# Unit 4: Water on the Earth

Instructional Days: 15

| Unit Summary |
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| ***How do individual communities use science ideas to protect Earth's resources and environment?*** |
| In this unit of study, students describe and graph data to provide evidence about the distribution of water on Earth. The crosscutting concepts of *scale, proportion, quantity* and *systems, and systems models* are called out as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate grade-appropriate proficiency in *using mathematics and computational thinking* and in *obtaining, evaluating, and communicating information*. Students are also expected to use these practices to demonstrate understanding of the core ideas.<br>This unit is based on 5-ESS2-2 and 5-ESS3-1. |
| **Student Learning Objectives** |
| **Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.** *[Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.]* **(5-ESS2-2)** |
| **Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. (5-ESS3-1)** |

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| 5-ESS2-2 | Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. |
| 5-ESS3-1 | Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment |
| ESS2.A | Earth's major systems are the geosphere, the hydrosphere, the atmosphere, and the biosphere |
| ESS2.C | Nearly all of Earth's available water is in the ocean |
| ESS3.C | Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space |

### Quick Links

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### Enduring Understandings

- Earthquakes, other natural disasters, and tectonics are responsible for the patterns and changes of Earth's rock formations
- The locations of fossils show the order in which rock layers were formed.
- Climate and weather shape the land and determine which living things are found in a region.

### Essential Questions

- Why does our planet look the way it does?
- How and why do the Earth's features constantly change?
- How does the Earth's constant change affect our future?

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| Unit Sequence | |
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| ***Part A:*** *Where is water found on the Earth? What percentage of the Earth's water is fresh water?* | |
| **Concepts** | **Formative Assessment** |
| • Standard units are used to measure and describe physical quantities such as weight and volume.<br>• Nearly all of Earth's available water is in the ocean.<br>• Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. | *Students who understand the concepts are able to:*<br>• Describe physical quantities, such as weight and volume, in standard units.<br>• Describe and graph quantities such as area and volume to address scientific questions.<br>• Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. *(Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.).* |

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| **Unit Sequence** | |
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| ***Part B:*** *How do individual communities use science ideas to protect Earth's resources and environment?* | |
| **Concepts** | **Formative Assessment** |
| • A system can be described in terms of its components and their interactions.<br>• Science findings are limited to questions that can be answered with empirical evidence.<br>• Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space.<br>• Individuals and communities are doing things to help protect Earth's resources and environments. | *Students who understand the concepts are able to:*<br>• Describe a system in terms of its components and interactions.<br>• Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.<br>• Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. |

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| What It Looks Like in the Classroom |
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| During this unit of study, students need to understand that Earth is a system made up of subsystems, all of which have multiple components that interact. Throughout this unit, students will consider scale and proportion when examining the amount of water on the Earth, and they will consider the impact that humans have on one of Earth's most valuable resources.<br><br>To begin the progression of learning in this unit, students conduct research, using informational texts and online resources, to determine the distribution of fresh water and salt water among Earth's oceans, rivers, lakes, glaciers, groundwater, and polar ice caps. Students organize their data into graphs or charts, showing the allocation of fresh water and salt water on Earth. (Amounts should be described in terms of volume, as well as in percentages.) After comparing and analyzing data, students should be able to conclude the following:<br><br>✓ Nearly all of Earth's available water is in the ocean.<br>✓ Fresh water makes up less than 3% of the total amount of water on the Earth.<br>✓ Most fresh water is found in glaciers or underground.<br>✓ Only a tiny fraction of the fresh water on Earth is in streams, lakes, wetlands, and the atmosphere.<br><br>Next, students conduct research in order to determine ways in which individuals and communities help to protect the Earth's resources and environments. Using books and other reliable media resources, as well as first-hand observations in the local community, students gather information about the ways in which humans affect the environment. They should look for examples of human activities in agriculture, industry, and in their everyday lives, and should describe, both orally and in writing, the ways in which these activities affect the land, oceans, streams, groundwater, air, and other organisms (both plants and animals). Students will need the opportunity to share their findings with the class, and then should conduct further research to find ways in which individual communities use science ideas to protect the Earth's resources and environments.<br><br>Working in pairs or small groups, students should gather relevant information from both observations and reliable resources to prepare a presentation that explains one way in which a community is minimizing the effects of human activities on Earth's resources and environment. The presentation should include both writing and speaking components, as well as a list of sources that were used to provide information. As a result of conducting research and creating a presentation, students should come to understand that the ecosystem is a system that includes both living and nonliving components that interact with one another. These interactions cause changes to the system and its components. Humans are just one of many components in an ecosystem, yet our activities affect all parts of the ecosystem, many times in adverse ways. |

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| **Connecting with English Language Arts/Literacy and Mathematics** |
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| *English Language Arts*<br><br>Students use print and digital sources to gather information and data that describe the amount of fresh water and salt water on the Earth and where it is found. As students gather information, they should organize the information into graphs, analyze and interpret the information to answer questions, and summarize the information in order to describe the amounts and percentages of fresh water and salt water on the Earth and to provide evidence about the distribution of water in oceans, lakes, streams, and reservoirs. Students also use several print and digital resources to find examples of:<br><br>✓ The effects of human activities in agriculture, industry, and everyday life on Earth's resources and environments<br><br>✓ Ways in which communities are using science ideas to protect Earth's resources and environments.<br><br>Students summarize and paraphrase the information and use it when creating presentations that describe ways in which communities are using science ideas to protect Earth's resources and environments. The presentation should include both oral and written components, and a list of sources should be included with the presentation.<br><br>*Mathematics*<br><br>Students model with mathematics by using tables, charts, and/or graphs to organize data and information they collect. This includes the amount of fresh and salt water on Earth, the locations of both fresh and salt water on Earth, how human activities affect Earth's resources, and ways in which communities protect the Earth's resources and environments. Students also reason abstractly and quantitatively when analyzing these data to use as evidence to support their thinking. |

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| **Modifications** |
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| *(Note: Teachers identify the modifications that they will use in the unit. See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)* |
| • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. |
| • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). |
| • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a 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 understandings. |
| • 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. |
| • Collaborate with after-school programs or clubs to extend learning opportunities. |
| • Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA). |

| **Research on Student Learning** |
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| **N/A** |

## Unit 4: Water on the Earth

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| Prior Learning |
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| **Grade 2 Unit 4: The Earth's Land and Water**<br>• Water is found in the ocean, rivers, lakes, and ponds. Water exists as solid ice and in liquid form. |

| Future Learning |
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| **Grade 6 Unit 7: Weather and Climate**<br>• Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land.<br>• The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns.<br>• Global movements of water and its changes in form are propelled by sunlight and gravity.<br>• Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.<br>**Grade 7 Unit 8: Earth Systems**<br>• Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations.<br>**Grade 8 Unit 3: Stability and Change on Earth**<br>• 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.<br>• 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 environments can have different impacts (negative and positive) for different living things.<br>• Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on |

Earth unless the activities and technologies involved are engineered otherwise.

- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.

| **Connections to Other Units** |
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| In **Unit 5,** students are able to describe ways in which the geosphere, biosphere, hydrosphere, and atmosphere interact. |

| **Sample of Open Education Resources** |
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| Global Water Distribution: In this lesson sequence, students predict and model the availability of water on Earth and discuss methods that can be used to purify and conserve this critical resource. They also assess how much water they and their families typically use, and think about ways to reduce their water usage. Finally, students explore different techniques being employed for water management around the world, including the use of dams to create reservoirs.<br><br>Simulating an Oil Spill to Understand Environmental Impact: This 8 minute instructional video provides a model for teachers to follow of a week long investigation of oil spills and the environmental impact they have on shorelines and creatures. Students take on the task of cleaning up a simulated oil spill. Educator uses the 5E curriculum model to engage students with fiction and non-fiction texts before exploring methods that simulate an oil spill and its cleanup. Video demonstrates the key portions of the activity and models appropriate teacher questioning and interactions with the students. |

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| Teacher Professional Learning Resources |
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| **Teaching *NGSS* in K-5: Making Meaning through Discourse**<br><br>The presenters were Carla Zembal-Saul, (Penn State University), Mary Starr, (Michigan Mathematics and Science Centers Network), and Kathy Renfrew (Vermont Agency of Education). After a brief introduction about the Next Generation Science Standards (*NGSS*), Zembal-Saul, Starr, and Renfrew gave context to the *NGSS* specifically for K-5 teachers, discussing three-dimensional learning, performance expectations, and background information on the *NGSS* framework for K-5. The presenters also gave a number of examples and tips on how to approach *NGSS* with students, and took participants' questions. The web seminar ended with the presentation of a number of recommended NSTA resources for participants to explore.<br><br>View the resource collection.<br><br>Continue discussing this topic in the community forums.<br><br>**Evaluating Resources for *NGSS*: The EQuIP Rubric**<br><br>The presenters were Brian J. Reiser, Professor of Learning Sciences in the School of Education and Social Policy at Northwestern University, and Joe Krajcik, Director of the CREATE for STEM Institute.<br><br>After a brief overview of the *NGSS,* Brian Reiser, Professor of Learning Sciences, School of Education at Northwestern University and Joe Krajcik, Director of CREATE for STEM Institute of Michigan State University introduced the Educators Evaluating Quality Instructional Products (EQuIP) Rubric. The web seminar focused on how explaining how the EQuIP rubric can be used to evaluate curriculum materials, including individual lessons, to determine alignment of the lesson and/or materials with the NGSS. Three-dimensional learning was defined, highlighted and discussed in relation to the rubric and the NGSS. An emphasis was placed on how to achieve the conceptual shifts expectations of NGSS and three-dimensional learning using the rubric as a guide. Links to the lesson plans presented and hard copies of materials discussed, including the EQuIP rubric, were provided to participants. The web seminar concluded with an overview of NSTA resources on the NGSS available to teachers by Ted, and a Q & A with Brian Reiser and Joe Krajcik.<br><br>View the resource collection.<br><br>Continue discussing this topic in the community forums<br><br>***NGSS* Crosscutting Concepts: Systems and System Models**<br><br>The presenter was Ramon Lopez from the University of Texas at Arlington. Dr. Lopez began the presentation by discussing the importance of systems and system models as a crosscutting concept. He talked about the key features of a system: boundaries, components, and flows and interactions. Dr. Lopez also described different types of system models, including conceptual, mathematical, |

physical, and computational models. Participants discussed their current classroom applications of systems and system models and brainstormed ways to address challenges associated with teaching this crosscutting concept.

**_NGSS_ Core Ideas: Earth's Systems**

The presenter was Jill Wertheim from National Geographic Society. The program featured strategies for teaching about Earth science concepts that answer questions such as "What regulates weather and climate?" and "What causes earthquakes and volcanoes?"

Dr. Wertheim began the presentation by introducing a framework for thinking about content related to Earth systems. She then showed learning progressions for each concept within the Earth's Systems disciplinary core idea and shared resources and strategies for addressing student preconceptions. Dr. Wertheim also talked about changes in the way *NGSS* addresses these ideas compared to previous common approaches.

Continue the discussion in the community forums.

**_NGSS_ Core Ideas: Earth and Human Activity**

The presenters were Susan Buhr Sullivan, Director of the CIRES Education and Outreach Group at University of Colorado; and Aida Awad, Science Department Chair at Maine East High School in Park Ridge, IL and president of the National Association of Geoscience Teachers (NAGT). The program featured strategies for teaching about Earth science concepts that answer questions such as "How do humans depend on Earth's resources?" and "How do humans change the planet?"

Dr. Buhr Sullivan began the presentation by describing the interconnections between this disciplinary core idea and other components of *NGSS*. She then talked about building a foundation for key concepts related to Earth and Human Activity at the elementary level. Ms. Awad continued the discussion by sharing the progression of this core idea through the middle school level and on to high school. The presenters provided a list of resources and activities that teachers can use to begin implementing *NGSS* in the classroom.

Visit the resource collection.

Continue discussing this topic in the community forums.

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### Appendix A: NGSS and Foundations for the Unit

**Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.** *[*Assessment Boundary: Assessment is limited to oceans, lakes, rivers, glaciers, ground water, and polar ice caps, and does not include the atmosphere.*]* **(5-ESS2-2)**

**Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. (5-ESS3-1)**

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| **Using Mathematics and Computational Thinking**<br>• Describe and graph quantities such as area and volume to address scientific questions. (5-ESS2-2)<br>**Obtaining, Evaluating, and Communicating Information**<br>• Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. (5-ESS3-1) | **ESS2.C: The Roles of Water in Earth's Surface Processes**<br>• Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere. (5-ESS2-2)<br>**ESS3.C: Human Impacts on Earth Systems**<br>• Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1) | **Scale, Proportion, and Quantity**<br>• Standard units are used to measure and describe physical quantities such as weight and volume. (5-ESS2-2)<br>**Systems and System Models**<br>• A system can be described in terms of its components and their interactions. (5-ESS3-1)<br>- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -<br>***Connections to Nature of Science***<br>**Science Addresses Questions About the Natural and Material World.**<br>• Science findings are limited to questions that can be answered with |

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| | | empirical evidence. (5-ESS3-1) |

| English Language Arts | Mathematics |
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| Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. (5-ESS3-1) **RI.5.1**<br><br>Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. (5-ESS2-2), (5-ESS3-1) **RI.5.7**<br><br>Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-ESS2-2), (5-ESS3-1) **W.5.8**<br><br>Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. (5-ESS3-1) **RI.5.9**<br><br>Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-ESS3-1) **W.5.9**<br><br>Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. (5-ESS2-2) **SL.5.5** | Reason abstractly and quantitatively. (5-ESS2-2), (5-ESS3-1) **MP.2**<br><br>Model with mathematics. (5-ESS2-2), (5-ESS3-1) **MP.4** |

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| Common Vocabulary | |
|---|---|
| Atmosphere | Rock breakage |
| Cycle | Rock composition |
| Earth's surface | Soil color |
| Force | Soil texture |
| Forms of water | Weathering |
| Fresh water glacial movement | Wedge |
| Moisture | Global |
| Properties of soil | Chemical |
| Properties of water | |