SOIL & WATER
CONSERVATION VIRTUAL FIELD TRIP SERIES

DIVISION OF AGRICULTURE RESEARCH & EXTENSION University of Arkansas System | USDA United States Department of Agriculture Natural Resources Conservation Service

7E and GRC-3D Lesson Guides for the Rice Agricultural Sustainability Virtual Field Trip

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DIVISION OF AGRICULTURE RESEARCH & EXTENSION University of Arkansas System

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SOIL & WATER
CONSERVATION VIRTUAL FIELD TRIP SERIES

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Rice Agricultural Sustainability Virtual Field Trip

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

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

1 Introduction to Agricultural Sustainability Virtual Field Trip

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 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

<u>Environmental Science:</u>

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)

4 Introduction to Agricultural Sustainability Virtual Field Trip

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)

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.C Adaptation, LS4.D Biodiversity and Humans

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

Connections to the Arkansas Mathematic Standards: MP.2

5 Introduction to Agricultural Sustainability Virtual Field Trip

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 rice crop sustainability regarding the environmental impact lessening the loss of nutrients and water have on the local ecosystem. Students will learn that collaboration between farmers and suppliers helps everyone by improving productivity while using innovative techniques to protect the local ecosystems.

Assessment: Students will write a reflection paper on what they learned about farmer and supplier collaboration and the innovative techniques farmers use to protect our ecosystem resources, from the Virtual Field Trip video.

Key Points: Sustainability in rice production, innovative technology, supply, and demand.

Materials:

- You will need to register online if you plan to watch the field trip 'live' on June 29. 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 ' *Rice Agricultural Sustainability 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. Keep in mind it will take several days for IT to edit and post.
- 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: one and a half class period.

The video is about 60 minutes long (45 minutes plus any questions). Assume about 10 minutes for students to look up vocabulary and prepare questions for the video session, 10 minutes to teach essential concepts and about 10 minutes for group discussion and reflection after the video.

Elicit:

Do a KWL Chart about what students know about Agricultural Sustainability. What is sustainability? How is sustainability measured? What are the advantages of practicing sustainability at all economic levels? What are some innovative techniques farmers can use to improve sustainable rice farming? How does sustainability concern at the buyer level help farmers? How can farmers who practice rice sustainability, help buyers? Help consumers?

Engage:

Tell the students that they are going to watch a video titled *'Rice Agricultural Sustainability Virtual Field Trip.'* Before they start the video, have the students break into groups to define the following words:

- Sustainability
- Wholesale suppliers and supply chain
- Retailers
- Cultivars
- Alternate wetting and drying (Intermittent Flooding)
- Furrow irrigated rice 'row rice'
- Precision Grading
- Zero Grade
- Greenhouse Gas

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 agricultural sustainability not only benefits the environment, but also the farmer and buyers too. Many rice farmers are aware that water and nutrient conservation can translate into more profits for them. Big businesses take advantage of this by advertising to consumers their choice to go with products from sustainable farms.

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 preserving water and nutrients in our ecosystems.

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 rice farming profitability by using innovative technology to improve sustainability.

Explore:

Rice farmers are constantly aware of the resources they use to grow their rice crops. Practicing sustainability in the field means less water and chemical (herbicide and insecticide) treatments. This translates into more profit for the farmer and a healthier environment. Many rice farmers are aware that by seeking agricultural sustainability on their farms, they can appeal to big businesses who are interested in marketing products that come from ecological friendly farms.

Show the video '*Agricultural Sustainability; Rice Virtual Field Trip.'*

Elaborate:

After the video, break the students into three groups: The *Retailer* group, The *Wholesaler* group, and The *Rice Farmer* group. Have each group brainstorm their area of study and explain to the class how important their area is to sustainability and conservation. 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 sustainability 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 rice farmers to decrease their dependence on water and chemicals has also had a huge impact on our personal lives through the water we use and the rice we eat. Reiterate how consumers concern for sustainable ecological friendly products can, in turn, drive how rice farmers and the supply chain approach production.

Assign a brainstorming project that allows students to design their own alternate way of saving water in rice fields or have students research sustainability practices and how they could benefit local rice farmers.

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

Additional Resources:

Row Rice:

https://talkbusiness.net/2019/03/row-rice-gaining-in-popularity-in-arkansas/

History of Rice:

http://www-plb.ucdavis.edu/labs/rost/Rice/introduction/intro.html#:~:text=As%20far%20back%20as%202500,and%20areas%20of%20the%20Mediterranean.

3D-Student Science Performance

Author: Diedre Young, Soybean Science Challenge Coordinator

Grade: 9-12:

Integrated Biology

Integrated Chemistry

Environmental Science

Agricultural Science

Agricultural Sustainability: Rice Virtual Field Trip

Lesson Topics:

Life and Earth Systems

Matter and Chemical Reactions

Human Impacts on Earth Systems

Sustainability

Performance Expectations (Standard) from State Standards or NGSS:

<u>Integrated Biology:</u>

Topic 6: Life and Earth 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. [AR Clarification Statement: Solutions could include those designed by students or identified from scientific studies.]

Connections to the Arkansas Disciplinary Literacy Standards:

RST.11-12.7: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem (BI16-ETS1-3)

RST.11-12.8: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information (BI16-ETS1-3)

RST.11-12.9: Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible (BI16-ETS1-3)

Connections to the Arkansas Mathematical Standards:

MP.2: Reason abstractly and quantitatively (BI16-ETS1-3)

MP.4: Model with Mathematics (BI16-ETS1-3)

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. [AR Clarification Statement: This PE is fully addressed in this course. Emphasis is on the way climate change has impacted human populations and how natural resources and natural hazards impact human societies. Examples of climate change results which affect populations or drive mass migrations could include changes to sea level, regional patterns of temperature and precipitation, and types of crops and livestock available. Examples of the dependence of human populations on technology to acquire natural resources and to avoid natural hazards could include damming rivers, natural gas fracking, thunderstorm sirens, and severe weather text alerts.]

Connections to the Arkansas Disciplinary Literacy Standards:

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. (BI-ESS3-1)

WHST.9-12.2: Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. (BI-ESS3-1)

Connections to the Arkansas Mathematical Standards:

MP.2: Reason abstractly and quantitatively. (BI-ESS3-1)

HSN.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (BI-ESS3-1)

BI-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost benefit ratios. *[AR Clarification Statement: This PE is fully addressed in this course. Emphasis is on the designs of possible solutions. Emphasis is on the conservation, recycling, and reuse of resources (minerals and metals), and on minimizing impacts. Examples could include developing best practices for agricultural soil use, mining (coal, tar sands, and oil shales), and pumping (petroleum and natural gas).]

Connections to the Arkansas Disciplinary Literacy Standards:

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. (BI-ESS3-2)

RST.11-12.8: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (BI-ESS3-2)

Connections to the Arkansas Mathematical Standards:

MP.2: Reason abstractly and quantitatively. (BI-ESS3-2)

BI-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. * [AR Clarification Statement: This PE is partially addressed in this course. Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, and changes in land surface (urban development, agriculture or livestock, and surface mining). Examples for limiting future impacts could range from local efforts (reducing, reusing, and recycling resources) to large-scale bioengineering design solutions (altering global temperatures by making large changes to the atmosphere or ocean).]

Connections to the Arkansas Disciplinary Literacy Standards:

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. (BI-ESS3-4)

RST.11-12.8: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (BI-ESS3-4)

Connections to the Arkansas Mathematical Standards:

MP.2: Reason abstractly and quantitatively. (BI-ESS3-4)

HSN.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (BI-ESS3-4)

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. [AR Clarification Statement:

Examples could include recycling, increased atmospheric carbon dioxide, ocean acidification, impacts on marine populations, increased wildfire occurrence, deforestation, and overfishing.]

Connections to the Arkansas Disciplinary Literacy Standards:

RST.11-12.7: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (B17-ETS1-1)

RST.11-12.8: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (B17-ETS1-1)

RST.11.12.9: Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (B17-ETS1-1)

Connections to the Arkansas Mathematical Standards:

MP.2: Reason abstractly and quantitatively. (B17-ETS1-1)

MP.4: Model with Mathematics. (B17-ETS1-1)

Integrated Chemistry:

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. [AR Clarification Statement: Examples of real-world problems could include wastewater treatment, production of biofuels, and the impact of heavy metals or phosphate pollutants on the environment.]

Connections to the Arkansas Mathematic Standards:

MP.4: Model with Mathematics. (CI1-ETS1-2)

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. [AR Clarification Statement:

Qualitative and quantitative constraints can be used to analyze a major global challenge. Examples could include water quality with relation to biosphere, atmosphere, cryosphere, and geosphere.]

Connections to the Arkansas Disciplinary Literacy Standards:

RST.11-12.7: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (EVS1-ETS1-1)

RST.11-12.8: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (EVS1-ETS1-1)

RST.11-12.9: Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (EVS1-ETS1-1)

Connections to the Arkansas Mathematic Standards:

MP.2: Reason abstractly and quantitatively. (EVS1-ETS1-1)

MP.4: Model with Mathematics. (EVS1-ETS1-1)

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. [AR Clarification Statement: Examples of solutions could include designing and refining solutions using solar cells and energy recovery from waste practices. Examples of constraints could include use of renewable energy forms and efficiency modeling.]

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. [AR Clarification Statement: Emphasis is on sustainability of natural resources, extracting natural resources, and how human societies are economically impacted by these phenomena.]

Connections to the Arkansas Disciplinary Literacy Standards:

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. (EVS-ESS3-1)

WHST.9 -12.2: Write informative/explanatory texts, including the narrations of historical events, scientific procedures/experiments, or technical processes. (EVS-ESS3-1)

Connections to the Arkansas Mathematic Standards:

MP.2: Reason abstractly and quantitatively. (EVS-ESS3-1)

HSN.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (EVS-ESS3-1)

HSN.Q.A.2: Define appropriate quantities for the purpose of descriptive modeling. (EVS-ESS3-1)

HSN.Q.A.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (EVS-ESS3-1)

EVS-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. * [AR Clarification Statement: Emphasis is on conservation, sustainability (e.g., recycling and reuse of resources), and minimizing impacts (e.g., Low Impact Design).]

Connections to the Arkansas Disciplinary Literacy Standards:

RST.11-12.8: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (EVS-ESS3-2)

Connections to the Arkansas Mathematic Standards:

MP.2: Reason abstractly and quantitatively. (EVS-ESS3-2)

EVS-ESS3-3: Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity. [AR Clarification Statement: Emphasis is on Arkansas-specific management and conservation of, costs of implementation and regulation of, and land use of (agriculture, mining, recreation, and urbanization) natural resources.]

Connections to the Arkansas Mathematic Standards:

MP.2: Reason abstractly and quantitatively. (EVS-ESS3-3)

MP.4: Model with Mathematics. (EVS-ESS3-3)

EVS-LS2-7: Design, evaluate and refine a solution for reducing the impacts of human activities on the environment and biodiversity. * [AR Clarification Statement: Emphasis in this course is on Arkansas-specific solutions. Examples of human activities can include land use (agriculture, forestry, recreation, industry); sustainable and non-sustainable practices (crop rotations, eradication of invasive species); and solution resources may include Low Impact Design (LID) or bioremediation (Faulkner County, AR; Gulf of Mexico hypoxia zone.)]

Connections to the Arkansas Disciplinary Literacy Standards:

RST.9 -10.8: Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. (EVS-LS2-7)

RST.11-12.8: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (EVS-LS2-7)

WHST.9-12.7: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (EVS-LS2-7)

Connections to the Arkansas Mathematic Standards:

MP.2: Reason abstractly and quantitatively. (EVS-LS2-7)

HSN.Q.A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (EVS-LS2-7)

HSN.Q.A.2: Define appropriate quantities for the purpose of descriptive modeling. (EVS-LS2-7)

HSN.Q.A.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (EVS-LS2-7)

EVS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity. * [AR Clarification Statement: Emphasis is on designing solutions for a proposed problem (e.g., micro-bead pollution, invasive species, effects of sedimentation on the Arkansas Fatmucket, White-nose Syndrome affecting bat populations, and environmental pollution from hormones and antibiotics).]

Connections to the Arkansas Disciplinary Literacy Standards:

WHST.9 -12.5: Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (EVS-LS4-6)

WHST:9 -12.7: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize

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multiple sources on the subject, demonstrating understanding of the subject under investigation. (EVS-LS4-6)

Connections to the Arkansas Mathematic Standards:

MP.2: Reason abstractly and quantitatively. (EVS-LS4-6)

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. [AR Clarification Statement: Modeling complex real-world problems using computer software could include simulating future population growth in terms of limited resources or evaluating water flow through different Earth and geo-engineered materials.]
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Lesson Performance Expectations:

Students will understand the importance of rice crop sustainability regarding the environmental impact lessening the loss of nutrients and water will have on the local ecosystem.
Students will learn that collaboration between rice farmers and suppliers helps everyone by improving productivity, while using innovative techniques to protect the local ecosystems.

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Objective: Students will understand the importance of rice crop sustainability regarding the environmental impact lessening the loss of nutrients and water have on the local ecosystem. Students will learn that collaboration between farmers and suppliers helps everyone by improving productivity while using innovative techniques to protect the local ecosystems.
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Student Science Performance

Phenomenon: Agricultural Sustainability and technology are the keys to rice productivity and profitability for both farmers and suppliers.
Gather

1. Students will break into groups and define the following words:

Sustainability
Wholesale suppliers and supply chain
Retailers
Cultivars
Alternate wetting and drying (Intermittent Flooding)
Furrow irrigated rice ‘row rice’
Precision Grading
Zero Grade
Greenhouse Gas

(Teaching Suggestions: This section should contain a brief overview of information teachers will need to facilitate the lesson. This may include links to video clips, links to readings, crosscutting concepts, and core ideas to emphasize. Safety advice and other insights about the gathering portion of the lesson should also be included here. When materials for the investigation are needed, we recommend that you include them in the appendix.)

Reason (In this section students are generally: evaluating information, analyzing data, using mathematical/computational thinking, constructing explanations, developing arguments, and/or using models to reason, predict, and develop evidence.)

2. Students in groups will come up with two questions they have about the above
</td></tr>
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Assessment: Students will write a reflection paper on what they learned about farmer and supplier collaboration and the innovative techniques farmers use to protect our ecosystem resources, from the Virtual Field Trip video.

Key Points: Sustainability in rice production, innovative technology, supply, and demand.

Materials:

- You will need to register online if you plan to watch the field trip 'live' on June 29. Once you have registered, you will receive a registration link via Constant Contact. If you do not

word groups that may be answered in the video.

Class Discussion:

Questions to initiate Discussion:
Q: What is sustainability?
Q: How is sustainability measured?
Q: What might be some innovative ways rice farmers could improve sustainability?
Q: What are the advantages of practicing sustainability at all economic levels?
Q: How can a consumer concerned about sustainability influence a farmer?
Q; How can farmers who practice sustainability benefit buyers?
Q: Why would retailers be interested in farmers practicing sustainability for their rice crops?

(Teaching Suggestions: In this section provide insights into the focus of the class discussion. The questions are typically how, why, or what causes. This is a good place to prompt with crosscutting concepts.)

Do a KWL Chart about what students know about Agricultural Sustainability. What is sustainability? How does one measure sustainability? What are the advantages of practicing sustainability at all economic levels? How does sustainability concern at the buyer level help farmers? How can farmers who practice rice sustainability help buyers? Help consumers?

Tell the students that they are going to watch a video titled '*Agricultural Sustainability: Rice Virtual Field Trip.'* Before they start the video, have the students break into groups to define the following words:

- Sustainability
- Wholesale suppliers and supply chain
- Retailers
- Cultivars
- Alternate wetting and drying (Intermittent Flooding)
- Furrow irrigated rice 'row rice'
- Precision Grading
- Zero Grade
- Greenhouse Gas

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

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 '*Rice Agricultural Sustainability Virtual Field Trip*, go to www.uaex.uada.edu/soywhatsup and click on the 'Virtual Field Trips and	video. ***BEFORE THE VIDEO,*** be sure the students understand that agricultural sustainability not only benefits the environment, but the farmer and buyers too. Many rice farmers are aware that water and nutrient conservation can translate into more profits for them. Big businesses take advantage of this by advertising to consumers their choice to go with products from sustainable farms. *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 preserving water and nutrients in our ecosystems. *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 rice farming profitability by using innovative technology to improve sustainability. Farmers are constantly aware of the resources they use to grow their crops. Practicing sustainability in the field means less water and chemical (herbicide and insecticide) treatments. This translates into more profit for the farmer and is environmentally friendly. Rice farmers are aware that by using innovative technology to improve sustainability on their farms, they can appeal to big businesses who are interested in marketing products that come from ecological friendly growers. Show the video '*Agricultural Sustainability: Rice Virtual Field Trip.*' ***Communicate*** *(In this section students will be communicating information, communicating arguments (written and oral for how their evidence supports or refutes an explanation, and using models to communicate their reasoning and make their thinking visible.)* After the video, break the students into three groups: The *Retailer* group, the *Wholesaler* group, and the *Rice Farmer* group. Have each group brainstorm their area of study and explain to the class how important their area is to sustainability and conservation. Tell students they need to come up with at least six ways total and then report them to the rest of the class. Students will turn in a two-paragraph reflection paper on what they learned and how these sustainability efforts can affect where they live. They also need to give the

Lessons' icon on the left-hand side of the page. This will take you to the link for the video. Keep in mind it will take several days for IT to edit and post. • 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: one and a half class period.** The video is about 60 minutes long (45 minutes plus any questions). Assume about 10 minutes	answers to their two questions from the video.

for students to look up vocabulary and prepare questions for the video session, 10 minutes to teach essential concepts and about 10 minutes for group discussion and reflection after the video. **Elicit:** Do a KWL Chart about what students know about Agricultural Sustainability. What is sustainability? How is sustainability measured? What are the advantages of practicing sustainability at all economic levels? What are some innovative techniques farmers can use to improve sustainable rice farming? How does sustainability concern at the buyer level help farmers? How can farmers who practice rice sustainability, help	

buyers? Help consumers? **Engage:** Tell the students that they are going to watch a video titled *'Rice Agricultural Sustainability Virtual Field Trip.'* Before they start the video, have the students break into groups to define the following words: • Sustainability • Wholesale suppliers and supply chain • Retailers • Cultivars • Alternate wetting and drying (Intermittent Flooding) • Furrow irrigated rice 'row rice' • Precision Grading • Zero Grade • Greenhouse Gas 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 agricultural sustainability not only benefits the environment, but	

also the farmer and buyers too. Many rice farmers are aware that water and nutrient conservation can translate into more profits for them. Big businesses take advantage of this by advertising to consumers their choice to go with products from sustainable farms. *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 preserving water and nutrients in our ecosystems. *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 rice farming profitability by using innovative technology to improve sustainability. **Explore:** Rice farmers are constantly aware of the resources they use to grow their rice crops. Practicing sustainability in the field means less water and chemical (herbicide and insecticide) treatments. This translates into more profit for the farmer and a healthier environment. Many rice farmers are	

aware that by seeking agricultural sustainability on their farms, they can appeal to big businesses who are interested in marketing products that come from ecological friendly farms. Show the video '*Agricultural Sustainability; Rice Virtual Field Trip.*' **Elaborate:** After the video, break the students into three groups: The *Retailer* group, The *Wholesaler* group, and The *Rice Farmer* group. Have each group brainstorm their area of study and explain to the class how important their area is to sustainability and conservation. 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 sustainability 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 rice farmers to decrease their dependence on water and chemicals has also had a huge impact on our personal lives through the water we use and the rice we eat. Reiterate how consumers concern for sustainable ecological friendly products can, in turn, drive how rice farmers and the supply chain approach	

production. Assign a brainstorming project that allows students to design their own alternate way of saving water in rice fields or have students research sustainability practices and how they could benefit local rice farmers. Have an agent from a local company or a local extension agent come to the classroom to explain how farmers and their people can and do collaborate. Additional Resources: Row Rice: https://talkbusiness.net/2019/03/row-rice-gaining-in-popularity-in-arkansas/ History of Rice: http://www-plb.ucdavis.edu/labs/rost/Rice/introduction/intro.html#:~	

:text=As%20far%20back%20as%202500,and%20areas%20of%20the%20Mediterranean.	

Evidence of Student Proficiency	Range of Typical Student Responses	Acting on Evidence of Learning
Students will understand the importance of rice crop sustainability regarding the lessening of the environmental impact the loss of nutrients and water have on the local ecosystem. Students will learn that collaboration between suppliers and farmers helps everyone by improving productivity and protecting local ecosystems.	*This section provides a range of typical student responses, often using a three-point scale.* *Descriptors of grade-level appropriate student responses:* • *Full understanding: Student will have all the vocabulary defined, two questions for the video and will participate fully in the post video discussion. Reflection paper will show full connection between what they experienced and understand.* • *Partial understanding: student will have 75% of the vocabulary defined and one question for the video. Reflection paper will only show partial connection between what they experienced and understand.* • *Limited understanding: Student will have 50% or less of vocabulary defined, no questions for the video and show no understanding of what was learned in the reflection paper.*	*This is a brief description of the instructional actions to take based on the students' performance. When the action includes extensive descriptors and/or materials, you may wish to use* ***Appendix C.*** *Description of instruction action and response to support student learning.* • *Action for student who displays partial or limited understanding: student will be partnered with a student who has full understanding and material will be reviewed with mentoring from the teaching student.* • *Extensions of learning for student who displays full understanding: Assign a brainstorming project that allows students to design their own way to save water in rice fields. Students could also interview local agencies as to the collaboration they have done with local farmers.*

SEP, CCC, DCI Featured in Lesson	**Science Essentials** *(Student Performance Expectations from Appendix C, D, E)*
Science Practices	
Developing and Using Models (B16-ETS1-3) (EVS-LS4-6) Constructing Explanations and Designing Solutions (BI-LS1-5) (BI-ESS3-1) (BI-ESS3-4) (EVS-ETS1-2) (EVS-ESS3-1) (EVS-LS2-7) (CI1-ETS1-2) Planning and Carrying Out	• Use a model to predict the relationships between systems or between components of a system. • Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade-off considerations. • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data and

Investigations (CI-ETS1-2) (EVS-ESS3-3) Engaging in Argument from Evidence (BI-ESS3-2) (EVS-ESS3-2) Asking Questions and Defining Problems (B17-ETS1-1) (EVS4-ETS1-3)	refine the design accordingly. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors. • Analyze complex real world-problems by specifying criteria and constraints for successful solutions.
Crosscutting Concepts Energy and Matter (EVS-ESS2-6) Stability and Change (BI-ESS2-2) (BI-ESS3-4) (EVS-ESS3-3) (EVS-LS2-7) Influence of Science, Engineering and Technology on Society and the Natural World (BI16-ETS1-3) (BI-ESS3-2) (BI-ESS3-4) (B17-ETS1-1) (EVS-ESS3-1) (EVS-ESS3-2) (EVS-ESS3-3) Cause and Effect (BI-ESS3-1) (EVS-ESS3-1) (EVS-LS4-6) Science Addresses Questions About the Natural and Material World (BI-ESS3-2)	• The total amount of energy and matter in closed systems is preserved. • Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. • New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • Science knowledge indicates what can happen in natural systems-not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge.
Disciplinary Core Ideas ETS1.B: Developing Possible Solutions ESS3.A: Natural Resources ESS3.C: Human Impacts on Earth Systems ETS1.A: Defining and Delimiting Engineering Problems	• 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. • Resource availability has guided the development of human society. • Humanity faces major global challenges today, such as the need for supplies of clean water and food or for an energy source that minimizes pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.

ETS1.C: Optimizing the Design Solution LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS4.C Adaptation	• Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. • Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. • Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. • A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.

Appendices: This section contains the lesson performance that students will see during the lesson and any other resources students will use to engage in the science performances. The appendices may also contain examples of student work.

Appendix A - Student Prompts

Student Prompts for the Lesson

Phenomenon: Agricultural Sustainability is the key to productivity and profitability for both farmers and suppliers.

Group Performances:

1. Ask questions to plan an investigation for understanding that by learning about and practicing agricultural sustainability, rice farmers, buyers, and the ecosystem benefit.
2. Plan an investigation by defining the words necessary and having questions ready for the video.
3. Construct an explanation by forming groups and discussing how these collaborations and conservation efforts can affect where they live.
4. Use a model to explain how practicing agricultural sustainability can decrease mineral loss, erosion and help both the local ecology and economy.

Class Discussion

Individual Performances:

1. Develop an argument that shows how rice farmers and buyers working together toward agricultural sustainability can and does help the economy and ecology in our local area.

The student prompt can be used to engage students in science performances and typically includes 3-5 group performances and one individual performance. The individual performance typically lies within the communicate reasoning part of the sequence and often serves as a formal formative assessment. Often teachers add opportunities for class discussion into the instructional sequence to discuss things like "Good Questions to Find Resources" or "Class Debate" or "Discussion of Science Language Student Should Use."

***Appendix B* – Materials, Preparation and Time Duration.**

Materials:

- You will need to register online if you plan to watch the field trip 'live' on June 29. 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 *'Rice Agricultural Sustainability Virtual Field Trip*, go to www.uaex.uada.edu/soywhatsup and click on the *'field trips and lessons'* link on the left-hand side of the page. This will take you to the video archive webpage. Keep in mind it will take several days for IT to edit and upload the video to the website.
- 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 on page 8.

Time Duration: two class periods.

The video is about 60 minutes long (45 minutes plus any questions). Assume about 10 minutes for students to look up vocabulary and prepare questions for the video session, 10-15 minutes to teach essential concepts and about 15 minutes for group discussion and reflection after the video.

Appendix C **- Below are good resources for understanding Rice and Sustainable Farming:**

https://talkbusiness.net/2019/03/row-rice-gaining-in-popularity-in-arkansas/

http://www.plb.ucdavis.edu/labs/rost/Rice/introduction/intro.html#:~:text=As%20far%20back%20as%202500,and%20areas%20of%20the%20Mediterranean.

https://www.uaex.uada.edu/publications/PDF/SRME203FR.pdf

https://www.uaex.uada.edu/farm-ranch/crops-commercial-horticulture/rice/

https://www.uaex.uada.edu/environment-nature/water/sustainability.aspx