Inquiry Based Learning Approaches

Introduction

"Tell me and I forget, show me and I remember, involve me and I understand." – Chinese Proverb

Science is, by its nature, inquiry based. Inquiry is an approach to learning that utilizes discovery and scientific thinking processes to explore and learn knowledge and skills. In order to achieve this, facilitators of inquiry based learning must create an environment rich with experiences that allows learners to act on their own curiosity. Youth need experiences that will stimulate their thinking and provoke questions (inquiry). Such experiences will help develop logical thinking abilities.

Formal science education is primarily focused upon transfer of knowledge from teacher to student. Teacher-centered learning usually incorporates a great deal of memorization. Inquiry, on the other hand, is *learner* centered. Inquiry requires action on the part of the learner: a *search* for information, a *pursuit* of knowledge, the *exploration* of phenomena in order to better understand the world. Provide youth with opportunities to explore environments and participate in activities designed to help them develop their own understanding – ultimately creating new knowledge for themselves. Involvement leads to understanding!

Thus, inquiry based learning requires:

- Learner-centeredness;
- Active, open questioning;
- Opportunities for active investigations that include the acquisition of knowledge and skills through observing and manipulating (mentally or physically) objects, phenomena, and/or nature.

A critical element for science inquiry is the need (or want) to find answers to questions or solutions to challenges. Scientists are the first to admit that engaging in the process of science discovery is *not* a strictly linear pursuit. Scientists do *not* engage in cookbook science! Science professionals practice inquiry. Science discovery begins with observations, with asking "how" and "why" and "when" and "what if" and "under what circumstances." Basic scientists observe phenomena, ask questions about what they have observed, and conduct experiments in order to deepen their understanding of the concept or event. Applied scientists are faced with a challenge and follow a similar approach that leads to development of solutions to the problem.

Allowing youth to engage in inquiry based learning allows them to experience science discovery and knowledge creation the way "real" scientists do! Providing youth with a challenge they *want* to solve is the first step in engaging them in inquiry based learning. It also allows youth to envision themselves as "real" scientists – doing "real" science – TODAY!

Facilitating inquiry based learning *does* require appropriate training (and often un-learning) in how to best guide youth experiences. The good news is that inquiry based learning should substantially reduce any fear non-science facilitators have about "knowing the right answer." Encourage facilitators to embrace the concept of co-learning

with the youth to discover solutions to challenges and develop understanding. Facilitators should also recognize that the inquiry process can be loud, messy, and at times lengthy. Some people, especially those from the field of formal education, may feel a certain loss of control because activities do not seem to progress in a "cookbook" fashion. Reassure them that chaos does not equate to a "bad" learning experience as long as youth are engaged in the challenge at hand.

The purpose of this chapter is to share promising practices to help program planners and facilitators understand and implement successful inquiry based 4-H Science programs. A little more structure and support may be needed the first few times an inquiry based learning approach is implemented, but if done well future sessions will require less structure and will become more learner focused. The results are well worth the effort, as youth become more comfortable with creating their own knowledge and understanding. This is a foundational skill that will serve them well in the formal education system, as well as throughout the course of their lives.

Promising Practices

The promising practices for *Inquiry Based Learning Approaches* are subdivided into three categories: (a) Program Planning and Evaluation, (b) Training, and (c) Program Delivery.

Program Planning and Evaluation

1. *Read the chapter 4-H Program Design – 4-H Science Checklist*. This chapter provides fundamental program planning and evaluation information required for successful 4-H Science programs. The information contained here is specific to developing programs that support inquiry based learning.

2. *Utilize existing inquiry- and research-based science curricula.* Curricula should support inquiry based learning, be age appropriate, and incorporate all components of the experiential learning cycle, including application of what is learned. It should be built on a positive youth development framework (*Essential Elements of 4-H Youth Development*).

    - Take the time to identify and procure the highest quality curriculum possible, using the *4-H Science Checklist* as a guide (see *4-H Science Program Design – 4-H Science Checklist*). Train facilitators to properly use selected curriculum (see *Training Others to Deliver High Quality Science Programming*).

    - Using inquiry based curricula helps facilitators understand how science happens, and emphasizes that science is about the process of thinking and doing, not just learning facts.

    - Inquiry based curricula such as robotics and other design challenges create authentic environments where youth must work in teams and create an object to meet the prescribed challenge.

    - Curricula that are competitive in nature (may or may not be explicit) will motivate teams of youth to work toward a successful solution.

    - Do not ask program staff or volunteers to develop curricula. Most program staff/volunteers do not have the time, experience, or knowledge necessary to develop program lessons and activities that are sequential, experiential, age-appropriate, research-based, support inquiry, and so forth. For best results utilize existing inquiry- and research-based science curricula.

3. *Create programs that focus on the inquiry process.* The focus of inquiry based learning is on the *process* of *doing* science, not simply completing activities or projects. These processes (inquiry, observation, inference,

problem-solving, etc.) are the same scientists use in their everyday work.

4. *Limit the number of activities facilitators need to complete in a session.* Again, the focus is on the processes, not the activities. Plan for ample time after the activity for youth to explore, ask questions, share thoughts and information, reflect, and so forth.

5. *Use rich contexts.* Target existing, or develop rich contexts for learning that will provide lots of opportunities for questions and exploration. Seek out off-site locations that are unique or that will encourage discovery. Some urban areas may require a switch from viewing the larger environment to looking at the micro-environment.

6. *Develop evaluation/assessment criteria, indicators, and data collection methods suited to the inquiry process.* Program planners and evaluators may need to be creative in order to capture the spirit of 4-H Science programs (e.g., focus on science/inquiry processes, the *Essential Elements of Positive Youth Development*, foundational skills, etc.). Perhaps the worst thing that can happen regarding evaluation/assessment is if the facilitator feels he/she must "teach to the test" so youth can "successfully" complete knowledge-based assessments. This poses a very real danger of stifling the inquiry process!

Training

Read the chapter *Training Others to Deliver High Quality Science Programming*. This chapter provides an in-depth discussion of promising practices for training staff and volunteers to deliver 4-H Science programs.

Program Delivery

1. *Prepare the room/area for the activity.* Space should be separate from other activities and away from distractions, allow for easy movement of the facilitator and the youth, include access to a whiteboard/flipchart, have adequate tables and chairs, and have all materials readily available (see *NPASS2* in *Resources* below).

2. *Provide a brief introduction to the activity.* Keep the introduction short. Review the previous activity; introduce the current activity with a story or scenario and relate it to the prior activity. There is no need to engage in application at this time (see *NPASS2* in *Resources* below).

    - *Divide youth into teams.* Teamwork is an important life skill and 4-H Science Ability (see *4-H Science Program Design – 4-H Science Checklist*).

    - *Present the activity as a challenge.* Provide youth with incentives and encouragement to solve the challenge. The incentive can be an inexpensive prize (4-H wristband, pencil, etc.), or some kind of snack.

3. *Engage often with youth teams.* Monitoring and interacting with the youth is just as important as the incentives.

    - Walk around the room, get close to their work, ask questions, but do *not* provide answers (and remember there are no right or wrong answers).

    - Encourage youth to think about what they are observing (reflection).

    - Visit each team often for about 60 seconds at a time (see *NPASS2* in *Resources* below).

4. *Provide opportunities for youth to come together as a learning community.* Break often (for about 5 minutes) away from projects/materials, to discuss what is working, what isn't working, and what they have observed. Record observations on a flipchart or whiteboard – do not judge or screen input. Allow youth to discover

"answers" collectively as a group (see *NPASS2* in *Resources* below).

5. *Provide closure to the activity.* The final discussion (away from projects/materials) should provide a summary of the session's findings, unresolved challenges, etc. Congratulate youth on successes, and give them an exciting preview of the next session. Wrap-up early if necessary to ensure youth have time to process the activity before leaving (see *NPASS2* in Resources below).

6. *Let youth create science words.* It is not important to focus on science vocabulary. It is much more important for youth to discover/observe what is happening than to have the "right" word for it.

7. *Encourage the "opt outs" and "don't wanna's."* Encourage participation and look for behaviors to praise to build confidence. Give youth an opportunity to warm up to the idea, and be particularly sensitive to developmental stages when deciding how best to address the difficulty.

    - Focus on building a safe and supportive environment for all participants so they can have confidence in trying new things.
    - Adopt an "always try" code of conduct, which challenges youth to make an effort even when afraid of failing.

8. *Leave extra materials (afterschool and summer programs).* Leave enough extra materials so afterschool and summer program staff can allow youth to do additional experiments between sessions.

Case Studies

Arnett – Facilitating Outdoor Exploration at Adventure Central. Adventure Central program staff noticed the connections between inquiry based and experiential learning a couple of years ago, and have been working on increasing the intentional inclusion of those methods into the program. Staff development sessions have been conducted around inquiry based learning to introduce the concept. The sessions included a tactic for lesson plans to incorporate at least one inquiry based learning activity per week. The focus is on having the inquiry based learning activity occur in an outdoor environment, which takes advantage of the program's unique setting within a 60-acre park. Group leaders present to the larger staff group what they did for their inquiry based learning activity at weekly staff meetings and include observations and key questions shared by the youth. Staff development is offered at least twice per year on inquiry based learning, and informal sessions are held throughout the year to include staff hikes, creek exploration, and assorted nature play.

Each day, time is set aside for youth to choose what kind of activity they want to pursue, and the vast majority consistently choose to go outside. Younger youth (ages 6-10) spend considerable time exploring the area by digging, catching insects, building structures, and engaging in imaginative play. The program encourages discovery by ensuring there are sufficient tools and materials available for youth to engage in the discovery process. Program staff interact with youth and ask questions or provide prompts as needed, but typically play more of an observer role, monitoring for safety and inclusion and letting the youth take the lead in their personal education process. When an interesting discovery is made, youth often seek out a reference resource to learn more, or work as a group to share knowledge on the subject. **–Nate Arnett, The Ohio State University**

Bird – From Answer-Giving to Question-Asking: Breaking the Habits of Direct Instruction. This has been the most challenging element of bringing truly high-quality science experiences to youth. The concept that science is about the process of discovery – and just how to make that happen – is difficult for most people to grasp. The common need to assure youth have the "right answers" leads to "telling" more than quality facilitating. This is especially apparent when training afterschool program staff, and when teens are learning to present the *4-H YES*

curriculum (far too often they are modeling how science is taught in schools). Fortunately, the *YES* curriculum is inquiry based and, if followed, guides the facilitator in question-asking as opposed to answer-giving. Teens who facilitate *YES* are taught the processes of science for primary-aged children and see, during training, how these elements happen in the activities they present. When using other science curricula it is much more difficult to help teen – and adult teachers – understand inquiry based science. As part of the On the Wild Side training we deliver a session on the difference between directive instruction and non-directive instruction. **–Marianne Bird, University of California**

Resources

4-H Science Professional Development Toolkit – an online set of resources and training activities to be used by youth development professionals and volunteers to prepare them to support their 4-H Science programs. Includes a section on *Experiential and Inquiry-Based Methods in 4-H Science and Inquiry–Theory to Practice*. Available at *http://www.4-h.org/resource-library/professional-development-learning/science-training-guides-resources/*.

Exploratorium's Institute for Inquiry® – workshops and facilitator guides (free downloads) for those providing professional development in the pedagogy and practice of science inquiry. Available at *http://www.exploratorium.edu/ifi/workshops/index.html*. Introductory information on science inquiry is available at *http://www.exploratorium.edu/ifi/about/philosophy.html* - including free downloads of *What is Inquiry, Pathways to Learning, Inquiry Structure*, and *Inquiry Descriptions*.

NPASS2 – National Partnerships for After School Science – includes best practices for afterschool science for science project leaders along with many other informal science education resources and professional development tools for OST. NPASS2 is led by the Center for Science Education at EDC. Available at *http://npass2.edc.org/*.