



## Richard Enfield



**4-H Youth Development Advisor**  
University of California  
San Luis Obispo and Santa Barbara Counties, CA  
[rpenfield@ucdavis.edu](mailto:rpenfield@ucdavis.edu)

# 4-H SLO Scientists

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## Abstract

4-H Youth-Adult Science Clubs (SLO Scientists) is a non-formal science education program developed, piloted and evaluated through the University of California 4-H Youth Development Program in San Luis Obispo County (SLO County). 4-H SLO Scientists is sustainable and adaptable to community-based non-formal science programming, and is aligned with STEM and human development research and best practices. It is also aligned with how scientists go about discovery. Using a constructivist approach to learning, the experiences, materials, and questions posed are simple, but finding the “answers” takes observation, gathering data, developing a solution using lines of evidence, and together with other youth-adult investigators, developing a concept. 4-H SLO Scientists provides settings, science-based co-inquiry experiences, and facilitation encouraging use of science process skills to help participants (youth and a significant adult in their lives) experience - and learn - how to make meaning and find the joy in developing concepts of science.

4-H SLO Scientists operates within the University of California 4-H Youth Development Program, which has a successful track record of taking STEM-focused demonstration programs to scale and sustaining them. The program has operated in SLO County since 1995. 4-H SLO Scientists facilitators are trained in inquiry, experiential learning, and content, which assures fidelity, sustainability and ongoing implementation of the program from session to session and year to year.

4-H SLO Scientists provide opportunities for parents or other significant adults to engage with children to strengthen STEM literacy, while providing a positive youth development context designed to create confident, articulate youth skilled in critical thinking. 4-H SLO Scientists combines (a) inquiry-based science learning processes and STEM activities, based on inquiry-based, hands-on curriculum; (b) a strong one-to-one relationship with a parent or other caring adult; and (c) an explicit focus on positive youth development.

## Program Needs

There is a significant need to offer programs that help to increase science literacy, interest in science fields, and careers in science, because the nation continues to face declining proficiencies in science, engineering, and technology, as well as a significant workforce shortage in these critical fields.

## Targeted Audience

4 H SLO Scientists focuses on developing science clubs where a child aged 8-12 enrolls with an adult (a parent, significant adult or mentor). Club cycles are 8-10 weeks long, each with a specific curricular focus and the child/adult teams can and often do choose to continue for multiple cycles (with different curriculum). Clubs are facilitated by a trained volunteer recruited for their interest in teaching science to youth.



## Program Goals and Objectives

The clubs were designed with these principles in mind: (a) the skills of scientific investigation would be taught in an enjoyable setting; (b) activities would encourage youth/adult pairs to utilize critical thinking skills; (c) participants would be encouraged to utilize their new skills and knowledge to better understand, and to initiate action on, science-related issues in their communities; (d) clubs would provide a safe and fun environment for adults to learn from children and children from adults; and (e) family dynamics of mutual respect would be fostered for all participants, so that involvement might allow a child to develop or strengthen an ongoing relationship with parent/guardians or other caring adults (Enfield, 2000; 2003).

The key goal of the University of California 4-H SLO Scientists program is to create awareness of the relevance and fun of science in our daily lives, and promote lifelong learning of science by all children and the significant adults in their lives outside the formal system of education. 4 H SLO Scientists offers learners of all ages enjoyable opportunities for voluntary, self-directed engagement in STEM-rich non-formal learning environments and experiences. The intention is to create awareness and excitement that leads to future educational and career choices focused in science.

### **Current Goals**

1. To increase science literacy and knowledge of and interest in careers in science among youth and their families
2. To expand opportunities for community collaborations which foster science education in non-formal settings
3. To create a pool of trained facilitators who are skilled in the delivery of inquiry-based curriculums and science activities while promoting positive youth development in the process
4. To increase awareness and commitment on the part of parents about the accessibility and importance of science education in their children's lives
5. To implement and refine a model of non-formal science education which can be adapted and replicated in diverse communities across the nation
6. Have both the child and adult investigators create knowledge at their own levels and share their inquiry and results with their fellow investigators

## Program Design/Curricula and Materials

4 H SLO Scientists enables group participation in STEM activities developed in earlier projects, such as the California 4 H Youth Development Science Experiences and Resources for Informal Education Settings (4 H SERIES). In addition, other curricula have been adapted to meet the criteria for 4-H SLO Scientists activities. The co-inquiry model used throughout 4 H SLO Scientists supports the National Research Council model for inquiry experiences aligned with the National Science Education Standards. The 4 H SLO Scientists sequencing and integration of the process skills are aligned with human development research on cognitive development (Lowery, 1998). Most materials are inexpensive and widely available materials that can be purchased in grocery, hobby or craft stores, or are available at no cost from backyards.



## Knowledge and Research Base

The nation is facing declining proficiencies in science, engineering, and technology, as well as a significant workforce shortage in these critical fields (National Commission on Teaching and America's Future, 1996). Longitudinal data from the Trends in International Mathematics and Science Study (Gonzales, et. al., 2008) reveal achievement scores for US 4th and 8th graders have been stagnant or declining over the past 12 years (National Science Teachers Association, 2009). Additionally, the Nation's Report Card (National Center for Education Statistics, 2007) revealed that only 18% of US high school seniors were deemed proficient in science in 2005, representing a 0% proficiency growth since 2000. Statistics for minority students show an even more dramatic disparity. Less than 2% of the STEM workforce is Hispanic while almost 20% of the country's youth population is Hispanic (Congressional Hispanic Leadership Institute, 2009).

There is a strong indication that our declining population of scientifically literate youth in the United States may be a contributing factor to the decreasing number of college students pursuing degrees in science-related fields. According to the report from the Committee on Prospering in the Global Economy of the 21st Century (2006), ". . . Rising Above the Gathering Storm. . ." only 32% of US undergraduates earn degrees in engineering and science, compared with 66% in Japan, 50% in China and 36% in Germany. Simply stated, too many of our nation's young people do not have the science, engineering and technology skills needed for careers in the 21st century.

This science literacy deficit continues despite the fact that, in 1995, The National Education Goals Report had as its Mathematics and Science goal, "By the year 2000, United States students will be the first in the world in mathematics and science achievement." Arguably, we are not number one, nor are we gaining much ground on the goal for science and mathematics literacy and ability, despite the school-based standards movements, No Child Left Behind legislation, and the variety of State mandated test-based requirements. What we find is that these legislated mandates further the strategy of teaching science (when it is taught at all) as a reading lesson with the goal that the student will pass a standardized paper-and-pencil test.

Informal, community-based education programs like 4-H are important resources that can be utilized to address the growing youth science literacy crisis (Carlson & Maxa, 1997; Kisiel, 2006; Kress, McClanahan, & Zaniewski, 2008) through hands-on, learner-centered strategies that include authentic problem-based learning experiences (Enfield, 2000).

The effectiveness of a strong one-to-one relationship in the positive youth development of children, particularly those classified as "at-risk" has been well documented (Werner & Smith, 1992). Research shows that when parents play an active role, their children achieve greater success as learners, regardless of socioeconomic status, ethnic/racial background, or the parents' own level of education (Henderson & Mapp, 2002; Pate & Andrews, 2006). In addition, the more intensely parents are involved, the more confident and engaged their children are as learners and the more beneficial the effects on their achievement (Cotton & Wikelund, 2001). The National Science Teachers Association (NSTA, 2009) cites research that shows that the involvement of parents and other caregivers in their children's learning is crucial to their children's interest in and ability to learn science.

For many children with parents too overwhelmed or uninvolved to participate in their child's educational experience, a mentor or other caring adult can fill a critical role. In fact, research shows that next to an engaged parent, participation of a caring adult is the most significant protective factor in both problem prevention and





academic success (Benard, 2004). In 4-H SLO Scientists, youth are supported by a bonded relationship with an adult, a parent, other relative or mentor who has learned the skills to support this development and who is an active partner in the child's learning.

In addition to making informal science experiences interesting and fun, 4-H SLO Scientists provide opportunities for "quality time" to be enjoyed by the child and adult as a team working together and involved in using the processes of science to investigate the world. 4-H SLO Scientists' activities are opportunities for youth to develop a bonded relationship, resulting in "resilience" when facing the challenges encountered growing up in today's world.

There are other benefits when young people and adults form a partnership in learning. Youth-adult partnerships in non-formal programs provide greater youth development outcomes for young people than in traditional structures where youth are the recipients of service (MacNeil, 2000). True youth-adult partnerships are formed when there is a scope for mutual learning, rather than when learning is one way (Camino, 2000). Often, both youth and adults find that both parties have something to offer that can advance their learning goals. The goal of science education is to engage the public in science literacy (Karplus, 1969-1970). Adults often times are not science literate themselves. Providing an opportunity for youth and *adults* to engage as partners in informal science learning provides an authentic avenue for science learning for adults as well as youth.

## Partners

There have been many agencies and organizations that have been partners in the 4-H SLO Scientists program, including:

- Salvation Army Youth Programs
- Exploratorium/Discovery Center
- Housing Authority sites
- Summer Recreation Programs
- County Library System
- Teachers at school sites

## Funding

The initial program start-up funding, which included monies for materials, graphic design, publicity materials and a research associate, were obtained from a mini-grant from the California 4-H Youth Development Center at UC Davis. Ongoing costs for 4-H SLO SCIENTISTS have been very minimal, with the largest expenditure being the salary of a 4-H SLO SCIENTISTS Coordinator (5-6 hrs./wk.). Funds for the salary costs have been obtained from the County 4-H Volunteer Leaders Organization and a number of small grants or gifts from public utilities, service clubs, banks, and other community-based funders. In addition, members are asked to contribute a \$5.00 materials fee when they enroll in a 4-H SLO Scientist Club, but no one is turned away if the materials fee cannot be paid. In fact, the County 4-H Volunteer Leaders Organization has funds set aside to pay the materials fee for any family unable to contribute.



## Staffing

The only staffing dedicated to the 4-H SLO SCIENTISTS program is a 0.10- 0.15 FTE (5-6 hrs./wk.) 4-H SLO SCIENTISTS Coordinator.

## Program Delivery

The 4-H SLO SCIENTISTS learning model has a trained facilitator working with a group of 6-10 youth/adult pairs, inviting the youth/adult “teams” to engage in seemingly simple experiences and activities together. The facilitators use open-ended questions such as “Is there life in a dirt clod?” and simple materials such as lenses, microscopes, tweezers, and plastic glasses to explore this and similar questions and spark excitement in the discovery. The teams are encouraged to also investigate questions they generate as they go along formulating theories and drawing conclusions. As teams come together in ever enlarging circles, they discuss and explore their individual findings and conclusions, notice their commonalities and differences, and engage in discussing multiple lines of evidence for their favorite conclusion. . . as scientists. The scientific thinking process becomes the basis for participants’ experiences.

Engaging the adult partner in the process as an equal participant in the discovery has the added benefit of making informal science experiences a learning opportunity for the adult as well. Interesting and fun interactions, enjoyed by the child and adult as a team working together using science processes to explore the world, have the additional benefit of strengthening the bond between adult and child. Additionally, 4-H SLO SCIENTISTS encourages the adult to value the process of scientific discovery, while creating a supportive network for children choosing to pursue the sparks ignited by the process.

Based on the mix and interests of youth in each of the 4-H SLO Scientists Clubs, facilitators select from a variety of peer-reviewed curricula to implement. Each of these curricula is inquiry-based, follows the experiential learning cycle, and aligns with National Science Education Standards (National Research Council, 1996). 4-H SLO SCIENTISTS uses activities and materials that are suitable for dyadic exploration, fit with the constructivist approach and include a positive youth development frame.

The 4-H SLO Scientists program asks the question “How do we create usable knowledge that can be used to better our home, community, and world?” A vignette is provided as an example of how 4-H SLO Scientists session is conducted (Enfield, 2000).

## Recognition of Participants

All participants enrolled in 4-H SLO Scientists are members of the San Luis Obispo County 4-H Youth Development program and receive all the rights and privileges of 4-H membership. Members of SLO Scientists participate in 4-H events and activities throughout the year and receive recognition for their efforts. Members of SLO Scientists sometimes are able to participate in special STEM categories at events, such as the STEM category at 4-H Presentation Day, and receive additional recognition because of their science involvement. Facilitators are also recognized for their years of service and are eligible for all 4-H conference scholarships and other forms of recognition offered by the County 4-H Volunteer Leaders Organization.





## Program Evaluation and Outcomes/Impact

Since the beginning of the 4-H SLO Scientists program, the most important findings from the evaluations have demonstrated both an increase in the direct involvement in science and scientific thinking for both youth and adult participants, as well as an increase in numerous aspects of positive family dynamics, including increased conversations about “things other than science” and an increase in “family meetings to talk things over and solve problems” (Enfield, 2000; 2003). Specifically, random sampling of participants has indicated that:

- Just over 50% of children reported they spent more time on such things as observing and experimenting after becoming involved in the SLO Scientists Program. Thirty-three percent of the adults reported an increase in this activity.
- Sixty-seven percent of the children reported they “always” or “most of the time” talked with other family members about the activities after each meeting. Ninety-five percent of adults reported doing this.
- Fifty percent of the children reported an increase in talking with her/his adult partner “about things other than science” since joining the program. Fifty percent of the adults also reported more talking with her/his child partner.
- Thirty-six percent of the children reported an increase in “family meetings to talk things over and solve problems” since starting the program. The adult participants reported a 25% increase in family meetings.

## Evidence of Sustainability

The program has been operating in SLO County since 1995, and offers participants up to 3-years of involvement in the program. 4-H SLO Scientists has been piloted, evaluated, refined and re-evaluated over the past 16 years.

## Considerations for Replication

Through replication and adaptation of the 4-H SLO Scientists model within the context of the 4-H Youth Development framework, 4-H professionals can make significant contributions to the ability of 4-H programs and collaborators to deliver effective STEM education in non-formal settings across the United States. A handbook is available to provide start-up assistance to 4-H SLO Scientist Clubs (Salisbury & Neuhauser, 1999). The 4-H SLO Scientists address the high priority issues of increasing science literacy in youth and significant adults in their lives.

In addition, this project may be applicable far beyond the scope of 4-H. 4-H SLO Scientists provides opportunities for partner organizations to incorporate inquiry-based science into their own programs by providing professional development to staff and volunteers of those organizations, thus expanding the quantity and quality of organizations engaged in effective non-formal science delivery.



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