

Got Water?

Next Generation Science Standards (NGSS) and the Common Core State Standards (CCSS)

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NGSS Performance Expectations(s)

[HS-ESS2-2](#): Analyze geoscience data to make the claim that one change to Earth’s surface can create feedbacks that cause changes to other Earth systems.

[HS-ESS3-1](#): Construct an explanation based on evidence for how the availability of [water] resources, natural hazards and changes in climate have influenced human activity.

[HS-ESS3-3](#): Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

Background Information

The following lessons have been developed by a committee of STEM teachers at GUHSD with funding from a NSF grant awarded to the Center for Water Studies at Cuyamaca College. Other lessons for Space & Earth Sciences and Physics have also been developed. More resources are available at [cws.careers](#).

There are three overarching themes that can be addressed as units from the NGSS performance expectations. ***Other themes are also addressed in the lesson plans for Physics and Chemistry available at [cws.careers](#):***

1. Water is a natural resource.
2. Water is an agent of shaping the earth’s surface.
3. What are the properties of water?

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking questions & defining problems Planning and carrying out investigations Constructing explanations and designing	ESS2.C : The roles of water in Earth’s Systems Processes ESS3.C : Human Impacts on Earth Systems	Cause and Effect- Land shaping effect of water(2-4) Energy and Matter- Water Cycle/Carbon Cycle(2-

solutions	ETS1.B : Developing Possible Solutions	6) Stability and Change- Sand on the Beach with dams (2-2) Influence of Eng., Tech and Sci on Society and Natural World. - Cost to improve beaches for tourist by sand replacement is it worth it?(2-2)Argumentation?
Guiding Question(s)		
<p>Guiding Question 1: Why should we care about water?</p> <p>Guiding Question 2: How and Why has the amount of water changed? Especially in CA</p> <p>Guiding Question 3: What is water and how is human management for supplying water affected by human populations and the environment?</p>		
CCSS Connections Support Reading, Writing, Speaking, Listening and Mathematics		
<p>Students construct an explanation that includes:</p> <p>i. Specific cause and effect relationships between environmental factors (natural hazards, changes in climate, and the availability of natural resources) and features of human societies including population size and migration patterns</p>		

Links to generally helpful websites can be found at the end of the document or [this link](#).

Instructional Sequence 1

<p>Performance Expectation(s)</p>	<p>HS-ESS3-1: Construct an explanation based on evidence for how the availability of [water] resources, natural hazards and changes in climate have influenced human activity.</p> <p>HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.</p>
<p>Concepts from:</p> <ul style="list-style-type: none"> ➤ <i>Evidence Statements</i> ➤ <i>Clarification Statements</i> 	<ul style="list-style-type: none"> ● Students construct an explanation: <ul style="list-style-type: none"> ○ Specific cause and effect relationships between environmental factors (natural hazards, changes in climate, and the availability of natural resources) and features of human societies including population size and migration patterns. ○ That technology in modern civilization has mitigated some of the availability of natural resources on human activity ● Students identify and describe* the evidence to construct their explanation: <ul style="list-style-type: none"> ○ How have each of these areas been affected humans and how has human society and ingenuity mitigated the issue. ○ Features of human societies that have been affected by the availability of natural resources. ● Students organize data that represent measurements of changes in hydrosphere, cryosphere, atmosphere, biosphere, or geosphere in response to a change in Earth’s surface. ● Students describe* simplified realistic (corresponding to real-world data) relationships between simulation variables to indicate an understanding of the factors (e.g., costs, availability of technologies) that affect the management of natural resources, human sustainability, and biodiversity. ● Students create a computational simulation (using a spreadsheet or a provided multiparameter program) ● Students use reasoning that connects the evidence, along with the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future, to describe*: How technology has changed the

	cause and effect relationship between the development of human society and natural resources.
3 Dimensions of Focus	<p>SEP: Constructing explanations and designing solutions Using mathematics and computational thinking Asking questions and defining problems Analyzing and interpreting data</p> <p>CCC: Cause and effect Stability and change Energy and matter</p> <p>DCI: ESS 3.A: Resource availability has guided the development of human society. ESS 3.C: The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources</p>
Guiding Question(s)	Why should we care about water?
Guiding Phenomenon	Earth Observatory of disappearing lakes

5E Stage	Driving Question(s)	What the Teacher Does	What the Student Does
Engage	How do you use water in your daily life and why is it important?	Engage students in a preliminary discussion about water availability in one or both of the following ways:	<ul style="list-style-type: none"> - Preset the room so that the water is off, turn on the tap, and start a discussion - what if we did not have tap water...? - Watch video on need for clean water
		Conservation Connection Teacher book p. 1-4 Teacher Resource: Per capita water use USGS link	Water Audit: Conservation Connection student booklet p. 4 <ul style="list-style-type: none"> - Three-day record keeping or longer as desired. After students complete their Water Audit, they do Water Math student book p. 13

Explore	What are the many other ways that our consumption uses water?	Hidden Water Use - Where's All the Water going? Teacher have items listed as visual. Video Day Without Water Intro Teacher Resources for reading and getting involved	Worksheet- Students make predictions on how much water is used for each item. Students are given a list of items to research the amount of water to make their favorite clothing, food, device, item. Advise company on water cutting mechanisms. Reading article (Blog option) a day without water?
Engage	Where has the water gone?	Earth Observatory of disappearing lakes. Use the comparison image of Lake Mead 1984 to 2016 to start a discussion What is happening to water? Alternative Global Issues Video series - "The Journey" Finding Clean Water	Students record: - What do they notice? - What do they wonder? - Do they have any predictions for the future or possible hypotheses? Students could also research additional lakes/reservoirs, maybe local. (El Capitan 8 fwy)
Explore	Where is water found? How much water is available for humans to use?	Demo: Breakdown by percentage using Liter of water for global to a drop representing available for consumption. Global Water and You or Earth's Water a Drop in your Cup Alternative option: Water in the human body	Students complete activity according to website - Have students make predictions about demo, as to how much water is available for humans. - Students convert their data percentages about where water is found to pie charts.
Explore	Why are there water wars & day zeros ?	Introduce the concept of " day zero " and facilitate brief discussion (Several articles are available at this link) - Could show a movie clip from Mad Max: Fury Road about fighting over water resources Provide links and research guidelines .	Students discuss reactions, thoughts, questions regarding "day zero" concept. Research areas of the world where lack of water resources have become a societal issue. <ul style="list-style-type: none"> ● Bolivia ● Cape Town ● Aral Sea ● North Africa ● Israel ● Mexico City ● Others can be added Jigsaw the learning with like teams, then mixed groups. What are some possible solutions to these global situations? Group Discussion- Write a letter to the United Nations addressing the goal of clean potable water for all.

Explore & Explain	How will we meet the growing demand of a growing global population and shifting climates.	(Teacher discretion which segments of this computer simulation - linked to the right - to utilize.) Option: Lead discussion (Socratic seminar) on the future of so many people on a planet with financially finite water supplies.	Use High Adventure Science online simulation to explore: Will there be enough fresh water? Option: Socratic Seminar
Explore	What about water for California? Water Distribution Population Precipitation Ca Physical Features	Copy maps for students to complete on p. 30, 36, 43, 60 of this PDF. Teachers will need to modify this large PDF to suit their students' needs. (Question and content can be modified to best fit your lesson and time)	Mapping Water in CA : (This is the teacher version) Students complete activities on maps and answer related questions regarding water locations and movement throughout California.
	Where does the lack of water have the greatest impact in our State?	Provide link to Map of water locations vs people density and facilitates a discussion of problems associated with securing safe water resources for CA's cities.	Students explain why 'moving water' and the impacts it makes on the environment are essential for survival in CA
Explain	Why must we move water around CA and import from other locations?	Using CA Education and the Environment Initiative Liquid Gold (L.G.) - Lesson 2: Supply & demand for CA's water Lesson 3: Moving California's Water - L.G. Student Workbook - L.G. Teacher Edition - L.G. Folder of resources	Students create a brochure or poster for other students at their school or the public (audience is teacher discretion), that explains: - Where CA water is found - How water is distributed throughout the state - How is freshwater used - Identifying areas in CA that are most at risk for water shortages (tie in guiding phenomena of "disappearing lakes") - How is the water managed so all areas have access to clean drinking water - Use Liquid Gold resources
Evaluate	Is our human need for water sustainable given current trends in climate and population growth?	Revisit the disappearing lakes of the engagement phenomena. Start a discussion to refresh memories on where 'our fresh water' in So. Cal. comes from.	Water & Population Trends CER
Engage	What is the current state of various sources of water?	Set up " Which water is which " demo	Students observe water samples from various sources and make predictions trying to match them.

<p>Elaborate</p>	<p>Where else can water come from? What are possible solutions used today?</p>	<p>Pose question to students: "Is there a water issue in East County? How would we know?" (Ideas for data: water cost changing over time)</p> <p>What is San Diego County's plan for a local water crisis? (Model for PSA presentation) Facilitate conversation toward what can East County do:</p> <ul style="list-style-type: none"> - Desalination - Reclamation - Sewage water - Conservation <p>Provide storyboard link rubric for PSA.</p>	<p>Students observe and analyze data, then discuss as a whole-class</p> <p>Fact Sheet and Video Students discuss ideas taken from throughout the unit and/or research to answer this question: "What can East County San Diego do to mitigate these issues?"</p> <p>Challenge students to produce a PSA (Public Service Announcement) or series of on campus projects to educate the campus on conservation and pending shortages; what should be done. Options for student products could include:</p> <ul style="list-style-type: none"> - WeVideo - AdobeSpark - Screencasting
<p>Elaborate</p>	<p>What types of jobs and careers are involved in water?</p> <p>Water's College Plan for State of CA.</p>	<p>Provide links WaterJobs.org</p> <p>CA Department of Water Resources Careers</p>	<p>Prepare a shared google slide presentation on the types of jobs and careers that are involved in water distribution</p>

This sequence is still under construction. If you have thoughts, ideas, or additions you'd like to make, please email dyoungblood@guhsd.net

Instructional Sequence 2	
Performance Expectation(s)	
Concepts from: ➤ <i>Evidence Statements</i> ➤ <i>Clarification Statements</i>	<ul style="list-style-type: none"> • Solutions to water distribution and drought problems • How climate has affected water cycle
3 Dimensions of Focus	<p>SEP: Engaging in argument from evidence</p> <p>CCC:</p> <p>DCI:</p>
Guiding Question(s)	How and why has the amount of water changed, especially in CA?
Guiding Phenomenon	

5E Stage	Guiding Question(s)	What the Teacher Does	What the Student Does
Engage	Can we drink recycled sewage?	Encourages discussion and debate regarding issue	
	What is desalination and is it a viable solution to a drought? Why can't saltwater be used for irrigation.	Teacher Resource Academy of Sciences	Conduct an investigation irrigating plants with seawater? Is there a safe level of salt concentration for plants to grow?

Explore			Read several articles on the process of water reclamation. Visit a sewage treatment plant. (Virtual or field trip)
		Set up conductivity lab/demo for Total Dissolved Solids with salts and organics	Conductivity test for TDS
Explain	How can you overcome the yuck factor of recycled sewage?		Develop a public service announcement to sell their idea for water reclamation (Toilet to Tap did not work) - Use Flip-grid (or similar short video clip)
	What makes water safe for humans vs plants	Provide links to research on what makes water safe to drink	Develop a model of how to claim water for safe use (original source & recycled)
Elaborate			
Evaluate			

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Instructional Sequence 3	
Performance Expectation(s)	ESS 2-5: ESS 2-2: ESS 2-3: ESS 3-3:
Concepts from: ➤ <i>Evidence Statements</i> ➤ <i>Clarification Statements</i>	•
3 Dimensions of Focus	<p>SEP: Constructing explanations and designing solutions Engaging in argument from evidence Planning and carrying out investigations</p> <p>CCC: Energy & Matter Structure & Function Cause and effect Patterns</p> <p>DCI:</p>
Guiding Question(s)	What is water and how is human management for supplying water affected by human populations and the environment?
Guiding Phenomenon	

5E Stage	Guiding	What the Teacher Does	What the Student Does
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	Question(s)		
Engage	What is water? What makes water so useful to all life?	Demonstrations -- Using a small Van deGraff generator, can show the electrostatic attraction of a stream of water -- solubility of some solids not others; immiscibility of oil, presence of minerals through precipitation	
	How has human construction of reservoirs and distribution systems impacted other environmental systems?		
	Is our human need for water sustainable given current trends in climate and population growth?		Water & Population Trends CER
Explore		Share the link or assign AL to water runoff article	Water Properties Investigations- Expansion on Freezing Universal Solvent High Heat Capacity Convection- Heat Transfer
	What effect does water have on life and the environment?		Erosive properties on a model land surface
	What does water need to taste good and still be safe?		Total Dissolved Solids (TDS) conductivity test. Inquiry into the conductivity of certain minerals commonly found in water, and/or designing their own drinking water .
Explain			

Elaborate			
Evaluate			

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Instructional Sequence 4	
Performance Expectation(s)	ESS 2-5:
Concepts from: ➤ <i>Evidence Statements</i> ➤ <i>Clarification Statements</i>	<ul style="list-style-type: none"> • Water's effects on earth materials and surface processes • Water's weathering effects on land surface and coastal regions
3 Dimensions of Focus	<p>SEP: Developing and using models Planning and carrying out investigations</p> <p>CCC: Structure and function</p> <p>DCI: ESS 2.A:</p>
Guiding Question(s)	
Guiding Phenomenon	Picture of Moab Utah, How was this landscape created? What do you notice? Change over time?

5E Stage (Time Frame)	Guiding Question(s)	What the Teacher Does	What the Student Does
Engage	How are the water cycle and the rock cycle related?	Set up lab stations with differing soil & rock types in painter trays or tubs	Weathering investigation- Flinn kit. Students will conduct an investigation using water and differing rock types to visualize the mechanical and physical weathering effects.

Explore	How does the removal of vegetation affect water systems/resources?		How can this be tested? What predictions would be made? What claims and evidence can be developed as a result?
Explore			Use will use High Adventure Science to explore: Will there be enough fresh water?
Explain			How should forestry or agriculture be managed to mitigate these problems?
Elaborate HSESS2-2	How have Dams impacted the Earth's surface? What are the purposes of Dams?	Present Geoscience Data Need resources here, Explain how trends can be useful in predicting future outcomes. What is good data?	Analyze data and develop claims as to the impacts that dammed rivers can have on sediment transport, coastal erosion, and beach sand.
Evaluate	Does this have economic impacts in San Diego?		Students will write a letter to the River Conservancy or Coastal Conservancy regarding the impact that dams, loss of vegetation, etc can have on local environments.

Helpful websites

- [NSTA Classroom Resources ESS 3](#)
- <https://earthobservatory.nasa.gov/>
- [San Diego County Water Authority](#)