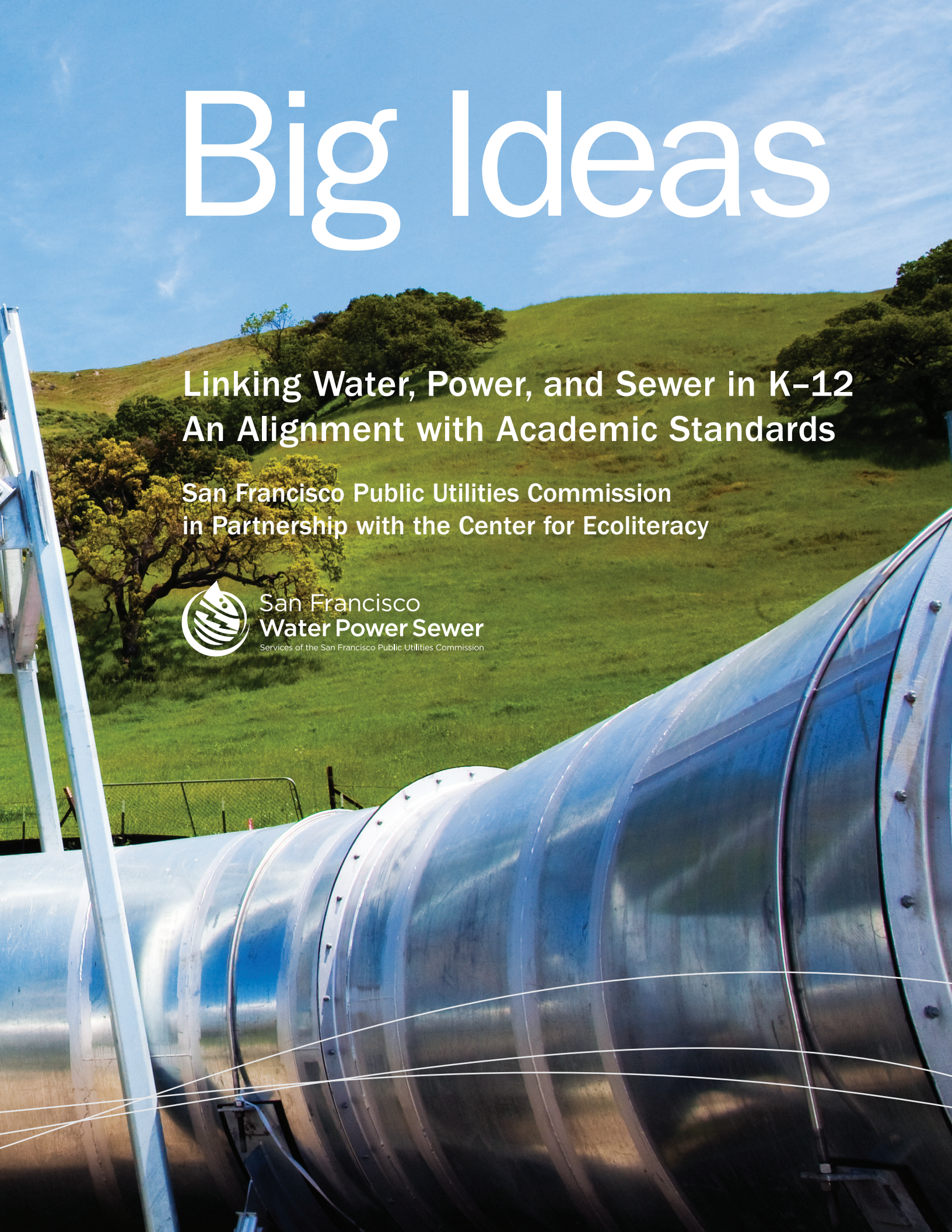
Big Ideas



Linking Water, Power, and Sewer in K–12
An Alignment with Academic Standards

San Francisco Public Utilities Commission
in Partnership with the Center for Ecoliteracy

San Francisco
Water Power Sewer
Services of the San Francisco Public Utilities Commission

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Big Ideas

Linking Water, Power, and Sewer in K–12
An Alignment with Academic Standards

Water, power, and sewer are integral parts of life that affect everyone, from the first moment of waking up and brushing teeth, until turning the last light off before bed. Our children use these resources every day but many of them don't know where their water comes from, how they get electricity in their homes, or where their waste goes when they flush it down the drain.

The idea for *Big Ideas: Linking Water, Power, and Sewer in K–12* came from our commitment to helping create the next generation of environmental stewards. The 2013 adoption of the Next Generation Science Standards (NGSS) provided the perfect opportunity to revisit our own curricular materials. This new framework focuses on the new science standards' emphasis on cross-cutting concepts, such as systems and cause and effect, which greatly align with how we think about infrastructure and the environment: **everything is connected**. We have also aligned the key concepts for grades K–12 to the Common Core State Standards for English Language Arts, and the History–Social Science Standards for California Public Schools, cultivating a cross-disciplinary approach to teaching about water, power, and sewer.

With help from staff across our agency, and the invaluable knowledge and expertise of the Center for Ecoliteracy, we are pleased to bring this resource for curriculum developers, teachers, and schools. This framework is not a lesson plan guide, but a guide for teachers to engage their students in learning about how we obtain, use, and conserve water; how we harness the power of nature to provide energy; and how we clean our waste and reuse resources to protect the environment and plan for a better tomorrow. The sample student engagements and connection with teaching and learning standards will provide a valuable foundation for developing lesson plans and project-based units, from kindergarten to advanced high school courses in science and technology.

It is our hope that the Framework will provide teachers with the foundation they need to ensure that every child starts to see the world in a new way. When students learn about water, power, and sewer, they will know which lake, river, or reservoir provided their water, how their schools and libraries get their power, and understand where their waste goes once it is out of sight. In this way, we hope they will use their new knowledge to take action and help protect these precious resources.

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March 2016

Equity and Access

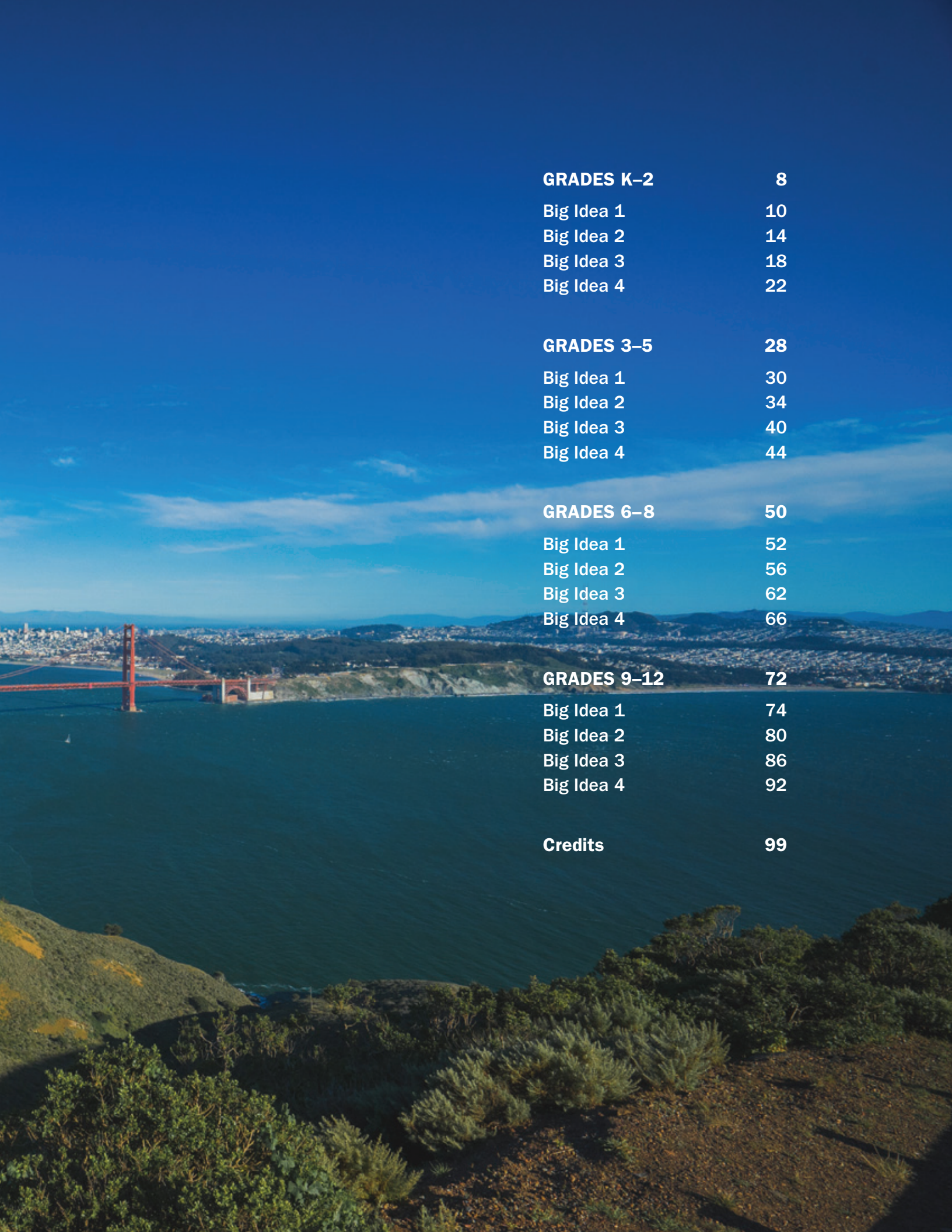
The San Francisco Bay Area—like most of California—is home to one of the most diverse populations in the country. K–12 schools increasingly recognize the vital role that they play in providing high-quality learning opportunities for all students. By intentionally incorporating creative strategies to help support students with limited English proficiency or learning differences, students of color, or other underserved populations, educators can have a significant impact on these students' ability to imagine themselves as environmental stewards, engaged citizens, and valuable members of the workforce.

Big Ideas: Linking Water, Power, and Sewer in K–12 highlights learning objectives that are essential to understanding the interconnectedness of San Francisco and the surrounding ecosystem. It also offers successful education strategies to help educators provide rigorous and engaging learning experiences for a wide range of students and learning styles. Drawing from the California International Studies Project's "Elements of Effective Teaching", *Big Ideas: Linking Water, Power, and Sewer in K–12* offers sample student activities that:

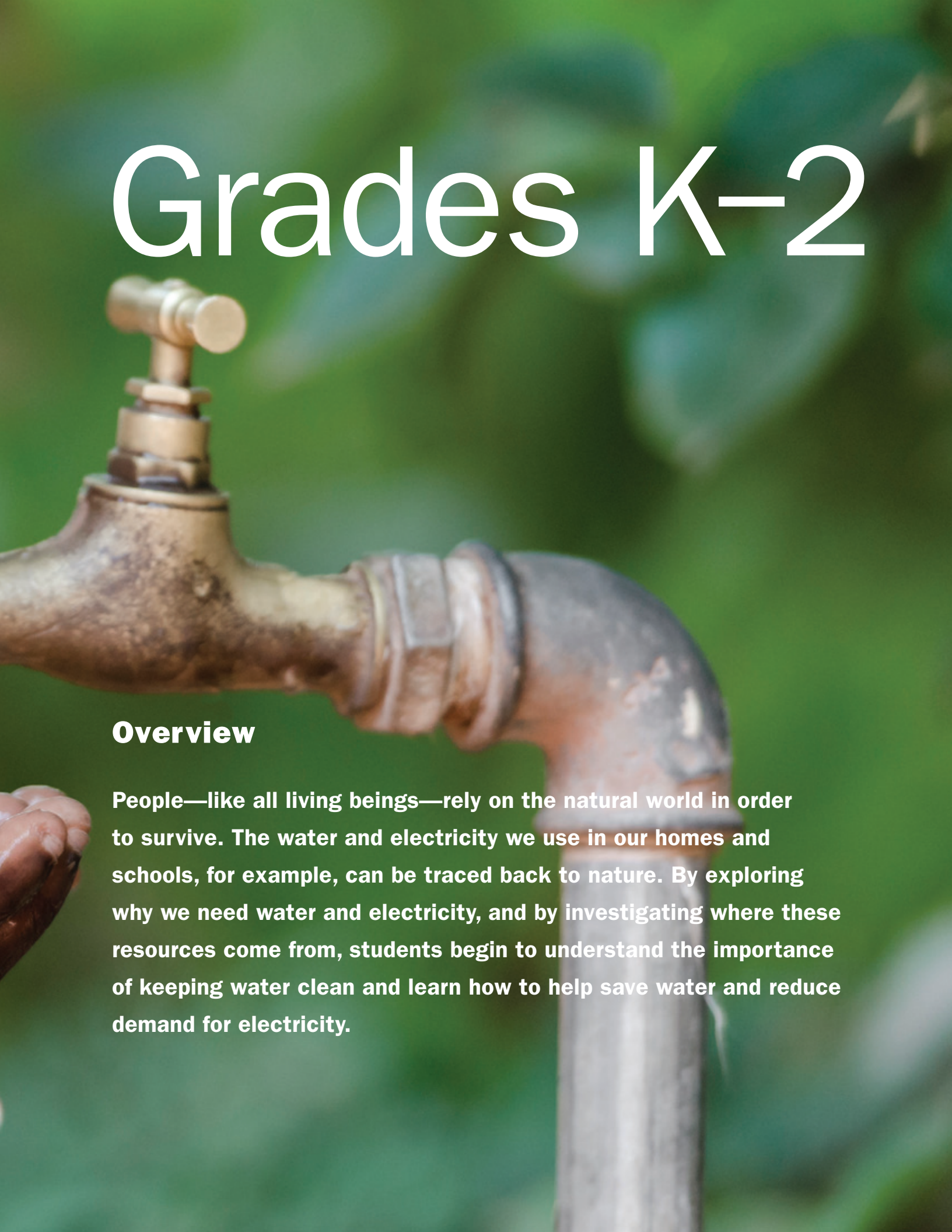
- maximize student participation by engaging students in collaborative work;
- increase students' ability to support their thinking by using evidence;
- create opportunities to share students' thinking through the use of visual representations, data, oral presentations, and use of Internet sources;
- prompt students to synthesize information, make connections, and draw conclusions;
- encourage students to analyze historical and current events through the lens of environmental justice;
- develop students' willingness to speak up and take risks; and
- apply analytic thinking to content materials.

We encourage educators at all grade levels to keep these strategies in mind as they use *Big Ideas: Linking Water, Power, and Sewer in K–12* to design rigorous and engaging learning experiences for their students.

Contents



Grades K–2



Overview

People—like all living beings—rely on the natural world in order to survive. The water and electricity we use in our homes and schools, for example, can be traced back to nature. By exploring why we need water and electricity, and by investigating where these resources come from, students begin to understand the importance of keeping water clean and learn how to help save water and reduce demand for electricity.

Big Idea 1

People need water, air, and resources from the land, and they seek to live in places that have the resources they need. (From NGSS ESS3.A)

Key Concepts

- Weather, climate, and other environmental factors affect people's lives in any given place or region.
- The amount of water on Earth stays the same, but that water is continually moving, whether falling as rain and snow, moving through streams and rivers into lakes and oceans, or evaporating into the air to form clouds.
- In San Francisco, most of the water that flows out of our faucets comes from snow melting and flowing down from the Sierra Nevada mountain range.
- In California, electricity is generated from sunlight, flowing water, and wind, and from burning natural gas, as well as forest, yard, and farm waste.

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Using Mathematics and Computational Thinking	Observe and record the weather for a week, using a chart and symbols such as the sun, clouds, rain, or snow to indicate the weather each day. Count the number of days it was sunny, cloudy, rainy, and so on. What kind of weather did you see the most?
Developing and Using Models	Create a play, dramatization, or dance to show the movement of water from rain to rivers and streams to lakes, the San Francisco Bay, and the ocean, and then into the air through evaporation to form clouds and fall as rain again. (This movement is known as the water cycle.)

CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Systems and System Models	Using a stream table or tub of soil, construct a model of mountains, valleys, and basins, and pour water over it to see how water moves across the landscape.
Patterns	Look at pictures of various bodies of water and frozen water, such as lakes, rivers, oceans, springs, glaciers, and ice caps. As a class, sort the pictures according to which provide fresh water that humans can use and which do not.

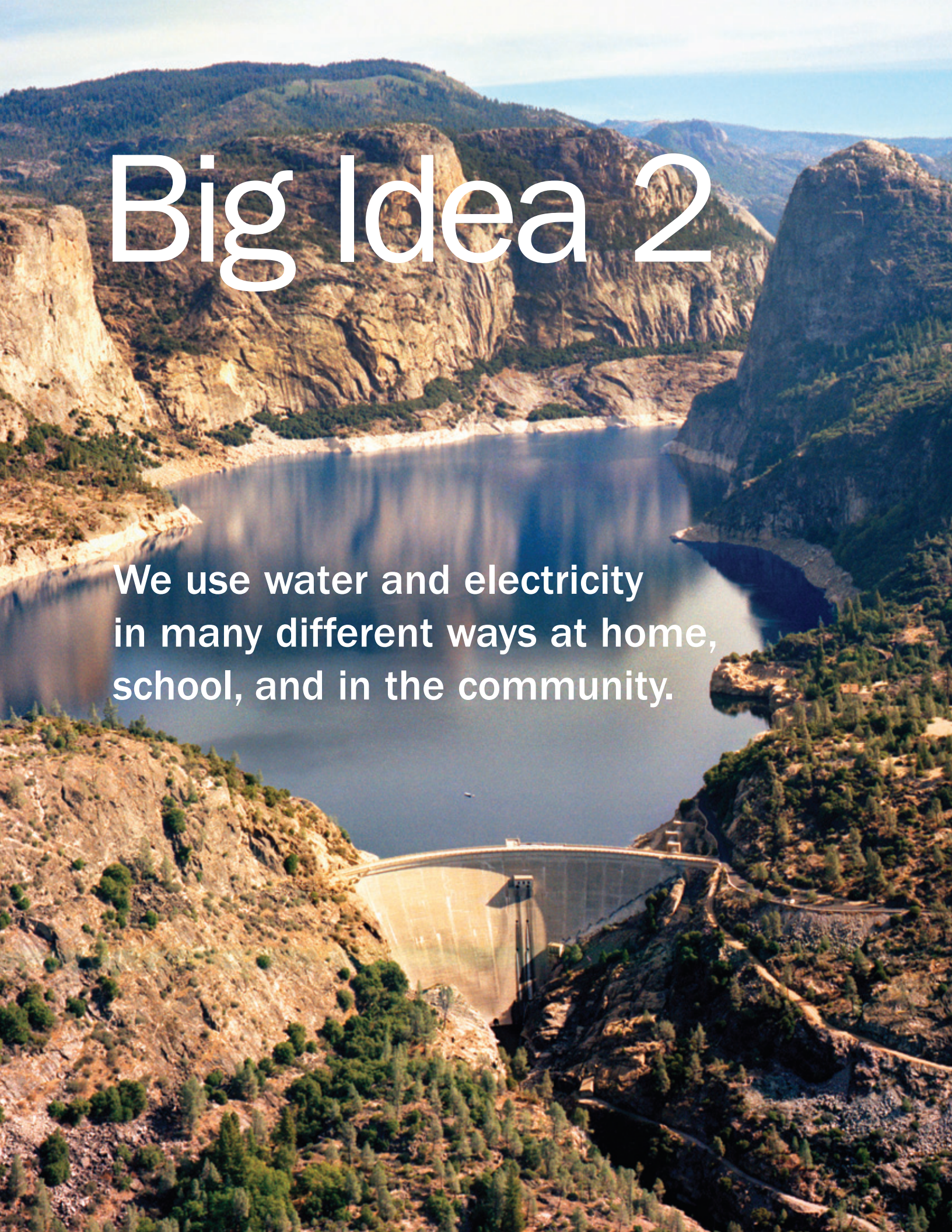
Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Reading Informational Text	Read *Switch On, Switch Off* by Melvin Berger and Carolyn Croll (Harper Collins, 2001) or another book that explains electricity. Discuss: What is electricity? What do people use it for? Where does it come from? What questions do you have about electricity? ***RI.K.1.*** *With prompting and support, ask and answer questions about key details in a text.* ***RI.1.1.*** *Ask and answer questions about key details in a text.* ***RI.2.1.*** *Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text.*

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Writing	Write or dictate a story about where water comes from and where it goes, including water that enters the sewer system. You might first read *Water Is Water: A Book About the Water Cycle* by Miranda Paul and Jason Chin (Roaring Brook, 2015) or another picture book about water. ***W.K.2.*** *Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which students name what they are writing about and supply some information about the topic.* ***W.1.2.*** *Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure.* ***W.2.2.*** *Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section.*

History–Social Science Content Standards for California Public Schools

HISTORICAL AND SOCIAL SCIENCE ANALYSIS SKILLS	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Chronological and Spatial Thinking	Looking at a large paper map or online map of your local area, locate your school and other landmarks and search for bodies of water such as streams, lakes, the San Francisco Bay, or the ocean, which are usually indicated with blue lines or blue shapes. ***K-5.4.*** *Students use map and globe skills to determine the absolute locations of places and interpret information available through a map's or globe's legend, scale, and symbolic representations.*



Big Idea 2

We use water and electricity in many different ways at home, school, and in the community.

Key Concepts

- Humans use natural resources for everything they do. (NGSS ESS3.A)
- We use water for drinking, cooking, cleaning, bathing, flushing toilets, and for making a variety of goods.
- We use electricity for lighting, heating, cooking, transportation, and entertainment. It helps to keep us warm, fed, safe, and comfortable.

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Analyzing and Interpreting Data	With digital cameras or electronic tablets, take photos around the school of objects that use electricity or of people doing things that require electricity.
Obtaining, Evaluating, and Communicating Information	Use the letters in the word “electricity” to identify the various ways in which we use it. For example, E is for “elevator,” which uses electricity to carry people up and down in a building.

CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Patterns	Create an alphabet book showing different ways that people use water at home, at school, or in the community, such as A is for "animals," B is for "bathing," C is for "cooking," and so on. Draw pictures to illustrate the pages or look through magazines for photos to include.
Energy and Matter	As a class, create a papier-mâché globe of the Earth and discuss why the Earth is sometimes referred to as the "water planet." Observe that most of the Earth's water is found in the oceans.

Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Writing	Use watercolors to paint a scene, such as your favorite memory of water, a water place that is special to you, or something else that shows the importance of water for people's enjoyment. Write or dictate simple words or sentences describing the scene. ***W.K.2.*** *Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.* ***W.1.2.*** *Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure.* ***W.2.2.*** *Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section.*

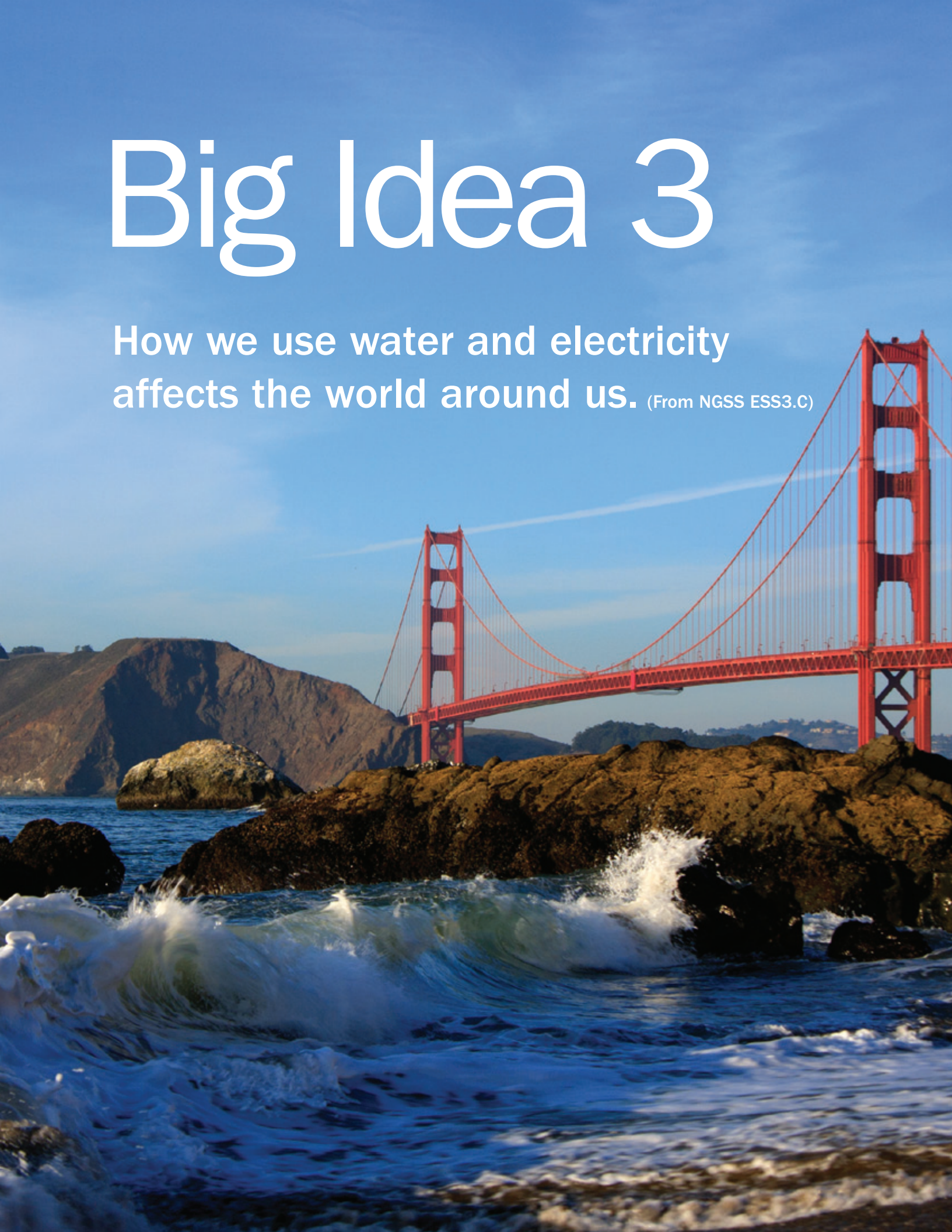
STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Speaking and Listening	Listen to a parent or community member, such as a grocer, a plumber, an artist, or a surfer, speak with the class about how their job or hobby uses water, electricity, or other natural resources. Develop a class list of questions to learn more from the speaker. ***SL.K.3.*** *Ask and answer questions in order to seek help, get information, or clarify something that is not understood.* ***SL.1.3.*** *Ask and answer questions about what a speaker says in order to gather additional information or clarify something that is not understood.* ***SL.2.3.*** *Ask and answer questions about what a speaker says in order to clarify comprehension, gather additional information, or deepen understanding of a topic or issue.*

History–Social Science Content Standards for California Public Schools

HISTORICAL AND SOCIAL SCIENCES ANALYSIS SKILLS	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Chronological and Spatial Thinking	Starting with a simple map of your school grounds drawn onto a large piece of butcher paper, add photos or drawings showing the locations of different water sources for people, plants, and animals. For example, you may include water faucets, sinks, and places where water gathers in puddles. ***K-5.4.*** *Students use map and globe skills to determine the absolute locations of places and interpret information available through a map's or globe's legend, scale, and symbolic representations.*

Big Idea 3

How we use water and electricity affects the world around us. (From NGSS ESS3.C)



Key Concepts

- If we use too much water, there will not be enough for all of us and for other living beings.
- Keeping the water we use as clean as possible helps people and other living beings to be safe and healthy.
- The less electricity we use, the less we will need to generate, reducing the impact on humans and other living beings and the natural world.
- Making new products, such as clothing, toys, and school supplies, uses energy and water, so it is often best to reuse or recycle these before buying them new.

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Asking Questions and Defining Problems	Discuss what the term "drought" means, how drought years in California affect people and other living beings, and what we can all do to conserve water and use it efficiently, whether or not we are experiencing drought.

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Analyzing and Interpreting Data	Take a water walk through the school or neighborhood to look for examples of people saving water (such as rain barrels, drip irrigation, or water-efficient toilets) and examples of people using too much of it (such as leaky faucets or water running down the street). Create a T-chart listing examples of saving water on one side and ways people waste it on the other. How does saving or wasting water affect people and other living beings?

CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Patterns	Create a Venn diagram showing the things that plants, animals, and humans need to live, including air, water, and food. What do all living beings need? How can we make sure that living beings get the water and other things they need to live?
Cause and Effect	As a long-term project, provide water sources for birds, butterflies, and other wildlife in your schoolyard. Grow native plants that bear fleshy fruits and flowers. Add bird baths made from clay pots and saucers, and observe what animals visit these sources.

Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Writing	Dictate or write a letter or email asking an organization, such as the San Francisco Public Utilities Commission or your local water department, for information on how to conserve water or electricity. ***W.K.7***, ***W.1.7***, ***W.2.7***. *Participate in shared research and writing projects.*
Reading Informational Text	Read *The Berenstain Bears and the Coughing Catfish* by Stan and Jan Berenstain (Scholastic, 1996) or another book about water pollution, and discuss what people can do to keep water clean. ***RI.K.1.*** *With prompting and support, ask and answer questions about key details in a text.* ***RI.1.1.*** *Ask and answer questions about key details in a text.* ***RI.2.1.*** *Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text.*

History – Social Science Content Standards for California Public Schools

PEOPLE WHO MAKE A DIFFERENCE	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Content Standards	Reuse scrap materials for class projects, rather than using new materials. Gather shoe boxes or other used containers for collecting scraps, and collect reusable pieces of construction and tissue paper, assortments of beads and buttons, textured papers and cardboard, ribbon, and other clean materials. Discuss how reusing materials reduces the amount of new materials that we need. ***2.4.3.*** *Understand how limits on resources affect production and consumption (what to produce and what to consume).*

Big Idea 4

There are many simple things we can do to keep water clean and to save water and electricity.

Key Concepts

- People can make choices that reduce their impacts on the land, water, air, and other living things. (From NGSS ESS3.C)
- We can save water by using it wisely, such as turning off the faucet when we are brushing our teeth or washing dishes, and taking short showers instead of baths.
- Sewer systems have to clean dirty water from buildings as well as streets, so it is important to be careful about what we put down toilets and drains, and keep trash off our streets.
- Individual people can use less energy throughout the day by turning off lights and devices when not using them.

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Constructing Explanations and Designing Solutions	Discuss ways to use less water in the classroom. Try putting a dishpan or bucket at the bottom of the classroom sink to catch any water that would go down the drain. Estimate how long it will take to fill the pan. Once it's full, use the water for indoor or outdoor plants, and then replace the pan in the sink. How many pans of water did the class use in a day? How could you use less water?

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Obtaining, Evaluating, and Communicating Information	Find out what should and should not be flushed down toilets and drains. (For example, see the San Francisco Public Utilities Commission's "Toilets Are Not Trash Cans!" at www.sfwater.org/trashnottoilets.) Collect pictures or examples of objects that shouldn't go down the drain, and create a bulletin board display for the school hallway.

CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Cause and Effect	Read *What Does It Mean to Be Green?* by Rana DiOreo and Chris Blair (Little Pickle Press, 2010), or a similar book that identifies things kids can do to help the environment. Discuss what people can do to keep water clean and to save water and electricity.
Scale, Proportion, and Quantity	Every time you do something to save water or energy, write or draw it on an animal shape cut from reused paper. Sort your class's shapes according to the different ways people used less water or energy, and graph the class results using the shapes. Discuss how saving water or energy helps wildlife.

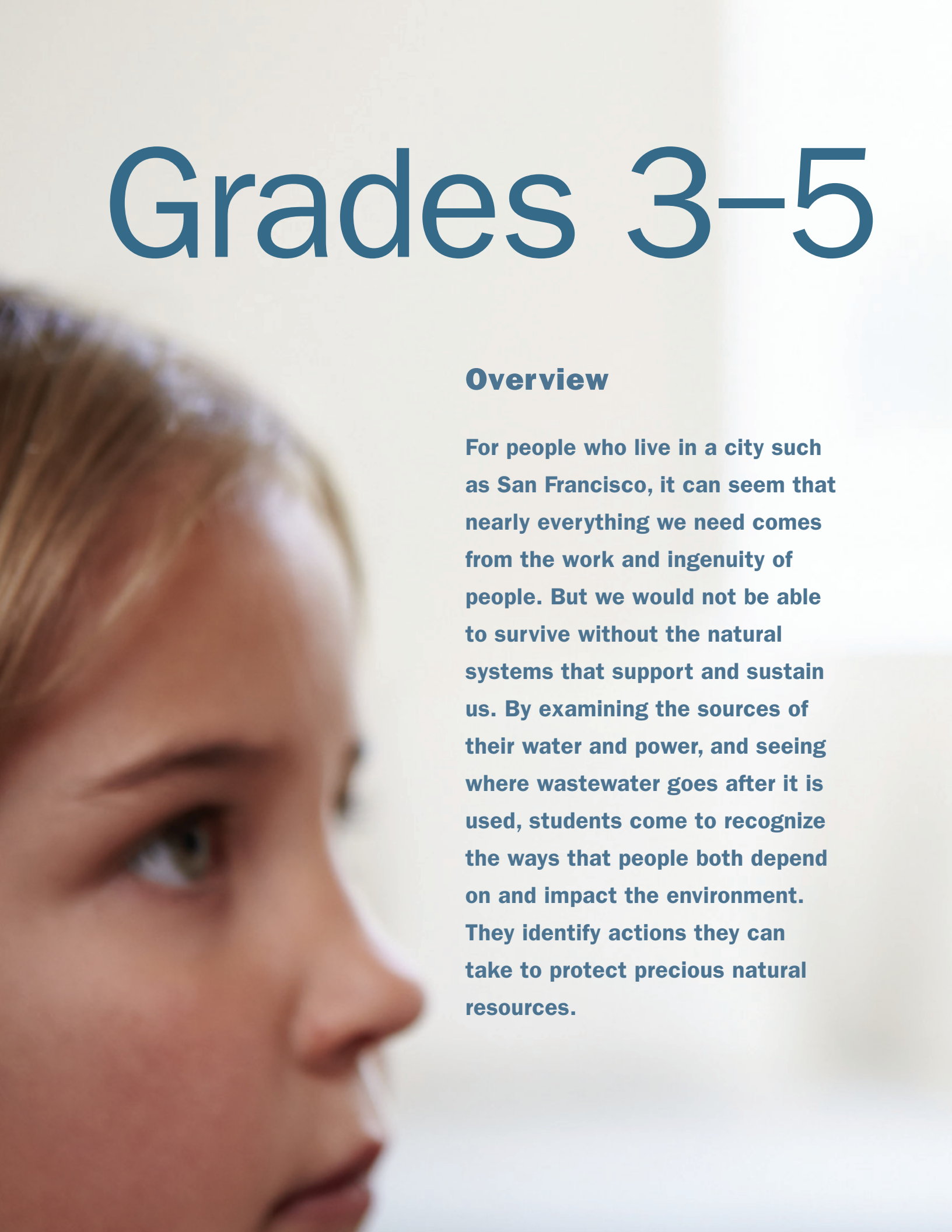
Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Reading Informational Text	Read *Why Should I Save Energy?* by Jen Green and Mike Gordon (Barron, 2005) or a similar book. Write or draw pictures showing how warming our homes and powering our devices use natural resources that cannot be easily replaced. ***RI.K.2.*** *With prompting and support, identify the main topic and retell key details of a text.* ***RI.1.2.*** *Identify the main topic and retell key details of a text.* ***RI.2.2.*** *Identify the main topic of a multi-paragraph text as well as the focus of specific paragraphs within the text.*
Writing	Make posters of ways to conserve water or electricity—using simple words and graphics—and display them around the classroom or at home as reminders. ***W.K.2.*** *Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.* ***W.1.2.*** *Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure.* ***W.2.2.*** *Write informative/explanatory texts in which they introduce a topic, use facts and definitions to develop points, and provide a concluding statement or section.*

History–Social Science Content Standards for California Public Schools

PEOPLE WHO MAKE A DIFFERENCE	SAMPLE STUDENT ENGAGEMENT, GRADES K–2
Content Standards	Create a class picture book of friends and family members who are everyday environmental heroes, including a photo or drawing of them as well as a few sentences describing their heroic actions. For inspiration, you might read *Olivia's Birds: Saving the Gulf* by Olivia Bouler (Sterling, 2011), a story about an 11-year-old who raised over $175,000 for the Gulf Coast oil spill recovery. ***K.1.*** *Students understand that being a good citizen involves acting in certain ways.* ***2.5.*** *Students understand the importance of individual action and character and explain how heroes from long ago and the recent past have made a difference in others' lives (e.g., from biographies of Abraham Lincoln, Louis Pasteur, Sitting Bull, George Washington Carver, Marie Curie, Albert Einstein, Golda Meir, Jackie Robinson, Sally Ride).*

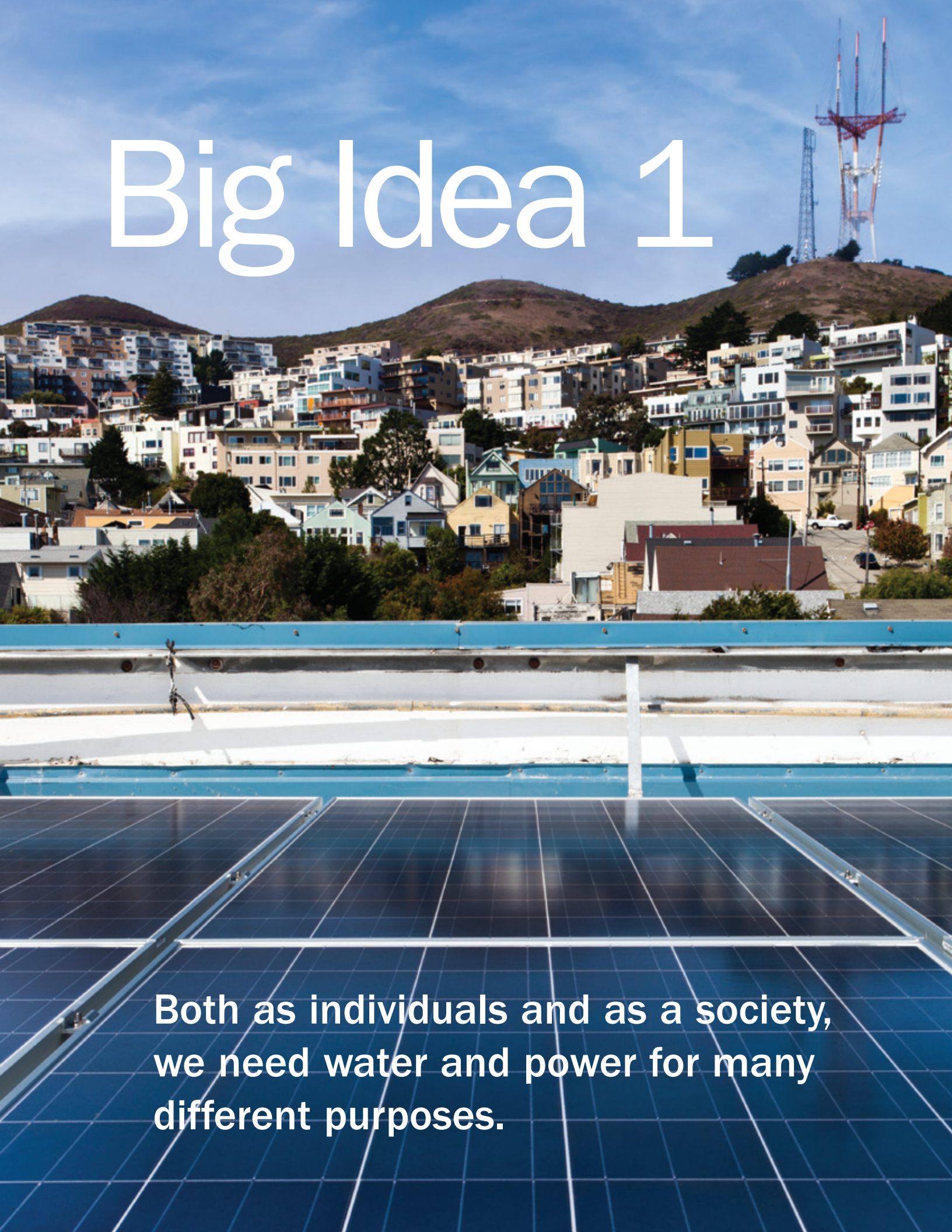
Grades 3–5



Overview

For people who live in a city such as San Francisco, it can seem that nearly everything we need comes from the work and ingenuity of people. But we would not be able to survive without the natural systems that support and sustain us. By examining the sources of their water and power, and seeing where wastewater goes after it is used, students come to recognize the ways that people both depend on and impact the environment. They identify actions they can take to protect precious natural resources.

Big Idea 1



Both as individuals and as a society, we need water and power for many different purposes.

Key Concepts

- We require water for drinking, cooking, cleaning, sanitation, firefighting, landscape irrigation, agriculture, manufacturing, and other purposes.
- We use power in some form or another every day: for heating and cooling, lighting, cooking, electronics, transportation, and industrial processes.
- The water we use, as well as the water that runs off of streets, becomes wastewater. Most wastewater must be cleaned before it is safe to release into the environment.

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Planning and Carrying Out Investigations	Record all the ways you use water and power during the school day or within a 24-hour period, including while playing or sleeping.
Using Mathematics and Computational Thinking	Consider how much water is used for household toilets, showers, and faucets, and calculate the approximate amount of daily water used at home. (New toilets use 1.28 gallons or less per flush, while older toilets can use as much as 3.5 to 7 gallons per flush. Standard showerheads use 2.5 gallons per minute, and a bathroom faucet generally runs at 2 gallons per minute.) Brainstorm ways to reduce water usage.

CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Scale, Proportion, and Quantity	Conduct research on the web to find out which sources (hydroelectric, natural gas, solar, coal, nuclear, etc.) provide power for homes, businesses, and government buildings in the local area. Contact your local utilities—PG&E and the SFPUC in the Bay Area—for information about the percentage or proportion of each source.
Stability and Change	Research the role of water and other resources during a time in California or San Francisco history, such as the California Gold Rush or San Francisco's 1906 earthquake.

Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Writing	Read a book or website about how wastewater is treated and returned to the environment, and create simple infographics that explain the process. ***W.3.2***, ***W.4.2***, ***W.5.2***. *Write informative/explanatory texts to examine a topic and convey ideas and information clearly.*

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Speaking and Listening	Prepare a brief story to share about a time—either real or imagined—that the power went out. What happened? What was it like? What did you do that was different from normal? You might check out one of the following books for ideas about living without power: *How to Live Without Electricity and Like It* by Anita Evangelista (Lehman's, 1997), or *Living Without Electricity* by Stephen Scott and Kenneth Pellman (People's Place Book #9, 1990). ***SL.3.4****. Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.* ***SL.4.4****. Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.* ***SL.5.4****. Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.*

History–Social Science Content Standards for California Public Schools

CONTINUITY AND CHANGE	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Content Standard	Choose one time period in local history before 1934, when the Hetch Hetchy water project was completed, and prepare a short report explaining how people acquired and used water and power. ***3.1.2*** *Trace the ways in which people have used the resources of the local region and modified the physical environment (e.g., a dam constructed upstream changed a river or coastline while providing communities with water and power).*

Big Idea 2

We rely on natural watersheds—as well as a system of dams, aqueducts, and reservoirs—for our water and some of our power.

Key Concepts

- The amount of water on Earth is finite: it continually cycles through Earth's systems, driven by energy from the sun and the force of gravity.
- California's moderate climate, with long, dry summers, means that water is an especially limited resource in our region.
- Watersheds collect and channel water from snowmelt and rainfall into streams, lakes, rivers, wetlands, and groundwater.
- San Francisco's watershed also includes a system of dams, reservoirs, aqueducts, storage facilities, and pipes that bring us clean drinking water, and then transport wastewater to be treated and released to the bay or ocean.
- San Francisco's water system generates hydropower, a renewable form of electricity that powers public services, like public schools and libraries.

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Developing and Using Models	Using a sand or soil table and water, simulate an urban watershed and demonstrate the various ways that water moves through it.
Analyzing and Interpreting Data	Locate a graph that depicts the average monthly rainfall in California and identify three ways that individuals can modify their habits to use water efficiently throughout the seasons.

CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Cause and Effect	Explore how the local climate affects human activities in the local community or region. For example, find out how the presence or lack of water or snow affects how people move around, what foods they grow, what they wear, and how they recreate.
Systems and System Models	Trace the source of your drinking water and where it goes after you use it for things like bathing, washing your hands or dishes, cooking, or using the bathroom.

Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Reading Informational Text	Drawing on information from at least two written sources, describe how the amount of rain changes throughout the seasons in your area. ***RI.3.9****. Compare and contrast the most important points and key details presented in two texts on the same topic.* ***RI.4.9.*** *Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.* ***RI.5.9.*** *Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.*
Writing	Using words and illustrations, create a diagram that depicts the water cycle in an urban environment. ***W.3.2****,* ***W.4.2****,* ***W.5.2****. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.*

History–Social Science Content Standards for California Public Schools

HISTORICAL AND SOCIAL SCIENCES ANALYSIS SKILLS	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Chronological and Spatial Thinking	Study a map of the state or local water system, and trace the routes water takes from its sources. Describe the towns and physical terrain along the way. For example, visit the SFPUC's headquarters in San Francisco to see an animated map of "Snowfall to Outfall," which shows our water's journey from the mountains to the ocean and bay. ***K-5.4****. Identify the human and physical characteristics of the places they are studying and explain how those features form the unique character of those places.*
Historical Interpretation	Consider the historical time periods of the Native Americans who resided in the area now called San Francisco, the residents of San Francisco during the California Gold Rush, and residents of San Francisco today. Compare how each community met its need for water. ***K-5.5****. Judge the significance of the relative location of a place (e.g., proximity to a harbor, or trade routes) and analyze how relative advantages or disadvantages can change over time.*

Big Idea 3

Our power comes from a variety of natural resources, including hydroelectricity, some of which are renewable and some of which are not.

Key Concepts

- Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. (From NGSS ESS3.A)
- Some natural resources are renewable over time, and others are not. (From NGSS ESS3.A)
- Renewable resources, such as sunlight, wind, and hydropower, are replenished through relatively rapid natural cycles. Nonrenewable resources, such as fossil fuels, are formed through extremely slow natural cycles.
- The power sources we choose can impact the global climate.

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Using Mathematics and Computational Thinking	Create timelines that depict how long it takes for various sources of energy to be replenished.
Engaging in Argument from Evidence	Debate the pros and cons of different sources of energy. Consider the financial costs, as well as the impacts of each source on the environment, including plants, humans and other animals, and climate.

CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Systems and System Models	Interview a representative from the local utility and find out what energy sources contribute to the local energy grid.
Energy and Matter	Make a list of energy sources and categorize them according to whether they are renewable or nonrenewable. Identify which sources are available only in certain places (like hydropower) or at certain times (like wind).

Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Writing	Write a short explanation of the difference between renewable and nonrenewable energy sources. ***W.3.2***, ***W.4.2***, ***W.5.2***. *Write informative/explanatory texts to examine a topic and convey ideas and information clearly.*
Speaking and Listening	Choose a source of power and personify it, explaining from a first-person point of view the contributions it provides to people and how its use might affect the environment. (For example, "I am sunlight and, when collected in solar panels, I can provide power for your home. Solar power is renewable, but it can take lots of land to produce.") ***SL.3.4***. *Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.* ***SL.4.4***. *Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.* ***SL.5.4***. *Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.*

History–Social Science Content Standards for California Public Schools

HISTORICAL AND SOCIAL SCIENCE ANALYSIS SKILLS	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Historical Interpretation	Discuss the impact of the 1906 San Francisco earthquake on the region's water supply, and the subsequent efforts to provide plentiful and clean water to local citizens and businesses as a result, including the Hetch Hetchy project. ***3.1****. Identify and interpret the multiple causes and effects of historical events.*

CALIFORNIA: A CHANGING STATE	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Content Standard	Create a chart that compares Northern and Southern California in terms of climate, geography, population density, and sources of water and power. ***4.1.5****. Use maps, charts, and pictures to describe how communities in California vary in land use, vegetation, wildlife, climate, population density, architecture, services, and transportation.*

Big Idea 4

There are actions we can all take to save and protect water and power resources.

Key Concepts

- We can save water—and minimize wastewater—through practices like turning off the faucet when not in use, checking for leaks, collecting rainwater, and choosing garden plants that are adapted to our climate.
- By being careful about what we put into our wastewater system, we can help to protect the San Francisco Bay and the Pacific Ocean, as well as the organisms living in them.
- Saving energy, using it efficiently, and using renewable sources help to maximize the benefits and minimize the potential harm of energy generation and use on people and the environment.
- Our actions can help to ensure the sustainability of water and power systems and sources.

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Asking Questions and Defining Problems	Draw a map of your street or neighborhood and identify possible sources of water pollution. For reference, see the EPA's webpage "Nonpoint Source Pollution for Kids" at water.epa.gov/polwaste/nps/kids/index.cfm. Discuss things people can do to keep our water clean.
Obtaining, Evaluating, and Communicating Information	Research practical ways that households can save water and energy and use them efficiently, and create a booklet or brochure that conveys that information to the public. For ideas, see the San Francisco Public Utilities Commission's "Energy Efficiency Tips," available at www.sfwater.org/energyefficiencytips.

CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Structure and Function	Find out what should and should not be flushed down toilets, and discuss what would happen in the sewer system if certain things are flushed. For information, see the San Francisco Public Utilities Commission's "Toilets Are Not Trash Cans" at www.sfwater.org/trashnottoilets.
Cause and Effect	Create a comic strip that identifies human behaviors that affect the quality of our water and energy and the subsequent influences on the health of humans and other living beings.

Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Writing	Write a short song or jingle that helps people remember what items should be kept out of our water system and why it is important to keep our water system clean. For an example, see the San Francisco Public Utilities Commission's "Sewer Rap" music video, available at www.sfwater.org/sewerrap. ***W.3.2***, ***W.4.2***, ***W.5.2***. *Write informative/explanatory texts to examine a topic and convey ideas and information clearly.*
Speaking and Listening	Choose an organism native to the San Francisco Bay region and create an oral report describing ways that pollution affects its ability to survive and reproduce. ***SL.3.4***. *Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly at an understandable pace.* ***SL.4.4***. *Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.* ***SL.5.4***. *Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.*

History–Social Science Content Standards for California Public Schools

HISTORICAL AND SOCIAL SCIENCES ANALYSIS SKILLS	SAMPLE STUDENT ENGAGEMENT, GRADES 3–5
Historical Interpretation	Choose two sources of energy that are available in your region, such as hydroelectric and solar, and create a chart that identifies the costs and benefits of each for the average homeowner or business. ***K-5.4****. Conduct cost-benefit analyses of historical and current events.*
Chronological and Spatial Thinking	Using the San Francisco Public Utilities Commission's map of the "San Francisco Water System" (available for viewing at sfcitizen.com/blog/wp-content/uploads/2009/05/img_0557-copy.jpg), note where water is stored in the city and hypothesize why water is stored in those particular locations. ***K-5.2****. Identify the human and physical characteristics of the places they are studying and explain how those features form the unique character of those places.*

Grades 6–8

Overview

Water not only sustains life on Earth, it is also a critical source of power in San Francisco and around the world. By exploring the ways communities obtain and use water and power, students see the impact of personal and collective actions on people and other living beings. They also learn how diversifying sources, using water and power efficiently, protecting watersheds, and keeping water clean all help to increase the resiliency of communities while safeguarding the environment.

Big Idea 1

The Earth's water system sustains life and is a vital source of power for residents of California and other parts of the world.

Key Concepts

- The hydrologic cycle is the sequence by which water moves between the atmosphere and Earth's surface: water falls to the land as precipitation; is absorbed or runs off to rivers, streams, and eventually the ocean; and then returns to the atmosphere as evaporation.

- A watershed is an area of land that water flows over or through on its way to a larger body of water. The Bay Area is made up of several watersheds, one of which takes water flowing from the Sierra Nevada mountain range to the Pacific Ocean through a vast system of pipes, pumps, and tunnels.

- Only a small fraction of freshwater is available for human consumption. In California, which is prone to a dry climate and drought years, water is a particularly limited resource. (From NGSS ESS3.A)

- One source of renewable power comes from harnessing the energy of moving water and converting it into electricity. This is called hydroelectric power.

- Other power sources include solar energy, wind energy, and the burning of fossil fuels that were formed from the remains of once-living organisms.

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Developing and Using Models	Using disposable cake pans or shallow boxes, florist foam or clay, and aluminum foil (to represent the ground surface), build a model of a watershed that demonstrates how water travels downhill and gathers in a larger body of water. Create ways to represent sediment and pollution that enters the flow of water along its way.
Obtaining, Evaluating, and Communicating Information	Using the Internet, find ads and marketing materials that promote various power sources, including solar, wind, and fossil fuels. Compare their messages to factual information about each power source.

CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Systems and System Model	Research various models and diagrams of the hydrologic system and choose one that best explains the processes involved, including evaporation, condensation, precipitation, and transpiration. Present them to the class.
Cause and Effect	Choose a halophyte (a plant that grows in water with high salinity) and investigate how it is adapted to tolerate a saline environment. Create one or more ideas for how humans could mimic nature by removing salt from seawater to make it palatable for human consumption. Describe how scientists might go about testing similar strategies for removing salt from saltwater.

Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Writing History/Social Studies, Science, and Technical Subjects	Research and write a brief essay accompanied by an illustration that explains how energy is harnessed from moving water and converted to electricity. ***WHST.6-8.9****. Draw evidence from literary or informational texts to support analysis, reflection, and research.*
Speaking and Listening	Work in teams to investigate various power sources, including solar energy, hydroelectric energy, and energy from fossil fuels. Form discussion circles with representatives from each team and articulate the pros and cons of each power source. ***SL.6.1***, ***SL.7.1***, ***SL.8.1****. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade-level topics, texts, and issues, building on others' ideas and expressing their own clearly.*

History – Social Science Content Standards for California Public Schools

HISTORICAL AND SOCIAL SCIENCE ANALYSIS SKILLS	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Chronological and Spatial Thinking	Examine maps showing the water sources of the Bay Area. How large an area do they encompass? How well protected are the sources? Choose one Bay Area city and learn more about the relationship between that city's growth and its water source. For reference, see "Where Does My Water Come From?" on the Water Education Foundation's website at www.watereducation.org/where-does-my-water-come. ***6-8.3****. Students use a variety of maps and documents to identify physical and cultural features of neighborhoods, cities, states, and countries and to explain the historical migration of people, expansion and disintegration of empires, and the growth of economic systems.*

Big Idea 2

How we obtain and use water and power, and how we treat dirty water, affects people, other living beings, and the environment.

Key Concepts

- Obtaining water and power—no matter the source—has environmental, economic, and social impacts. (From NGSS ESS3.C)

- The urban water cycle is the process by which cities get and use water and treat wastewater. In San Francisco, this cycle involves moving water from the source in the Sierra Nevada mountain range, treating the water for safe consumption, distributing it to businesses and households, collecting and treating the wastewater, and then releasing the water back into the environment for the cycle to begin again. Each step of this cycle can impact the environment.

- Human communities create wastewater from their homes and surface streets, which may carry diseases, toxins, and other contaminants that must be treated and removed from the water before it is released into the environment.

- Burning fossil fuels is impacting the global climate, but even renewable energy resources have environmental consequences.

- Typically, as human populations and per capita consumption of natural resources increase, so do their impacts on Earth. (From NGSS ESS3.C)

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Asking Questions and Defining Problems	Explore what happens to San Francisco's dirty water and runoff by touring the San Francisco Public Utilities Commission's wastewater treatment facility.
Analyzing and Interpreting Data	Determine your ecological footprint, using a calculator such as the one at www.earthday.org/footprint-calculator. Try inputting different responses to find out which factors or behaviors have the biggest impact on your ecological footprint. Discuss the implications for the future, given the rising world population.

CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Cause and Effect	Find out how California agriculture uses energy and water and how those uses affect the climate. Identify the shifts that farmers are making to reduce negative effects on climate.
Systems and System Models	San Francisco's water system also generates power from the same source: the Hetch Hetchy Regional Water and Power System. View the system at prezi.com/ste1lo1ce_iq/hetch-hetchy-reservoir/. Discuss the benefits of a combined water and power system.

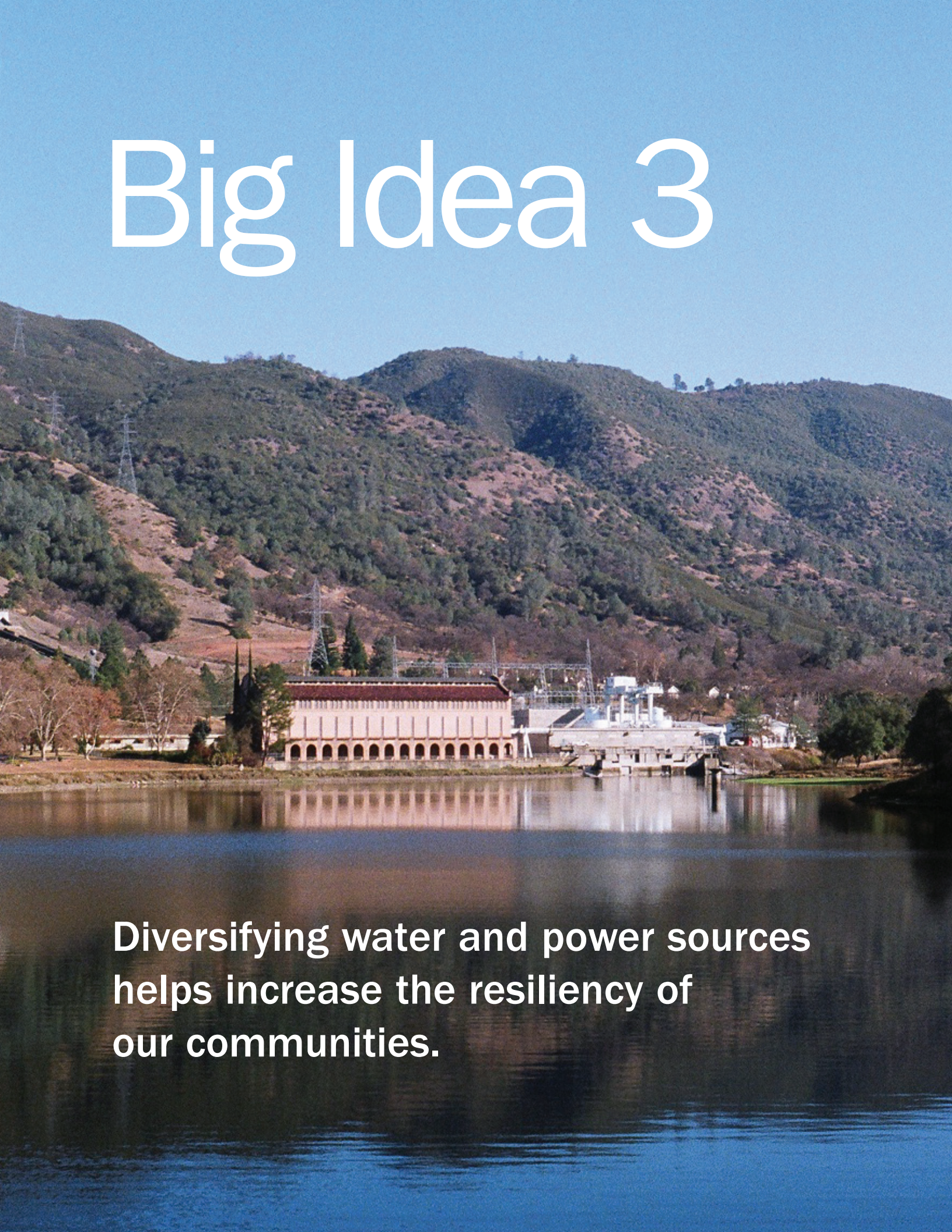
Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Writing History/Social Studies, Science, and Technical Subjects	In order to restore the Hetch Hetchy Valley, some citizens today propose removing O'Shaughnessy Dam, which has existed since 1923. Investigate the arguments for and against draining the reservoir and provide an overview of the controversy to the class. ***WHST.6-8.7****. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.*
Speaking and Listening	With a team, develop a dramatic presentation that explains the urban water cycle, starting with the source of municipal water and its movement from the source to the city. Include as many steps as possible and demonstrate the environmental and health impacts along the way. ***SL.6.4****. Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes.* ***SL.7.4****,* ***SL.8.4****. Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.*

History–Social Science Content Standards for California Public Schools

UNITED STATES HISTORY AND GEOGRAPHY: GROWTH AND CONFLICT	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Content Standards	Using a cartoon format, depict the evolution of urban wastewater treatment systems as local populations changed over time, from the time of the Native American inhabitants to the present day. ***8.12.1****. Trace patterns of agricultural and industrial development as they relate to climate, use of natural resources, markets, and trade, and locate such development on a map.*

Big Idea 3



Diversifying water and power sources helps increase the resiliency of our communities.

Key Concepts

- The resiliency of our communities depends on a steady, safe, and local supply of water and power.
- The primary source of San Francisco's water—and some of its power—is Hetch Hetchy reservoir and dam, supplemented by groundwater, and by reusing and recycling other diverse sources, such as graywater and blackwater.
- By locally diversifying our water supply, we reduce the amount of water we must bring from the Sierra Nevada mountain range.
- No one method of electricity generation can meet our power needs; we need a diversity of sources. For example, wind energy can only be produced when it is windy, so we cannot rely solely on it for power.

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Planning and Carrying Out Investigations	Investigate the sources of power that provide energy to the local community and use that information to predict how that energy profile might change over the next 50 years.
Constructing Explanations and Designing Solutions	Visit the San Francisco Public Utilities Commission headquarters or another local building that uses alternative on-site water sources like graywater or recycled water, and explore where and how these systems collect water for reuse. Design a way to use on-site water sources at your home or school.

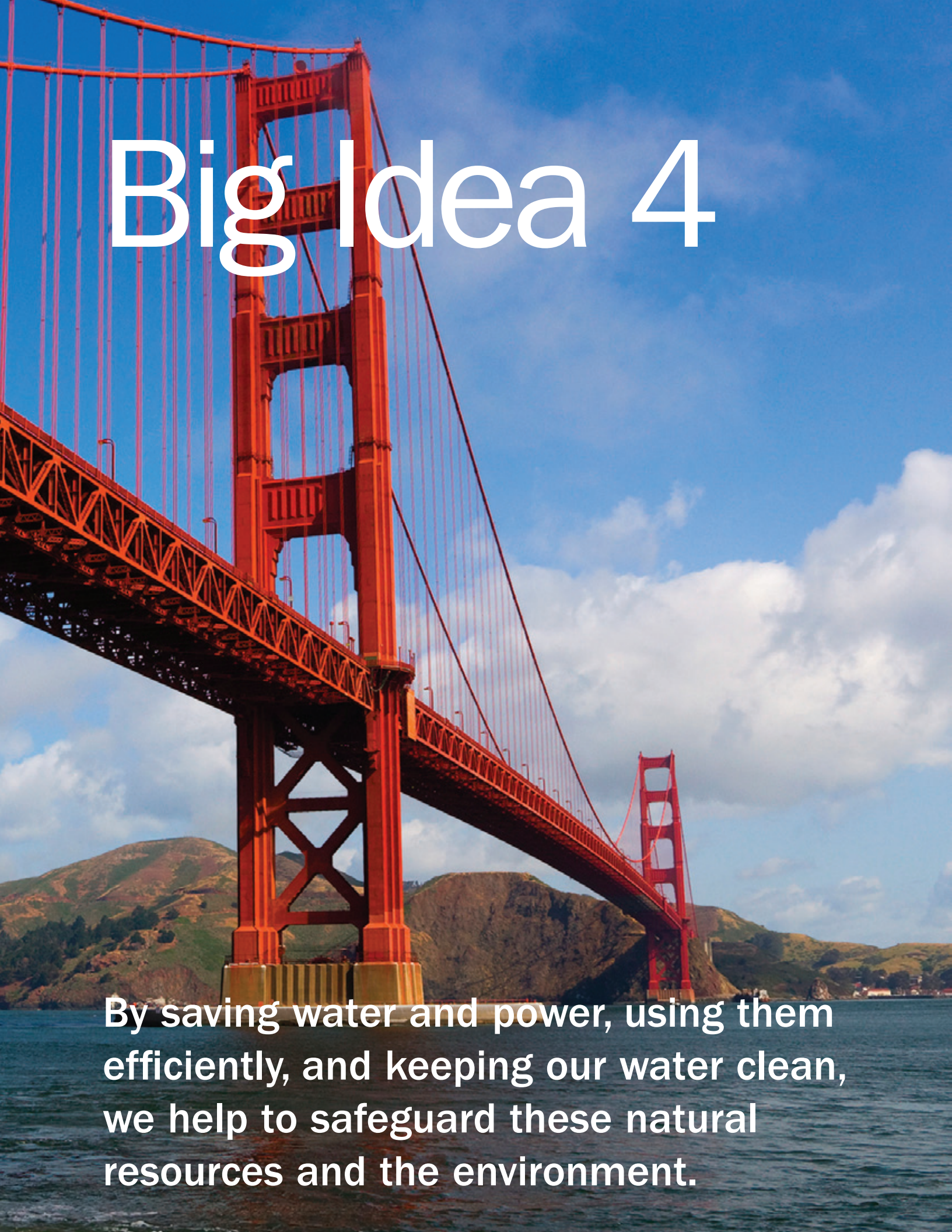
CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Cause and Effect	Create a concept map or flow chart that indicates the impact of drought conditions on our food and water supply, recreation, and the health and well-being of other living beings.
Structure and Function	Design and build a simple device that is fueled by solar or wind power.

Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Reading Informational Text	Examine claims about "clean" sources of energy (e.g., hydroelectric, solar, nuclear, and wind) and form a set of questions to ask industry experts to help determine if the claims are accurate. ***RI.6.8****. Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.* ***RI.8.8****. Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims.*
Writing History/Social Studies, Science, and Technical Subjects	Learn about San Francisco's efforts to diversify its water supply, and then write a letter to a local newspaper editor advocating for increasing your community's resilience with more diverse sources of water and power. For reference, see "Local Water Supply" at www.sfwater.org/localwater. ***WHST.6-8.2****. Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.*

History – Social Science Content Standards for California Public Schools

HISTORICAL AND SOCIAL SCIENCE ANALYSIS SKILLS	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Historical Interpretation	Find out how pricing rates for local water or power differ between regional and retail customers, and how rates have changed over the past 20 years. Determine reasons for those changes. ***6-8.6****. Students interpret basic indicators of economic performance and conduct cost-benefit analyses of economic and political issues.*



Big Idea 4

By saving water and power, using them efficiently, and keeping our water clean, we help to safeguard these natural resources and the environment.

Key Concepts

- There are many different things we can do—as individuals, families, utility companies, municipalities, and society as a whole—to reduce water consumption, from reducing the lengths of showers to choosing foods that require less water to grow.

- By collecting rainwater in rain gardens, bioswales, or cisterns, or as groundwater, we keep it from becoming wastewater.

- It is important that we protect our water, power, and sewer resources from contamination, vandalism, and other human-induced threats.

- Energy conservation and energy efficiency are two different approaches to saving energy: Energy conservation is a change in behavior that results in using less energy, while energy efficiency is a technological approach that requires less energy to perform the same function.

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Asking Questions and Defining Problems	Design and implement a method for collecting rainwater at home or at school. Consult design plans from schools that already have rainwater collection systems. Consider the importance of minimizing exposed, standing water where, for instance, mosquitoes can lay eggs. Include in the design provisions for transferring water to smaller containers, managing overflow, and ensuring that the water stays clean enough to water plants.
Obtaining, Evaluating, and Communicating Information	Research and present information about the water requirements of food crops that are grown in California, such as rice, almonds, and various fruits and vegetables. Find out about new strategies that farmers are using to conserve water and use it efficiently.

CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Cause and Effect	Learn how to read a home water meter, or log in at myaccount.sfwater.org to see your household's water usage over time. To discover if you have any water leaks, record the water usage to date in either gallons or cubic feet, don't use any water for two hours, and then check the meter again to see if it shows that more water has been used. If the number has increased, there is probably a leak, so check faucets and toilets to see if you can determine the source of the leak.
Systems and System Models	Create a diagram of how you think a home water system works, then look up diagrams online and recreate your diagram to be more accurate.

Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Writing History/Social Studies, Science, and Technical Subjects	Conduct research about one of the largest fires in California's history: the Rim Fire in the Sierra Nevada, which took place in August 2013. Determine how the fire threatened San Francisco's water supply and what contingency plans the San Francisco Public Utilities Commission set in motion to ensure that the City's water supply did not get contaminated. ***WHST.6-8.7****. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.*
Speaking and Listening	Pose the question: Who owns water? Use the question to launch research and discussion about the potential consequences of a growing global population and a finite amount of water on Earth. ***SL.6.4.*** *Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes.* ***SL.7.4****,* ***SL.8.4****. Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.*

History–Social Science Content Standards for California Public Schools

HISTORICAL AND SOCIAL SCIENCES ANALYSIS SKILLS	SAMPLE STUDENT ENGAGEMENT, GRADES 6–8
Historical Interpretation	Investigate a historical conflict over water and conduct a cost-benefit analysis of the environmental justice issues involved. For example, in 2004 Chinese farmers protested against a hydroelectric dam being constructed on the Dadu River, which would have displaced thousands of people who were dependent on the river and adjacent farmland for their livelihood. For a chronological list of global water conflicts, visit www2.worldwater.org/conflict/list/. ***6-8.6****. Students interpret basic indicators of economic performance and conduct cost-benefit analyses of economic and political issues.*

Grades 9–12

Overview

Our society relies on natural systems and a complex infrastructure to bring us the water and power we need in order to live. By exploring the environmental, economic, political, and social consequences of our individual and collective decisions about water and power, students will understand the impacts of their own actions regarding these vital resources. They will also be able to assess different strategies for conserving water and power and for sourcing them more efficiently.

Big Idea 1

We rely on a complex infrastructure of tunnels, pipes, and pumps to bring us the water and power we need in order to live and to clean our wastewater.

Key Concepts

- Urban water, power, and sewer cycles depend on infrastructure, including conduits for moving water and power from their sources to where they are used, and systems for controlling surface water, processing wastewater, and releasing treated wastewater into the Pacific Ocean and bay.
- Many different people and jobs are involved in sourcing, extracting, and delivering water and energy resources, and processing wastewater.
- A variety of energy sources can be used to power human activities, and the energy must often be transmitted from its source to its destination.
- Individual decisions about when and how much energy to use affect the electrical power system, which must match demand with supply on a real-time basis.

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Developing and Using Models	Model your community's watershed using a mapping application such as Integrated Water Information System's interactive mapping program (available at www.water.ca.gov/iwris/), which focuses on California public water systems.

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Analyzing and Interpreting Data	Using a spreadsheet program or other tool, graph data showing energy production and energy consumption in the United States by source, as well as energy imports and exports. For example, see "Annual Energy Review" data from the U.S. Energy Information Administration, www.eia.gov/totalenergy/data/annual/. What conclusions can you draw from the graphs?

CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Scale, Proportion, and Quantity	Examine graphics of the San Francisco Public Utilities Commission's water, power, and sewer systems, and research how many miles of pipes convey water from Hetch Hetchy reservoir to users around the Bay Area, including within San Francisco. Charts of the water and power systems are available at www.sfwater.org/systemmap and www.sfwater.org/HHPsystem. Using these and additional resources, compare the volume of water and quantity of power produced by each source, and the approximate distance from each source to the final destination.
Energy and Matter	Research the California Independent Service Operator (ISO), which manages the state's electric power grid. Find out why electricity supply and demand must be continually balanced, and what challenges that creates for the ISO as well as for energy providers and consumers.

Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Reading Science and Technical Subjects	Read the San Francisco Public Utilities Commission's most recent "Water Quality Report," available online. This annual report describing where your water comes from and what it contains is required by federal law. Choose a table or section of a table from the report, and write in paragraph form the main conclusions one can draw from it. ***RST.9-10.7****. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.* ***RST.11-12.7****. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.*
Writing History/Social Studies, Science, and Technical Subjects	As a class, develop a list of jobs—such as watershed keeper, water quality analyst, communications officer, water distribution operator, civil engineer, customer service representative, or general manager—involved in bringing water and power to communities. Choose one job and research the skills, education, and personal traits needed, and the typical salary. Write a fictional job announcement to attract qualified applicants. ***WHST.9-12.7****. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.*

History–Social Science Content Standards for California Public Schools

HISTORICAL AND SOCIAL SCIENCE ANALYSIS SKILLS	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Chronological and Spatial Thinking	Search online or in local newspapers for recent articles related to the Bay Area's or California's water or electricity resources, and choose an article to analyze. Ask: What is the issue? Who or what does it affect? In what way is this issue unique to the region? How is it being addressed? ***9-12.4****. Students relate current events to the physical and human characteristics of places and regions.*

Big Idea 2

There are environmental impacts associated with every source of water and power we use.

Key Concepts

- Water cycles between the ocean, the atmosphere, and the land, and can cause physical and chemical changes in the environment, such as the formation of glaciers, soil erosion, and the acidification of the oceans.
- Much of the water used by individuals, industries, and business becomes contaminated and must be treated before it is released into the environment.
- Energy and fuels that people use are derived from natural resources, and their use affects the environment in multiple ways. (NGSS ESS3.A)
- All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. (NGSS ESS3.A)
- Changes in the global climate have an impact on our water supply and power resources, and on how people use them.

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Asking Questions and Defining Problems	Identify questions about the environmental impacts of water and power resource development that could be investigated using a stream table or sloped area on the school grounds. For example: What area of land is covered by water before and after a stream is dammed? Where is the best siting for a dam to maximize the amount of power it produces? Develop a hypothesis based on what you know.

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Analyzing and Interpreting Data	Create a short film, slide show, or other presentation that compares two or more different sources of electricity in terms of their environmental, economic, and social benefits and costs.

CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Patterns	Devise and test a methodology to clean and purify a sample of contaminated water, which may contain a combination of various materials such as food coloring, grass clippings, dental floss, "flushable" wipes, pharmaceuticals, mineral oil, salt, pepper, and small pieces of newspaper. Identify the challenges of treating wastewater on a citywide scale.
Cause and Effect	Examine the potential influence of climate change on water and power resources (see the U.S. Environmental Protection Agency website's "Climate Impacts on Water Resources" at www3.epa.gov/climatechange/impacts/water.html and "Climate Impacts on Energy" at www3.epa.gov/climatechange/impacts/energy.html). Choose one cause–effect relationship, and create an electronic or three-dimensional model to describe and explain the connection.

Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Reading Scientific and Technical Subjects	Read a report about California's wastewater, such as the *Layperson's Guide to California Wastewater* by the Water Education Foundation, available at www.watereducation.org/publication/laypersons-guide-california-wastewater. Check the sources of information it cites, and judge whether its conclusions are valid. ***RST.11-12.8.*** *Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.*

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Writing History/Social Studies, Science, and Technical Subjects	Investigate two reservoirs proposed by the California Department of Water—the Sites Reservoir on the Sacramento River and the Temperance Flat Reservoir on the San Joaquin River—identifying the possible environmental and other consequences if they are built. For each, read the environmental impact statements, which are documents required by the California Environmental Quality Act, as well as reports by both proponents and opponents of the projects. Consider the people that would be affected by the dam. Are there any groups that would be unjustly affected? Write a recommendation for whether one or both should be built. ***WHST.9-12.7****. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.*

History–Social Science Content Standards for California Public Schools

HISTORICAL AND SOCIAL SCIENCES ANALYSIS SKILLS	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Historical Interpretation	Research a contentious event in California history involving water or power development, such as the Hetch Hetchy Valley reservoir, the California Delta system, or the Los Angeles Aqueduct. Find out the main issues of the debate, how it was resolved, who was most affected and how, and any changes in policy or public opinion that resulted from it. ***9-12.5****. Students analyze human modifications of landscapes and examine the resulting environmental policy issues.*

Big Idea 3

Decisions about water and power are influenced by economic, political, environmental, and social factors.

Key Concepts

- The amount of water and power used by society depends on both individual and collective choices.
- Consumers "drive" the marketplace with their demands for goods and services.
- All products—including food, clothing, and consumer goods—require energy and water in their manufacture or distribution. These "embedded" resources contribute to the monetary and environmental cost of a product, but are often hidden to consumers.
- Environmentally literate persons know how much energy and water they use, and for what purpose, and where their energy and water comes from.

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Analyzing and Interpreting Data	Compare the embedded water in different products you use, or try out a water footprint calculator to determine which of your activities use the most water resources. For example, see National Geographic's "The Hidden Water We Use" at environment.nationalgeographic.com/environment/freshwater/embedded-water/ and National Geographic's water footprint calculator at environment.nationalgeographic.com/environment/freshwater/change-the-course/water-footprint-calculator/.

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Engaging in Argument from Evidence	Evaluate the benefits and costs of your household's participating in a renewable energy program such as the San Francisco Public Utilities Commission's CleanPowerSF. Identify questions you have about the program, conduct research to find the answers, and then write a recommendation based on your findings.

CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Patterns	Model what happens to energy resources over time, using a mixture of black and white beads in a bag to represent nonrenewable and renewable energy sources, respectively. Randomly draw a specified number of beads to represent one year's energy use, count the number of each color that you used, and return the white beads to the bag. Repeat, graphing the results over 20 "years." Try different starting ratios of black and white beads or an increasing rate of energy each year and observe how it affects the outcome.
Scale, Proportion, and Quantity	Conduct a life cycle assessment of a product you use, such as a cell phone or skateboard. Include in your assessment the resources, energy, and labor that go into making, distributing, using, and disposing of the product. Discuss whether this type of information should be made available for all products that we buy or use.

Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Writing History/Social Studies, Science, and Technical Subjects	Write an ad campaign that inspires people to shift away from buying new things and toward reusing or practicing other alternatives to ownership such as borrowing or swapping. Include in the ad information about how such a shift would affect water and power usage. ***WHST.9-12.2****. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.*
Speaking and Listening	Create a play, video, or other oral presentation that explains where your community's water or power comes from, as well as some of the biggest uses by individuals and societies of this resource. Include visuals and digital media to enhance the presentation, and share it with younger students or community members. ***SL.11-12.5****. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.*

History–Social Science Content Standards for California Public Schools

UNITED STATES HISTORY AND GEOGRAPHY: CONTINUITY AND CHANGE IN THE TWENTIETH CENTURY	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Content Standards	Create a timeline showing major milestones in the history of California's water rights laws, with an emphasis on how California's climate, geography, economy, and culture have shaped its water laws. For information, see "Chapter 1: Floods, Droughts, and Lawsuits: A Brief History of California's Water Policy" in *Managing California's Water: From Conflict to Reconciliation* by Ellen Hanak et. al. (Public Policy Institute of California, 2011). Available at www.ppic.org/content/pubs/report/R_211EHR.pdf. ***11.11.5.*** *Trace the impact of, need for, and controversies associated with environmental conservation, expansion of the national park system, and the development of environmental protection laws, with particular attention to the interaction between environmental protection advocates and property rights advocates.*
PRINCIPLES OF AMERICAN DEMOCRACY AND ECONOMICS **Content Standards**	Study how California's drought years—exacerbated by higher temperatures—periodically lead to severe water shortages. Determine which industrial sectors and consumer applications use the highest quantities of water in California, and who is most affected by water shortages, and develop recommendations for the most effective, realistic, and fair ways to conserve water. ***12.1.1****. Examine the causal relationship between scarcity and the need for choices.*

Big Idea 4

People have innovative ideas for conserving water and power, for reusing waste, and for sourcing and using these resources efficiently.

Key Concepts

- Methods for conserving water include using groundwater or recycled water and using water collected locally in rain barrels and cisterns.
- Conserving water saves energy, and vice versa, because it takes power to gather, purify, and distribute water, and many methods of generating power require water.
- Reusing waste materials, such as methane gas, used cooking oil, or by-products of the wastewater treatment process, are all ways cities can reduce their reliance on other energy resources,
- Energy efficiency—using less energy to provide the same product or service—reduces energy consumption and also costs less than new energy resources.
- Engineering can help to address today's global challenges, such as the need for clean water supplies and for energy sources that minimize pollution. (From NGSS ETS1.A)
- Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (From NGSS ETS1.B)
- New technologies and social regulations can change the balance of economic, social, environmental, and geopolitical costs and benefits. (From NGSS ESS3.A)

Standards Connections

Next Generation Science Standards

SCIENCE AND ENGINEERING PRACTICES	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Constructing Explanations and Designing Solutions	Examine the structure and energy efficiency of the light bulb through its 150-year history, from incandescent to compact florescent to LED bulbs (for example, see "The History of the Light Bulb," U.S. Department of Energy at energy.gov/articles/history-light-bulb). Choose another product or service that uses energy, and—after analyzing its essential components—develop a design for a more energy efficient version of it.
Obtaining, Evaluating, and Communicating Information	Create a brochure describing different methods (such as cisterns and graywater and blackwater systems) that families can use to collect, store, reuse, and recycle water locally. Discuss the constraints that families residing in multiunit or public housing buildings may have. Include information about how reducing water use means that less water needs to be treated. Include both text and graphics to convey the information.

CROSSCUTTING CONCEPTS	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Cause and Effect	Explore the relationship between saving water and saving energy, identifying specific actions individuals can take to save both. Calculate the amount of water and energy that could be saved by the entire city if everyone took one or more of these actions.
Structure and Function	Investigate the "whole house systems approach" to designing an energy-efficient home. (For an overview, visit energy.gov/energysaver/articles/whole-house-systems-approach.) Design a home for your geographic region that optimizes energy use.

Common Core State Standards – English Language Arts

STRAND	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Reading Science and Technical Subjects	Evaluate different policy strategies related to water or power use in the Bay Area, considering their impacts on the resource and the short- and long-term social and economic effects. For example, review the *SPUR Report: Future-Proof Water* at www.spur.org/sites/default/files/publications_pdfs/SPUR_Future-Proof_Water.pdf. Examine each of the tools it identifies for managing developing water supplies in the Bay Area, and compare its recommendations to regional population growth projections. ***RST.11-12.9****. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.*
Writing History/Social Studies, Science, and Technical Subjects	Read about uncommon sources of energy (for example, see "11 Bizarre Sources for Alternative Energy," *Discovery News*, at news.discovery.com/tech/alternative-power-sources/ten-bizarre-sources-alternative-energy.htm). Choose one source to investigate, and write an argument for or against developing that proposed source more extensively. ***WHST.9-12.1.*** *Write arguments focused on discipline-specific content.*

History–Social Science Content Standards for California Public Schools

PRINCIPLES OF AMERICAN DEMOCRACY AND ECONOMICS	SAMPLE STUDENT ENGAGEMENT, GRADES 9–12
Content Standards	Conduct a debate on the pros and cons of privatizing water. How might it help or hinder water conservation? Which groups of people would gain or lose? For sample arguments and resources, see "Debate: Water Privatization," International Debate Education Association at www.debatepedia.org/en/index.php/Debate:_Water_privatization. ***12.1.4****. Evaluate the role of private property as an incentive in conserving and improving scarce resources, including renewable and nonrenewable natural resources.*

About the San Francisco Public Utilities Commission

The San Francisco Public Utilities Commission is a department of the City and County of San Francisco that provides retail drinking water and wastewater services to San Francisco, wholesale water to three Bay Area counties, and green hydroelectric and solar power to San Francisco's municipal departments. We comprise three essential 24/7 service utilities: Water, Wastewater, and Power. Our mission is to provide our customers with high-quality, efficient, and reliable water, power, and sewer services in a manner that is inclusive of environmental and community interests and that sustains the resources entrusted to our care.

San Francisco
Water Power Sewer
Services of the San Francisco Public Utilities Commission

About the Center for Ecoliteracy

The Center for Ecoliteracy is a nonprofit organization that advances ecological education in K–12 schools. Founded in 1995, the Center engages with school communities, foundations, civic leaders, and other change agents at multiple levels of scale from the local to the national. It creates and publishes books and guides, facilitates professional development and conferences, and provides strategic consulting to schools and businesses.

The Center has published dozens of free downloadable resources for educators and nearly 150 essays and interviews with leading thinkers, educators, and policy makers. Its books include *Ecoliterate: How Educators Are Cultivating Emotional, Social, and Ecological Intelligence* (Jossey-Bass, 2012); *Smart by Nature: Schooling for Sustainability* (Watershed Media, 2009); and *Ecological Literacy: Educating Our Children for a Sustainable World* (Sierra Club Books, 2005). Well known as a leader in K–12 school food reform and school gardens, the Center developed the *Rethinking School Lunch* guide and planning framework; collaborated with the Berkeley Unified School District and Chez Panisse Foundation in the School Lunch Initiative; and is partnering with Oakland Unified School District in the Rethinking School Lunch Oakland initiative.

The Center's food-related resources include *Big Ideas: Linking Food, Culture, Health, and the Environment*; the cookbook and professional development guide *Cooking with California Food in K–12 Schools; Making the Case for Healthy, Freshly Prepared School Meals*; and classroom discussion guides for Academy Award-nominee *Food, Inc.* and the *Nourish: Food + Community* series. To learn more, see www.ecoliteracy.org.

CENTER FOR
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