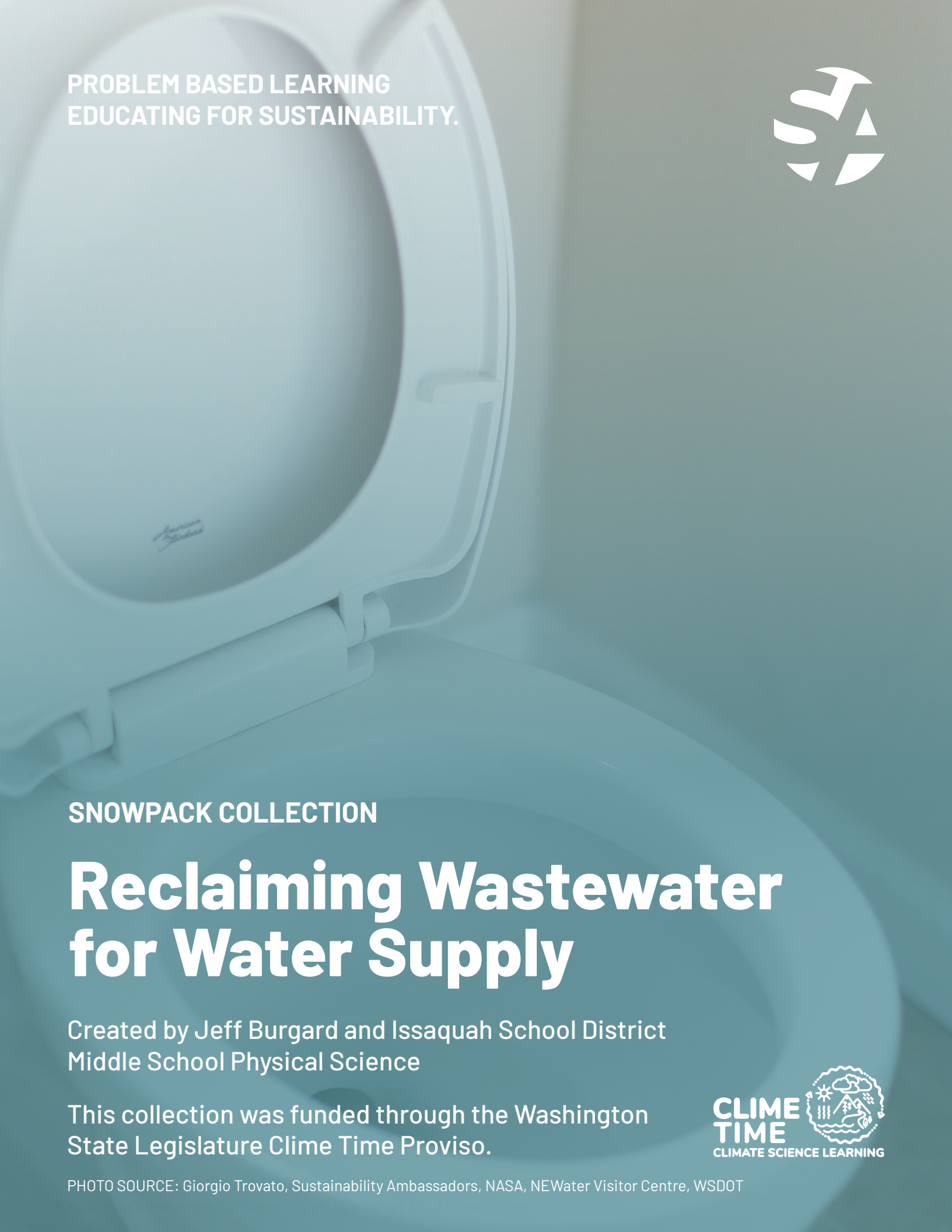


PROBLEM BASED LEARNING
EDUCATING FOR SUSTAINABILITY.

SNOWPACK COLLECTION

Reclaiming Wastewater for Water Supply

Created by Jeff Burgard and Issaquah School District
Middle School Physical Science

This collection was funded through the Washington State Legislature Clime Time Proviso.

CLIME TIME
CLIMATE SCIENCE LEARNING

PHOTO SOURCE: Giorgio Trovato, Sustainability Ambassadors, NASA, NEWater Visitor Centre, WSDOT

PROBLEM STATEMENT

With a shrinking snowpack and big changes coming in the seasonal patterns of our water cycle due to climate change, what are the issues and opportunities related to reclaiming water from the wastewater treatment process?

SUMMARY

Students will reflect on their own feelings of using reclaimed wastewater as a viable source of water for everyday use. Would you drink it? How clean would it need to be? What might be some other practical uses for reclaimed wastewater?

Getting beyond the "yuck factor," students apply science and engineering skills to analyze the pros and cons of integrating reclaimed wastewater into our local water supply. Examples include uses in King County as well as the Singapore Success Story and Recycling water on the International Space Station.

As students critically analyze these examples and others through keyword searches, they pay attention to both the technical elements of solving the problem, and the communication strategies used to influence consumers like all of us on the benefits of integrating reclaimed wastewater. What are the current issues and opportunities in this process? Considering the twin drivers of climate change and population growth, what are the future issues and opportunities?

This learning will culminate with students developing an informational message to promote the use of reclaimed wastewater in their community. Students will integrate a scientific understanding to inform the public about safety, a clear message of its intended purpose, a creative name or "angle" for promotion, and compelling infographics to reinforce the message. This process will include engaging with stakeholders, those who can advise and advance student understanding, as well as those who need to be influenced.

Learning Objectives

1. **I can apply systems thinking to build connections between my personal experience and the range of current and expected local impacts from climate change.**
2. **I can explain the basic science behind projected climate impacts in our bioregion on water supply.**
3. **I can use my science knowledge to promote the use of reclaimed wastewater for a variety of purposes in my community.**

Formative Assessment

Menu of possibilities...

1. Student Pre Learning Survey: Would you use recycled water? Use this Google Form as a model but make your own so you can access the data for your class sections.
2. Discussion: Would you use recycled water? For what purpose?
3. Research notes on issues and opportunities related to reclaimed wastewater.
4. Research notes on local climate science impacts.

Summative Assessment

Students develop and informational message to promote the use of reclaimed wastewater in their community which includes: (1) scientific understanding to inform the public about safety (2) a clear message of its intended purpose (3) a creative name or "angle" for promotion (4) and compelling graphics to reinforce the message.

Student Post Learning Survey (Use the same Google Form as a model.)

ACADEMIC STANDARDS

NGSS: MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems.

Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy)

MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

Examples of technologies can be global or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts)

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

Examples of data on the impacts of human activities could include the quantities and types of pollutants released

BIG PICTURE

NGSS Global Climate Change

NGSS Human Sustainability Standards

OSPI Environmental Sustainability Standards

OSPI Social Studies Standards

College, Career, and Civic Life (C3)

Common Core State Standards

COMMUNITY CONTEXT

My family's sustainable practices

My Neighborhood Association

Nonprofits focused on this issue

My School and School District

My City Climate Action Plan

My City Equity Strategy

My County Climate Action Plan

My County Equity Strategy

My Energy and Water Utility

My Waste, Recycling, Compost Company

Watershed Salmon Recovery Plan

Puget Sound Regional Council

Puget Sound Vital Signs

Washington Dept of Ecology

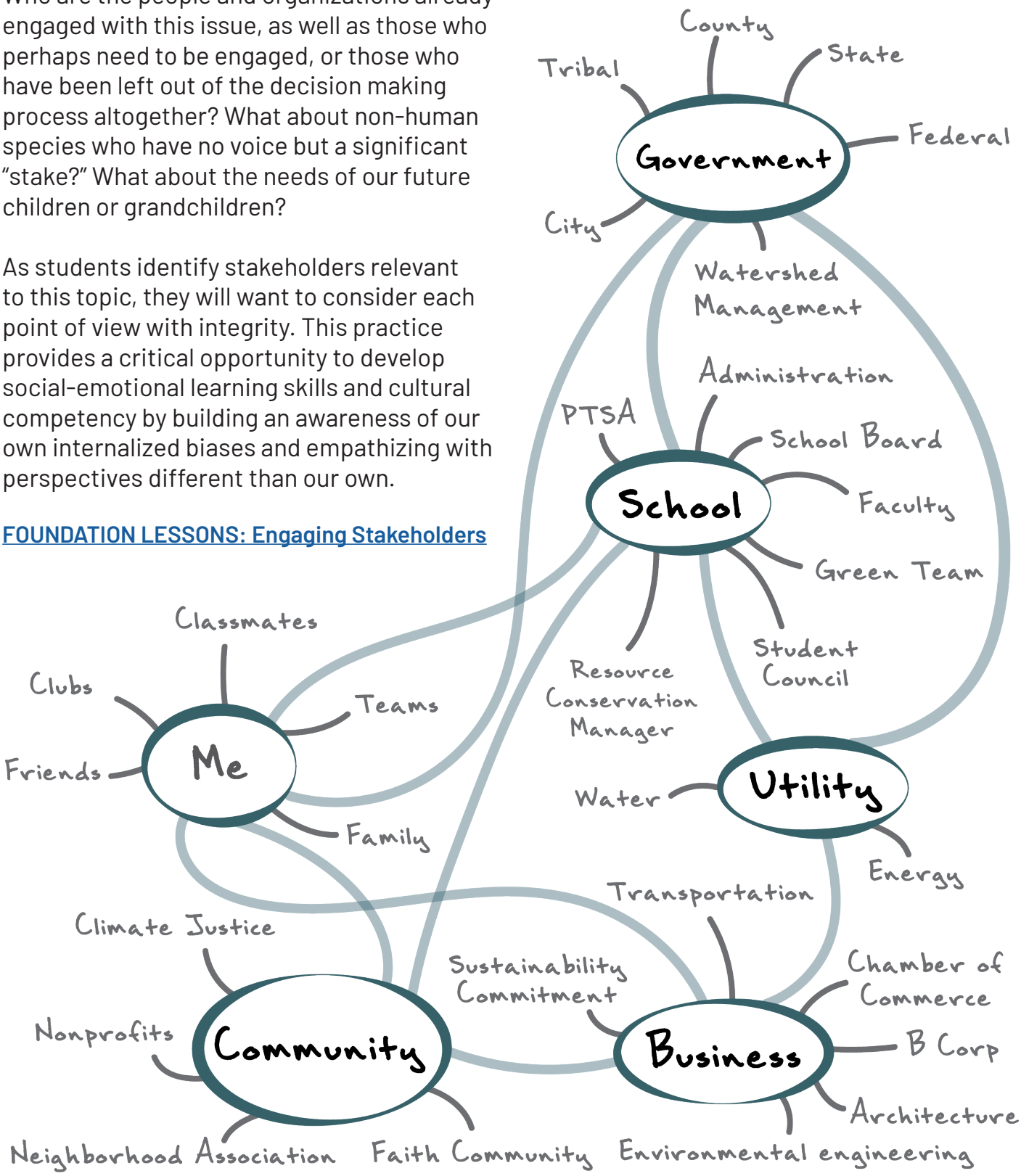
Tribal Treaty Rights

Stakeholders

Who are the people and organizations already engaged with this issue, as well as those who perhaps need to be engaged, or those who have been left out of the decision making process altogether? What about non-human species who have no voice but a significant "stake?" What about the needs of our future children or grandchildren?

As students identify stakeholders relevant to this topic, they will want to consider each point of view with integrity. This practice provides a critical opportunity to develop social-emotional learning skills and cultural competency by building an awareness of our own internalized biases and empathizing with perspectives different than our own.

FOUNDATION LESSONS: Engaging Stakeholders



BACKGROUND
We Depend on Snowpack

We have built our economy, here in the Pacifc Northwest, around the assumption of a sustained snowpack. **Our snowpack is shrinking** due to human-caused climate change.

Get the latest science from the University of Washington **Climate Impacts Group.**

Study the **Climate Change infographics series** from King County.

We depend on snowpack. Over the last hundred years, we have constructed dams across a number of our cascade alpine cannons to hold water in huge man-made reservoirs that serve the water supply needs of millions of people. In our region it rains a lot, especially at the higher elevations. This rain can be captured and held in our system of reservoirs.

What is not known by most people, is that we have been depending on a certain depth of snowpack each year to serve as a **second, natural reservoir** of water... **A frozen one**. This is important, because as we enter the summer months with little or no rainfall until October, our reservoirs would be drained by the water consumption demands of millions of people if not for our snowpack. The snow that packs down through the long winter will **slowly melt through the summer.** We count on this phenomena to supplement and sustain water levels in our reservoirs. We drink snow in August.

But with a shrinking snowpack over the next several decades, water resource managers, policy makers, and each of us within our own families, schools, and cities, need to make critical decisions about how to conserve water right now.

The same amount of precipitation. Part of this strange new reality is that we will actually have the same amount of annual precipitation. The water cycle will continue to lift vapor from Puget Sound and the Pacfic Ocean and drop it across the landscape. But the science points to a much different annual pattern.

We can expect **much more rain in the winter** (when we don't need it) along with bigger storm events, which can cause flooding and mudslides. And we can expect **much less rain in the summer** (when we do need it) which can lead to droughts, forest fires, parched streams for salmon, and dangerous heat waves for humans. We will experience the same total amount of precipitation. It's just that, as each decade continues to bring warmer temperatures, less of this precipitation will be held in the form of snow. Diminished snowpack throughout the winter means diminished water supply late in the summer.

At the same time that we are grappling with how to adapt to our shrinking snowpack, we will need a **thousand good ideas** for how to slow, stabilize, and reverse the effects of climate change. This will take a century or more. It is critical to understand the science and make wise decisions together at all scales right now. We are all stakeholders in this challenge.

SNOTEL stations. Water resource managers carefully monitor our snowpack by analyzing daily and weekly data reports from a series of remote sensing SNOTEL stations built on ridgelines throughout the Cascades. The Natural Resource Conservation Service manages a Snow Survey Program that provides "mountain snowpack data and streamflow forecasts for the western United States. Common applications of snow survey products include water supply management, flood control, climate modeling, recreation, and conservation planning."

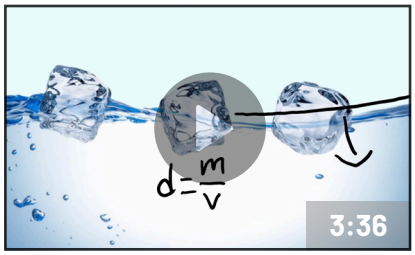
The Washington Snow Survey website includes **snow survey data, products, and reports** that students can use to understand the science and math behind the need to monitor our snowpack and make critical decisions for the current season as well as 10-30 years out.

Inquiries Across the Curriculum

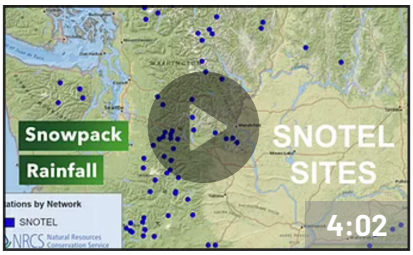
To understand more about the breadth and depth of curricular concepts using snowpack as catalyst, explore a rich set of additional inquiries.

Youth-voiced tutorials

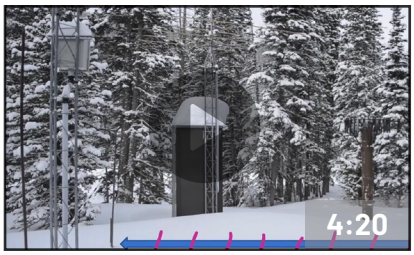
For additional support, student teams with Sustainability Ambassadors have researched and produced a series of short videos on snowpack issues. All of these videos are voiced by students.



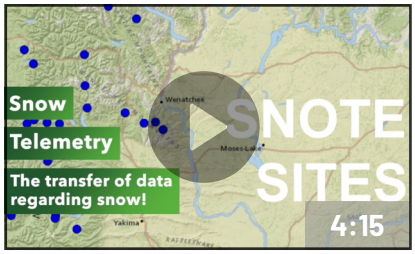
What is Snow Water Equivalent?
Harini Baskar



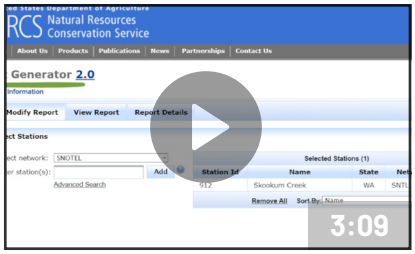
Introduction to SNOTEL
Rishi Hazra



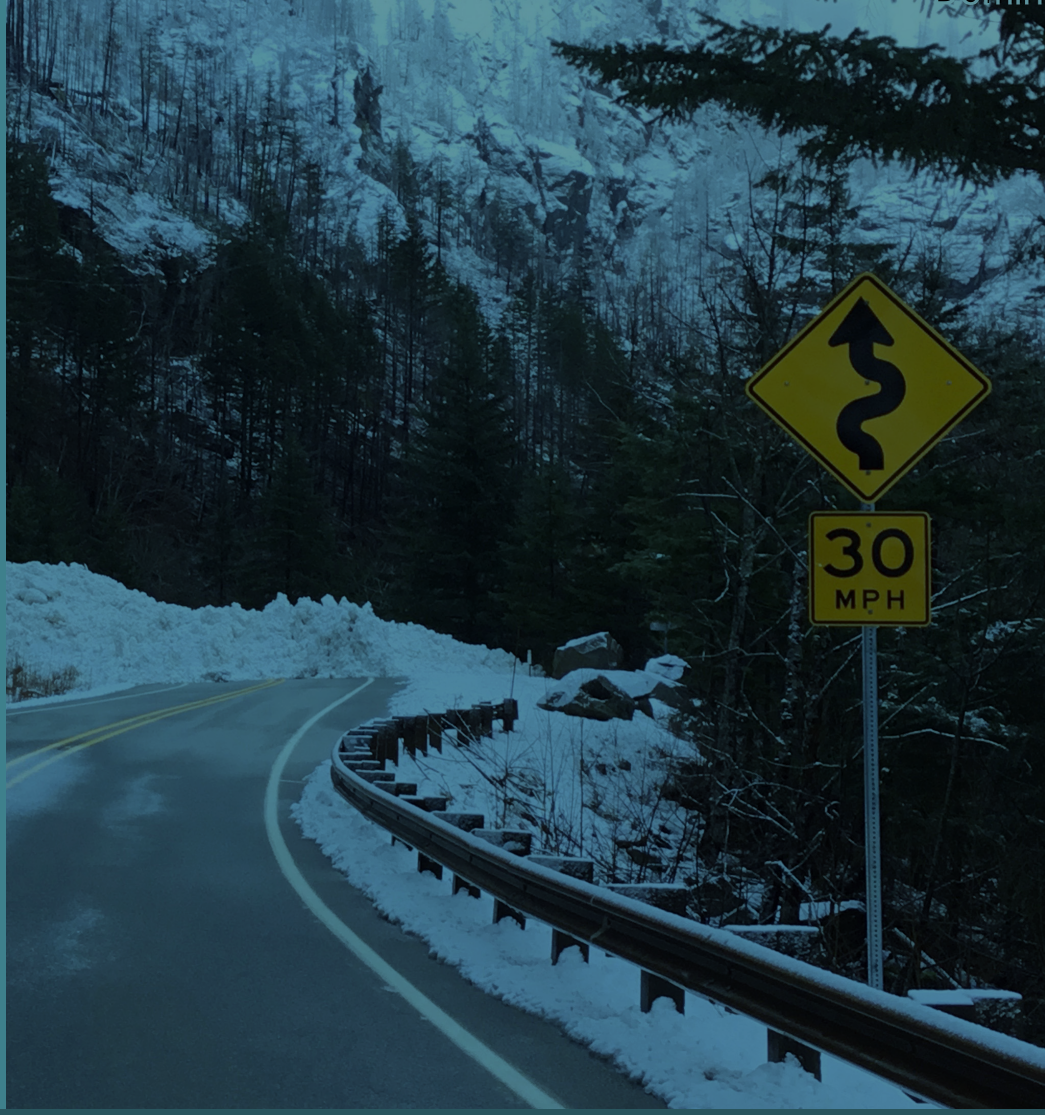
How do SNOTEL Sites Work?
Santoshi Pisupati



Locate Your SNOTEL Station
Rishi Hazra



Generating SNOTEL Data Reports
Rishi Hazra



LESSON OUTLINE

Materials Needed
Internet Access

Time Needed
1-3 class periods

ENTRY EVENT

1. Introduce the idea of converting wastewater into drinking water. Have the students take this survey and/or conduct a discussion about how they feel about the topic.
2. Allow them to discuss this question for a minute or so getting ready to present their ideas.
3. Have one person from each group share their ideas, listening non-judgmentally and repeating back what they have said. Invite students to repeat what other groups have said if they have no other ideas.
4. Have students watch the video: New York Times - Reclaimed Water and have a discussion. What are the challenges to changing people's minds about reclaimed wastewater? Did this video influence your opinion?

Activity 2

What is already happening?

Have students examine the King County Reclaimed Water Diagram. Have a discussion about what King County is doing with it's reclaimed water, where it is being produced, and its current uses.

Break students into groups and have them research the King County Reclaimed Water Plan. There, they will find descriptions and links describing how recycled water has been used for irrigation, industry and environmental restoration.

Students can also research recycled water use at Puget Sound Keeper and WA Department of Health Water Recycling.

Groups should be prepared to share 3 reasons why recycled water is right for each sector.

Brainstorm possible applications and challenges using these discussion questions:

Should the use of reclaimed wastewater be expanded?

How would we fund the infrastructure needed? Where would it be built?

How should we promote its use?

Who are the other stakeholders and what is their perspective?

Activity 3

Beyond the "Yuck Factor"

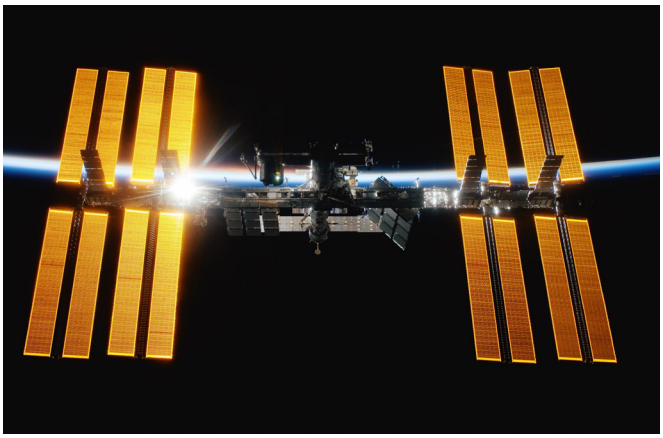
Have students watch the video on how the astronauts on the International Space Station get their water. Recycling water on the International Space Station. Also Recycling Water on the ISS 2

Have a discussion about adapting and scaling the system used on the International Space Station to an entire neighborhood, city or region.

Have students watch A Singapore Success Story and/or read the information and have a discussion about how the ideas were promoted to gain public acceptance.

Could it happen here?

Which elements are most applicable in our region?



Activity 4

Crafting an Informational Message

Group students to develop an informational message to create awareness and encourage people to use reclaimed wastewater in their chosen application.

Watch Video: Would you drink water made from sewage to show other ways to help change peoples minds.

The project should be targeted to a specific group of stakeholders and include the following elements: (1) scientific understanding to inform the public about safety, (2) a clear message of its intended purpose, (3) a creative name or "angle" for promotion, and (4) compelling infographics graphics to reinforce the message.

Engineering Design (Extension)

Invite students to work in teams with a large sheet of paper (or similar digital drawing tool) to design a systems map for where reclaimed wastewater would be produced, and how it would travel through either existing or new infrastructure.

The map should consider conveyance pipes, pump stations (for hills) and delivery to a range of specific community or environmental applications.

What scale is the most cost effective and energy efficient?

Are these regional systems, community scale, or at the local neighborhood scale?

Can elements of such a system happen at the scale of an office building or school?

ACKNOWLEDGEMENTS

Thank you to our **Washington State Legislature for funding the ClimeTime Proviso.** Your investment in climate science education is vital for engaging the next generation in applied learning for a sustainable future that benefits everyone. We thank you for your vision and commitment.

Thank you **Cascade Water Alliance** for supporting student and teacher research on SNOTEL data analysis as a foundational understanding for water resource management decision making. And for supporting the original design of the PBL Curriculum Design Lab and Teacher Fellows Program.

Thank you **King County WaterWorks Grant Program** for supporting additional partnership building and curriculum design related to water quality.

About Sustainability Ambassadors

Sustainability Ambassadors is a professional development program for student leaders, teacher leaders and community leaders committed to rapidly advance a sustainable future by aligning classroom rigor with community relevance for real world impact.

We support a year-round training program for over 60 highly motivated youth, a paid Equity Advocacy Internship, a Green Jobs Youth Pathways Portal, and a Teacher Fellows Program, working with hundreds of educators to design new models of problem-based, place-based learning around a shared vision of ***educating for sustainability.***

We focus on middle school and high school youth, the teachers and school districts that guide their learning, and the community stakeholders, local government and business leaders who are relying on the next generation to be engaged voters, informed taxpayers, conscious consumers, and employees who can create and lead sustainability initiatives.

Visit: https://www.sustainabilityambassadors.org/