

Stormwatchers Predict Flooding Educator Guide



A resource for using QUEST audio in the classroom

Listen to it online <http://www.kqed.org/quest/radio/view/180> | 5:45 minutes

QUEST SUBJECTS

Life Science
Biology
Health
Environment

Earth Science
Geology
Weather
Astronomy

Physical Science
Physics
Chemistry
Engineering

CA SCIENCE STANDARDS

Grade 4

Earth Science

5. Waves, wind, water and ice shape and reshape Earth's land surfaces. (c)

Grades 5

Earth Science

3 Water on Earth moves between the oceans and land through the processes of evaporation and condensation. (b,c,d,e)

4. Energy from the Sun heats Earth unevenly, causing air movements that result in changing weather patterns. (c,d)

Grades 6

Earth Science

2. Topography is reshaped by the weathering of rock and soil and by the transportation and deposition of sediment. (a,b,d)

Grades 9-12

Earth Science

9. The geology of California underlies the state's wealth of natural resources as well as its natural hazards.. (b,c)

PROGRAM NOTES

Global warming and seasonal storms are endangering California's low-lying areas and dam and reservoir systems. Now a new network of high-tech weather sensors is making the American River's streams, tributaries and dams the country's most closely monitored water system.

In this segment you will discover...



- 🔍 why it's important to predict storms that could affect the American River.
- 🔍 what decisions dam operators have to make when a storm approaches.
- 🔍 where and how water flows downstream during a large storm in the Sacramento area.

TOPIC BACKGROUND

The Pineapple Express is a winter (November to March) weather phenomenon that tends to create storms along the Pacific coast. This subtropical jet stream brings warm, moist air from Hawaii to the West Coast. When the warm air collides with cold air, the result is rain -- and often lots of it. The Pineapple Express can cause disastrous flooding in the Sacramento area and other places.

As you know from studying the water cycle, rain falls onto the earth and gravity pulls it downhill. Some of the water seeps into the ground to become groundwater. Most of it feeds into rivers and streams that lead to the ocean. But what happens when there is too much water for the rivers to handle? During big rainstorms, especially in Sacramento, large quantities of water flow out of the Sierra Nevada and into the American River. Levees and dams, built to help control flooding, can't always control a deluge.



People and communities need dams for many reasons. Millions of people throughout the U.S. depend on dams to provide flood control; drinking water supplies; irrigation water for farming; clean, renewable energy via hydropower; and recreational areas. The need for dams has increased as the population has grown and more people move to arid or flood-prone regions. But dams can be problematic, if not disastrous, to ecosystems, too. By altering the naturally occurring waterways, dams can cause habitat loss for plants and animals.

During a storm, dam operators have to make tough decisions about how much water to release in order to prepare for storm-related runoff. Any water they release is water lost to irrigation, recreation or drinking. In order to make this decision easier, dam operators turn to high-tech sensors to track river levels. This technology helps officials warn residents and prepare for the extra runoff.

Media Enhance Education

Video and audio can be powerful tools for meaningful learning. It all depends on you, the educator. The key to using media effectively is preparation. Make the most of learning opportunities by encouraging students to become active viewers and listeners. Pick and choose from the suggested questions and activities to offer an engaging media experience.

Questioning

Oftentimes, teachers and students become frustrated during a media segment when students can't find the answers to a long list of questions. Provide a limited number of questions or topics for students. This focuses their attention during a media segment, helps to keep them engaged and generally results in higher quality answers. QUEST Ed. has provided a number of options for focus questions ranging from fact based to opinions, as well as "big picture" ideas.

PRE - LISTENING

- What is your local watershed? Where does your water come from?
- Why do you think it's important to be able to predict storms?
- What are the purposes of dams, especially in the Sacramento area?
- Do you think we should be concerned with how much water we use in our daily lives?
- Why are storms and flooding an important part of the water cycle?

LISTENING FOCUS

NOTE: You may choose to listen to the story twice with your students: once to elicit emotional responses and to get an overview of the topic and again to focus on facts and draw out opinions.

- Record any facts you find interesting while you listen.
- Where are the boundaries of the American River basin?
- What decisions do dam operators have to make about the Folsom Reservoir?
- What do Schneider's high-tech sensors do?
- Name some pieces of Schneider's weather-monitoring equipment. What do these tools do?
- What happens to the collected weather data?

POST- LISTENING – Links to activities mentioned here can be found on the following page.

- **Review** students' answers to the Listening Focus Questions.
- **Experiment** with water and watersheds using the Save the Bay Watershed Curriculum. Learn about your local watershed, erosion control and wetlands.
- **Participate** in the "Water Is Life" poster/slogan contest. Create art and poems about your local watershed and compete with other Bay Area students.
- **Role play** with your classmates. What would you do if you were a dam operator and knew a storm was coming? How would you decide how much water to release?
- **Learn** about floods and the conservation of water through songs, puzzles and the water curriculum on the Santa Clara Water District's Web site.

Rain! whose soft architectural hands have power to cut stones, and chisel to shapes of grandeur the very mountains.

- Henry Ward Beecher

LESSON PLANS / ACTIVITIES

Save the Bay

<http://www.savesfbay.org/site/pp.asp?c=dgKLLSOwEnH&b=490227>

- Explore the Save the Bay Watershed Curriculum, which has over 30 activities on the San Francisco Bay watershed.

Santa Clara Water District Web site

<http://www.valleywater.org/Programs/TeacherMaterials.aspx>

- Discover games and puzzles, curricula, CDs, DVDs and activities about water.

Alameda County Water District Web site

http://www.acwd.org/education_poster_contest.php5

- Find out about classroom presentations, teacher workshops, field trips and how to create a poster or slogan with the theme "Water Is Life."

Watershed Action Program

<http://www.kidsforthebay.org/programs/watershed.htm>

- KIDS for the BAY comes to your classroom to engage students with their local watershed. The program includes two days of interactive in-class workshops; a field trip to a local creek, bay or delta habitat; and an environmental action project.

ARTICLES / READING

National Severe Storm Laboratory

http://www.nssl.noaa.gov/briefings/vol6_no4/hmt.html

- A research project by the HydroMet Testbed (HMT) explores what is required to make better predictions about where, when and how much rain will fall in the American River basin.

San Francisco Bay Area Graphic Creek & Watershed Finder

<http://www.museumca.org/creeks/wb-resc.html>

- Use this great link at the Oakland Museum of California Web site to click on maps and find your local watershed. It also has links to local watershed resources.

U.S. Environmental Protection Agency

<http://www.epa.gov/region09/water/>

- Information on groundwater and drinking water, wetlands, oceans, watersheds and water science in the San Francisco Bay Area.

Look for the



indicating resources from QUEST partner organizations

QUEST QUAD

FIELD NOTES 	FIELD TRIP 
<p>Go outside and ...</p> <ul style="list-style-type: none"> ⦿ Map your storm drains <ul style="list-style-type: none"> • Draw the locations of all the storm drains around your house or school. • Observe and write down what you see near the drains, such as leaves, trash or soap. • Predict how those items will affect the water when it flows into the drains. ⦿ Visit your local creek <ul style="list-style-type: none"> • Where does the water come from and flow to? • What plants and animals use your creek? Create a journal about them. 	<p>Visit ...</p> <ul style="list-style-type: none"> ⦿ The headquarters of your local water district <ul style="list-style-type: none"> • Find out where your water comes from and how it's purified. Santa Clara Water District: http://www.valleywater.org/ Alameda County Water District: http://www.acwd.org/education_field_trips.php5 San Francisco Water Power Sewer: http://sfwater.org/index.aspx?page=157 ⦿ A local reservoir to see how water is contained and where it comes from <ul style="list-style-type: none"> • Talk to a dam operator to discuss the decision-making process for releasing water. <p>Reservoirs in Alameda, Contra Costa, Santa Clara and Marin counties include Del Valle, Lake Chabot, Shadow Cliffs, San Pablo , Lafayette, Steven's Creek, Anderson, Soulajule, Nicasio and Bon Tempe.</p>
FIELD RESEARCH 	FIELD TEST 
<p>Find out more about...</p> <ul style="list-style-type: none"> ⦿ The history of the San Francisco Bay watershed <ul style="list-style-type: none"> • Visit the link below and read chapters of From the Sierra to the Sea. View maps to learn about the history of this watershed, conflicts over water resources and ambitious restoration efforts. • Have students write a story about what life was like historically in the Bay Area and how water affected daily life. http://www.bay.org/publications ⦿ Dams in California <ul style="list-style-type: none"> • Visit the following Web site and click on a dam to find out about its dimensions, hydraulics and general statistics. • Have students design their own dams. What will they be used for? http://www.usbr.gov/projects/DynamicMap.jsp 	<p>Experiment with...</p> <ul style="list-style-type: none"> ⦿ Ways you and your family can conserve water at home <ul style="list-style-type: none"> • Some include taking shorter showers, not letting the water run as you do dishes and watering your lawn at night or early in the morning. ⦿ Making your own watershed <ul style="list-style-type: none"> • Crumple a piece of white paper into a tight ball and then partly smooth it out so it looks like a topographic map. The highest points on the paper represent mountaintops and the lowest wrinkles are valleys. • Use a bottle of colored water to drop "rain" on the maps. Discuss what you observe. Where does the water go? Where are the rivers? What part of the land is a watershed for one of the rivers?

VISIT OUR PARTNERS

The Bay Institute
www.bay.org

California Academy of Sciences
www.calacademy.org

Chabot Space and Science Center
www.chabotspace.org

East Bay Regional Park District
www.ebparks.org

Exploratorium
www.exploratorium.edu

Girl Scouts of San Francisco Bay Area
www.girlscoutsbayarea.org

Golden Gate National Parks Conservancy
www.parksconservancy.org

Lawrence Berkeley National Laboratory
www.lbl.gov

Lawrence Hall of Science
www.lawrencehallofscience.org

Oakland Zoo
www.oaklandzoo.org

The Tech Museum of Innovation
www.techmuseum.org

UC Berkeley Natural History Museums
<http://bnhm.berkeley.edu/>

OTHER WAYS TO PARTICIPATE IN QUEST



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89.3 FM Sacramento**
Fridays at 6:30am and 8:30am



WATCH

KQED Channel 9
Tuesdays at 7:30pm

PHOTO CREDITS

Flooded River; Jessica Merz
Image link <http://www.flickr.com/photos/jessicafm/77284749/>

Dam; Schizoform on Flickr.com
Image link <http://www.flickr.com/photos/schizoform/42148718/>



From KQED Radio News, this is Quest, a new series exploring science and environmental issues across northern California. I'm Andrea Kissack. It's been a fairly very dry winter so far in California. One group who could really use some rain is a team of scientists trying to unlock the secrets of how storms work. What they find out has critical implications for people living in flood-prone areas like Sacramento, where information is the best defense. Amy Standen has more.

Nothing gets a meteorologist fired up quite like a good storm. On this particular day, driving east out of Sacramento, it's raining. If we're lucky, it might even turn into what meteorologists call an "event." For Timothy Schneider, a scientist with the National Oceanic and Atmospheric Administration, or NOAA, that's big news.

The weather affects humanity at its most base level every single day.

In his tweed hat and red sweater, Schneider is every bit the friendly, mild-mannered Midwesterner. These days he lives in Colorado, but he misses the dramatic weather he grew up in.

I think every school kid in Minnesota is always looking for that great and wondrous thing called a snow day where school is cancelled because the weather is severe. Or in the summers hiding in the basement when tornado warnings are issued. When something affects you, your curiosity is drawn to it and maybe that's how a meteorologist is made.

Schneider's job is to try and understand one of the most complicated natural systems on earth: storms and what happens when they hit land. He and his team are using the American River as a test case, to see what they can learn, and then apply that knowledge to other parts of the country. This week, during a late winter rain, he's been called out to Sacramento to experience the weather firsthand.

So I think this is where we want to stop...

We pull over about 35 miles east of Sacramento.

We're standing alongside the north fork of the American River, one of three forks of the American River basin.

The water level is low here, but looks can be deceiving.



And there's also a sign here that says warning cold water and strong currents. River water changes quickly. Stay out, stay alive.

Say the word "flooding" and it's New Orleans that often comes to mind. But Sacramento's flood risk is at least as high. The city sits at a confluence of two major rivers, the Sacramento and the American. Much of its population lives in low-lying areas, kept dry during floods by a patchwork of levees, some more than a century old.

The lives and property of almost a million people could feel the effects of what happens on the river here.

As the river flows downstream from here near Auburn, it's collected in Folsom Dam, and it's stored.

There's not a lot of extra room in Folsom Reservoir, so when the river swells, dam operators face some tough choices. Should they retain the water to be released later in the summer to farmers and other users? Or, should they keep the dam's spillways open, to make room for more water if the storm continues? If they release too much and no more rain comes, farms and cities could go dry and fish could suffer. If they don't release enough and a deluge sets in, the dam could overflow, spelling disaster downstream. Without accurate weather forecasting, it's a high-stakes gamble. And that's where Schneider and his team, armed with increasingly high-tech gadgetry, come in.

We're at Alta, California and this site here at Alta is a California Department of Forestry site, a fire station. They've got a little space out back and they've let us set up some of our instrumentation.

It's pouring up in the Sierra foothills, about 50 miles east of Sacramento, and our little black umbrellas aren't much help. But Schneider is undeterred. From a distance, all this weather monitoring equipment looks like dilapidated household appliances at a yard sale. But every item here supplies a critical piece of information. Schneider points to what looks like a pair of camcorders perched atop a ten foot pole.

This instrument on the pole there is the optical disdrometer. And what it's doing is using light and lasers to measure the size of the droplets as they fall. So there's a little transmitter on one side and a detector on the other and when the rain falls between them it can actually image the droplets, so we can count how many droplets there are and how big they are.

Whether this area floods depends on what seems like an infinite number of factors. Not just how much rain, but how cold is it? Is it falling on bare rock? Into a creek? Onto Dirt? How saturated is the ground? Schneider says one of



the most important measurements comes from a network of wires running beneath our feet, which uses electrical conductivity to detect moisture in the soil.

You can imagine if we get a lot of rain and the ground is dry, for awhile the ground is just going to soak it up and it's not going to run down into the stream,. But like the rain that's just beginning now, it began an hour ago and the ground is already wet, and more of this water is going to run down into the stream.

All in all, a staggering amount of data is uploaded to the internet where meteorologists can monitor it around the clock. But, back in the car, Schneider says they'll never completely understand the weather.

We'd have to accurately sample every inch of the globe to be able to do a perfectly accurate prediction. So we'll never have perfection, but we will always be able to strive and do better.

Even an imperfect model can go a long way toward protecting people in flood-prone areas. By understanding just what kind of impact storms are likely to have, dam operators and city officials can improve their odds of helping California weather even the most dangerous downpours.

For Quest, this is Amy Standen, KQED Radio News.