CASCADE WATER ALLIANCE

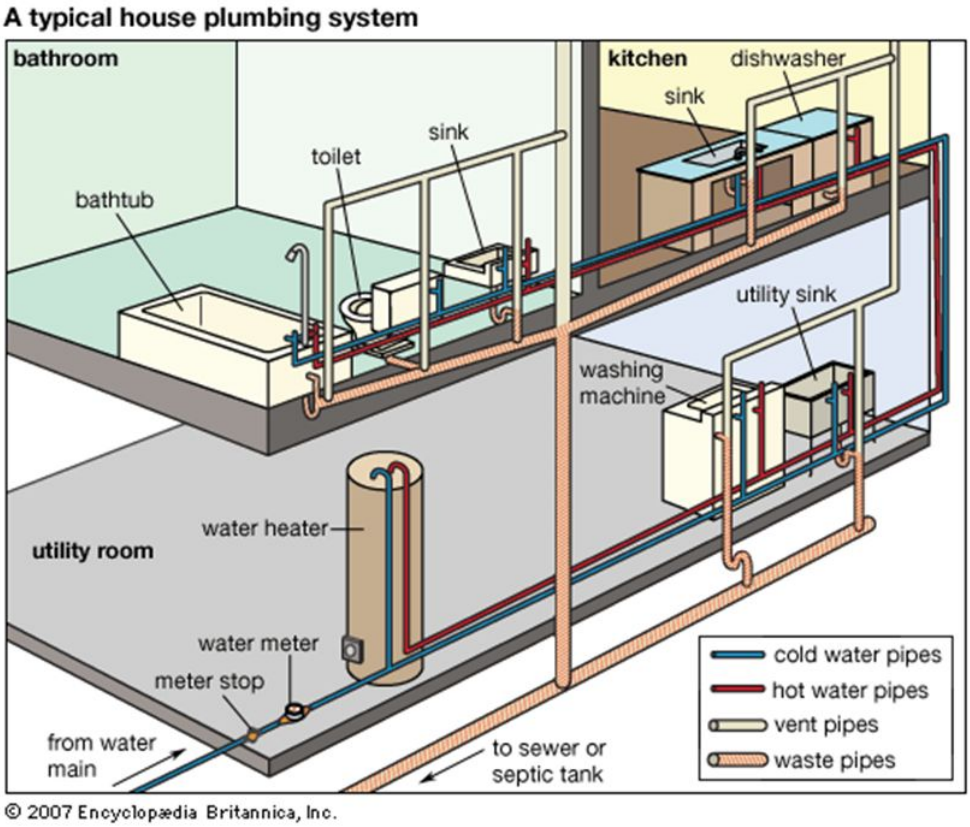
Water Systems Teacher Fellows Program
Community Curriculum Case Study

Water Cycle and Human Impact

7th Grade NGSS Earth Science

Problem Statement

"How can we engineer our homes to work with the natural water cycle so that we can sustain human water use well into the future?"



Teacher Design Team
Courtney Peterson, Kathryn Velloth

Grade 7 - Earth Science
Pacific Cascade Middle School
Issaquah School District, WA.

About the Water Systems Teacher Fellows Program

Teacher Fellows (grades 6-12) are paid a stipend over a 12-month period to develop new or refine existing problem-based curriculum that integrate water supply, wastewater, and stormwater management systems. Fellows integrate classroom rigor with community impact while advocating for district-wide adoption of the methods and resources they develop. Fellows are selected from the Lake Washington, Bellevue, Issaquah, and Tukwila School Districts. The Program is funded by Cascade Water Alliance and facilitated by Sustainability Ambassadors.

Peter Donaldson | Facilitator, Sustainability Ambassadors
206-227-9597, peterdonaldson50@gmail.com
Mike Brent | Water Resources Manager, Cascade Water Alliance
425-453-1810, mbrent@cascadewater.org

About Problem-Based Learning

Problem-based learning (PBL) is experiential learning organized around the investigation and resolution of messy, real-world problems. Teachers coach student thinking and guide student inquiry as a co-investigator. PBL increases student motivation through the pull of problem dissonance, intrinsically inspiring students to take on more and delve deeper as they make a personal investment in the outcome of their inquiry. Coupled with cognitive coaching strategies, PBL calls upon critical and creative thinking by suspending the guessing game of: “What's the answer that the teacher wants me to find?" PBL promotes metacognition and self-regulated learning as students generate strategies for defining problems, gathering information, analyzing data, building and testing hypotheses, comparing strategies with those of other students and mentors, and sharing results with real-world stakeholders. Source: http://bie.org/about/why_pbl

School District Context

The Issaquah School District has a stated goal of “building a culture of sustainability.” The district Sustainability Coordinator facilitates both curricular and extracurricular programs to advance this goal. The district Resource Conservation Manager tracks and reports annual energy, water and waste conservation efforts. Every school in the district has a student Green Team with an assigned Faculty Advisor. All middle school and high school Green Team leaders attend a kick off leadership training in the fall to develop annual work plans and a Community Sustainability Summit each spring to report results across generations and community sectors. The district website features a sustainability link on the home page.

City Context / Sammamish Plateau Water

Sammamish Plateau Water (SPW) is committed to sustainability through their robust Conservation Program. SPW provides support to residences, business, and schools within their service area through participating in technical studies, providing technical assistance, and supporting conservation education programs at no cost to participating schools. SPW also conducts numerous public outreach events to help their consumers better understand their water supply and how to use this limited resource efficiently and sustainably, which is especially important given the tremendous growth the service area is experiencing.

Water Cycle and Human Impact

7th Grade NGSS Earth Science

Problem Statement

"How can we engineer our home to work with the natural water cycle so that we can sustain human water use well into the future?"

Project Summary (12 Weeks)

The unit was taught by two teachers in 12 science classes to a total of 360 students. The experience was framed by the learning target *"I can design a system that optimizes my water use at home."*

Students used this framework to study the water cycle, weather, and climate. Students learned where water comes from in Issaquah and how our water use impacts the environment. The entry event for the first part of the unit was the scenario, "When you drink from your water bottle, you could be drinking dinosaur pee!" Students created a model to explain how this is possible. As students learned about the water cycle they updated their model to explain how water moves through Earth's systems. Students also learn how they fit into the water cycle and where their water comes from.

In the second part of the unit, students worked on the learning target, *"I can utilize data to recognize patterns and explain changes in weather conditions."* Students applied their knowledge of the water cycle to weather systems to complete a series of labs to build their understanding of convection currents and how weather fronts develop.

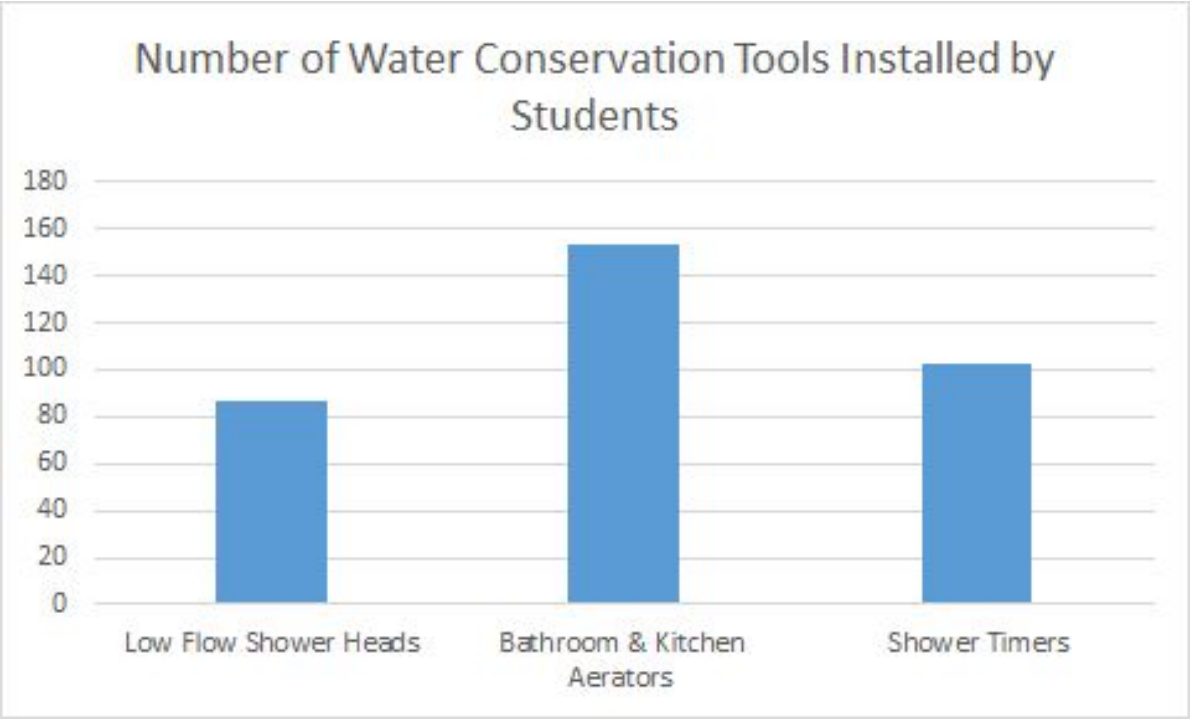
For the third part of the unit, students completed the learning target, *"I can use a model to describe the factors that determine climate."* Students learned about ocean currents, the coriolis effect, and unequal heating of the Earth.

The fourth part of the unit involved students in the learning target *"I can explain a range of factors that have caused the current rise in global temperatures."* Students looked at human impact on climate and how that affects weather. The unit opened with students reading a series of local articles about how climate change is affecting the Pacific Northwest. They then dug into the data to explain why these changes are occurring.

Call to Action

Students applied all of their knowledge from the unit to an engineering project to optimize water use at home. Students researched three different methods of water conservation used in homes and analyzed the three methods to make a recommendation for their home. At the same time students conducted a **Home Water Conservation Audit** of their home to determine opportunities to reduce their water use, save money, and reduce greenhouse gas emissions.

For the culmination, students took a pledge to change their practices at home to reduce their water use. Three hundred students took the pledge and ninety students ordered water conservation tools from Cascade Water Alliance to be installed in their homes.



About the Home Water Conservation Audit

By conducting the Home Water Conservation Audit students are empowered to collect real world data that will demonstrate the benefits of water conservation. Students learn what actions they can take and how those actions benefit the environment around them through quantifiable data.

Using an instruction guide and audit kits supplied by Cascade Water Alliance, students independently audit the water used where they live. The kits include tools such as a water flow rate bag to measure water volume and dye test strips to check toilets for leaks. The data collected is formally entered into an excel spreadsheet or **"water use calculator"** where students can assess the potential for water, energy, and CO2 equivalent savings.

Once students commit to action using supplies provided by Cascade Water Alliance, the final data is assessed with total savings for water, energy, and CO2 equivalent reductions.

Students prepare and **present their data to key community stakeholders** such as the school Green Team, school board, city staff, city council and the Cascade Water Alliance.

Community Impact Statement

GOAL
Students will be able identify potential water saving areas in their home. This will lead to practices, at the household level, that support Cascade Water Alliance's goal of achieving 600,000 gallons of cumulative water savings per day from 2014-2019 which will lead to water use that is efficient, cost effective and as environmentally friendly as possible.

Original Conditions *What were the conditions before we took action?*	**Impact** *How did conditions improve as a result of our action?*	**Recommendation** *What do we think should happen next?*	**Stakeholders** *Who should know about our results and recommendations?*
Students conducted a home water audit to determine baseline data	Post audit survey to determine the collective impact of our classroom actions to conserve water and improve efficiencies in student homes	Students made recommendations for potential future actions including a campaign to educate neighborhood or school community, or having future classes conduct the audit to have a larger impact.	Student families and parent networks District leadership Community members, civic groups City of Issaquah Cascade Water Alliance

Community Performance Measures

1. Issaquah's Goal: Reduce water usage by conserving 6% per household by 2020 from 2010 levels, corresponding to approximately 141 gallons per equivalent residential unit or 170,000 gallons per day on an average basis**.** Download pdf

2. Cascade Water Alliance has established a conservation goal of saving 1.0 million gallons of water per day on an average annual basis and 1.45 million gallons of water during the peak season. Download pdf

3. Cascade also administers water efficiency services on behalf of its members with a goal of achieving 600,000 gallons per day of cumulative water savings from 2014-2019. Download pdf

Curriculum Rigor meets Community Relevance

Engineering Project
How can we engineer our home to work with the natural water cycle so that we can sustain human water use well into the future?

Washington Science Standards
MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Standards to be assessed	Critical Content	Community Connections
MS-ESS2-4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. **MS-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.** **MS-ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.** **MS-ESS3-5:Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.** **MS-ESS3-3 Apply scientific principles to design a method**	**Disciplinary Core Ideas** Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. Global movements of water and its changes in form are propelled by sunlight and gravity. The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. Because these patterns are so complex, weather can only be predicted probabilistically. Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents. Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional	Students understand and model where Issaquah's drinking water comes from and where they fit into the water cycle. Students gain understanding of their local weather systems and the factors that influence it. Students read local news articles about the changing climate in the Pacific Northwest and the effects of those changes. Students understand key goals of Cascade Water Alliance water conservation plan. Students gain awareness of their own water use at home. Students learn about and analyze different water conservation measures that could be implemented in their home.

for monitoring and minimizing a human impact on the environment.	geography, all of which can affect oceanic and atmospheric flow patterns. The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. **Cross Cutting Concepts:** ● Energy and matter ● Cause and Effect ● Systems and models ● Stability and change **Science / Engineering Practices** ● Developing and Using Models ● Planning and carrying out investigation ● Asking Questions and Defining Problems ● Analyzing and interpreting data ● Constructing explanations ● Engaging in argument from evidence	

Teacher Reflection

This year my colleague and I added a new context on the weather and climate unit to both engage my students and meet the NGSS standards. Implemented over three months, the unit was taught in 12 science classes to a total of 360 students. The students were instantly engaged because the topic was local, impacted their lives, and featured a call to action which they could implement, measure and report.

The highlight of the unit was when students took a pledge to implement behavioral water conservation changes. At the end of the unit, 300 students took the pledge and 90 students ordered water conservation tools for their home. The Home Water Audit was designed but not fully implemented during this unit (not enough time to use the “water use calculator”) so we are very excited to put all of the pieces together next year.

It was rewarding to see students so motivated to delve into the topic and go above and beyond their usual academic output. Many students reported talking with their families over dinner about water conservation and what they could do in their home. Parents were involved through weekly e-news from the classroom to give them updates on what their student was learning and how they could engage their student at home.

The most exciting day for the class was the day we handed out all the water conservation tools that students ordered based on the Home Water Conservation Audit. The students couldn’t wait to go home and install their new equipment and see their impact.

We learned over the course of developing and piloting this unit that it is very important to honor and employ the driving problem statement on a regular basis, not only upfront at the beginning of the unit, but throughout, so that students can reflect on and refine their understanding of the nature of the problem and the ways they can directly participate in solving it. Building the importance of why students should care about this problem at the start and connecting it to their community was important.

We also plan to provide students with more data, readings, videos and infographics from a variety of resources and points of view to aid in their learning and differentiate instruction as students relate to different topics and delivery systems in unique ways. This unit could easily be amplified if it were integrated with Language Arts and/or Social Studies. We plan to initiate those conversations with our grade level colleagues next year.

Student Testimonials of Learning, Motivation and Application

Coming in 2016-2017 school year

Really Helpful Resources

Cascade Water Alliance: http://cascadewater.org/

EPA Water Sense: https://www3.epa.gov/watersense/

UW Climate Impacts Group: https://cig.uw.edu/

NOAA Education Resources on Climate: http://www.education.noaa.gov/Climate/

NOAA Education Resources on Weather and Atmosphere:
http://www.education.noaa.gov/Weather_and_Atmosphere/

Washington State Department of Ecology - Water Topics: http://www.ecy.wa.gov/water.html

Water Systems Experts - short video talks in front of a live audience produced by Sustainability Ambassadros:
http://www.sustainabilityambassadors.org/apps/videos/channels/show/4243207-water-systems