PROJECT WET Water Education for Teachers

California Project WET Gazette

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Flood and Fire

'… The only way the pilot could tell where the channel of the river was, was by the cottonwood trees on each side of the river. The boat had to stop several times and take men out of the tops of trees and off the roofs of houses. In our trip up the river we met property of every description floating down- dead horses and cattle, sheep, hogs, houses, haystacks, household furniture, and everything imaginable was on its way for the ocean.'

- John Carr describing his riverboat trip up the Sacramento River during floods of 1861-62

Tales of the world ending in flood and fire are found in societies throughout the world. It may not be hard to see the merit in recent predictions that the end is near with the storms and floods of biblical proportions that have struck the Mid-West and South this spring. California is certainly not immune to severe flooding and it is quite possible end of the world scenarios may have been crossing Governor Leland Stanford's mind as he rowed to his January 1862 inauguration at the state capitol after heavy December rains turned the Central Valley into an inland sea. The flow of water across the California landscape has greatly altered since Governor Stanford's day, but the fact remains that many of us live in a floodplain and all of us pay taxes to maintain flood control infrastructure. That infrastructure and a surprisingly long cool spring have helped blunt predictions of a La Nina inspired flooding disaster on the scale of what we are witnessing in other states. But with the calendar claiming summer will soon be upon us and a record Sierra Nevada snowpack waiting to melt, it may be a good time to gain a better understanding of two key ingredients in the recipe for a California flood: geography and climate.

Geography is a huge factor. The collision of geological and atmospheric forces shaping California has left a convoluted landscape of steep mountains and well- worn hills surrounded by floodplains throughout the state. Like the Mississippi Valley, our Central Valley is a relatively flat floodplain, formed over millennia by erosion within the watershed and deposition of this material in the valleys- a process easily demonstrated on a stream table or in the Project WET activity *'Just Passing Through' (p: 166).* This natural process has created deep, rich soils primed for growing riparian forests, dense grasslands and a tremendous quantity of food crops. Unlike the broad Mississippi watershed that spans all or parts of 31 U.S. states and two Canadian provinces, our Central Valley is sandwiched between the weathered debris of colliding continental plates (Coast Ranges) and the volcanic propelled rise of the Sierra Nevada mountain range. The spine of the Sierra Nevada juts from 3,000 to 9,000 feet above that of the Coast Ranges. It is a formidable obstacle to moisture laden air masses heading east off the Pacific Ocean- and has a significant influence on the climate of California.

A region's climate is based on *long-term* weather conditions. Some are concluding a link to climate change with the deluge of extreme weather reports from across the country this year; yet, while this one year worth of data will contribute to the larger climate picture, it needs to be evaluated within the broader context of past and future data. The Project WET activity *'Wet Vacation' (p: 206)* delves into this distinction. Read the background and try Part I of the activity. The extreme weather across the

country provides an opportunity to observe a stark contrast between the long-term data presented in the Project WET activity and the current annual precipitation. Observe for yourself with a data comparison for several of the same cities in the activity on this NOAA website. In my quick comparison of several cities, I noted all California locations are recording annual precipitation to date in excess of their long-term average, with Eureka exceeding 10 inches above normal- as are numerous cities within the Mississippi watershed. It is easy to compare the precipitation of selected cities in the Mississippi watershed and simply trace the flow to see how the excess water directly relates to the current flooding, but not for those included in the activity for California. None are in the same watershed, though some may make a case to link San Francisco and Fresno.

Instead, our geography lends itself well to the suggestion in Part II of *'Wet Vacation'* to have students study the climate and weather patterns for regions of a state- and the Sierra Nevada provides an excellent example to use with the entire class. Using a fairly simple map of the Central Valley and Sierra Nevada Mountains that includes some elevations and the attached data from the Western Regional Climate Center (See 'Websites of Interest'), have students form teams and plot the data for the given locations– using the assistance of an more detailed atlas to locate the more remote data sites as needed. In doing this activity with a group of upper elementary teachers, they noted in amazement that annual precipitation jumps almost 20" as one travels uphill from Sacramento to Auburn– and 20" again as one continues traveling up I-80 to Nevada City.

Once all data is plotted, each team studies adjacent data points on their maps to determine the probable location of isohyets lines in increments of 10" between each point. See Part II of the Project WET activity '*The Thunderstorm' (p: 196)* if students are unfamiliar with isohyets. Once all have been determined, the team connects the points of common increments to create a precipitation map that looks uncannily like the one that can be downloaded from the California Department of Forestry Fire and Resource Assessment Program (FRAP) (See 'Websites of Interest'). A comparison of the student maps to a topographic map of the Sierra Nevada reveals a distinct correlation between isohyet and topographic lines- the Sierra Nevada being a prime example of the orographic precipitation. It becomes easy to observe why the Sierra is a source for so many streams flowing into the Central Valley and this orographic signature can also be observed with further comparison of the student data maps FRAP vegetation cover, wildlife habitat, surface fuels and fire hazard maps.

"The Sierra Rivers are flooded every spring by the melting of the snow as regularly as the famous old Nile. Strange to say, the greatest floods occur in winter, when one would suppose all the wild waters would be muffled and chained in frost and snow…But at rare intervals, warm rains and warm winds invade the mountains, and push back the snow line from 2000 to 8000, or even higher, and then come the big floods." - John Muir (1900)

Early forecasts predicted California weather condition were ripe for one of the 'rare intervals' mentioned by John Muir, but the weather patterns failed to align with the long term climate trends. Instead, a long cool spring has preserved- and added- to the above average Sierra snowpack. Take another look at the 365 day graphs for the Southwestern states on the NOAA website. Click on any California location west of the Sierra and you'll see all display the classic signature of a Mediterranean climate from Eureka to San Diego- our dry period coincides with our summer. Mediterranean climates are also noted for their relatively mild, wet winter growing season. Ours has been exceptionally long this year and a return to our usual summer heat could trigger a rapid snowmelt and drying of vegetation across the landscape, raising the threat of wildfire even as flood waters roar down the canyons into the Central Valley- which brings us back to the human element.

Urban planning and development also play a key role in influencing the extent and economic impact of flood and fire. There are several Project WET activities that analyze the role of planning and development, including *'Back to the Future' (p: 293)* – where students analyze streamflow data to determine the safest location for a community within a floodplain- and *'Color Me A Watershed' (p: 223)* – which involves the interpretation of maps to analyze the impact of land cover and management

decisions on run-off in a watershed. Your Project WET guide has additional activities that also study the role of planning and development. You can also keep yourself informed on flood concerns and other current water news on our news blog Aquafornia and instantly monitor the status California streamflows with the interactive map on the USGS California Water Science Center homepage. You can also peruse the 'Websites of Interest' for additional resources.

One final note- if you click around on other southwest locations on the NOAA website, note the times of the year when they are dry on the *'daily observed'* graph and where they stand on accumulated vs. normal precipitation. May and June are the dry months for Arizona and much of the Colorado Plateau- and this pattern has extending into south and west Texas this year. Both areas were experiencing below normal precipitation as each entered the dry period of the year- and both are currently on fire. The dry period for the Plains states is December and January- Remember the Oklahoma wildfires a few Decembers past?

WEBSITES OF INTEREST

USGS: WaterWatch *http://waterwatch.usgs.gov*

This U.S. Geological Survey site displays maps, graphs, and tables describing real-time, recent, and past streamflow conditions for the United States. WaterWatch tables provide tables of current streamflow information, locations of flooding and drought conditions. The real-time information generally is updated on an hourly basis and is based on more than 3,000 long-term (30 years or more) USGS streamgages and feature a point-and-click interface allowing users to retrieve graphs of stream stage (water elevation) and flow.

California Data Exchange Center *http://cdec.water.ca.gov/*

The California Data Exchange Center (CDEC) installs, maintains, and operates an extensive hydrologic data collection network including automatic precipitation and river stage sensors for flood forecasting. CDEC provides a centralized location to store and process real-time hydrologic information gathered by various cooperators throughout the State.

USGS Fact Sheet: The "1OO-Year Flood" *http://pubs.usgs.gov/fs/FS-229-96/*

Rivers across the Nation seem to be rising to record flood levels almost every year. In some areas of the nation, more than one 100-year flood has happened on a few rivers in just the past several years. Why Don't These Floods Happen Every 100 Years? Check-out this USGS fact sheet to learn what is meant by the term ***'100- year flood'*** and how it is calculated.

Regional Climate Centers *http://www.wrcc.dri.edu/rcc.html*

NOAA's Regional Climate Centers (RCCs) are a federal-state cooperative effort. The RCC Program is managed by the NOAA's National Climatic Data Center (NCDC). The six centers that comprise the RCC Program are engaged in the timely production and delivery of climate data, information and knowledge for decision makers and other users at the local, state, regional and national levels. The climate data provided is a wealth of information one can use with Project WET activities ranging from *'Wet Vacation' (p: 206)* to a US focused adaptation of *'Piece It Together' (p: 174)*. Click the following link to find current California data summaries: http://www.wrcc.dri.edu/monitor/cal-mon/index.html

USGS CoreCast: The ARkStorm Scenario *http://gallery.usgs.gov/audios/387*

Beginning on Christmas Eve 1861, an extreme series of storms lasting 45 days struck California. The storms caused severe flooding, turning the Sacramento Valley into an inland sea. The storms were caused by atmospheric rivers, a hurricane-like phenomenon that occurs on the west coast. A storm comparable to

that of 1861-1862 could occur again. Hear more about the ARkStorm study from Lucy Jones, chief scientist for the USGS Multi-Hazards Demonstration Project.

Fire and Resource Assessment Program *http://frap.cdf.ca.gov/data/frapgismaps/select.asp*
The California Department of Forestry and Fire Protection's Fire and Resource Assessment Program (FRAP) assesses and analyzes the amount and extent of California's forests and rangelands. The FRAP program also produces superb, easy to download maps that can be used with Project WET activities and California Environmental Education Initiative modules. Check-out the Bioregions, Mean Annual Precipitation Zones, Land Cover, Wildlife Habitat and Surface Fuels maps for use with the *'Wet Vacation'* adaptation described in the article.

Sierra Nevada Geography *http://www.sierranevadaphotos.com/geography/index.asp*
One of the things that makes the Sierra Nevada so unique is its diverse and complex geography, ranging from pastoral rolling oak dotted foothills to rugged alpine peaks; from barren desert to forests of towering sequoias; from the warm, dry lowlands to winter passes clogged with up to 30 feet of snow. This page contains links to lists, charts and maps of some of the many geographic features of the range, including elements of the physical landscape, climate and the human landscape.

Water Education Foundation *http://www.watereducation.org*
The Foundation offers a variety of programs to teach students, our future voters and leaders, about water. Students in grades K-14 learn about the history, geography and science of water, and the difficult decisions surrounding this complex issue. All Foundation classroom materials are consistent with the standards of the California State Frameworks for Science and History/Social Science and are designed to correlate with grade-level teaching requirements.

Aquafornia *http://aquafornia.com/archives/category/flood-control-stormwater*
Aquafornia is the water news blog of the Water Education Foundation. Aquafornia is a news aggregator covering California water news from both traditional and non-traditional news sources, presenting the many sides and views of the water picture, with the goal of fostering understanding of various positions and discussion toward resolution of these often controversial issues. All articles are categorized by region and topic, making the site an excellent source of multiple viewpoints for use with a variety of Project WET issues analysis activities. Current articles on flood and stormwater ossues can be found at the link above, and articles on water and energy are at: *http://aquafornia.com/archives/category/water-energy*.

Water Use in the United States ***http://water.usgs.gov/watuse/***
The U.S. Geological Survey's National Water-Use Information Program is responsible for compiling and disseminating the nation's water-use data. The USGS works in cooperation with local, State, and Federal environmental agencies to collect water-use information. USGS compiles these data to produce water-use information aggregated at the county, state, and national levels.

Energy-Water Nexus Overview ***http://www.sandia.gov/energy-water/nexus_overview.htm***
Federally supported research and development (R&D) is being carried out to address key pieces of this puzzle including advanced fossil and nuclear energy technologies, energy efficiency, infrastructure systems, pollution control and prevention, and renewable and alternative energy. However, one critical component of the R&D mix is missing - water. Currently, there is no national research program directed specifically at understanding the intimate relationship between energy and water.

The School Water Audit Project *http://cals.arizona.edu/arizonawet/teachersupport/swap*
The School Water Audit Project (SWAP) was created by the Arizona Project WET program. It combines water education with practical applications of scientific methodology. The program brings community

members together with students for the purpose of accomplishing a unified goal- and both empower students and adults alike to be responsible stewards of energy and water resources.

The Home Energy Education Challenge

http://www.homeenergychallenge.org

The U.S. Departments of Energy and Education and the National Science Teachers Association (NSTA) announce America's Home Energy Education Challenge. School teams from grades 3-8 will implement and monitor energy efficiency activities at home over a three month period. Schools will compete against each other, culminating in a national competition. A second part of the Challenge is aimed at helping students better understand basic energy issues such as the connection between energy use and energy bills. Online activities will improve students' knowledge of energy use, energy-saving techniques and various energy calculations to enable them to identify opportunities and develop a plan for saving energy

Cold Cash in the Icebox

Summer is fast approaching and despite our never-ending winter this spring, it is only a matter of time before the mercury shoots through the century mark. This thought crossed my mind as I listened to a recent radio interview of U.S. Department of Energy Secretary, Steven Chu. It was interesting to hear that in each home he has lived in since his early 30s, he has managed to reduce his energy bills by a factor of two simply by understanding the role of insulation and the ability of various materials to conduct or reflect energy. Here's a guy who has a Ph.D. in advanced physics, but he is simply closing the shades and using materials anybody can get pretty cheaply at any hardware store in America to keep his house cooler in the summer and warmer in the winter. Now, Secretary Chu is working on a new education initiative, in a partnership between the U.S. Departments of Energy and Education and the National Science Teachers Association (NSTA), to educate America's young people about energy efficiency and using energy responsibly. America's Home Energy Education Challenge aims to harness the creativity and zeal of students to inspire families to save energy at home- and Project WET can help!

'Cold Cash in the Icebox' (p: 373) introduces students to the concept of insulation and helps them discover the conductive properties of a variety of materials through direct experimentation- and it is a great activity to do during summer heat. Students are challenged to design mini-iceboxes using milk cartons and a variety of materials in an attempt to keep ice from melting. In the process, they discover not only the challenges of refrigeration in the days before electricity, but also effective insulation strategies and materials. They also learn the value of keeping and comparing records on their attempt(s) to see what was most effective and how to improve their design. Can they create a design that will keep ice cubes frozen for an entire day?

So what does this have to do with water? As highlighted in the Fall 2010 Gazette, a recent Department of Energy's National Laboratories report states '*Electricity production from fossil fuels and nuclear energy requires 190,000 million gallons of water per day, accounting for 39% of all freshwater withdrawals in the nation... That means U.S. citizens may indirectly depend upon as much water turning on the lights and running appliances as they directly use taking showers and watering lawns.'* Conserving energy conserves water and vice versa and home heating and air conditioning is at the top of this list on residential energy use as landscape watering and the toilet are for in-home water use.

Rather than having students conclude the activity with summarizing the importance of ice for refrigeration in the days before electricity, challenge them to apply their new found knowledge to improve the energy efficiency of the house. Are there locations where sun energy is directly entering the house

during the day? Are there gaps where outside and inside air can freely flow into rooms? For those budding architects, are there a set of plans or a supervised way for those curious to see how a house is insulated- and is the design using anything similar to that used in creating their icebox? What modern materials are used to insulate a house? Can students come up with a plan that can keep the house below 75 to 80 degrees throughout most of a hot summer day? If nothing else, it may at least get students to not leave the door wide-open when entering or leaving a house!

The idea that doing something as simple as installing and properly maintaining good insulation can not only save individual homeowners and businesses significant amount of dollars, but can also take a huge bite out of our national energy demand has raised a snort of derision from quite a few people and has been used as a point of ridicule in some recent elections. Yet, an understanding of insulation to retain or exclude heat was something our ancestors grappled with up until the advent of modern appliances- and seems to have been completely forgotten as we've morphed into an out-of-sight, out-of-mind society with an instant messaging attention span. As Secretary Chu added in his interview, *'We think that the enthusiasm of kids is something that could be a very powerful force, and that kids can form their own networks and get their families to think about how they can actually save money.'*

Please see your Project WET guide for additional activities that can be used to study home water and energy conservation. There are also several new funding opportunities for schools and students in the 'Grants & Scholarships' section of this Gazette. I hope you find other ideas, links and events in this Gazette to make your summer enjoyable – and don't forget to check-out the ice-cream making activity in the *'Cold Cash in the Icebox'* Extensions!

If you would like more information on Project WET please contact Brian Brown, California Project WET Coordinator at: projectwet@watereducation.org or (916) 444-6240.

Check our website www.watereducation.org and/or contact us for updates.