



SEARCHING FOR SUSTAINABILITY: AGRICULTURE AND WATER IN THE CENTRAL SANDS OF WISCONSIN

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GRADE LEVELS

High School, Grades 9-12

CONTENT AREA

Biology/Life Science

UNIT THEME

Ecology or Environmental Science

TOPIC

The connection between agricultural decisions and water resources

TIME REQUIRED

120-180 minutes



OVERVIEW

People view sustainability in many different ways. Some may say that sustainability means having the same quality of resources over time, while others may look more towards a balance between humans and other natural organisms. The Environmental Protection Agency (2017) notes that pursuing sustainability means, “to create and maintain conditions under which humans and nature can exist in productive harmony to support present and future generations.” Human sustainability is a component of sustainability; human sustainability may also consider quality of life. Sustainability can be rather complicated, especially when considering the balance of impacts (both positive and negative) on the environment, society, and the economy.

Decisions humans make have the potential to affect the quality of the natural world (environmental impact), to benefit or hinder the quality of life for particular people and/or communities (social impacts), and/or to provide monetary advantages or disadvantages to specific communities, businesses, and/or people (economic impact). Many regions in the United States are currently facing the question of how to sustain profitable agriculture along with water quality and quantity, and Wisconsin is no different. In the Central Sands, farmers and agribusinesses grow crops, some of which require irrigation to maintain and to maximize profitability. Many of the agribusinesses irrigate crops by pumping water from the ground; some use high capacity wells. High capacity wells pump 70 or more gallons per minute (DNR 2017). Humans use these crops for their own consumption, to feed animals, and to produce ethanol. Humans and wildlife also depend on that same water, which supports the numerous streams and lakes in the area. Pumping water decreases the flow of water in streams and the water in lakes, which affects waterfront property owners, fish and wildlife, real estate and property tax values, and tourism. With many different stakeholders depending on this water environmentally, socially, and economically, what decisions can humans make to sustain both agriculture and water?

In this lesson, students will demonstrate an understanding of the different stakeholders involved in and dependent on the use of high capacity wells in the Central Sands of Wisconsin through role-play. While role-playing, the students will develop and justify a sustainable solution for both agriculture and water in the Central Sands.

CONCEPT Human sustainability

ENDURING UNDERSTANDING:

Students will understand that agriculture and water are connected, that water use by one person affects the availability to others, and that people value water in different ways. Decisions to allow use of high capacity wells in the Central Sands affect multiple stakeholders as well as the sustainability of humans in the area.

CONTENT OBJECTIVES:

Students will be able to describe how agricultural decisions impact water quantity and quality in the area, as well as the overarching concept of the sustainability of humans.

LEARNER OBJECTIVES:

Students will identify a variety of environmental, economic, and social impacts surrounding high capacity wells, evaluate the consequences of possible solutions, and select and defend a position based on evidence.

PROCESS OBJECTIVES:

Students will work in small groups and as a class to process new information and will use evidence to develop and defend a possible solution.

MATERIALS NEEDED (each group, each student):

1. Student worksheets
2. Writing utensils
3. Access to internet



PROCEDURES

Day One

1. Students will view the Searching for Sustainability video. If class time is not available, students may view the video as a homework assignment.

Day Two

1. Students will discuss the meaning of sustainability. During the discussion, the students should consider how the availability of groundwater has guided the development of agriculture in the Central Sands and what will happen if water usage continues to increase.
2. Students will review the video focused on the Central Sands. As the students review, they should identify categories of stakeholders and the cause of low water levels in lakes and streams in the Central Sands.
3. Students will identify categories of stakeholders interested in water and agriculture in Wisconsin. Note: The teacher might remind students of the definition of stakeholders (i.e. someone or something that is interested or concerned about an issue). Categories may include farmers (small to middle scale farms), agribusinesses (large scale/commercial farms), recreational enthusiasts, politicians (e.g. city mayor), business owners, homeowners, animal rights activists, and/or citizens.
4. Students will nominate two students to be the facilitators; the facilitators will help the stakeholders come to a sustainable solution. The other students will break up into small groups based on the categories of stakeholders, which they identify.

PROCEDURES *(continued)*

The teacher should handout the student worksheets, so that each group can independently research the interests of their specific group using available technology. Each stakeholder group should describe 1) economic, social, and environmental concerns regarding high capacity wells, 2) objective criteria (e.g., market value, professional standards, and scientific judgment) for evaluating possible solutions, and 3) their preferred solution along with a justification. While the stakeholder groups conduct research, the facilitator group should develop a method for facilitating a solution, along with conduct their own research on the stakeholders and their concerns with high capacity wells.

Day Three

1. Each group will role-play as their specific stakeholder group.
2. The facilitators will work with the stakeholder groups as a whole to come to a consensus on the specific objective criteria they will use to evaluate possible solutions.
3. The facilitators will explain their method of facilitating a solution to the stakeholder groups.
4. Facilitators will work with the stakeholder groups to develop a solution to sustain both agriculture and water that balances economic, social, and environmental impacts.
5. The class (as opposed to the individual stakeholder groups) should justify why they chose their specific solution to sustain both agriculture and water using scientific evidence.

ASSESSMENT

The teacher can conduct the assessment during day three of class or through an exit slip completed by each student at the end of day three. The assessment should consider the following questions:

- Explain the connection among agriculture, water, and human sustainability as described in the video.
- Compare stakeholders' concerns with using high capacity wells to support agriculture in the Central Sands.
- Justify a sustainable solution for agriculture and water in the Central Sands.

EXTENSION ACTIVITIES

- Visit the Center for Watershed Science and Education website (<https://www.uwsp.edu/cnr-ap/watershed/Pages/default.aspx>) to learn more about the water quality where you live, how streamflow is measured, or about the groundwater model.
- Compare other areas in the United States that are currently experiencing challenges balancing water and agriculture to challenges Wisconsin is experiencing. Other states might include California, Texas, Oklahoma, Kansas, and Nebraska.
- Review the guide titled, "A Guide to Developing Discussion Materials to Get Your Community Deliberating" at the following website (<https://naaee.org/eeopro/resources/lets-talk-about-water>).



This activity is richest when completed in groups with answers shared to a whole class. This worksheet is not a typical worksheet as it encourages students to construct knowledge as they answer questions. The questions build off of each other.



RESOURCES

- <http://dnr.wi.gov/topic/wells/highcapacity.html>
- <https://www.uwsp.edu/cnr-ap/clue/Documents/megatrends/WaterMegatrendsFINAL.pdf>
- <https://www.wpr.org/high-capacity-wells-bill-passes-state-senate>

The following **Student Proficiency Standards** can be met by teaching **AGRICULTURE AND WATER IN THE CENTRAL SANDS OF WISCONSIN:**

NGSS Standards focused on Human Sustainability (<https://www.nextgenscience.org/topic-arrangement/hshuman-sustainability>):

PERFORMANCE EXPECTATIONS/ASSESSABLE COMPONENT:

- HS-ESS3-1. 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.
- HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.



FOUNDATIONS:

Science and Engineering Practices

- Constructing Explanations and Designing Solutions – Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations (HS-ESS3-4).



Disciplinary Core Ideas

- ESS3.A: Natural Resources – Resource availability has guided the development of human society (HS-ESS3-1).
- ETS1.B: Developing Possible Solutions – When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts (secondary to HS-ESS3-2 and HS-ESS3-4).



Crosscutting Concepts

- Cause and Effect – Empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects (HS-ESS3-1).

CONNECTIONS:**ELA/Literacy**

- RST.11-12.1 – Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account (HS-ESS3-1), (HS-ESS3-4).

Mathematics

- MP.2 – Reason abstractly and quantitatively (HS-ESS3-1), (HS-ESS3-4).

WISCONSIN ENVIRONMENTAL EDUCATION STANDARDS:

- B.12.11 - Assess how changes in the availability and use of natural resources (especially water and energy sources) will affect society and human activities such as, transportation, agricultural systems, and manufacturing.
- B.12.12 – Evaluate the environmental and societal costs and benefits of allocating resources in various ways and identify management strategies to maintain economic and environmental sustainability.

CITATIONS

DNR. 2017. High Capacity Well. Retrieved August 18, 2017, from: <http://dnr.wi.gov/topic/wells/highcapacity.html>.

EPA. 2017. Learn About Sustainability. Retrieved August 11, 2017, from: <https://www.epa.gov/sustainability/learn-about-sustainability#what>.

Fisher, R., Ury, W., Patton, B. 1991. Getting to Yes. New York: Penguin Books.