REVIEWED & RECOMMENDED
National 4-H Curriculum

Product Number 08420

There's No New Water!

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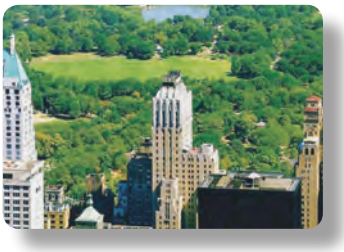

Conceptual Framework

There's No New Water! is a water conservation and water quality curriculum grounded in a simple yet powerful concept that water is a non-renewable, finite natural resource whose quantity and quality must be responsibly preserved, protected, used, and reused. As authors Maude Barlow (*Blue Covenant and Blue Gold*) and Tony Clarke state in their landmark article "Who Owns Water?" (2002): "The world is running out of freshwater… With every passing day, our demand for freshwater outpaces its availability, and… unless we dramatically change our ways, between one-half and two-thirds of humanity will be living with severe freshwater shortages within the next quarter-century." Corral-Verdugo, Bechtel, & Fraijo-Sing (2003) further corroborate this need by stating: "Water conservation represents one of the most important pro-ecological activities to be modeled and developed for a sustainable way of life on this planet."

On a national level, the water issue is at the forefront of many debates and discussions regarding usage and conservation. In April 2008, the National Science Foundation featured water as one of three topics in the "Bridges to the Future" webcast exploring best ideas for improving American infrastructure in the 21st century. Furthermore, as noted by Dr. Peter Gleick in his July 2008 interview about reliance on water in the United States: "If there was more education and awareness about water issues, if we started to really think about the natural limits, about where humans and ecosystems have to work together to deal with water, if we were to start to think about efficient use of water, we could reduce the severity of the problems enormously."

The *There's No New Water!* curriculum is designed for high school age youth, with six sequential learning modules that utilize effective pedagogy and scaffold learners' knowledge and skills. The curriculum begins with an exploration of the natural water cycle; explores human interventions that affect water quality and quantity; examines the effects of the urban/rural interface on water quality and quantity; includes the identification and implementation of service-learning projects that address local water conservation issues; and culminates with a set of activities for younger youth and families designed to be led by teens as teacher. Furthermore, a unique feature of this curriculum involves youth using GPS technologies as tools for mapping local watersheds and associated human interventions (e.g., waste water treatment

Teaching and Learning Strategies

All activities in the *There's No New Water!* curriculum are designed around the use of inquiry and experiential learning. Inquiry is a teaching strategy where individuals are engaged in learner-centered activities that involve observing and manipulating objects and phenomena and acquiring or discovering knowledge. The process is steeped in experience and focuses on development of logical thinking abilities and on learning and applying content knowledge (Kolb, 1984).

Experiential learning (EL) involves youth having a concrete experience, a reflection phase where the learner's observations and reactions are shared and discussed, and lastly a phase where learners' new knowledge and skills are applied to a real-life setting. The 5-step learning cycle – Experience, Sharing, Processing, Generalizing, and Application – is a commonly used model (Figure 1). The five steps are part of a recurring process that helps build learners' understanding over time. All activities in the *There's No New Water!* curriculum are designed to include these steps in sequential fashion.

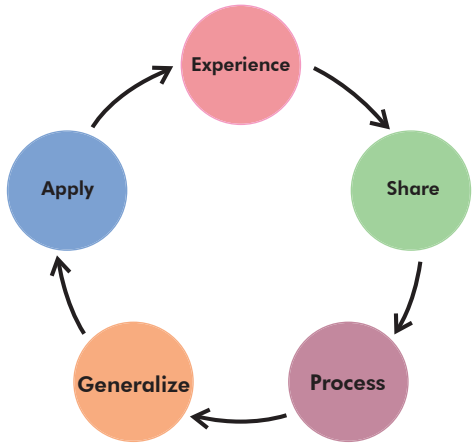

Figure 1: 5-Step Experiential Learning Model

For more information on inquiry, EL, and the 5-step learning cycle, please visit the University of California's Science, Technology, Environmental Literacy Workgroup's Experiential Learning website at: http://www.experientiallearning.ucdavis.edu/

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Module 1
The Natural Water Cycle

Background Information

Water is unique in that it exists naturally as a solid, liquid, and gas. When we think of places on Earth where we find water, we often think of bodies of water that are familiar to us, such as lakes, oceans, or streams. However, are these the only places we find water, and how much of this water can be used directly to help support life on Earth? The distribution of water on Earth (**global water distribution**), its form (solid, liquid, or gas), and the **natural water cycle** influence the lives of plants, animals, and humans in a number of ways.

Although water covers 70-75% of the Earth's surface, most of it (97.2%) is found in the world's oceans in the form of **saltwater**. A small amount of saltwater is also found in inland bodies of water like Utah's Great Salt Lake. Saltwater cannot support terrestrial life (life on land) because of its salinity (salt content). Only plants and animals with special adaptations to live in saltwater are able to survive in these environments. The remaining water on Earth (2.8%) is **freshwater**; however, most freshwater is frozen as icecaps and glaciers and thus unavailable to terrestrial life. Therefore, less than 1% of the Earth's water can be used by terrestrial plants and animals, and this is available as groundwater, freshwater lakes and streams, and water vapor in the atmosphere.

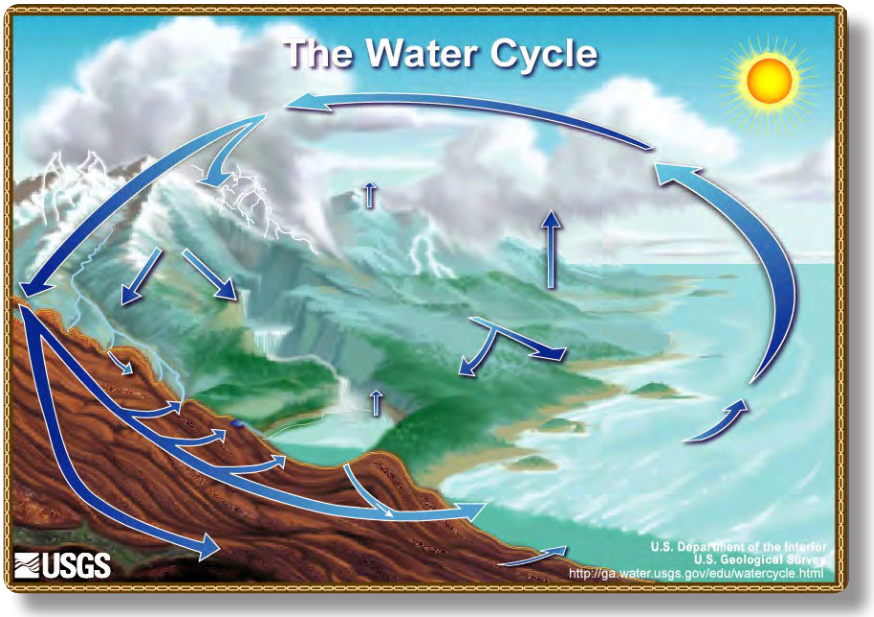
Water is distributed from one geographic location to another through the natural water cycle. Water from streams, lakes, oceans, or the soil enters the water cycle through the process of **evaporation**, which occurs when energy from the sun converts liquid water into water vapor. Water can also enter the water cycle via **transpiration**, which is the release of water vapor by plants.

Once in the atmosphere, water vapor is referred to as **humidity**, and warm air holds much more water vapor than cold air. When water vapor rises to higher elevations in the atmosphere it cools and **condenses**, which results in the formation of clouds. **Precipitation** results when water in a liquid (e.g., rain) or solid (e.g., snow) falls from clouds to the Earth's surface. Precipitation occurs when the atmosphere is saturated (humidity is at 100%) and the solid or liquid water in the atmosphere becomes too heavy to remain suspended in the clouds.

While most precipitation falls on the ocean, that which falls on land may be used by plants, but some may make its way to deep water storage areas consisting of porous spaces in the soil and rocks and is called **groundwater**. Groundwater is the source of water for aquifers, springs, and wells. Water that is not absorbed or retained by the soil creates **surface runoff** which can result in **soil erosion**. Water that falls to the Earth as precipitation might also enter into a body of water – a stream, lake, or pond – directly; or, it may become part of a layer of snow in a mountainous region and will be absorbed by the soil or enter a body of water when it melts in the springtime.

An area of land where groundwater and surface runoff drain to the lowest point in that region is referred to as a **watershed**. Water typically flows into small streams that converge into large ones that move surface water toward an ocean. Watersheds come in all shapes and sizes, and there are well over 2,000 in the continental United States alone! Water within any watershed – whether it's in the soil or in a body of water such as a stream or lake – can reenter the water cycle again through evaporation or transpiration.

Humans interact with the environment in a variety of ways, some of which can be beneficial to the Earth's ecosystems and others which can be harmful. Water helps sustain human life as a nutritional necessity and it also supports residential, agricultural, recreational, and industrial activities. However, finite amounts of water move through watersheds and it must be used wisely so it can support the natural environment and human activities. Thus, as human populations grow and human impacts on watersheds increase, the protection, development, and efficient management of water supplies through **water conservation** efforts and efforts to maintain water quality become increasingly more important.



Activity 1
Where in the World is Water?*

Activity Overview
Over two-thirds of the Earth is covered by water! However, the vast majority of this is in the form of saltwater located in the world's oceans and cannot be used to support life on land. This activity will help provide youth with a general understanding of global distribution of water and will lead to subsequent activities that explore the water cycle and the distribution of saltwater and freshwater in more detail.

Time Required
- 20-30 minutes

Concepts and Vocabulary
- Freshwater: Water on the surface of the Earth that has very low amounts of dissolved salts. Freshwater is found principally as groundwater and in lakes and streams.
- Global water distribution: Approximately 97% of all water on Earth is in the ocean. Most freshwater is in the form of glaciers and icecaps. Less than 1% of all water on Earth is useable freshwater.
- Saltwater: Water on the surface of the Earth that has high amounts of dissolved salts. Saltwater is found principally in oceans.

Life Skills
Activities that promote positive youth development advance the development of life skills. Life skills promoted though this activity include:
- Head: Wise Use of Resources, Critical Thinking
- Heart: Sharing, Cooperation, Communication
- Hands: Teamwork
- Health: Self-discipline

Volunteer Tip: For more information on life skills, please visit http://www.extension.iastate.edu/4h/lifeskills/

Subject Links
- Science, Math, and Physical Education

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National Science Education Standards Supported

- Unifying Concepts and Processes Standard - Fundamental science concepts that unify and connect scientific disciplines.
- Content Standard A: Science as Inquiry Standards
  - Abilities necessary to do scientific inquiry.
  - Understanding about scientific inquiry.
- Content Standard F: Science in Personal and Social Perspectives
  - Science and technology in local, national and global, challenges - Everyone needs a basic level of science understanding in order to participate fully in civic processes that can impact the environment.

Volunteer Tip: For more information on the National Science Education Standards, please visit http://www.nap.edu/openbook.php?record_id=4962

Suggested Groupings

- Groups of 5-10 youth (each group has one recorder)

Materials Needed for Each Group

- 12-inch inflatable globe outlining continents and oceans (Can be obtained at most toy stores; also available online.)
- Flip chart paper
- Writing implements (e.g., markers)
- Calculator

Getting Ready

- Subdivide the youth participants into small groups.
- Provide each group with the materials needed.

Opening Questions/Prompts

Ask participants to respond to each question/prompt below by sharing their ideas verbally or recording them on the flip chart paper provided.

- Describe some things you know about water.
- Describe why you think water is important to humans. Why do you think water is important to plants and animals?
- Predict how much water on the Earth's surface is freshwater and how much is saltwater.

Petr Kratochvil

Procedure (Experiencing)

1. Have each group inflate their globe and stand in a circle. Ask one youth to be the recorder.

2. Standing in a circle, have the youth play "soft toss" catch, throwing the globe to one another. Each group should make 100 tosses.

3. After each toss, ask the youth who catches the globe to look where his or her left thumb is on the globe - water or land?

Volunteer Tip: Land only counts if it is a continent or major land mass such as Cuba or Greenland; small islands do not count.

4. Have each group's recorder keep a record of how many times someone catches the globe on water and on land.

5. Based on what the youth observed during this activity, ask them to again predict how much water on the Earth's surface is freshwater and how much is saltwater.

6. Ask the recorder to total the numbers for all groups and determine the percentages. Share these results.

Volunteer Tip: The percentage of catches made "on land" will be roughly equivalent to the amount of the Earth's surface covered by land; the percentage of catches made "on water" will be roughly equivalent to the amount of the Earth's surface covered by water.

Sharing, Processing, and Generalizing

Follow the lines of thinking developed by the youth as they share and compare their thoughts and observations; if necessary, use more targeted questions as prompts to get to particular points. These may include:

1. Share your observations and thoughts about the distribution of water on the Earth.

2. Share your thoughts on this new knowledge as it relates to what you know or wonder about where plants and animals might live and why they live there.

Note: Ask participants to share their ideas verbally or record them on the flip chart paper provided.

Concept and Term Discovery/Introduction

At this point, it is important to ensure that the terms freshwater and saltwater, and the concept of global water distribution have been introduced or discovered by the youth. (**Note**: The goal is to have the youth discover terms and concepts on their own.) If their calculations are accurate, the youth should have discovered that approximately two-thirds of the Earth's surface is covered by water, and most of it is in the world's oceans as saltwater; the remaining water is freshwater.

Concept Application

The true test of learners' understanding is when they can apply new knowledge and skills to authentic situations. When engaging youth in inquiry-based learning, hands-on activities serve as vehicles for learning new concept knowledge and skills; however, it is the application of new knowledge or skills to independent, real-world situations that is the critical factor in the learning process. Thus, to complete the cycle of experiential learning it is important to intentionally provide youth specific opportunities for authentic applications. Suggestions for real-world applications for the *Where in the World is Water* activity include:

- Determine the distribution of water in your community, county, region, or state. Prepare a short report that estimates what percentage of your state is made up of land versus water. How much of your state's water comes from lakes? From ground water or rivers?

- Discuss with friends or family why water conservation in your home or community might be important. Share ideas with other youth and community members.

Volunteer Tip: Youth can check their family's water bill and make month-to-month comparisons of water usage.

Steven Worker

Activity 2
H_2O By the Numbers

Activity Overview
Water is found in different forms and in different places on the Earth. This activity will help youth understand the distribution of water globally by challenging them to identify different sources of water and calculate percentages for each source based on a simulation of the Earth's total supply of water.

Time Required
- 25-35 minutes

Concepts and Vocabulary
- Freshwater: Naturally occurring water on the surface of the Earth that has very low amounts of dissolved salts. Freshwater is found principally as groundwater and in lakes and streams.
- Global water distribution: Approximately 97% of all water on the Earth is in the oceans. Most freshwater is in the form of glaciers and icecaps. Less than 1% of all water on Earth is useable freshwater.
- Groundwater: Water located in open pore spaces below the surface of the Earth.
- Lake: A large inland body of standing water. Most lakes are filled with freshwater.
- Polar ice caps and glaciers: Freshwater frozen on land and in the ocean, typically occurring at extreme altitudes and latitudes.
- Saltwater: Naturally occurring water on the surface of the Earth that has high amounts of dissolved salts. Saltwater is found principally in oceans.
- Rivers: Water that has a steady current, flowing through a channel or bed (e.g., river).
- Water conservation: The protection and/or efficient management of water resources.
- Water vapor: Water in a gaseous state.

Peter Griffin

Life Skills

Activities that promote positive youth development advance the development of life skills. Life skills promoted through this activity include:

- Head: Critical Thinking
- Heart: Sharing, Cooperation, Communication
- Hands: Teamwork
- Health: Self-discipline

Volunteer Tip: For more information on life skills, please visit http://www.extension.iastate.edu/4h/lifeskills/

Subject Links

- Science and Math

National Science Education Standards Supported

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- Content Standard F: Science in Personal and Social Perspectives
  - -Natural resources - Realizing the impact humans can have on the natural ecosystem.
  - -Science and technology in local, national and global challenges - Everyone needs a basic level of science understanding in order to participate fully in civic processes that can impact the environment.

Volunteer Tip: For more information on the National Science Education Standards, please visit http://www.nap.edu/openbook.php?record_id=4962

Suggested Groupings

- Small groups of 4-6 youth

Materials Needed for each Group

- One five-gallon container (e.g., aquarium; bucket; bottle)
- Writing instrument, preferably markers
- One piece of flip chart paper
- Basic calculator
- Measuring cup
- 5 paper cups
- One set of measuring spoons (1 TBSP; 1 TSP; ¾ TSP; ½ TSP; ¼ TSP)

Getting Ready

- Provide each group with the materials needed for the activity.
- Divide youth into groups of 4-6 individuals.

Opening Questions/Prompts

Ask participants to respond to each question/prompt below by sharing their ideas verbally or recording them on the flip chart paper provided.

- Share some things you know about water.
- Please explain what you know or wonder about natural sources of water.

Procedure (Experiencing)

1. Ask each group to fill their 5-gallon container (1280 TBSP) with water. Tell them that this represents all of the water on the Earth.

2. Label 5 paper cups, a-e.
   Using the measuring spoons, have the youth calculate and then extract the following amounts from the 5-gallon container, placing each amount of water into the paper cups labeled a-e.
   a. 0.0002%
   b. 0.001%
   c. 0.0078%
   d. 0.76%
   e. 1.7%
   f. 97.5%

Volunteer Tip: 5 gallons = 80 cups = 1280 TBS = 3840 TSP.

3. After completing all measurements and calculations, have the youth discuss the possible natural water sources that the 6 containers (paper cups a-e; 5-gallon container) represent.

Volunteer Tip: *A Volunteer Key* that outlines the different natural water sources and the percentages of the Earth's total water supply is found as an appendix for this activity.

Sharing, Processing, and Generalizing

Once the youth have completed their measurements, have them reflect on the observations, comparisons, and results of their explorations. If necessary use more targeted questions as prompts to get to particular points, such as:

1. How, in your opinion, does this activity reflect the distribution of water on the Earth?
   Ask the youth to write their thoughts and ideas on the paper provided.

2. Explain how this activity might help demonstrate the need for water conservation.
   Ask the youth to write their thoughts and ideas on the paper provided.

Note: Ask participants to share their ideas verbally or record them on the flip chart paper provided.

Concept and Term Discovery/Introduction

At this point, it is important to ensure that the concepts of global water distribution and water conservation have been introduced or discovered by the youth. Additionally, important terms to introduce include: saltwater; freshwater; groundwater; lakes; streams, and water vapor. (**Note**: The goal is to have the youth discover terms and concepts on their own.)

Concept Application

The true test of learners' understanding is when they can apply new knowledge and skills to authentic situations. When engaging youth in inquiry-based learning, hands-on activities serve as vehicles for learning new concept knowledge and skills; however, it is the application of new knowledge or skills to independent, real-world situations that is the critical factor in the learning process. Thus, to complete the cycle of experiential learning it is important to intentionally provide youth specific opportunities for authentic applications. Suggestions for real-world applications for the H_2O *by the Numbers* activity include:

- Determine the major sources of freshwater in your community. Ground water? Surface water (lake & streams)? Another source?
- Estimate the amount of water your family uses at home.
- From these data, develop a plan to conserve water at home. Review this list with your parents or care givers and try to estimate how many gallons of water you conserve weekly or monthly after implementing your plan.

Volunteer Tip: Visit Water Science for Schools USGS at http://ga.water.usgs.gov/edu/sq3.html to find quantities of water used in household activities.

APPENDIX

Volunteer Key:

5 gallons = 80 cups = 1280 TBS = 3840 TSP

- a. **Rivers** = Less than a water drop - .007TSP/3840 TSP = .0002% = amount of freshwater in world's streams.
- b. **Water vapor** = Less than a water drop - .03TSP/3840TSP = .001% = amount of freshwater in the atmosphere as water vapor.
- c. **Lakes** = ¼ TSP / 3840TSP = .0078% = amount of freshwater in the world's lakes.
- d. **Groundwater** = 9 ¾ TBS/1280 TBS = .76% = amount of the world's freshwater in groundwater.
- e. **Polar ice caps and glaciers** = 22 ½ TBS/1280 TBS = 1.76% = amount of the world's freshwater in polar ice caps and glaciers.
- f. **Oceans and other saltwater sources** = 1248 TBS/1280 TBS = 97.5% = amount of water in the form of saltwater on the Earth's surface.