“These young people are our future scientists, politicians and other leaders. We want to make sure that all youth, not only youth that are in traditional rural communities, but urban communities as well, have this background in order to make sound decisions affecting how we raise our food.”

- Laura Foell, United Soybean Board Biotech Initiative
PROJECT DESCRIPTION

Overview
Today, many young people are generationally and geographically removed from farming and agriculture. Yet, it is vital that these young leaders and future decision makers understand the critical role of agricultural science innovation in addressing the world’s most pressing problems. 4-H, with more than 1.4 million urban participants, is uniquely positioned to reach new and underserved urban youth audiences. 4-H has systems and the infrastructure in place to share promising practices and strategies that can engage and excite urban teens about AgriScience and biotechnology. These tactics will lay a foundation for increased outreach and impact with urban youth audiences.

National 4-H Council in partnership with the United Soybean Board (USB) and five Land Grant Universities conducted four AgriScience/biotechnology demonstration programs in ten urban areas of Delaware, Illinois, Indiana, Missouri, and Ohio. These programs are part of the larger 4-H Science in Urban Communities Initiative, and were designed using the 4-H Science in Urban Communities Promising Practices Guide available at http://urban4hscience.rutgers.edu.

Objectives
- Each demonstration program will include a leadership team composed of four Teen Leaders, at least one 4-H Program professional, and at least one AgriScience/biotechnology partner from their state soybean board, industry, and/or their Land Grant University.
- All leadership team members will attend the project kickoff/grantee training, January 11-14, 2012 in Indianapolis, Indiana.
- The project will engage a total of 80 urban teens and 400 younger youth participants with biotechnology education in order to identify promising practices for future replication with expanded urban audiences.
  * Eighty urban teens will be recruited and extensively trained to deliver the program for youth in afterschool, club, and summer/camp programs.
  * Eighty urban teens will exhibit increases/gains in the dimensions evaluated by the Youth, Engagement, Attitudes and Knowledge Survey (YEAK), and a content specific Knowledge Assessment.

Concepts
Agricultural Literacy
Agricultural Products (how and where produced)
Plants and People—Food, Feed, Fuel, Fiber
Seed Production
Yield and Yield Trends; Factors Influencing Yield

Challenges for Agriculture
Global Food Security
Sustainability

Introduction to Agricultural Biotechnology
Definition and Historical Perspective
Input and Output Traits
Types of Biotech Crops (and how they work)
Regulation of Biotechnology
Public Concerns Regarding Biotechnology
International Perspective

Science of Biotechnology
Cell Biology, DNA, Genetics
Genetic Engineering
Tools and Techniques
AgriScience/Biotechnology Career Awareness

National Kickoff Training
The Kickoff Training was a four-day program held in Indianapolis, Indiana for 16 Teen Leaders and 16 adults serving on state leadership teams. Program kickoff partners included USB, the Indiana Soybean Alliance (new uses, communicating the biotech story, and a panel of Purdue students and faculty from the Soybean Innovation Contest), Purdue University (Biotechnology 101, DNA extraction and sequencing activities), Beck’s Hybrids (seed production, input and output traits, trait testing activity, tour), Dow AgroSciences (biotechnology and global food security, product pipeline, tour), and Adayana, Inc. (GetBiotechSmart.com). In addition to presentations and tours from our partners, the youth also experienced several activities and practiced teaching these activities on the last day.

“When I first started I didn’t even know what biotechnology was, and now I have a sense of what it is and how it is used in everyday life.”

-Indiana 4-H Teen Teacher
**DELAWARE**  
Program Director—Kristin Cook, University of Delaware Extension; kristin@udel.edu  
Claymont, Dover, Hartly, and Wilmington, Delaware

Delaware 4-H partnered with Boys and Girls Club in Clayton, the Delaware Housing Authority in Dover, Urban Promise in Wilmington, and a local school to deliver four agricultural biotechnology summer camps from June through August. Their content rich partners included the Delaware Biotechnology Institute; Dr. Richard Taylor, a University of Delaware agronomist; and Jesse Vanderwende of the Delaware Soybean Board. In addition to hosting part of the teen training, the Delaware Biotechnology Institute opened their labs and provided activities for the youth camp participants. The Delaware team also incorporated several of the biotech activities into their annual science adventure camp.

**ILLINOIS/MISSOURI (a partnership)**  
Program Director—Steve Wagoner, University of Illinois Extension; wagoners@illinois.edu  
Cahokia and Madison, Illinois; Kansas City and St. Louis, Missouri

Illinois and Missouri 4-H programs joined forces to implement nine 20-hour programs with afterschool, camp, and summer school partners in the greater St. Louis and Kansas City areas. From the beginning, they benefitted from the expertise of Dr. Terry Woodford-Thomas of the Danforth Plant Science Center who hosted a planning retreat and the weekend teen training. She also assisted with activities and mentoring the Teen Teachers. The teenagers also incorporated agricultural biotechnology activities into the Missouri State 4-H Congress in May and the Youth Futures Conference in July. The program was presented to afterschool professionals at the Midwest Regional Science Conference.

**INDIANA**  
Program Director—Stephanie Femrite, Purdue University Extension; sfemrite@purdue.edu  
Columbus and Lafayette, Indiana

Two county 4-H educators partnered to deliver the program in afterschool sites in Columbus and Lafayette. They also incorporated the agricultural biotechnology content into two three-day campus-based summer camps in June, Purdue 4-H Roundup and one of the Purdue 4-H Science Workshops (PINE—Plants, Insects, Natural Resources, Environment). Dr. Kathryn Orvis, State 4-H Specialist, served as the primary content partner, lending her background in plant science and biotechnology education to the Indiana team. Dr. Orvis was instrumental in training the Teen Teachers and in engaging other content rich partners such as the Biotechnology Learning Center of the Children’s Museum of Indianapolis.

**OHIO**  
Program Director—Nate Arnett, Ohio State University Extension; arnett.67@osu.edu  
Dayton, Ohio

The Teen Leaders conducted a pilot of the program at a partnering afterschool site in Dayton, Ohio from February to April before recruiting and training the rest of the teens to deliver the program as part of the six-week Adventure Central summer camp in June and July for 111 youth. The agricultural biotechnology training was incorporated into the weeklong teen counselor training prior to camp. In addition to the camp-based programming, the Ohio 4-H team partnered with the Ohio Soybean Council and the Ohio BioProducts Innovation Center to coordinate a day trip to The Ohio State University to meet with faculty from Food Science, Horticulture and Crop Science, and Agricultural Engineering.

*All leadership teams (teens and staff) traveled to Washington DC in April to represent National 4-H and this project at the USA Science and Engineering Festival—the largest celebration of science in the US, featuring over 500 interactive exhibits for approximately 500,000 people. In addition to their time in the 4-H booth, the teens participated in activities from a variety of universities, federal agencies, and science centers.*
**PROJECT REACH**

Reach and Demographics

- A total of eighteen 20-hour programs were implemented by the trained teenagers.
- 82 teenagers, an average of 20.5 per demonstration program, were trained as Teen Teachers.
  * 49% of the Teen Teachers were African American, 48% White, and 3% Other (American Indian, Asian). 4% were Hispanic. 60% were female.
  * This program was the first experience with 4-H for 45% of the teens. 47% had participated in 4-H for three or more years.
  * 76% were from urban or metropolitan areas.
- 620 youth were taught by the Teen Teachers, an average of 155 per demonstration program.
  * 71% of the youth were African American, 27% White, and 2% Other (American Indian, Asian, Pacific Islander). 10% were Hispanic. 53% were female.
  * 85% were from urban or metropolitan areas.
- 800 additional youth were reached at the USA Science and Engineering Festival in Washington, DC (April 2012). Leadership teams from the four demonstration programs led a DNA Extraction activity for participants.

**EVALUATION**

Teen Leaders (teens who attended the National Kickoff Training and were responsible for planning and implementing state trainings and who also served as Teen Teachers) and Teen Teachers were evaluated using multiple instruments and multiple administrations. Instruments included the Youth Engagement, Attitudes, and Knowledge Survey (YEAK), a content-based Knowledge Assessment, a Retrospective Assessment, and several open-ended questions.

Youth Engagement, Attitudes, and Knowledge Survey (YEAK)

- YEAK was administered to the Teen Teachers before training (pre-survey) and again after completing their teaching responsibilities (post-survey). 49 teens returned both the pre- and post-survey.
- For selected results in science and life skills, see Table.
- The post-survey asked teens to select three things (from a list of 10 items) they liked best about the program as a measure of their opinions of the program environment.
  * 67% liked the opportunity to do hands-on activities and projects.
  * 47% liked the opportunity to demonstrate what they have learned in front of others.
  * 41% liked that adult staff, leaders, and volunteers were kind and caring.

“It is more fun to work with children and teach it [AgriScience/biotechnology] than to learn out of a textbook.” -Illinois 4-H Teen Teacher

<table>
<thead>
<tr>
<th>Residence of Youth Taught</th>
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<tbody>
<tr>
<td>Farm</td>
</tr>
<tr>
<td>Town&lt;10K</td>
</tr>
<tr>
<td>Town 10-50K</td>
</tr>
<tr>
<td>Urban/Metro&gt;50K</td>
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</tbody>
</table>

| Residence of Youth Taught | 85% |

Reach At-A-Glance

<table>
<thead>
<tr>
<th>Achieved</th>
<th>Item</th>
<th>Grant Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Demonstration Programs in 5 States: Delaware, Illinois/Missouri (partnership), Indiana, Ohio</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>Urban Areas</td>
<td>4</td>
</tr>
<tr>
<td>16</td>
<td>Teen Leaders</td>
<td>16</td>
</tr>
<tr>
<td>18</td>
<td>Out-of-School Time Sites/Programs</td>
<td>8</td>
</tr>
<tr>
<td>82</td>
<td>Teen Teachers (including Teen Leaders)</td>
<td>80</td>
</tr>
<tr>
<td>620</td>
<td>Youth Participants</td>
<td>400</td>
</tr>
</tbody>
</table>

YEAK Survey Results (selected)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>SCIENCE SKILLS</th>
<th>Increased Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can analyze the results of a scientific investigation.</td>
<td>51%</td>
<td></td>
</tr>
<tr>
<td>I can communicate a scientific procedure to others.</td>
<td>45%</td>
<td></td>
</tr>
<tr>
<td>I can use science terms to share my results.</td>
<td>43%</td>
<td></td>
</tr>
<tr>
<td>I can design a scientific procedure to answer a question.</td>
<td>41%</td>
<td></td>
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<table>
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<tr>
<th>LIFE SKILLS</th>
<th>Increased Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>When solving a problem I compare each possible solution with others to find the best one.</td>
<td>45%</td>
</tr>
<tr>
<td>I compare ideas when thinking about a topic.</td>
<td>38%</td>
</tr>
</tbody>
</table>
Knowledge Assessment

- A 29-item (36 points) Knowledge Assessment was administered to the Teen Teachers and Leaders (the teens who attended the National Kick-off Training and were responsible for planning and implementing state trainings and who also served as Teen Teachers).
- The assessment was given three times, pre-training (n=73), post-training (n=72), and post-teaching (n=40).
- The assessment included items on genetics, the science of biotechnology, input and output traits, types of biotechnology crops, biotechnology benefits and concerns, and biotechnology regulation.
- Question formats included multiple choice, matching, true/false, and short answer.
- On average, teens demonstrated statistically significant ($p < 0.05$) improvements in knowledge over the course of the project (see Graph).

Skills and Abilities

- A 7-item Retrospective Assessment was administered twice to Teen Teachers, after training and again after teaching.
- The response set included strongly disagree, disagree, agree, and strongly agree.
- Items asked teens about their:
  * Understanding of the science of biotechnology,
  * Confidence in program development and implementation (see Graph),
  * Awareness of careers in biotechnology, and
  * Awareness of the many opportunities to engage content rich partners in programming.
- Analyses of both administrations (n=39 pairs) indicated statistically significant ($p < 0.05$) improvements across all items.

Open-Ended Questions

- Teen Teachers were asked to provide responses to several open-ended questions in the pre- and post-assessments.
- What are the three (3) most valuable things you learned about biotechnology this week (see Table)?
- What was the most valuable part of this training?
  * Learning about project content and how to teach it
  * Interacting with a variety of people involved in biotechnology and visiting their work places
  * Gaining confidence to speak in front of others
  * The experience of working together as a team
- What was the most valuable part of this biotechnology program experience?
  * Learning about agriculture and biotechnology
  * The experience of teaching
  * Meeting so many new people
  * Life/job experience (e.g., leadership, teamwork)

Most Valuable Things Learned About Biotech

- **Breadth of Biotechnology** (it’s everywhere, used beyond farming, in the supermarkets, affects our lives every day)
- **Bio-products** (soybeans are a huge part of many things we use daily, lots of alternatives to crude oil, bio-plastics are eco-friendly, can use soybeans to make common products)
- **Food Security** (can produce more food for a growing population)
- **Science of Biotechnology** (cells, DNA, genetics)
- **Application of Biotechnology** (biotech traits, longer shelf life, can drastically improve a plant’s genetic traits, make plants healthier)
- **Careers in Biotechnology** (a rapidly growing field, opportunities are limitless, many different scientists for this field, there are many careers to choose from that involve biotechnology)
PROMISING PRACTICES

The four Demonstration Programs developed and implemented their programs according to principles outlined in the 4-H Science in Urban Communities Promising Practices Guide (http://urban4hscience.rutgers.edu). When asked to identify five “Promising Practices” for this project, Program Directors considered the following items especially important.

4-H Science Core Principles and Program Design
- Teen Involvement in Program Design. Teen leaders must be intimately involved in all aspects of program planning, curriculum development, training, and teaching.
- Frequency and Duration. Afterschool and summer programs should meet for a minimum of 20 hours to allow adequate time for youth to master basic concepts.
- Partnering with Afterschool and Summer Program Providers
  - Roles and Responsibilities. Partnership agreements should clearly outline all roles, requirements, and expectations.
- Partnering with Content Rich Partners
  - Colleges and Universities. Faculty, staff, and students can serve as content rich volunteers for training, activities, supplies, and getting youth on campus. Utilize University resources (research, curricula, labs, etc.).
  - Science Centers and Museums. These institutions have resources to assist with field trips, training, and activities.
- Content Rich Volunteers. Include representatives from science/agricultural related businesses/institutions and commodity groups on the leadership team. They can also provide assistance with program implementation.

Staffing with Teenagers and Teens as Cross-Age Teachers
- Recruitment. Develop a detailed position description including expectations and time commitment required.
- Training. Provide quality training for teens. Include adequate time to practice and reflect upon all lessons.
- Program Implementation. Create teaching teams to provide support and accountability.
- Make Role Special. Provide customized t-shirts so teens will stand out and to foster a sense of inclusiveness.

RECOMMENDATIONS

1. Curriculum. While the programs drew from a collection of sources such as AgriScience Online (4-H.org/AgriScience) and the Iowa State University Office of Biotechnology (biotech.iastate.edu/outreach.html), development of a unified curriculum is strongly recommended.
   - The scope and sequence of activities should be developed based on gaps in resources currently available.
   - Activities must be specifically developed for delivery by Teen Teachers.
   - The AgriScience component of the curriculum must be emphasized before biotechnology concepts.
   - A strong international perspective (production challenges, world hunger, etc.) is vital for youth to develop a global view of food production and utilization.

2. Recruitment and Training. The Teen Leaders exhibited stronger gains on the Knowledge Assessment than Teen Teachers. Recommendations are based on the several possible reasons for this outcome.
   - The same care and focus used when recruiting Teen Leaders should be taken in recruiting Teen Teachers.
   - The state level training for Teen Teachers should mirror the duration and scope of the National Training, including emphasis on participation by content rich partners.

3. Scale. The success of this project clearly demonstrates the potential impact of this type of programming. Expansion of the project is recommended to reach additional states. A 3-year commitment in order to help states achieve sustainability would be ideal.

“We really think that this grant . . . has rejuvenated our science programming . . .”
—Kristin Cook, Delaware Extension Agent

For more information contact the Project Director. Chad Ripberger, Rutgers Cooperative Extension at ripberger@njaes.rutgers.edu. Special acknowledge to Lydia B. Blalock, Ph.D., for assistance with program development and evaluation, and to Policy Studies Associates for administration and analysis of the YEAK survey.