarters and National 4-H Council introduced an initiative aimed at increasing the number and quality of science, engineering, and technology programs that 4-H offers around the country, and increasing the number of youth involved in these programs. By engaging youth in informal science educational opportunities through the 4-H Science Initiative, the organization hopes to increase science interest and literacy among youth, the number of youth pursuing postsecondary education in scientific fields, and the number of youth pursuing science-related careers. In order to expand and improve science programming, 4-H has created new curricula and programming, and provided professional development and supports for state and county staff and volunteer leaders.

4-H Science programs are intended to help youth build their science skills and knowledge, improve their life skills, and become engaged in their communities through involving youth in experiential and inquiry-based activities. They are designed to take place in a positive youth development context and to thereby build a sense of belonging and independence among youth.

With the support of the Noyce Foundation, National 4-H Council has worked with Policy Studies Associates (PSA) since 2009 to evaluate the implementation of this initiative. Evaluators have examined state- and county-level implementation and delivery of science programming; youth engagement in science, attitudes towards science, and knowledge of science; and promising practices used in science programs. Data collection methods have included surveys at the state and county levels; interviews; site visits; and surveys of youth (Exhibit 1).

Exhibit 1
Data collection: Sources and methods, by year

	2009	2010	2011	2012
LGUs	Enrollment survey Implementation survey	Enrollment survey Focus groups Phone interviews in nine states	Enrollment survey	Enrollment survey
Counties	Implementation survey	Phone interviews in nine states	Implementation survey	
Programs and science educators			Survey of science educators in nine states	Site visits to eight case-study programs
Youth	YEAK survey (2009-10)		YEAK survey	YEAK survey (2012-13)

Exhibit reads: In 2009, evaluators collected data from LGUs through an enrollment survey and an implementation survey.

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The end of the evaluation is an opportunity to draw together insights into the implementation of 4-H Science, synthesizing findings that PSA has communicated through a series of separate reports. By looking across these many snapshots, taken across levels and over time, we identify programmatic strengths, recurring issues, potentially promising directions, and questions for the future.

Strengths of the Initiative

The 4-H Science Initiative has gained momentum over the years of this evaluation. While it has grown, it has maintained signature strengths in programming, such as hands-on experiences, a positive environment with peers and supportive adults, and connection to the real world and to careers. Participating youth have consistently reported positive attitudes about science and confidence in their own skills in science, as well as satisfaction with their 4-H activities; similar positive findings have come from different samples of youth over the three administrations of a youth survey, suggesting that they hold true for a range of 4-H science settings.

Momentum in Implementation and Enrollment

4-H is facilitated by 106 Land-Grant Universities and Colleges (LGUs) in more than 3,000 counties as a part of the Cooperative Extension System. Thus the Science Initiative relies heavily on the commitment and leadership of the LGUs, and the participation of LGUs in initiative activities has risen over the years of the evaluation. Starting in 2007, with guidance from National 4-H Council, LGUs began to develop strategic plans to implement the 4-H Science Initiative in their states. Each plan outlined the LGU's goals and priorities for science program development, curricula, funding, marketing, professional development, and evaluation. By 2009, 56 LGUs submitted a strategic plan (known as a Plan of Action) to National 4-H Council. By 2012, the number submitting a Plan of Action had risen to 65.

Over time, too, increasing numbers of LGUs have developed their information-gathering capacity to the point of being able to provide information on the number of participants in 4-H Science who are first-time 4-H enrollees. By 2012, there were 22 LGUs that provided this information, compared with 9 LGUs in 2009.

The county-level focus on science has increased as well. As of 2011, among the survey respondents at the county level who had been working in their position as a youth development agent in their county since 2006 or earlier, 73 percent said that their county was then placing more emphasis on establishing and maintaining science programming than it had before 2006, when the initiative was launched. An additional 25 percent said that their county placed the same emphasis on science programming as it had before 2006. These data came from a broad base of county staff; almost three-quarters (73 percent) reported that they had been in their position as their county's youth development agent since at least 2006.

Enrollment has grown during the initiative. The full number of youth in what 4-H defines as Science Ready programming[1] is not known, because applying this definition consistently has been a challenge and not every LGU is comfortable reporting either the number of Science Ready programs or the number of youth in such programs who are new to 4-H. However, with increasing numbers of LGUs reporting over time, a partial tally of the cumulative number of new 4-H enrollees in Science-Ready programs is available (Exhibit 2). By 2011, it had risen to more than half a million, based on reports from 22 LGUs, with 217,031 youth reported to be newly enrolled in that year alone.

Exhibit 2
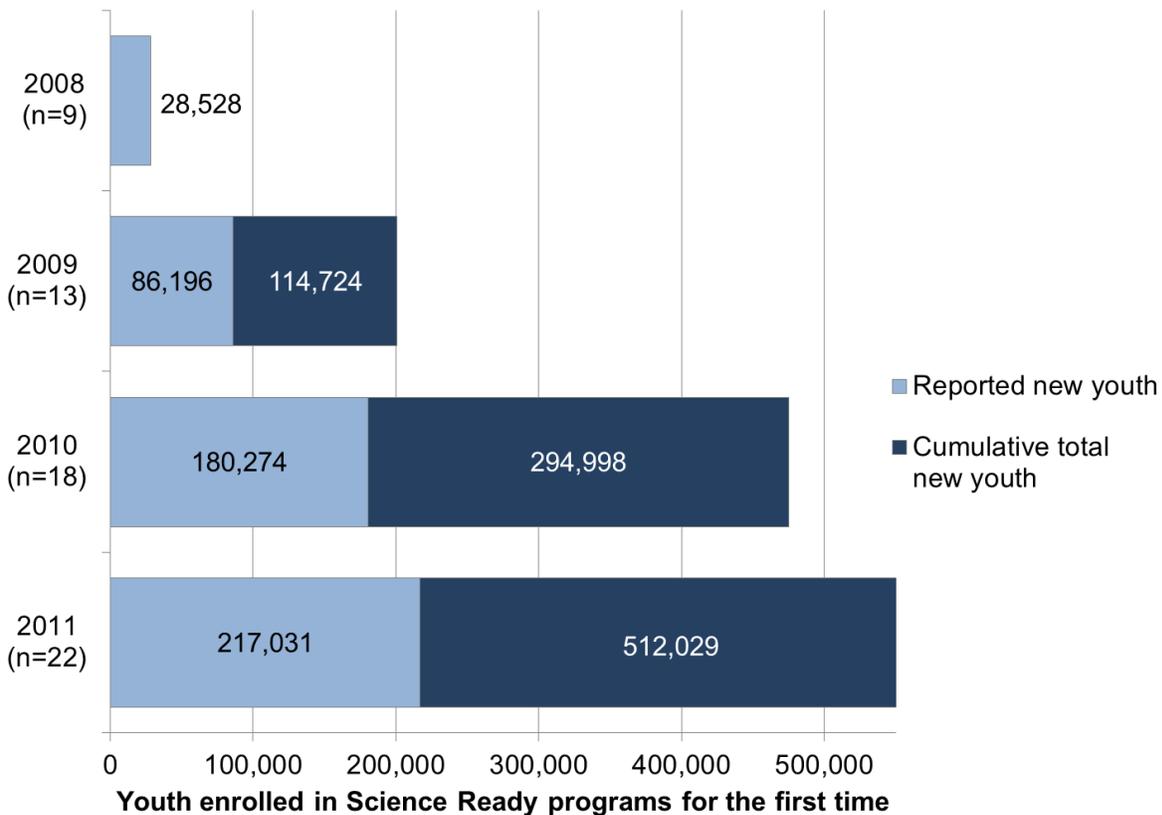**Newly enrolled youth, by year and by number of LGUs reporting**

Exhibit reads: For 2008, nine LGUs reported that a total of 28,528 youth in Science Ready programs were new to 4-H.
Source: Annual surveys of state leaders and science liaisons. Reported in: 4-H Science, Engineering and Technology (SET) Initiative: Enrollment and Implementation Study (2009), Year 2 Enrollment Survey Results (2011), Year 3 Enrollment Survey Results (2012) Year 4 Enrollment Survey Results (2013).

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[1] At the start of the 4-H Science Initiative, 4-H developed a set of expectations, referred to as the 4-H Science Checklist, which outlines what characteristics programs must meet to be considered Science Ready. The 4-H Science Checklist requires that programs: (1) be based on National Science Education Standards, (2) develop participants' science-related skills and abilities, (3) use positive youth development practices, (4) be led by staff who are well-trained in youth development and appropriate content, (5) use an experiential approach to learning, (6) foster creativity and curiosity among participants, and (7) address outcomes on the 4-H Science Logic Model.

Strengths of 4-H Offerings in Science

4-H's locally driven programming structure is unique in its ability to adapt to the particular needs of communities. State 4-H programs have capitalized on this flexibility as they have worked to support science programming in their localities. In interviews conducted in 2010, state 4-H Program leaders described a variety of topics on which they have focused science programming, such as sustainable living, agriculture, robotics, and wind energy. These emphases often corresponded with each state's major industries and the topics of interest identified in their communities.

Wide-ranging content areas. County 4-H staff responding to a survey conducted in 2011 reported implementing youth programs in a diverse set of content areas in their county. Traditional 4-H content areas such as animal science, gardening, and food science were widely reported, with less traditional content areas such as engineering and computer technology reported somewhat less often (Exhibit 3).

Exhibit 3
4-H Science content areas

	Percent of counties *(n=367)*
Large animal science	81
Gardening	75
Small animal science	74
Food science	67
Environmental science	63
Horticulture	61
Consumer and family sciences	58
Veterinary science	56
Robotics	53
Aerospace/rocketry	53
Plant science	51
Technology	45
Environmental stewardship	43
Engineering	34
Geospatial technology (GPS/GIS)	31
Earth science	30
Weather and climate	27
Computer technology	29
Physical sciences	28
Other	7

Exhibit reads: Eighty-one percent of responding counties offer large animal science programming.
Source: Survey of county 4-H professionals. Reported in: *Year 3 Implementation Study* (2012).

High-quality programming. In order to foster high-quality science programming, 4-H seeks to provide learning environments that support both informal science learning and positive youth development. In particular, 4-H believes that certain elements should be present in its science programs, such as the facilitation of inquiry- and experiential-based program activities, the promotion of science skills, youth leadership, and positive youth development practices (specifically, the Essential Elements of Positive Youth Development: mastery, independence, belonging, and generosity).

The qualities that 4-H seeks in science programming are supported by a growing body of research. This research examines features of informal science learning that improve youth content knowledge and engagement in the STEM fields: hands-on, investigation-based activities (Minner, Levy, and Century, 2010) and opportunities to link content to the daily lives of participants (Peterson, 2007; Tai, 2006). Elements of informal science learning that may increase youth engagement and content knowledge in the STEM fields include:

- active learning and hands-on activities
- gathering, analyzing, interpreting, and presenting data
- inquiry-based learning practices such as posing questions, making predictions, and responding to questions
- connecting activity content to the real world, and
- discussing STEM careers and their educational pathways.

In addition, practices found to be associated with high-quality informal learning programs include the presence of clear goals, engaging activities, activity sequencing that supports skill-building, and a youth-focused environment (Eccles & Gootman, 2002; McLaughlin, 2000; Noam, 2008; Vandell et al., 2006). Youth-centered content delivery, which 4-H encourages for its science programs, can contribute to positive youth outcomes. By providing opportunities for youth to contribute their ideas and experiences, informal science programs can help participants develop increased interest in science learning, knowledge of science content, and improvements in science achievement (Institute for Learning Innovations, 2007). Through youth-centered content delivery, youth and adults become equal partners in the learning process.

For a description of program offerings, we cite here the data provided by science educators in nine states who responded to a 2010 survey. These individuals—extension educators, staff members, and volunteers who serve as the leader of a 4-H Science Ready program—provided up-close testimony about practice by describing their programs for the survey.

When asked to list the primary objectives of their science programs, educators largely reflected 4-H's expectations, with an overwhelming majority saying that providing hands-on experiential activities (94 percent), encouraging youth to develop an interest in science (79 percent), or helping youth develop pro-social and interpersonal skills (67 percent) were major objectives of their programs (Exhibit 4).

Exhibit 4
Major program objectives *(n=184)*

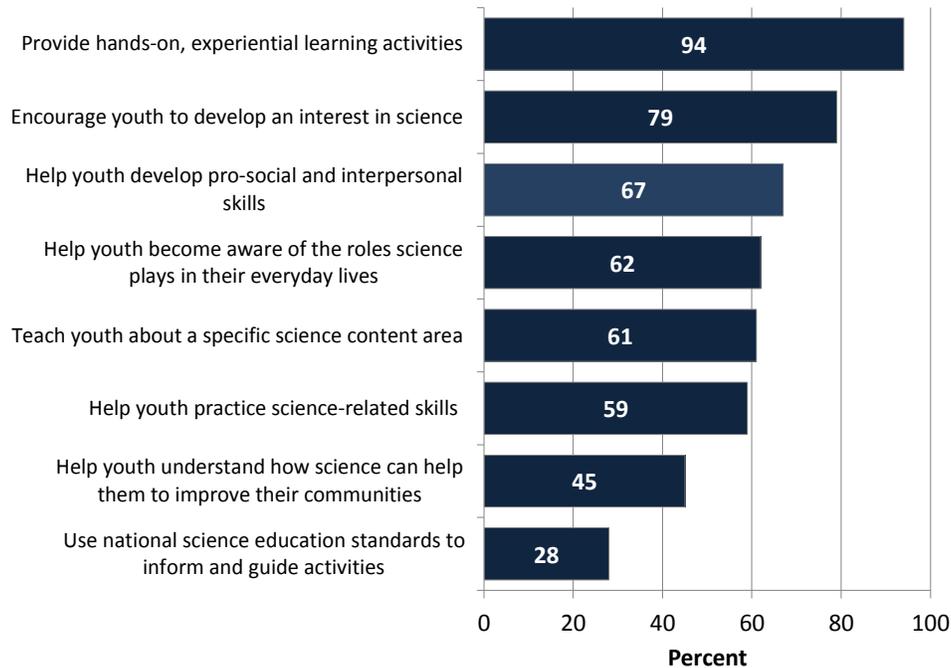| Objective	Percent
Provide hands-on, experiential learning activities	94
Encourage youth to develop an interest in science	79
Help youth develop pro-social and interpersonal skills	67
Help youth become aware of the roles science plays in their everyday lives	62
Teach youth about a specific science content area	61
Help youth practice science-related skills	59
Help youth understand how science can help them to improve their communities	45
Use national science education standards to inform and guide activities	28

Exhibit reads: Ninety-four percent of science educators reported that a goal of their program is to provide hands-on, experiential learning opportunities.

Source: Survey of science educators. Reported in: *Youth Engagement, Attitudes, and Knowledge Study* (2012).

More than half of all science educators also reported that their programs aim to: help youth become aware of the roles science plays in their everyday lives (62 percent), teach youth about a specific science content area (61 percent), and help youth practice science-related skills (59 percent).

When asked to report on the frequency with which youth participated in certain types of learning activities, science educators reported that youth not only practiced science skills such as gathering and interpreting data, but also had many opportunities to work in groups and use teamwork to solve problems. This focus on communication and interpersonal skills reflects the National Research Council's Committee on Conceptual Framework for K-12 Science Education Standards' suggestion that science education reflect that "science is fundamentally a social enterprise, and scientific knowledge advances through collaboration and the context of a social system with well-developed norms."

Eighty-two percent of these science educators' programs were said to engage youth in activities that encourage them to work in teams or small groups—allowing youth to develop interpersonal skills as they master science content—and 61 percent of programs integrate activities that require youth to build or construct models to demonstrate scientific phenomena (Exhibit 5). Youth also have opportunities to practice science-related skills, including gathering

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data or information (52 percent), developing questions and conducting research (45 percent), and analyzing and interpreting data (43 percent).

Exhibit 5
Program activities occurring at every or nearly every meeting,
in percents *(n=182)*

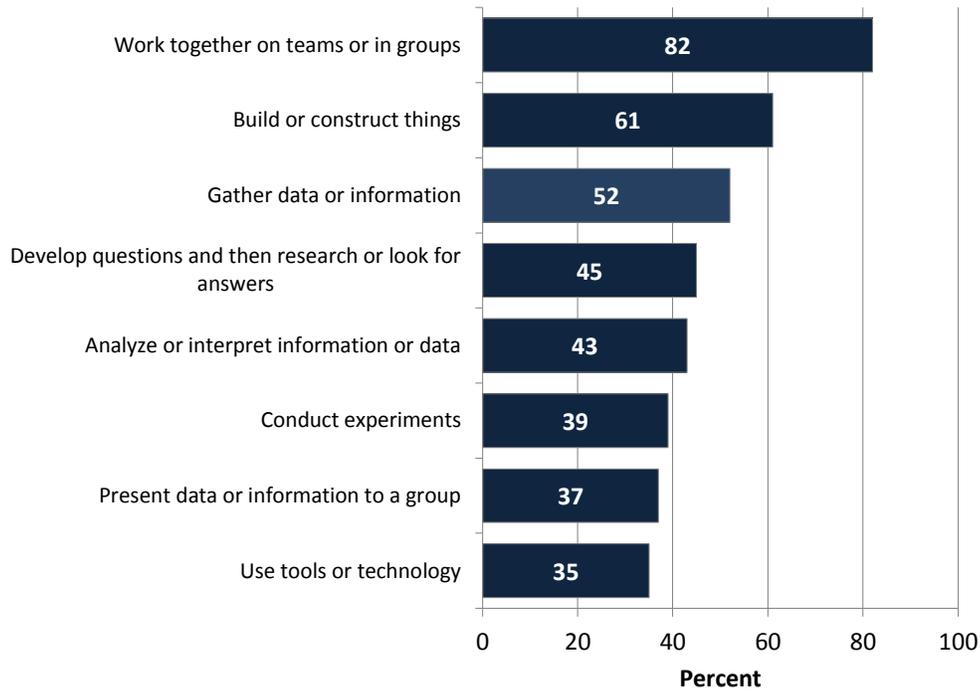| Activity	Percent
Work together on teams or in groups	82
Build or construct things	61
Gather data or information	52
Develop questions and then research or look for answers	45
Analyze or interpret information or data	43
Conduct experiments	39
Present data or information to a group	37
Use tools or technology	35

Exhibit reads: Eighty-two percent of programs engage youth in activities in which they work together on teams on in groups at every or at nearly every meeting.

Source: Survey of science educators. Reported in: Youth Engagement, Attitudes, and Knowledge Study (2012).

Eighty-nine percent of science educators reported that they engage youth in activities that allow them to learn about careers that use science, and 81 percent of science educators reported using activities that involve meeting with adults who work in science-related fields. Providing youth with opportunities to learn about careers in science is a practice in line with current research that suggests that exposing youth to science early on can affect their education and career choices later in life (Tai, Liu, Maltese, & Fan, 2006).

Finally, 81 percent of the educators reported using lesson plans to guide activities at some point. However, activities were not rigidly planned; fewer than half of this group reported using lesson plans consistently for all program meetings (42 percent).

Strengths as Reported by Participating Youth

In all years in which PSA conducted a youth survey (2009-10, 2011, and 2012-13), youth responded positively when asked about the environment of their programs. Relationships with peers and positive experiences with adults were consistently among their favorite characteristics of programs. "I get to do hands-on science activities and projects," "I get to spend time with my friends," and "The adults are caring and kind" were the top three responses in each year of the survey.

As part of the evaluation of Science programs, PSA worked with the 4-H Science Instrument Design Team to develop the 4-H Science Youth Engagement, Attitudes and Knowledge (YEAK) survey. The YEAK survey addresses the following questions about the youth in the survey sample:

- What are the characteristics of the youth involved in Science Ready programming?

- What are participants' attitudes toward the scientific fields? Do participants aspire to pursue career opportunities in science-related fields?

- What level of education do participants want to achieve?

- To what extent are participants engaged in both formal and informal science learning? Do participants pursue science leadership opportunities?

- What science-related skills, abilities, and knowledge do participants have?

Responses suggest that the 4-H participants in this sample are highly engaged in science-related activities and are eager to participate in those activities, especially in informal settings. Although this evaluation cannot isolate the impact that participation in 4-H science programs may have had on youths' engagement and interest in science, youth in 4-H Science programs were generally more enthusiastic about science than were their peers surveyed for the National Assessment of Educational Progress (NAEP). In the 2012-13 survey, 77 percent of the fourth-grade 4-H Science participants agreed with the statement, "I like science," compared with 64 percent of fourth-graders in NAEP's national sample. More than half of 4-H Science participants in the eighth grade (64 percent) agreed that science is one of their favorite subjects, compared with 47 percent of 2011 NAEP respondents in the eighth grade. Twelfth-grade youth participating in 4-H Science programs were more likely than their peers in the NAEP sample to agree that they would like to have a science-related job when they graduate from high school: 77 percent of 4-H Science participants agreed that they would like to have a science-related job, compared with 37 percent of NAEP respondents.

In response to a set of items developed for the Noyce Foundation for use in out-of-school-time programs, the 4-H participants in 2012-13 indicated that they are highly engaged in science-related activities and are eager to participate in those activities, especially in informal settings (Exhibit 6). Most respondents agreed or strongly agreed that they like to see how things are made (85 percent) and participate in science projects (84 percent), and that they like to watch television programs about nature and discoveries (77 percent). These responses are similar to those of participants surveyed in 2011, when the items were first available for use in this study.

When asked if they would like to have a job related to science when they graduate from high school, 59 percent of youth surveyed in 2012-13 agreed or agreed strongly. In 2010, 50 percent of respondents reported wanting a science career, and 2011, 54 percent of respondents did so.

It is noteworthy that the YEAK surveys administered in 2012-13 yielded answers very similar to those gathered in its two previous administrations, because the sample was drawn in a different way and thus captured a different group of program offerings. By sampling programs from all of those designated in the 4-H database as Science Ready, this latest round of surveys tapped a wider range of programs than the previous ones, which had relied on program nominations from the county or state level. The programs sampled for 2012-13 were more likely to be traditional clubs than those sampled in previous years. The similarities in findings lend weight to the idea that the attitudes and experiences of youth in 4-H Science programs are similar among youth with different types of 4-H experiences.

Exhibit 6
Noyce Enthusiasm for Science survey items, in percents *(n=388)*

Survey item	Strongly Agree	Agree
I like to see how things are made	43	42
I like to participate in science projects	33	51
I like to watch programs on TV about nature and discoveries	33	44
I want to understand science	32	46
I like to work on science activities	30	52
I like to take things apart to learn more about them	29	51
I get excited learning about new discoveries or inventions	29	48
I am curious to learn more about science, computers, or technology	28	45
I'd like to get a science kit as a gift	29	32
I get excited to find out that I will be doing a science activity	28	50
Science is something that I get excited about	26	50
I pay attention when people talk about recycling to protect our environment	27	48
When I grow up and have kids, I will take them to a science museum	26	53
I am curious to learn more about cars that run on electricity	22	40
I enjoy reading science fiction books	22	35
I like reading science magazines	16	34

Percent of respondents
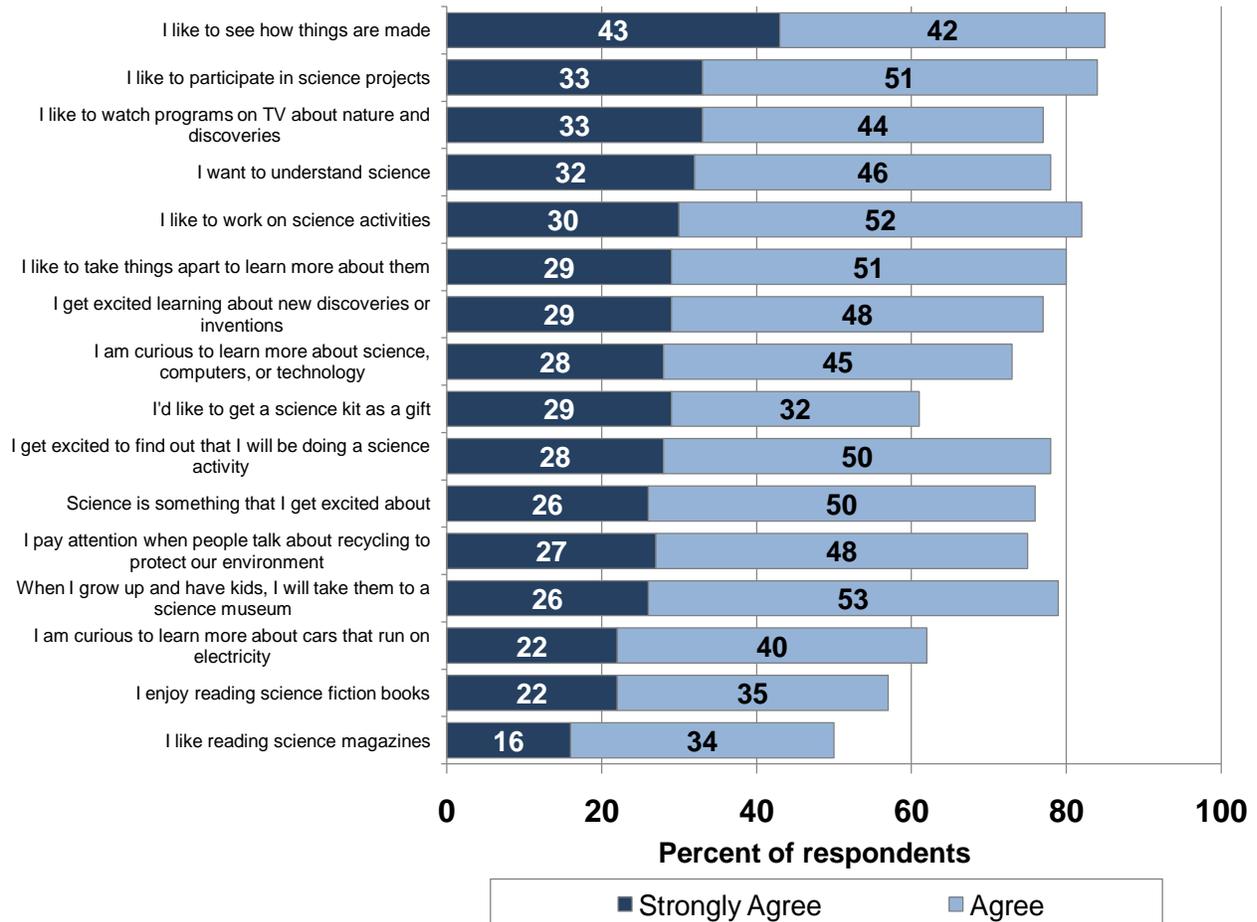
■ Strongly Agree ■ Agree

Exhibit reads: Forty-three percent of respondents agreed strongly and 42 percent agreed that they like to see how things are made.

Source: Survey of youth in 4-H Science programs. Reported in: *Youth Engagement, Attitudes, and Knowledge Study* (2013).

Challenges to Implementation

Nationally, 4-H is a decentralized system reliant on state and county creativity and on volunteer efforts. While this brings strengths, it also brings challenges. In repeated surveys, this evaluation found that LGUs frequently pointed to a lack of funds and a lack of staff time as impediments to moving forward with science programming. For county 4-H professionals, who each represented a unique county, the three biggest challenges in implementing science programming all related to staffing. Roughly half of counties reported in 2011 that finding science content expert staff, finding youth development staff, and maintaining enough support staff in the county office were major challenges (Exhibit 7). More than half of counties felt that each of the elements listed in the graph below posed at least a minor challenge.

Exhibit 7
Challenges to implementation

Percent of county 4-H professionals *(n=371)*

Exhibit reads: Fifty-three percent of county youth development professionals said that finding qualified science content expert staff and/or volunteers was a "major challenge"; 37 percent of professionals said this was a "minor challenge."

Source: Survey of county 4-H professionals. Reported in: *Year 3 Implementation Study* (2012).

Similarly, finding time for staff and volunteers to attend training and finding funds to pay for that training were reported to pose major challenges for the majority of county 4-H

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professionals surveyed in 2011. Finding the time for volunteer leaders to attend trainings when they may have jobs aside from 4-H likely contributes to this challenge. A lack of staff and/or volunteer interest in attending training also presented a major challenge to 49 percent of counties.

Limits on staff capability and on training resources (especially the resource of time) can impede advances in science programming. Thus, while the value of "hands-on" learning is understood well throughout the 4-H system, other pedagogical strategies such as inquiry-based learning are less widespread and may be less well understood among county staff and the adults who lead science programs. For example, 73 percent of county staff said in 2011 that they incorporate experiential learning when designing or adapting curricula or programming, compared with 54 percent of staff who said they incorporate inquiry-based science learning.

More could be done to infuse standards-based science content into programming. Although almost all counties provided programs in traditional content areas, only 55 percent of counties reported that they integrated intentional science learning into traditional 4-H content areas. Fewer than half of county professionals reported that they always or almost always worked to align science programming with state science standards (38 percent), and just 21 percent reported striving to make science programs Science Ready as described by the 4-H Science Checklist.

A year earlier, in interviews and focus groups, participants noted that because many adult volunteers and staff have trepidations about leading science activities, it is important to provide them with appropriate training. We heard that the biggest challenges LGUs face with regard to professional development included: (1) the need to train volunteers in both content knowledge and positive youth development skills, (2) the need to develop training materials that fine-tune traditional 4-H science programming to meet 4-H Science standards, and (3) a lack of sustainable funding for professional development opportunities. Focus group participants also said that they would benefit from increased opportunities to communicate with other states about 4-H and learn from one another.

Just as innovations in programming are slowed by the challenges of staff capacity and training, so too are the systematic data-collection methods that 4-H has tried to implement in connection with the Science Initiative. The designation of programs as Science Ready has not been intuitively easy, and neither has use of the 4-H ACCESS database that is meant to capture useful information on science programming, among other topics.

In 2010, the state and county leaders from nine states interviewed for this evaluation were often unsure how to use the Science Checklist in their development and assessment of science programs. In the following year's national survey of county youth development 4-H professionals, only 21 percent of county 4-H professionals surveyed reported striving to make science programs Science Ready as described by the 4-H Science Checklist. While this designation is primarily made at the state level, this response from county 4-H professionals may indicate that the idea of Science Ready programming has yet to reach most counties.

ACCESS has also been subject to less than full implementation. As of spring 2012, among the 65 LGUs that had submitted plans to implement the Science Initiative, 35 had adopted

the ACCESS system, and 19 had completed the process of marking programs and projects in their states as Science Ready.

Differing Priorities, Differing Program Choices

Across the board, counties have reported the challenge of lack of staff time. Still, some counties have done more than others in 4-H Science despite this barrier, and the differences in actions taken are related to differences in the priority placed on science.

The 2011 survey asked county-level staff to identify the extent to which their county and their state prioritized science programming. About one-third (37 percent) said that science programming was a high priority in their county, while almost twice as many (66 percent) reported that science was a high priority in their state (Exhibit 8).

Exhibit 8
Science as a priority at state and county levels

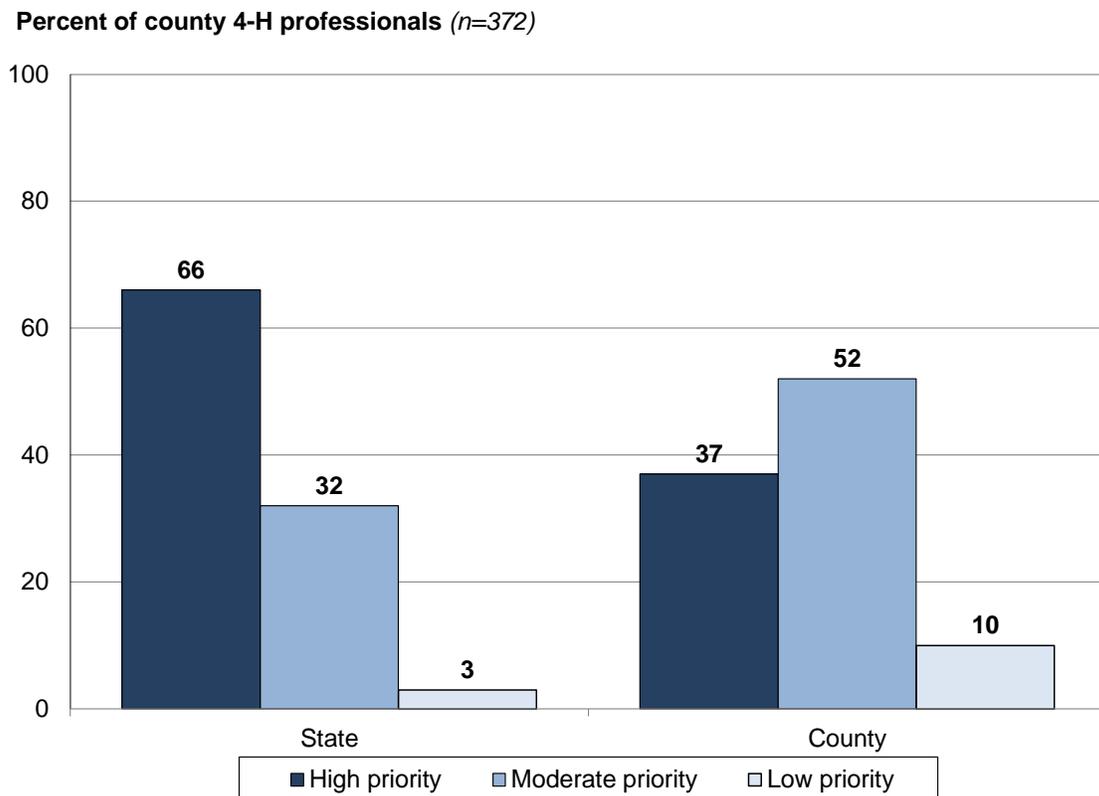**Percent of county 4-H professionals** *(n=372)*

Exhibit reads: Sixty-six percent of respondents reported that science is a high priority in their state. Thirty-seven percent of respondents indicated that science is a high priority in their county.

Source: Survey of county 4-H professionals. Reported in: *Year 3 Implementation Study* (2012).

Counties more often followed recommendations of the 4-H Science Initiative when the county placed a high priority on science. It is possible that a county made a decision to prioritize science and then implemented the recommended practices, or that implementing these practices sparked a greater commitment to science as a core component of 4-H programming. Although our survey does not reveal *how* priorities and practices developed, it does show that in 37 percent of counties—those that reported placing a high priority on science—program design and support activities showed significant differences from those found in other counties.

The counties that reported placing a high priority on science were more likely than other counties to take many of the actions 4-H considers necessary for high-quality science programs, such as ensuring that programming helps youth build science skills, training staff and volunteers in science content, and evaluating science programs; they also reached out more widely in recruiting youth and staff. At the same time, in the 63 percent of counties that reported a moderate or low priority on science, the practices encouraged in the 4-H Science Initiative were less common, and some of these practices were quite rare. Analysis of the survey data showed significant differences (both in statistical significance and in effect size) between the two groups of counties in the reported frequency of each of the following practices:

■ Incorporating experiential learning into curriculum (reported in 88 percent of counties that placed a high priority on science vs. 65 percent of other counties)

■ Incorporating inquiry-based science learning (74 percent vs. 42 percent)

■ Connecting curricula to issues directly affecting their county or region (73 percent vs. 49 percent)

■ Asking staff to incorporate college and career exploration activities in their programs (50 percent vs. 23 percent)

For every survey item asking about the 4-H professionals' efforts to ensure high-quality programs, a higher proportion of 4-H professionals in counties where science was a high priority said that they "always" or "almost always" engaged in that particular type of effort (Exhibit 9), compared with 4-H professionals in other counties. For example, 84 percent of these 4-H professionals reported ensuring that science programming would help youth build science skills, while this was reported by 58 percent of the 4-H professionals in counties that gave science a lesser priority.

Exhibit 9
Supports for high-quality programming

Supports for high-quality programs	Prioritization of science		All counties *(n=362)*
	High priority *(n=135)*	Not a high priority *(n=225)*	
I encourage activities that include experiential learning elements	93*	78	83
I encourage activities that focus on youth inquiry, creativity, and curiosity	87*	73	78
I ensure that programs are facilitated by adults who are well-trained	77*	64	69
I ensure that science programming helps youth build science skills	84*	58	68
I design, or help design, programming that addresses the Essential Elements of Positive Youth Development	67*	55	59
I work to align science programming with state science education standards	48*	32	38
I work to align science programming with national science education standards	28*	16	21
I strive to make science programs in my county Science Ready as described by the 4-H Science Checklist	29*	16	21
I require volunteers and staff to submit lesson plans or activity guides for the science activities they lead	18*	9	12

Exhibit reads: Among counties who consider science a high priority, 93 percent said they "always" or "almost always" encourage activities that include experiential learning, compared to 78 percent of counties who do not consider science a high priority.
*Differences were statistically significant.

Source: Survey of county 4-H professionals. Reported in: *Year 3 Implementation Study* (2012).

County 4-H professionals who described science as a high priority were significantly more likely than their peers to go outside of their 4-H networks to recruit science content experts. While both groups recruited science content experts from parents of 4-H participants and from former 4-H participants, counties that placed a higher emphasis on science reported more recruitment of science experts from:

■ Local science-related businesses (68 percent in counties that placed a high priority on science vs. 36 percent in other counties)

■ High school and/or college students (58 percent vs. 37 percent)

- University departments (56 percent vs. 22 percent)

- Other community members (67 vs. 45 percent)

There were differences in science training for county 4-H professionals and other staff, based on whether science programming was a high priority for the county:

- Training in science content for 4-H professionals (65 percent in counties that placed a high priority on science vs. 39 percent in other counties) or for staff and volunteers (49 percent vs. 25 percent)

- Training in how to teach science concepts to youth for 4-H professionals (54 percent vs. 29 percent) or for staff and volunteers (48 percent vs. 22 percent)

- Training in how to design activities that focus on youth inquiry, creativity, and curiosity for staff and volunteers (46 percent vs. 23 percent)

- Shared resources for staff and volunteers to use, such as curriculum guides, a Wiki, or a website (59 percent vs. 37 percent)

Generating staff and/or volunteer interest in attending training was easier in counties where science was a high priority: just 36 percent of those counties called it a major challenge, compared with 56 percent of respondents in counties where science was a moderate or low priority.

Building partnerships and securing resources often posed challenges, regardless of the priority the county placed on science, but the nature of partnerships differed in some respects across counties. Counties in which science was a high priority were more likely to report the following:

- Partnerships with local colleges or university departments other than their state's land grant university (52 percent vs. 25 percent in other counties).

- Partners that contributed volunteers or mentors to support science programming (88 percent vs. 68 percent).

Finally, evaluation practices also varied with the priority placed on science. In counties where science programming was a high priority, respondents were more likely to say that they evaluate at least some science programs in their counties (82 percent of counties, vs. 53 percent of counties where science was a lower priority).

Resources for Continuing Improvement in Science

Our surveys have provided data about the channels for communication and assistance that are used now by the people responsible for carrying out 4-H Science. Both in the survey data

and also in a set of case studies of promising programs, we also see other opportunities for communication about program ideas and approaches.

4-H Resources Used

To look for science curricula or programming ideas, county staff tended to use their network of 4-H colleagues and 4-H online resources, according to the 2011 survey. Sixty-six percent of county staff said that they looked to other 4-H professionals for ideas, 64 percent said they used the National 4-H Council website, 61 percent used another state's 4-H website, and 60 percent made use of their own state's 4-H website.

Comparatively few county staff used resources from outside of the 4-H network; 10 percent said they found ideas from a website not associated with 4-H, and 6 percent said they used a collaborative website for youth development educators. Since partners such as school districts and other youth development organizations could potentially be rich sources of curricula and professional development resources, investigating such sources could be beneficial for science programming.

Communication between LGUs and counties regarding 4-H Science is widespread but still has room for improvement. Two-thirds of county 4-H professionals, 67 percent, said they had worked with a state-level staff person to learn more about 4-H Science. Those county 4-H professionals who looked to their state 4-H Program leader as an information source were more likely than others to report specific practices that are encouraged for 4-H Science. For example, county 4-H professionals who worked with their state 4-H Program leader to learn more about teaching experiential and inquiry-based science to participants were more likely to provide professional development on youth inquiry for their staff and volunteers.

Several differences also existed between the 26 percent of county 4-H professionals with a state science leader who worked with that person to find professional development for staff in their county, and the 4-H professionals who did not. County 4-H professionals who contacted their state 4-H Program leader to find professional development were more likely to support high-quality programming in their counties by encouraging staff to develop activity goals, incorporate college and career exploration, and align program content with national and state science education standards. These county 4-H professionals were also more likely to provide training on teaching science concepts to youth, and on designing inquiry-based activities.

Few counties reported using tools from either their state office or from 4-H at the national level designed to help them find partners and funders, although survey results indicated that such tools could be helpful to them. Finding partners and funders posed a major challenge for 20 percent of counties and a minor challenge for 54 percent. It could be that available tools at the state and national level for finding partners and funders are not advertised sufficiently to counties, or that these tools do not meet their needs.

Possibilities for Peer-to-Peer Learning

Another way of looking at resources for program improvement is to tap existing promising programs as a source of ideas. Our case studies of eight programs, conducted in 2011-12, suggest a variety of potential solutions to the challenges that perennially arise in the field. The case studies were not intended to generate models for replication but rather to spark ideas about approaches that could be adapted and applied in other settings. Selected through a structured process of nominations and vetting, the programs studied reflect a variety of program delivery modes, content areas, geographic regions, and youth served. They include the following:

- Adventure in Science (AIS) (Montgomery County, Maryland)
- Bucks County Vet Science Clinics (Bucks County, Pennsylvania)
- GEAR-Tech-21, A'ROR'N Bots (Aurora, Nebraska)
- 4-H Great Lakes & Natural Resources Camp (Michigan)
- Langston Community 4-H SET Team (Logan County, Oklahoma)
- Montana Sustainable Communities Project, Pretty Eagle (St. Xavier, Montana)
- Rutgers 4-H Summer Science Program (New Jersey)
- Texas 4-H Technology Team (Texas)

Collectively, these programs offer ideas relevant to the challenges described in this report. Sharing how-to lessons from these programs and many others like them could help inspire and support further problem-solving in the development of 4-H science programming. For example, in response to the perennial need for staff and volunteer expertise, they illustrate specific ways of strengthening science know-how and coupling it with experience in youth development. Several draw heavily on science experts, and by recruiting scientists to deliver the content they know and love, the programs provide an authentic window into the practice of science. Some of the programs cast a wide net, recruiting from a wide range of businesses and other organizations, and they draw on standing organizational partnerships. Still, because most science experts do not have deep expertise in youth development, program coordinators may help science instructors develop lesson plans, and youth-development volunteers may provide support as needed.

The programs have found ways to make it easy to participate in professional development. They have developed training materials and delivery that minimize the burden on staff, such as user-friendly materials that provide practical guidance and can be accessed by volunteers on their own time. They develop, use, and often update manuals for use by staff and volunteers. They attend to the science experts' need for help in planning engaging activities and understanding youth development, and to youth development experts' need for resource materials on science content.

To infuse science content and science standards into their activities, some of the case-study programs have active partnerships with schools, enlisting teachers to help plan activities aligned with science curriculum. They build in not only hands-on learning but also inquiry learning, structuring activities so that youth are making predictions and using evidence. They also ensure that the activities are engaging, and that youth can take control of their own learning in a positive environment.

Questions for the Future

Our evaluation has shown many accomplishments of the 4-H Science Initiative, at the state and county levels and in the settings where youth enjoy learning in a positive environment. Looking ahead, it would be possible to draw still more lessons from recent evaluations and also to pose other questions about this initiative and others like it.

PSA's evaluation, while encompassing a range of questions and designs over several years, is not the only window into 4-H Science. Another evaluation has focused on professional development offerings and experiences, and still another is being designed to follow youth longitudinally. Bringing together the lessons of multiple evaluations could lend further depth to the understanding of this initiative.

And, while the last section of this report reviewed PSA's findings about communication channels and assistance related to science programming, more could be learned about the ways in which ideas travel through the many formal and informal 4-H networks. What supports the spread and adaptation of promising practices? What impedes innovation and practice improvement, besides the perennial issue of a lack of time? What is the story of the counties that prioritize science and are setting the pace in Science Ready programming: did they decide to make science a priority and then pursue it, or did a few early successes build their enthusiasm—or both? Who and what helped them along the way? And what can be done to support and assist programs that are not so far along at this time?

The Science Initiative benefits from the energy and commitment of countless staff and volunteers. Evaluators can support their work, both by assessing the current state of 4-H Science programming and by analyzing the opportunities for learning and improvement in the 4-H system. The PSA team is pleased to have participated in these efforts.

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Full Reports and Resources

Full reports of each study, as well as additional resources associated with this report and the National 4-H Science Initiative evaluation design can be found at: http://www.4-h.org/about/youth-development-research/science-program-research/.