SOIL&WATER

CONSERVATION VIRTUAL FIELD TRIP

DIVISION OF AGRICULTURE RESEARCH & EXTENSION University of Arkansas System

United States Department of Agriculture Natural Resources Conservation Service

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# Farm Surface Water Irrigation Aquifer Issues Virtual Field Trip

## Grades 9-12 Integrated Chemistry, Environmental Science, Physics and Agricultural Science

**Arkansas NGSS Suggestions:**

***Chemistry:***

**Topic One: Matter and Chemical Reactions:**

**Cl-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.**

*Science and Engineering Practices:* Planning and Carrying Out Investigations (CL-ESS2-5)

*Crosscutting Concepts:* Structure and Function (CL-ESS2-5)

*Disciplinary Core Ideas:* ESS2.C: The roles of water in Earth's Surface Processes (CL-ESS2-5)

*Connections to the Arkansas Disciplinary Literacy Standards:* WHST.9-12.7

*Connections to the Arkansas Mathematic Standards:* HSN.Q.A.3

**Cl1-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.**

*Science and Engineering Practices:* Constructing Explanations and Designing Solutions (Cl1-ETS1-2)

*Disciplinary Core Ideas:* ETS1.C: Optimizing the Design Solution (Cl1-ETS1-2)

*Connections to the Arkansas Mathematic Standards:* MP.4

***Environmental Science:***

**Topic One: Systems**

**EVS-ESS2-5: Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.**

*Science and Engineering Practices:* Planning and Carrying Out Investigations (EVS-ESS2-5)

*Crosscutting Concepts:* Structure and Function (EVS-ESS2-5)

*Disciplinary Core Ideas:* ESS2.C The roles of water in Earth's Surface Processes (EVS-ESS2-5)

*Connections to the Arkansas Disciplinary Literacy Standards:* WHST.9-12.7

*Connections to the Arkansas Mathematic Standards:* HSN.Q.A.3

**EVS1-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.**

*Science and Engineering Practices:* Asking Questions and Defining Problems. (EVS1-ETS1-1)

*Crosscutting Concepts:* Influence of Engineering, Technology and Science on Society and the Natural World. (EVS1-ETS1-1)

*Disciplinary Core Ideas:* ETS1.A: Defining and Delimiting Engineering Problems. (EVS1-ETS1-1)

*Connections to the Arkansas Disciplinary Literacy Standards:* RST.11-12.7, RST.11-12.8, RST.11-12.9

*Connections to the Arkansas Mathematic Standards:* MP.2, MP.4

**Topic 4: Sustainability**

**EVS-ESS3-2: Evaluate competing design solutions for developing, managing and utilizing energy and mineral resources based on cost-benefit ratios.**

*Science and Engineering Practices:* Engage an Argument from Evidence (EVS-ESS3-2)

*Crosscutting Concepts:* Influence of Science, Engineering and Technology on Society and the Natural World. Science Addresses Questions about the Natural and Material World. (EVS-ESS3-2).

*Disciplinary Core Ideas:* ESS3.A: Natural Resources. ETS1.B: Developing Possible Solutions (EVS-ESS3-2).

*Connections to the Arkansas Disciplinary Literacy Standards:* RST.11-12.8

*Connections to the Arkansas Mathematic Standards:* MP.2

**EVS-LS2-7: Design, evaluate and refine a solution for reducing the impacts of human activities on the environment and biodiversity.**

*Science and Engineering Practices:* Constructing Explanations and Designing Solutions (EVS-LS2-7).

*Crosscutting Concepts:* Stability and Change (EVS-LS2-7)

*Disciplinary Core Ideas:* LS2.C: Ecosystem Dynamics, Functioning, and Resilience, ESS3.A: Natural Resources, ESS3.C: Human Impacts on Earth Systems, ETS1.B: Developing Possible Solutions. (EVS-LS2-7).

*Connections to the Arkansas Disciplinary Literacy Standards:* RST.9-10.8, RST.11-12.1, RST.11-12.8, WHST.9-12.7

*Connections to the Arkansas Mathematic Standards:* MP.2, HSN.Q.A.1, HSN.Q.A.2, HSN.Q.A.3

**EVS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.**

*Science and Engineering Practices:* Using Mathematics and Computational Thinking (EVS-LS4-6).

*Crosscutting Concepts:* Cause and Effect (EVS-LS4-6).

*Disciplinary Core Ideas:* LS4.C: Adaptation, LS4.D: Biodiversity and Humans, ETS1.B: Developing Possible Solutions (EVS-LS4-6).

*Connections to the Arkansas Disciplinary Literacy Standards:* WHST.9-12.5, WHST.9-12.7.

**EVS4-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.**

*Science and Engineering Practices:* Using Mathematics and Computational Thinking (EVS-ESS3-3)

*Crosscutting Concepts:* Cause and Effect (EVS-LS4-6), Stability and Change (EVS-ESS3-3), Systems and System Models (EVS-ESS3-6)

*Disciplinary Core Ideas:* ETS1.B: Developing Possible Solutions (EVS-LS4-6).

*Connections to the Arkansas Mathematic Standards:* MP.2

***Physics:***

**Topic 1: Motion**

**P-PS1-1AR: Create a model of motion and forces, including vectors graphed on the coordinate plane, to describe and predict the behavior of a system**.

*Science and Engineering Practices:* Developing and Using Models (P-PS1-1AR), Using Mathematics and Computational Thinking (P-PS1-2AR)

*Crosscutting Concepts:* System and System Models (P-PS1-1AR)

*Disciplinary Core Ideas:* PS2.A: Forces and Motion

*Connections to the Arkansas Disciplinary Literacy Standards:* RST.9-10.7

*Connections to the Arkansas English Language Arts Standards:* SL.11-12.2

*Connections to the Arkansas Mathematic Standards:* HSN.VM.A.1, HSN.VM.B.4

**P-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.**

*Science and Engineering Practices:* Analyzing and Interpreting Data (P-PS2-1)

*Crosscutting Concepts:* Structure and Function (P-PS2-1)

*Disciplinary Core Ideas:* PS2.A: Forces and Motion

*Connections to the Arkansas Disciplinary Literacy Standards:* RST.11-12.1, RST.11-12.7, WHST.9-12.9

*Connections to the Arkansas Mathematic Standards:* MP.2, MP.4, HSN.Q.A.1-3, HSN.VM.A.1,3, HSN.VM.B.4, HSA.SSE.B.3

**P1-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.**

*Science and Engineering Practices:* Constructing Explanations and Designing Solutions (P1-ETS1-2)

*Crosscutting Concepts:* Interdependence of Science and Technology (P1-ETS1-2)

*Disciplinary Core Ideas:* PS2.A: Forces and Motion, ETS1.C: Optimizing the Design Solution.

*Connections to the English Language Arts Standards:* SL.11-12.2

*Connections to the Arkansas Mathematic Standards:* MP.2, HSN.VM.A.3

**Topic 2: Work and Energy**

**P-PS2-5AR: Use mathematical representations to support the claim that the change in kinetic energy of a system is equal to the net work performed upon the system.**

*Science and Engineering Practices:* Using mathematics and computational thinking (P-PS2-5AR).

*Crosscutting Concepts:* Energy and Matter (P-PS2-5AR).

*Disciplinary Core Ideas:* PS3.C: Relationship between energy and forces.

*Connections to the English Language Arts Standards:* SL.11-12.4

*Connections to the Arkansas Mathematic Standards:* MP.2, MP.4, HSN.Q.A.1-3, HSF.IF.C.7

**Topic 3: Heat and Thermodynamics**

**P-PS3-3AR: Use mathematical representations to model the conservation of energy in fluids.**

*Science and Engineering Practices:* Using mathematics and computational thinking (P-PS3-3AR)

*Crosscutting Concepts:* Energy and Matter (P-PS3-3AR)

*Disciplinary Core Ideas:* PS3.B: Conservation of Energy and Energy Transfer

*Connections to the Arkansas Mathematic Standards:* MP.2, MP.4, HSN.Q.A.1-3, HSA.CED.A.3, HSA.CED.A.4

**Objective:** Students will understand the importance of irrigation watering with regards to conservation of water. Students will understand the current concerns with reference to the decreasing aquifer stores in the Alluvial Aquifer. Farmers are addressing this shortage though crop rotation, surface water storage, precision and zero leveling, ditch water recycling and underground pipelines for surface water movement.

**Assessment:** Students will turn in a two-paragraph reflection paper on what they learned and how these water conservation efforts can affect where they live. They also need to give the

answers to their two questions from the *Farm Surface Water Irrigation Issues Virtual Field Trip video.*

**Key Points:** Definition of an aquifer. Alluvial water shortage in Arkansas. Surface water storage through rain and river winter/spring overflow. Water conservation through precision field leveling, ditch water recycling, row rice and crop rotation. Technology being used to help with water conservation such as underground pipelines for channeling surface water, VFD electric pumps, moisture sensors and the Pipe Planner application for Poly-pipe Irrigation. Benefits of irrigation conservation (wildlife and aquatic flora and fauna).

**Materials:**

- You will need to register online if you plan to watch the field trip 'live' on March 19. Once you have registered, you will receive a registration link via Constant Contact. If you do not have a link, email dyoung@uada.edu and one will be emailed to you.
  If you register during the live feed, you will be automatically directed to the site and you will receive an automated email with the link to the live feed and a reminder email with a link one hour before the VFT begins.
- If you plan to watch the recorded *Farm Surface Water Irrigation Issues Virtual Field Trip* video after March 19, go to www.uaex.uada.edu/soywhatsup and click on the ' teacher curriculum' icon on the left hand side of the page. This will take you to the link for the video.
- Paper writing utensils for students.

**Preparation:**

It is highly recommended that you, the teacher, do research on the key words given below.

While the video covers the aquifer, it is recommended that you also do a quick review of the basis and history of the Alluvial Aquifer in Arkansas, including the decline in water levels.

**Time Duration: two class periods.**

The video is about 60 minutes long (45 minutes plus any questions). Assume about 15 minutes for students to look up vocabulary and prepare questions for the video session, 15 minutes to teach essential concepts and about 15 minutes for group discussion and reflection after the video.

**Elicit:**

Do a KWL Chart about irrigation. How do farmers water their crops? Where does the water that farmers use come from? Why would this water consumption be an issue in Arkansas? (mainly AG state, lots of crops, rice takes a lot of water to grow, etc). Considering the properties of water and the interaction water has on the environment, how could farmers decrease water usage from the Alluvial Aquifer yet still give adequate moisture to their crops?

**Engage:**

Tell the students that they are going to watch a video titled '*Farm Surface Water Irrigation Issues Virtual Field Trip'*. Before they start the video, have the students break into groups to define the following words:

- Definition of an Aquifer; how they form, etc.
- Alluvial Aquifer
- Surface water storage
- Precision field leveling
- Zero incline fields
- Row rice for water conservation
- Crop Rotation
- VFD Electric vs Diesel pumps
- Moisture Sensors
- Pipe Planner Application

Once all the words are defined, have each group come up with two questions they have about the above word groups that may be answered in the video. ***Their jobs are to turn in the questions and the answers by the end of the virtual field trip*.***

*The live video stream will give your students an opportunity to ask questions throughout the field trip. If they are not finding their questions adequately answered during the broadcast, you can send in their questions to be answered at the end of the video.

**Explain:**

***BEFORE THE VIDEO*** be sure the students understand that irrigation water is a precious commodity both economically and ecologically. Already the Alluvial Aquifer is showing a water deficit and it is becoming both ecologically and economically expensive to continue to use this aquifer for irrigation in Arkansas. This video shows how our farmers are using innovative ways to decrease their reliance on the Alluvial by using rain and recycled irrigation groundwater, plus water reservoir storage from river overflows.

*If you are in chemistry*, this is a good time to discuss the water cycle, the physical/chemical properties of water and the structure and function of the dipole molecule and how it plays into an aquifer. You could also cover how sensors measure moisture.

*Environmental Science* concepts could involve ecosystem dynamics, natural resources, human impact and the role of water in surrounding systems.

*Physics teachers:* This video covers the physics of flow (open and closed channel) involving volume, height, pressure flow, and velocity of water dependent on ground elevation and pipe

diameter. Consider developing some problems beforehand for your students to work on after the video.

**Explore:**

Farmers have to be constantly aware of the amount and origin of the water they use to irrigate their crops. Aquifer water availability has dropped over the years so farmers are always looking for ways to use alternate sources of water; alternate water usage means less cost, better sustainability and is better for the environment.

Show the video '*Farm Surface Water Irrigation Issues Virtual Field Trip'.*

**Elaborate:**

After the video, break the students into four groups; the *Irrigation runoff capture* group, the *River overflow reservoir* group, the *Crop variation (row rice, crop rotation)* group and the *Precision leveling/Zero grade* group. Have each group brainstorm their area of study's good and bad points. Tell students they need to come up with at least six ways total and then report them to the rest of the class. The class can debate how to 'mix and match' these different practices to fit where they live.

**Evaluate:**

Students will turn in a two-paragraph reflection paper on what they learned and how these conservation efforts can affect where they live. They also need to give the answers to their two questions from the video.

**Extend:**

End the lesson with how the conservation practices of farmers to decrease their dependence on the Alluvial Aquifer has also had a huge impact on our personal lives through the water we use and the food we eat.

Assign a brainstorming project that allows students to design their own alternate irrigation methods, moisture sensor equipment or calculate flow based on different ground elevations.

Have an extension agent or local farmer come to your classroom and talk about irrigation of crops in your local community.