Middle School Green Career Awareness Module

CLEAN WATER

Unit Storyline

During this module, students embark on a transformative journey to understand the significance of clean water and its critical role in sustaining life on Earth. The adventure begins with a deep exploration of the sources of global freshwater, as students define watersheds and trace the water cycle's pathway through these essential systems. They delve into the physical and cultural importance of water to humanity, discovering the marvels of the salmon life cycle while identifying threats to their survival due to human impacts and climate change. Empowered with knowledge, they communicate ways to protect and restore healthy habitats for salmon in their community, connecting their actions to a global water conservation effort. As they venture into wetlands, students learn about their invaluable roles in flood and erosion protection for coastal communities, exploring the intricate web of interactions among plants, animals, mud, and water that create a healthy ecosystem. Comparing human-influenced water pathways to natural ones, they gain insight into the consequences of altering nature's course. In pursuit of clean water, they study water quality parameters and perform tests to evaluate different water sources, highlighting the importance of treating wastewater to preserve this precious resource. Recognizing the global impact of a growing human population, students engage in thought-provoking debates on water distribution, quality, and management, utilizing research skills, critical thinking, and collaboration to explore various perspectives and potential solutions. Throughout the unit, students refine their understanding of the interconnectedness of climate change, drought, and sea level rise with human access to clean water, recognizing the urgency of water sustainability in safeguarding our planet's lifeline. Armed with knowledge and a sense of responsibility, they embrace their roles as stewards of the environment, vowing to protect and conserve the Earth's most precious resource – clean water.

Essential Question	Enduring Understanding
Why is clean water important and how can we ensure that its supply is maintained for all life?	Clean water is essential to life, so we must protect and restore our watersheds to ensure the health of humans and all living things.

Alignment with California Middle School Content Standards

CCSS ELA RST 6-8. 9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
CCSS ELA SL6-8. 2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
CCSS ELA RST 6-8. 4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.
CCSS ELA LITERACY.W.7.7: Conduct short research projects to answer a question.
CCSS ELA LITERACY.RI.7.8: Trace and evaluate the argument and specific claims in a text.
CCSS ELA LITERACY.SL.7.4: Present claims and findings, emphasizing salient points.
CCSS ELA LITERACY.SL.7.1.B: Follow rules for collegial discussions and decision-making.
CCSS ELA LITERACY.SL.7.1: Engage effectively in a range of collaborative discussions.
CCSS ELA LITERACY.RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts.
CCSS ELA LITERACY.RST.6-8.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
CCSS Math 7.RP.A.1: Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units.
EP&Cs Principle 1: People Depend on Natural Systems; Concept 1: Natural systems have many components that interact.
EP&Cs Principle 2: People influence natural systems. The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies.
EP&Cs Principle 3: Natural systems proceed through cycles that humans depend upon, benefit from, and can alter. Concept C. Human practices can alter the cycles and processes that operate within natural systems.
EP&Cs Principle 5: The Common Good Depends on a Healthy Environment; Concept 5: Resources are limited and should be used wisely.
NGSS MS-ESS2-4: Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
NGSS MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
NGSS MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
NGSS MS-LS1-4: Use argumentation based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
NGSS MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
NGSS MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
NGSS MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
NGSS MS-ETS1-1: Define the criteria and constraints of a design problem
NGSS MS-ETS1-2: Evaluate competing design solutions using a systematic process

NGSS MS-ETS1-5: Construct a prototype to test a design

Alignment with California Industry Sectors, Career Technical Education (CTE) Pathways, and CTE Model Curriculum Standards

Energy, Environment, and Utilities Sector

- A5.0 Identify the role and impact of waste management systems and their operations on the environment.
  - A5.1 Understand the role of waste and stormwater management systems, their operation, and their impact on the environment.A5.2 Explore the causes and effects of pollution linked to wastewater treatment facilities.
  - A5.3 Identify wastewater treatment processes that lessen environmental impacts and improve water reuse.
  - A5.4 Explain the types and sources of hazardous waste and associated safety practices and legal requirements for handling and disposing of such waste.
  - A5.5 Design solid waste disposal processes that lessen environmental impacts and improve recycling.
- A9.0 Research drinking-water sources, systems, treatment, and conservation.
  - A9.1 Understand water reuse: issues, strategies, technologies, and applications.
  - A9.2 Analyze strategies for improving energy efficiencies in water collection and distribution.
  - A9.3 Describe the role of environmental engineering and green energy in water systems.
  - A9.4 Understand the functions and operations of water storage, reservoirs, aqueducts, and dams.
- A10.0 Evaluate the impact and flow management of stormwater, rivers, and groundwater.
  - A10.1 Understand the designs and tools used in water flow management.
  - A10.2 Describe watershed modeling.
  - A10.3 Understand the principles and applications of drainage engineering.
  - A10.4 Use the Hydrologic Engineering Centers River Analysis System (HEC-RAS).
  - A10.5 Analyze and interpret contaminated harbor and river sediment.
  - A10.6 Describe the concerns and strategies for catastrophic storm water events and management.

Equipment, Instructional Resources, and Materials

1. Full materials list spreadsheet

The Learning Sequence

The Nature of Water

Guiding Questions: What are the sources of global freshwater? What role do watersheds play in the water cycle and in maintaining ecosystem health?

Lesson #	Learning Objectives	Summary of Activities	Content Areas and Careers
Lesson One Following the Flow of Water	1. Understand the sources of global saltwater and freshwater 2. Define watershed. 3. Describe the pathway water takes through a watershed (water cycle).	1. Students engage with a model of all the world's water, as represented by one liter. 2. Students learn about watersheds. 3. Students kinesthetically model the water cycle to demonstrate how water naturally moves from place to place.	Hydrology, Geology, Ecology, Conservation
Lesson Two Why is Clean Water Important?	1. Understand the physical and cultural importance of water to humans. 2. Describe the salmon life cycle. 3. Identify threats to salmon survival, related to human impacts and climate change. 4. Communicate ways their community can help protect and restore healthy habitats for salmon.	1. Students reflect upon the importance of clean water for people, plants, animals, and the environment. 2. Students learn about salmon, as a case study for the relationships within an ecosystem and why clean water is important for aquatic species. 3. Students explore threats to salmon populations and the roles humans play.	Hydrologists, Hydraulic Engineers, Political advocates, Environmental Educators
Lesson Three Wetland in a Pan	1. Describe a Wetlands role in flood protection for cities and local coastal communities. 2. Describe a Wetlands role in erosion protection for coastal communities.	1. Students share prior knowledge about wetlands. 2. Students build models of wetlands, change the conditions and variables, and compare the results.	Wetland restoration, City planning, Watershed science, Environmental engineer.
Lesson Four Healthy Marsh Pursuit	1. Describe four major groups that combine to create a healthy marsh. 2. Give examples of living organisms that use a marsh.	1. Students review what they know about marshes and the types of organisms that live there. 2. Students play a game that reinforces their knowledge about marshes.	Wetland restoration, Urban planning, Coastal ecosystem studies, Biology,

	3. Describe how plants, animals, mud and/or water interact in a marsh to create a healthy ecosystem.		Wetland management
Lesson Five Where does the Bay Area's water come from?	1. Describe the components of our regional water infrastructure system. 2. Construct one of four types of dam and list their advantages and disadvantages.	1. Students learn about the complex water infrastructure system in the Bay Area. 2. Students learn about the Hetch Hetchy Reservoir and the O'Shaughnessy Dam, and how water is distributed to homes from that source. 3. Students engineer different types of dams to see their advantages and disadvantages.	Urban Planning, Water management. Civil Engineer, Structural Engineer
Impacting our Water Supply			
Guiding Questions: How does the growing human population impact the global freshwater supply? What actions can individuals and communities take to mitigate the effects of a diminishing freshwater supply?			
Lesson Six How do people use water?	1. Calculate how much water is required to properly wash hands 2. Describe the average amount of water used in their household on a daily basis 3. Understand how water is used in the Bay Area 4. Explain how climate change impacts water use	1. Students predict how much water is used during hand washing and then calculate it. 2. Students use an online water calculator to determine their daily household use of water. 3. Students learn about how water is used in the Bay Area and the factors contributing to limiting water supply, both locally and globally. 4. Students discuss how we can conserve water to maintain supply for the future.	Water management, Civil Engineer.
Lesson Se… The Impact of Climate Change on Access to Clean Water	1. Explain how climate change, sea level rise, and drought are connected to human's access to clean water. 2. Explain how drought and sea level rise are and will affect their local community. 3. Identify solutions to the climate / water crisis at an individual and community level.	1. Students share prior knowledge about climate change, specifically about drought and sea level rise. 2. Students engage with a Bay Area map to discover sea level rise trends over the next 50 years. 3. Students learn about the relationship between climate change and drought by observing a graph, and learn how humans adapt to drought conditions. 4. Students observe a demonstration of freshwater vs. saltwater density to learn about saltwater intrusion.	Climatologist, Hydrologist, Environmental Scientist, Farmer, Agricultural Engineer, Urban Planner

		5. Students reflect on this lesson and share how we can help mitigate the impacts of climate change on clean water.	
Lesson Eight The Impact of a Growing Human Population on the Global Freshwater Supply	1. Analyze the impact of a growing human population on global freshwater supply. 2. Identify the main causes of water pollution and their consequences. 3. Explain the concept of biomagnification and its implications for human health and the environment. 4. Recognize the importance of water conservation and individual actions in addressing the challenges of climate change and water sustainability.	1. Observe graphs of human population growth and trends, and discuss how this might impact the global freshwater supply. 2. Describe the main causes of water pollution. 3. Learning about mercury toxicity and biomagnification and how toxins consumed by fish populations can impact human health.	Environmental Scientist, Ecologist, Conservation Biologist, Water Quality Specialist, Environmental Educator, Environmental Policy Analyst
Lesson Nine Water Quality	1. Describe the importance of water quality and its impact on human health and the environment. 2. Identify and understand the significance of various water quality parameters. 3. Perform water quality tests using testing kits. 4. Analyze and interpret the results of water quality tests. 5. Evaluate the quality of different water sources based on the test results.	1. Review the importance of clean water and the major causes of water pollution. 2. Discuss the factors that can be measured in water to determine its quality. 3. Perform a water quality test on three types of water using a testing kit. 4. Analyze data from water quality testing to draw conclusions about the quality of the different water sources based on the test results.	Environmental Scientist, Water Quality Specialist, Environmental Engineer, Water Resource Manager, Public Health Officer, Laboratory Technician, Conservation Biologist
Lesson Ten Wastewater Treatment	1. Describe the purpose of treating wastewater and, generally, how a wastewater treatment plant functions. 2. Create a water filtration system using household materials. 3. Describe why it is important to conserve our freshwater supply.	1. Learn about how wastewater is treated in water treatment facilities and on the International Space Station. 2. Design, test, and analyze the effectiveness of a water filtration system.	Wastewater Treatment Plant Operator, Environmental Engineer, Water Quality Analyst, Industrial Waste Treatment

			Specialist, Environmental Health and Safety Specialist

Debating the Solutions

Guiding Question: What is the most effective approach to achieving sustainable water management: prioritizing environmental conservation or meeting human needs?

Lesson #	Learning Objectives	Summary of Activities	Content Areas and Careers
Lesson Eleven Introduction to Debate, Team Formation, and Topic Exploration	1. Understand the purpose and format of a debate. 2. Analyze and evaluate different perspectives on water distribution, water quality, and water management. 3. Develop research skills to gather information and evidence related to the debate topic. 4. Collaborate in teams to explore different aspects of the debate questions.	1. Students form teams and assume specific roles: Opening Statement, Rebuttal, Closing Argument 2. Teams conduct research on the assigned debate question using various resources. 3. Each team collaboratively prepares arguments and uses ChatGPT to assist in information gathering and refining positions.	
Lesson Twelve Research and Argument Development	1. Conduct in-depth research on the assigned debate question. 2. Evaluate and analyze various sources of information to support arguments. 3. Utilize ChatGPT as a resource to enhance research and understanding of the debate topic. 4. Develop critical thinking and information synthesis skills.	1. Students review guidelines for constructing persuasive arguments and debate format. 2. Teams analyze research findings and develop evidence-based arguments. 3. Teams collaborate to organize arguments, practice presenting, and provide feedback for improvement.	

Lesson Thirteen Debate Preparation and Rehearsal	1. Refine arguments and evidence-based claims based on research findings. 2. Practice public speaking skills and effective delivery of arguments. 3. Collaborate within teams to strengthen arguments and provide constructive feedback. 4. Enhance teamwork and collaboration skills.	1. Teams review their arguments and supporting evidence, refining and strengthening their positions. 2. Students engage in research to gather additional data and examples to support their arguments. 3. Teams collaborate to anticipate counterarguments and prepare rebuttals to strengthen their positions.	
Lesson Fourt… The Debate	1. Present opening statements that clearly articulate team positions. 2. Construct rebuttals and counter arguments based on the opposing team's arguments. 3. Deliver persuasive closing statements summarizing key arguments and leaving a lasting impact. 4. Develop critical thinking skills by evaluating opposing viewpoints and reflecting on the debate.	1. Teams present their arguments in a structured debate format, following the rules and guidelines discussed in previous lessons. 2. Students engage in constructive debates, presenting their positions, supporting evidence, and rebuttals. 3. The class observes the debates and actively participates in critical analysis and evaluation of arguments, taking notes on key points raised by each team.	