Stackable Instructionally-embedded Portable Science (SIPS) Assessments Project

Grade 5 Science

Unit 3 Instructional Framework

Earth Systems and the Solution of Water Problems

January 2023

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Unit 3 Overview

Storyline Synopsis:

This unit consists of four segments, each engaging students in multiple science and engineering practices as students make sense of the key disciplinary ideas of Earth materials and systems, the roles of water in Earth's surface processes, and human impacts on Earth systems.

- **Instructional Segment 1:** By engaging in the practices of obtaining, evaluating, and communicating information, constructing explanations and designing solutions, using mathematical and computational thinking, and asking questions and defining problems, students learn about the distribution of water on Earth and how individual communities use science ideas to protect the Earth's resources and the environment. Students begin the unit by exploring an anchor phenomenon based on a discussion of where a glass of their school's drinking water comes from, particularly how it gets clean and ready to drink. Possible driving questions include, "Where does water go once it goes down the drain?", "Is the water we use for nearby irrigation the same water we drink in the school?", etc. This investigation is revisited in the segment as students learn more about where the glass of school water comes from and compare it to other sources of water on Earth.
- **Instructional Segment 2:** By engaging in the practices of obtaining, evaluating, and communicating information, constructing explanations and designing solutions, and asking questions and defining problems, students are able to explore a local problem, understand the positive and negative impacts of humans on the environment, then use this information to define an engineering problem connected to water in their local community.
- **Instructional Segment 3:** By engaging in the practices of planning and carrying out investigations, constructing explanations and designing solutions, and obtaining, evaluating, and communicating information, students develop and refine a proposed solution to the problem identified in Segment 2. Students develop, evaluate, and revise possible solutions to problems around protecting Earth's resources.
- **Instructional Segment 4:** By engaging in the practices of planning and carrying out investigations, obtaining, evaluating, and communicating information, developing and using models, constructing explanations and designing solutions, and asking questions and defining problems, students learn about the four major Earth systems, create models of those systems and how they interact, and learn about the importance of protecting Earth's resources.

Unit Storyline Framing: *The teacher fills up a glass of water from a source in the school, and then has the students brainstorm about its origin. Potential driving questions that students might generate based on their observations include: What water does our school use? What is the water used for besides drinking? Where does the water go after we wash our hands? Where does the pipe water go? How does the water we drink get cleaned? Where is the pipe that takes the water out of the building? (The teacher may use a map of the pipes in the school to teach where it goes from one room to full water exit for the building.)*

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Stage 1 – Desired Results

Overview of Student Learning Outcomes

The Grade 5 Unit 3 Topic Bundle, **“Earth Systems and the Solution of Water Problems,”** organizes performance expectations with a focus on the interconnectedness of how different Earth systems interact with each other and how water plays an important role for each of the four Earth systems, especially the biosphere. In this unit, there is a significant overlap and synergy between the DCI and CCC dimensions, where system models are used to identify interacting Earth spheres. Similarly, the SEPs allow students to define problems, design solutions, and obtain information that is useful in conserving Earth’s resources. By building familiarity with previous Unit 2 ideas related to matter and energy in organisms and ecosystems, Unit 3 allows students to use and extend this knowledge to water as it cycles through the Earth. Unit 3 focuses on problem solving around human impacts on Earth’s systems.

Unit 3 Big Ideas:

ESS2.A: Earth Materials and Systems	1. Earth’s four systems (i.e., geosphere, hydrosphere, biosphere, and atmosphere) interact with each other and changes in one system can cause changes to other systems. (5-ESS2-1)
ESS2.C: The Roles of Water in Earth’s Surface Processes	2. Nearly all of Earth’s water is salt water and is present in the ocean, while the largest freshwater sources are glaciers and underground water. (5-ESS2-2)
ETS1.A: Defining and Delimiting Engineering Problems **ETS1.B: Developing Possible Solutions**	3. Solutions to a design problem require research and consideration of the criteria for success and constraints in terms of likely outcomes given available materials and resources. (3-5-ETS1-1 & 3-5-ETS1-2)
ESS3.C: Human Impacts on Earth Systems **ETS1.C: Optimizing the Design Solution**	4. Human activities such as agriculture and industry have had major effects on Earth’s systems (e.g., land, vegetation, water sources), but some negative effects of human activities are reversible with responsible management informed by points of failure and improvement of design solutions to enable identification of the optimal solution. (5-ESS3-1 & 3-5-ETS1-3)

The SIPS Unit 3 Student Profile describes what students should know and be able to demonstrate prior to and at the culmination of three-dimensional science instruction in Unit 3 to prepare for new and increasingly sophisticated learning opportunities in Unit 4.

Next Generation Science Standards (NGSS) Performance Expectations & Foundation Boxes

5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. [Clarification Statement: Examples could include the influence of the ocean on ecosystems, landform shape, and climate; the influence of the atmosphere on landforms and ecosystems through weather and climate; and the influence of mountain ranges on winds and clouds in the atmosphere. The geosphere, hydrosphere, atmosphere, and biosphere are each a system.] [Assessment Boundary: Assessment is limited to the interactions of two systems at a time.]

5-ESS2-2. Describe and graph the amounts of salt 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, groundwater, and polar ice caps, and does not include the atmosphere.]

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

3-5-ETS1-1. Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.

3-5-ETS1-3. Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

Targeted Scientific Practices	Targeted Disciplinary Core Ideas	Targeted Cross-Cutting Concepts
[SEP-2] Developing and Using Models • Develop a model using an example to describe a scientific principle. **(5-ESS2-1)** **[SEP-5] Using Mathematics and Computational Thinking** • Describe and graph quantities such as area and volume to address scientific questions. **(5-ESS2-2)** **[SEP-8] Obtaining, Evaluating, and Communicating Information** • Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem. **(5-ESS3-1)** **[SEP-1] Asking Questions and Defining Problems** Asking questions and defining problems in 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. **(3-5-ETS1-1)** **[SEP-6] Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 3–5 builds on	**ESS2.A: Earth Materials and Systems** • Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather. **(5-ESS2-1)** **ESS2.C: The Roles of Water in Earth's Surface Processes** • 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)** **ESS3.C: Human Impacts on Earth Systems** • 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	**[CCC-4] Systems and System Models** • A system can be described in terms of its components and their interactions. **(5-ESS2-1) (5-ESS3-1)** **[CCC-3] Scale, Proportion, and Quantity** • Standard units are used to measure and describe physical quantities such as weight and volume. **(5-ESS2-2)** ***Influence of Science, Engineering, and Technology on Society and the Natural World*** • People's needs and wants change over time, as do their demands for new and improved technologies. **(3-5-ETS1-1)** • Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. **(3-5-ETS1-2)**

K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems. • Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. **(3-5-ETS1-2)** **[SEP-3] Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. **(3-5-ETS1-3)**	Earth's resources and environments. **(5-ESS3-1)** **ETS1.A: Defining and Delimiting Engineering Problems** • Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. **(3-5-ETS1-1)** **ETS1.B: Developing Possible Solutions** • Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. **(3-5-ETS1-2)** • At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. **(3-5-ETS1-2)** • Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **(3-5-ETS1-3)** **ETS1.C: Optimizing the Design Solution** • Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints. **(3-5-ETS1-3)**	

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Acquisition Goals
Acquisition Goals are multi-dimensional knowledge-in-use statements that integrate aspects of the NGSS dimensions (SEP & DCI or SEP & DCI & CCC) but are smaller in breadth than a performance expectation. Acquisition Goals describe the essential concepts and key skills a student must acquire to obtain mastery of the unit's objectives and emphasize student understanding as rooted in engagement with the science and engineering practices and not in memorization of science facts. The acquisition goals intentionally include SEP and CCC from outside of the unit's PE bundle. ***Students will know and be able to . . .*** **A1.** Use mathematics to describe and graph quantities about the distribution of water on Earth. **A2.** Obtain information from multiple sources to communicate information about the distribution of water on Earth to illustrate that nearly all of Earth's available water is in the ocean. **A3.** Obtain information from multiple sources to communicate information about the sources and distribution of fresh water on Earth to illustrate that nearly all of Earth's available freshwater reserves are glaciers and groundwater. **A4.** Construct an explanation using evidence on what are the largest sources of fresh water on Earth. **A5.** Define the problem provided to them in ways that specify criteria for success and the nature of the resources and materials that will be used in solving the problem. **A6.** Use information on available resources, materials, and prior design ideas to support the elements of their design. **A7.** Present the definition of the problem in the form of a system model that documents how a possible solution will address the given problem using available resources and addressing possible constraints. **A8.** Specify a design that provides a solution to a given problem, indicating the way resources and materials will support meeting the design criteria and addressing constraints. **A9.** Obtain information from multiple sources to communicate information about the elements of the four major systems of the Earth. **A10.** Develop a model to describe the relationship between two Earth's systems under study. **A11.** Construct an explanation on the cause-and-effect relationship between two interacting systems to address how changes in one system can cause changes in another interacting system. **A12.** Use a model to describe the four major systems of the Earth. **A13.** Construct an explanation to address a problem/challenge by using data on the interaction of two of Earth's systems under study. **A14.** Obtain and evaluate information from a variety of sources as the basis for claims about the positive or negative impact of human activities on Earth's systems. **A15.** Design and carry out an investigation to characterize the impact of human activities on a particular design solution. **A16.** Modify a design solution using information on the impact of human activities on the outcome of the solution, including specifying the way that the human activities can be reversed or addressed. **A17.** Design investigations where different conditions are considered relative to the outcomes that are important for a design solution. **A18.** Use information from available tests as the basis for deciding how a particular solution meets constraints and success criteria and how this can be used to choose an optimal solution. **A19.** Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. [5-ESS2-1]

A20. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. [5-ESS3-1] **A21.** Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. [3-5-ETS1-2] **A22.** Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. [3-5-ETS1-3]
Cross-curricular Integration
Students deepen their knowledge about the impact of human activities on the Earth's resources. They also learn about Earth's four spheres and how they interact. Students develop these understandings by using system models, building, and revising design solutions, and analyzing and defining problems related to Earth's four interacting spheres and how its resources can be used. Students will use reading and research skills to **acquire new information** and to **draw on** and **integrate information** from **multiple sources**. Students will also use mathematical concepts related to **measurement and data** to explain phenomena or create solutions to design problems.

Common Core State Standards for Literacy	Common Core State Standards for Mathematics
Reading Informational Text **RI.5.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text. **(5-ESS3-1) (3-5-ETS1-2)** **RI.5.7** 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-ESS2-1) (5-ESS2-2) (5-ESS3-1) (3-5-ETS1-2)** **RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably. **(5-ESS3-1) (3-5-ETS1-2)** ***Speaking and Listening*** **SL.5.5** Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes. **(5-ESS2-1) (5-ESS2-2)** ***Writing*** **W.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. **(3-5-ETS1-1) (3-5-ETS1-3)** **W.5.8** 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	***Mathematical Practice*** **MP.2** Reason abstractly and quantitatively. **(5-ESS2-1) (5-ESS2-2) (5-ESS3-1) (3-5-ETS1-1) (3-5-ETS1-2) (3-5-ETS1-3)** **MP.4** Model with mathematics**. (5-ESS2-1) (3-5-ETS1-1) (3-5-ETS1-2) (3-5-ETS1-3)** **MP.5** Use appropriate tools strategically. **(5-ESS2-2) (5-ESS3-1) (3-5-ETS1-1) (3-5-ETS1-2) (3-5-ETS1-3)** ***Operations & Algebraic Thinking*** **3-5.OA** Represent and solve problems involving multiplication and division; Understand properties of multiplication and the relationship between multiplication and division; Multiply and divide within 100; Solve problems involving the four operations and identify and explain patterns in arithmetic. **(3-5-ETS1-1) (3-5-ETS1-2)** ***Geometry*** **5.G.A.2** Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane and interpret coordinate values of points in the context of the situation. **(5-ESS2-1)**

sources. **(5-ESS2-2) (5-ESS3-1) (3-5-ETS1-1) (3-5-ETS1-3)** **W.5.9** Draw evidence from literary or informational texts to support analysis, reflection, and research. **(5-ESS3-1) (3-5-ETS1-1) (3-5-ETS1-3)**	
Enduring Understandings	***Essential Questions***
Students will understand that . . . **EU1.** Earth's four systems interact in multiple ways to affect Earth's surface materials and processes. **EU2.** Human activities in agriculture, industry, and everyday life have major effects on the land, vegetation, streams, ocean, air, and even outer space. **EU3.** Individuals and their communities can use science ideas to protect the Earth's resources and environment. **EU4.** Scientists and engineers determine if a solution to a problem is successful by testing the solution under a range of conditions to see if it meets specified criteria and to identify failure points or difficulties, which suggest the elements of the design that need to be improved. **EU5.** Scientists and engineers can test multiple solutions and share ideas with peers to help improve their designs.	**EQ1.** How can one Earth system affect another? **EQ2.** What major effects do human activities, including our everyday actions, have on Earth's systems? **EQ3.** What actions can individuals and communities take to protect Earth's resources and environment? **EQ4.** How do I measure and test the success of a solution to a problem? **EQ5.** How do we improve on the design?

Vocabulary		
• Iterate	• Design	• Snowpack
• Resource	• Engineer	• Salt water
• System	• Hydrosphere	• Groundwater
• Earth surface	• Geosphere	• Landforms
• Reservoir	• Biosphere	• Physical vs. biotic environment
• Aquifer	• Atmosphere	• Agriculture
• Water resources	• Fresh water	• Industry
• Human impact criteria	• Glaciers	• Interaction
• Sedimentation	• Icebergs	• Filter
• Particles	• Purification	• Chemicals
• Impurities	• Absorbed	

Stage 2 – Assessment Evidence

Assessment Overview

For each of the acquisition goals listed in the Stage 1 - Desired Results, evidence statements were developed. These statements provide information about what we would expect students to do in order to determine the degree to which students have met the acquisition goals. These acquisition goals and evidence statements were then sequenced into instructional segments. Evidence statements and acquisition goals that were deemed critical were identified and assessment opportunities were developed. For this unit, four instructional segments were identified. An overview of each segment is provided below.

Instructional Segment 1 focuses on Big Idea 2 which has students obtaining and evaluating information, using mathematics and computational thinking, and constructing explanations about where and how much salt water and fresh water are present on Earth, where local fresh water comes from, and what happens when water is used locally. Students are informally assessed on their ability to use mathematics to describe where water comes from and to obtain information about freshwater reserves. Students are formally assessed on obtaining information about fresh and saltwater reserves and using mathematics and representations to show the distribution of water on Earth.

Instructional Segment 2 focuses on Big Idea 3 and introduces Big Idea 4 which have students defining problems and beginning to design solutions for a local water problem that involves the protection and preservation of the water resource. Students explore how humans interact with the environment and consider how their solution can positively impact the environment. Students explore the problem in depth through a series of activities while refining their solution to the problem. Students are informally assessed on their definition of the problem, the use of design constraints, and their description of a design. Students are formally assessed on the definition of problems, constraints, and how their solution addresses both real life and fictional problems and on the identification of human impacts on the local ecosystem.

Instructional Segment 3 focuses on Big Ideas 3 and 4 which have students designing solutions, evaluating, and refining those solutions, and communicating information about their solutions for a local water problem while considering the impacts of humans on the environment. Students develop, refine, test, revise, and then present their solutions to the class. Students are informally assessed on their understanding of the impact of humans on the environment. Students are formally assessed on their design of solutions for the engineering problem.

Instructional Segment 4 focuses on Big Idea 1 which has students obtaining and evaluating information, developing, and using models, analyzing, and interpreting data, and constructing explanations on the interaction of the different spheres of Earth. Students are informally assessed on identifying information and using models on the interaction of Earth's spheres. Students are formally assessed on supporting claims on how human activities impact all four spheres of Earth, and on identifying information and explaining how the spheres of Earth interact.

End-of-Unit Stackable, Instructionally-embedded, Portable Science (SIPS) Assessment:

For the end-of-unit SIPS assessment, students engage in three scenario-based assessment tasks. The tasks focus on the PEs: 5-ESS2-1, 5-ESS2-2, 5-ESS3-1, 3-5-ETS1-1, 3-5-ETS1-2, 3-5-ETS1-3.

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Instructionally-Embedded Assessments
For each instructional segment, descriptions of *informal* and *formal* instructionally-embedded assessments are included based on the acquisition goals and evidence statements deemed critical to assess along an instructional plan. Informal assessments defined as "in the moment" assessment opportunities identify student challenges and lack of knowledge or misconceptions and could include class check-ins such as discussion prompts, exit tickets, or graphic organizers. Formal assessments measure how well students perform when engaging with more complex tasks that require integration of the dimensions (SEPs, DCIs, CCCs) in the service of sense-making. They are administered at specific, intentional points in time along an instructional plan before or after a lesson or a series of lessons. Examples include performance tasks, concept maps, research projects, or hands-on tasks.

Instructionally-embedded Assessments for Use during Instructional Segment 1

Informal Assessment: A Globe Full of Water

Students use small squares of paper to cover oceans and land in squares that are different colors. Students then count the squares of each color (land and water) to calculate the approximate surface area of water and land on Earth. Encourage students to use different sized squares, potentially providing suggested sizes (sizes should be appropriate for the size of the globe). Encourage students to find solutions to uneven coast lines and seas. Students should present their findings in four different ways, a table, a graph, text, and one other way that makes sense to them. After students share their findings, encourage a conversation where they consider why the results may be different between different students and different groups.

Note: If multiple globes are not available, this activity could be done as part of a center/station activity or whole group activity. Avoid using flat/paper maps as there will be distortions in sizes due to the map projection.

Assessment Purpose and Use

- These informal assessments are typically used for formative purposes. The goal is to gauge where students are in their learning, identify what challenges students are facing, and determine next steps for the class and/or individual students. The assessments provide information that can be used either at the class level or the individual student level to help determine what instructional activities will best support the students.
- This assessment should be used at the start of the lesson, *A Globe Full of Water*.

Administration Time: 30-45 minutes

Scoring Time: 15 minutes

Assessment Type(s)

Informal - Classroom Check-In

Assessment Sub-Type(s)

Hands-on Task

Graphic Organizers

This assessment will assess students' ability to:

- Use mathematics to describe the distribution of water on Earth.
- Generate a graph that shows the distribution of water on Earth.

Stage 1 & Stage 3 Associations:

Stage 3 Connection(s):	NGSS PEs:	CCSS:	EUs/EQs:	AGs:
• A Globe Full of Water	5-ESS2-2	MP.2	EU1/EQ1	A1

	MP.4	A2*
	3-5.OA	
	5.G.A.2	

Formal Assessment: Where's the Water?

Using multiple sources (e.g., websites, books, guest speaker, videos), students gather information to support where water is located and answer the question, "Where do we get the water we need?". Students use a graphic organizer to help organize their information. The teacher provides opportunities for students to share information with their classmates and learn from each other as they gather and organize their information.

Assessment Purpose and Use

- Students are provided with (or pick out) a specific research topic and are asked to explore this topic. The purpose is to provide an opportunity for the students to apply their knowledge to a particular question, or to demonstrate their ability to research a specific topic. It allows them to demonstrate how they would apply concepts over an extended period of time.
- Teachers can use this assessment to determine how much support students might need in obtaining and communicating information for future tasks.

Administration Time: 2 class periods

Scoring Time: 15 minutes

Assessment Type(s)

Formal - Research Project

Assessment Sub-Type(s)

Research Report

Graphic Organizers

This assessment will assess students' ability to:

- Obtain information that supports the statement that most of Earth's available water is in the ocean as salt water, with very little in freshwater reserves.
- Obtain information that supports the statement that most of Earth's available freshwater reserves are in glaciers and groundwater.
- Use a graphic organizer to sort multiple pieces of information into categories about salt water and fresh water.
- Use mathematics to describe the distribution of water on Earth.
- Generate a graph that shows the distribution of water on Earth.
- Identify information from multiple sources that supports the argument that nearly all of Earth's available water is in the ocean.
- Provide support for the statement that nearly all of Earth's available water is in the ocean, based on multiple sources of information.
- Identify information from multiple sources that supports the argument that nearly all of Earth's available freshwater reserves are glaciers and groundwater.
- Provide support for the statement that nearly all of Earth's available freshwater reserves are glaciers and groundwater.

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Stage 1 & Stage 3 Associations:

Stage 3 Connection(s):	NGSS PEs:	CCSS:	EUs/EQs:	AGs:
• Where Does Your Glass of Water Come From and Where Does it Go? • A Globe Full of Water • Water in the Snow, Glaciers, and Underground • Our Glass of Water	5-ESS2-2	RI.5.7 RI.5.9 W.5.7 W.5.8	EU1/EQ1	A1 A2 A3

Formal Assessment: Fresh Water by the Numbers

Students gather data from multiple sources about the global volume of freshwater reserves such as groundwater, glaciers, wetlands, lakes, and rivers, and then graph the data. Students create multiple representations to communicate the data about fresh water (e.g., a drawing, computer graphics, drop(s) diagrams, etc.). Last, students add a representation of the glass of water (from the Unit Entrance/Hook) to connect the glass of water to the larger global water distribution.

Assessment Purpose and Use

- Students are provided with (or pick out) a specific research topic and asked to explore this topic. The purpose is to provide an opportunity for the students to apply their knowledge to a particular question, or to demonstrate their ability to research a specific topic. It allows them to demonstrate how they would apply concepts over an extended period of time.
- Teachers can use this to determine aspects they may want to revisit when talking about the different spheres.

Administration Time: 50 minutes

Scoring Time: 15 minutes

Assessment Type(s)

Formal - Research Project

Assessment Sub-Type(s)

Research Report

Graphic Organizers

Sample Formal Assessment Task: "Fresh Water by the Numbers"

This assessment will assess students' ability to:

- Obtain information that supports a model that most of Earth's available freshwater reserves are in glaciers and groundwater.
- Generate representations that show the sources of Earth's fresh water.
- Use mathematics to describe the distribution of water on Earth.

Stage 1 & Stage 3 Associations:

Stage 3 Connection(s):	NGSS PEs:	CCSS:	EUs/EQs:	AGs:
• A Globe Full of Water	5-ESS2-2	RI.5.7 W.5.7 W.5.8	EU1/EQ1	A1 A3

Instructionally-embedded Assessments for Use during Instructional Segment 2

Informal Assessment: Let's Share

[1]Students tackle an engineering challenge and solve a real problem in gardening and agriculture: A field has three different soil types (sand, silt, and clay) that retain water at different rates. A farmer needs to water the field by supplying the ideal amount of water to each soil type. Can you construct a device that will vary the rate of water flow to different parts of the field suitable for each soil type? Students are tasked to share a given amount of water that is poured into one cup with three additional cups. The goal is to build a system to divide 16oz of water into three cups with 2 oz., 6 oz., and 8 oz. of water in each to reflect the exact needs of each soil type. The system requires that water is only poured into the initial cup.

- Determine criteria and constraints.
- Describe the materials available and the amount of time students have to work.
- Provide cups marked with lines to denote 2oz, 6oz, and 8oz.
- Provide access to a 16 oz. water bottle, 3 cups, scissors, and a choice of straws and other construction materials to each group.
- For an extra challenge, students can be given a fictional price list and challenged to create the least expensive system possible.
- Brainstorm solutions: during this time, students should be able to sketch their ideas, explore potential materials, and discuss ideas with one another.
- Remind students to accept all ideas enthusiastically at this stage! Don't rule any idea out just yet. Practice being accepting of all ideas by saying "Yes, and…" instead of "Yes, but…" or outright saying "No".
- Create a prototype and test the design at least once.

Assessment Purpose and Use

- These informal assessments are typically used for formative purposes. The goal is to gauge where students are in their learning, identify what challenges students are facing, and determine next steps for the class and/or individual students. The assessments provide information that can be used either at the class level or the individual student level to help determine what instructional activities will best support the students.
- This task can help determine how well students can address constraints. It can provide information on what challenges students have when designing

Administration Time: 45 minutes

Scoring Time: 5 minutes (observation)

Assessment Type(s)

Informal - Classroom Check-In

Assessment Sub-Type(s)

In-the-moment Questions

Discussion prompts

[1] Found at https://agclassroom.org/matrix/lesson/513/]. National Agricultural Literacy Curriculum Matrix (2013) is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License. Although this assessment was originally intended for middle school students, it can be adapted and used at grade 5 by focusing on the qualitative aspects of the investigation rather than quantitative.

solutions and inform how to modify instruction to help students address these challenges.

This assessment will assess students' ability to:

- Identify how elements of a design are supported by information from available resources, materials, and/or prior design ideas.
- Use information from available resources, materials, and prior designs to explain how elements of a design meet given criteria.
- Describe the constraints of a problem, including criteria for success, and available resources and materials for solving problems.
- Describe a design for a solution to a problem.
- Describe how a solution to a problem addresses constraints of a problem.
- Describe how resources and materials support the design of a solution.

Stage 1 & Stage 3 Associations:

Stage 3 Connection(s):	NGSS PEs:	CCSS:	EUs/EQs:	AGs:
• Water, Water Everywhere and Not a Drop to Drink • Can You Catch the Water?	3-5-ETS-1	MP2	EU4/EQ4	A5 A6 A8

Formal Assessment: Engineering Challenge–Clean Water on the Trail

The teacher introduces the assessment by explaining the problem: a hiker is in the woods without water and needs to filter dirty local water to be safe for drinking. Students define the problem and constraints, and then use the materials list provided to design and create a design idea for the problem. If the teacher has access to the materials, students could build, test, and then refine their design.

Assessment Purpose and Use

- Performance tasks generally provide opportunities for students to engage with the practices of the discipline along with the content. This task is used to measure how well students perform when provided with a complex task and an opportunity to engage in a meaningful way with the content in the curriculum.
- This task can help identify student understanding of a problem, demonstrate their understanding of key vocabulary, and determine their ability to write step-by-step instructions for success.
- This task can help to determine how much support students will need in later design tasks.

Administration Time: 45 minutes

Scoring Time: 10 minutes (observation)

Assessment Type(s)

Formal - Short Performance Task

Assessment Sub-Type(s)

Hands-on Task

Design Project

Scenario/Phenomena-based Assessment Task

Sample Formal Assessment Task: "Clean Water on the Trail"

This assessment will assess students' ability to:

- Identify how elements of a design are supported by information from available resources, materials and/or prior design ideas.
- Describe the constraints of a problem, including criteria for success, and available resources and materials for solving problems.
- Describe a design for a solution to a problem.
- Describe how resources and materials support the design of a problem.
- Describe how a solution to a problem addresses constraints of a problem.

Stage 1 & Stage 3 Associations:

Stage 3 Connection(s):	NGSS PEs:	CCSS:	EUs/EQs:	AGs:
• Water, Water, Everywhere and Not a Drop to Drink • You Are What You Drink	3-5-ETS-1	MP2	EU4/EQ4	A5 A6 A7 A8

Formal Assessment: Let's Get Serious: Can We Solve Real Life Problems?

Can students use what they have learned about the design process to solve a real-life problem affecting their community? Students take time to evaluate their community and identify potential sources of water waste and then work to design a solution to limit water waste. Alternatively, students design ways to address a problem relating to the community and/or family such as designing either a clean water source or finding a new water source, depending on the hypothetical family scenarios. Students also explain/communicate their design by creating a system model to show how it will solve the problem.

Resources for Design Activity:

- Designing Ways to Get and Clean Water - Activity - TeachEngineering
  [https://www.teachengineering.org/activities/view/cub_earth_lesson3_activity1]
- Water Filtration DIY | Generation Genius
  [https://www.generationgenius.com/activities/water-quality-and-distribution-activity-for-kids/]
- Student Project: Make a Water Filter | NASA/JPL Edu
  [https://www.jpl.nasa.gov/edu/learn/project/make-a-water-filter/]

Assessment Purpose and Use

- Performance tasks generally provide opportunities for students to engage with the practices of the discipline along with the content. This task is used to measure how well students perform when provided with a complex task and an opportunity to engage in a meaningful way with the content in the curriculum.
- This task can help to identify challenges students have with designing solutions to real-world problems.

Administration Time: 60 minutes

Scoring Time: 30 minutes (observation)

Assessment Type(s)

Formal - Extended Performance Task

Assessment Sub-Type(s)

Scenario/Phenomena-based Assessment Task

Extended Project

Other

Science
Grade: 5 Unit: 3
20 days of instruction

This assessment will assess students' ability to:

- Identify how elements of a design are supported by information from available resources, materials, and/or prior design ideas.
- Use information from available resources, materials, and prior designs to explain how elements of a design meet given criteria.
- Develop a model that shows a design problem system.
- Develop a model that shows how a solution can address a design problem.
- Describe the constraints of a problem, including criteria for success, and available resources and materials for solving problems.
- Use a model to describe the constraints of a problem and/or solution.
- Describe a design for a solution to a problem.
- Describe how resources and materials support the design of a solution.
- Describe how a solution to a problem addresses constraints of a problem.

Stage 1 & Stage 3 Associations:

Stage 3 Connection(s):	NGSS PEs:	CCSS:	EUs/EQs:	AGs:
• Water, Water, Everywhere and Not a Drop to Drink	3-5-ETS-1	W.5.7	EU4/EQ4	A5
• Well, How Did That Happen?		W.5.8		A6
• You Are What You Drink		W.5.9		A7
• Can You Catch the Water				A8

Formal Assessment: Explaining Impacts of Human Activity

In this task, students obtain and combine information, construct explanations, and engage in argumentation. Students' ability to link evidence to reasons and state a claim is assessed as well. Students are given resources to use and asked to construct an explanation about whether human activity has positive or negative impacts on the Earth system based on these resources. Students use evidence from an investigation on how different solutions address the negative impacts of this activity. Students use that evidence to engage in an argument about how well these solutions work in different conditions.

Assessment Purpose and Use

- Performance tasks generally provide opportunities for students to engage with the practices of the discipline along with the content. This task is used to measure how well students perform when provided with a complex task and an opportunity to engage in a meaningful way with the content in the curriculum.

Administration Time: 20-30 minutes

Scoring Time: 20-30 minutes

Assessment Type(s)

Formal - Short Performance Task

Assessment Sub-Type(s)

Scenario/Phenomena-based Assessment Task

These assessments will assess students' ability to:

- Identify information from one or more sources that relate to how human activities affect the Earth system.

- Evaluate information to determine whether or not the information supports claims for how human activities impact the Earth system.
- Describe how human activities impact Earth system(s) based on information found from a variety of resources.
- Modify a design solution to reduce the negative effect of human activities on a solution.
- Describe how a design activity can help address or reverse negative effects of human activities.
- Obtain and combine information from books and other reliable media about:
  - How a given human activity (e.g., in agriculture, industry, everyday life) affects the Earth's resources and environments.
  - How individual communities can use scientific ideas and a scientific understanding of interactions between components of environmental systems to protect a natural resource and the environment in which the resource is found.
- Use scientific knowledge to generate design solutions.
- Describe criteria and constraints, including quantification when appropriate.
- Evaluate potential solutions.

Stage 1 & Stage 3 Associations:

Stage 3 Connection(s):

- You Are What You Drink
- Can You Catch the Water
- Nature Impact

NGSS PEs:	CCSS:	EUs/EQs:	AGs:
5-ESS3-1	RI.5.1	EU2/EQ2	A14
3-5-ETS1-2	RI.5.7	EU3/EQ3	A15*
	RI.5.9	EU4/EQ4	A16
	W.5.7		A20
	W.5.8		A21
	W.5.9		

Instructionally embedded Assessments for Use during Instructional Segment 3

Informal Assessment: Class Discussions

Throughout this segment, the teacher can use informal classroom check-ins (e.g., exit tickets, discussion prompts, or in-the-moment questions) to get a sense of whether students understand the key disciplinary concepts and can apply them while engaging in the SEPs (as outlined by the evidence statements). Teachers can use quick "in-the-moment" questions to check how well students are able to describe and use models and investigations related to Earth's systems and the effects of human activity on such systems.

Assessment Purpose and Use

- These informal assessments are typically used for formative purposes. The goal is to gauge where students are in their learning, identify what challenges students are facing, and determine next steps for the class and/or individual students. The assessments provide information that can be used either at the class level or the individual student

Administration Time: 5-15 minutes

Scoring Time: 5-10 minutes

Assessment Type(s)

Informal - Classroom Check-In

Assessment Sub-Type(s)

In-the-moment Questions

level to help determine what instructional activities will best support the students.

Exit Tickets
Graphic Organizers
Discussion prompts

These assessments will assess students' ability to:

- Identify information from one or more sources that relate to how human activities affect the Earth system.
- Evaluate information to determine whether or not the information supports claims for how human activities impact the Earth system.
- Describe how human activities impact Earth system(s) based on information found from a variety of resources.
- Modify a design solution to reduce the negative effect of human activities on a solution.
- Obtain and combine information from books and other reliable media about:
  - How a given human activity (e.g., in agriculture, industry, everyday life) affects the Earth's resources and environments.
  - How individual communities can use scientific ideas and a scientific understanding of interactions between components of environmental systems to protect a natural resource and the environment in which the resource is found.
- Use scientific knowledge to generate design solutions.
- Describe criteria and constraints of the design solution, including quantification when appropriate.
- Evaluate potential solutions to the design problem.
- Describe the purpose of the investigation, which includes finding possible failure points or difficulties to identify aspects of a model or prototype that can be improved.
- Describe the evidence to be collected, including how the design prototype performs against given criteria and constraints.
- Describe how the evidence is relevant to the purpose of the investigation.
- Create a plan for the investigation that describes different tests for each aspect of the criteria and constraints.
- Carry out the investigation, collecting and recording data according to the developed plan.

Stage 1 & Stage 3 Associations:

Stage 3 Connection(s):

- Nature Impact (Segment 2)
- Investigating Efficacy of Design Solutions

NGSS PEs:	CCSS:	EUs/EQs:	AGs:
5-ESS3-1	RI.5.7	EU2/EQ2	A14
3-5-ETS1-2	RI.5.9	EU3/EQ3	A15*
3-5-ETS1-3	W.5.8	EU4/EQ4	A16
	W.5.9		A20
			A21
			A22

Informal Assessment: Groundwater on the Move

Students use a clear plastic soda bottle or a glass beaker with aquarium gravel or sand with a pump to model groundwater withdrawal. Students fill the container with gravel/sand and add blue-colored water. Students should draw a diagram of the model and add labels identifying what each part of the model is and what it represents in the environment. If possible, the teacher provides students with several different pumps to experiment with, varying the volume drawn and the length of the pump. Students then pump out the water so they can see the movement of water as it leaves the Earth/ground. Students observe the setup and water being pumped out of the groundwater. Students record their thoughts, observations, drawings of stages, predictions, and questions that they have.

Assessment Purpose and Use

- These informal assessments are typically used for formative purposes. The goal is to gauge where students are in their learning, identify what challenges students are facing, and determine next steps for the class and/or individual students. The assessments provide information that can be used either at the class level or the individual student level to help determine what instructional activities will best support the students.
- Teachers can use this assessment to determine how much support students might need for organizing their information and making predictions in future activities.

Administration Time: 30-45 minutes

Scoring Time: 30 minutes

Assessment Type(s)

Informal - Classroom Check-In

Assessment Sub-Type(s)

Discussion prompts

In-the-moment Questions

This assessment will assess students' ability to:

- Identify how elements of a design are supported by information from available resources, materials, and/or prior design ideas.
- Use information from available resources, materials, and prior designs to explain how elements of a design meets given criteria.

Stage 1 & Stage 3 Associations:

Stage 3 Connection(s):	NGSS PEs:	CCSS:	EUs/EQs:	AGs:
• Well, How Did That Happen?	5-ESS2-2	RI.5.7	EU1/EQ1	A5*
		RI.5.8		A6
				A7*
				A8*

Formal Assessment: Wrench in the Plans

In this task, students pick a design solution and determine how humans have made an impact on this design. Students first pick a design solution and then investigate how human activity has impacted this solution. Students then modify the design to reduce negative effects of human activities, and then carry out an investigation to look at how well their modifications worked depending on different conditions.

Assessment Purpose and Use

Administration Time: 90-120 minutes

- Performance tasks generally provide opportunities for students to engage with the practices of the discipline along with the content. This task is used to measure how well students perform when provided with a complex task and an opportunity to engage in a meaningful way with the content in the curriculum.
- This task can help identify how well students can consider human impacts and generate ideas for how to modify the solutions.

Scoring Time: 30-40 minutes

Assessment Type(s)

Formal - Extended Performance Task

Assessment Sub-Type(s)

Design Project

These assessments will assess students' ability to:

- Modify a design solution to reduce the negative effect of human activities on a solution.
- Describe how a design activity can help address or reverse negative effects of human activities.
- Describe how an investigation can be used to determine how different conditions may affect the outcomes of a design solution.
- Carry out aspects of an investigation for determining how different conditions affect the outcomes of a design solution.
- Draw a conclusion based on an investigation about how different conditions affect the outcomes of a design solution.
- Determine how a solution meets the success criteria and/or constraints of a problem.
- Compare multiple design solutions, using information from available tests, to determine which solution is more optimal.
- Use scientific knowledge to generate design solutions.
- Describe criteria and constraints, including quantification when appropriate.
- Evaluate potential solutions.
- Describe the purpose of the investigation, which includes finding possible failure points or difficulties to identify aspects of a model or prototype that can be improved.
- Describe the evidence to be collected, including how the design prototype performs against given criteria and constraints.
- Describe how the evidence is relevant to the purpose of the investigation.
- Create a plan for the investigation that describes different tests for each aspect of the criteria and constraints.
- Carry out the investigation, collecting and recording data according to the developed plan.

Stage 1 & Stage 3 Associations:

Stage 3 Connection(s):

- Investigating Efficacy of Design Solutions
- Evaluating Design and Preparing Presentations

NGSS PEs:	CCSS:	EUs/EQs:	AGs:
5-ESS3-1	W.5.7	EU2/EQ2	A16
3-5-ETS1-1		EU3/EQ3	A17
3-5-ETS1-2		EU4/EQ4	A18
3-5-ETS1-3		EU5/EQ5	A21

A22

Formal Assessment: How Did Our Design Do?

Students take their design solution for water conservation (or other identified community problem earlier) and create a presentation that focuses on how well their designs met the criteria and constraints of the problem the solution is addressing.

Assessment Purpose and Use

- Performance tasks generally provide opportunities for students to engage with the practices of the discipline along with the content. This task is used to measure how well students perform when provided with a complex task and an opportunity to engage in a meaningful way with the content in the curriculum.
- This task can help determine how well students can assess their own designs and communicate their assessment.

Administration Time: 30-45 minutes

Scoring Time: 90 minutes

Assessment Type(s)

Formal - Extended Performance Task

Assessment Sub-Type(s)

Design Project

Research Report

These assessments will assess students' ability to:

- Develop a model that shows a design problem in a system.
- Develop a model that shows how a solution can address a design problem.
- Use a model to describe the constraints of a problem and/or solution.
- Describe a design of a solution to a problem.
- Describe how resources and materials support the design of a solution.
- Describe how a solution to a problem addresses constraints to a problem.
- Determine how a solution meets the success criteria and/or constraints of a problem.
- Compare solutions, using information from available tests, to determine which solution is more optimal.
- Describe how a phenomena or design solution addresses an effect of human activities on the environment, based on information found from multiple sources.
- Describe the purpose of the investigation, which includes finding possible failure points or difficulties to identify aspects of a model or prototype that can be improved.
- Describe the evidence to be collected, including how the design prototype performs against given criteria and constraints.
- Describe how the evidence is relevant to the purpose of the investigation.
- Create a plan for the investigation that describes different tests for each aspect of the criteria and constraints.
- Carry out the investigation, collecting and recording data according to the developed plan.

Stage 1 & Stage 3 Associations:

Stage 3 Connection(s):	NGSS PEs:	CCSS:	EUs/EQs:	AGs:

- Investigating Efficacy of Design Solutions
- Evaluating Design and Preparing Presentations
- Presentation Day

3-5-ETS1-1	RI.5.9	EU3/EQ3	A7
3-5-ETS1-2	SL.5.5	EU4/EQ4	A8
3-5-ETS1-3		EU5/EQ5	A18
			A22

Instructionally-embedded Assessments for Use during Instructional Segment 4

Informal Assessment: Earth's Spheres: We Are All Connected!

At various points in time during Segment 4, educators may use informal classroom check-ins (e.g., exit tickets, in-the moment questions) to determine student understanding of Earth's systems and their interactions and how human activities have influenced these interactions.

Assessment Purpose and Use

- These informal assessments are typically used for formative purposes. The goal is to gauge where students are in their learning, identify what challenges students are facing, and determine next steps for the class and/or individual students. The assessments provide information that can be used either at the class level or the individual student level to help determine what instructional activities will best support the students.
- This assessment can be used to determine if students need support when obtaining information, developing their model, and then using that model in an investigation.

Administration Time: 5-15 minutes

Scoring Time: 5-10 minutes

Assessment Type(s)

Informal - Classroom Check-In

Assessment Sub-Type(s)

In-the-moment Questions

Exit Tickets

Graphic Organizers

Discussion prompts

This assessment will assess students' ability to:

- Identify information from one or more sources that relate to elements of four major systems of the Earth.
- Describe aspects of the elements of the four major systems of the Earth as found in different sources.
- Describe relationships and/or interactions between elements of the four major systems of the Earth as found in different sources.
- Describe how a model shows changes in one or more systems.
- Predict how changes in one system will impact another system based on what is shown in a model.
- Develop a model that shows how changes in one system impact another system.
- Describe how a model represents the four major systems of the Earth.
- Describe the relationships between two (or more) Earth's systems shown in a model.
- Develop a model that shows the relationships between two of Earth's systems.
- Identify information that shows how the cause in one system can cause changes in another interacting system.

- Develop a model, using a specific given example of a phenomenon, to describe ways that the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- Identify and describe relationships (interactions) within and between the parts of the Earth systems identified in the model that are relevant to the example.
- Use the model to describe how parts of an individual Earth system:
  - Work together to affect the functioning of that Earth system.
  - Contribute to the functioning of the other relevant Earth system.

Stage 1 & Stage 3 Associations:

Stage 3 Connection(s):

- Explaining our Classifications
- Earth's Spheres in a Terrarium
- Interaction of Earth's Spheres
- Modeling Earth's Systems

NGSS PEs:	CCSS:	EUs/EQs:	AGs:
5-ESS2-1	RI.5.7	EU1/EQ1	A9
	W.5.7		A10
			A12
			A19

Formal Assessment: Where in the Bottle are the Earth's Spheres?

Students view a video entitled, "Interactions of Earth's Spheres," as well as use books from the school's library to research the Earth's spheres to identify the four Earth Systems. They create an "Earth Spheres" presentation about the four Earth systems. Students use the information referenced in their research to describe, illustrate, identify, and explain the four Earth systems, and connect that learning to their terrarium model by answering the following questions:

- What part of the model represents the biosphere?
- What part of the model represents the atmosphere?
- What part of the model represents the geosphere?
- What part of the model represents the hydrosphere?

Video located at [Geosphere, Biosphere, Hydrosphere & Atmosphere | Fun Video For Kids (generationgenius.com)] [https://www.generationgenius.com/videolessons/earths-spheres-video-for-kids/]

Assessment Purpose and Use

- Students are provided with (or pick out) a specific research topic and are asked to explore this topic. The purpose is to provide an opportunity for the students to apply their knowledge to a particular question, or to demonstrate their ability to research a specific topic. It allows them to demonstrate how they would apply concepts over an extended period of time.
- Determine how well students can describe how a model shows the four major systems of Earth. The teacher can use this to determine what additional information students need to learn about the four major Earth systems/spheres and what supports

Administration Time: 40 minutes

Scoring Time: 5-10 minutes

Assessment Type(s)

Formal - Research Project

Assessment Sub-Type(s)

Graphic Organizers

Research Report

students may need for using their terrarium model to represent Earth's systems.

This assessment will assess students' ability to:

- Identify information from one or more sources that relate to elements of four major systems of Earth.
- Describe aspects of the elements of the four major systems of Earth as found in different sources.
- Describe how a model shows the four major systems of Earth.
- Develop a model, using a specific given example of a phenomenon, to describe ways that the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- Identify and describe relationships (interactions) within and between the parts of the Earth systems identified in the model that are relevant to the example.
- Use the model to describe how parts of an individual Earth system:
  - Work together to affect the functioning of that Earth system.
  - Contribute to the functioning of the other relevant Earth system.

Stage 1 & Stage 3 Associations:

Stage 3 Connection(s):	NGSS PEs:	CCSS:	EUs/EQs:	AGs:
• Earth's Spheres in a Terrarium	5-ESS2-1	RI.5.1	EU1/EQ1	A9
• Modeling Earth's Systems		W.5.7		A12
				A19

Formal Assessment: Protecting Earth's Environment!

Students use teacher-provided resources to describe ways in which communities have used science ideas to protect different aspects of the Earth's spheres. The teacher focuses students on a specific problem that occurs with the interaction between two spheres and then students must describe how science idea(s) can help address the problem and protect those spheres. Students identify which of the four spheres are involved and the interactions between these spheres. Students construct an explanation about how a change in one system affects the other system, creating a problem/challenge and/or solution to such challenges for affected communities.

Assessment Purpose and Use

- Performance tasks generally provide opportunities for students to engage with the practices of the discipline along with the content. This task is used to measure how well students perform when provided with a complex task and an opportunity to engage in a meaningful way with the content in the curriculum.

Administration Time: 45 minutes

Scoring Time: 10-15 minutes

Assessment Type(s)

Formal - Extended Performance Task

Assessment Sub-Type(s)

Scenario/Phenomena-based Assessment Task

Research Report

These assessments will assess students' ability to:

- Describe how changes in one system can cause changes in another system.
- Identify information that shows the cause/and effect relationship between two interacting systems.
- Create an explanation for how changes in one system can cause changes in another interacting system.
- Describe how two of Earth's systems interact based on data.
- Identify data and/or information about the interaction of two of Earth's systems under study that is related to a problem or challenge.
- Describe a problem/challenge and explain the cause of this problem/challenge based on data involving the interaction of two of Earth's systems under study.
- Identify information from sources that relates to how a phenomenon or design solution addresses an effect of human activities on the environment.
- Describe how a phenomenon or design solution addresses an effect of human activities on the environment, based on information found from multiple sources.
- Obtain and combine information from books and other reliable media about:
    - How a given human activity (e.g., in agriculture, industry, everyday life) affects the Earth's resources and environments.
    - How individual communities can use scientific ideas and a scientific understanding of interactions between components of environmental systems to protect a natural resource and the environment in which the resource is found.
- Describe the purpose of the investigation, which includes finding possible failure points or difficulties to identify aspects of a model or prototype that can be improved.
- Describe the evidence to be collected, including how the design prototype performs against given criteria and constraints.
- Describe how the evidence is relevant to the purpose of the investigation.
- Create a plan for the investigation that describes different tests for each aspect of the criteria and constraints.
- Carry out the investigation, collecting and recording data according to the developed plan.

Stage 1 & Stage 3 Associations:

Stage 3 Connection(s):	NGSS PEs:	CCSS:	EUs/EQs:	AGs:
• Interaction of Earth's Spheres	5-ESS3-1	RI.5.9	EU1/EQ1	A11
		W.5.8	EU2/EQ2	A13
		W.5.9	EU3/EQ3	A20
				A22

Formal Assessment: Earth's Four Spheres Interaction Challenge

For this last assessment, students are tasked with revisiting both their explanatory model and their engineering solution to identify the different interactions between two spheres in each. Students then create a short reflection piece on how these different spheres of the Earth work as part of both the explanation and the engineering solution. This could be writing, a media creation, or some other method that the teacher and student think is appropriate.

Assessment Purpose and Use

- Performance tasks generally provide opportunities for students to engage with the practices of the discipline along with the content. This task is used to measure how well students perform when provided with a complex task and an opportunity to engage in a meaningful way with the content in the curriculum.

Administration Time: 50 minutes

Scoring Time: 5-10 minutes

Assessment Type(s)

Formal - Short Performance Task

Assessment Sub-Type(s)

Scenario/Phenomena-based Assessment Task

These assessments will assess students' ability to:

- Describe how two of Earth's systems interact based on data.
- Identify data and/or information about the interaction of two of Earth's systems under study related to a problem or challenge.
- Describe a problem/challenge and explain the cause of this problem/challenge based on data involving the interaction of two of Earth's systems under study.

Stage 1 & Stage 3 Associations:

Stage 3 Connection(s):

- Earth's Spheres in a Terrarium
- Interaction of Earth's Spheres

NGSS PEs:	CCSS:	EUs/EQs:	AGs:
5-ESS3-1	SL.5.5	EU1/EQ1	A11*
	W.5.8	EU2/EQ2	A13
	W.5.9	EU3/EQ3	A19*

Guidance for Equitable Assessments for Diverse Learners

How do we optimize accessibility for diverse learners and why is this important? Designing Equitable Assessments for Diverse Learners provides steps to planning and developing equitable assessments that incorporate the principles of Universal Design for Learning (UDL) and the elements of Universally Designed Assessments (UDA). Both UDL and UDA are designed to provide access to instruction and/or assessment to the widest range of students. This includes, but is not limited to, students with varying abilities, cultures, primary languages, background knowledge, and interests. For more information about equitable assessment design and use, and why it is important, view *Chapter 4: Fairness and Accessibility* of the Strengthening Claims-based Interpretations and Uses of Local and Large-scale Science Assessment Scores (SCILLSS) Digital Workbook on Educational Assessment Design and Evaluation: Creating and Evaluating Effective Educational Assessments.

Assessment Resources

Stage 2 Instructionally-embedded Classroom Assessment Resources:

Segment 1

- Earth's Water Globe Activity | Precipitation Education (nasa.gov)
  [https://gpm.nasa.gov/education/interactive/earths-water-globe-activity]
- STEM Lessons for Educators – NASA Jet Propulsion Laboratory Interactive: Animated Water Cycle
  [https://www.jpl.nasa.gov/edu/teach/tag/search/5-ESS2-2]

- Earth's Water | Precipitation Education (nasa.gov) Where's the Water? EarthLabs
  [https://gpm.nasa.gov/education/lesson-plans/earths-water]
- Water Science Questionnaire #3: Water use at home (usgs.gov) Better Lesson: Where do we get Water?
  [https://water.usgs.gov/edu/activity-percapita.html]
- Water Science Questionnaire #3: Water use at home (usgs.gov) Australian Curriculum Elem: Wonder of Water
  [https://water.usgs.gov/edu/activity-percapita.html]
- Groundwater on the Move | Earth Science Week (earthsciweek.org) Groundwater Flow and the Water Cycle
  [https://www.earthsciweek.org/classroom-activities/groundwater-move]
- Australian Curriculum | Wet Rocks
  [https://www.wetrocks.com.au/national-curriculum/2-geography/13-how-groundwater-forms-and-flows]
- Year 4 science: How my water travels (resources.qld.gov.au)Australian Waterwise Curriculum: Making a Groundwater Model
  [Year 4 science: How my water travels (resources.qld.gov.au)]
- Glacier | National Geographic Society
  [https://education.nationalgeographic.org/resource/glacier]
- Explaining Glaciers, Accurately | National Science Teaching Association (nsta.org)Glacier melting in the classroom
  [https://my.nsta.org/resource/?id=10.2505/4/sc09_046_08_21]
- Water distribution on Earth - WikipediaVideo: Show Me the Water by NASA
  [https://en.wikipedia.org/wiki/Water_distribution_on_Earth#Distribution_of_saline_and_fresh_water]
- Infographic: All the Water in the World - Circles of Blue - Circle of Blue
  [https://www.circleofblue.org/2008/world/infographic-alircles-of-blue/]
- USGS Water Science School
  [https://water.usgs.gov/edu/gallery/watercyclekids/earth-water-distribution.html]
- Lesson Plan | Earth's Water: A Drop in Your Cup (calacademy.org)
  [https://www.calacademy.org/educators/lesson-plans/earths-water-a-drop-in-your-cup]
- Water Pie (calacademy.org)
  [https://www.calacademy.org/sites/default/files/assets/docs/pdf/067_earthswateradropinyourcup_revised_redesign.pdf]

Segment 2

Let's Share:

- Each group of 3 students will need: 16 oz bottle of water, 3 plastic cups, a permanent marker, scissors, and straws of assorted sizes (coffee, regular, jumbo). Optional: Other construction materials such as cotton balls, spoons, etc. for variety, paper towels for cleaning up spills, engineering design process diagram, student worksheet or notebook, pencils, or pens.

Problem Solve Our School:

- Problem Solve Your School - Activity - TeachEngineering [https://www.teachengineering.org/activities/view/cub_design_lesson01_activity2]

Let's Get Serious: Can We Solve Real Life Problems?

- Each group needs one large sheet of paper, poster board or chart paper, colored pencils or markers**,** one water scenario from the Family Scenario Note Cards**,** large plastic soda bottles**,** cotton balls, a cup of sand, a cup of rocks/gravel, a cup of activated charcoal, a pair of scissors**,** a plastic cup, and a liter of muddy water (make your own by mixing dirt or mud into water).
- Family Scenario Note Cards (teachengineering.org)
  [https://www.teachengineering.org/content/cub_/activities/cub_earth/cub_earth_lesson3_activity1_family_scenario_notecards.pdf]

Segment 3

Earth's Spheres: We Are All Connected!

- How do I construct a terrarium? | Let's Talk Science (letstalkscience.ca) [https://letstalkscience.ca/educational-resources/hands-on-activities/how-do-i-construct-a-terrarium]

Where in the Bottle are the Earth's Spheres?

- Four Spheres Part 1 (Geo and Bio): Crash Course Kids #6.1 - YouTube
  [https://www.youtube.com/watch?v=VMxjzWHbyFM]
- Four Spheres Part 2 (Hydro and Atmo): Crash Course Kids #6.2 - YouTube
  [https://www.youtube.com/watch?v=UXh_7wbnS3A]
- The Four Spheres of Earth: Geosphere, Hydrosphere, Biosphere, and Atmosphere - Video & Lesson Transcript | Study.com
  [https://study.com/academy/lesson/the-four-spheres-of-earth-geosphere-hydrosphere-biosphere-and-atmosphere.html]

Stage 3 – Learning Plan

Learning Plan Rationale

The learning plan is based on an articulation of learning goals (i.e., NGSS PEs, CCSS, EUs/EQs, and acquisition goals (defined in Stage 1) distributed over four instructional segments. These learning goals are used in Stage 2 to identify and describe the assessments that will be used to assess (to collect evidence of) students' learning throughout the course of the unit and instruction. The lessons in Instructional Segments 1 through 4 are designed to ensure students have opportunities to acquire and apply the learning goals in Stage 1. The instructional segments in both Stage 2 and Stage 3 are similar in terms of the learning goals they represent. Assessments listed in Stage 2 for a segment might use (assess) fewer learning goals than are present in the respective Stage 3 but will not use additional learning goals (unless they were taught in a prior segment).

Unit Entrance

The unit opening focuses on students experiencing and discussing a phenomenon that sparks their interest and curiosity. To do so, the class engages with an "anchor phenomenon" and generates questions based on that phenomenon, posting their questions to the "driving question board." Some of the questions added to the driving question board can be used by the teacher to transition into Instructional Segment 1, by framing the lessons (and segment) as a means by which to investigate and answer some of the questions that students generate based on the anchor phenomenon.

Throughout the unit (e.g., at the conclusion of each instructional segment) the teacher returns to the driving question board and has students reflect on their recent learning, and which questions they can now answer based on their learning in the prior segment. Following this reflection, the teacher uses the driving question board again, this time identifying remaining unanswered (or partially answered) questions that can motivate the activities and investigations that are the focus of the next instructional segment.

Anchor Phenomenon

In this unit, the anchor phenomenon is based on a glass of water filled from a source in the school. Students brainstorm where it could have come from. They discover that the faucet is actually in the *middle* of the water's path, not the beginning. The teacher can problematize this for students by setting up the general question of, "What water does our school use, what does it use it for, and where does it go (e.g., inside the building, outside the building, etc.)?"

- Details for this anchor phenomenon activity appear in the Segment 1 lesson, *A Glass of Water*.

Unit Framing

Framing for SIPS Instructional Framework

Using the example of a glass of water that is clean and ready to drink, the class brainstorms where this water comes from and where it goes after it is poured down the drain. The teacher can provide a map of the pipes in school for students to trace where it goes from one room to the full water exit for the building. Some schools might be able to trace water from the school back to its ultimate, original source (e.g., lake or glacier that feeds the lake, etc.).

Example Driving Questions

Potential/example driving questions that students might generate include (These might be based on questions motivated by the engineering challenge(s) or they might be prompted by the school use context and then used to link to the engineering challenge)**:**

- Why does water sometimes taste different?
- What is a drought?
- Why do people sometimes have to water their lawn on only some days of the week?
- Why can't you drink water from the ocean?
- Why can't we make water?
- Why do some places have water, and some places don't have water?
- What does it mean to "run out of water"?
- Since we need more fresh water, why can't we just reduce the amount of salt in the ocean water?
- Why can't we melt icebergs?
- Where does water go once it goes down the drain?
- Could you use an iceberg for drinking water?
- Is the water we use for nearby irrigation the same water we drink in the school?

Potential Investigative Phenomena (Scaffolded by having a Common Point of Exploration)

- Sinkholes (cause; prevention) [opportunity to connect hydrosphere and geosphere]
- Bends in rivers [opportunity to connect hydrosphere and geosphere]
- Aquifers (what is their purpose? can we design one to solve a problem?)
- Plants as a tool to stabilize river channel [opportunity to connect hydrosphere and biosphere]
- Human uses of water (recreation, transportation, drinking, industrial uses, etc.)
- Differences in local precipitation and surface water amounts by season [opportunity to connect atmosphere and biosphere OR atmosphere and geosphere. From the PE clarification statement "…influence of the atmosphere on landforms and ecosystems through weather and climate…]
- Flooding
- Effects of flooding, landslides, and/or sinkholes on road systems, buildings, land use, and industry in those communities
- Water to support plant and animal life
- Contamination or pollution in a body of water (e.g., river or lake, groundwater/aquifers, etc.)

The teacher can also pivot to engineering aspects (identifying the problem and engineering a solution to protect the Earth's resource and environment) focused on developing a clean water solution (e.g., purify water / decontaminate water / desalinate water / etc.). This also introduces how Earth's spheres interact with the clean water solution.

Instructional Segment 1

Learning Investigations and Sample Lessons

Stage 1 Associations **NGSS PEs:** **5-ESS2-2** **CCSS:**	**Estimated Classroom Time: 350 minutes** **A Glass of Water (Anchor Phenomenon)** • 5Es: Engage, Explore • Estimated Time: 50 minutes

RI.5.7 **RI.5.9** **W.5.7** **W.5.8** **MP.2** **MP.4** **3-5.OA** **5.G.A.2** **MP.5** **EUs/EQs:** **EU1/EQ1** **EU3/EQ3** **AGs:** **A1** **A2** **A3** **A4** **A5*** **A6*** **A7*** **A8*** **A20***	• AGs: A4*, A5 Students brainstorm on the anchoring phenomenon: where a glass of their school's drinking water comes from, and how it gets to them clean and ready to drink. They discuss what is needed for water to be suitable for drinking, where their school water supply comes from, and how they could find out specific details. Students then compare that to an example of another country using an unusual water supply from polar icebergs (e.g., United Arab Emirates). The discussion can continue with questioning if water from icebergs is salty like ocean water. Students create an initial explanatory model that helps explain where the glass of water comes from. Resources: • 5-ESS2-2 Assessment - Svalbarði Water - The World's Most Expensive Water - Google Docs [https://docs.google.com/document/d/18_Hh2Evas5Ali9k88Tcb6CcgpJ9t4jNs9i0X63El1Y4/template/preview] • Towing An Iceberg to The United Arab Emirates — The Wonder of Science [https://thewonderofscience.com/phenomenon/2018/5/13/towing-an-iceberg-to-the-united-arab-emirates] **Where Does Our Water Come From and Where Does It Go?** • 5Es: Explore, Explain • Estimated Time: 100 minutes • AGs: A4*, A5 This lesson introduces students to the idea that fresh water is used throughout their daily life, and that access to clean and potable fresh water is a problem that can be solved with engineered solutions. First, students research where their glass of school water comes from by interviewing the local school's personnel responsible for water (or watching a pre-recorded interview), individuals from the local water utility, individuals from well drilling companies, or other local water resource individuals. These experts vary locally and might be the maintenance supervisor, principal, town water engineer, etc. Students use their findings to create an infographic or written response to answer questions about their school water. Students revise their explanatory model to add in this information. Students brainstorm lists of all the ways a family uses water in their home throughout a typical day. Optional: Students follow this up by going home and observing how their family uses water in a typical evening. Students calculate the amount of used water a family generates in one day and brainstorm ideas on how to reduce water usage and reuse water. Students share their results and discuss implications. Students use these ideas to revisit and refine their explanatory model about a glass of water. Home is not the only place we use water. Students work with partners to brainstorm their use of water during the school day, by doing a group tour around the school to find and map uses of water at school. Then, students research the typical amounts of water needed

	for these school day activities using reference materials. Students then add to their model to show the other uses of water in the school besides drinking water. Resources: • [Lesson The Distribution of Water on Earth | BetterLesson] [https://teaching.betterlesson.com/lesson/645625/the-distribution-of-water-on-earth?from=breadcrumb_lesson] • [Third grade Lesson Water Use Thinking About Liters (betterlesson.com)] [https://teaching.betterlesson.com/lesson/591322/water-use-thinking-about-liters?from=search] • [USGS How Much Water Do You Use At Home, Online Activity] [https://water.usgs.gov/edu/activity-percapita.html] • [How Much Water Do You Use: Magnificent Groundwater Connection (epa.gov)] [https://www.epa.gov/sites/default/files/2015-08/documents/mgwc-gwa21.pdf] • [Show Me The Water | Precipitation Education (nasa.gov)] [https://gpm.nasa.gov/education/videos/show-me-water] **A Globe Full of Water** • 5Es: Explore, Explain • Estimated Time: 50 minutes • AGs: A1, A2, A3, A4* The lesson opens with the formative assessment activity, *A Globe Full of Water,* where students use small paper squares to cover the Earth in different colored papers and then use those papers to estimate the percentages of surface area of water on Earth. Then, students hypothesize and investigate the small-scale model of global water as a liter bottle distribution activity. Then, the teacher demonstrates a similar model of distribution of amounts of salt and fresh water on Earth, but with a larger scale using a large bucket. Students continue with additional research of the volumes and percentages of salt and fresh water to develop graphs. Then, they observe and interpret other types of data infographics that show distributions, and/or create and share their own versions in infographics to illustrate the global water distribution data. Students then add to their explanatory models on water and water usage to incorporate this new information on water sources and water destinations. (For example: the water eventually may make its way to the ocean.) To place a focus on fresh water, students are provided with (or research) data about freshwater supplies and distribution globally and regionally/locally. This data should illustrate that the largest sources of freshwater reserves are in glaciers and groundwater. Students use the data to develop multiple representations of the information they have learned, including but not limited to traditional graphs, text, tables, and/or develop other creative infographics to show where fresh water is. Students choose one of their graphics to develop an explanation to support the argument that usable fresh water is in limited supply. This can be customized to local water supplies, such as groundwater, glacial ice, surface reservoirs, lakes, and rivers. The students then connect this activity back to the anchor phenomenon (A Glass of Water; Where Does Our Water Come From and Where

Does it Go?) by adding this information to their explanatory model. Teachers may need to use questioning to help students connect this exploration of freshwater sources to the larger phenomenon/context around the need for available sources of fresh and clean water.

Resources:

- Earth's Water Globe Activity [https://gpm.nasa.gov/education/interactive/earths-water-globe-activity]
- EPA All the Water In the World Aquarium Demonstration [https://www.epa.gov/sites/default/files/2015-08/documents/mgwc-gwa5.pdf]
- Earth's Water: A Drop in Your Cup, California Academy of Sciences [https://www.calacademy.org/educators/lesson-plans/earths-water-a-drop-in-your-cup]
- Earth's Water: A Drop in Your Cup, Lesson Plan [https://www.calacademy.org/sites/default/files/assets/docs/pdf/067_earthswateradropinyourcup_revised_redesign.pdf]
- Water Distribution on Earth with One Liter Model by Lynda Williams [https://teachingscience.us/water-distribution-on-earth-ngss-aligned-activities-ngss-5-ess2-2/]
- Data for Earth's Distribution of Water, Saline and Fresh [https://en.wikipedia.org/wiki/Water_distribution_on_Earth#Distribution_of_saline_and_fresh_water]
- Better Lesson Use Scale Model to Illustrate Quantity Water [https://teaching.betterlesson.com/lesson/645625/the-distribution-of-water-on-earth]
- Living in a Fresh Water World [https://gpm.nasa.gov/education/interactive/living-freshwater-world]
- Data for Earth's Distribution of Water, Saline and Fresh [https://en.wikipedia.org/wiki/Water_distribution_on_Earth#Distribution_of_saline_and_fresh_water]
- Video: Show Me the Water by NASA [https://gpm.nasa.gov/education/videos/show-me-water]
- Circles of Blue Water Infographic [https://www.circleofblue.org/2008/world/infographic-alircles-of-blue/]
- Where is Earth's Water USGS [https://water.usgs.gov/edu/gallery/watercyclekids/earth-water-distribution.html]
- Better Lesson Distribution of Water on Earth, 2 Water Sources that Make Up Freshwater [https://teaching.betterlesson.com/lesson/645625/the-distribution-of-water-on-earth?f
- Video: Show Me the Water by NASA [https://gpm.nasa.gov/education/videos/show-me-water]
- Circles of Blue Water Infographic [https://www.circleofblue.org/2008/world/infographic-alircles-of-blue/]
- Where is Earth's Water USGS [https://water.usgs.gov/edu/gallery/watercyclekids/earth-water-distribution.html]
- How Much Water is in the World, Mystery Science

	[https://mysteryscience.com/earth/mystery-1/hydrosphere-the-roles-of-water/122] **Water in the Snow, Glaciers, and Underground** • 5Es: Explore, Explain • Estimated Time: 100 minutes • AGs: A3, A4*, A5*, A6*, A7*, A8*, A20* Snow and glaciers, which are the frozen reservoirs of the global water supply, are both important for both seasonal winter and year-round water storage. As they melt, they provide available flow for surface and groundwater supplies. Students investigate how much water is in snow and ice with simple melting and measuring experiments, which can be extended with various types of snow (loose fresh, hard packed, drifted) and/or how long the melting takes. Glaciers change the surface of the landscape, and models can be made to demonstrate changes. Students add information from this activity to their explanatory model on the sources of water and its destinations. Approximately 36% of public water systems and many private home systems use groundwater from wells as their source. Many students are unaware of the vast supplies of groundwater and how it is accessed for availability for our many uses. Students read about groundwater and water tables, and then design models of groundwater aquifers to educate younger students about groundwater. The models need to include different layers of the ground which act like the different layers in real life. Their model will include examples of water table levels, aquifer types (sand, gravel, clay), and movement of water through the materials. Additionally, they can include information of where to drill wells to access groundwater in various settings. The students share their teaching models with peers for feedback and refine them. If possible, students share their models with a younger grade level to teach them about groundwater. Finally, students should revisit their water glass explanatory model to add information about groundwater. Resources: • Water Distribution on Earth. Wikipedia [https://en.wikipedia.org/wiki/Water_distribution_on_Earth#Distribution_of_saline_and_fresh_water] • Video: Show Me the Water by NASA [https://gpm.nasa.gov/education/videos/show-me-water] • Teach Engineering Snow vs Water [https://www.teachengineering.org/activities/view/cub_earth_lesson2_activity1] • There is a Glacier Melting in the Classroom by Better Lesson [https://teaching.betterlesson.com/lesson/634147/there-is-a-glacier-melting-in-the-classroom] • How Much Water is in Snow Simple Science Experiment [https://www.kcedventures.com/blog/simple-science-experiment-how-much-water-is-in-snow] • Melting Magic, Snow Ice Simple Science [https://www.steampoweredfamily.com/activities/snow-ice-simple-science/] • NRCS USDA Snow Water Equivalent Data Current

	[https://www.nrcs.usda.gov/wps/portal/wcc/home/] • EPA Magnificent Groundwater Connections [https://www.epa.gov/education/magnificent-ground-water-connection] • Groundwater Movement, Earth Science Week BLM [https://www.earthsciweek.org/classroom-activities/groundwater-movement] • EPA Deep Subjects Wells and Groundwater [https://www.epa.gov/sites/default/files/2015-08/documents/mgwc-ww-well.pdf] • EPA Where Does Your Water Come From? [https://www.epa.gov/sites/default/files/2016-03/documents/activity_grades_4-8_wherewatercomes.pdf] • When you turn on the faucet, where does the water come from? Mystery Science [https://mysteryscience.com/earth/mystery-3/groundwater-as-a-natural-resource/123] **Our Glass of Water** • Explain, Evaluate • Estimated Time: 50 minutes • AGs: A2, A3, A4 Students work to finalize their explanatory models about where a glass of water in their school comes from and where the water used in the school goes. Students give feedback to peers to help improve their explanatory models and then share their final models with the class.
Instructional Segment 2	
Learning Investigations and Sample Lessons	
Stage 1 Associations **NGSS PEs:** **3-5-ETS1-1** **3-5-ETS1-2** **CCSS:** **RI.5.1** **RI.5.7** **RI.5.9** **W.5.7** **W.5.8** **W.5.9** **MP.2** **MP.4** **EUs/EQs:** **EU2/EQ2**	**Estimated Classroom Time: 250 minutes** **Water, Water, Everywhere and Not a Drop to Drink** • Engage • Estimated Time: 50 minutes • AGs: A5, A6, A7, A8*, A21 Now that students have learned some information about their own water and water sources on Earth, the teacher introduces the engineering problem for the unit. The teacher shares with students the challenge of the Ogallala Aquifer, and how the level of water is dropping faster than it can be recharged. It is an important source of water for a large population, and it is at risk for pollution. (Note: The teacher should use a topic that is relevant for the students based on their location involving water usage and water access. The Ogallala Aquifer preservation/protection is presented as an example, but teachers should select a topic relevant to the students.) The students should be grouped in heterogenous groups that allow for everyone to participate in all parts of the design process. The teacher presents students with information about the topic and then introduces their engineering team to the challenge.

EU3/EQ3 **EU4/EQ4** **EU5/EQ5** **AGs:** **A5** **A6** **A7** **A8** **A14** **A15** **A16*** **A17*** **A21**	Students should start brainstorming ideas for their solution with the understanding that they will learn more about the topic and refine their solution as they proceed through the unit. **[See Sample Lesson:** *Water, Water, Everywhere and Not a Drop to Drink***]** Resources: • Sciencebuddies.com "Define the Problem" [https://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-problem-statement] • The Engineering Design Process, Teach Engineering [https://www.teachengineering.org/activities/view/usu-1961-everyday-problems-introduction-engineering-design] • OSU Extension, Ogallala Aquifer [https://extension.okstate.edu/fact-sheets/the-ogallala-aquifer.html] • US Gov: NRCS/USDA Ogallala Aquifer Project [https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives/colorado/ogallala-aquifer-project] • Water Encyclopedia: Ogallala Aquifer [http://www.waterencyclopedia.com/Oc-Po/Ogallala-Aquifer.html] **Well, How Did that Happen?** • 5Es: Engage, Explore • Estimated Time: 50 minutes • AGs: A5*, A6, A7*, A8* A student's initial thinking may need more support. This activity provides the opportunity to explore the problem by using equipment to simulate the problem of water draw down. The teacher may want to replace this activity with "You Are What You Drink" depending on the local problem they have identified, or if time allows, students could experience both. The teacher pairs students or puts them into groups of three. To simulate the challenges of wells, each pair/group receives a glass beaker or other transparent container, aquarium gravel/sand to simulate the ground, and a selection of shampoo bottle pumps that are different lengths and draw different volumes. Students use food coloring to make the water easier to see and then pour the water into their tub. Using their science journal to map their progress, students draw a diagram of what they are starting with and label what each of the pieces represent. Next, students determine how to place their pump to fill the cup. They use the shampoo pumps to simulate the pumping of groundwater at different volumes and depths and as they do, they should record observations of the water movement and other factors. Using questioning, the teacher encourages students to consider how the volume and depth impacted the water table and ask students to consider how water is replaced into a well.

	Students should add this information to their notes on the engineering problem. Students should refine their planned solution as they learn more about the problem. Resources: • Fourth grade Lesson Well Water | BetterLesson [https://teaching.betterlesson.com/lesson/631980/well-water?from=search]] • Who's Down the Well? - Lesson - TeachEngineering [https://www.teachengineering.org/lessons/view/cub_enveng_lesson04] **You Are What You Drink** • 5Es: Engage, Explore • Estimated Time: 50 minutes • AGs: A5*, A6, A7*, A8*, A14, A15, A17*, A21 A student's initial thinking may need more support. This activity provides the opportunity to explore the problem of water pollution/purification (not all water is naturally drinkable). The teacher may want to replace this activity with "Well, How Did That Happen?" depending on the local problem they have identified, or if time allows, students could experience both. In addition to reducing our water usage, accessing other sources of water and reusing water may be another solution. Identifying safe and sustainable drinking water sources is a common environmental challenge. When identifying potential water sources, engineers must consider the amount of dissolved organic matter that is present. Before water comes out of the tap it goes through several water treatment steps to make sure it is safe for human consumption. Engineers also need to remove pollutants from water that are the result of human activity. To start, students investigate the process and consequences of water contamination on the land, groundwater, and plants. Students review articles and media about pollution events and risks. Topics include but are not limited to: oil spills (Kalamazoo River), septic tanks, chemical runoff (PFAS), on purpose pollution (Occidental), and other events. The students should also research and understand the methods for cleaning the groundwater and restoring the environment. Students will: • Describe how polluted water contaminates the land, groundwater, and plants. • Understand how contaminants leach into the soil and groundwater and how they are absorbed by plants. • Describe how drinking water can be affected by pollutants. • Understand the role of engineers in water treatment systems. Students consider these negative impacts and potential concerns for their own water reduction process and refine their solutions to the engineering problem to minimize negative impacts. Next, to explore the idea of water purification, students design and build simple water filters. Then, they test their filters using dirty water. They investigate how soil and other inexpensive organic substances can be used as a filter.

	Alternative Investigation: Students measure the permeability of different types of soils, compare results, and realize the importance of size, voids, and density in permeability response. Finally, students revisit their proposed solution to the main engineering problem and consider how they may impact the environment positively and negatively. Students should revise their design to minimize negative impacts on the environment and incorporate ideas from their filters. Resources: • How Fast Does Water Travel through Soils? - Activity - TeachEngineering [https://www.teachengineering.org/activities/view/nyu_permeability_activity1] • All About Water! - Lesson - TeachEngineering [https://www.teachengineering.org/lessons/view/cub_drink_lesson01] • You Are What You Drink! - Lesson - TeachEngineering [https://www.teachengineering.org/lessons/view/cub_enveng_lesson06] • Bio | Earth (nasa.gov) [http://soil.gsfc.nasa.gov/] • Water, Water Everywhere: Designing Water Filters [https://eiestore.com/water-water-everywhere-designing-water-filters.html] • What's Gotten Into You? https://www.teachengineering.org/activities/view/cub_environ_lesson06_activity1 • USGS: Contamination of Groundwater (For Teachers) [https://www.usgs.gov/special-topics/water-science-school/science/contamination-groundwater] • What We Can All Do To Reduce Groundwater Pollution (CT.gov) [https://portal.ct.gov/DEEP/Aquifer-Protection-and-Groundwater/Ground-Water/Understanding-Ground-Water/What-we-can-all-do-to-reduce-groundwater-pollution] • Understanding Groundwater-Protecting a Natural Resource (CT.gov) [https://portal.ct.gov/DEEP/Aquifer-Protection-and-Groundwater/Ground-Water/Understanding-Ground-Water/Understanding-Groundwater] **Can You Catch the Water?** • 5Es: Explore, Explain • Estimated Time: 50 minutes • AGs: A5*, A6*, A7, A8, A14*, A15*, A16*, A17* Catchment basins and watersheds are important to most living things since water flow, direction, and location are vital to water availability for everyday life. Understanding how human-made technologies affect our water sources, water quality, and watersheds is of great importance to protect the people, industries, and wildlife that depend upon a working system of clean water for survival.

	Students build three-dimensional models of water catchment basins and experiment to determine how they can be altered by natural and human activities, as well as how water can be caught and conserved for use without large impact to the environment. Alternative Investigation: Floodplain - Students explore the impact of changing river volumes and different floodplain terrain in experimental trials with tabletop-sized riverbed models. After students complete the investigation/s they return to their own engineering problem and revise their proposed solutions. **[See Sample Lesson:** ***Can You Catch the Water?*****]** Resources: • Floodplain Modeling - Activity - TeachEngineering [https://www.teachengineering.org/activities/view/cub_natdis_lesson07_activity1] • Dam Impacts - Lesson - TeachEngineering [https://www.teachengineering.org/lessons/view/cub_dams_lesson05] • Can You Catch the Water? - Informal Learning Activity - TeachEngineering [URL: https://www.teachengineering.org/sprinkles/view/cub_catchwater] **Nature Impact** • 5Es: Explore, Explain • Estimated Time: 50 minutes • AGs: A5, A6, A7*, A8*, A14, 15, A17*, A21 The teacher shares with students some footage/images of large dams and water reservoirs around the world. The teacher asks students to consider how something like this might connect with our own water challenge. Students, as a class, discuss the usage of dams and how they could be part of the engineering solution. Next, students should review news articles and resources on the impact of dams from both positive and negative aspects. The teacher provides students with several videos and articles that present this complex topic for them to consider. The students then share their thinking about dams and their usage for water reservoirs, flood control, energy, and the impact that has on the local fish, wildlife, and people in those areas. Students are shown a video on water reservoirs and their usage for storing drinking water and flood control in the desert, and on how Indigenous peoples used simple dams to slow water flow down, and how people are restarting those practices today to do the same, allowing for flood control, water protection, and preservation of the environment. After watching the video, the students are split into teams and each team is presented with the same challenge: What are some other strategies like this to help with our challenge in protecting and preserving the water in the Ogallala Aquifer/local water source in ways that sustain and protect the environment? Students should explore digital resources provided by the teacher or use search engines to find resources that are reliable, and present other solutions to their problem. They should consider these solutions and then refine their solution based on what they see others are doing.

	Resources: • Engineer a Dam - TryEngineering.org Powered by IEEE [https://tryengineering.org/teacher/engineer-dam/] • Invitation to Build: Create a Dam [https://www.pinterest.com/pin/507429082998640330/] • Build Your Own Beaver Dam Activity [https://www.pinterest.com/pin/567383253060086598/] • What are the True Costs of Damming a River? (Anti-dam Video) [https://www.youtube.com/watch?v=XfJdTCmkoaA] • Check Dams [https://www.youtube.com/watch?v=hy_zDXGvhP8] • Land-based Rainwater Harvesting [https://www.youtube.com/watch?v=-yhWEkXqVR0]
Instructional Segment 3	
Learning Investigations and Sample Lessons	
Stage 1 Associations **NGSS PEs:** **3-5-ETS1-2** **3-5-ETS1-3** **5-ESS3-1** **CCSS:** **MP.2** **MP.5** **RI.5.1** **RI.5.7** **RI.5.9** **SL.5.5** **W.5.8** **W.5.9** **EUs/EQs:** **EU2/EQ2** **EU3/EQ3** **EU4/EQ4** **EU5/EQ5** **AGs:** **A6** **A8**	**Estimated Classroom Time: 200 minutes** **Designing Solutions, Revising, and Improving** • Explore • Estimated Time: 50 minutes (plus time outside of class) • AGs: A6, A8, A16*, A17* In Segment 2, students were presented with the engineering problem and some additional background information on the impact of human activities on water resources. Over several days students work on revising their design based on what they have learned in class and through research about a limited supply of fresh water and how humans have contributed to its depletion. Students document their prototype and revisions in their science journal with drawings, labels, text, and any other representations that they think are important. **Investigating Efficacy of Design Solutions** • 5Es: Explore • Estimated Time: 50 minutes • AGs: A8, A16, A17, A18, A21, A22* Students have been carrying out an engineering design challenge, iterating upon their prior design solution as they learn about additional factors related to the impact of human activities on a design problem, in this case the overuse of water drawn from the Ogallala Aquifer. Next, students determine how different conditions affect the impact/efficacy of their design solution. The students conduct an investigation to determine if their proposed solution to water conservation/protection may be effective using a prototype that they create. Following their investigation, students may again refine/revise their design solution to account for their investigation results. This final design iteration is an opportunity for students to use everything they have learned during previous iterations, including what worked and what did not, to improve upon their design solution.

A16 A17 A18 A19 A21 A22	**Evaluating Design and Preparing Presentations** • 5Es: Explain, Evaluate • Estimated Time: 50 minutes • AGs: A19 Students determine how their solution met the success criteria and/or constraints of the water conservation problem brought about by human activities and develop an explanation of their design. Then, students prepare a presentation that explains the problem their design is solving whose goal is to lessen the impact of human activity on depleting water resources. Students' presentations should clearly show how the criteria and constraints (e.g., how many people will be using the water, funds, materials, resources) are addressed through their design solution, which in the long run brings about water conservation. **Presentation Day** • 5Es: Explain, Evaluate • Estimated Time: 50 minutes • AGs: A19 The students present their solution and an evaluation of how well their solution meets the design criteria and constraints. The teacher should invite local experts in engineering and design to provide feedback to students. This could include civil engineers, local farmers, gardeners, homeowners, renters, individuals from the local water utility, and environmental organizations. Across the class students compare various solutions, using information from available tests, to determine which solution is optimal. Finally, students draw conclusions based on the presentations and the design process about how different conditions affect the outcomes of a design solution.
Instructional Segment 4	
Learning Investigations and Sample Lessons	
Stage 1 Associations **NGSS PEs:** 5-ESS2-1 5-ESS3-1 3-5-ETS-1 **CCSS:** RI.5.1 RI.5.7 SL.5.5 W.5.7 W.5.8	**Estimated Classroom Time: 200 minutes** **Nature Walk: Observations of the Earth's Spheres** • 5Es: Engage & Explore • Estimated Time: 25 minutes • AGs: A9, A10*, A11*, A19* Students investigate Earth spheres/systems by making observations in nature. They go on a nature walk in a neighboring preserve. [Teacher Note: If you do not have access to a preserve, students can take a walk around their school grounds or in the neighborhood around their school, or videos of such nature walks could be show to students.] Students use their senses to make observations. The teacher reviews the five senses with students prior to the nature walk and discusses which senses are applicable for the nature walk. Students are given a clipboard with a graphic organizer to record their observations.

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EUs/EQs:

EU1/EQ1
EU3/EQ3
EU4/EQ4

AGs:

A9
A10
A11
A12
A13
A14
A19
A22

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The teacher provides students with binoculars, magnifying glasses, test tubes, gloves, recyclable bags, and/or forceps if they are available. Students may collect water samples or other objects such as leaves, twigs, and rocks.

During the nature walk, students observe and record their observations. Questions for students to ponder while on the nature walk:

- What do you notice (see, smell, hear)?
- Do you notice any changes?
- What is happening in nature?

Students then classify the material they collected from their nature walks as well as their observations. Illustrations can be used to classify their observations. Students participate in a gallery walk to observe their classmates' classifications.

Explaining our Classifications

- 5Es: Explain
- Estimated Time: 25 minutes
- AGs: A9, A11*

Students explain their classifications and observations. The teacher discusses with students how scientists use their observations to classify. The teacher then defines "classify" as grouping objects together using similar attributes, or features, of the objects. Students note similarities in classifications such as plants, trees, flowers, water, air, rocks, soil, and the sun. After students explain their classifications, they watch a video about the Earth's spheres. Students then reclassify their observations into the "Four Earth Spheres" and create a chart based on the information from the videos below.

Resources:

- **Video:** Crash Course Kids: Four Spheres Part 1 (Geo and Bio) – Episode 6.1 | SciTech Institute
  [https://scitechinstitute.org/listing/crash-course-kids-four-spheres-part-1-geo-and-bio-episode-6-1/]
- **Video:** Four Spheres Part 2 (Hydro and Atmo): Crash Course Kids #6.2 – YouTube
  [https://www.youtube.com/watch?v=Uxh_7wbnS3A]

Hydrosphere	Biosphere	Geosphere (ground)	Atmosphere
Water (fresh water and ocean water), rain	Animals, frogs, birds, trees, grass, flowers, human beings	Soil, rocks, sand	Air

ELA Integration: Discuss the meaning of each prefix with students:

GEOSPHERE: GEO = EARTH
HYDROSPHERE: HYDRO = WATER
BIOSPHERE: BIO = LIFE
ATMOSPHERE: ATMOS = AIR

Earth's Spheres in a Terrarium

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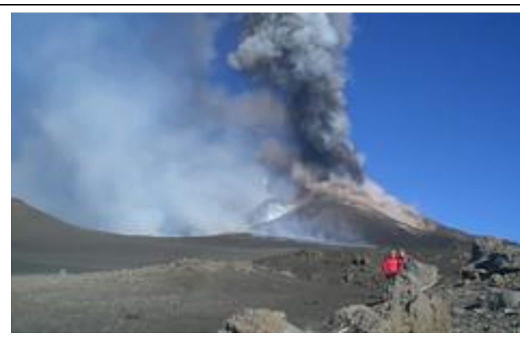
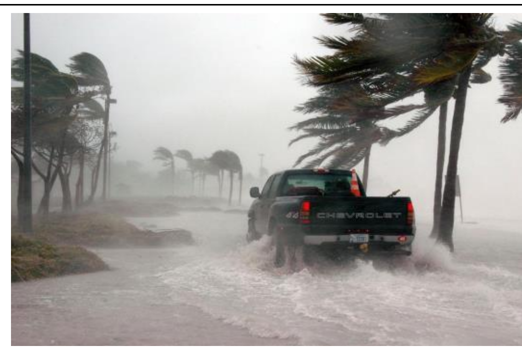
	• 5Es: Elaborate & Evaluate • Estimated Time: 50 minutes • AGs: A9, A10, A11*, A12, A19 To acquaint students with Earth's systems/four spheres, students design and construct a bottle terrarium to observe a system and identify the parts of the terrarium's four spheres. Students work in pairs to create their terrarium. After constructing the terrarium, students develop a visual model of the terrarium that also labels/includes the four Earth spheres. **Materials**: Empty clean plastic water bottle, string, soil, radish seeds, water, earthworm, gravel or tiny rocks, sand, scissors *The seeds take about 3-5 days to germinate. Students observe their terrarium daily and record their observations in their science journal. Students also draw a visual model of their terrarium and label the four spheres. Students' models should show how at least two of the four spheres are related/interact. They then record what they see in the terrarium and classify their observations into the four spheres that they have included in their model. **Interaction of Earth's Spheres** • 5Es: Explore, Explain • Estimated Time: 50 minutes • AGs: A11*, A13, A22* Now that students have been introduced to Earth's four spheres/systems and are able to identify and describe each sphere, they are ready to observe how the spheres interact. The teacher begins the lesson with a review of Earth's four spheres. Students play the game, "Name that Sphere." They identify the sphere to which each object from the list below represents: • Sand • Rocks • Water • Worms • Air • Birds • Glacier • Dogs • Ice • Rain Next, students work in small groups. Each group is given several photos from which to choose. Students observe the pictures to identify and describe the Earth's four spheres and explain their interactions as part of writing a short caption/paragraph on the scene. Students put their photos into a digital slide show presentation and share their photos and captions with their peers. In their slideshow, they identify at least two spheres in every photo and explain how it shows those two spheres interacting. They should have one photo for each interaction between two spheres (geo/hydro, geo/atmo, geo bio, hydro/atmo, hydro/bio, and atmo/bio). Example pictures might include:

A farmer spraying crops.	 Image in the public domain. Source: www.pixabay.com
Beachgoers enjoying the ocean.	 Image in the public domain. Source: www.pixabay.com
A volcano erupts.	 Image in the public domain. Source: https://www.flickr.com/photos/gnuckx/10491870055/sizes/s/
Hurricane winds in Key West, Florida.	 Image in the public domain. Source: https://www.pikist.com/free-photo-scuox

Modeling Earth's Systems

- 5Es: Elaborate, Evaluate
- Estimated Time: 50 minutes

	• AGs: A14, A19 Students use a model of the Earth systems and spheres and add to the model to represent how human activity can affect the Earth systems. Students obtain information to be used in their model from multiple sources. After modifying the model, students explain how the activities impact an Earth system (or systems).

Accessibility and Differentiation for Diverse Learners

"Universal Design for Learning (UDL) is a framework to improve and optimize teaching and learning for all people based on scientific insights into how humans learn" (CAST, 2022). Taking time to reflect on prior instruction when planning for accessible, differentiated, and culturally responsive instruction for diverse learners and culturally diverse classrooms serves to identify ways to improve future instructional practices. The UDL Guidelines provide a framework for this reflection. The guidelines include three principles, Multiple Means of Engagement, Multiple Means of Representation, and Multiple Means of Action & Expression as ways to focus on variety and flexibility in instructional practices. By examining instruction and instructional materials through the lens of each of these principles, we can identify and thus reduce or remove barriers to diverse learners.

Providing Multiple Means of Engagement (e.g., allowing choices, authentic scenarios, varying demands, and clear goals), broadens the opportunities for gaining and sustaining students' interest and cognitive engagement in learning the content. Providing Multiple Means of Representation (e.g., variety of presentation modes, clarifying vocabulary, activating background knowledge) allows students to receive and comprehend the content. Providing Multiple Means of Action & Expression (e.g., a variety of methods to respond to instruction, and a variety of ways to interact with the instructional materials) helps students to use their strengths and abilities to access the instructional materials and express what they understand. Accommodations typically reserved for students receiving special education, students who have a 504 plan, and English Learners can be made available to all students using the UDL principles, thus allowing all students to benefit from the accommodations.

The SIPS Grade 5 Unit 3 Instructional Framework Differentiation Strategies and Resources support educators' intentional planning of accessible, differentiated, and culturally responsive instruction for all students aligned to the specific performance expectations in focus for this unit.

Core Text Connections

- Water Related Picture Book Texts:
  - Strauss, R. (2007). One well: The story of water on earth
    [https://www.amazon.com/One-Well-Story-Water-CitizenKid/dp/1553379543/ref=sr_1_1?crid=2JJZ7GTP3W9M2&keywords=One+well%3A+The+story+of+water+on+earth.&qid=1670005233&s=books&sprefix=one+well+the+story+of+water+on+earth.%2Cstripbooks%2C126&sr=1-1]
  - Bang, M. (2014) Common ground: The water, Earth and air we share
    [https://www.amazon.com/Common-Ground-Water-Earth-Share/dp/0590100572]
  - Mulder, M. (2014). Every last drop: Bringing clean water home
    [https://www.amazon.com/Every-Last-Drop-Bringing-Footprints/dp/1459802233/ref=sr_1_1?crid=2MXB6LATRACFN&keywords=Every+last+drop%3A+Bringing+clean+water+home.&qid=1670005252&s=books&sprefix=every+last+drop+bringing+clean+water+home.%2Cstripbooks%2C95&sr=1-1]

- Engineering Related Picture Book Texts:
  - Berne, J. (2016) On a beam of light: A story of Albert Einstein
    [https://www.amazon.com/Jennifer-Berne-Light-Albert-Einstein/dp/B00HTJNZD4/ref=sr_1_2?crid=ZZRAIOUULR14&keywords=On+a+beam+of+light%3A+A+story+of+Albert+Einstein.&qid=1670005275&s=books&sprefix=on+a+beam+of+light+a+story+of+albert+einstein.%2Cstripbooks%2C72&sr=1-2]
  - Fleming, C. (2013) Papa's mechanical fish
    [https://www.amazon.com/Papas-Mechanical-Fish-Candace-Fleming/dp/0374399085/ref=sr_1_1?crid=3SW01I9GHZ3RR&keywords=Papa's+mechanical+fish.&qid=1670005304&s=books&sprefix=papa+s+mechanical+fish.%2Cstripbooks%2C65&sr=1-1]
  - Wallmark, L. (2015). Ada Byron Lovelace and the thinking machine
    [https://www.amazon.com/Ada-Byron-Lovelace-Thinking-Machine/dp/1939547202/ref=sr_1_1?crid=A2N1DUZE1A9D&keywords=Ada+Byron+Lovelace+and+the+thinking+machine.&qid=1670005339&s=books&sprefix=ada+byron+lovelace+and+the+thinking+machine.%2Cstripbooks%2C66&sr=1-1]
  - Yamada, K. (2016). What do you do with a problem?
    [https://www.amazon.com/What-Do-You-Problem/dp/1943200009/ref=sr_1_1?crid=1DGQS9QP0JOAU&keywords=What+do+you+do+with+a+problem.&qid=1670005359&s=books&sprefix=what+do+you+do+with+a+problem.%2Cstripbooks%2C73&sr=1-1]
  - Beaty, A. (2013). Rosie Revere, engineer
    [https://www.amazon.com/Rosie-Revere-Engineer-audiobook/dp/B0771W8PQC/ref=sr_1_1?crid=2ODFR3JR44DHJ&keywords=Rosie+Revere%2C+engineer.&qid=1670005382&s=books&sprefix=rosie+revere%2C+engineer.%2Cstripbooks%2C78&sr=1-1]
  - Spires, A. (2014). The most magnificent thing
    [https://www.amazon.com/Most-Magnificent-Thing-Ashley-Spires/dp/1554537045/ref=sr_1_1?crid=3MMGUWOJDSSRW&keywords=The+most+magnificent+thing.&qid=1670005405&s=audible&sprefix=the+most+magnificent+thing.%2Caudible%2C110&sr=1-1-catcorr]
  - Offill, J. (2011). 11 experiments that failed
    [https://www.amazon.com/Experiments-That-Failed-Jenny-Offill/dp/0375847626/ref=sr_1_1?crid=5N2LWEPCDC7E&keywords=11+experiments+that+failed.&qid=1670005436&s=audible&sprefix=11+experiments+that+failed.%2Caudible%2C63&sr=1-1]
- USGS: How much water is there on, in, and above Earth?
  [https://www.usgs.gov/special-topics/water-science-school/science/how-much-water-there-earth]
- NASA: How much water is on Earth?
  [https://spaceplace.nasa.gov/water/en/]
- The Global Education Project: Fresh Water
  [https://www.theglobaleducationproject.org/earth/fresh-water]
- Science Buddies: Engineering Design Process

[https://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-process-steps]

- NASA: Engineering Design Process
  [https://www.nasa.gov/audience/foreducators/best/edp.html]

Instructional Resources
Stage 3 Instructional Resources:

- National Geographic: Earth's Freshwater Educator Guide
  [https://education.nationalgeographic.org/resource/earths-fresh-water]
- Science Buddies Engineering Design Sample Lesson, Elementary School
  [https://www.sciencebuddies.org/teacher-resources/lesson-plans/paper-airplane-engineering-design]
- NASA: Beginning Engineering Science, and Technology
  [https://www.nasa.gov/pdf/630753main_NASAsBESTActivityGuide3-5.pdf]
- STEM Teaching Tool 7: Learning STEM Through Design: Students Benefit From Expanding What Counts as "Engineering"
  [https://stemteachingtools.org/brief/7]
- STEM Teaching Tool 31: How to Launch STEM Investigations That Build on Student and Community Interests and Expertise
  [https://stemteachingtools.org/brief/31]
- STEM Teaching Tool 36: Failing Forward: Managing Student Frustration During Engineering Design Projects
  [https://stemteachingtools.org/brief/36]
- STEM Teaching Tool 39: How can Students' Everyday Experiences Support Science Learning Through Engineering Design?
  [https://stemteachingtools.org/brief/39]
- STEM Teaching Tool 45: How to Focus Students' Engineering Design Projects on Science Learning
  [https://stemteachingtools.org/brief/45]
- STEM Teaching Tool 87: Identifying Local Environmental Justice Phenomena For Science and Engineering Investigations
  [https://stemteachingtools.org/brief/87]
- Ambitious Science Teaching: Models and Supporting Students Working On Their Ideas
  [https://ambitiousscienceteaching.org/tools-face-to-face/]