3D-Student Science Performance

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Grade: 9-12th grade

Integrated Biology

Environmental Science

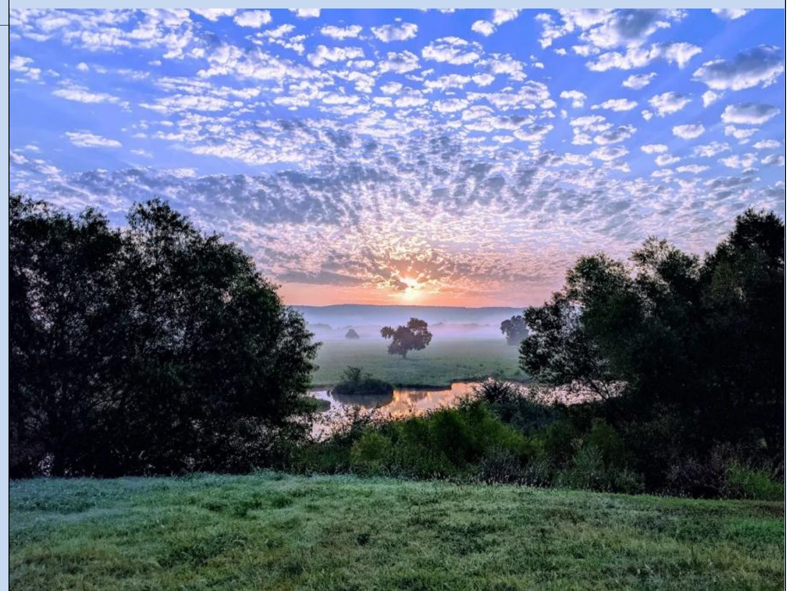
Agricultural Science

Lesson Topics:

Life and Earth Systems

Human Impacts on Earth Systems

Sustainability



Prairie Grove Battlefield State Park Soil Restoration Virtual Field Trip

Photo courtesy of Prairie Grove Battlefield State Park

Performance Expectations (Standard) from State Standards or NGSS:

Integrated Biology:

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.]

Prairie Grove Battlefield State Park Soil Restoration Virtual Field Trip

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) 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)

Prairie Grove Battlefield State Park Soil Restoration Virtual Field Trip

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-ESS3-4: 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)

Environmental Science:

Topic 1: 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 impact of human activities on the environment and biodiversity. * [AR Clarification Statement: Emphasis 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 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.]

Lesson Performance Expectations:

- Students will understand the significance of soil, flora, and fauna restoration in an Arkansas State Park.
- Students will comprehend the importance of soil sampling and ecological restoration (in several micro-environments).
- Students will understand the reasons why this restoration is necessary in relation to the nearby Illinois River Watershed.
- Students will realize that not only do battles affect people, but they also affect the environment.

Objective: Students will understand the significance of soil, flora, and fauna restoration in an Arkansas State Park. Students will comprehend the importance of soil sampling, ecological restoration (in	**Student Science Performance** ***Phenomenon: By restoring the Prairie Grove Battlefield State Park to its pre–Civil War state, native flora and fauna will return to the area, and the Illinois Watershed will regain its purity.*** ***Gather:*** *Students will break into groups and define the following words:* Conservation River Watershed Ecological restoration Soil sampling Carbon sequestration Prairie Woodland Savannah

several micro-environments), and the reasons why this restoration is necessary in relation to the nearby Illinois River Watershed. Students will realize that not only do battles affect people, but they also affect the environment. **Assessment**: Students will write a half-page research paper on how they would go about restoring this area of the park. Encourage the students to be creative but still follow the restoration guidelines. **Key Points:** Illinois River Watershed, carbon sequestration, soil sampling and testing, ecological	Soil pH, soil Phosphorus, Soil Nitrogen, Soil total Carbon, Soil Calcium, Magnesium, Iron, Copper, Boron Soil Bulk Density Soil Electrical Conductivity ***Reason:*** 1. Students will watch the video on the Virtual Field Trip. 2. Students will compare different agricultural testing methods. ***Class Discussion:*** *Questions to initiate Discussion:* *Q: What is ecological restoration?* *Q: What are the advantages of practicing ecological restoration?* *Q: What are the types of conservation practices that are involved in a restoration project?* *Q: Why is restoration important in the local ecosystem?* *Q: How can this restoration impact those who live in the neighboring towns?* Do a KWL Chart and inquire about ecological restoration. What is ecological restoration? What are the advantages of practicing ecological restoration, especially in a historical area? What are the types of conservation practices that are involved in a restoration project? Why is restoration important in the local ecosystem? How can this restoration impact those who live in the neighboring towns? ***BEFORE THE VIDEO,*** be sure students understand what ecological restoration is, and the science behind the foundation of this endeavor. Also introduce the students to the history of one of the most intact Civil War battlefields in the United States. To know how to proceed, one needs to look behind for guidance. By learning the history of this state park, they will understand the ecological damage that needs repairing. ***Biology Teachers:*** This is a suitable time to review human impact on ecological systems and how population dynamics/agriculture affect the local ecology and economics. ***Environmental Science Teachers:*** This is a suitable time to review human impact on ecological systems and how population dynamics/agriculture affect the local ecology and economics. ***AG Teachers:*** This is a suitable time to review human impact on ecological systems and how

restoration.

Materials:

To watch the live *'Prairie Grove Battleground State Park Soil and Land Restoration VFT* on June 19, go to https://uada.zoom.us/webinar/register/WN_gijOglnqQ2m88EQB-eVatQ, and register. To watch the recorded VFT, 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 is

population dynamics/agriculture affect the local ecology, and how historical areas, like Prairie Grove, need to be allowed to go back to a natural state.

Prairie Grove Battlefield was the sight of the last major Civil War conflict in Arkansas in December of 1862. The Confederacy wanted to take back Missouri and chose this area to get a foothold in the 'Show-Me' State. Over 20,000 men fought in this battle, with 2700 total being killed, wounded, or missing in action. The battle lasted one day, with the conflict ending in a draw. The Confederate army chose to retreat that night, and Missouri was cemented under Union control.

Prairie Grove Battlefield State Park was started in the 1970's. It is around 1,000 acres with 800 of that under park control, and 200 to be transferred to the state in the future. It is a park that contains three major ecosystems; prairie, woodlands, and savannah. Due to years of agriculture, urbanization, and past damage from the Civil War (there were artillery, cannons, etc. in the battle) Prairie Grove is a shadow of its original condition. Invasive flora and fauna have swept the area, metal pollution in the soil from the battle, grazing from cattle, drainage of water from lowland prairie bottoms, and the encroachment of homes have all taken their toll. This area drains into the million-acre Illinois River Watershed. Water from this area, unfiltered and full of pollution, ends up in the drinking water of those cities who use this watershed.

There are several stakeholders in this restoration project. The goal is to restore the original flora (tall prairie grass like Little and Big Blue Stem, etc.) by cleaning out the current grasses, and reseeding or exposing dormant wild seeds in the soil. Invasive plant management in the woodlands will bring back the native plants, and by allowing the water seepage to feed the lowland prairie bottoms, natural water filtration will occur. By removing the current flora and replacing it with the original, species of fauna that would normally live in these ecosystems will return. Birds, insects, amphibians, etc. will make their way back to the park.

This requires planning and soil testing to determine what needs to be done to restore it before this project can start. This entails several soil sampling sites and soil tests. Once the samples have been completed and analyzed; restoration can begin.

important that the teacher understands the vocabulary below. Time Duration: 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 think of questions to ask the presenters (if live), and 10 minutes to teach essential concepts. Assume 10 minutes for reflection and discussion after the video.	Show the video '*'Prairie Grove Battleground State Park Virtual Field Trip'*. ***Communicate:*** After the video, the students break into three groups: the *'Prairie' gr*oup, the *'Woodlands'* group, and the '*Savannah* group.Each group brainstorms their area of study, explaining why their area of study is important to the health of this park. **Assessment**: Students will write a half-page research paper on how they would go about restoring this area of the park. Encourage the students to be creative but still follow the restoration guidelines

Elicit: Do a KWL Chart and inquire about ecological restoration. What is ecological restoration? What are the advantages of practicing ecological restoration, especially in a historical area? What are the types of conservation practices that are involved in a restoration project? Why is restoration important in the local ecosystem? How can this restoration impact those who live in the neighboring towns? **Engage:** Tell the students that they are going to watch a video titled *'Prairie Grove Battleground State*	

Park Virtual Field Trip'. Before starting the video, have the students break into groups to define the following words: Conservation River Watershed Ecological restoration Soil sampling Carbon sequestration Prairie Woodland Savannah Soil pH, soil Phosphorus, Soil Nitrogen, Soil total Carbon, Soil Calcium, Magnesium, Iron, Copper, Boron Soil Bulk Density Soil Electrical Conductivity **Explain:** ***BEFORE THE VIDEO,*** be sure students understand what ecological restoration is, and the science behind the foundation of this	

endeavor. Also introduce the students to the history of one of the most intact Civil War battlefields in the United States. To know how to proceed, one needs to look behind for guidance. By learning the history of this state park, they will understand the ecological damage that needs repairing. ***Biology Teachers:*** This is a suitable time to review human impact on ecological systems and how population dynamics/agriculture affect the local ecology and economics. ***Environmental Science Teachers:*** This is a suitable time to review human impact on ecological systems and how population	

dynamics/agriculture affect the local ecology and economics. ***AG Teachers:*** This is a suitable time to review human impact on ecological systems and how population dynamics/agriculture affect the local ecology, and how historical areas, like Prairie Grove, need to be allowed to go back to a natural state. Prairie Grove Battlefield was the sight of the last major Civil War conflict in Arkansas in December of 1862. The Confederacy wanted to take back Missouri and chose this area to get a foothold in the 'Show-Me' State. Over 20,000 men fought in this battle,	

with 2700 total being killed, wounded, or missing in action. The battle lasted one day, with the conflict ending in a draw. The Confederate army chose to retreat that night, and Missouri was cemented under Union control. Prairie Grove Battlefield State Park was started in the 1970's. It is around 1,000 acres with 800 of that under park control, and 200 to be transferred to the state in the future. It is a park that contains three major ecosystems; prairie, woodlands, and savannah. Due to years of agriculture, urbanization, and past damage from the Civil War (there were artillery, cannons, etc. in the	

battle) Prairie Grove is a shadow of its original condition. Invasive flora and fauna have swept the area, metal pollution in the soil from the battle, grazing from cattle, drainage of water from lowland prairie bottoms, and the encroachment of homes have all taken their toll. This area drains into the million-acre Illinois River Watershed. Water from this area, unfiltered and full of pollution, ends up in the drinking water of those cities who use this watershed. There are several stakeholders in this restoration project. The goal is to restore the original flora (tall prairie grass like Little and Big Blue	

Stem, etc.) by cleaning out the current grasses, and reseeding or exposing dormant wild seeds in the soil. Invasive plant management in the woodlands will bring back the native plants, and by allowing the water seepage to feed the lowland prairie bottoms, natural water filtration will occur. By removing the current flora and replacing it with the original, species of fauna that would normally live in these ecosystems will return. Birds, insects, amphibians, etc. will make their way back to the park. This requires planning and soil testing to determine what needs to be	

done to restore it before this project can start. This entails several soil sampling sites and soil tests. Once tests have been completed and analyzed, restoration can begin. **Explore:** Show the video '*'Prairie Grove Battleground State Park Virtual Field Trip'*.' **Elaborate:** After the video, the students break into three groups: the *'Prairie' g*roup, the *'Woodlands'* group, and the *'Savannah* group.Each group brainstorms their area of study, explaining why their area of study is important to the health of this park.	

Tell the students they need to produce at least six ways to explain why their area of study is important to Prairie Grove, and report this to the class. **Evaluation:** Students will turn in a two-paragraph reflection paper on what they learned and how this project can have long lasting impact on the watershed. **Extend:** End the lesson with how the restoration of an ecologically diverse area can affect people in other states and improve the health of the local landscape. Assign a brainstorming	

project that allows students to design and implement their own ecosystem project on the school grounds. Have an agent from a local company or a local extension agent come to the classroom to explain how ecological restoration is essential for healthy land.	

<table>
<tr><th colspan="3">Formative Assessment for Student Learning</th></tr>
<tr><td colspan="3">Elicit Evidence of Learning: This box is the individual communication performance from the student prompts in appendix A</td></tr>
<tr>
<td>Evidence of Student Proficiency

Students will understand the importance of soil and water sampling to determine how to proceed on a soil restoration project.

Students will learn that the results of these tests have a major impact on what needs to be done to restore a damaged ecosystem.

Students will learn that soil restoration not only benefits the local ecosystem’s flora and fauna, it can also benefit waterways that are downstream from that ecosystem.</td>
<td>Range of Typical Student Responses
This section provides a range of typical student responses. A three-point scale is often used.

Descriptors of grade-level appropriate student responses:
Full understanding: Student will have all the vocabulary defined and participate fully in the post-video discussion. Reflection paper will show a full connection between what they experienced and understanding.
Partial understanding: Student will have 75% of the vocabulary defined. The reflection paper will only show a partial connection between what they experienced and what they understood.
Limited understanding: Student will have 50% or less of vocabulary defined</td>
<td>Acting on Evidence of Learning
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 a 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 students who display full understanding: Assign a brainstorming project that allows students to design their own ecosystem and how they would go about restoring</td>
</tr>
</table>

	and show no understanding of what was learned in the reflection paper.	*an area to that ecosystem..*

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) Planning and Carrying Out Investigations (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)	• 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 investigate 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 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)	• 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.

(EVS-ESS3-1) (EVS-ESS3-2) (EVS-ESS3-3) Cause and Effect (BI-ESS3-1) (EVS-ESS3-1) (EVS-LS4-6)	• 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 ETS1.C: Optimizing the Design Solution LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS4.C Adaptation	• 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. • 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: By restoring the Prairie Grove Battlefield State Park to its pre–Civil War state, native flora and fauna will return to the area, and the Illinois Watershed will regain its purity.

1. ***Group Performances:*** Ask questions to plan an investigation for understanding that by learning about and practicing agricultural restoration of a damaged ecosystem, both the ecosystem and areas downstream can benefit.
2. Plan and an investigation by defining the necessary words and preparing for group collaboration.
3. Construct an explanation by forming groups and discussing the understanding of different types of ecosystems, and how restoration would help the local ecology.
4. Use a model to explain how restoring an ecosystem's soil, water filtration, flora and fauna, can not only help the local ecosystem, but areas around it as well.

Class Discussion

Individual Performances:

1. Develop an argument that shows how ecological restoration (soil, water, flora and fauna), benefits the local ecology but also areas around the ecological area.

Appendix B - **Materials, Preparation, Assessment, and Time Duration.**

Materials:

To watch the recorded VFT, 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 is important that the teacher understands the vocabulary above.

Prairie Grove Battlefield State Park Soil Restoration Virtual Field Trip

Time Duration: 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 think of questions to ask the presenters (if live), and 10 minutes to teach essential concepts. Assume 10 minutes for reflection and discussion after the video.

Assessment: Students will write a half-page research paper on how they would go about restoring this area of the park. Encourage the students to be creative but still follow the restoration guidelines.

Appendix C – **Resources**

Below are good resources for understanding the science used in this VFT.

https://www.uaex.uada.edu/publications/PDF/MP499.pdf#search=ecological%20restoration

https://www.uaex.uada.edu/publications/PDF/FSPPC116.pdf#search=ecological%20restoration

https://www.decadeonrestoration.org/what-ecosystem-restoration

https://www.uaex.uada.edu/environment-nature/water/quality/ANRC2018-2023NPSPollutionManagementPlan.pdf#search=ecological%20restoration

https://www.uaex.uada.edu/publications/PDF/MP483.pdf#search=ecological%20restoration