



National Science Education Standards

The 4-H SET Initiative is based on the *National Science Education Standards (1996)*. The *Standards* present a vision of a scientifically literate populace. Using a grade-level approach, they outline what content and processes students need to know, understand, and be able to do to be scientifically literate.

Principles of the *Standards*

1. Science is for all youth.
2. Learning science is an active process.
3. Science reflects the intellectual and cultural traditions that characterize the practice of contemporary science.

Science Concepts and Content

The *Standards* outline content youth need to learn about science, which include:

- Physical Science
- Life Science
- Earth and space science
- Science and technology
- Science in personal and social perspectives
- History and nature of science



Unifying Processes and Abilities

Science abilities (processes) unify science disciplines and provide youth with powerful ideas to help them understand the natural world. For example, what it means to measure and how to use measurement tools.

Science Education through Inquiry Learning

In inquiry-based learning, youth build understanding through active exploration and questioning. The key to inquiry is that youth seek answers to questions rather than being given answers, which requires those who lead activities to facilitate learning and not simply disseminate knowledge.

Effective Science Education Requires Good Educators

Good educators of science create environments in which they and their youth work together as active learners. Science educators should be able to:

- Plan inquiry-based science programs.
- Be able to guide and facilitate youth learning.
- Develop environments that enable youth to learn science.
- Create communities of science learners.

National Science Education Standards (1996) - http://www.nap.edu/openbook.php?record_id=4962

Science Content Standards (NSES Chapter 6)

GRADES K-4 Ages 5-9	GRADES 5-8 Ages 10-13	GRADES 9-12 Ages 14-18
PHYSICAL SCIENCE		
Properties of objects and materials Position and motion of objects Light, heat, electricity, and magnetism	Properties and changes of properties in matter Motions and forces Transfer of energy	Structure of atoms Structure and properties of matter Chemical reactions Motions and forces Conservation of energy and increase in disorder Interactions of energy and matter
LIFE SCIENCE		
Characteristics of organisms Life cycles of organisms Organisms and environments	Structure and function in living systems Reproduction and heredity Regulation and behavior Populations and ecosystems Diversity and adaptations of organisms	The cell Molecular basis of heredity Biological evolution Interdependence of organisms Matter, energy, and organization in living systems Behavior of organisms
EARTH AND SPACE SCIENCE		
Properties of earth materials Objects in the sky Changes in earth and sky	Structure of the earth system Earth's history Earth in the solar system	Energy in the earth system Geochemical cycles Origin and evolution of the earth system Origin and evolution of the universe
SCIENCE AND TECHNOLOGY		
Abilities to distinguish between natural objects and objects made by humans Abilities of technological design Understanding about science and technology	Abilities of technological design Understanding about science and technology	Abilities of technological design Understanding about science and technology
SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES		
Personal health Characteristics and changes in populations Types of resources Changes in environments Science and technology in local challenges	Personal health Populations, resources, and environments Natural hazards Risks and benefits Science and technology in society	Personal and community health Population growth Natural resources Environmental quality Natural and human-induced hazards Science and technology in local, national, and global challenges
HISTORY AND NATURE OF SCIENCE		
Science as a human endeavor	Science as a human endeavor Nature of science History of science	Science as a human endeavor Nature of scientific knowledge Historical perspectives



4-H SET Abilities

Learning science is not about memorization. When youth are encouraged to use science processes to discover knowledge themselves, youth become engaged and motivated to learn science content.

Both science **content** and **abilities** (processes) are critical to increase science literacy. The National Science Education Standards call for the learning of unifying abilities as these provide youth with powerful ideas to help them understand the natural world. Emphasis has shifted from being solely on “the content to be learned” to “**how** students learn the content” and “**how** the content is taught.”



The 4-H SET program outlines thirty important science processes and refers to them as **4-H SET Abilities**. These thirty 4-H SET Abilities include distinct and measurable behaviors and are critical elements of experiential learning and inquiry. For example – A young person may *state a problem* about water quality (content), *plan an investigation*, *collect data*, *analyze* the data, *graph* results, *summarize*, *communicate to others*, and then work on *implementing a solution*. Through these steps, content is learned by engaging youth in the process of science, engineering and technology.

Thirty 4-H SET Abilities

1.	Build/Construct	Make by putting materials together.
2.	Categorize/Order/Classify	Put objects or events in groups or classes.
3.	Collaborate	Work together; applies both to the work of individuals as well as larger groups.
4.	Collect Data	Record information in an organized fashion about objects and events that illustrate a specific situation.
5.	Communicate/Demonstrate	Methods and for involving various media that transfer information from one person to another.
6.	Compare/Contrast	Examine and evaluate <i>similarities</i> and <i>differences</i> . All measurements are forms of comparing.
7.	Design Solutions	Written plan or <i>design brief</i> , that identifies a problem to be solved, its criteria, and its constraints.
8.	Develop Solutions	Systematic strategy used to develop many possible solutions to solve a problem or satisfy human needs and wants.
9.	Draw/Design	Plan in systematic graphic form; process of originating and developing a plan for a product, structure, system or component.
10.	Evaluate	Technique of examining and judging data presented.

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11.	Hypothesize	State of tentative generalization, which is subject to immediate or eventual testing by one or more experiments; to explain a relatively large number of events.
12.	Invent/Implement Solutions	Practical application to fulfill a desired purpose.
13.	Infer	Explain an observation in terms of one's previous experience. Leads to predictive explanations.
14.	Interpret/Analyze/Reason	Determine the nature and relationship of the parts of the whole. Find a pattern inherent in a collection of data. This process leads to stating a generalization or drawing conclusions. In an experiment, it is the process by which one establishes the relationship between controlled factors and the outcome.
15.	Measure	Procedure by which one uses an instrument to estimate a quantitative value associated with some characteristic of an object or event.
16.	Model/Graph/Use Numbers	Devise a scheme or structure that will describe specific real objects or events.
17.	Observe	Most basic process of science, in which learners use their senses to obtain information about themselves or the world around them.
18.	Optimize	Make the best or most of a condition.
19.	Organize/Order/Classify	Put into working order; get together and arrange.
20.	Plan Investigations	Use a body of techniques, often referred to as the Scientific Method, for considering <i>phenomena</i> and acquiring <i>knowledge</i> , including the elements of hypothesis development, prediction, and the effects and limits of observation and based on gathering <i>observable, empirical, measurable evidence</i> , subject to the principles of <i>reasoning</i> .
21.	Predict	Projecting future observations on the basis of previously known information.
22.	Problem Solve	Part of the <i>thinking</i> process considered the most complex of all <i>intellectual</i> functions, that includes <i>problem finding</i> and <i>problem shaping</i> .
23.	Question	Raise an uncertainty, doubt, or unsettled issue that may be based on the perception of a discrepancy between what is observed and what is know by the questioner.
24.	Redesign	Plan, draw or sketch again.
25.	Research a Problem	Active, diligent, and systematic process of inquiry aimed at <i>discovering, interpreting</i> and <i>revising facts</i> . Is usually associated with the output of <i>science</i> and the <i>scientific method</i> .
26.	State a Problem	First step in the engineering process focused on assessing/creating the need in order to define the problem to be solved.
27.	Summarize	Make a brief statement giving the main points of substance of a matter.
28.	Test	Verify or falsify an expectation with an observation, often as part of an experiment within the scientific method.
29.	Troubleshoot	Systematic search for the source of a problem so that it can be solved.
30.	Use Tools	Manipulate objects, instruments and materials as a means of furthering a learner's understanding, appreciation and application of scientific knowledge.

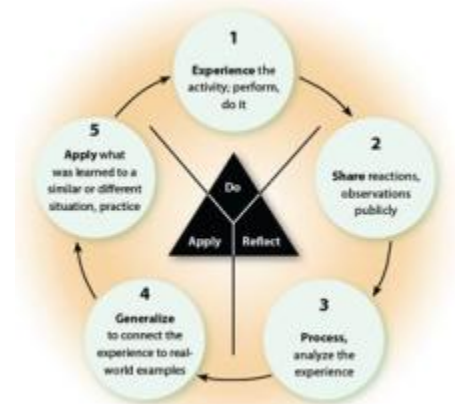
Experiential and Inquiry Learning

Experiential Learning

Experiential learning (EL) is based on the idea that experience matters in the learning process. Through a concrete learning **experience**, youth are encouraged to think, explore, question, and make decisions. EL is more than just having the learner be engaged in an experience, however. To ensure that learning does take place, two other components are required – a **period of reflection** where the learner shares and processes the experience, and the **application** of new learning in authentic situations

4-H promotes EL through projects and programs that:

- are direct and hands-on;
- invite discussion through open-ended questioning;
- involve active reflection; and
- make connections between the activity and the real-world.



The experiential learning model contains five steps – Experience, Share, Process, Generalize, and Apply – but can also be summarized in three main stages: Do, Reflect and Apply.

Inquiry Learning – Discovery!

In inquiry-based learning, youth build understanding through active exploration and questioning. The key to inquiry is that youth seek answers to questions rather than being given answers, which requires those who lead activities to facilitate the learning process and not simply disseminate knowledge.

Inquiry-oriented instruction engages youth in the investigative nature of science.

This will include:

- active questioning and investigating;
- acquiring new knowledge; and
- observing and manipulating (mentally or physically) objects, phenomena, and/or nature.

For more information, please visit <http://www.experientiallearning.ucdavis.edu/>





Positive Youth Development (PYD)

Positive Youth Development builds on young peoples' strengths and assets. PYD occurs from an intentional process that promotes positive outcomes for young people by providing opportunities, choices, caring relationships, and the support necessary for youth to fully participate in families and communities. Youth development occurs in families, peer groups, schools, neighborhoods and communities.

Providing SET learning experiences within a positive youth development framework is critical in helping youth learn, grow, and contribute to their communities.

In 4-H SET activities and projects, adults and teens facilitate learning experiences by mentoring and partnering with youth.

Learning experiences are led by trained, caring adult staff and volunteers acting as mentors, coaches, facilitators and co-learners who operate from a perspective that youth as partners and resources in their own development.



High-quality 4-H SET programming doesn't only provide valuable benefits in SET content knowledge and process understanding, but also in the form of leadership development, life skills development, and civic development. Studies confirm that these skill areas can have numerous long-lasting positive benefits for youth and their communities. These findings support the high educational priority assigned to these goals for 4-H YD Program activities.

Essential Elements of Positive Youth Development

- **Caring Relationships (Belonging):** All youth need a caring, supportive relationship in their lives. Adult 4-H volunteers and members provide this fellowship by showing interest in, actively listening to, and fostering the gifts of 4-H youth.
- **Constructive Learning Experiences (Mastery):** 4-H offers opportunities to take on new challenges and learn new skills. The presence of self-confidence and positive self-esteem are today considered to be two of the most important indicators of personal wellness and success in an individual.
- **Leadership Opportunities (Independence):** Creating opportunities for youth to develop skills and confidence for leadership and self-discipline is a cornerstone of 4-H. 4-H helps young people recognize the connection between independence and responsibility.
- **Service to Communities (Generosity):** 4-H helps youth focus on developing concern for others and taking action to demonstrate that concern. Service forges bonds between youth and the community, and doing something valued by others raises feelings of self-worth and competence.