

# Unit 3: Water and Water Pollution

Content Area: **Science**  
Course(s):  
Time Period: **MP2**  
Length: **25 days**  
Status: **Published**

## NJSLS - Science

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9-12.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.
9-12.HS-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
9-12.HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
9-12.HS-ESS2-5	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

## Science and Engineering Practices

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### Developing and Using Models

Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS2-1),(HS-ESS2-3),(HS-ESS2-6)

### Planning and Carrying Out Investigations

Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, me), and refine the design accordingly. (HS-ESS2-5)

### Analyzing and Interpreting Data

Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) to make valid and reliable scientific claims or determine an optimal design solution. (HS-ESS2-2)

### Engaging in Argument from Evidence

Construct an oral and written argument or counter-argument based on data and evidence. (HS-ESS2-7)

## **Disciplinary Core Ideas**

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### **ESS2.A: Earth Materials and Systems**

Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1),(HS-ESS2-2)

### **ESS2.C: The Roles of Water in Earth's Surface Processes**

The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HS-ESS2-5)

### **ESS2.D: Weather and Climate**

The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (HS-ESS2-2)(HS-ESS2-4)

Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6),(HS-ESS2-7)

Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6),(HS-ESS2-4)

### **ESS2.E Biogeology**

The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. (HS-ESS2-7)

## **Crosscutting Concepts**

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### **Energy and Matter**

The total amount of energy and matter in closed systems is conserved. (HS-ESS2-6)

## **Structure and Function**

The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials. (HS-ESS2-5)

## **Stability and Change**

Much of science deals with constructing explanations of how things change and how they remain stable. (HS-ESS2-7)

Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS2-2)

## **Influence of Engineering, Technology, and Science on Society and the Natural World**

New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ESS2-2)

## **Rationale and Transfer Goals**

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Water is recycled, but the amount of clean water can be considered a finite resource. Clean water is also unevenly distributed throughout the world, and this can lead to advantages and disadvantages for different societies across the globe. Lack of clean water can be associated with poor health and the spread of disease. Students should see that the amount of clean water available to everyone is a small % of the total water on Earth. Water pollution doesn't just affect one small area, because water can move through the water table (underground) and cover large areas. There are different types of pollution, and in the US we have laws requiring farmers and industry to monitor what chemicals are released that may affect local water sources. We also have our drinking water monitored to check for different pollutants and pathogens that may be in the water. Not every country has these standards in place. On a local level, students should realize that the small ponds and lakes in Lindenwold are connected to larger systems, such as the Timber Creek Watershed, which in turn is connected to the Delaware River. Pollution in one area can trickle into other areas since all water is part of a cycle. We will become familiar with the different parts of the water cycle, and how this affects the movement of different types of pollutants that enter the water cycle. The value of clean water will be discussed, and how dirty water can have large consequences on health, jobs, and the economy. We will look at the oil spill in the Gulf as an example.

## **Enduring Understandings**

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- Clean water is a finite resource, even though water is recycled through the water cycle.
- Water can travel through the ground, so pollutants can be spread.

- Pollution is caused by humans and products that we use.
- Pollution can spread over large areas, and can have an impact on human health and the health of other species, can affect the food chain, and can ultimately affect the economy.
- Water needs to be monitored and conserved to ensure that future generations will also have access to clean water.

## **Essential Questions**

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- How do the properties and movements of water shape Earth's surface and affect its systems?
- How does carbon cycle among the hydrosphere, atmosphere, geosphere, and biosphere?
- How do living organisms alter Earth's processes and structures?

## **Content - What will students know?**

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- The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics.
- The properties include water's exceptional capacity to absorb, store, and release large amounts of energy; transmit sunlight; expand upon freezing, dissolve, and transport materials; and lower the viscosities and melting points of rocks.
- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen.
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.
- The total amount of energy and matter in closed systems is conserved.
- The total amount of carbon cycling among and between the hydrosphere, atmosphere, geosphere, and biosphere is conserved.
- The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it.

## **Skills - What will students be able to do?**

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- Be able to name and explain all parts of the water cycle (evaporation, precipitation, transpiration, condensation)
- Describe available freshwater sources.
- Map out the local watershed for Lindenwold, and connect our watershed to its source, the Delaware River.
- Simulate how water can move through different layers of the ground, and how a pollutant can also travel, move and spread through these same layers.
- Create and simulate a wastewater treatment center that cleans and treats dirty wastewater
- Examine a bird's feather that has been covered in oil. Deduct how this affects their ability to thermoregulate and how it affects their ability to fly.

- Simulate an oil spill, and try different methods to contain the oil, and clean it up. Relate to what is happening in the Gulf.
- Be able to differentiate between a sorbent and a dispersant in oil spill clean-ups.
- Analyze the effects of pollutants on human health and other organisms. (Ex: the effect of acid rain on plant growth, or the effect of lead or mercury on human health)
- Identify the main types of water pollution: thermal, chemical pollution, wastewater/sewage, and eutrophication. Examine their source, and methods that are in place to prevent these pollutants in the first place, and then available clean-up methods in the event of an accident.
- Be able to test for dissolved oxygen. Correlate increased water temperature with lower DO, and describe impacts on fish and other aquatic organisms.
- Examine various ways to conserve water, and implement them at home, at school, and in your community. (EX: we will be selling clear water thermoses to discourage people from buying so much bottled water)

### **Activities - How will we teach the content and skills?**

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- Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
- Develop a model based on evidence to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
- Develop a model based on evidence to illustrate the biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere, providing the foundation for living organisms.
- Construct an argument based on evidence about the simultaneous BOE Approved September 2020
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.
- The total amount of energy and matter in closed systems is conserved.
- The total amount of carbon cycling among and between the hydrosphere, atmosphere, geosphere, and biosphere is conserved.
- The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it.
- Examine a bird's feather that has been covered in oil. Deduct how this affects their ability to thermoregulate and how it affects their ability to fly.
- Simulate an oil spill, and try different methods to contain the oil, and clean it up. Relate to what is happening in the Gulf.
- Be able to differentiate between a sorbent and a dispersant in oil spill clean ups.
- Analyze the effects of pollutants on human health and on other organisms. (Ex: effect of acid rain on plant growth, or the effect of lead or mercury on human health)
- Identify the main types of water pollution: thermal, chemical pollution, wastewater/sewage, eutrophication. Examine project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.

- Provide ELL students with multiple literacy strategies. coevolution of Earth's systems and life on Earth.

## Evidence/Assessments - How will we know what students have learned?

### Environmental Benchmark #2

### Spiraling for Mastery

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity
<ul style="list-style-type: none"> <li>• A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions</li> <li>• Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (the number of individuals) of species in any given ecosystem.</li> <li>• Ecosystems have carrying capacities, which are limits to the number of organisms and populations they can support.</li> <li>• These limits result from such factors as the availability of living and nonliving resources and from such challenges as predation, competition, and disease.</li> <li>• If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the</li> </ul>	<ul style="list-style-type: none"> <li>• Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.</li> <li>• In any ecosystem, organisms, and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.</li> <li>• Growth of organisms and population increases are limited by access to resources.</li> <li>• Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these compete, predatory, and</li> </ul>	<ul style="list-style-type: none"> <li>• Resources from the Holt Environmental Science Text: <ul style="list-style-type: none"> <li>○ Using the Figure: Life Depends on the Sun</li> <li>○ Skill Builder: Vocabulary</li> <li>○ MathPractice: A Meal Fit for a Grizzly Bear</li> <li>○ Case Study: DDT in an Aquatic Food Chain</li> <li>○ Using the Figure: The Nitrogen Cycle</li> <li>○ Graphic Organizer: Chain-of-Events Chart</li> <li>○ Case Study: Communities Maintained by Fire</li> <li>○ Maps in Action: Doppler Radar Tracking of Bats and Insects in Central Texas</li> <li>○ Society &amp; the Environment: Eat the Bait</li> </ul> </li> </ul>

ecosystem) as opposed to becoming a very different ecosystem.

- Compare and contrast the ecological footprints of various countries around the world.
- Examine factors that increase or decrease your footprint
- Read a current event that compares tap water vs. bottled water. • Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. • Research composing as a way to reduce the ecological footprint. • Research and write about a current event pertaining to env. science and present it to the class. • Much of science deals with constructing explanations of how things change and how they remain stable. • Visit Lindenwold Waste Management and interview the supervisor to learn about recycling in Lindenwold. • Examine ways that the school could reduce its own footprint, by expanding the recycling program. • Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation.

mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.

- Ecosystems are dynamic; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.
- Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.
- Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources.
- Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.
- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environment can have different impacts (negative and positive) on different living things.
- Typically, as human populations and per-capita consumption of natural resources increase, so do

	<p>the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.</p> <ul style="list-style-type: none"> <li>• The many dynamic and delicate feedbacks among the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors.</li> <li>• Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.</li> <li>• Although the magnitude of human impacts is greater than it has ever been, so too are human abilities to model, predict, and manage current and future impacts.</li> <li>• Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities.</li> </ul>	
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## Key Resources

[Bunny Population Growth Activity](#): Students collect data during a simulation and use it to support their explanation of natural selection in a rabbit population and how populations change over time when biotic or



abiotic factors change.

[African Lions Acvity](#): Students use the data presented to predict the zebra population during periods of increased rainfall. Students will create a representation of the data that illustrates both the lion population and zebra population during the same period

[Animal Behavior](#): Students will make detailed observations of an organism's behavior and then design and execute a controlled experiment to test a hypothesis about a specific case of animal behavior. Students will record observations, make sketches, collect and analyze data, make conclusions, and prepare a formal report.

[Biodiversity](#): Students use this lab to represent how biodiversity stops a disease from spreading

## **Career Readiness, Life Literacies, & Key Skills**

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TECH.9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
TECH.9.4.12.CT.4	Participate in online strategy and planning sessions for course-based, school-based, or other project and determine the strategies that contribute to effective outcomes.
TECH.9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political, economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).
TECH.9.4.12.IML.2	Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources (e.g., NJLSA.W8, Social Studies Practice: Gathering and Evaluating Sources).
TECH.9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).
TECH.9.4.12.IML.4	Assess and critique the appropriateness and impact of existing data visualizations for an intended audience (e.g., S-ID.B.6b, HS-LS2-4).
TECH.9.4.12.IML.5	Evaluate, synthesize, and apply information on climate change from various sources appropriately (e.g., 2.1.12.CHSS.6, S.IC.B.4, S.IC.B.6, 8.1.12.DA.1, 6.1.12.GeoHE.14.a, 7.1.AL.PRSNT.2).
TECH.9.4.12.IML.6	Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity (e.g., NJLSA.SL5).
TECH.9.4.12.IML.7	Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change (e.g., NJLSA.W1, 7.1.AL.PRSNT.4).

## **Interdisciplinary Connections/Companion Standards**

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LA.RST.11-12.1

Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.

LA.WHST.11-12.2

Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.