Compelling Question: Why is water important?		
Supporting Question #1 How much water is available to us, and how do we use it?	Supporting Question #2 How do living things biologically depend on water?	Supporting Question #3 How do water scarcity and water quality impact our environment and our economies?

Overview of Inquiry

The purpose of this inquiry is for students to discover the many ways that we depend on water in our daily lives. This lesson discusses the distribution of clean water on earth, introduces the concepts of water quality and scarcity, and gives students a chance to explore the scientific explanations for how water sustains life.

The activities in this lesson are organized into thematic choice boards. In each section, the students will explore the same topics, but they will not all complete the same activities. For example, while one student might learn about water pollution by watching a video and answering reflection questions, another might put on a play, and a third might do a lab experiment. You must decide how you want your students to navigate the choice boards, as well as how you wish to assess their work. You may, for example, require

your students to choose a certain number of activities from the different choice board categories. You could also assign different point levels to different activities and ask the students to complete enough activities to equal a certain number of points. For some sections, it might be appropriate for different students to focus on different choice board categories, and then report back to each other on what they learned. You could even assign activities to students based on their varying levels of academic proficiency. This lesson format is designed to give students more control over their own learning, to increase engagement, and to ensure that all students stay busy throughout the lesson. However, feel free to hand pick activities from the choice boards if you want to follow a more traditional lesson format.

To demonstrate their learning, the students will write an essay about the skills and knowledge they gained from this lesson. They may also create a plan for measuring and reducing their school's water footprint.

This inquiry is designed for a high school science course (biology or earth science) and highlights the following standards:

Nebraska High School Science Standards

SC.HS.13.3.D Plan and conduct an investigation of the properties of water and their effects on Earth materials, surface processes, and groundwater systems.

SC.HS.13.3.A Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

SC.HS.12.2.C Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate and scale of global or regional climate change systems.

College, Career, and Civic Life (C3) Framework

MS-ESS2-4 Earth's Systems Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

MS-ESS3-3 Earth and Human Activity Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

HS-ESS2-2 Earth's Systems Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

HS-ESS2-5 Earth's Systems Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

HS-ESS3-1 Earth and Human Activity Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

The length of this lesson (just like any lesson in this curriculum) will depend on which and how many of the activities you choose to incorporate into your teaching. Keep in mind that **you do not need to teach every activity for the lesson to make sense**; it is expected that you will pick and choose the activities that will best suit the needs, abilities, and learning styles of your own students.

Supporting Question #1: How much water is available to us, and how do we use it?

The students will complete activities from a choice board. They will learn about topics such as basic water vocabulary, the water cycle, water quality, water scarcity, the global distribution of water resources, water usage, and Nebraska's water resources.

Supporting Question #2: How do living things biologically depend on water?

The students will complete activities from a choice board. They will learn about topics like dehydration and water-borne illness.

Supporting Question #3: How do water scarcity and water quality impact our environment and our economies?

The students will complete activities from a choice board. They will learn about the effects of poor water quality and drought on ecosystems, economies, and cultures.

Connections to Interdisciplinary Learning Suggestions

Although this inquiry lesson focuses on Nebraska high school science standards, there are several other disciplinary standards that connect to the activities. Whenever possible, a teacher should seek to partner with other teachers to create interdisciplinary units of learning. In the spirit of promoting interdisciplinary learning, this guide provides advice below.

Overlapping standards and skills

- **Geography:** Multiple activities in this lesson offer students opportunities to practice analyzing maps.
- **Geography:** One key theme of this lesson is exploring the unequal distribution of water resources - and economic wealth - throughout the world. Another key theme is human-environment interaction. The students will learn about how water influences different human cultures, as well as how it plays a role in our conflicts.
- **English:** Both the summative performance task and the taking informed action task for this lesson involve writing an essay. In addition, many of the activities in this lesson provide opportunities for students to practice their writing skills.

- **English:** Some of the activities in this lesson - like the activity that requires them to write a short story, and the one that requires them to write and perform a play - provide students with opportunities to practice their creative writing skills.

- **Art**: This lesson gives students a chance to express themselves artistically by creating infographics, PSA posters, and more.

- **History:** During this lesson, students will learn a little about how water has shaped our history. For example, they may complete an activity where they have to create a timeline of water-related conflicts. This activity could easily be expanded into a more thorough historical investigation. They may also complete an activity about the legacy of the Colorado River Compact, which requires them to analyze a primary source.

Relevant lessons from other disciplines

This lesson pairs well with the English lesson **"How do we write an effective paragraph using the "Claim, Reasoning, Evidence, Warrant (CREW)" model?"** In this lesson, both the summative performance task and the taking informed action task for this lesson involve writing an essay. In addition, many of the activities in this lesson provide opportunities for students to practice paragraph-writing skills.

Staging the Compelling Question

My Water - A Day in the Life

In this activity, the students will reflect on the many ways they use water in their daily lives.

1. *Quick write*: Have your students write in response to the following prompt:

   How do you depend on water in your daily life? Come up with as many responses as you can!

2. *Pair share*: Instruct the students to share their list with a nearby classmate. Just for fun, you may also have them circle items on their list that their partner did not write down to see who came up with the most unique responses (i.e. not listed by their partner).

3. *Class discussion*: Bring the class together to discuss what they all came up with. Create a master list of the many ways that they use water every day, and consider displaying it somewhere in the classroom to help them remember why protecting local water is important. During this conversation, you should discuss the difference between direct and indirect water usage (e.g. drinking and growing plants vs cooking food and manufacturing products). Just for fun, you may

also have the students consult with each other to figure out who came up with the most unique responses (i.e. not listed by any of their classmates).

Supporting Question #1

Supporting Question and Featured Sources

The first supporting question asks, *"How much water is available to us, and how do we use it?"* In answering this question, the students will complete activities concerning water vocabulary, the water cycle, water quality, water scarcity, the global distribution of water resources, water usage, and Nebraska's water resources.

Learning just how scarce clean freshwater is on Earth will help students appreciate the value of water.

Formative Performance Tasks

Section 1 Choice Board - Instructions

The choice board for this section of the lesson can be accessed here.

Consider the following possible scenarios:

- You could hand pick certain activities and have your entire class complete them.
- You could instruct your students to complete a certain number of activities from the choice board.
- You could instruct your students to complete a certain number of activities from each choice board category.
- You could assign point values to each activity based on length and/or difficulty and instruct your students to complete enough activities to earn a certain number of points.
- You could assign different choice board categories to different students and have them report back to each other on what they learned.
- You could assign different activities to different students based on their varying levels of academic proficiency.
- Work together with other teachers to complete more activities.

No matter how you choose to format this activity, be sure to create clear guidelines for your students. You may also want to establish the expectation that everyone should stay busy during class time, even if that means completing more activities than required.

Section 1 Choice Board - Assessment

As the students complete their choice board activities, they should hold onto the "end products" they create (e.g. answers to reflection questions, infographics, journals, slides, etc.). At the end of this section of the lesson, have them compile their end products into a portfolio. Then, ask your students to write in response to the following prompts:

- *What did you learn during this section of the lesson? What knowledge did you gain? What skills did you develop? Share your learning.*
- *Defend your answer to the previous question by referencing the end products in your portfolio. Prove your learning.*

Instead of (or in addition to) writing about their learning, you may also have your students create a concept map that visually represents what they learned during this section of the lesson. Remind them that their concept maps should not only show key concepts, but also how those key concepts are related to each other.

ASSESSMENT OPPORTUNITIES

The assessment criteria you use for this activity will depend on how you chose to format it. For example, if you did not require the students to complete at least one activity from each choice board category, you cannot expect them to have learned about all of the topics. Having acknowledged this, consider the following possible criteria for this assessment:

- ☐ Can the student recognize, define, and correctly use water-related vocabulary?
- ☐ Can the student explain the various steps in the water cycle, as well as how they are connected to one another?
- ☐ Does the student understand the extent of water scarcity on Earth (how scarce it is and why it is scarce)?
- ☐ Can the student distinguish between direct and indirect water use?
- ☐ Can the student explain how people use their finite water resources and why?
- ☐ Can the student identify their own role in using (and conserving) Earth's freshwater?
- ☐ Can the student explain different forms of water pollution?
- ☐ Can the student describe how Earth's water is distributed and explain why?
- ☐ Can the student read and interpret charts and maps?
- ☐ Can the student describe Nebraska's water resources and explain how they are used?
- ☐ Can the student explain which water quality problems threaten Nebraska and why?

Re-teaching: Have underperforming students complete more activities from the choice board, especially ones that will help them fill in gaps in their knowledge/skills.

Supporting Question #2

Supporting Question and Featured Sources

The second supporting question asks, *"How do living things depend on water?"* In answering this question, the students will complete activities concerning dehydration and water-borne illness.

Understanding how their lives depend on clean water will help students appreciate the value of water.

Formative Performance Tasks

Section 2 Choice Board - Instructions

The choice board for this section of the lesson can be accessed here.

Consider the following possible scenarios:

- You could hand pick certain activities and have your entire class complete them.
- You could instruct your students to complete a certain number of activities from the choice board.
- You could instruct your students to complete a certain number of activities from each choice board category.
- You could assign point values to each activity based on length and/or difficulty and instruct your students to complete enough activities to earn a certain number of points.
- You could assign different choice board categories to different students and have them report back to each other on what they learned.
- You could assign different activities to different students based on their varying levels of academic proficiency.
- Work together with other teachers to complete more activities.

No matter how you choose to format this activity, be sure to create clear guidelines for your students. You may also want to establish the expectation that everyone should stay busy during class time, even if that means completing more activities than required.

Section 2 Choice Board - Assessment

As the students complete their choice board activities, they should hold onto the "end products" they create (e.g. answers to reflection questions, infographics, journals, slides, etc.). At the end of this section of the lesson, have them compile their end products into a portfolio. Then, ask your students to write in response to the following prompts:

- *What did you learn during this section of the lesson? What knowledge did you gain? What skills did you develop? Share your learning.*
- *Defend your answer to the previous question by referencing the end products in your portfolio. Prove your learning.*

Instead of (or in addition to) writing about their learning, you may also have your students create a concept map that visually represents what they learned during this section of the lesson. Remind them that their concept maps should not only show key concepts, but also how those key concepts are related to each other.

ASSESSMENT OPPORTUNITIES

The assessment criteria you use for this activity will depend on how you chose to format it. For example, if you did not require the students to complete at least one activity from each choice board category, you cannot expect them to have learned about all of the topics. Having acknowledged this, consider the following possible criteria for this assessment:

- [ ] Can the student describe the biological effects of dehydration?
- [ ] Does the student understand how much water they should be drinking every day?
- [ ] Can the student describe the biological effects of poor water quality?

Re-teaching: Have underperforming students complete more activities from the choice board, especially ones that will help them fill in gaps in their knowledge/skills.

Supporting Question #3

Supporting Question and Featured Sources

The third supporting question asks, *"How do water scarcity and water quality impact our environment and our economies?"* In answering this question, the students will complete activities concerning the effects of poor water quality and drought on ecosystems, economies, and cultures.

Exploring how practically every aspect of our lives depend on clean water will help students appreciate the value of water.

Formative Performance Tasks

Section 3 Choice Board - Instructions

The choice board for this section of the lesson can be accessed here.

Consider the following possible scenarios:

- You could hand pick certain activities and have your entire class complete them.
- You could instruct your students to complete a certain number of activities from the choice board.
- You could instruct your students to complete a certain number of activities from each choice board category.
- You could assign point values to each activity based on length and/or difficulty and instruct your students to complete enough activities to earn a certain number of points.
- You could assign different choice board categories to different students and have them report back to each other on what they learned.
- You could assign different activities to different students based on their varying levels of academic proficiency.
- Work together with other teachers to complete more activities.

No matter how you choose to format this activity, be sure to create clear guidelines for your students. You may also want to establish the expectation that everyone should stay busy during class time, even if that means completing more activities than required.

Section 3 Choice Board - Assessment

As the students complete their choice board activities, they should hold onto the "end products" they create (e.g. answers to reflection questions, infographics, journals, slides, etc.). At the end of this section of the lesson, have them compile their end products into a portfolio. Then, ask your students to write in response to the following prompts:

- *What did you learn during this section of the lesson? What knowledge did you gain? What skills did you develop? Share your learning.*
- *Defend your answer to the previous question by referencing the end products in your portfolio. Prove your learning.*

Instead of (or in addition to) writing about their learning, you may also have your students create a concept map that visually represents what they learned during this section of the lesson. Remind them that their concept maps should not only show key concepts, but also how those key concepts are related to each other.

ASSESSMENT OPPORTUNITIES

The assessment criteria you use for this activity will depend on how you chose to format it. For example, if you did not require the students to complete at least one activity from each choice board category, you cannot expect them to have learned about all of the topics. Having acknowledged this, consider the following possible criteria for this assessment:

- ☐ Can the student describe the effects of drought on ecosystems?
- ☐ Can the student describe the effects of poor water quality on ecosystems?
- ☐ Can the student describe the effects of drought and poor water quality on economies?
- ☐ Can the student describe the effects of drought and poor water quality on cultures?

Re-teaching: Have underperforming students complete more activities from the choice board, especially ones that will help them fill in gaps in their knowledge/skills.

Summative Performance Task

"Why Is Water Important" Essay

For this summative performance task, the students will write an essay about what they learned during this lesson. They should respond to the following prompt:

> *Why is water important? Write an essay featuring your key takeaways from this lesson. Be sure to reference the end products in your portfolio to support your ideas.*

Alternatively, you could have the students write an essay about one of the supporting questions for this lesson (either assigned or chosen). You could even have them write three essays - one for each supporting question.

ASSESSMENT OPPORTUNITIES

Essay: Grade the students' essays based on the following criteria:

- ☐ Did the student offer multiple reasons why water is important?
- ☐ Did the student explain why clean freshwater is scarce?
- ☐ Did the student describe the many ways humans depend on water (biologically, economically, culturally, etc.)?
- ☐ Did the student explain how ecosystems depend on water?

For more information about assigning and grading essays, see this Essay Writing Guide.

Taking Informed Action

Reducing My School's Water Footprint

In this activity, the students will come up with ways for their school to save water.

1. *Quick write*: Have your students write in response to the following prompts:
   - *What steps could we take to measure our school's "water footprint"?*
   - *How could we reduce our school's "water footprint"?*

ADDITIONAL TIP: Keep in mind that your students may need to develop some skills before they can put their plan into action. For example, you may need to teach them the basics of how to give a survey, conduct an interview, or launch an awareness campaign.

2. *Class discussion*: Bring the class together for a discussion about ways they could measure and reduce their school's water footprint. Be sure to take notes on the board as the students talk, so that they can keep track of the ideas they come up with. During this conversation, the students should decide what they want to do and create a plan for how they're going to do it. For example, to measure their school's water footprint, the students might decide that they want to conduct a schoolwide survey, as well as interview people like the principal, the lunch servers, and the janitors. They might also decide that they want to wait for the results of their survey before choosing how they will take action. Finally, they would assign different tasks to different students to set their plan in motion.

3. *Work time*: Give the students time to work on their project.

4. *Essay*: Have your students write an essay in response to the following prompts:
   - *What did we find out about our school's water footprint?*
   - *What did we do to try to reduce our school's water footprint?*

- *What skills did you learn/develop by completing this project? Provide specific examples.*
- *What are some strengths and weaknesses of the plan we came up with? What went well, and what didn't?*
- *Do you feel that the effects of our project will be long lasting? Why or why not?*
- *If we were to continue this project, what do you think the next step would be? How could we build on what we have already done?*

ASSESSMENT OPPORTUNITIES

Essay: Grade the students' essays based on the following criteria:

- ☐ Did the student provide a summary of what the class did to try to measure their school's water footprint?
- ☐ Did the student provide a summary of what the class did to try to reduce their school's water footprint?
- ☐ Did the student identify both strengths and weaknesses of their chosen course of action?
- ☐ Did the student identify skills they learned while completing this project, and did they defend their claims with specific examples?
- ☐ Did the student provide an adequate analysis of the long-term impact of their project?
- ☐ Did the student explain multiple ways that they could continue their project?

For more information about assigning and grading essays, see this Essay Writing Guide.

Citations

Re: 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, Accessed June 6, 2023.

Re: Concept Map Instructions: http://www.scienceideas.org/binders/matter/Tab1/Concept-Mapping-Routine.pdf Accessed July 3, 2023.

Filedownload.ashx

https://www.usgs.gov/special-topics/water-science-school/science/ice-snow-and-glaciers-and-water-cycle

https://www.calacademy.org/educators/lesson-plans/earths-water-a-drop-in-your-cup

Distribution-water-and-above-earth

Water_scarcity_2

https://thewaterproject.org/water-scarcity/water_scarcity_2

https://watercenter.unl.edu/resources/publications/WaterPosterPDF.pdf

Areas-high-risk-nitrogen-contamination-groundwater

702_20231127-113929.pdf

Evapotranspiration-research.aspx

Environmental-pollution-caused-factories-3651.html

Water-ph-amp-pollution-5850000.html

Effects-bioaccumulation-ecosystem-13721.html

Watch

Toxic-plastic-pollution-food-chain

Watch

Impacts-drought-water-quality-and-wildlife

What-is-thermal-pollution-causes-impact

Animal-waste-and-agrochemicals-are-leading-cause-of-fish-kills-in-iowa-waterways

Watch

Watch

https://www.epa.gov/caddis/ph

Watch

Drought-is-hurting-nebraskas-economy-and-the-impacts-could-ripple-worldwide

102211838

Toxic-algae-to-blame-for-cattle-deaths-062512

In-last-30-days-200-dead-cows-in-the-state-of-missouri

Livestock-production-value-economic-impact-nebraska

Nebraska

“A Dire Wake-Up Call: If Southwest Florida Water Quality Tanks, So Does Our Economy”

“Continued Water Woes in Florida Hamstring Tourist-Based Economy”

081112124418.htm

Watch

People-move-where-water-flows-global-patterns-of-water-driven-human-migration

List

The-water-wars-of-the-future-are-here-today

Colorado-river-compact

https://www.usbr.gov/lc/region/pao/pdfiles/crcompct.pdf

Water-health

Education

Paris-olympics-2024-seine-water-quality

20240408-french-charity-sounds-alarm-about-seine-ahead-of-olympics

https://www.latimes.com/sports/olympics/story/2021-08-04/tokyo-olympics-marathon-swimming-hot-weather-pollution

150130-ebola-virus-outbreak-epidemic-sierra-leone-funerals-1

https://www.youtube.com/watch?v=OCzYdNSJF-k&t=40s

https://www.youtube.com/watch?v=9iMGFqMmUFs

https://www.wowt.com/content/news/Small-town-residents-want-clean-drinking-water-501920822.html

https://www.pcanaction.org/facts

https://www.wowt.com/content/news/West-Points-unsafe-water-raising-concerns-for-other-rural-water-systems-559294601.html

https://www.youtube.com/watch?v=vS-fQ5B4JrA&t=361s

https://www.labmanager.com/dehydration-alters-human-brain-shape-and-activity-slackens-task-performance-3676

Hydration-calculator

Watch

https://www.extendednotes.com/after-school-activities/stem-experiment-understanding-the-effects-of-dehydration

https://www.projectwet.org/sites/default/files/inline-files/healthy-water-heathly-people-educator-guide-2.pdf

Watch

https://courses.lumenlearning.com/earthscienceck12/chapter/water-on-earth/#x-ck12-QmlvIDAyIDAyIDEzIGE

https://nebraskapublicmedia.pbslearningmedia.org/resource/f64f4933-7597-429e-a638-de9eefd2f6d9/water-usage/

https://worldwatermap.nationalgeographic.org

https://www.usgs.gov/special-topics/water-science-school/science/water-basics-information-topic

https://water.usgs.gov/edu/activity-tf-properties.html#/
https://water.usgs.gov/edu/activity-tf-groundwater.html

https://slidesgo.com/slidesgo-school/google-slides-tutorials/how-to-create-a-jeopardy-game-in-google-slides

https://medicine.yale.edu/news-article/cloud-wars/

https://www.youtube.com/watch?v=gi3aZLA1tMw

http://www.watercalculator.org/wfc2/

https://ssec.si.edu/sites/default/files/games/Aquation/index.html

https://ssec.si.edu/sites/default/files/games/Aquation/TextVersion/index.html

https://education.nationalgeographic.org/resource/water-inequality/

https://www.nrdc.org/stories/water-pollution-everything-you-need-know#whatis