Soil AND WATER
CONSERVATION VIRTUAL FIELD TRIP SERIES
U of A DIVISION OF AGRICULTURE RESEARCH & EXTENSION University of Arkansas System
USDA United States Department of Agriculture Natural Resources Conservation Service

3D-Student Science Performance	
Grade: 9-12: **Integrated Biology** **Environmental Science** **Agricultural Science**	**Lesson Title**  **Photo courtesy of Unsplash©** **Blackberry High Tunnels and Shade Structures Virtual Field Trip**
Lesson Topics: **Life and Earth Systems** **Human Impacts on Earth Systems** **Sustainability**	

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.]

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)

Connections to the Arkansas Mathematical Standards:

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

HSN.Q.A.1: Use units 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. The emphasisasis is on the design 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 the impact 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 of 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 importance of soil, water, and sun for blackberry cultivation.
- Students will learn that these impacts indirectly influence micro-environments such as water and wind systems.
- Students will learn that current conservation methods can make a difference not only ecologically but also economically to a blackberry farmer.

	Student Science Performance
Objective: Students will understand the importance of soil, water, and sun for blackberry cultivation. Students will learn that these impacts indirectly influence micro-environments such as water and wind systems. Students will learn that current conservation	***Phenomenon: Agricultural Sustainability and Conservation are the keys to healthy blackberry production.*** ***Gather:*** *(In this section, students will generally be asking questions, obtaining information, planning and carrying out an investigation, using mathematical and computational thinking, or using models to gather and organize data and/or information.)* *Students will break into groups and define the following words:* Conservation Arkansas Discovery Farms Leaf Moisture Measurement Blackberry High Tunnels Blackberry Shade Structures White Drupelet Disorder Surface Water Irrigation Drip Irrigation

methods can make a difference not only ecologically but also economically to a blackberry farmer. **Assessment**: Students will write a half-page research paper on either blackberry tunnels or shades, explaining why they feel this practice is the most important. **Key Points:** Blackberry tunnels, blackberry shades, Discovery Farms **Materials:** To watch the recorded *'Blackberries in High Tunnels and Shade Structures Virtual Field Trip'* go to www.uaex.uada.edu/soywhatsup and click on the 'Virtual	Broad Mites Rossette Fungus ***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.)* 1. Students will watch the video on the Virtual Field Trip. 2. Students will compare different agricultural methods. ***Class Discussion:*** *Questions to initiate Discussion:* *Q: What is conservation?* *Q: What is sustainability in agriculture?* *Q: What are the advantages of practicing these two principles?* *Q: What are some testing practices that blackberry farmers are practicing, and how can these practices help blackberry farmers ecologically and economically?* *Q: Where can farmers get help with these testing procedures?* Do a KWL Chart and inquire about blackberry production. How do farmers grow blackberries? What are the advantages of practicing conservation with blackberries? What is the type of conservation practices that blackberry farmers are doing? How can these practices help blackberry farmers ecologically and economically? Where could farmers get help with these practices? ***BEFORE THE VIDEO,*** be sure the students understand that agricultural sustainability for blackberries not only benefits the environment, but also farmers. Blackberry farmers need to learn that water and nutrient conservation and sustainability can translate into more profit for them. ***Biology Teachers:*** This is a good time to address/review human impact on ecological systems and how population dynamics/agriculture affect the local ecology and economics. ***Environmental Science Teachers:*** This is a good time to address/review human impact on

Field Trips and Lessons' icon to the left of the webpage. Paper and writing utensils for students in the classroom. **Preparation:** If this is done in class; it is highly recommended that the teacher understands the key vocabulary words below. Time Duration: one and a half class periods. The video is about 60 minutes long	ecological systems and how population dynamics/agriculture affect the local ecology and economics. ***AG Teachers:*** This is a good time to examine/review human impact on ecological systems and how population dynamics/agriculture affect the local ecology, and the economics of farming profitability by using and testing for continuous agricultural improvement. Farmers must be constantly aware of the resources they use to grow their crops. Practicing sustainability and conservation in the field means less water and chemicals (herbicide and insecticide) treatments. This translates into more profit for farmers and is environmentally friendly. Many farmers are aware that by continuously improving agricultural conservation on their farms, they can appeal to big businesses who are interested in marketing products that come from ecological friendly farms, thus improving their overall profit. Show the video '*Blackberry Tunnels and Shade Structures 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, students will break into three groups: the '*High Tunnel* group, the '*Blackberry Shade'* group, and the '*Surface Irrigation'* group. Each group brainstorms and conducts research in their area of study, explaining why their area of study is important to blackberry production. Tell the students they need to produce at least six ways to explain why their area study is important, and report this to the class.

Commented [KH1]: Should students be conducting research (not brainstorming new ideas) here on their group topic in order to debate why their topic of study is important?

Commented [DY2R1]: I think it can be both. I am assuming that the students will not have a lot of time to do much research, which is why I suggest brainstorming.

(45 minutes plus 15 minutes of question/answer). Assume about 10 minutes for students to look up vocabulary, and 10 minutes to teach essential concepts. Assume 10 minutes for reflection and discussion after the video. **Elicit:** Do a KWL Chart and inquire about blackberry production. How do farmers grow blackberries? What are the advantages of practicing conservation with blackberries? What is the type of conservation practices that blackberry farmers are doing? How can these practices help blackberry farmers	

ecologically and economically? Where could farmers get help with these practices? **Engage:** Tell the students that they are going to watch a video *titled 'Blackberries in High Tunnels and Shade Structures Virtual Field Trip'.* Before starting the video, have the students break into groups to define the following words: Conservation Arkansas Discovery Farms Leaf Moisture Measurement Blackberry High Tunnels Blackberry Shade Structures White Drupelet Disorder Surface Water Irrigation Drip Irrigation Broad Mites	

Rossette Fungus **Explain:** ***BEFORE THE VIDEO,*** be sure the students understand that agricultural conservation of blackberries not only benefits the environment, but also farmers. Blackberry farmers need to learn that water and nutrient conservation and sustainability can translate into more profit for them. ***Biology Teachers:*** This is a suitable time to address/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 address/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 examine/review human impact on ecological systems and how population dynamics/agriculture affect the local ecology, and the economics of farming profitability by using continuous agricultural improvement. Farmers need to be continually aware of the use of their resources in farming. Blackberries, while	

considered a high value crop, are also a high maintenance fruit that requires constant monitoring. Blackberries are particularly vulnerable to pests and environmental factors during the berry ripening period. It is for this reason that farmers are looking to High Tunnels and Shades to help improve their crops. Farmers are realizing that high tunnels improve fruit quality and extend the harvest season, all while causing a minimum effect on the local environment. **Explore:** Show the video '*Blackberries in High Tunnels and*	

Shade Structures Virtual Field Trip'.' **Elaborate:** After the video, the students break into three groups: the '*High Tunnel* group, the '*Blackberry Shade'* group, and the '*surface Irrigation'* group.Each group brainstorms their area of study, explaining why their area of study is important to blackberry production. Tell the students they need to produce at least six ways to explain why their area of study is important, and report this to the class. **Evaluate:** Students will turn in a two-paragraph	

reflection paper on what they learned and how these conservation efforts can affect blackberry farming in Arkansas. **Extend:** End the lesson with how the sustainability and conservation practices of blackberry farmers decreasing their dependence on water and chemicals has also had a significant impact on our personal lives through the water we use and the food we eat. Reiterate how the concern for ecological friendly products can, in turn, drive how farmers approach production. Assign a brainstorming project that allows	

students to design their own alternate growing methods or have students research innovative conservation practices and how they could benefit local 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 collaborate to increase profitability while decreasing herbicide and insecticide use.	

Formative Assessment for Student Learning

Elicit Evidence of Learning: *This box is the individual communication performance from the student prompts in Appendix A*

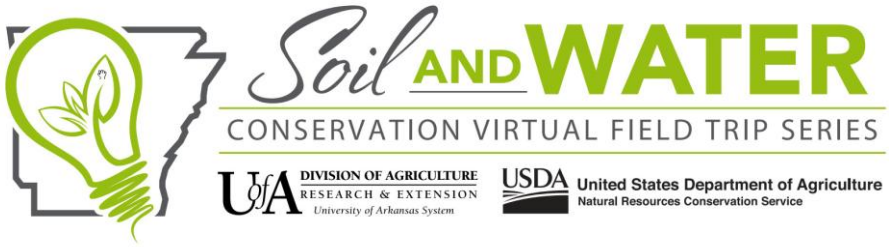
Evidence of Student Proficiency	Range of Typical Student Responses	Acting on Evidence of Learning
Students will understand the importance of conservation and sustainability to produce healthy blackberry crops with the least amount of water and added nutrients. *Students will learn that these impacts indirectly influence micro-environments such as water and temperature.*	*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. The reflection paper will show a full connection between what they experienced and understanding.* ● *Partial understanding: Student will*	*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*

Students will learn that current conservation methods can make a difference not only ecologically but also economically to a blackberry farmer.	*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 and show no understanding of what was learned in the reflection paper.*	*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 technology to help farmers. Students could also interview local agencies for the collaboration they have made 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) 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)	• The total amount of energy and matter in closed systems is preserved. • Change rates and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

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)	• 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 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 precludes 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 and Conservation are the keys to healthy blackberry production.

Group Performances:

1. Ask questions to plan an investigation for understanding how blackberry farmers and the ecosystem benefit from practicing agricultural sustainability and conservation.
2. Plan an investigation by defining the necessary words and preparing for group collaboration.
3. Construct an explanation by forming groups and discussing how, by using different conservation and sustainability methods, both blackberry farmers and the ecosystem benefit.
4. Use a model to explain how agricultural sustainability and conservation can help both crop productivity and local ecology.

Class Discussion

Individual Performances:

1. Develop an argument that shows how blackberry farmers working toward agricultural conservation and sustainability can and do help the economy and ecology in our local area.

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

To watch the recorded '*Blackberry High Tunnels and Shade Structures Virtual Field Trip'*:

- Go to www.uaex.uada.edu/soywhatsup and click on the *'Virtual Field Trips and Lessons'* link on the left-hand side of the page. This will take you to the video archive webpage.
- Paper writing utensils for students (if in class).

Preparation:

If this is done in class, it is highly recommended that you, the teacher, research the key

words given above.

Time Duration: One to 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, 10 minutes to teach essential concepts, and about 10 minutes for group discussion and reflection after the video.

Appendix C **– Resources**

Below are good resources for understanding blackberry farming and research.

https://www.uaex.uada.edu/farm-ranch/crops-commercial-horticulture/horticulture/commercial-fruit-production/blackberries-production.aspx

https://www.uaex.uada.edu/media-resources/news/2015/august2015/08-14-2015-Ark-Wind-Tunnels.aspx

https://www.uaex.uada.edu/publications/pdf/MP586.pdf#search=blackberry%20high%20tunnels