

**4-H Science, Engineering and Technology (SET) Initiative:  
Youth Engagement, Attitudes, and Knowledge Study**

**Executive Summary**

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# Executive Summary

## Introduction

With the support of the Noyce Foundation, National 4-H Council has contracted with Policy Studies Associates (PSA) to evaluate the implementation of the 4-H Science, Engineering and Technology (SET) Initiative. The goals of this initiative are to increase the number and quality of science, engineering, and technology programs that 4-H offers around the country, and to increase the number of youth involved in these programs. Objectives for the SET initiative are to increase SET interest and literacy among youth, to increase the number of youth pursuing post-secondary education in SET, and to increase the number of youth pursuing SET careers.

Annually, nearly six million youth participate in 4-H, which is implemented by 106 Land-Grant Universities and Colleges (LGUs) in more than 3,000 counties as a part of the Cooperative Extension System. National leadership is provided by 4-H National Headquarters at the National Institute for Food and Agriculture, USDA, and National 4-H Council, which is the national nonprofit partner of 4-H and the Cooperative Extension System. National 4-H Council focuses on fundraising, branding, communications, and legal and fiduciary support to 4-H programs.

4-H has set an enrollment goal: by the end of 2013, one million youth who have never before been in 4-H will enroll in SET programs. In order to meet this goal, 4-H has sought since 2006 to increase its capacity and infrastructure for providing 4-H SET programming. As part of this effort, 4-H formed the National 4-H SET Leadership Team, which consists of national, state and county-level 4-H professionals. In addition, SET Liaisons have been appointed at Land Grant Universities (LGUs) around the country to help implement SET programs and to recruit youth into these programs.

The evaluation's winter 2009 report on the implementation of SET programs nationwide suggested that SET programs offer programming on a variety of SET-related topics through a range of delivery methods. Some SET programs deliver content on topics that have traditionally been covered by 4-H programming, while other SET programs offer youth the opportunity to explore topics that are new to 4-H, such as rocketry and robotics. The National 4-H SET Leadership Team created an outline of SET program requirements, called the 4-H SET Checklist, for universities to use as a guide in the development of SET programs.<sup>1</sup> Generally, this Checklist sets out the expectation that SET programs: be inquiry-based and grounded in experiential learning; involve building SET-related skills; and, like all 4-H programs, employ positive youth development practices.

In addition to the 4-H SET Checklist, 4-H has also developed a logic model for the SET initiative. According to the 4-H SET Logic Model, programs should be designed with the following short-term youth outcomes in mind:

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<sup>1</sup> The 4-H SET Checklist is reproduced in Appendix D.

- Increased awareness of SET
- Improved SET skills (scientific methods) and knowledge (content areas)
- Increased awareness of opportunities to contribute to society using SET skills
- Increased life skills (self-efficacy)

## Methods

**Youth survey design.** As part of the evaluation of SET programs, PSA worked with the 4-H SET Instrument Design Team: Melissa Cater, Mary Arnold, Lisa Bouillion Diaz, Katherine Heck, June Mead, Beverly Spears, Ben Silliman, and Maureen Mulroy, and with Jill Walahoski and Suzanne LeMenestrel to develop the 4-H SET Youth Engagement, Attitudes and Knowledge (YEAK) survey for administration to SET participants. In this first year of the evaluation, the YEAK survey serves to address the following questions about the youth in the survey sample:

- What are the characteristics of the youth involved in SET programming?
- What are participants' attitudes toward the SET fields? Do participants aspire to pursue career opportunities in the SET fields?
- What level of education do participants want to achieve?
- To what extent are participants engaged in both formal and informal SET learning? Do participants pursue SET leadership opportunities?
- What SET-related skills, abilities, and knowledge do participants have?
- What factors, if any, are associated with participants' engagement, attitudes, and knowledge of SET?

**Sample selection.** In order to create a sampling frame from which to draw a sample of youth, PSA surveyed county- and state-level 4-H staff and asked them to identify 4-H SET programs where youth could be surveyed. From the list of SET programs generated, PSA drew a random sample of SET programs for the youth survey. In drawing this sample, PSA ensured that programs: (1) represented all five regions, (2) were located in communities of all sizes, (3) enrolled participants of varying ages, and (4) utilized a variety of delivery methods.

**Response rate.** PSA sent paper and electronic surveys to a total of 94 SET programs and received surveys from 65 programs, for a program response rate of 69 percent. This process yielded a total of 1,060 youth surveys, a sample large enough to allow for statistically sound comparisons of multiple subgroups on survey items (Exhibit ES1).

**Exhibit ES1  
Program and Youth Survey Response Counts**

Region	Programs surveyed	Programs returning surveys	Youth survey responses
Northeast	19	16	482
North Central	18	10	169
South	11	10	47
West	38	26	259
1890	8	3	103
<b>Total</b>	<b>94</b>	<b>65</b>	<b>1,060</b>

Exhibit reads: Nineteen programs in the Northeast region were surveyed and 16 of these programs returned a total of 482 completed surveys.

***Representativeness of data.*** At this time, because 4-H does not have a uniform way of collecting data on individual participants, it was not possible for evaluators to select a nationally representative sample of youth for participation in the survey.<sup>2</sup> For this reason, the survey data presented in this report only speak to the population of participants surveyed and are not generalizable to the entire 4-H SET participant population.

***Statistical tests employed.*** Data in this report include descriptive statistics from the first administration of the YEAK survey. Evaluators also explored the relationships between various youth characteristics and youth responses to survey items using independent samples t-test or analysis of variance (ANOVA) for continuous variables and chi-square tests for categorical variables. Where statistically significant differences were found (using the threshold of  $p < 0.05$ ), we computed an effect size to measure the magnitude or strength of the finding.

The statistical tests and measures of effect size used in analysis varied based on the properties of the data analyzed. For analyses of continuous variables, we computed a Cohen's *d* measure of effect. For categorical variables we calculated a Cramer's *V* effect. Conventions for educational research suggest that effect size values between 0.10 and 0.20 indicate a "small but meaningful" association, between 0.21 and 0.50 an "important" association, and 0.51 or higher an "impressive" association (Cohen, 1988; Lipsey, 1990). This report focuses on findings with

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<sup>2</sup>Details about the sample selection and survey administration can be found in Appendix A.

an effect size of at least 0.20; comparisons or associations below this threshold were considered too weak to warrant reporting.

In addition, evaluators used multiple regression to further explore the report's findings by controlling for certain youth characteristics that could affect survey responses. This method produces an estimate of the impact of each element in the regression model, while all other elements in the model are held equal. In this report, an  $R^2$  statistic is displayed along with each regression result. This statistic represents the amount of variation in a particular outcome that the regression model can explain. For example, a regression model with an  $R^2$  statistic of 0.20 concerning a certain survey question could explain twenty percent of the variation in youth's responses to that question. This means that approximately eighty percent of the variation in youth's responses is due to factors that were not in the model (and were not captured by the survey). We also report the beta ( $b$ ) statistic for each regression finding, which explains the influence of a particular factor on youth's survey responses.<sup>3</sup>

**Analysis approach.** We explored the associations between a variety of factors that might influence youth's engagement, attitudes, aspirations, and knowledge regarding SET, including:

- Respondents' **gender, age, and race/ethnicity**. Responses from youth ages 9 to 12 were compared with those from youth ages 13 to 18. In addition, youth responses were compared based on their self-reported race/ethnicity; survey responses from the two largest respondent groups, white youth and African American youth, were compared.
- Respondents' **educational aspirations**. Youth's educational aspirations were measured by the survey question, "How far do you want to go in school?" The five response categories for this question were combined into three for analysis purposes: (1) graduate from high school, go to a trade or vocational school, or go to college for a little while; (2) finish college; and (3) get more education after college.
- Respondents' **exposure** to their SET program. In order to obtain a more complete picture of the amount of time respondents spent in their SET programs, we combined responses to two questions, "In general, how many hours do you spend

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<sup>3</sup> Beta,  $b$ , is a coefficient used in regressions to indicate the amount of change in an outcome that can be attributed to a predictor (independent) variable, when other predictors are held constant.

In regressions with continuous outcome (dependent) variables,  $b$  can be interpreted in terms of the outcome variable. For example, if a predictor variable has a  $b$  of 2.5, for every 1 point increase in that predictor variable, the outcome variable will increase by 2.5 points.

A transformed  $b$  coefficient, called exponential  $b$  ( $\exp b$ ) is used in regressions with categorical outcome variables and can be interpreted as the change in the odds of an outcome occurring. An  $\exp b$  of greater than one indicates that as the predictor increases, the odds of the outcome occurring also increase. If  $\exp b$  is less than one, as the predictor increases, the odds of the outcome occurring decrease (Field, 2005).

Further details about regression results can be found in Appendix E.

in this program/project each week?”, and “How long have you been participating in *this* science, engineering or technology program/ project?”, to create an index that rates their self-reported degree of exposure to SET programming. Youth who reported participating in their program for the greatest number of hours and months were categorized as “high exposure.” Youth who participated for fewer hours per week and for fewer months were categorized as “moderate exposure,” and youth who reported participating in their program the least were categorized as “low exposure.” Thirty percent of respondents were categorized as high exposure, 31 percent as moderate exposure, and 40 percent as low exposure.<sup>4</sup>

- **Types of 4-H programs** youth are involved in. In the YEAK survey, youth were able to indicate the types of 4-H activities they have been involved in, including: clubs, camps, after-school programs, local fairs or events, community service projects, and working on their projects at home. Youth were compared based on whether or not they were involved in 4-H clubs and whether or not they were involved in 4-H after-school programs.
- The **type of community** in which the program was located. Information about community type came from the Program Survey that was administered to county- and state-level 4-H Staff in fall 2009. For analysis purposes, the five original categories were combined into three: (1) farming community, town of under 10,000 people or rural non-farm; (2) town, city, or suburb of a city with 10,000 to 50,000 people; and (3) suburb or city with more than 50,000 people.

There were some relationships between the factors listed above. If youth reported being involved in clubs, they were more likely to be in the “high exposure” group than youth who were not involved in clubs. Involvement in 4-H clubs was also associated with the type of community in which youth’s SET programs were located: youth involved in clubs were more likely to be in programs in middle-sized towns or cities than in large suburbs or cities. In addition, a greater proportion of white youth than African American youth have been involved in 4-H clubs, and a greater proportion of African American youth than white youth have been involved in 4-H after-school programs. Community type and race/ethnicity were also associated with one another. These relationships should be kept in mind when considering the findings in this report.

***Interpreting results.*** While the associations and regression models discussed in this report describe notable relationships between youth characteristics and survey responses, they should not in any instance be interpreted as implying causation.

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<sup>4</sup> Details about the exposure index can be found in Appendix C.

# Youth Characteristics: Key Findings

## Youth Demographics

Youth who completed the survey participated in 4-H SET programs located in a variety of communities. About half of youth participated in programs that were located in farming communities or towns with less than 10,000 people (52 percent of youth). One-quarter of youth participated in programs that were located in towns, cities, or suburbs of cities with between 10,000 and 50,000 people, and 23 percent of youth participated in programs that were located in suburbs or cities with more than 50,000 people.

The SET participants surveyed included a slightly higher percentage of females than males (Exhibit ES2). More than half of the youth were between the ages of 9 and 12 (62 percent) and the remaining youth were between the ages of 13 and 18 (38 percent). The majority of SET participants identified themselves as white (68 percent), followed by African-American (19 percent), and Latino/a (9 percent). Nearly 90 percent of SET participants reported being enrolled in a public school, with the next largest group indicating that they are home schooled (7 percent).

**Exhibit ES2  
Youth Demographic Characteristics**

		<b>Percent of Respondents (n=1,060)</b>
Gender	Female	54
	Male	46
Age	9-12	62
	13-18	38
Race	White	68
	African American/Black	19
	Hispanic/Latino	9
	Native American/Alaskan Native	3
	Asian	2
	Native Hawaiian/Pacific Islander	1
School Type	Public school	88
	Home school	7
	Private school	4
	Religious school	2



Exhibit reads: Fifty-four percent of respondents were female.

## Exposure to 4-H and 4-H SET Programming

While the majority of survey respondents had previously been enrolled in 4-H programming, there were many respondents enrolled in 4-H SET programs who reported that they were either new to 4-H or new to 4-H SET programming. Forty-one percent of youth said that they were currently enrolled in their first year of 4-H programming and 63 percent reported that they were currently enrolled in a 4-H SET program for the first time.

When asked about the types of 4-H programming they are involved in, more than half of youth said that they are involved in 4-H clubs (55 percent), 42 percent reported being involved in after-school programs, and 32 percent said that they were involved in local fairs and events.

## Youth Attitudes: Key Findings

### Educational and Career Aspirations

SET participants who responded to the survey reported having high educational aspirations. More than 80 percent of respondents indicated that they intend to finish college or continue to get more education after college. Nine percent of youth said that they would likely attend some college or attend a trade or vocational school, and another nine percent of youth indicated that they only intended to finish high school.

When asked what type of career they anticipated pursuing in the future, respondents gave a wide range of answers, with similar numbers of youth expressing interest in a career in the medical field, the military, and the arts (items adapted from: Tai, 2006). When the career choices were collapsed into SET and non-SET careers, 50 percent of respondents reported wanting to pursue a SET career.

**Gender.** Further analyses found that there were significant differences between the career aspirations of boys and girls: 61 percent of boys said they would like to pursue a SET career while only 40 percent girls said the same. Using regression analysis, respondents' gender was found to be a significant predictor of their aspiration to a SET career. Controlling for other significant predictors, boys were three times more likely than girls to aspire to SET careers (exp  $b=3.10$ ,  $R^2=0.18$ ).<sup>5</sup>

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<sup>5</sup> Significant predictors in this regression model were: gender, race, educational aspirations, exposure to SET programming, involvement in 4-H afterschool, and the type of community in which respondents' programs were located. Respondents' age and involvement in clubs did not have a significant impact on their aspirations toward SET careers. Details about this regression model can be found in Exhibit E1 of Appendix E.

## Attitudes Toward Science

Youth were asked to respond to a set of items in order to gauge their interest in and enthusiasm for science. These items were taken from the National Assessment of Education Progress (NAEP) science exam, a subject-based assessment that is administered periodically to a nationally representative sample of fourth, eighth, and twelfth grade students.

Seventy-one percent of SET participants said that science is one of their favorite subjects, 68 percent said that they do science-related activities that are not for school work, and 59 percent said that they would like to have a job related to science when they graduate from school.

***Exposure to 4-H SET programming.*** Data analysis showed that the amount of time a respondent has spent in their SET program was related to their expressed interest in having “a job related to science.” Youth in the high exposure group were more likely to strongly agree or agree that they wanted to pursue a job in science than those youth who were in the low exposure group (73 percent versus 46 percent). Also, regression analyses showed that being in the low exposure group made respondents about half as likely to want a job related to science compared to other youth, when other significant factors were held constant (exp  $b=0.48$ ,  $R^2=0.13$ ).<sup>6</sup>

***Comparison against a national sample.*** SET participants were separated by age into three groups and their responses were compared with those of 2005 NAEP respondents of similar ages (Exhibits ES3, ES4, and ES5).<sup>7</sup> While the differences between the SET participants and NAEP respondents were statistically significant, these differences should be interpreted with caution because the effect sizes were not strong enough to meet this evaluation’s threshold.<sup>8</sup>

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<sup>6</sup> Significant predictors in this regression model were: exposure to SET programming, gender, race, educational aspirations, involvement in 4-H afterschool, and the type of community in which respondents’ programs were located. Respondents’ age and involvement in clubs did not have significant impacts on youth’s interest in having a job related to science. Details about this regression model can be found in Exhibit E2 of Appendix E.

<sup>7</sup> Data downloaded from the NAEP Data Explorer at <http://nces.ed.gov/nationsreportcard/nde>, on December 16, 2009.

<sup>8</sup> The number of SET respondents in each age group was not large enough to yield strong effect sizes when compared with the large group of NAEP respondents.

**Exhibit ES3**  
**Fourth Grade SET and NAEP Respondent Attitudes Toward Science**

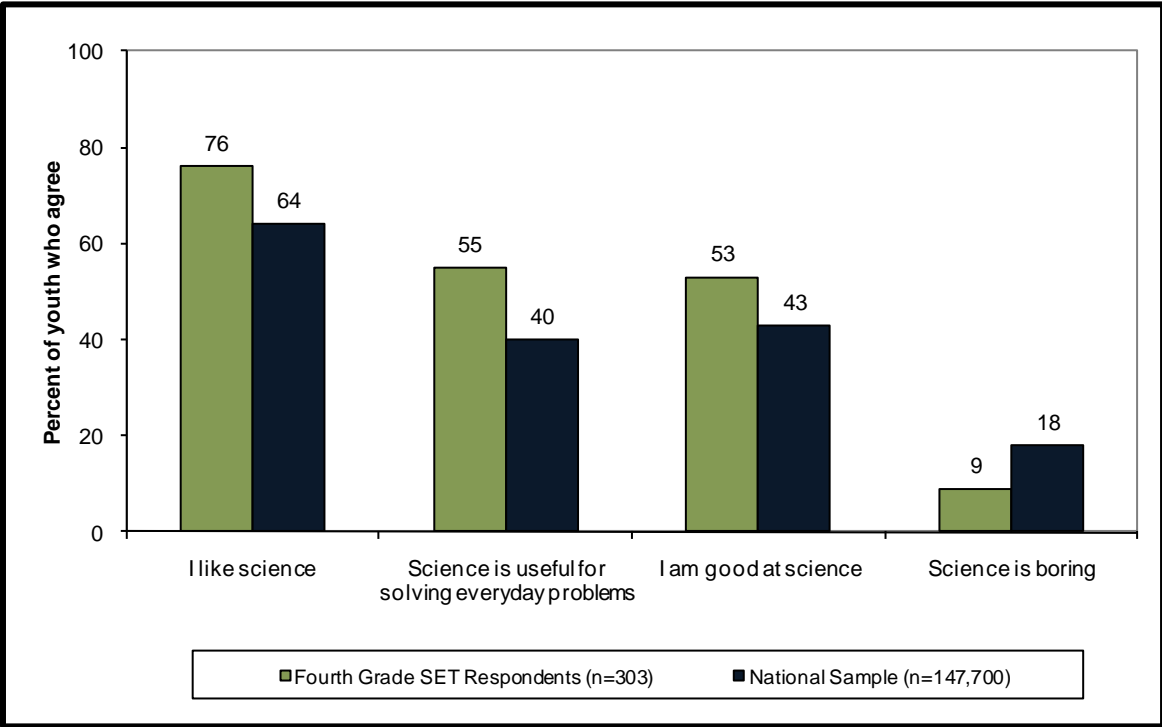


Exhibit reads: Seventy-six percent of fourth grade 4-H respondents agreed with the statement “I like science” compared to 64 percent of youth in the national sample.

Note: National sample data are from the NAEP science assessment, administered to students in grades 4, 8, and 12 in 2005. 4-H respondents ages 9 and 10 were classified as fourth graders for this analysis.

**Exhibit ES4**  
**Eighth Grade SET and NAEP Respondent Attitudes Toward Science**

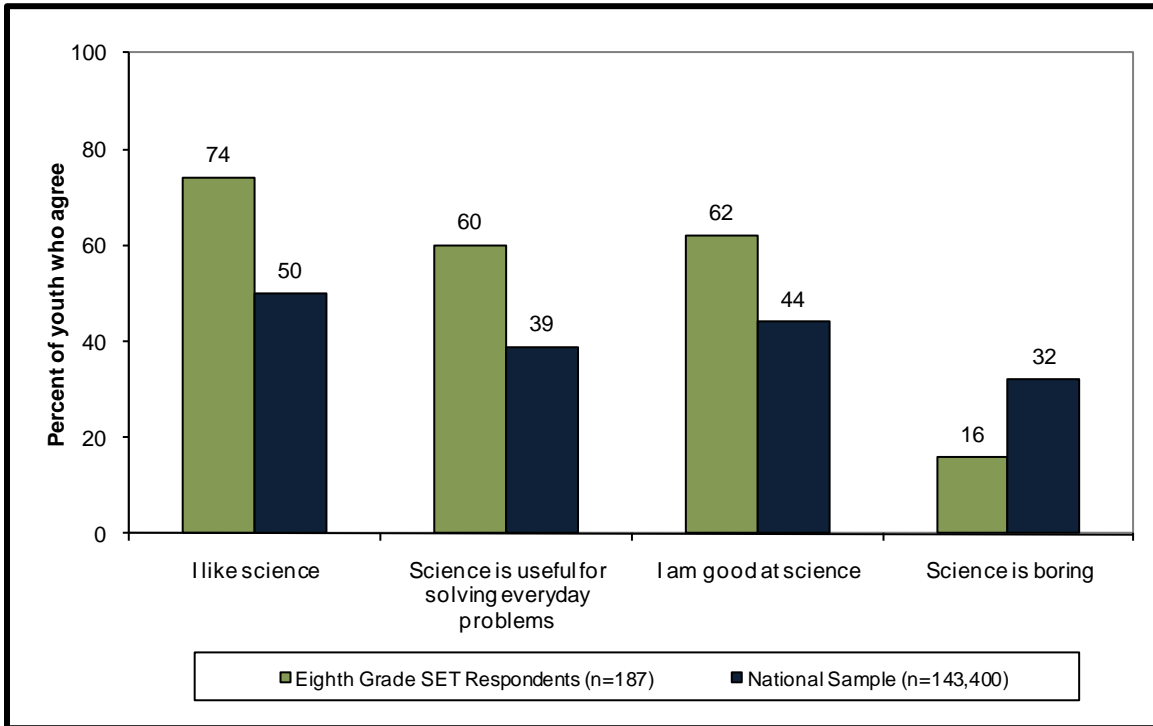


Exhibit reads: Seventy-four percent of eighth grade 4-H SET respondents agreed with the statement “I like science” compared to 50 percent of youth in the national sample.

Note: National sample data are from the NAEP science assessment, administered to youth in grades 4, 8, and 12 in 2005. 4-H respondents ages 13 and 14 were classified as eighth graders for this analysis.

## Exhibit ES5 Twelfth Grade SET and NAEP Respondent Attitudes Toward Science

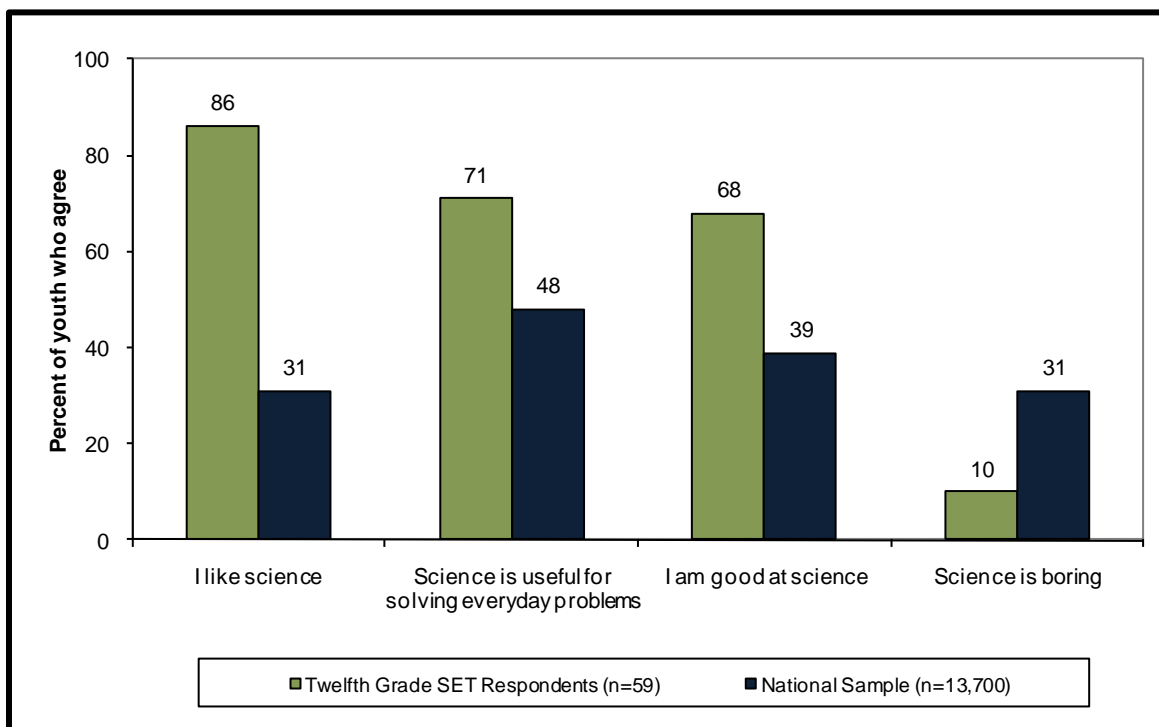


Exhibit reads: Eighty-six percent of twelfth grade 4-H SET respondents agreed with the statement “I like science” compared to 31 percent in the national sample.

Note: National sample data are from the NAEP science assessment, administered to students in grades 4, 8, and 12 in 2005. 4-H respondents ages 17 and 18 were classified as twelfth graders for this analysis.

## Exposure to Informal SET Activities: Key Findings

In order to assess the extent to which SET participants have been exposed to informal learning opportunities related to SET content, the YEAK survey asked participants to report their involvement in SET-related activities.

Respondents were given a list of SET-related activities and asked to indicate whether they had previously participated in any of the activities. A variety of activities were included, from visiting an aquarium or zoo to taking apart a device in order to determine how it works. Overall, youth reported having been involved in a large number of informal SET activities, with the average respondent reporting that they had participated in 9 of the 13 listed activities.

One of the long-term goals identified in the 4-H SET Logic Model is that youth participating in SET programs should become increasingly aware “of opportunities to contribute to society using SET skills.” Survey respondents were asked whether or not they participated in a series of science leadership and community activities (items adapted from Silliman, 2010). Many SET participants reported being involved in such activities: more than three-quarters of

respondents reported that they had helped with a community service project related to science and more than half said that they had taught others about science (Exhibit ES6).

**Exhibit ES6**  
**Participation in Science Leadership Activities**

	Percent of Respondents (n=1,010)
Helped with a community service project related to science	76
Taught others about science	58
Used science tools to help the community	38
Organized or led science-related events	32

Exhibit reads: Seventy-six percent of respondents have helped with a community service project related to science in the past year.

**Race and ethnicity.** When compared to their white peers, African American respondents reported participating in higher average numbers of science leadership activities. African American participants reported that they were involved in an average of 2.5 science leadership activities while white participants said they were involved in an average of 2.0 activities.

**Educational aspirations.** There were differences between youth’s participation in informal SET and science leadership activities based on their educational aspirations. The more education youth reported wanting to pursue, the more likely they were to participate in informal SET activities and science leadership activities. Youth who want to get more education after college reported participating in an average of 10 informal SET activities, while youth who do not expect to earn college degrees participated in an average of 8 activities. Similarly, youth who want to get more education after college said that they participated in an average of 2.2 science leadership activities, while their peers who do not expect to earn college degrees participated in an average of 1.8 activities. In addition, regression analysis showed that wanting to get more education after college was associated with participating in 1.2 more informal SET activities, when other significant predictors were held constant ( $b=1.2$ ,  $R^2=0.17$ ).<sup>9</sup>

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<sup>9</sup> Significant predictors in this regression model were: educational aspirations, level of exposure to SET programming, race, involvement in afterschool, age, and the type of community in which respondents’ programs were located. Respondents’ gender and involvement in clubs did not have significant impacts on youth’s participation in informal SET activities. Details about this regression model can be found in Exhibit E5 of Appendix E.

**Exposure to 4-H SET programming.** Youth with more exposure to 4-H SET programming participated in more informal SET and science leadership activities than youth with less exposure to SET programming. Youth in the high exposure group participated in an average of 10 informal SET activities and 2.3 science leadership activities, while their peers in the low exposure group participated in an average of 9 informal SET activities and 1.8 science leadership activities. Regression analysis supported this finding: when other significant predictors were held constant, being in the high exposure group was associated with participating in 1.0 more informal SET activities ( $b=1.0$ ,  $R^2=0.17$ ).<sup>10</sup>

**Types of 4-H program involvement.** On average, youth who reported being involved in 4-H clubs participated in more informal SET activities than did youth who were not involved in 4-H clubs. Youth involved in clubs participated in an average of 10 informal SET activities, compared to an average of 9 activities for youth who were not involved in clubs. In addition, youth involved in clubs participated in 2.1 science leadership activities on average, compared to an average of 1.9 activities for youth not involved in clubs. However, regression analysis did not show involvement in clubs to significantly predict participation in informal SET activities.

Youth involved in after-school 4-H SET programs participated in an average of 9 informal SET activities, compared to an average of 10 activities for youth who were not involved in after-school programs. Regression analysis also showed that being involved in after-school was associated with participating in 0.8 fewer informal SET activities, controlling for other significant factors ( $b=-0.8$ ,  $R^2=0.17$ ).<sup>11</sup>

**Community type.** Youth whose programs were located in farming communities or towns of less than 10,000 people participated in more informal SET activities on average (10) than did youth whose programs were located in suburbs or cities of more than 50,000 people (8). Youth whose programs are located in towns or cities with between 10,000 and 50,000 people also reported taking part in more informal SET activities (10) than youth in programs located in large cities (8). When other significant predictors were held constant, attending a program located in a large city was associated with participating in 1.8 fewer informal SET activities ( $b=-1.8$ ,  $R^2=0.17$ ).<sup>12</sup>

Youth whose programs are located in farming communities or small towns also reported participating in more science leadership activities than youth in programs located in large cities (2.2 science leadership activities compared to 1.7 activities, respectively).

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<sup>10</sup> Details about this regression model can be found in Exhibit E5 of Appendix E.

<sup>11</sup> Details about this regression model can be found in Exhibit E5 of Appendix E.

<sup>12</sup> Details about this regression model can be found in Exhibit E5 of Appendix E.

## **Skills and Knowledge: Key Findings**

4-H is committed to developing life skills in young people and empowering them to make sound decisions and thoughtful choices. The SET logic model articulates the development and application of life skills as key outcomes for youth participating in SET programs. Life skills such as decision making, problem solving, and critical thinking are aligned with the learning opportunities 4-H expects SET programs to provide.

### **Life Skills**

A majority of respondents reported having many of the life skills that 4-H programming aspires to instill in youth. More than three-quarters of youth reported that: when they have a decision to make, they always think before making a choice; they always keep their mind open to different ideas when planning to make a decision; they first figure out exactly what the problem is when trying to solve a problem; and they try to determine what caused a problem when they try to solve it.

### **SET Skills and Abilities**

The survey asked a subset of questions of youth ages 9 to 12 to assess their ability to perform certain science process skills. Youth were most likely to report that they are able to make a chart or picture to show information (88 percent). More than three-quarters of youth reported that they can: write down information correctly, do an experiment to answer a question, tell others how to do an experiment, and explain why things happen in an experiment.

SET participants ages 13 to 18 were asked a similar set of questions about their mastery of certain science process skills (items adapted from: Arnold & Bordeau, 2009). Most of these older youth reported that they were always or usually capable of: recording data accurately (76 percent), using data to create a graph for presentation to others (75 percent), and using the results of an investigation to answer the questions asked (73 percent) (Exhibit ES7).



**Exhibit ES7**  
**Science Process Inventory, Ages 13-18**

	Percent of Respondents, Ages 13-18 (n=382) Always/Usually
I can record data accurately	76
I can use data to create a graph for presentation to others	75
I can use the results of my investigation to answer the questions I asked	73
I can create a display to communicate my data and observations	71
I can analyze the results of a scientific investigation	71
I can use models to explain my results	71
I can ask a question that can be answered by collecting data	68
I can use scientific knowledge to form a question	67
I can use science terms to share my results	66
I can design a scientific procedure to answer a question	63
I can communicate a scientific procedure to others	61

Exhibit reads: Seventy-six percent of respondents ages 13-18 report that they can always or usually record data accurately.

In order to analyze responses to the science-process skills inventory, we computed two scales representing youth responses. For respondents ages 9-12, the scale ranges from zero to five where a score of zero indicates that the respondent did not report being able to do any of the listed science-process tasks and a score of five indicates that the respondent reported being able to do all of the science-process tasks. For respondents ages 13-18, a mean scale was created where youth responses were averaged across all 11 items; a response of “always” received a four and “never” received a one.<sup>13</sup>

***Educational aspirations.*** Across both age groups, youth who said they planned to pursue education beyond college rated their science-process skills more highly than those youth who said that they did not plan to complete college. Respondents ages 9-12 who want to get more education after college said “yes” to an average of 4.4 items out of 5, while youth who do not plan to complete college said “yes” to an average of 3.8 items. Youth between the ages of 13 and 18 who want to get more education after college scored an average of 3.2 out of 4 on the science-process scale, while youth who do not plan to complete college averaged a score of 2.4.

<sup>13</sup> Details about scales can be found in Appendix B.

These findings were supported in regression analyses. For younger youth, wanting to get more education after college was associated with a 0.7 point increase out of 5 points, when controlling for other significant factors ( $b=0.69$ ,  $R^2=0.11$ ).<sup>14</sup> Also, wanting to finish college was associated with an increase of 0.4 points out of five for younger youth ( $b=0.35$ ). Controlling for other significant factors, wanting to get more education after college was associated with an increase of 0.3 points out of 4 on the SET-related skills scale ( $b=0.29$ ,  $R^2=0.16$ ).<sup>15</sup> Also, not aspiring to finish college was associated with a decrease of 0.4 points ( $b=0.43$ ).

**Community type.** Youth ages 9-12 from programs located in farming communities or towns of less than 10,000 people rated their SET-related skills more highly than did youth whose programs were located in suburbs or cities of more than 50,000 people (4.3 out of 5, compared to 3.4). Regression analysis found that, controlling other significant factors, participating in a program located in a suburb or large city was associated with a decrease of 1.0 points out of 5 on younger youth's ratings of their SET skills ( $b=-0.95$ ,  $R^2=0.11$ ).<sup>16</sup>

## SET Program Environment: Key Findings

In order for out-of-school time and enrichment programs such as 4-H to be most effective, they need to create a healthy, positive program environment by employing practices that have been shown to support youth development. Like all 4-H programs, 4-H SET programs are designed to focus on youth development, on experiential learning, and on creating supportive environments for youth.

When asked to choose the three things they liked best about their SET program, 62 percent of respondents cited the opportunity to spend time with their friends (Exhibit ES8). A similar number reported that the opportunity to do hands-on activities and projects ranked among their favorite aspects of their SET program (60 percent). For 30 percent of youth, the presence of kind, caring adults was a favorite aspect of their program. In addition, 30 percent of participants said a favorite part of their program was that it is “a group where I feel like I belong.”

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<sup>14</sup> Significant predictors in this regression model were: educational aspirations, youth's exposure to SET programs, and the type of community in which their program was located. Respondents' gender, race, and involvement in clubs or afterschool did not have significant impacts on younger youth's assessment of their SET skills. Details about this regression model can be found in Exhibit E6 of Appendix E.

<sup>15</sup> Significant predictors in this regression model were: exposure to SET programs and educational aspirations. Respondents' gender, race, involvement in clubs or afterschool, and the type of community in which their SET program was located did not have significant impacts on older youth's score on the SET-related skills scale. Details about this regression model can be found in Exhibit E7 of Appendix E.

<sup>16</sup> Details about this regression model can be found in Exhibit E6 of Appendix E.

**Exhibit ES8**  
**Favorite Characteristics of this SET Program**

	<b>Percent of Respondents (n=965)</b>
I get to spend time with my friends	62
I get to do hands-on activities and projects	60
The adults are caring and kind	30
It is a group where I feel like I belong	30
I can use tools and materials here that I don't have at school or home	28
I get opportunities to demonstrate things I have learned or made in front of others	26
It is a place where I feel safe	18
I get positive feedback from adults and other kids	14
I get to do community service	14
I like the curriculum/project book	9

Exhibit reads: Sixty-two percent of respondents said that one thing they like best about coming to their 4-H SET program is that they get to spend time with their friends.

Note: Because youth could select up to three responses, percents do not add up to 100.

The survey asked youth to rate their experiences in 4-H SET on a series of items measuring the environment of their program (items adapted from: Silliman, 2008). Overall, participants surveyed gave positive reports of their program environments: 69 percent of youth said that in their program, all kinds of kids are always welcome (Exhibit ES9). More than half of youth said that the following are “always” true in their programs: that it is OK to make mistakes, that they are encouraged to take responsibility, and that they feel safe and respected.

## Exhibit ES9 Youth Assessments of Program Environment

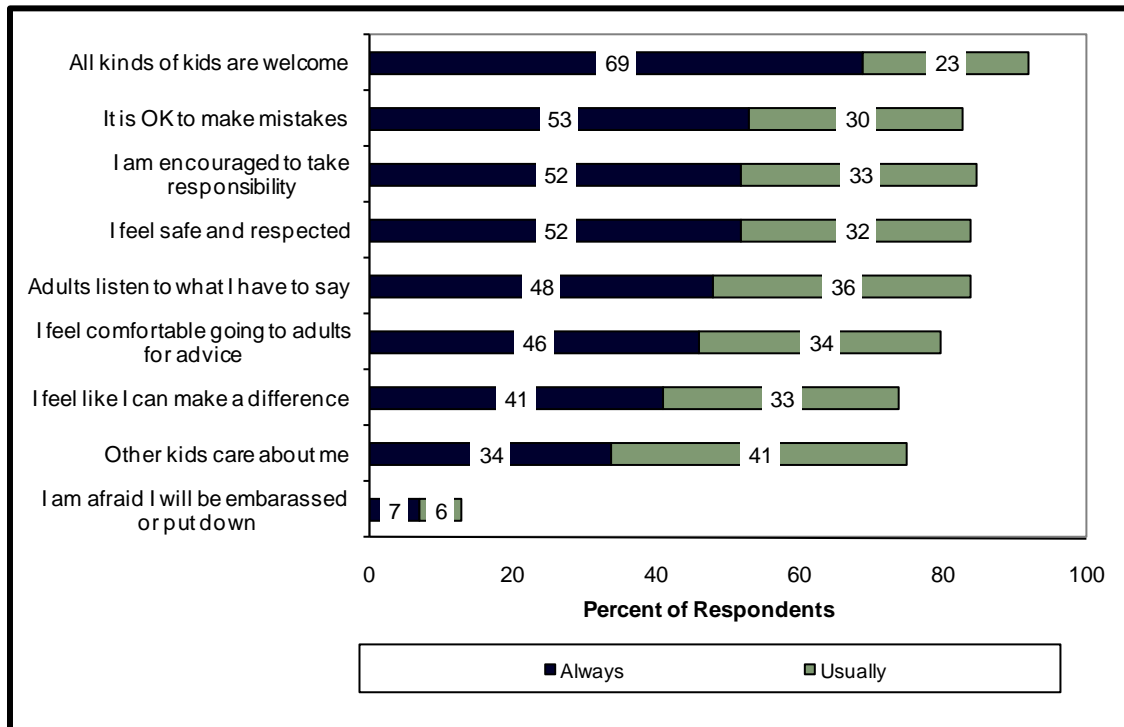


Exhibit reads: Sixty-nine percent of respondents reported that all kinds of kids are always welcome.

As stated above, participants value the opportunity their SET program gives them to spend time with friends. Almost all youth (94 percent) reported that that in their 4-H SET program, they can learn with their friends (Exhibit ES10). In addition, the vast majority of youth said that at their program they: can see science in a fun way, get answers to their questions from leaders, and do hands-on science activities.

## Exhibit ES10 Opportunities in SET Programs

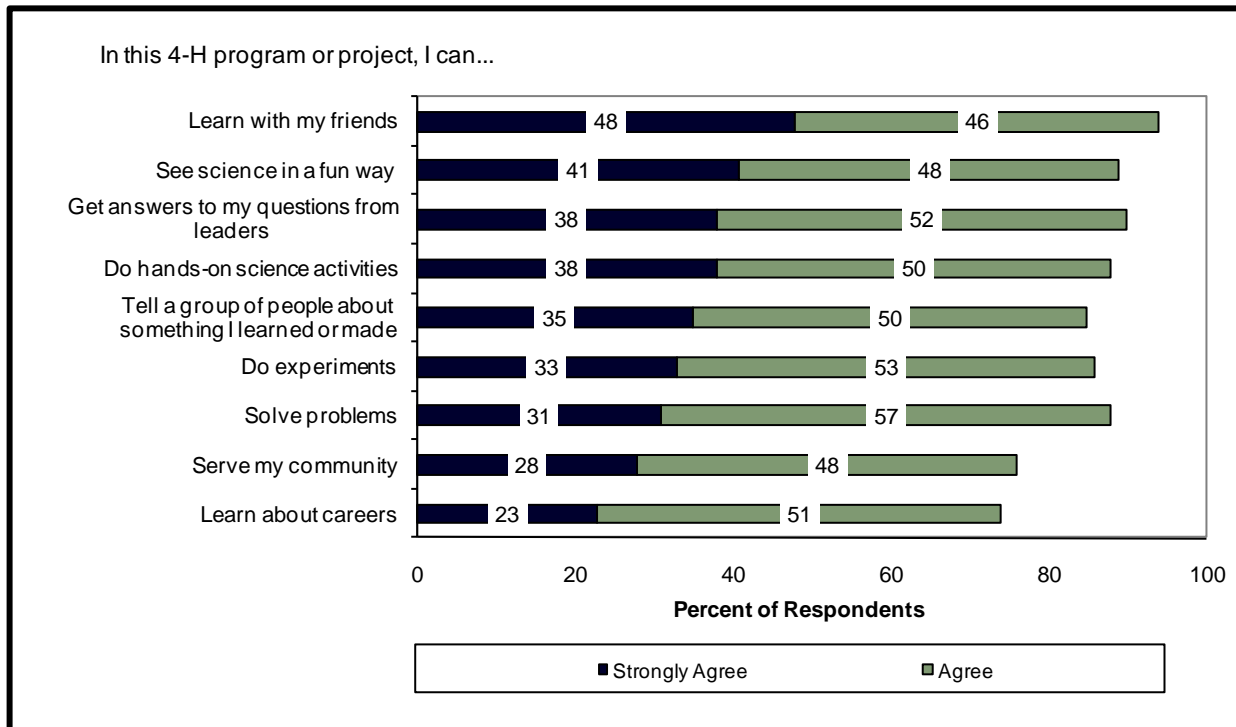


Exhibit reads: Forty-eight percent of respondents “strongly agreed” that in their SET program, they are able to learn with their friends.

In order to create an overall measure of participant evaluations of their program environment, the items shown in Exhibit ES9 above were combined into a scale in which an “always” response received four points and “never” received one point (the question “I am afraid I will be embarrassed or put down” was reverse-coded). When participant responses were combined into this scale, the average score was 3.3, indicating that respondents on the whole feel positively about their program. This scale was then used to compare how different groups of respondents rated their programs.

***Educational aspirations.*** Participant ratings of their program environment differed by their educational aspirations. The further youth said they wanted to go in school, the better, on average, they rated their program environment. Youth who said they wanted to get more education after college had an average scale score of 3.3 out of 4 on the program environment scale, compared to an average of 3.1 for youth who reported they did not aspire to finish college. Youth who said they wanted to finish college also scored higher on average (3.3 out of 4) than youth who did not. Regression analysis showed that, controlling for other significant factors, not aspiring to finish college was associated with a decrease of 0.3 points on the program

environment scale ( $b=-0.31$ ,  $R^2=0.11$ ).<sup>17</sup> Aspiring to finish college (but not get more education after college) was associated with a decrease of 0.1 points on the scale ( $b=-0.13$ ).

**Exposure to 4-H SET programming.** On average, the more time participants reported spending in their SET program, the better they rated their program's environment. Youth in the high exposure group scored an average of 3.4 out of 4 points on the program environment scale, which was better than the average rating the low exposure group gave their programs (3.2 out of 4). Youth in the moderate exposure group also tended to rate their program environment higher than did those youth in the low exposure group (3.3 out of 4). Regression analysis showed that, controlling for other significant factors, being in the high exposure group was associated with an increase of 0.1 points on the program environment scale ( $b=0.10$ ,  $R^2=0.11$ ).<sup>18</sup>

**Community type.** Youth whose programs were located in medium-sized towns or cities rated their program environment highest on average, compared to youth from programs located in large suburbs or cities, and to youth whose programs were located in farming communities or small towns. Youth in medium-sized towns or cities averaged 3.4 points out of 4 on the program environment scale, compared to 3.3 for youth in farming communities or small towns, and to 3.1 for youth in large suburbs or cities. Youth in farming communities or small towns also rated their program environments higher than did youth in large cities (3.3 compared to 3.1 out of 4). Regression analysis showed that participating in a program in a medium-sized town was associated with an increase of 0.1 points on the program environment scale (controlling for other significant factors) ( $b=0.09$ ,  $R^2=0.11$ ).<sup>19</sup>

## Conclusions

Most 4-H SET participants surveyed for this evaluation are enthusiastic about SET, have SET skills, and many are interested in pursuing SET careers. Evaluators found potentially important relationships between youth characteristics and survey responses. However, these results should be interpreted with caution as they do not imply causation.

- Youth who completed the survey participated in 4-H SET programs located in a variety of communities, from farming communities and small towns to large urban centers. Youth surveyed included a slightly higher percentage of females than males, and the majority of respondents identified themselves as white (68 percent), followed by African-American (19 percent), and Latino/a (9 percent).
- SET participants who responded to the survey reported having high educational aspirations. More than 80 percent of respondents indicated that they intend to finish college or continue to get more education after college.

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<sup>17</sup> Significant predictors in this regression model were: educational aspirations, involvement in clubs, exposure to SET programming, race, and community type. Respondents' gender and involvement in afterschool did not have significant impacts on youth's ratings of their program environment. Details about this regression model can be found in Exhibit E8 of Appendix E.

<sup>18</sup> Details about this regression model can be found in Exhibit E8 of Appendix E.

<sup>19</sup> Details about this regression model can be found in Exhibit E8 of Appendix E.

- The majority of respondents said that science was one of their favorite subjects, that they do science-related activities that are not for school work, and that they would like to have a job related to science.
- Overall, youth reported having been involved in a large number of informal SET activities in their lives. The majority of youth also reported that they had helped with a community service project related to science and more than half said that they had taught others about science.
- Participants rated themselves highly on a variety of life skills and also gave themselves high marks on an inventory of science process skills.
- Participants gave positive reports of their program environments. Their favorite aspects of their programs are the relationships they form with adults and youth and the opportunities they have to do hands-on science activities.

### **Demographic Characteristics**

- Female participants were less likely than their male counterparts to anticipate pursuing a SET-related career.
- African American respondents were more likely than their white peers to report that they take science courses only to meet requirements.
- When compared to their white peers, African American respondents reported participating in higher average numbers of science leadership activities.

### **Educational Aspirations**

- The more education youth reported wanting to pursue, the more likely they were to participate in informal SET activities and science leadership activities.
- The more education youth reported wanting to pursue, the higher youth rated their science process skills.
- The more education youth reported wanting to pursue, the better, on average, they rated their program environment.

### **Exposure to SET programming**

- Youth with higher levels of exposure to their SET programs were more likely to report wanting to pursue a job in science than were youth with less exposure. Youth whose interest in SET has been sparked may be more likely to spend time

in a SET program, or SET programs may be affecting participants' career aspirations.

- Youth with higher levels of exposure to their SET programs participated, on average, in a greater number of informal SET activities than youth with less exposure to their programs.
- Youth with higher levels of exposure to their SET programs rated their life skills higher than did youth in the low exposure group.
- The more time youth reported spending in their SET program, the higher they rated their program's environment.

### **Involvement in 4-H Clubs**

- Youth involved in clubs rated their life skills higher than did youth who were not involved in clubs.
- Youth involved in clubs reported being involved in more informal SET activities than youth who were not involved in clubs. It could be true that youth involved in clubs are already interested in pursuing science learning opportunities before they enroll in their 4-H SET program, or it could be that involvement in clubs inspires youth to explore science, engineering, and technology in their lives outside of 4-H.

### **Community Type**

- Youth in programs located in farming communities, small towns, and medium-sized cities participated in more informal SET activities than youth in programs located in suburbs or large cities.
- Youth in programs located in farming communities or small towns rated their science process skills more highly than other youth.
- Youth in programs located in medium-sized towns or cities rated their program environment highest on average, compared to youth from programs in large cities and farming communities or small towns.



## Recommendations

- The difference in SET career aspirations found in this study based on gender is in agreement with other research showing that eighth-grade girls were less likely to indicate interest in a mathematics- or science-related career than were boys with similar levels of achievement, attitudes toward their mathematics class, and family background (Catsambis, 1994). 4-H SET programs are uniquely poised to encourage girls who have expressed interest in SET fields by enrolling in SET programs to further pursue education and career opportunities.
- The differences between white and African American respondents' reasons for pursuing science courses reflect other research showing that students of color are still less likely to take advanced science courses than their white counterparts. Data from the National Center for Education Statistics (NCES) show that the number of high school youth completing higher level mathematics and science courses has increased over the past 20 years; however, there are continuing disparities by race, especially at the highest course levels. A 2007 analysis of NCES data revealed that there were significantly fewer African American and Latino/a students taking advanced mathematics and science classes than white and Asian American students.

Because 4-H SET programs offer informal, out-of-school opportunities for youth to engage in SET content, 4-H is well positioned to help generate genuine interest and excitement among African American youth that can help shape their interests in pursuing SET education and careers.

- Research suggests that career aspirations are often solidified in early adolescence (Kerka, 1994). In order to ensure that 4-H SET participants consider pursuing careers in the SET fields, SET programming should include ample opportunities for youth to not only learn about careers in the SET fields, but also about the educational trajectories that they must follow in order to successfully pursue these careers.
- By providing engaging out-of-school programming, 4-H SET programs have the potential to bolster participants' interest in pursuing education and careers in the SET fields. Continuing to encourage 4-H SET programs to employ best practices will help ensure that programs inspire life-long interest in SET among all participants.
- For many of the youth in this study, the opportunity to do hands-on learning activities formed a major part of their attraction to 4-H. 4-H has the potential to positively impact youth's interest in SET by giving them the opportunity to learn about the SET fields in a hands-on manner. SET programs, regardless of delivery method, should be set up to provide active learning opportunities for youth. 4-H may want to consider how youth-centered SET programming could best be implemented using various delivery methods.

- In addition to the opportunity to participate in hands-on learning activities, SET participants reported that the relationships they have with other youth and with adults in their programs are important to them. By fostering healthy, supportive relationships among youth and between youth and adults, programs lay the groundwork for engaging youth in SET.
- Since the types of communities in which respondents' SET programs were located were associated with different youth responses to survey measures, 4-H may want to examine the types of programming being offered in different communities to ensure that 4-H's flagship delivery methods are available to all participants.
- Data on youth participation in SET programs, as well as data on program implementation, would enhance the power of the evaluation and allow evaluators to tie youth outcomes directly to participation in SET programs.

## References

- Arnold, M. E., & Bourdeau, V. D. (2009). *The Science Process Skills Inventory (SPSI)*. Corvallis, OR: Oregon State University 4-H Youth Development.
- Behrman, R.E. (Ed). (1997). Children and poverty. *The Future of Children*, 7(2).
- Borland, J.H. (2004). *Issues and practices in the identification and education of gifted students from under-represented groups* (RM04186). Storrs, CT: The National Research Center on the Gifted and Talented.
- Catsambis, S. (1994). The path to math: Gender and racial-ethnic differences in mathematics participation from middle school to high school. *Sociology of Education*, 67, 199-215.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (Second Edition). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Dryfoos, J.G. (1998). *Safe passage: Making it through adolescence in a risky society*. New York: Oxford.
- Eccles, J.S., & Gootman, J.A. (Eds.). (2002). *Community programs to promote youth development*. Washington, DC: National Academies Press.
- Field, A. (2005). *Discovering statistics using SPSS*. London, England: SAGE Publications Inc.
- Hechinger, F.M. (1992). *Fateful choices: Healthy youth for the 21<sup>st</sup> century*. New York: Carnegie Corporation of New York.
- Kerka, S. (1994). *Self-directed learning, myths and realities* (ED 365 818). Columbus: ERIC Clearinghouse on Adult, Career, and Vocational Education.
- Larson, R.W. (2000). Toward a psychology of positive youth development. *American Psychologist*, 55(1), 170-183.
- Lerner, R.M. (1998). Theories of human development: Contemporary perspectives. In W. Damon (Series Ed.) & R.M. Lerner (Vol. Ed.), *Handbook of child psychology: Vol. 1. Theoretical models of human development* (Fifth Edition., pp. 1-24). New York: Wiley.
- Lipsey, M. (1990). *Design sensitivity: Statistical power for experimental research*. Newbury Park, CA: Sage.
- Mahoney, J.L., Lord, H., & Carryl, E. (2005). An ecological analysis of after-school program participation and the development of academic performance and motivational attributes for disadvantaged children. *Child Development*, 76(4), 911-925.

- McDonald, J.L. & Jessell, J.C. (1992, Summer). Influence of selected variables on occupational attitudes and perceived occupational abilities of young adolescents (EJ445 435). *Journal of Career Development, 18*(4), 239-250.
- McLaughlin, M.W. (2000). *Community counts: How youth organizations matter for youth development*. Washington, DC: Public Education Network.
- Perkins, D. F., & Mincemoyer, C. C. (2002). *Skills for Everyday Living*. University Park, PA: The Pennsylvania State University.
- Silliman, B. (2008). *Youth program climate survey*. Raleigh, NC: North Carolina Cooperative Extension Service.
- Silliman, B. (2010). *Participation in science leadership survey*. Raleigh, NC: North Carolina Cooperative Extension Service.
- Tai, R.H., Liu, C.Q., Maltese, A.V., & Fan, X. (2006). Planning early for careers in science. *Science, 312*.