



new faces, new places

A 4-H Science Learning Program in Urban Out-of-School Settings

by Walter A. Barker, Eric Killian, and William P. Evans

Young people in the U.S. are falling behind their peers in the rest of the developed world in science, technology, engineering, and math. The Program for International Student Assessment study, conducted every three years, ranked the U.S. 24th in math and science out of 29 countries in the Organization for Economic Cooperation and Development (Baldi et al., 2007).

Out-of-school time programs can support young people in learning science, technology, engineering, and math (STEM) concepts and skills. A decade of research and evaluations (National Institute on Out-of-School Time, 2009) provides strong evidence that afterschool programs make a difference in the lives of youth who attend.

4-H—one of the oldest and largest out-of-school youth development programs in the country—can make a unique contribution. Its roots in the national land-grant university system give 4-H substantial experience in developing hands-on STEM programming that engages young people. Moving beyond its rural and agricultural roots, 4-H is tak-

ing this expertise into urban settings. A twelve-week introductory science program piloted by University of Nevada Cooperative Extension 4-H Youth Development in three Nevada cities illustrates how 4-H's experiential learning model can engage urban youth in science learning.

The 4-H Model of Experiential Learning

4-H is sponsored by cooperative extension programs in land-grant universities located in every state of the nation. The original mission of these institutions was to teach agri-

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culture, military tactics, and mechanical arts, as well as classical studies, so that members of the working classes could obtain a liberal and practical education. Today's land-grant universities continue to be open and accessible to the public. Their 4-H youth programs, which are available in nearly every county in the nation, provide opportunities to millions of young people (Washington State University Extension, 2009).

4-H is the largest out-of-school youth development program in the U.S., with over 7 million members and 500,000 teen and adult volunteers (4-H National Headquarters, 2009). It is also one of the oldest, having begun between 1890 and 1900 (Iowa State University, 2009). 4-H has a track record of providing a variety of positive youth outcomes, including personal and life skills development as well as career development (Arnold, 2004; Hendrick, Homan, & Dick, 2009; Rockwell, Stohler, & Rudman, 1984). The program started in order to provide youth in rural areas with knowledge in agriculture and other practical areas as well as with life skills and support for career goals. Today, 4-H's innovation, creativity, and diversity of programs can foster the development of capable young people not only in rural areas but also in cities and towns.

The 4 "H"s of the organization's name are:

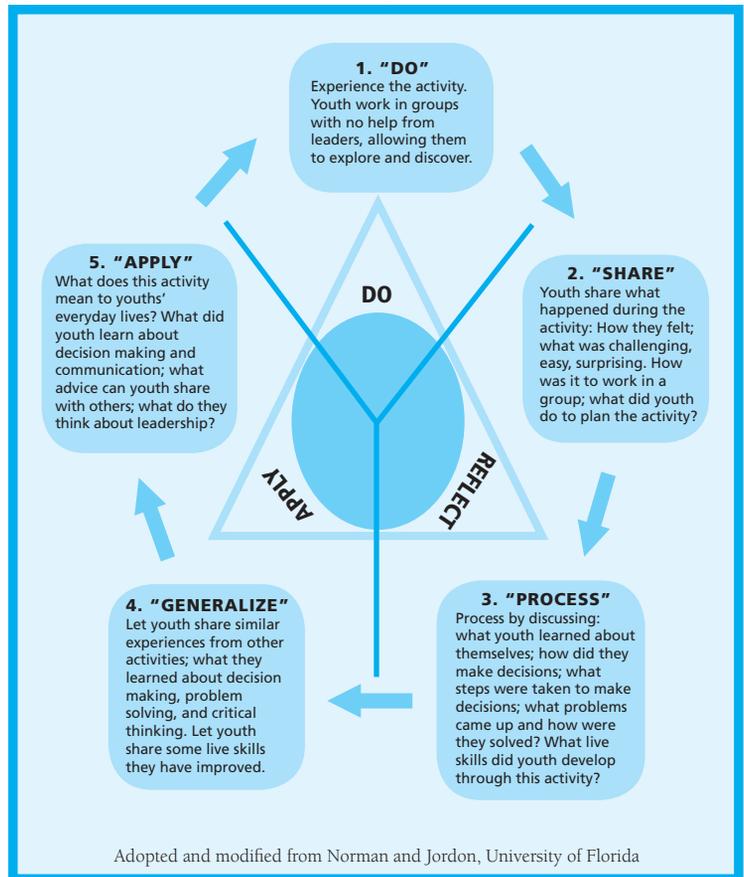
- Head: cognition, critical thinking
- Heart: emotional well-being, self-discipline, integrity, communication
- Hands: social development, citizenship, service to others
- Health: physical capability, healthy lifestyle

Teaching in 4-H uses a model of hands-on experiential learning, illustrated in Figure 1.

- **Do.** Participants use all their senses to experience an activity. This process leaves lasting memories of their involvement.
- **Reflect.** Participants look back on their experience critically and share it with others. They describe, discuss, and share concrete examples of problems encountered in the first phase and the ways they overcame them.
- **Apply.** Participants generalize (*so what?*) and apply what they have learned (*now what?*) to similar situations.

The greatest benefits of the 4-H model come from cooperative learning, when members work together in a small group to achieve a common goal. Youth and adults work together in partnership. Hands-on involvement ensures that each participant is connected to the activity and engaged in the task. In addition to developing life skills, participants gain knowledge and often find reasons to ad-

Figure 1. 4-H's experiential learning model (Norman & Jordan, 1999)



just their attitudes. A focus on fun is paramount. Because of this emphasis, the youth tend not to think of 4-H learning activities as being similar to school classes.

The 4-H program is delivered in various settings including afterschool programs, community clubs, overnight and day camps, and school enrichment programs. Its project activities can be customized to meet the needs of various audiences.

The 4-H Science and Technology Program

In response to a national critical need to encourage youth to engage in science, University of Nevada Cooperative Extension 4-H Youth Development (UNCE4-HYD) developed a 12-week program called "New Faces, New Places: An Introduction to Science, Technology, Engineering, and Math." This program was a recruitment tool that would allow graduates to form new 4-H STEM programs similar to 4-H special interest clubs.

The mission of the UNCE4-HYD is to provide educational strategies and opportunities for youth to develop life skills that will help them to become healthy, self-directing, and contributing members of society. In 2006–2007, UNCE4-HYD was engaged in several afterschool programs with the cities of Las Vegas, Henderson, and Logandale—with remarkable success. In 2008, UNCE4-HYD brought together 12 youth development organizations—including

local schools, Boy Scouts, faith-based organizations, youth members from surrounding 4-H clubs, and UNCE faculty and staff—to participate in a needs assessment. A key outcome was the formation of a partnership among the groups that prioritized areas for youth programming and provided an opportunity for collaboration.

The main priority in terms of content was STEM learning. Participating groups agreed that UNCE4-HYD, because of its long history and expertise, would provide educational programming, curricula, and training and development for site volunteers. The collaborating agencies' responsibilities were to organize the youth and to provide volunteers and locations for program delivery. The agencies were new to 4-H, and their leaders were excited to partner with 4-H. These new outlets also expanded the opportunities for 4-H programming to reach more urban youth.

New Faces, New Places was a direct response to the Program for International Student Assessment study (Baldi et al., 2007) evaluation. Its STEM educational components are:

- Science: basic scientific concepts, plant and animal science, nutrition
- Technology: computer simulation on geospatial information systems (GIS) and global positioning systems (GPS), robotics
- Engineering: construction of robots and rockets
- Math: measurements and calculations required by activities throughout the program

The program goals were to enhance participants' acquisition of scientific knowledge; develop skills such as critical thinking, problem solving, decision making, and teamwork; and create positive attitudes toward science. The program built on 4-H's experience in STEM programming while modifying its basic activities for urban participants. For example, "butter making" is an activity in the 4-H animal science program. It was renamed "chemical reactions" in the basic science sessions of New Faces, New Places. Participants learned about chemical reactions by observing what happens in the butter-making process: After rapid shaking in a closed container, milk cream turns solid because of the accumulation of fat. Continued shaking brings it back to a liquid state and then separates the whey and produces butter, a solid.

Program Description

New Faces, New Places was delivered after school at 15 sites, each with 40 youth ages 8–15. Sites included community clubs, school sites, community centers, faith-based organizations, and day and overnight camps in

Table 1. New Faces, New Places Sessions and Content

PROGRAM SESSION	CONTENT
1. What Is 4-H?	4-H youth development, the 4 Hs (see page XX)
2. Dr. Germ	Importance of hand washing for a healthy lifestyle
3. Healthy Nutrition	Food selection, preparation of a fruit smoothie
4. Plant Science	Plants and their relationship to the environment, types of trees
5. Animal Sciences	Animals and the environment, activity with small animals
6. Basic Science	Simple chemical reactions
7. Space Science	Rocketry, robotics, geospatial information system (GIS) and global positioning system (GPS)
8. Plant Science	Properties of wood
9. My First 4-H Project	Making a wooden key holder
10. 4-H Clubs	What 4-H is, how to belong, benefits
11. So You Want to Start a 4-H STEM Club?	Logistics of beginning a 4-H club to build mastery and life skills

three cities: Las Vegas, Henderson, and Logandale. The program was conducted twice a week for 12 weeks.

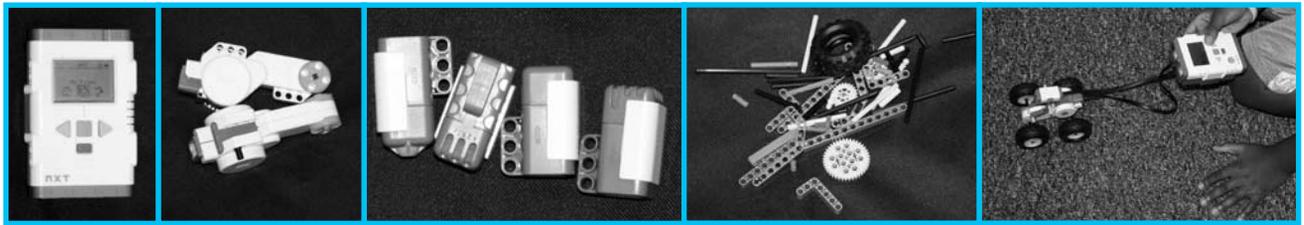
Activities in New Faces, New Places were designed to engage youth in enjoyable, concrete projects that would pique future interest in 4-H and STEM learning. The curriculum that guided the program (Barker, Leas, & Sanders, 2008) is illustrated in Table 1. Every session included one or more hands-on activities.

The Experiential Learning Model in Action

Learning in New Faces, New Places incorporated 4-H's experiential model. For example, in the robotics session, a set of activities introduced engineering and the construction of robots. The session began with knowledge building: Participants played a bingo-like game, SciPhi-O, in which they learned the robotic parts.

The **Do** segment involved planning, constructing, and testing a simple robot using parts from Lego Mindstorms kits (see Figure 2). Participants were divided into groups of ten. Each group received the same instructions, reproduced in the box "Robotics Scenario." Groups were given two hours to build their robots. The main

Figure 2. Lego Mindstorms parts for a simple robot



parts, a processor “brick” and motor, were provided to each group; groups had to “purchase” the additional pieces and sensors they would use to build their robots. Once parts were purchased, they could not be returned or swapped with other groups. To ensure that they worked as a team, participants were not allowed help from outside their groups.

The **Reflect** segment enabled participants to discuss and analyze their experiences. Specific questions guided the discussion: What happened? What did you see, hear, touch? How did you feel? What was the most difficult or the easiest? What problems or issues seemed to occur over and over? What similar experiences have you had? How did your group solve the challenges?

The **Apply** segment also was guided by specific questions. For example, “What did you learn about yourself?” encouraged critical thinking and decision making. “What did you learn about working in a group?” enabled participants to reflect on their teamwork and problem-solving strategies. “How will you react in the future as a result of this activity?” helped participants apply what they had learned.

ROBOTICS SCENARIO

An office has been contaminated with a radioactive material. No one can enter the office because of this material. Your group is one of several groups contacted to design and build a robot to clean the office of all contaminants. The most creative robot at the lowest production cost will be selected for this job. To finance the project, Clark County 4-H Financial Bank, Inc., will donate to each group \$1,000 as a start for the project. Groups can borrow, in addition to the \$1,000, any amount that will help to complete their project.

All completed and/or submitted robots will be judged according to the group’s robot plan. This means that the robot will have to perform the work as designed by the robot’s plan. The group with the winning robot will receive a \$10,000 prize.

Site Leader Training

The training of the volunteer program leaders at each site was crucial to the success of New Faces, New Places. These leaders were typically associated with the nonprofit partner organization that was hosting the UNCE4-HYD program. For the safety of participants, a background check was conducted on each site leader.

All leaders received eight hours of training in program delivery and class management. The content included instruction and activities on ages and stages of youth development in order to develop leaders’ understanding of the behavior and characteristics of youth ages 8–15—and how to deal with these behaviors and characteristics. Site leaders learned to distinguish a program, an activity, and a project in the 4-H youth development model. They learned critical elements of youth development (Kress, 2004) that are necessary for youths’ safety and positive learning.

The experiential learning model of Do, Reflect, and Apply occupied most of the leader training time. Site leaders experienced the model and had to demonstrate their ability to use it. At the end of the training, they learned to evaluate progress toward the program’s goals and objectives.

Data Collection and Analysis

This article summarizes the findings of the evaluation of the first round of New Faces, New Places. Both quantitative and qualitative data were collected. A 31-item evaluation Likert scale instrument was developed to measure program outcomes pre- and post-participation. Data were collected using an on-site program PowerPoint evaluation survey using the PRS (Personal Response System) RF “clickers” and Interwrite personal response software (Penn State Information Technology Service, 2009).

Leader Reactions

Between 2006 and 2009, leader training made it possible to increase the number of afterschool clubs. Using the PRS system, 88 percent of the site leaders gave a positive rating for the training. The PRS system itself received a high rating. Leaders’ reflections reveal the importance of the training:

[I] never thought of the importance of risk management before now. Wish we could have more of this type of training.

I will keep some of the ideas I have learned; it gives me a greater understanding about youth development. What I have learned about youth development is that there is a lot to know; it will help me to be a little more understanding about kids.

The meaning of the 4-Hs, first time I heard and learned what it means. The most important thing I have learned is understanding the ages and stages of youth.

A special comment came from a volunteer who had been with the Clark County 4-H for more than six years:

Compared to five years ago, these trainings have been more effective in helping us with 4-H. You have made a great difference with the program. After so many years working with 4-H, I now really know what 4-H means.

One site leader commented on the content of the youth program itself:

[I] wish we had this when we were in school—never heard about 4-H and Extension.

Participant Reactions

Use of the PRS system improved the accuracy and response rates of data collection. Of the 600 student participants, 450, or 75 percent, completed the 12 sessions. Ninety percent said that they enjoyed using the electronic PRS system. Seventy percent indicated that they were likely to become members of existing or new 4-H clubs.

From 2006 to 2009, enrollment in the 4-H program increased from 175 to 650. This is one of the greatest increases in program history. County fair 4-H exhibits doubled, and youth from diverse ethnic backgrounds now demonstrate and display their projects at the fair.

Post-participation survey results show important gains in life skills. Quantitative and qualitative results show that the program taught some students not to hesitate to ask questions, to listen more, and to work with a team. About 25 percent of students indicated that they now had more confidence in working on science projects. A majority of participants, 55 percent, noted that they would be confident in using the information they had learned in school.

Qualitative comments reinforce the quantitative findings. As one participant put it when asked what was important about this program:

The meaning of the 4-Hs—first time I heard and



learned what it means. This is awesome! The most important thing I have learned is in robotics and rocketry. It's real fun, cool.

The most important outcome may be the interest participants have shown in future 4-H activities. Fifteen graduated youth now form a core of youth leaders to expand the GIS / GPS activities. In addition, four new 4-H clubs have formed. One club with 32 members, 80 percent of whom are Hispanic, is fully chartered and has carried out its first program activity, a parent-community night. The other three clubs, whose populations are approximately 80 percent African American, 10 percent Caucasian, and 10 percent Hispanic, are awaiting their final chartering approval. Of the 450 youth who were engaged in New Faces, New Places, more than 200 are officially enrolled in existing or newly formed clubs.

Learning from Experience

Bringing 4-H into an urban environment means modifying programs and emphases to suit new audiences. To respond to the needs of community partners and schools, UNCE4-HYD promoted the STEM aspects of existing 4-H programming. To the familiar aspects of 4-H, such as plant and animal sciences, we added chemistry, engineering, computer technology, and the math without which none of these activities could work. Our urban participants found this focus appealing, as their survey results and post-participation comments showed.

As we market this program beyond the three pilot cities, we emphasize that we are complementing what the schools are doing by providing a *hands-on approach* to problem solving. Our experience with introducing 4-H programming in urban environments suggests additional considerations for out-of-school youth development programming.

Networking, partnering, and collaboration must be in place to achieve success. Most of the partnering agencies in these urban settings did not know of Cooperative Extension

and only a few had heard of 4-H. One of the biggest challenges for University of Nevada Cooperative Extension faculty and staff was to increase credibility with collaborators. Our position as an outreach program of University of Nevada helped us approach this challenge successfully. We partnered with potential partners in the needs assessment, providing leadership and enabling them to experience the benefits of our programming. These activities helped to expand the new partners' views of our possible contributions, indicating that Extension had a great deal to offer—more than most of the other organizations involved—in the areas of research-based program development, evaluation, and professional development support. Taking Extension to the people through a recruiting and networking program paid great dividends, enabling us to emphasize Extension's role and expand our youth development focus.

Recruiting and training site leaders is another critical component of program success. We provided professional development opportunities and then allowed site leaders to deliver parts of the program until they achieved confidence in the skills they had learned. All of the training emphasized the 4-H experiential learning model. The collaborative training led to better communication, a shared sense of program purpose, and higher levels of competency to deliver the curriculum.

Recruiting and retaining youth is another challenge. Our observation was that maintaining maximum attendance was less a challenge than getting support from parents of youth who were not attending. We had some success with hosting parents' nights at the beginning and the end of the program. One strategy we used in promoting the program was to include photos and videos of actual participants in promotional materials. We shared the successes of the program through newsletters and radio and TV shows, making the point that everyone is a stakeholder in youth development efforts. Since every participant in New Faces, New Places had filled out the 4-H enrollment form, we had permission from most parents to take and use pictures of their children.

4-H is a national youth development program that is available in all states and most counties. If your organization is not affiliated with a land-grant university's Cooperative Extension, consider developing a partnership to foster a S.T.E.M. program in your location. Most Cooperative Extension systems are looking for ways to partner and to assist in fulfilling the needs of people in their communities. New Faces, New Places is expanding to become a popular youth program in Clark County, Nevada. Its success can be replicated elsewhere; the potential of this model in urban areas is great. Longitudinal evaluation of participant outcomes will assist in expanding this model to other audiences and contexts.

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