Soil AND WATER
CONSERVATION VIRTUAL FIELD TRIP SERIES

UofA DIVISION OF AGRICULTURE RESEARCH & EXTENSION University of Arkansas System

USDA United States Department of Agriculture Natural Resources Conservation Service

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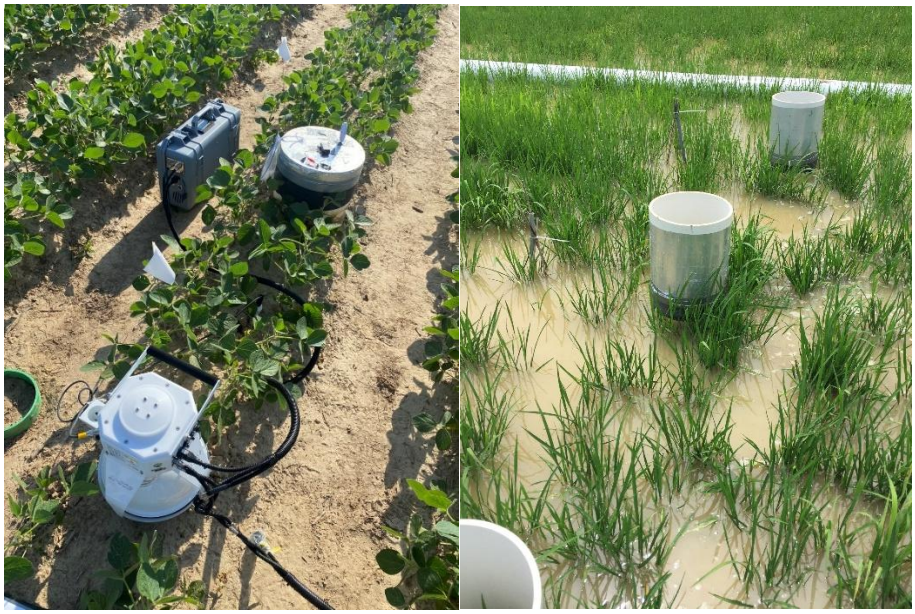

The Science Behind Soil and Water Conservation Practices Field Trips

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

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Arkansas NGSS Suggestions:

Integrated Biology:

Topic 6: Life and Earth's Systems

B16-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs 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: Constructing Explanations and Designing Solutions (B16-ETS1-3)

Connections to Engineering, Technology and Applications of Science: Influence of Science, Engineering and Technology on Society and the Natural World. (BI16-ETS1-3)

Disciplinary Core Ideas: ETS1.B: Developing Possible Solutions

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

Connections to the Arkansas Mathematical Standards: MP.2, MP.4

Topic 7: Human Impacts on Earth Systems

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

Science and Engineering Practices: Constructing Explanations and Designing Solutions (BI-ESS3-1)

Crosscutting Concepts: Cause and Effect (BI-ESS3-1)

Disciplinary Core Ideas: ESS3.A: Natural Resources, ESS3.B: Natural Hazards

Connections to the Arkansas Disciplinary Literacy Standards: RST.11-12.1, WHST.9-12.2

Connections to the Arkansas Mathematical Standards: MP.2, HSN.Q.A.1

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

Science and Engineering Practices: Engaging in Argument from Evidence (BI-ESS3-2)

Connections to Engineering, Technology and Applications of Science: Influence of Science, Engineering and Technology on Society and the Natural World (BI-ESS3-2). Science Addresses Questions About the Natural and Material World (BI-ESS3-2)

Disciplinary Core Ideas: ESS3.A: Natural Resources, ETS1.B: Developing Possible Solutions *Connections to the Arkansas Disciplinary Literacy Standards:* RST.11-12.1, RST.11-12.8 *Connections to the Arkansas Mathematical Standards:* MP.2

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

Science and Engineering Practices: Constructing Explanations and Designing Solutions (BI-ESS3- 4)

Crosscutting Concepts: Stability and Change (BI-ESS3-4)

Connections to Engineering, Technology and Applications of Science: Influence of Science, Engineering and Technology on Society and the Natural World (BI-ESS3-4)

Disciplinary Core Ideas: ESS3.C: Human Impacts on Earth Systems, ETS1.B: Developing Possible Solutions.

Connections to the Arkansas Disciplinary Literacy Standards: RST.11-12.1, RST.11-12.8

Connections to the Arkansas Mathematical Standards: MP.2, HSN.Q.A.1

B17-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 (B17-ETS1-1)

Connections to Engineering, Technology and Applications of Science: Influence of Science, Engineering and Technology on Society and the Natural World (B17-ETS1-1)

Disciplinary Core Ideas: ETS1.A: Defining and Delimiting Engineering Problems *Connections to the Arkansas Disciplinary Literacy Standards:* RST.11-12.7-9 *Connections to the Arkansas Mathematical Standards:* MP.2, MP.4

<u>Integrated Chemistry:</u>

Topic One: Matter and Chemical Reactions:

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

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

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 2: Energy

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

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

Disciplinary Core Ideas: ETS1.C: Optimizing the Design Solution

Topic 4: Sustainability

EVS-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.

Science and Engineering Practices: Constructing Explanations and Designing Solutions (EVS- ESS3-1)

Crosscutting Concepts: Cause and Effect (EVS-ESS3-1)

Connections to Engineering, Technology and Applications of Science: Influence of Science, Engineering and Technology on Society and the Natural World (EVS-ESS3-1)

Disciplinary Core Ideas: ESS3.A: Natural Resources. ESS3.B: Natural Hazards *Connections to the Arkansas Disciplinary Literacy Standards:* RST.11-12.1, WHST.9-12.2 *Connections to the Arkansas Mathematic Standards:* MP.2, HSN.Q.A.1,2,3

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-ESS3-3: Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity.

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

Crosscutting Concepts: Stability and Change (EVS-ESS3-3)

Connections to Engineering, Technology and Applications of Science: Influence of Science, Engineering and Technology on Society and the Natural World (EVS-ESS3-3)

Disciplinary Core Ideas: ESS3.C: Human Impacts on Earth Systems

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

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)

5 The Science behind Discovery Farm-based Water and Soil Conservation Practices Field Trip

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

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.CAdaptation,LS4.DBiodiversityandHumans

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

Connections to the Arkansas Mathematic Standards: MP.2

EVS4-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs 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: Constructing Explanations and Designing Solutions (EVS- ESS3-4)

Crosscutting Concepts: Cause and Effect (EVS-ESS3-1)

Disciplinary Core Ideas: ESS3.A: Natural Resources

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

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

Objective: Students will understand the importance of soil and water sampling to produce healthy crops with the least amount of water and added nutrients. Students will learn that the results of these tests have a major impact not only on plant growth but on the environment as well, as farmers use this information to decrease greenhouse gases and improve the ecological stance of the farming area, all

while producing a viable crop. Students will learn that testing during current conservation methods can make a difference not only ecologically but also economically to a farmer.

Assessment: Students will write a half-page research paper on an agricultural science measurement of their choice, explaining why they feel this measurement is the most important.

Key Points: Laboratory practices in Agriculture, use of analyzers in lab and in the field, relationship of analyzer values to ecology. Testing of various key elements while implementing conservation practices.

Materials:

To watch the recorded *'The Science Behind Water and Soil Conservation Virtual Field Trips*', go to www.uaex.uada.edu/soywhatsup and click on the 'Virtual Field Trips and Lessons' icon to the left of the webpage.

Paper and writing utensils for students in the classroom.

Preparation: If this is to be done in class, it's highly recommended that the teacher understands the key vocabulary words below.

Time Duration: one to one and a half class periods.

The video is about 60 minutes long (45 minutes plus 15 minutes question/answer). Assume about 10 minutes for students to look up vocabulary, and 10 minutes to teach essential concepts. Assume 10 minutes for reflection and discussion after the video.

Elicit:

Do a KWL Chart about agricultural sampling methods. What needs to be sampled in a field and why? How does one measure those samples? What are the advantages of measuring samples in real time versus taking the samples back to a lab? How can these practices help farmers ecologically and economically? Where do you think farmers could get help with these practices?

Engage:

Tell the students that they are going to watch a video titled 'The Science Behind Discovery Farm-Based Water and Soil Conservation Practices Field Trip." Before the video, the students will break into groups to define the following words:

Biochar
Greenhouse gases N_2O, (Nitrous Oxide) water vapor, CO_2, CH_4 (Methane)
Cover crops

Gas Chromatography
Buffer strips
No Tillage
Polypipe irrigation
Soil health
Crop rotation
LI-COR Analyzer
Gasmet Analyzer

Explain:

BEFORE THE VIDEO, be sure the students understand that real time testing in agriculture not only benefits the environment, but also farmers. Farmers need to learn that testing during agricultural conservation of water and nutrients can translate into more profit for them.

Biology Teachers: This is a good time to cover/review human impact on ecological systems and how population dynamics/agriculture affect the local ecology and economics.

Chemistry Teachers: Cover how today's technology is helping to preserve water and nutrients in our ecosystem.

Environmental Science Teachers: This is a good time to cover/review human impact on ecological systems and how population dynamics/agriculture affect the local ecology and economics.

AG Teachers: This is a good time to cover/review human impact on ecological systems and how population dynamics/agriculture affect the local ecology, and the economics of farming profitability by using continuous testing during agricultural improvement.

Explore:

Farmers must be constantly aware of the resources they use to grow their crops. Practicing conservation in the field means less water and chemical (herbicide and insecticide) treatments. This translates into more profit for the farmer and is environmentally friendly. To be successful at growing healthy crops all while protecting our environment from greenhouse gases, and decreasing water and nutrient loss on those crops, farmers need to do nutrient and moisture testing on a regular basis to determine what is needed in real time. This helps to decrease water and nutrient usage and helps farmers to also decrease greenhouse gas emissions.

Many farmers are learning that by continuously improving agricultural conservation, they can not only improve their overall economic gain but also the environment.

Show the video ‘*The Science behind Discovery Farm-Based Water and Soil Conservation Practices Field Trip*’.

Elaborate:

After the video, the students break into three groups: the *Gasmet* group, the *LI-COR group*, and the *‘In lab gas chromatography’* group. Each group brainstorms their area and explains to the class the pros and cons of the testing method they have. Have the class decide which testing method overall is the best.

Evaluate:

Students will turn in a two-paragraph reflection paper on what they learned and how these testing methods can make a difference in ecology.

Extend:

End the lesson with how the conservation practices of farmers decrease their dependence on water and chemicals and has a huge impact on our personal lives through the water we use and the food we eat. Reiterate how our concern for the local ecology can, in turn, drive how farmers approach production.

Assign a brainstorming project that allows students to design their own alternate testing method or have students research cutting edge testing practices and how they could benefit local farmers.

Have an agent from a local testing company or a local extension agent come to the classroom to explain how farmers and their people can collaborate.

Pursuant to 7 CFR § 15.3, the University of Arkansas System Division of Agriculture offers all its Extension and Research programs and services (including employment) without regard to race, color, sex, national origin, religion, age, disability, marital or veteran status, genetic information, sexual preference,pregnancy or any other legally protected status, and is an equal opportunity institution.