



**SOIL&WATER**

CONSERVATION VIRTUAL FIELD TRIP SERIES

**U of A** DIVISION OF AGRICULTURE  
RESEARCH & EXTENSION  
University of Arkansas System

**USDA** United States Department of Agriculture  
Natural Resources Conservation Service

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"Improve Water Quality & Reduce Water Use with Surge Irrigation"

Virtual Field Trip

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

Arkansas NGSS Suggestions:

*Chemistry:*

Topic One: Matter and Chemical Reactions:

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

**1 Improve Water Quality & Reduce Water Use with Surge Irrigation**

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

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

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

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

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

**CI1-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 (CI1-ETS1-2)

*Disciplinary Core Ideas:* ETS1.C: Optimizing the Design Solution (CI1-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

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*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)*

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*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**

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**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*

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## 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 regard to conservation of water through surge and Poly Pipe Irrigation. Students will understand the science behind the checking of moisture levels in soil and water chemistries.

**Assessment:** Students will write a reflection paper on what they learned about irrigation conservation and testing in the *'Improve Water Quality & Reduce Water Use with Surge Irrigation'* Virtual Field Trip.

**Key Points:** water irrigation management, furrow irrigation, surge irrigation, Poly Pipe Irrigation, water flow pacing, water chemistries and soil moisture testing, Pipe Planner Software, tail water loss.

### Materials:

- You will need to register online if you plan to watch the field trip 'live' on September 10. Once you have registered, (you will receive a registration link via Constant Contact. If you do not have a link, email [dyoung@uada.edu](mailto: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) 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 *Improve Water Quality & Reduce Water Use with Surge Irrigation* Virtual Field Trip, go to [www.uaex.uada.edu/soywhatsup](http://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:

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It is highly recommended that you, the teacher, watch *The History of Discovery Farms Virtual Field Trip* before the *Improve Water Quality & Reduce Water Use with Surge Irrigation* VFT as it will give you a strong understanding about how and why Discovery Farms work in Arkansas. This will provide background when explaining the *Improve Water Quality & Reduce Water Use*

*with Surge Irrigation* video to your students. It is also recommended that you familiarize yourself with the vocabulary words.

No other significant preparation is necessary.

### **Time Duration: 1-2 class periods**

The video is about 45 minutes long. 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? How do farmers control irrigation water to prevent waste? How important is soil moisture depths and irrigation?

Get students thinking about the drawbacks of irrigation runoff (tail water loss) by asking students how do farmers keep plants healthy (fertilizers) and do they think all the fertilizer that is placed on the field goes into the plant? If not, where does the excess fertilizer go?

Considering the properties of water and the interaction water has on the environment, how could this excess fertilizer impact our ecosystem? How can farmers measure excess fertilizer in water, and what can they do to prevent this? What can farmers do to decrease water (and fertilizer) loss yet have optimum soil moisture depth for their crops?

### **Engage:**

Tell the students that they are going to watch a video titled '*Improve Water Quality & Reduce Water Use with Surge Irrigation*' Virtual Field Trip. Before they start the video, have the students break into groups to define the following word groups:

- Furrow irrigation
- Tail water loss
- Automated run-off monitoring station
- Automated distribution of irrigation flow
- Surge irrigation

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- Poly Pipe tubing furrow irrigation
  - Water flow pacing
  - Pipe Planner Computer Program
  - Soil moisture sensors
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- Water quality analysis; focus on nitrates, phosphates, total phosphorous and total solids in water.

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. Water that is getting to the plant roots isn't becoming runoff and isn't taking fertilizer with it.

If you are in chemistry, this is a good time to discuss the water cycle, the properties of water, the structure and function of the dipole molecule and its impact on systems around it, and water chemistries.

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 diameter of pipe holes, volume, height, pressure flow and velocity of water. It also discusses the velocity of particulates in a water stream. Consider developing some problems beforehand for your students to work on after the video.

### **Explore:**

Farmers have to be constantly aware of the amount of water they use to irrigate their crops. Farmers are always looking for ways to conserve and increase efficiency of their irrigation water; lower water usage means less cost, better sustainability and less contaminated water

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runoff. Working with local agencies not only helps farmers, it helps citizens by keeping our water plentiful and clean.

Show the video *Improve Water Quality & Reduce Water Use with Surge Irrigation* Virtual Field Trip.

## Elaborate:

After the video, break the students into three groups; the *Furrow Irrigation with Polypipe* Group, the *Surge Irrigation* group and the *Water Quality Analysis* group. Have each group brainstorm how their 'area of study' affects their daily lives. Tell students they need to come up with at least five ways and then report them to the rest of the class.

## Evaluate:

Students will turn in a two-paragraph reflection paper on what they learned and how these conservation efforts affect their personal lives and the answers to their two questions from the video.

## Extend:

End the lesson with how conservation practices of farmers also have 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 method, runoff water chemistry testing protocols or calculate flow based on different Poly Pipe hole diameters and surge times.

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



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