PURDUE UNIVERSITY | Extension - 4-H Youth Development

4-H-1030

Facilitator's Guide

SOIL and WATER SCIENCE

NATIONAL PEER REVIEWED

SOIL and WATER SCIENCE

Facilitator's Guide

TO THE 4-H LEADER

Thank you for taking the time to help a young person learn more about their soil and water. Healthy soil and clean water are necessary to support all forms of life.

The 4-H Soil and Water Science curriculum is written for youth who enjoy learning about science and these two important natural resources.

Level 1 introduces basic terms and concepts. Activities focus on understanding important soil and water processes.

Level 2 activities help youth put the basic concepts into action to understand more advanced soil and water concepts, and interactions with the environment.

Level 3 activities are divided into chapters based on how someone might utilize the information: as a homeowner, resident of a watershed, food and fiber producer (farmer), mayor, teacher, or legislator. Level 3 delves deeper into soil and water science concepts to prepare youth to be well informed and to study these topics at a college or university. Youth are encouraged to supplement their learning by consulting knowledgeable people and current written materials in Level 3 with references from governmental and/or university sources (online extensions *.gov and *.edu).

Author: Natalie Carroll, professor, Purdue University

Graphic Designer: Kathi Brethauer, KB Design
Editor: Nancy Alexander

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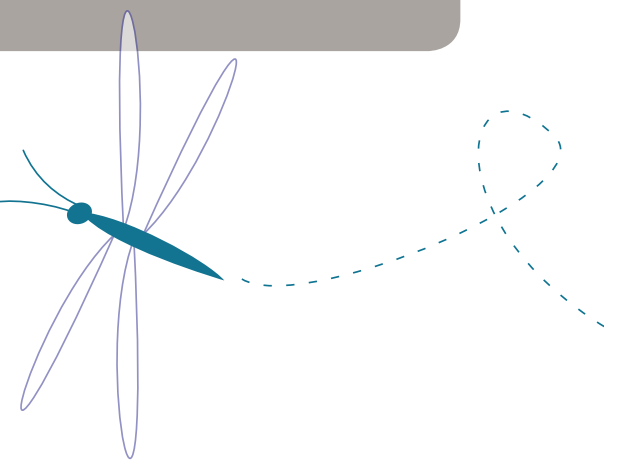
NGSS indicates the Next Generation Science Standards for each activity. See www.nextgenscience.org for more information.

See the Purdue Extension Education Store, edustore.purdue.edu, for additional resources on many of the topics covered in the 4-H manuals.



NOTE TO PROJECT FACILITATOR

Thank you for helping a 4-H member learn about Soil and Water Science as a project facilitator. This Facilitator's Guide answers the questions in the youth guides and suggests ways to facilitate the activities. It also gives additional information about working with youth, for those who wish to learn more.

You can help youth get the most out of this project by being enthusiastic and asking thoughtful questions. Team up with youth to help them select goals, identify resources, gain confidence, and evaluate their own progress. The activities are designed so youth have an opportunity to learn by doing with your help and guidance.

Your main role is to provide a safe, supportive environment for youth to practice important life skills as they explore the world of Soil and Water Science through many exciting activities.

KEY CONCEPTS

- Gather materials. Youth should collect the materials listed in the Tool Kit before doing the activity. All the supplies used in these activities can be found around the home or purchased at minimal cost.
- Read and understand the activity. Each activity is self-contained.
- Encourage youth to try different activities and to enjoy learning.
- Show the relevance of each activity. Explore with youth the interconnectedness of each activity to the real world.
- Emphasize relying on others. Expand the learning activity and get additional supporting information from your Extension office. The Internet can provide a wealth of information to enrich learning. Take care to use sites that are supported by educational organizations (*.edu), government agencies (*.gov), professional societies, national organizations, and not-for-profit groups associated with the study of soil and water.
- Keep safety in mind at all times. Some activities are done outdoors where wasps, bees, and other potentially harmful insects might be. Keep a watchful eye on the surroundings, and look out for weather changes.

LEARNING GOALS

4-H Soil and Water Science, Level 1

- Begin to learn about soil and water resources.
- Learn basic terms and concepts.

4-H Soil and Water Science, Level 2

- Understand soil formation, stormwater, how to test water, soil health, and conservation practices.
- Develop an understanding of and appreciation for soil and water resources.

4-H Soil and Water Science, Level 3

- Understand why learning about soil and water resources is important.
- Educate others about soil and water science.
- Become a lifelong learner; continue to read and learn about soil and water science.

4-H LIFE SKILLS

4-H programs help youth develop knowledge and skills that help them become caring, competent adults. In "Targeting Life Skills in 4-H" (University of Florida IFAS Extension, 4-H FS

101.9) Norman and Jordan define life skills as competencies that assist people in functioning well in the environments in which they live. 4-H uses the Targeting Life Skills Model (Hendricks, 1998) to identify important assets that youth can learn through 4-H programming. The model uses the 4-H Pledge to categorize various life skills under four general competency areas: Head, Heart, Hands, and Health.

- **Head:** knowledge, reasoning, and creative competencies

  Thinking – using one's mind to form ideas and make decisions; to imagine; to examine carefully in the mind; to consider

  Managing – using resources to accomplish a purpose

- **Heart:** personal and social competencies

  Relating – establishing a mutual or reciprocal connection between two people that is whole some and meaningful to both

  Caring – showing understanding, kindness, concern, and affection for others

- **Hands:** vocational and citizenship competencies

  Giving – providing, supplying, or causing to happen; social responsibility

  Working – accomplishing something or earning pay to support oneself through physical or mental effort

- **Health:** health and physical competencies

  Living – acting or behaving; the manner or style of daily life

  Being – living one's life; pursuing one's basic nature; involved in personal development

Targeted life skills are listed for each activity in this curriculum to remind youth that they are learning more than subject matter knowledge. Facilitators should review the life skills to understand the overarching goals of the activity with respect to youth development.

THE EXPERIENTIAL MODEL

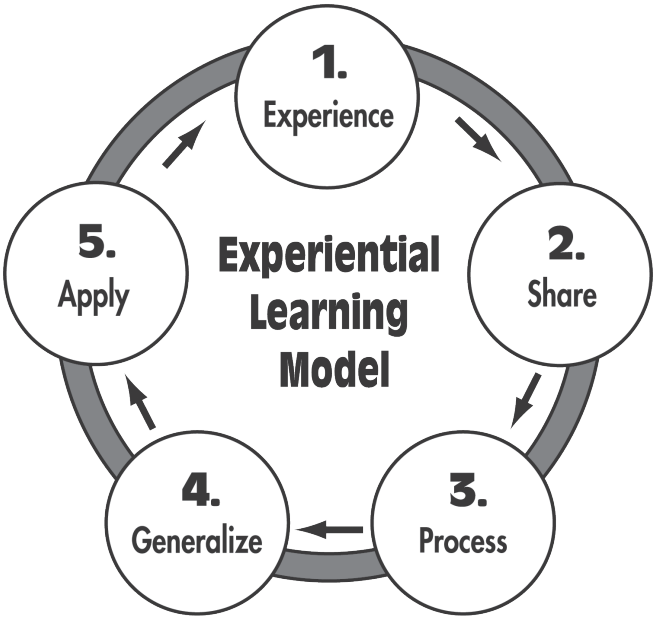
The 4-H National Headquarters Fact Sheet explains, "Experiential learning takes place when a youth is involved in an activity, looks back at it critically, determines what was useful or important to remember, and uses this information to perform another activity. 4-H uses this hands-on learning approach to teach new topics and life skills." Experiential Learning Principles, www.4-h.org/resource-library/curriculum/development/, July 2014.

Step	Excellent	Average	Minimal
Experience			
Share			
Process			
Generalize			
Apply			

The experiential learning model is a way of teaching to help youth make the most of any activity. It distinguishes 4-H activities from many other educational methods. Experiential learning is a process that allows youth to first learn by doing, before being told or shown how, and then to process the experience. Activities are designed so youth experience a learning activity; share what they did; process what they did through discussion, analysis, and reflection; generalize what they learned to test their comprehension and appreciation of the activity; and think about how they can apply what they learned to other situations.

Using the experiential learning process in group settings offers these advantages:

- The adult can quickly assess the youth's knowledge of the subject.
- The youth builds on past experience or knowledge.
- The adult acts as coach rather than as teacher.
- The youth relate the experience to their own lives and experiences.



Pfeiffer, J.W., & Jones, J.E., "Reference Guide to Handbooks and Annuals"
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- Mentors may use a variety of methods to involve the youth in the experience.
- Youth with different learning styles can be successful.
- Discussions can move from the concrete to the abstract and analytical, which particularly benefits youth in middle school and high school.
- Youth are stimulated to learn through discovery and to draw meaning from the experience.
- Youth can work together, share information, provide explanations, and evaluate themselves and others.
- Youth take responsibility for their own learning.

Evaluating youth learning using a simple rubric such as the one shown can help 4-H volunteer leaders assess the effectiveness of their teaching methodology and youth interest. Evaluate each step of the experiential model by indicating what you think the 4-H members learned in a particular activity (your best guess). Work on improving any low scores.

YOUTH DEVELOPMENT STAGES

Understanding the physical, mental, social, and emotional development of youth will help you when working with the 4-H members in your club. No two youth develop at the same rate, and transitions are often gradual. Your teaching and involvement helps 4-H club members grow and mature, and makes 4-H a rewarding and fulfilling experience.

Activities at 4-H club meetings are not always as successful as you, the volunteer leader, hope and plan for. Sometimes youth talk among themselves rather than listening to you; no one comes to a scheduled field trip; or no one speaks up to answer your questions when you are trying to involve the youth in a discussion. If you are working with a broad age range, the activity might be too simple for the older youth and too difficult for the younger ones. This is challenging for the 4-H leader. Giving the older 4-H members leadership opportunities can be effective.

Youth of the same age can vary greatly in physical, mental, social, and emotional growth and interests. These differences are even more marked between age groups. Research provides some generalities that can help you understand how to plan activities for different age groups.

EARLY ELEMENTARY (MINI 4-H)

This is an active age, so keep these children busy. They are concrete thinkers and need to understand what you want them to do and how to do it. They are generally more interested in making something than in completing a project — process is more interesting than product. Youth in this age group tend to seek adult approval and depend on adults, although their peers' opinions are beginning to be important. They do best in small groups with set rules and rituals. Competition is inappropriate for this age group.

UPPER ELEMENTARY

This is also a physically active age, so hands-on activities work best. Youth in the upper elementary grades are still fairly concrete thinkers — things are black and white, right or wrong — but

are beginning to think logically and symbolically. Because this age group has a strong need to feel accepted, an adult should evaluate each product, rather than encouraging competition among peers with only one winner. This age prefers to know how much they have improved against past efforts and how to improve in the future.

These youth are beginning to identify with peers but continue to value adult guidance. They are also beginning to discover the benefits of making other people happy, but more for the benefits to themselves rather than the benefit to others. They begin to take responsibility for their actions and to develop increased independence of thought, which might allow them to try new things. Letting this age group help in the decisions of the club helps them start learning about leadership.

MIDDLE SCHOOL

Middle school youth are beginning to move to more abstract thinking. Justice and equality are important to this age. Therefore, project judging may now be viewed in terms of what's fair as well as a reflection of self-worth. They prefer to find their own solutions, rather than adults giving them. Try to provide supervision without interference. Independent thinking and actions begins to emerge. Avoid comparing middle school youth with each other; compare performance with past accomplishments.

Junior volunteer organizations often are popular with teens toward the upper end of this age group, particularly with opportunities for developing leadership.

HIGH SCHOOL

Most high school-aged teens know their abilities, interests, and talents. They tend to be concerned with themselves and their peer group. While they can understand the feelings of others, they lean toward self-absorption, particularly in the earlier years of high school. Relationship skills are usually fairly well developed. Getting a driver's license increases both independence and dating, and acceptance by members of the opposite sex is important.

High school-aged youth begin to think about the future and make realistic plans. They enjoy career exploration and preparation. Their vocational goals influence the activities they select. Projects requiring research and creativity give teens an opportunity to demonstrate how much they have learned and what they can accomplish. Teens set goals based on their personal needs and priorities and generally reject goals that others set for them.

As teens master abstract thinking, they might try new ideas in ways that confuse adults. Teens can generally initiate and complete tasks without supervision. A leader can help by arranging new experiences in areas of interest to teens but must be sure to allow them plenty of input. Assume the role of advisor/coach for independent workers, rather than teacher/lecturer. Club meetings, rituals, and uniforms do not generally appeal to this group. However, many teens enjoy looking back on their achievements in 4-H and appreciate special recognition for leadership activities. By the time they graduate from high school and begin college or a career, youth feel they have reached full maturity and expect to be treated as such.

SOME FINAL THOUGHTS

These guidelines give only a brief overview of child and youth development as a resource to help you plan your activities as a volunteer leader. The publication Ages and Stages of Child and Youth Development* has more in-depth information and is available from your county Purdue Extension office.

You, as the club volunteer, are a valuable asset to your community and to your club's members. The guidelines for the stages of child and youth development, in combination with your special skills and interest in youth, will help you plan and carry out a successful 4-H program and make a positive impact on the lives of young people.

*Ages and Stages of Child and Youth Development, A Guide for 4-H Leaders, NCR-292, available at Purdue Extension's Education Store, www.edustore.purdue.edu; search NCR-292.

LEVEL 1 ACTIVITIES SUGGESTIONS AND ANSWERS

ACTIVITY: SPLASH EROSION

BIG PICTURE

Splash erosion starts the erosion process. Splash erosion is caused by the impact of a raindrop dislodging soil particles and creating a small crater in the soil. The detached soil particles are vulnerable, and water easily moves them. Splash erosion refers to the impact of one drop of water. Many water droplets collectively moving through a watershed cause runoff. Erosion is the process of soil being transported by water.

Surface runoff occurs when the rate of rainfall is faster than the rate that water soaks into the soil (infiltration). Surface runoff often carries loosened soil particles down a slope. Rainfall can cause soil particles to splash up to 2 feet high (vertically) and 5 feet away (horizontally) from their original position on level ground. When splash erosion occurs on a hill, more soil moves downhill due to gravity. Other factors such as slope and wind affect the direction and amount of erosion that occurs after particles have been displaced.

The impact of a raindrop begins the erosion process. When surface runoff occurs, detached particles are transported from their original place. So the goal of soil conservation is to stop detachment and transport. Soil residue slows these processes and helps hold soil in place.

FACILITATING THE ACTIVITY

Youth might find the picture helpful as they set up this experiment.

ESSENTIAL QUESTIONS

Apply: How might soil erosion be reduced?

- Youth might suggest cover crops, grassed waterways, or not farming highly erodible lands.

Generalize to Your Life: Why is it important to prevent soil loss?

- Healthy soil is required to produce the food and fiber that people need. A lack of adequate food can cause hunger and political instability.

NGSS: ESS2.A, 5-ESS2-1, 4-ESS2-1

Success Indicator: Youth can describe how splash erosion occurs.

ACTIVITY: WATER EROSION

BIG PICTURE

Erosion is the wearing away of land surface by rain or irrigation water, wind, ice, or other agents that abrade, detach, and remove soil from one point on the earth's surface and deposit it elsewhere. In the United States the cost of water and wind erosion each year is estimated in billions of dollars, because loss of the upper soil layer causes reduced productivity and soil pollution of water and air. Soil erosion is a global problem. It can contribute to instability in regions that are unable to produce adequate food and fiber.

Agricultural fields and gardens need healthy soil to be productive. The loss of topsoil reduces productivity. Soil that is left uncovered is more susceptible to erosion than soil that is covered. Therefore no-till practices and cover crops are recommended to retain soil. Youth in the 4-H Soil and Water Science project learn about conservation practices in other activities. In this activity, we focus on understanding how erosion occurs.

The factors that contribute to soil erosion by wind or water are climate, soil properties such as aggregation and soil moisture, soil cover, and land management (see Figure 1). Surface roughness, unsheltered distance, and wind velocity also contribute to the amount of wind erosion. Topography also contributes to water erosion.

Soil movement has some benefits. Soil nourishes floodplains, creates deltas and islands, and replenishes wetlands. In a more natural system, soil movement would occur on a more sustainable scale, and the loss of productive soils would not be an issue. However, many people are concerned that world urbanization, agricultural methods, and other modern-day impacts on soil have tipped the balance significantly. The concerns of soil movement include:

- Loss of excessive amounts of fertile soil
- Decrease in the depth of streams, rivers, lakes, and reservoirs . . .
- . . . Which can lead to increased water temperature, affecting aquatic species
- Increased water purification requirements

FIGURE 1. Factors of Soil Erosion

Wind Erosion	Water Erosion
Climate	
Soil Properties (aggregation and soil moisture)	
Soil Cover	
Land Management	
Surface roughness	
Unsheltered distance	
Wind velocity and turbulance	

FACILITATING THE ACTIVITY

Constructing the boxes and gathering the materials can be difficult for youth. They might need help finding and making them correctly. The boxes can vary in size. Working in groups with different soil types would be beneficial to compare the results and share some of the materials, such as the sprinkling can, stepladder, and fan.

Water erosion falls into five categories: splash, sheet, rill, gully, and stream bank erosion.

Type of Erosion	Scrambled Letters	Definition
Gully	LYGLU	A channel worn in the ground by running water after it rains. Gullies are deep enough that normal tillage does not smooth them over.
Rill	LIRL	A small channel only a few inches deep, caused by runoff water.
Sheet	STEEH	A thin layer of soil removed by runoff.
Splash	HSPLAS	Large raindrops loosen small particles of soil from the surface.
Stream bank	SATMRE AKNB (two words)	A running stream undercuts into stream banks, leaving "shelves" of soil, which then collapse into the streambed.

ESSENTIAL QUESTIONS

Apply: How might soil erosion be reduced?

- Home: planting native plants (prairie planting), installing rain gardens, or stabilizing stream banks.
- Agriculture: cover crops, residue (rough surface), grassed waterways, plant rows perpendicular to prevailing wind, strip cropping, planting crops of varying heights, or not farming highly erodible lands.

Generalize to Your Life: Why is it important to prevent soil loss?

- Healthy soil is required to produce the food and fiber that people worldwide need. A lack of adequate food can cause hunger and political instability.

CONNECTIONS

- Discuss local examples of soil erosion caused by water. Construction sites and agricultural crop fields are good places to look.

NGSS: ESS2.A, 5-ESS2-1, 4-ESS2-1

Success Indicator: Youth can describe different types of soil erosion caused by water.

ACTIVITY: WIND EROSION

BIG PICTURE

Wind erosion occurs when wind forces of about 13 miles per hour or more start to move soil particles. Soil-blowing usually starts on large, flat, open areas, exposed hilltops, in tracks or paths made by tractors or animals, and in corners or turnrows where excessive turning and cultivation have pulverized surface soils. Wind erosion is most common on sandy soils and muck soils, which are more easily windblown than silts and clays. The pore space around the larger sand particles allows them to be dislodged easier. The smaller pore space of silts and clays help hold the particle together, especially if they are wet or moist.

FACILITATING THE ACTIVITY

Youth might find the picture helpful as they set up this experiment. They should observe how wind can erode soil, and imagine that grass and plant residue might slow erosion.

ESSENTIAL QUESTIONS

Apply: How might splash erosion be reduced?

- Home: planting native plants (prairie planting), installing rain gardens, or stabilizing stream banks.
- Agriculture: cover crops, residue (rough surface), grassed waterways, plant rows perpendicular to prevailing wind, strip cropping, planting crops of varying heights, or not farming highly erodible lands.

Generalize to Your Life: Why is it important to prevent soil loss?

- Healthy soil is required to produce the food and fiber that people worldwide need. A lack of adequate food can cause hunger and political instability.

NGSS: ESS2.A, 5-ESS2-1, 4-ESS2-1

Success Indicator: Youth can describe how wind erosion occurs.

CONNECTIONS

- The Dust Bowl refers to a period of severe dust storms that occurred in the panhandles of Texas and Oklahoma and adjacent parts of New Mexico, Colorado, and Kansas in the 1930s. See Level 2, Soil Erosion, Connections, for more information.
- See the Purdue Driftwatch website, https://in.driftwatch.org/ (July 2014)