



4-H Water Wizards

Guided Inquiry Water Education
for grades 4-6

Developed by
Marianne Bird and Trisha Dixon



Virtual Adaptation by
Marianne Bird, Nicole Marshall-Wheeler, and Steven Worker



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UNIVERSITY OF CALIFORNIA
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■ 4-H Youth Development Program

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Carina Bell	Albert Chiem	Brandy Kloph	Sam Sandoval
Marianne Bird	Claudia Diaz	Sue Kong	Steven Worker
Montana Cariglio	Beryl Johnson	Nicole Marshall-Wheeler	Amy Xiong

For more information, please contact Marianne Bird at mbird@ucanr.edu, Nicole Marshall-Wheeler at nmarshall@ucanr.edu, or Steven Worker at smworker@ucanr.edu.

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Photos: Marianne Bird

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Welcome to 4-H Water Wizards

Guided Inquiry Water Education for Grades 4-6

4-H Water Wizards offers hands-on, minds-on activities designed not only to educate elementary school students about water and its importance, but to engage young learners as scientists themselves. The project balances the student's need for critical information about water with discovery through the process of doing science.



Project Overview

The University of California Cooperative Extension developed 4-H Water Wizards for implementation in afterschool programs where it was extensively piloted and refined. Classroom teachers have also implemented the curriculum, and the service-learning component makes it an especially adaptable as a project in 4-H Clubs. Whether delivered in formal (schools) or informal (afterschool or 4-H) learning settings, 4-H Water Wizards has proven easy to deliver and engaging for students.

4-H Water Wizards consists of 11 different sessions, some done over two days, but most of which can be completed in an hour. Activities fall into three areas:

Water and the Environment: The first four sessions explore how water moves through the environment including activities about the water cycle, watersheds, water pollution, and water conservation.

Water Properties: The middle four sessions encourage experimentation as youth explore water taste, salinity, density, and hardness.

Service-Learning Project: The last three sessions guide youth in understanding the importance of making a difference in their community and creating and implementing a plan to address a water issue of their choosing.

4-H Water Wizards addresses two related issues: the need for high-quality science education programming both in and after school, and the desire to foster a citizenry that understands and can make informed decisions about water. Water is a valuable and limited natural resource that is critical to communities, agriculture, and the environment. It is often the center of policy debate as communities contend with floods, drought, pollution, loss of ecosystems and how to allot this sometimes-scarce commodity. Yet water issues are also personal ones as individuals ponder conservation and how to keep waterways clean. Education is the first step in helping children appreciate and understand water and its role in their community.

Project Delivery

Originally designed for in-person delivery to class-size groups of children, the project has been revised for virtual or in-person delivery to small groups. Science education happens best in-person. However, with the proper planning and technology, on-line science experiences can still be rich experiences.

Curriculum Layout

Each session contains:

- **Time Needed:** How much time is needed for the activity(ies).
- **Next Generation Science Standards (NGSS):** The K-12 science content standards the session addresses. A full summary of the NGSS covered in this curriculum are listed in an appendix.
- **Vocabulary and Concepts:** Definitions of words and concepts presented in the session. Definitions are also found in the Water Glossary at the end of the unit.
- **Materials:** A list of all materials needed for the session, both for students and for educators.
- **Overview:** A brief description of the session's content and its relevance.
- **Purpose:** The learning outcomes for participants.
- **Background Information:** Provides basic information about the session topic to help the educator feel prepared to lead the activity. It is not meant to be lecture material presented to youth, but rather foundational information for the facilitator.
- **Introduction:** A brief description of each activity.
- **Session Outline:** Roadmap outlining session components and approximate times.
- **Getting Ready:** The preparation required prior to leading the session.
- **Experiencing:** One or more interactive segments where participants explore the session topic.
- **Sharing, Processing and Generalizing:** Questions that help the learner process the experience, facilitate reflection, and encourage concept application.
- **Application Suggestions:** Ideas for out-of-classroom activities that allow students to apply what they've learned in the session.
- **Educator Tips:** Helpful hints to facilitate session preparation, delivery, and safety.
- **Handouts:** Printed material to be duplicated for each student. These materials may be printed as a whole and combined into a "Student Lab Book" for each participant or printed and handed out for each session.
- **Educator Aids:** Charts or other materials the facilitator will use in processing data and discussion ideas for the whole group.

Each session has two options for delivery.

Virtual Delivery allows students to participate in the session remotely and requires access to online platforms like Zoom. Students will need a set of their own materials at home. In almost all instances, the educator facilitates group participation just as they would in-person, with occasional demonstrations where necessary.

In-Person Delivery is designed for small cohorts of children and considers social distancing and other health precautions. Students work independently with their own set of supplies, which the educator will have and distribute. This curriculum can be used in traditional education settings as allowed.

While teamwork—an important component of science education—is missing in both delivery options when doing experiments and building models, students participate in group discussions as they question, explore ideas, and problem solve together.

Materials

Most of the materials needed for the sessions are available at grocery or dollar stores, but some sessions require more specialized materials. Hydrometers can be purchased at many aquarium stores or found on-line.

The video *The Water Cycle* is available through the California Department of Water Resources, which also provides a variety of free and low-cost water education materials to educators. Session three uses an Enviroscape® model to show how pollutants enter the water system. Information for purchasing an Enviroscape® is found at www.enviroscapecom.com. These models may be available to borrow from local water districts or other groups who conduct water education in the community. Know it will take time to purchase and assemble materials, especially if items are packaged for distribution to students learning from home.

To simplify information, trade names of products have been used. No endorsement of products or services are granted or implied by the University of California, 4-H, the US government, or any of its organizational units or employees.

Recommendations for Virtual Delivery

4-H Water Wizards in the virtual format is designed to allow interaction between instructor and student and youth themselves. Things to consider when working in a virtual environment include:

- **Familiarize yourself with technology:** The 4-H Water Wizards curriculum does not specify any online learning software. In 2020, popular connectivity platforms included Zoom, Google Hangouts, and Skype for Business, yet platforms come and go. When selecting a virtual learning platform, make sure it includes (a) digital whiteboard or the ability to share screen so you can share posters and record notes; (b) break-out rooms; and (c) ability to share video. Young people often have vast experience in digital tools, media, and websites. Tap into their expertise and invite them to offer options and, together as a group, select digital tools to enhance the learning experience.
- **Prepare:** Before engaging with students, make sure you are fully prepared to facilitate the educational experience. Understand the session, its objectives and concepts. Make sure your video equipment captures what you want or need the students to see. Check web-based links and pull up Google documents, if the session requires them. If possible, have a second adult help manage the logistics of the session.
- **Focus on relationships.** Youth-adult relationships are an essential part of learning. Youth need positive, sustained, and trusting relationships with caring, competent, and committed adults, in a traditional in-person program or in an online program. Educators should be present in three ways: (a) socially by creating connections with youth and becoming aware of their interests and abilities; (b) practically, though facilitating the learning experience; and (c) cognitively to support each young person as they develop knowledge and skills.
- **Recognize missteps happen:** Inevitably, things will not go as planned. Perhaps students don't have supplies or learners (and perhaps yourself) experience connectivity issues. It's okay! Be flexible and recognize we're all learning in this virtual space. Stay positive and adapt as you go.

Consider a Field Trip

A trip to a water-related place can solidify what students learn in 4-H Water Wizards. Water education centers, water agencies, treatment plants, dams, wetlands, creeks, and habitats dependent upon water are scattered throughout our communities. Plan a field trip or invite a speaker if you can't get away.

Doing—Not Talking—Science

The learn-by-doing philosophy 4-H embraces encourages children to build their own knowledge through activities, discussion, and reflection. Allowing learners to discover through exploration is not easy for many adults: the temptation is to tell information. Yet developing deductive reasoning skills requires asking questions, hypothesizing, experimenting, analyzing, concluding. For those facilitating the process, it requires trust that learners will discover on their own.

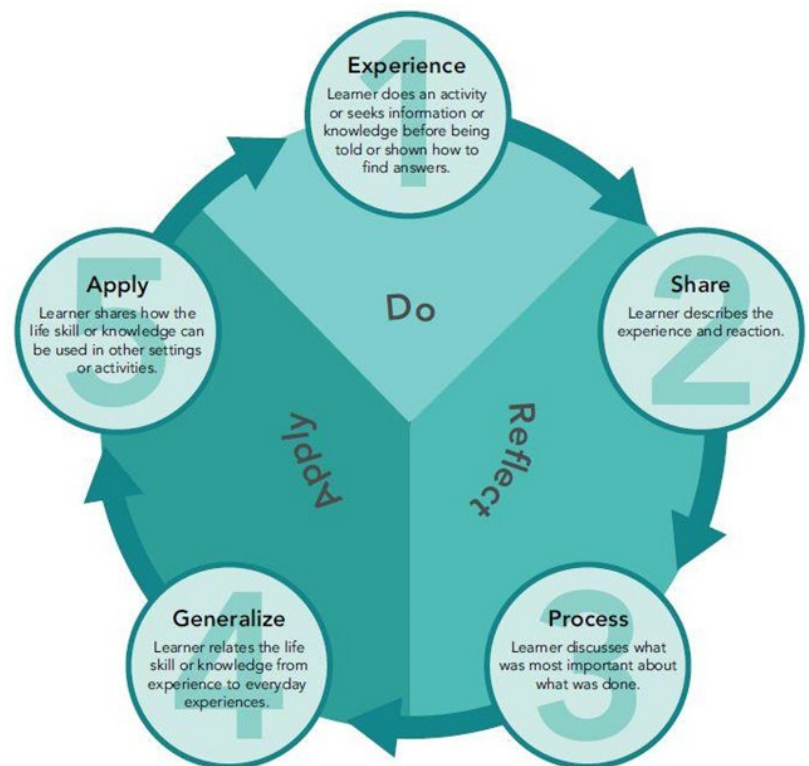
4-H Water Wizards builds in opportunities for children to be scientists: constructing models, experimenting, collecting and comparing data, and sharing findings through graphs and pictures and words. Each session outlines the Next Generation Science Standards—the practices, core ideas and crosscutting concepts central to building science knowledge and skills—that youth will experience through the activity.

Experiential Learning Cycle

Experiential learning is a cyclical process where learners have opportunities to construct meaning through experiences. The Experiential Learning Model (Kolb, 1984) includes a concrete hands-on experience; a reflection phase where students share and process the experience, and the opportunity for youth to generalize and apply new skills and knowledge.

The Experiential Learning Cycle guide 4-H Water Wizards and are imbedded in the curriculum.

- **Experiencing:** This includes introductory questions and prompts to get students thinking about the topic they're about to explore, then the procedures and instructions for a hands-on activity.
- **Sharing, Processing, Generalizing:** Students question, share, and compare their observations. Often, some of the sharing and processing takes place during the “experiencing” phase, however it is important for the group to reflect after the activity. During this phase, ensure students have discovered or been introduced to the session’s primary learning objectives and concepts.
- **Application:** The true test of learners’ understanding is when they can apply new knowledge and skills to authentic situations. Hands-on activities serve as vehicles for learning new concepts and skills to apply to real-world situations. It is important to provide students specific opportunities where they will use what they learned.



Summary

Water is an excellent topic to spark curiosity, encourage investigation, and apply learning. Water surrounds us and is a substance on which everyone relies. Its presence in our lives naturally draws us to wonder and think deeper as we begin to explore its properties. It is a topic that appears regularly in the news, allowing students to connect what they're learning to a broader context. It's exciting to watch learners—not only young people who participate in the project, but also the adults trained to deliver it—develop their own questions or experience the “Ah-ha!” moment, when they tie an activity to their own life experience.

Most importantly, allow students to ask and explore their own questions. Trite as it may sound, science really is a journey, not a destination. Have fun, and enjoy the journey!

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Upper Saddle River, NJ: Prentice Hall.



Session 1: The Water Cycle – Nature’s Recycling System

What is the water cycle?



Overview

Activities in this session will help students understand that there is no new water and how water cycles in our world. Water is in perpetual motion: With heat, water evaporates and becomes a gas. As it rises and cools the gas becomes a solid and falls back to the earth as rain or snow. Finally, water accumulates in lakes, rivers, and oceans where the cycle begins again. Students come to appreciate that water is limited and the importance of conservation.

In Activity 1, students will explore what they know about water, watch a short video on the water cycle, and create a picture or poster of how water travels through the water cycle. Through an experiment in Activity 2, the group investigates evaporation and what enhances it. They will observe evaporation’s role in making rain in the water cycle.

Next Generation Science Standards

Describe ways the geosphere, biosphere, hydrosphere, and atmosphere interact.

Practices: Analyzing and interpreting data; Obtaining, evaluating, and communicating information

Disciplinary Core Idea: Earth systems interact in multiple ways to affect Earth’s surface

Crosscutting Concept: Energy and matter: Flows, cycles, and conservation

Purpose

Students will:

- Understand how nature recycles water
- Learn terms that relate to the water cycle
- Explore one of the water cycle terms: evaporation

Time Needed

Activity 1: 55-60 minutes

Activity 2: 55-60 minutes (done over two days)

Day 1: 35 minutes

Day 2: 20 minutes

Materials

For Educators	For Students	
1. Link to video or DVD: The Water Cycle from the California Department of Water Resources	1. Blank paper	6. Permanent marker
2. Water Knowledge Chart (for virtual delivery)	2. Crayons or colorful felt-tip markers	7. Plastic wrap
3. Flip chart and markers (for in-person delivery)	3. Sponge	8. Rubber band
4. Sponge (for in-person delivery)	4. Three plastic cups	9. Measuring cups
5. Access to water (for in-person delivery)	5. Ruler	10. Access to water

Background Information (for educator only)

The definition of recycling is “To put or pass through a cycle again; to use again, especially to reprocess” (www.thefreedictionary.com/recycle). Nothing fits that definition better than the water cycle. The water (hydrologic) cycle is a perpetual motion – a natural process of water molecules recycling from the land, the air, and back to the land.

The sun’s energy warms water, which is transferred as vapor from oceans, lakes, and land into the atmosphere. This is the evaporation stage of the cycle.

Once in the atmosphere, the vapor forms clouds, the condensation stage of the cycle. Water molecules attach themselves to dust in the air. Eventually the water vapor in the air becomes heavy and falls to the earth as rain or snow. This is called precipitation. Whether the water ends up as a raindrop, snow crystal, or hail, is dependent upon the season, location, and climate. Not all the water will reach the earth. Some will evaporate on the way down and then return to the atmosphere to start the process over again.

On the ground, water gathers as snow and ice, in surface water, and in the soil. This is called the accumulation phase of the cycle. Most of the water infiltrates into the soil. Excess water travels across the land’s surface into various bodies of water like creeks, rivers, and lakes. Then the process returning the water back into the atmosphere begins again.

Water can be a gas, a liquid, or a solid. As water travel through the water cycle it changes states. When water molecules are heated, they become a gas and rise into the atmosphere. The air around us contains water, even if we can’t see it. When water freezes it becomes a solid like snow and ice.

Though relatively small in the scheme of the water cycle, living things also play a part. When people and animals breathe, they release water vapor. This is called respiration. We also drink and release water. Plants, too, take in water through their roots, and release water as vapor through their leaves in the process of photosynthesis. This is called transpiration.

Another term associated with the water cycle is infiltration. Infiltration is the process by which water seeps into the earth where it accumulates as groundwater. Groundwater is stored in natural aquifers or continues to move through the earth to the ocean.

This is how nature recycles water. Water changes form and is used, stored, and reused. There is no new water.

Vocabulary and Concepts

Accumulate: To pile up, gather, collect.

Atmosphere: The layer of air surrounding the earth.

Aquifer: A layer of permeable rock, sand, or gravel through which groundwater flows, containing enough water to supply wells and springs.

Condensation: The conversion of a vapor or gas to a liquid.

Evaporation: To remove moisture; to change a liquid or a solid into vapor.

Hydrology: The study of water, its properties, laws, and distribution.

Infiltrate: To pass through a substance by filtration, or to make a liquid or gas pass through a substance by filtration.

Molecules: The smallest parts of an element or compound that can still exist and keep the characteristics of that element or compound.

Precipitation: Rain, hail, sleet, and snow.

Respiration: The process by which a living organism or cell takes in oxygen from the air or water, utilizes it and gives off products of oxidation such as water vapor and carbon dioxide.

Transpiration: The passage of water through a plant from the roots, through the vascular system in the leaves, to the atmosphere.

Vapor: A gas, such as mist, fog, steam, and or clouds.

Virtual Delivery

Activity 1: Exploring the Water Cycle

Introduction

Students begin their exploration about water by brainstorming what they know and what they'd like to know about water. They view a video and become familiar with parts of the water cycle. They then work to create a water cycle poster.

Session Outline

Activity 1	Time
Welcome and opening questions	5 minutes
Experiencing	
• Brainstorming session: Water Knowledge Chart	10 minutes
• Watch video: The Water Cycle	15 minutes
Sharing, Processing, Generalizing	
• Create a water cycle poster	25 minutes
Assign and explain at home evaporation experiment with sponge	5 minutes

Getting Ready

1. A few days in advance, package materials for students to pick-up. Or share the materials list and ask students to gather the materials at home. Make sure to include the necessary pages from the Student Lab Book.
2. Pull up the Water Knowledge Chart located at the end of this session.
3. Load the video: The Water Cycle, from either DVD or online.
4. Be prepared to share your screen with the students.

Experiencing

1. Gather students together. Tell them that for the next several weeks they will be exploring something that they use every day, probably without thinking much about it. In fact, all living things use it. Do they have an idea of what this is?
2. **Brainstorming What We Know:** Ask the students to brainstorm what they already know about water. Sharing your screen, record their responses on the Water Knowledge Chart under the "What we know about water" title.
3. **Brainstorming What We Want to Know:** After students have shared their knowledge about water, ask them what they don't know about water that they'd like to know. What questions do they have about water? Record these on the other side of the Water Knowledge Chart under the "What we want to know about water" heading.

Educator Tip: *Students may need some questions to prompt their thoughts about water. You may want to have some ready like, “Where does water come from?” or “How do we use water?” When students share an answer or an idea, repeat what they say to assure all students hear what is said.*

4. Tell the students that today they’re going to begin their exploration of water by learning about the water cycle. Tell them that they’ll watch a video about the water cycle and afterwards will work to create a water cycle poster.
5. **Video:** Play the DVD or linked video online, [The Water Cycle](#), from the California Department of Water Resources.
6. When the video is over, ask the students to share something new about water that they didn’t know before. Why should we care about water?

Sharing, Processing, Generalizing

1. **Creating the Water Cycle Poster:** Have each student get out a piece of paper and crayons or markers. Allow 15-20 minutes for the students to create their posters.
2. At the end of the poster-making session, ask each student to share their water cycle posters. What did they choose to include? Ask students how the posters are similar. How are they different? Use this as an opportunity to check for understanding.

Assign Sponge Experiment

1. Tell students that in the next activity they are going to take a closer look at a part of the cycle called *evaporation*. Ask the students what they know about evaporation.
2. **Explain Evaporation Assignment.** Tell students that before the next Activity, students will have a short assignment. Have students wet their sponge, then go outside to a sunny stretch of sidewalk or street. Have students swipe the wet sponge across the sidewalk and watch as the wet spot disappears.
3. **Debrief:** Students will debrief this experiment at the beginning of the next Activity.

Educator Tip: *The sponge evaporation experiment works best in a sunny location.*

Application Suggestions

Have students consider where they see different aspects of the water cycle in their own lives. Condensation can be found in half-full water bottles left in a hot car. Accumulation can be seen in puddles in the street after it rains. Evaporation can be found in steam coming off a hot pot of water. Precipitation can be seen when it rains.

Students can experience “respiration,” the process by which living organisms take in oxygen from the air and give off water vapor. Have students exhale into a clear, plastic cup and see and feel the moisture left on the inside of the cup.

Educator Tip: *Save the “Water Knowledge Chart” for future reference.*
