Stackable Instructionally-embedded Portable Science (SIPS) Assessments Project

Grade 5 Science
Unit 3 Sample Lesson "Water, Water, Everywhere and Not a Drop to Drink"
Earth Systems and the Solution of Water Problems
January 2023

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Science Grade 5
Unit 3: Earth Systems and the Solution of Water Problems
Sample Lesson: Water, Water, Everywhere and Not a Drop to Drink
Suggested Time to Complete: 50 minutes

Purpose & Use Statement: *This sample lesson was developed for state and local administrators and teacher leaders (e.g., curriculum directors, instructional facilitators, professional learning specialists) to (1) illustrate an example of an instructional lesson developed using a principled design approach, and (2) support accompanying process documentation about how to use the SIPS unit as an instructional framework to intentionally design high-quality lessons in an aligned curriculum, instruction, and assessment system. This sample lesson should be evaluated and refined, as necessary, to align appropriately with a standards-based curriculum, instruction, and assessment system prior to its use. Additionally, teachers should refine this lesson to meet the local, cultural, and individual needs of the students.*

Desired Results

Overview of the Learning Goals

In this lesson, "Water, water, everywhere. But not a drop to drink.", students engage with Big Ideas 2 and 3 (The Roles of Water in Earth's Surface Processes and Defining and Delimiting Engineering Problems and Developing Possible Solutions) as they are introduced to a real-life problem in their area related to water and water usage.
Students discuss the problem, identify constraints, and work towards a prototype solution.

Connections to Prior Learning

DCIs – ESS2.A, ESS2.C, ESS3.C, ETS1.A, ETS1.B & ETS1.C (from NGSS Appendix E: DCI Progression within NGSS)

- **Prior Learning from K-4:**
  - Wind and water change the shape of the land.
  - Water is found in many types of places and in different forms on Earth.
  - Things people do can affect the environment, and they can make choices to reduce their impacts.
  - Designs require understanding a problem and conveying solutions through sketches, drawings, or models. Multiple solutions may also be possible.

SEP – Asking Questions and Defining Problems

- **Prior learning from K-2**: Students have had opportunities in the context of asking questions about systems and defining a simple problem. More specifically, students should be able to:
  - Define how a new or improved object or tool can be developed.
- **Prior learning from this grade band (e.g., Grades 3 & 4 and/or prior SIPS G5 units):** During grades 3-5, students should progress in their ability to define problem statements and to identify how objects or tools can be used to address the problem [Appendix F].
  - Define a statement of a problem that can be addressed by an object or tool.
  - Two PEs (3-PS2-3 and 3-PS2-4) focus on Asking Questions and Defining Problems in the domain of relationships of electrical and magnetic interactions.
  - One PE (4-PS4-3) focuses on generating solutions to use patterns to transfer information. (This also integrates Connections of Science, Engineering, and Technology).

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SEP – Constructing Explanations and Designing Solutions

- **Prior learning from K-2:** Students are expected to have had opportunities to design multiple simple solutions to a problem associated with wind or water and its impact on the shape of the land.
  - Students can construct a device to address a problem in a way that mimics the way plants or animals survive, grow, and meet their needs.
  - Students can develop evidence-based accounts of how multiple solutions can address a problem.
- **Prior learning from this grade band (e.g., Grades 3 & 4 and/or prior SIPS G5 units):** During grades 3-5, students are expected to include investigations that design solutions to problems using appropriate information.
  - Two PEs (4-ESS3-2 and 4-PS3-4) ask students to consider multiple solutions based on how they meet criteria and constraints in the context of the impact of natural Earth processes on humans or to develop a device for energy conversion. (These also integrate the Influence of Science, Engineering, and Technology on Society and the Natural World).

CCC – Systems and System Models

- **Prior learning from K-2:** Students develop experience describing organisms (and other systems) in terms of their parts and considering how the parts work together to achieve a desirable goal for the organism (or system). [Appendix G]
  - In K-ESS3-1, students work with modeling a system in which multiple plants and animals live in the same area and can satisfy their needs.
- **Prior learning from this grade band (e.g., Grades 3 & 4):** Students continue developing experience with considering systems in terms of their parts, with an additional emphasis on the idea that some behaviors of the system are enabled by the functioning of multiple parts working together. [Appendix G]
  - In 3-LS4-4, students work with the idea that the plants and animals living in an ecosystem may be affected when the environment changes. In 4-LS1-1, students interrogate the functioning of plants (and/or animals) in terms of the organisms' structures that enable the activity of the larger system (i.e., the organism).

Key Vocabulary

Students build conceptual meaning with and use key tier II and tier III vocabulary terms to make sense of phenomena and phenomena-based design problems. This is not an exhaustive list of terms and should be reviewed and modified by educators, as appropriate.

- Iterate
- Resource
- System
- Design
- Engineer

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Targeted Stage 1 Learning Goals

Acquisition Goals (AG)

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.*
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]

Common Core State Standards (CCSS):

RI.5.1	W.5.8
W.5.7	

Enduring Understandings (EU)/ Essential Questions (EQ):

EU3/EQ3	EU4/EQ4	EU5/EQ5

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
☐ Analyze & Interpret Data ☐ Ask Questions ☐ Construct Explanations ☒ Define Problems ☒ Design Solutions ☐ Develop & Use Models ☐ Engage in Argument from Evidence ☐ Mathematics & Computational Thinking ☒ Obtain, Evaluate, & Communicate Information ☐ Plan & Carry Out Investigations	☒ ESS2.C: The Roles of Water in Earth's Surface Processes ☒ ETS1.A: Defining and Delimiting Engineering Problems ☒ ETS1.B: Developing Possible Solutions ☒ ETS1.C: Optimizing the Design Solution	☐ Cause & Effect ☐ Energy & Matter ☐ Patterns ☐ Scale, Proportion, & Quantity ☐ Stability & Change ☐ Structure & Function ☒ Systems & System Models

Formative Assessment Opportunities

Monitoring	Success Criteria	Possible Instructional Adjustments
• Teacher monitoring of student responses • Student questioning • Problem, constraints, brainstorming handout responses	Students can: • Read and interpret text to identify evidence to support or change their initial thinking • Identify a local engineering problem, the constraints and requirements of the problem, and brainstorm	• Students may need support around text with new vocabulary. A vocabulary-supporting literacy strategy in tandem with the anticipation guide could help students with vocabulary acquisition • The teacher can organize the constraints into

	potential solutions to the problem	categories and ask students about specific categories, such as size, cost, or other limitations • The teacher can encourage students to research other solutions already created for similar problems and consider how they could be adapted/incorporated into ideas for the local problem

Link to Stage 2 Instructionally-embedded Assessment: *Clean Water on the Trail*

Instructional Plan

Lesson Overview

In this lesson, students are presented with a local real-life problem involving water access and water usage. Students read an article detailing the problem with an anticipation guide. After learning about the problem, students begin working through an engineering design process of identifying the problem, constraints, and brainstorming potential solutions.

Materials & Set-Up

- Engineering notebook/science notebook
- Handouts
  - Local news article about a water access issue (E.g., The Ogallala Aquifer: When will the wells run dry? What, then? By Cat Keenan)
  - Engineering Design Process Handout
  - Anticipation guide

Anchor or Investigative Phenomenon: A local water access challenge such as the drawing down of the Ogallala Aquifer in the Central United States. Knowledge from the "glass of water" anchoring activity is also utilized as a part of the lesson.

Driving Question: How can we reduce water usage in our own community?

	Teacher Does	Students Do
Engage ☑ Introduce object, event, phenomenon, problem, or question ☑ Build background knowledge ☑ Facilitate connections	The teacher will introduce the problem for the engineering unit by providing a real-life water access issue that is relevant to the students. The teacher gives the students a reading passage about a local water access issue (As an example, in this lesson, we	Students read through the statements on the anticipation guide and check if they agree or disagree. Then students turn and talk about their choices and why followed by a short class discussion

will use the drawing down of the Ogallala Aquifer) and provide the students with an anticipation guide featuring several statements related to the article. For students who need additional support or background information, the teacher may want to “frontload” the lesson with a video or other piece of media to introduce the concepts before utilizing the print resource for the anticipation guide.

After reading the article, the teacher facilitates a class discussion around the key takeaways of the article and what the major issue is in this situation. The teacher may need to use sentence stems and additional questioning strategies to support students in identifying key takeaways.

Next, the teacher presents the students with the engineering problem posed by the local problem, how can we reduce water usage in our local community? The teacher makes sure to remind students of all that they learned about the glass of water, where it came from, where it goes, and how water is used around them. The teacher should place the students in heterogenous groups to work together on identifying solutions to the problem and designing prototypes.

The teacher will provide students with a copy of the Engineering Design Process, and then the class will review the sheet together. In their small groups, where a few students share their thinking with the entire class.

Students read the article, and as they read, they should document evidence in the reading passage that helps them determine if their original thinking was correct or if they have changed their position.

Students share their key takeaways, their new positions around the anticipation guide statements, and evidence that they found to support or change their initial thinking.

In their small groups, the students work together to review the engineering design process and start on the first step, identifying the need. Students begin by answering three questions: 1. What is the problem? 2. Who has the problem? And 3. Why is it important to solve?

Next, students identify the requirements and the limitations of the project. This should be done as a whole class with guidance from the teacher.

In their small group, the students brainstorm initial ideas for a solution to their problem. (They will learn more about water usage and the issue over the next few lessons, and their idea may be refined over that time.)

Students draw a diagram with labels and a key of their initial solution. They write a short initial explanation of their solution.

the students begin by [Defining the Problem](). The teacher can either direct students to the website or may want to present the information to the students through visual aids and walk the class together through the steps.

To define constraints, the teacher will facilitate a whole group discussion around the problem and the limitations of what they can do. Students will not be designing a working solution to a problem; the goal is to create a prototype to help the community reduce water consumption.

If time allows, after the class has identified the requirements and limitations, the students should work in small groups to brainstorm possible solutions to the problem.

Closing

Each student individually writes down the biggest challenge their solution will face as they move forward and why they think it is the biggest challenge. They should document their thinking in their notebook or as part of an exit ticket to be turned in to the teacher.

Differentiation Strategies and Resources

"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 as ways to focus on variety and flexibility in instructional practices:

- Multiple Means of Engagement
- Multiple Means of Representation
- Multiple Means of Action & Expression

By examining instruction and instructional materials through the lens of each of these principles, teachers can identify and thus reduce or remove barriers to diverse learners.

Learning Opportunities	UDL Principle	Example Differentiation Strategies & Resources
Engage		
Students review an anticipatory guide and read and discuss a passage about a local water access issue.		Make the work authentic and relevant • Allow students to explore and choose a local problem that is relevant to their situation or that they find particularly engaging
		Provide support for decoding written text and symbols • Have peers read to each other, read aloud to the class, provide an audio version, provide a summarized version, etc. • Digitize text and have the student use a screen reader.
Students collaborate in small groups to identify the problem, identify the requirements and the limitations of the project, and brainstorm initial ideas for a solution to their problem.		Provide safety and reduce distractions • Offer opportunities for students to share in a way that is comfortable given their culture and family dynamics. (e.g., Some cultures find talking over each other as normal while others wait for complete silence before contributing; some are comfortable with directness or do not have the language level to be polite. Eye contact varies by culture.) Resources: Cultural Differences in the Classroom, 10 Sites for Creating a Backchannel Encourage collaboration with partners and in groups • Be intentional about how groups are formed so that they include a variety of students. (e.g., race, national origin, socioeconomic status, disability, etc.) • Ensure everyone has the means to contribute. For some this might be to assign a role that matches their strengths, for some it might be to provide needed vocabulary on their AAC system, and for some, it might be to reduce the size of the group and allow options for seating (e.g., exercise ball).
		Provide models and scaffolds to aid in comprehension

		• Provide a variety of explicit prompts for each step or chunk of the small group activity (e.g., verbal, visual steps, checklist, checklist paired with graphics, tactile steps). Resources: Mini Schedules, Using Mini Schedules and Task Organizers to Help Students with ASD in Classroom Settings
Students draw a diagram with labels and a key of their initial solution and write a short initial explanation of their solution.		Vary the ways for students to respond to questions or a task • Allow students to use a variety of ways to present their prototype ideas (e.g., drawing, pictures, objects, multimedia). • Use multi-media tools to assist students with disabilities and English Learners. • Provide sentence starters, a writing template, or an expanded word bank. • Provide a variety of ways in which students can "write" to respond to questions. (e.g., traditional form of writing, with sentence starters, using pictures, etc.) Resources: Tactile Science Lesson: Using Play-Doh; Power-Assisted Writing for Science: Developing Expository Writing in a Multimedia Environment, ; Better Living Through Technology – Keyboards for People with Disabilities, Pathways to Reading to Learning for Students with Cognitive Challenges.

Resources

- Identify Criteria and Constraints | Engineering for Good | PBS LearningMedia (Additional sample lesson)

  [https://www.pbslearningmedia.org/resource/criteria-constraints/identify-criteria-and-constraints-engineering-for-good/]
- Engineering for Good Student Notebook (Examples of handouts for engineering problem)

  [https://wkar.pbslearningmedia.org/resource/beba0557-1763-4686-bb72-5df16c4070f3/engineering-for-good-student-notebook-engineering-for-good/]
- The Engineering Design Process: Define the Problem (sciencebuddies.org)

  [https://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-problem-statement]
- Solving Everyday Problems Using the Engineering Design Cycle - Activity - TeachEngineering

[https://www.teachengineering.org/activities/view/usu-1961-everyday-problems-introduction-engineering-design]

- Classroom Strategies | Reading Rockets
  [https://www.readingrockets.org/strategies]

Core Text Connections *Core text(s) linked to this lesson; other texts as needed*

- The Ogallala Aquifer | Oklahoma State University (okstate.edu)
  [https://extension.okstate.edu/fact-sheets/the-ogallala-aquifer.html]
- The Ogallala Aquifer: When will the wells run dry? What, then? (msn.com)
  [https://www.msn.com/en-us/news/us/the-ogallala-aquifer-when-will-the-wells-run-dry-what-then/ar-AA10GJe9]
- Ogallala Aquifer Project - Colorado | Natural Resources Conservation Service (usda.gov)
  [https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives/colorado/ogallala-aquifer-project]
- Ogallala Aquifer - depth, important, system, source (waterencyclopedia.com)
  [http://www.waterencyclopedia.com/Oc-Po/Ogallala-Aquifer.html
- Water-level Change in the High Plains Aquifer System - YouTube
  [https://www.youtube.com/watch?v=3rSnf-u0bzc]
- Introduction to Aquifer Recharge - RUVIVAL Toolbox - YouTube
  [https://www.youtube.com/watch?v=NUM9OAKjcyA]