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Soil and Water Conservation Soil Health Virtual Field Trip

Grades 9-12 Integrated Biology, Integ

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

Integrated Chemistry, Environmental Science, Earth Science and Agricultural Science

1 Arkansas Soil and Water Conservation: Soil Health

Arkansas NGSS Suggestions:

Integrated Biology:

BI-LS2-3: Construct and revise an explanation based on evidence for cycling of matter and flow of energy in aerobic and anaerobic conditions.

Science and Engineering Practices: Constructing explanations and designing solutions (BI-LS2-3).

Crosscutting Concepts: Energy and matter (BI-LS2-3).

Disciplinary Core Ideas: LS2.B: Cycling of matter and energy transfer in ecosystems.

Connections to the Arkansas Disciplinary Literacy Standards: RST11-12.1, WHST.9-12.2, WHST.9-12.5.

BI-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, hydrosphere, atmosphere and geosphere.

Science and Engineering Practices: Developing and using models (BI-LS2-5).

Crosscutting Concepts: Systems and system models (BI-LS2-5).

Disciplinary Core Ideas: LS2.B: Cycling of matter and energy transfer in ecosystems. PS3.D: Energy in chemical processes.

Topic 6: Life and Earth's Systems

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

Science and Engineering Practices: Analyzing and interpreting data (BI-ESS2-2).

Crosscutting Concepts: Stability and Change (BI-ESS2-2).

Connections to Engineering, Technology and Applications of Science: Influence of Science, Engineering and Technology on Society and the Natural World (BI-ESS2-2).

Disciplinary Core Ideas: ESS2.A: Earth Materials and Systems. ESS2.D: Weather and Climate.

Connections to the Arkansas Disciplinary Literacy Standards: RST.11-12.1-12.12.

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

BI-ESS2-5: Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth's systems.

Science and Engineering Practices: Planning and Carrying Out Investigations (BI-ESS2-5).

Crosscutting Concepts: Structure and Function (BI-ESS2-5).

Disciplinary Core Ideas: ESS2.C: The Role of Water in Earth's Surface Processes.

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

Connections to the Arkansas Mathematical Standards: HSN.Q.A.3.

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, 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 Solution.

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.

Integrated 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.

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.

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).

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

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.

Earth Science:

Topic 2: Earth Systems

ES-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: Carrying Out Investigations (ES-ESS2-5).

Crosscutting Concepts: Structure and Function (ES-ESS2-5).

Disciplinary Core Ideas: The Roles of Water in Earth's Surface Processes (ES-ESS2-5).

Connections to the Arkansas Literacy Standards: RST.9-12.7.

Connections to the Arkansas Mathematics Standards: HSN.Q.A.3.

ES-ESS2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

Science and Engineering Practices: Developing and Using Models (ES-ESS2-6).

Crosscutting Concepts: Energy and Matter (ES-ESS2-6).

Disciplinary Core Ideas: ESS2.D: Weather and Climate.

Connections to the Arkansas Literacy Standards: RST.11-12.1, 8.

Connections to the Arkansas Mathematics Standards: MP.2, MP.4, HSN.Q.A.1-3.

ES2-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 (ES2-ETS1-1).

Crosscutting Concepts: Influence of Engineering, Technology and Science on Society and the Natural World (ES2-ETS1-1).

Disciplinary Core Ideas: ETS1.A: Defining and Delimiting Engineering Problems.

Connections to the Arkansas Literacy Standards: RST.11-12.7-9.

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

ES2-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 (ES2-ETS1-3).

Crosscutting Concepts: Influence of Engineering, Technology and Science on Society and the Natural World (ES2-ETS1-3).

Disciplinary Core Ideas: ETS1.B: Developing Possible Solutions (ES2-ETS1-3).

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

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

Topic 3: Human Sustainability

ES-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 (ES-ESS3-1).

Crosscutting Concepts: Cause and Effect (ES-ESS3-1). Influence of Engineering, Technology and Science on Society and the Natural World. (ES-ESS3-1).

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

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

Connections to the Arkansas Mathematics Standards: MP.2, HSN.Q.A.1-3.

ES-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 (ES-ESS3-2).

Crosscutting Concepts: Influence of Engineering, Science Addresses Questions about the Natural World (ES-ESS3-2).

Disciplinary Core Ideas: ESS3.A: Natural Resources, ETS1.B: Developing Possible Solutions.

Connections to the Arkansas Literacy Standards: RST.11-12.1, 8.

Connections to the Arkansas Mathematics Standards: MP.2.

ES-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 (ES-ESS3-4).

Crosscutting Concepts: Stability and Change (ES-ESS3-4), Science Addresses Questions about the Natural World (ES-ESS3-4).

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

Connections to the Arkansas Literacy Standards: RST.11-12.1, 8.

Connections to the Arkansas Mathematics Standards: MP.2, HSN.Q.A.1-3.

ES3-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 (ES3-ETS1-1).

Crosscutting Concepts: Influence of Engineering, Technology and Science on Society and the Natural World. (ES3-ETS1-1).

Disciplinary Core Ideas: ETS1.A: Defining and Delimiting Engineering Problems.

Connections to the Arkansas Literacy Standards: RST.11-12.7-9.

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

ES3-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 (ES3-ETS1-2).

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

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

Objective: Students will understand that soil health encompasses the physical (how well the soil holds together and infiltrates water), chemical (pH, nutrient concentrations, etc.), and biological (living plant roots, soil microbes and other organisms like earthworms) properties of soils. When all of these properties are improved, it can have positive impacts on agricultural production and profitability.

Assessment: Students will write a reflection paper on what they learned about soil health and its impact on agriculture production and profitability.

Key Points: Physical soil health (water and soil retention), chemical soil health (pH and nutrient concentrations), biological soil health (humus, living organisms and microbes/fungus), biodiversity, biological controls, conservation of water and minerals.

Materials:

- You will need to register online if you plan to watch the field trip 'live' on November 5. 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. 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 *Arkansas Soil and Water Conservation Soil Health Virtual Field Trip*, go to www.uaex.uada.edu/soywhatsup and click on the '*virtual field trips and lessons*' icon on the left-hand side of the page. This will take you to the link for the video.
- Paper writing utensils for students (if in class).

Preparation:

If this is being done in class, it is highly recommended that you, the teacher, do research on the key words given below.

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 what students know about soil health. What is soil health? What three areas encompass soil health? How does someone determine soil is healthy? Why would soil health be important to a farmer? Why would soil health be important to you as a consumer?

Engage:

Tell the students that they are going to watch a video titled '*Arkansas Soil and Water Conservation Soil Health Virtual Field Trip.'* Before they start the video, have the students break into groups to define the following words:

- Cover Crops
- Biodiversity
- Humus
- Soil; Include the major types of soil (sandy, loam, clay) definitions
- No-till system
- pH of soil
- Types of nutrients found in soil
- Types of organisms found in soil (nematodes, earthworms, fungus, etc.)
- Biomass
- Water infiltration in soil
- Integrated weed management

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 no-till cover crops are an ecological alternative to tilling and standard chemical usage. Crop cover also increases water retention in

the soil and protects beneficial insects that live in the area. Crop cover adds essential minerals to the soil (especially nitrates) keeping it healthy, and it discourages weed growth. Crop cover, no-till and soil health measurements not only help the farmer, but they ensure the environment is protected also.

Biology Teachers: This is a good time to cover/review cycling of matter, the water cycle, soil composition and soil biology. Also consider covering biodiversity of insects (Hemiptera, Odonata, etc.) that might interact with crops.

Chemistry Teachers: Consider covering soil chemistries and reactions, water properties and the water cycle plus herbicide/insecticide chemical reactions.

Earth Science Teachers: Soil health is paramount to a thriving ecology. Cover soil components, the carbon and water cycle and soil chemistries.

Environmental Science Teachers: This is a good time to cover/review soil (and its components), soil erosion, water cycle, biodiversity of insects, human impact on ecological systems and how population dynamics/agriculture affect the local ecology. Also cover how technology and new crop techniques can improve ecological conservation.

AG Science Teachers: This is a good time to review no-till vs tilling, soil health including mineral load, basic plant physiology and conservation farming practices.

Explore:

Farmers have to be constantly aware of the resources they use to grow their crops. No-till cover crops mean less water and chemicals (herbicide and insecticide) treatments. This translates into less cost for the farmer, better sustainability and is environmentally friendly.

Show the video *'Arkansas Soil and Water Conservation Soil Health Virtual Field Trip.'*

Elaborate:

After the video, break the students into three groups; *The Impact of Soil Health* group, the *No- Till* group, and the *Cover Crop* 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.

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 water and chemicals also has 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 growing methods, or ways to improve soil health while growing crops.

Have an extension agent or local farmer come to your classroom and talk about no-till cover crops in your local community.