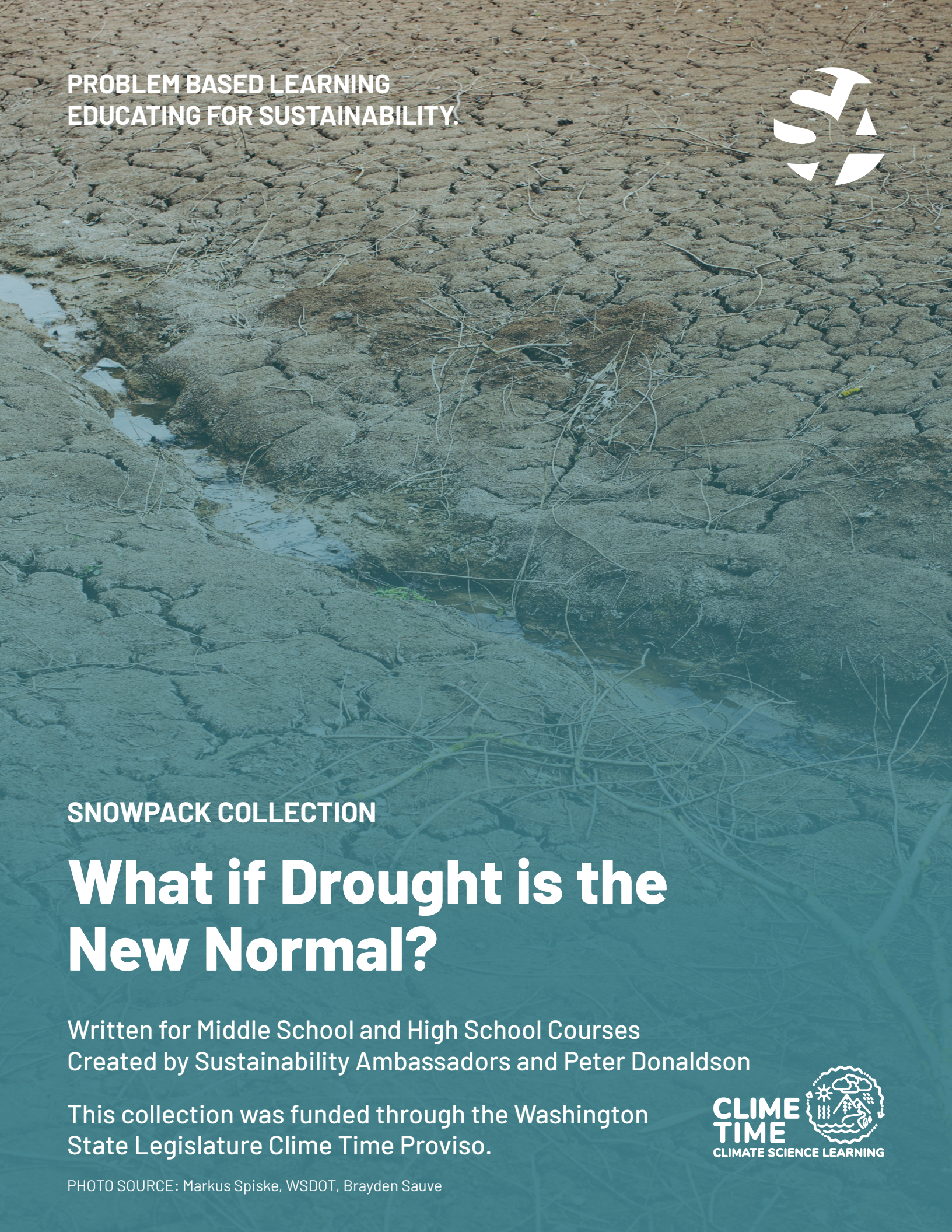


PROBLEM BASED LEARNING
EDUCATING FOR SUSTAINABILITY.

SNOWPACK COLLECTION

What if Drought is the New Normal?

Written for Middle School and High School Courses
Created by Sustainability Ambassadors and Peter Donaldson

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

CLIME TIME
CLIMATE SCIENCE LEARNING

PHOTO SOURCE: Markus Spiske, WSDOT, Brayden Sauve

PROBLEM STATEMENT

With a shrinking snowpack and big changes coming in the seasonal patterns of our water cycle due to climate change, how will we adapt to an increase in annual drought conditions, some of them extreme?

SUMMARY

Every four years our country publishes the National Climate Assessment. In the 2018 publication, in the 3rd paragraph of the **Northwest Chapter**, the team of science authors asserts that the extreme drought we experienced in 2015 may become commonplace and that the data bears this out for all climate change scenarios. Since 2015, devastating wildfires have ravaged our bioregion, from California to British Columia. Farmers have struggled to irrigate crops. Reservoir levels are dropping so low that hydropower generation may be affected. Endangered salmon populations continue to decline due to lethal water temperatures in local streams and insufficient stream flow to migrate and spawn.

In this Lesson students will learn the science behind the issues by reviewing infographics, charts and maps. They will read a range of current news reports, websites, and scientific papers to understand how drought is occurring, which regions it is impacting the most, and what the consequences are for our economy and our health. They conduct a comparative analysis between 2-3 other regions in the western or soutwestern part of our country and the situation in our own region.

Many of these regions are making resiliency plans to adapt to climate change over the next several decades and throughout the rest of this century during which time, our own lifetime, human civilization will experience a series of inflection points.

What is a regional climate resiliency plan? Students reflect on the water footprint of their own daily patterns, food choices, transportation choices, and consumption habits and decide on actions they can take to contribute to the success of our region's resiliency.

Learning Objectives

1. **I understand the basic science behind current and projected climate impacts in our bioregion with a focus on rising temperatures and changing water cycle patterns.**
2. **I apply systems thinking to analyze the consequences of increasing annual drought conditions in our region and in other regions throughout the western and southwestern United States.**
3. **I understand the importance of resiliency planning to adapt to the "new normal" of worsening annual droughts.**
4. **I can take personal action to reduce my water footprint.**

Formative Assessment

Menu of possibilities...

1. An initial personal reflection, mind map or video-self-interview on how local drought conditions have already impacted me personally.
2. An analysis of Infographics on local climate change science and related impacts.
3. Jigsaw notes on analysis of readings, websites, and group discussion.
4. Review and prioritization of possible impact projects for reducing my water footprint..

Summative Assessment

Produce a comparative analysis between at least one other region in the western or southwestern part of our country and the situation in our own region including elements of resiliency planning already underway.

Implement at least one action to reduce my water footprint and a present a justification for how this will help slow down the effects of climate change in our region.

ACADEMIC STANDARDS

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

Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions

MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

[Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes Emphasis is on the major role that human activities play in causing the rise in global temperatures]

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

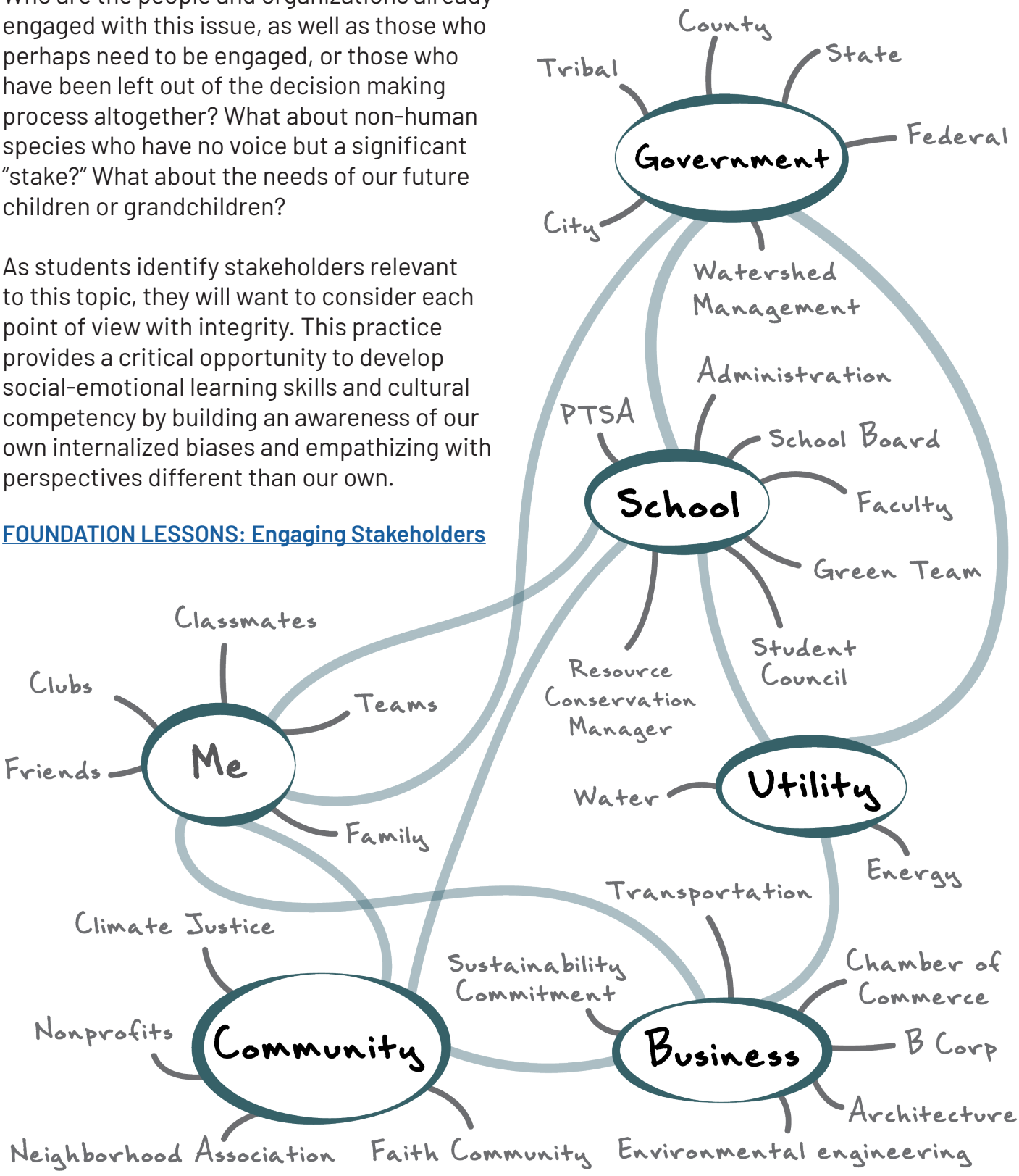
Tribal Treaty Rights

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."

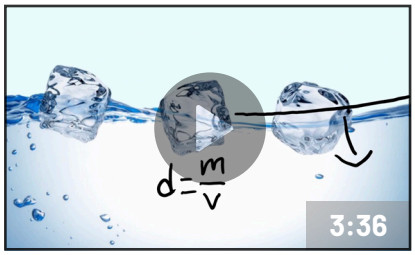
The Washington Snow Survey website includes **snow survey data, products, and reports** that students can use to understand the science and math behind the need to monitor our snowpack and make critical decisions for the current season as well as 10-30 years out.

Inquiries Across the Curriculum

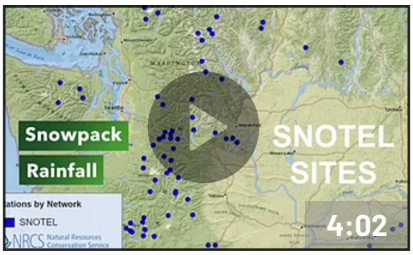
To understand more about the breadth and depth of curricular concepts using snowpack as catalyst, explore a rich set of additional inquiries.

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.



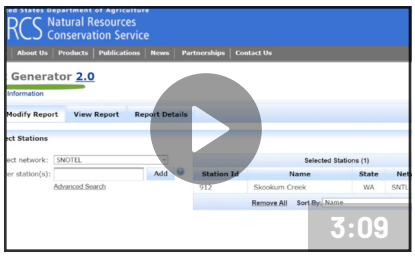
What is Snow Water Equivalent?
Harini Baskar



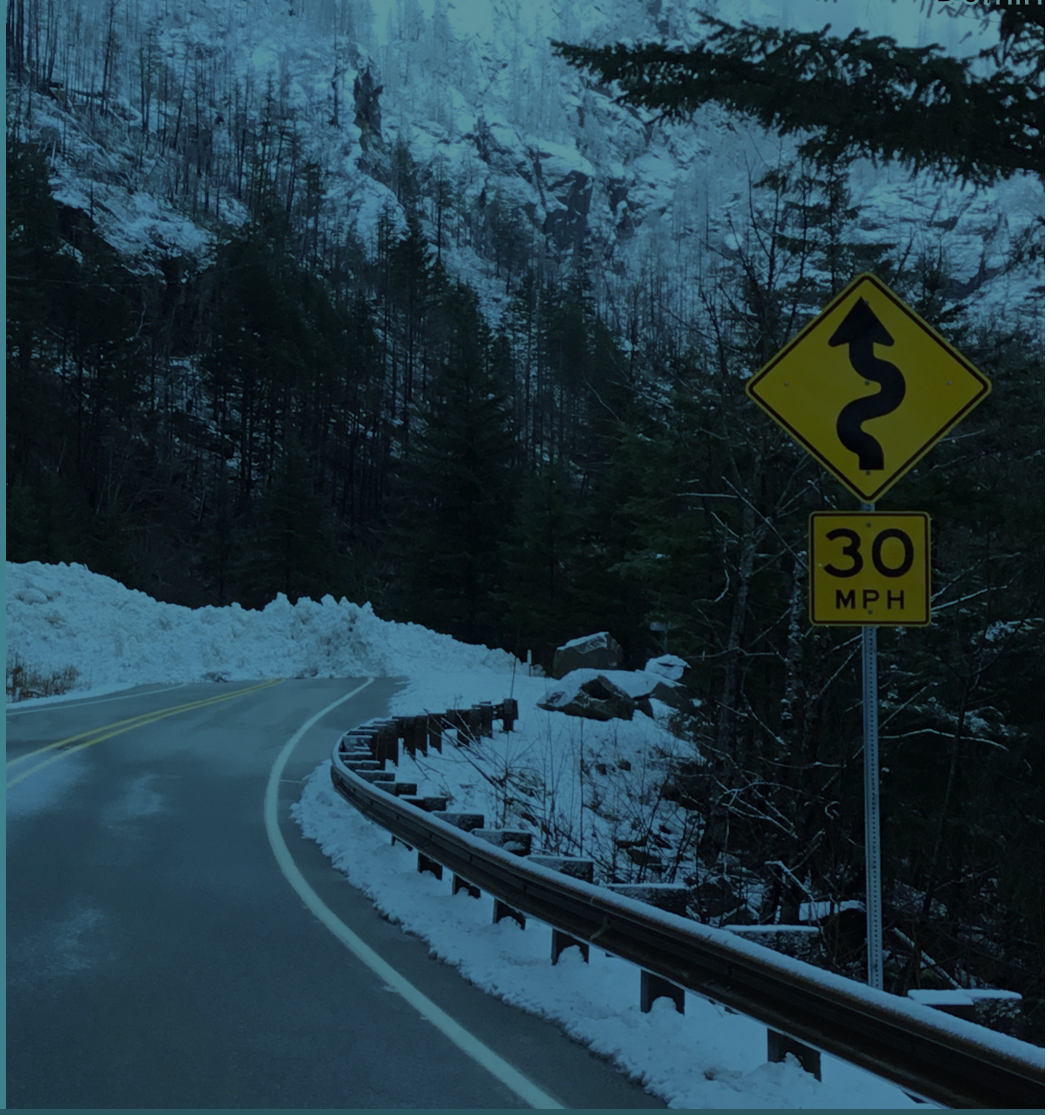
Introduction to SNOTEL
Rishi Hazra

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
3-4 class periods

ENTRY EVENT

See for Yourself

Students independently review the maps in this article from the New York Times, [How Severe Is the Western Drought? See For Yourself.]

Working in small groups, their goal is to be able to articulate both the diversity of climate conditions year by year and region by region, as well as the general trajectory towards an increase in drought conditions.

June 11, 2021 - "An intense drought is gripping the American West. Extreme conditions are more widespread than at any point in at least 20 years, according to the U.S. Drought Monitor, the government's official drought-tracking service. And the hottest months of summer are still to come."

Activity 1

What's causing this?

Invite students to click on 3-5 of the Climate Change infographics developed by King County. Allow 10 minutes to explore and take notes individually, followed by another 10-15 minutes working in small groups to share, refine, and expand on key insights. Consider the following prompts:

Which infographics were most effective in helping you understand climate change?

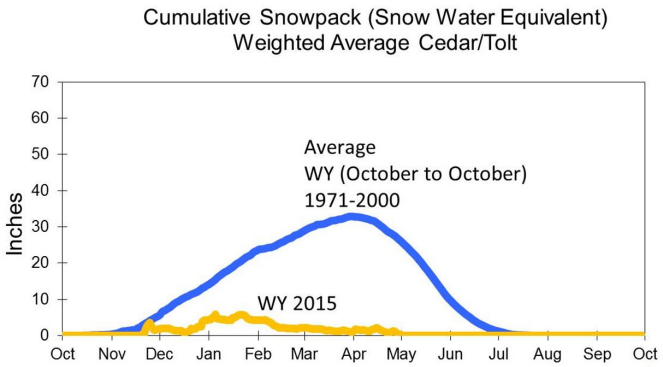
What did you notice about the design, composition, color, and text choices that the graphic artist used to communicate essential information?

What are the 3-5 most significant impacts we will experience locally? What can we do?

Activity 2

The New Normal?

Invite students to explore and discuss the relationship between the two lines on this graph. The letters "WY" stand for water year. The yellow line tracks snow water equivalent for the drought year of 2015 and the blue line tracks snow water equivalent over a 30-year average. Is 2015 the new normal for our lifetimes? How can we find out? If true, what will be the impacts? What actions can we take to minimize or adapt to these impacts?
[Get the graph.]



2018 National Climate Assessment

Every four years our country publishes the National Climate Assessment. In the 2018 publication, in the 3rd paragraph of the Northwest Chapter, the team of science authors asserts that the extreme drought we all experienced in 2015 may become commonplace and that the data bears this out for all scenarios. Since 2015, devastating wildfires have ravaged our bioregion, from Californa to British Columia. Farmers have struggled to irrigate crops, and endangered salmon populations continue to decline.

Activity 3

What impacts are we likely to experience?

In this research phase, with goal of understanding basic climate science, you may want to support individual or team-based research, or engage students in a jigsaw using some or all of the following resources:

The Natural Resource Conservation Service manages a Snow Survey Program that uses remote sensing SNOTEL stations to produce mountain snowpack data and streamflow forecasts for our region. Also see one or more of the student-produced, short videos in the SNOTEL series featured in the background section of this lesson.

Northwest Climate Impacts in Brief. One concise paragraph on each of the major impacts expected in the coming decades based on climate change data analyzed by the University of Washington Climate Impacts Group.

State of Knowledge Report – Climate Change in Puget Sound. A comprehensive synthesis report summarizing relevant research on the likely effects of climate change on the lands, water, and people of the Puget Sound region.

Formative Assessment: Students submit a research log with related notes and schematics based on their deeper understanding of what the science tells us about local climate change impacts.

Activity 4

Drought Conditions in the News - Comparative Analysis

Students return to the New York Times article used in the Entry Event, How Severe Is the Western Drought? See For Yourself.

The focus this time is on reading the full article and pulling out and jotting down a series of talking points. Have them practice in small groups, interviewing one another so that the talking points they develop are not only refined and varied, but become internalized as actual "talking points" in the minds of the students.

From this foundation students conduct their own internet research for current news on drought conditions in at least three different regions shown in the map infographic that accompanies the New York Times article. Brainstorm as a class the most useful set of keyword searches such as a major city or state...

Arizona / Phoenix / California / Los Angeles

And descriptive words that focus on the research topic such as...

drought, heat wave, water shortages, wildfires, impacts of climate change

Research questions might include...

What is the range of current and expected impacts in this region?

Who are the experts working on this locally, the researchers, the managers, the various stakeholder groups like local government, environmental groups, farmers, tribes?

Do you find evidence of local groups collaborating when they may have competing interests? Do you find evidence of conflict?

What solutions are being discussed that might benefit everyone in some way?

Any success stories? Are there policy solutions? Are their technology innovations being explored?

Are there new business opportunities that might follow technology innovations?

What strategies are being used to educate people on small, everyday behavior changes? What's happening at the level of neighborhoods with communities organizing their own solutions?

Sample resources from keyword searches

U.S. Drought Monitor. This series of state-by-state maps are released every Thursday, showing parts of the U.S. that are in drought. The map uses five classifications: abnormally dry (D0), showing areas that may be going into or are coming out of drought, and four levels of drought: moderate (D1), severe (D2), extreme (D3) and exceptional (D4).

The Western Drought Is Bad. Here's What You Should Know About It. Answers to questions about the current situation in California and the Western half of the United States.

Where's the Water? Drought Threatens California's Lifeline. According to the United States Drought Monitor, 84 percent of the West is now in drought conditions, with 47 percent rated as "severe" or "extreme." In California, 73 percent of the state falls into those categories.

Amid Historic Drought, a New Water War in the West: A drought crisis has erupted in the Klamath Basin along the California-Oregon border, with fish dying en masse and farmers infuriated that they have been cut off from their main water source.

California's Drought Is So Bad That Almond Farmers Are Ripping Out Trees. The famed farming valleys of California are being swept into what feels like permanent dryness, raising the specter of food inflation.

The Drought and Food Access in California.An excellent PowerPoint listing the multiplier effects of drought on food systems, workers mad public health. And it's not just a California challenge. Much of the nation, including our own families depend on food grown in California.

In California's Drier Future, What's the Best Investment for Securing Water? California's water system, already stressed by the dueling needs of massive urban centers and its agricultural sector, is crumbling in the face of climate change. What are the options?

Monday, June 28, 2021 - Pacific Northwest's record-smashing heat wave primes wildfire, buckles roads; health toll not yet known.

Tuesday, June 29, 2021 - How Weird Is the Heat in Portland, Seattle and Vancouver? Off the Charts. To understand the magnitude of the departure from historical norms, it helps to visualize it.

Activity 5

Creating a Climate Resilience Plan

How resilient are we to the impacts of climate change? How do we plan? At what scale?

Invite students to reflect individually for 5-8 minutes, writing or sketching out an initial "resilience plan" for their household, their community, or the bioregion. Ask them to build a working definition of the word resilience.

After the initial reflection, share the following definition of climate resilience.

According to Wikipedia...

Climate resilience can be generally defined as the adaptive capacity for a socio-ecological system to: (1) absorb stresses and maintain function in the face of external stresses imposed upon it by climate change and (2) adapt, reorganize, and evolve into more desirable configurations that improve the sustainability of the system, leaving it better prepared for future climate change impacts.

With the rising awareness of climate change impacts by both national and international bodies, building climate resilience has become a major goal for these institutions. The key focus of climate resilience efforts is to address the climate vulnerability that communities, states, and countries currently have with regards to the many consequences of climate change.

Currently, climate resilience efforts encompass social, economic, technological, and political strategies that are being implemented at all scales of society. From local community action to global treaties, addressing climate resilience is becoming a priority, although it could be argued that a significant amount of the theory has yet to be translated into practice. Despite this, there is a robust and ever-growing movement fueled by local and national bodies alike geared towards building and improving climate resilience. From Wikipedia

Facilitate a classroom discussion on how this definition expands their initial plans. Break into groups to develop a more refined collective plan. Prompts might include...

Will your family buy an air conditioner to adapt to heat waves?

Will you install solar panels to power your air conditioner with clean energy?

What if your family is renting or lives in a poorly insulated house? Do we need new policies for energy conservation retrofits and subsidized solar?

Will you help plant lots more neighborhood trees to create shade, hold moisture, and cool the air?

Will you ride your bike, the bus, and organize carpools more often?

Will you redesign your yard with drought tolerant plants that do not require as much watering?

Advanced students may want the challenge of reviewing the literature on community-based climate resilience planning and integrating the best ideas into their own plan.

Accelerating a Just Transition in Washington State: Climate Justice Strategies from the Frontlines: Washington State's Just Transition requires action in four key areas, that while not historically the focus of climate work, are necessary conditions for achieving climate goals: (1) Center Those Disproportionately Impacted in Governance, 2) Restore Community Connections to Place, (3) Create Livelihoods within a Healthy Environment, (4) Transition to Renewable Resources and Energy.

Got Green; Our People, Our Planet, Our Power: Climate change is causing more floods, heat waves, mold and high utilities bills. The homes being hit hardest are working-class families and families of color in South Seattle.

Only with strong and powerful communities rooted in place will we be able to weather the storm of climate change. Being rooted means having fair housing, dignified work, public transit, and healthy food. With a rapidly changing city, Got Green is drawing the links between gentrification, displacement, climate change and community power.

King County - Confronting Climate Change
Review lists of actions that King County is taking to confront climate change.

Activity 6

What can we do?

There are many ways for reducing the impacts of climate change. But sometimes it is hard to know where to start. Or, if we do take an action, it can sometimes feel too small to make a difference. Not true. Every action adds up. Here are some resources from Sustainability Ambassadors to inspire and guide student impact project development.

Student Impact Project Ideas

Sample Student Impact Projects

It is important for students to feel agency, voice, and choice in how they are called to make a difference in their community. And it adds rigor to the impact project design process when students are empowered to demonstrate a direct and measurable connection between the project they design and the goals of a local Climate Action or Resilience plan.

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/