Promising Practices In 4-H Science

4-H Science

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4-H Science Abilities: Providing Youth With Opportunities to Engage in the Process of Science

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An essential component of improving youth scientific literacy is offering opportunities for youth to develop and deepen their understanding of science process skills. The 4-H Science-Ready Checklist contains a set of items and approaches for 4-H Science programs. An important item on the checklist asks, "*Are you providing children and youth opportunities to improve their science abilities?*" (4-H Science Checklist). In 4-H, the term 'science abilities' refers to behaviors and tends to be synonymous with the term 'science process skills'. Providing these intentional opportunities will help youth improve their ability to engage in the scientific enterprise and can also increase motivation for youth to continue their involvement in 4-H.

What are the basic skills youth need to develop in order to become scientifically literate? Unfortunately, there is not a definitive list of critical science process skills forming the foundation upon which youth develop their scientific literacy. Outlined below are three examples of documents developed for use in 4-H programming.

Over Fifty Years of 4-H Programming Emphasize Science Process Skills

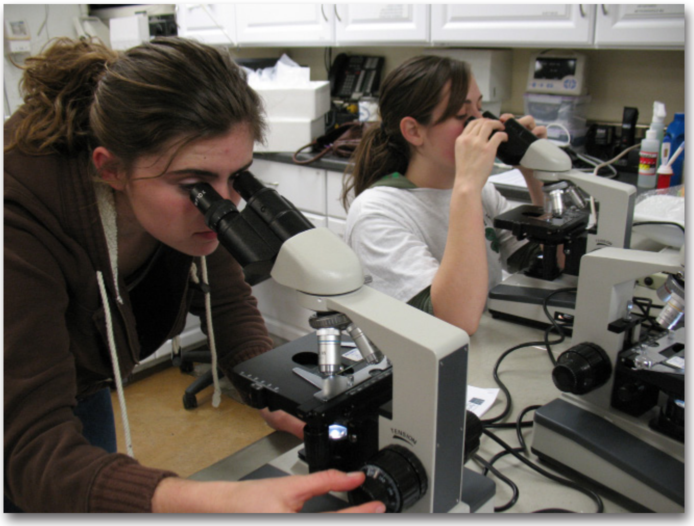
In the 1960's, a national 4-H study was conducted on improving science education in 4-H. The report, *Science in a 4-H Study*, contained several recommendations for strengthening 4-H science programs, seven of which relate to science process skills. (National 4-H Club Foundation, 1963)

In the late 1990's, a 4-H guide was developed, Science Guidelines for Non-Formal Education, that reflected eight basic scientific and process skills essential to scientific inquiry (Carlson & Maxa, 1997). The processes were posited to be appropriate for youth ages 5 through adulthood; with the first five being particularly relevant to children ages five through nine.

In 2007, a report commissioned by the National 4-H Council, Science, Engineering, and Technology (SET) Programming in the Context of 4-H Youth Development, identified thirty 4-H Science, Engineering, and Technology Abilities (Horton, Gogolski, & Warkentien, 2007). These thirty skills were identified as commonly reoccurring in current scientific literature (e.g., National Science Education Standards, AAAS Benchmarks, various State Science Standards, etc.). The authors mapped the "Abilities" to the experiential learning path. The report emphasized the importance of 4-H programs supporting youth in developing process skills in addition to learning content. To view the full list, please visit http://www.ca4h.org/files/124249.pdf

Promising Practices of 4-H Programs Emphasizing Science Abilities

University of California
Science Experiences and Resources for Informal Education Settings (SERIES)
http://www.ca4h.org/files/13928.pdf
The University of California 4-H created a collaboration to address science literacy programs in nonformal settings. The goal of the SERIES curriculum was to help youth develop competence in science processes (Ponzio, 2006). SERIES emphasized science process skills - *observing, communicating, comparing, organizing, relating, inferring, and applying*. Over the course of a decade, eight science-based curricula were developed for youth ages nine to thirteen grounded in a specific science content (e.g., recycling, chemicals, agriculture, watersheds, etc.). A future outgrowth of SERIES was the 4-H Youth Experiences in Science (YES) curriculum. The YES curriculum added a nonformal science education curriculum for five to eight year olds which emphasized the skills critical to the younger age group – (Ponzio, Junge, Manglallan & Smith, 2000).



Oregon State University
Summer Science Camp
http://www.pearweb.org/atis/tools/18
For several years, the Oregon 4-H program has sponsored a summer science camp on the OSU campus with 60 hours of educational programming targeting hands-on, real world experiences, collaborative learning, development of science processing skills, and positive youth development (Arnold & Day, 2010). The camp lasts two weeks with youth, grades 6-8th, living and learning together at the University. The program involves a variety of content, including mechanical and chemical engineering, computers, field trips, and youth led research projects based on a provided scenario. Post-camp evaluations have shown significant improvements of science process skills, as measured by changes in pre- versus post-tests.

Texas A & M AgriLife Extension Service
Discover Scientific Method Research Poster Contest
http://texas4-h.tamu.edu/library/files/project_4h_science_poster_guide_11
In 2011, Texas 4-H created a statewide contest to allow youth to learn and use the scientific method within the content of their 4-H projects (Tarpley, 2011). The contest allowed youth to share and explain a research project undertaken in one of their projects. The approach is a promising strategy in integrating the 4-H Science Initiative into all 4-H project work. Youth identify a question or problem in a project area, and then utilize the scientific method to research and communicate a solution.

University of California
Tools of the Trade II: Inspiring Young Minds to be SET Ready for Life!
http://www.ca4h.org/Projects/SET/SETResources/ToTII/

Tools of the Trade II is a staff-development guide for afterschool program staff and youth to incorporate science, engineering, and technology (SET) into afterschool programming. Module 3: SET Abilities for the 21st Century, helps prepare educators to support the development of science abilities in young people.

4-H science education programs help increase youth scientific literacy in nonformal educational settings to improve attitudes, content knowledge, and science process skills.

Promising Practices of Assessment and Evaluation Emphasizing Science Abilities

Evaluating outcomes of educational programming is a critical stage in ensuring high quality programming, appropriate youth outcomes, and data to support fund development efforts. The National Science Framework for evaluating informal science education programs outlined five categories for evaluation: knowledge, engagement, attitude, behavior, and skills (Friedman, 2008). The category of skills is defined as "skills based on STEM* concepts, processes, or careers" (p. 11). This outcome category dealt with the procedural aspects of knowing which included scientific inquiry skills (observation, exploration, questioning, prediction, experimentation, argumentation, interpretation, and synthesis); specific skills related to using technology; and broader life skills.

Science Process Skills Inventory (SPSI)
http://www.pearweb.org/atis/tools/18
A particularly promising evaluation instrument for assessing science process skills, *Science Process Skills Inventory (SPSI)*, was developed by Virginia Bourdeau and Mary Arnold at Oregon State University (2009). The instrument measures youth, ages 12 and over, ability to engage in the scientific inquiry process.

Assessment Tools in Informal Science (ATIS)
http://www.pearweb.org/atis/
A searchable database of assessment tools for information science learning is hosted by the Harvard Program in Education, Afterschool, and Resiliency (PEAR). The database provides practitioners, evaluators, and researchers with a range of potential evaluation instruments for assessing program quality and outcomes for youth. The database categories assessment instruments by domain, with a specific domain for skills called "Competence and Reasoning."

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