# Water Conservation Specialist 101

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## STANDARDS

**Next Generation Science Standards (NGSS)**

*HS-ESS2-2*: Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth's systems.

*HS-ESS2-5*: Plan and conduct an investigation of the properties of water and its effects on the Earth's materials and surface processes.

**California's Common Core State Standards (CCSS)**

**Math**

*Numbers and Quantities:( N-Q)*

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
2. Define appropriate quantities for the purpose of descriptive modeling.

**ELA Literacy**

*Reading Standards for Informational Text* (Grades 11-12)

7. Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

*Reading Standards for Literacy in Science and Technical Subjects* (Grades 11-12)

3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

*Writing Standards* (Grades 11-12)

4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3.)
7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

*Speaking and Listening Standards* (Grades 11-12)

1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners *on grades 11-12 topics, texts, and issues,* building on others' ideas and expressing their own clearly and persuasively.
2. Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

**California Career Technical Education Model (CTE) Curriculum Standards**

**Agriculture and Natural Resources**

*Pathway E. Forestry and Natural Resources Pathway*

E2.6 Analyze the way in which water management affects the environment and human needs.

**Energy, Environment, & Utilities**

3.0 *Career Planning and Management*: Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans. (Direct alignment with SLS 11-12.2)

3.1 Identify personal interests, aptitudes, information, and skills necessary for informed career decision making.

3.2 Evaluate personal character traits such as trust, respect, and responsibility and understand the impact they can have on career success.

3.3 Explore how information and communication technologies are used in career planning and decision making.

3.4 Research the scope of career opportunities available and the requirements for education, training, certification, and licensure.

3.5 Integrate changing employment trends, societal needs, and economic conditions into career planning.

3.8 Understand how digital media are used by potential employers and postsecondary agencies to evaluate candidates.

## Becoming a Water Conservation Specialist

- Define sustainability
- Explain the impacts of greenhouse gases on the atmosphere
- Demonstrate a scientific understanding of the causes & consequences of climate change
- Understand the connection between wasting and energy – wasting water wastes energy and vice versa
- Understand the water cycle by observing condensation, evaporation, and precipitation in an experiment
- Understand that water is a precious and limited resource
- Identify and analyze the major ways we use water in our society
- Describe the process of pumping, treating, and distributing water and re-construct the treatment process through an experiment
- Evaluate the human impacts on the water cycle

## Vocabulary

**Water Cycle:** The water cycle describes the continuous movement of water on, above, and below the surface of the Earth

**Transpiration**: Water within a plant that is released into the atmosphere through its leaves

**Sublimation:** The transition of a substance directly from the solid to the gas phase without passing through an intermediate liquid phase

**Infiltration:** The process by which water on the surface enters the soil

**Surface Runoff:** The flow of water that occurs when excess water from rain, meltwater (water resulting from melting snow and ice), or other sources flows over the earth's surface

**Groundwater:** The water located beneath the earth's surface in soil pore spaces and in fractures of rock formations

**Scarcity:** Short supply of a limited resource

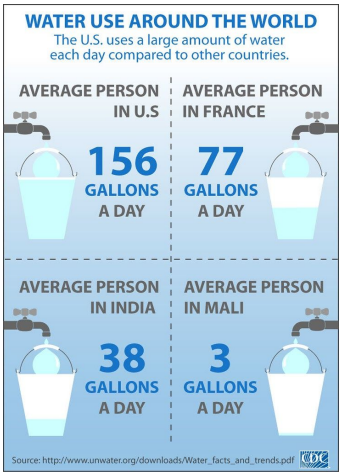
**Potable:** Water that is safe for drinking and domestic uses

**Wastewater:** Used water that goes down the drain

**Aeration**: This is the first step in the water treatment process and involves adding air to the water. This allows gases trapped in the water to escape.

**Coagulation**: Alum and other chemicals are added to the water to help dirt and other suspended particles "stick together" to form clumps, called floc. This way, they can be easily removed from the water.

clean as traditional dishwashers. The U.S. is one of the highest consumers of water in the world, especially when looking at individual and home water use.



[3]

Energy conservation and efficiency are also important to think about when using water. Water requires significant amounts of energy to pump, transport, and heat. One-fifth of California's electricity is used to support water use. In homes with electric water heaters, 25 percent of the households' electricity is often used just to heat water. Conserving water and using water more efficiently saves energy and reduces greenhouse gas emissions.

Not only does reducing water usage save energy, saving energy also conserves water. The power plants that create electricity also require a lot of water to produce steam to turn turbines that produce electricity. Water also cools this steam down so it can be used again in the plant.

Water conservationists help prevent wasting resources by working with governments and companies to reduce their water usage through technology, decreasing leaks, and conservation habits[4]. In this way, conservationists reduce costs and environmental footprint.

We can take many steps in our own lives to reduce our use of water and protect the climate, such as:

- Purchasing low flow toilets and sinks.
- Ensuring washing machines are full before running.
- Turn off faucets when not in use.
- Take shorter showers.

## Why Perform a Personal Water Assessment?

Performing a personal energy assessment is a useful way to assess the efficiency of your living space and identify conservation opportunities. The information collected in an assessment can provide an understanding of how energy is used and wasted in your daily activities.

A water assessment includes examining faucets and other water appliances as well as habits that can decrease energy use in a building.

The results of an audit can help consumers of water make informed choices on how to best improve the efficiency of a home and also help identify opportunities for conservation by making users more aware of their habits.

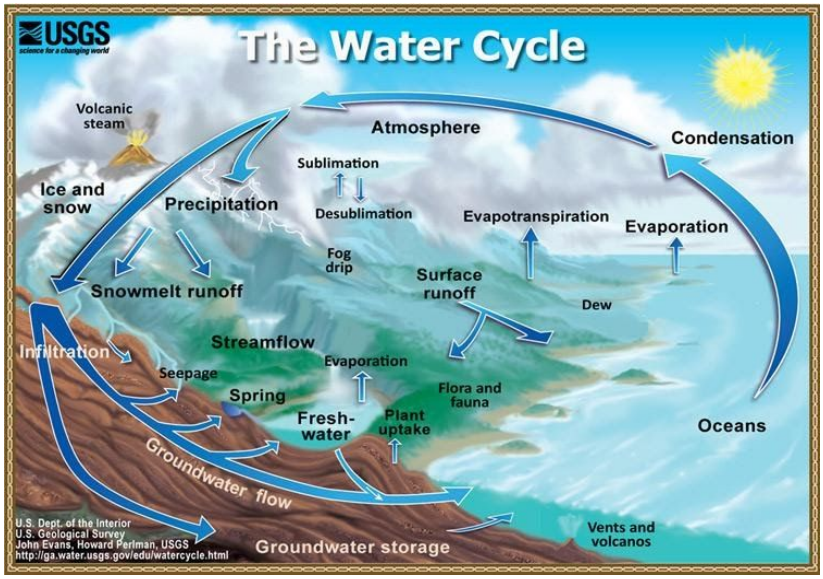
[3] CDC Global, "Infographic: Water Use Around the World", https://www.flickr.com/photos/cdcglobal/16870255267

[4] https://www.bls.gov/green/water_conservation/water_conservation.pdf

## READER: THE WATER CYCLE AND WATER SCARCITY

Water is essential to all life on the planet. All animals and plants need to take it up into their cells, one way or another. Water is the foundation of all ecosystems on the planet, from oceans, to rainforests, to mountains – even deserts. Today, we will explore the **water cycle** to understand how water moves around the earth and observe the key processes of evaporation, condensation, and precipitation in action.

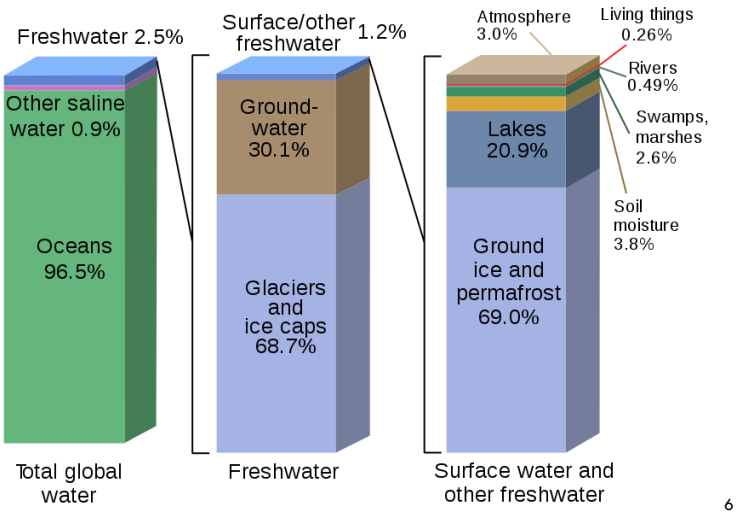
The water cycle is the natural flow of water on our planet from oceans, to atmosphere, to land, and into the ground. The water cycle naturally creates fresh water through evaporation, transpiration, condensation, and precipitation.



[5]

The water we drink today has been around in one form or another for hundreds of millions of years! While the amount of freshwater on the planet has remained relatively constant over time, our population has grown very quickly, increasing demand and competition for clean, accessible water. While freshwater scarcity might be an abstract concept for many of us in the United States, it is a reality here and in the rest of the world.

[5] United States Geological Survey: The Water Cycle. http://ga.water.usgs.gov/edu/watercycle.html




[6]

About 97 percent of the water on Earth is salt water, which means that it is not safe for us to drink or use for our water needs. Two of the remaining three percent is locked up as ice in the poles, which means that only 1 percent of water on Earth is possibly available for human use. Of this one percent, about two-thirds is underground, and of this underground water, half is too deep or salty to use effectively, and another quarter is polluted. The other one-third of 1 percent of available water is surface fresh water, and half of this fresh water is too polluted to treat for use. The non-polluted portion of underground and surface water is what's left for us. This is a lot of math, but it boils down to one thing: only about four to five-tenths of a percent of the planet's water is reasonably available for *all* human use.[7]

## Climate Change and the Water Cycle

The water cycle is a delicate balance of flows and storages. Climate change is leading to warmer temperatures, which increases the rate of evaporation of water into the atmosphere. In arid areas, this might dry out soil, while in more humid climates this could lead to increased rainfall.

Climate change is also exacerbating many of the other human impacts on the water cycle, with varying effects in different regions. One consequence of climate change is an increase in extreme weather events: droughts will become more common in some places, floods in others. Glaciers and snow packs will disappear in some areas, affecting the freshwater supplies to those downstream communities. Although on the surface, an increase in freshwater supply may seem like a good thing, often our infrastructure cannot handle the increased load and sewer systems and water treatment plants are overwhelmed. Heavy downpours can increase the amount of stormwater runoff into water bodies, polluting them and making them unsafe for recreation or drinking.

[6] USGS, Wikimedia Commons, https://commons.wikimedia.org/wiki/File:Earth%27s_water_distribution.svg

[7] *Water, Water, Everywhere*, by Rob Watson, www.greenerbuildings.com/enewsletter

## HANDOUT: WATER CYCLE EXPERIMENT

**Name** _____ **Date** _____

Materials:


- Large bowl
- Mug that fits in the center of the large bowl
- Salt
- Food coloring
- Stirring rod or spoon
- Plastic wrap
- String
- Pebble or another small heavy object (change works well)

Read through the procedure below and create your hypothesis.

Procedure:

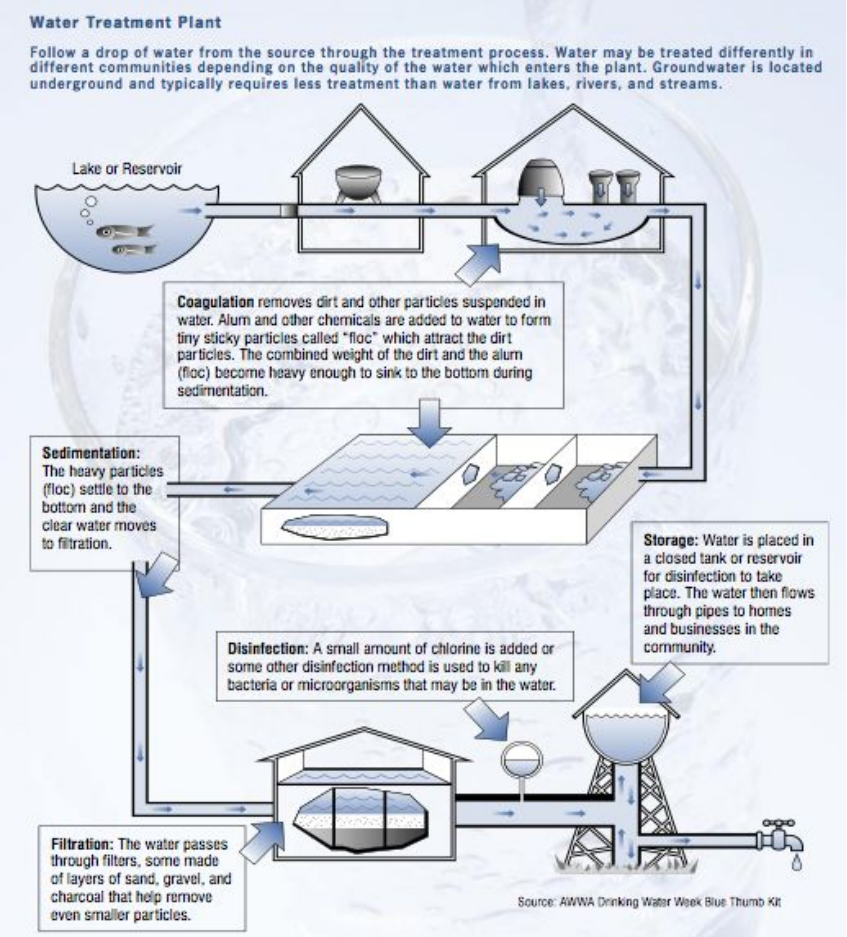
1. Gather all materials. In order for students to taste test the water in the mug at the end of the experiment, make sure all materials are clean.
2. Pour hot water into the large bowl until it is about ¼ full.
3. Place the large bowl in a sunny place outside or near a sunny window. The warmer, the better!
4. Add salt and a few drops of food coloring to water in the large bowl. Using the stirring rod or spoon, stir well to make sure the salt dissolves.

## READER: HOW HUMANS USE AND IMPACT WATER

Now we know about the scarce supply of freshwater on Earth, but how do we get this water? Where does it come from and what does it take to make sure we have a safe and steady supply?

- Typically, drinking water is sourced from groundwater and rivers. A less common source is ocean water, which requires a different treatment process and must go through a desalination plant. Although modern water treatment techniques can remove many pollutants, there are some contaminants that are very difficult to remove. Thus, it is important that the water source is fairly clean. It is also important that the source is constant throughout the seasons.

- Pumps are required to divert the water from the river and to collect water from underground. The water is pumped from the water source into a water treatment plant where it undergoes a series of treatment processes: aeration, coagulation, sedimentation, filtration, and disinfection. The image below describes these processes in more detail:



[8]

[8] U.S. EPA
http://water.epa.gov/lawsregs/guidance/sdwa/upload/2009_08_28_sdwa_fs_30ann_treatment_web.pdf