Lesson title:
Farming for the Future

Overview:
Although sustainability can be defined in many different ways, the overarching principle involves meeting society's short-term needs while not jeopardizing its ability to fulfill its long-term needs. Furthermore, its implementation involves environmental, social, and economic considerations. In this activity, students will research sustainable agricultural practices used by farmers and evaluate technological solutions utilized in sustainable agriculture. As an extension, students will develop a proposal for designing a sustainable garden at their school.

Objectives
Students will be able to:
- Investigate sustainable agricultural practices used by farmers
- Evaluate technological advancements that are used in sustainable agriculture
- Propose a solution for a sustainable school garden

Materials
- Computers connected to the Internet
- Farming for the Future Capture Sheet

Have you ever wondered . . .
How farmers use recycling to help crops grow?
What role technology plays in making agriculture more efficient?

Make connections!

How does this connect to students?	**How does this connect to careers?**	**How does this connect to our world?**
Planning for the future by promoting and maintaining sustainable food production will help us meet the ever-growing demand for food.	**Soil scientists** collect and analyze soil data through soil surveys to help manage soil for crop production, biofuel products, etc. **Agronomists** are "crop doctors" since their job is to develop the best methods for increasing the quality	Continuing to embrace technology of many forms (mechanical, chemical, biological, etc.) will enable growers to raise crops for food, fuel, and fiber in a way that is precise and less resource-intensive.

	and yield of crops. Areas that agronomists specialize in include soil fertility and classification, crop rotation, drainage, weed control, etc. **Agricultural engineers** design and test farm machinery and equipment using computer-based technology, such as robotics, sensors, and programming, to make sure everything functions properly. They also help make farming sustainable, safe, and environmentally friendly.	

Blueprint for Discovery

1. As a class, watch the video "How to Use Trash to Help Crops Grow" [first 1 min. 39 sec.] https://www.bing.com/videos/search?q=usfra+video+how+to+use+trash+to+help+crops+grow&docid=608006596988046766&mid=9EBA38DF4455A9D6DC2F9EBA38DF4455A9D6DC2F&view=detail&FORM=VIREHT

2. Pause the video and lead a class discussion to elicit the following key points from students:

   Guiding questions for the discussion include:
   - What does the term "sustainable agriculture" mean?
   - What makes "trash" from a farm different from other trash?
   - How does field trash serve to protect the soil?
   - What does it mean if a farmer uses "no till" technology? What is its impact on soil health?

   Anticipated responses:
   - "Trash" from a farm field is different from the trash (garbage) we're used to. Field trash contains organic residue, such as shredded corn stalks and other materials.
   - This field residue protects the soil from wind and soil erosion by creating a blanket; runoff is prevented and the soil rebuilds vital nutrients.
   - No till technology (no digging) keeps the soil on the field to absorb vital nutrients

3. Now, watch the remainder of the video with students (1 minute 40 seconds to the end).

https://www.bing.com/videos/search?q=usfra+video+how+to+use+trash+to+help+crops+grow&docid=608006596988046766&mid=9EBA38DF4455A9D6DC2F9EBA38DF4455A9D6DC2F&view=detail&FORM=VIREHT

4. Lead a class discussion to elicit the following key points from students:

   Guiding questions for the discussion include:
   - What role does biotechnology play in agriculture?
   - How can agricultural engineers and farmers use various technologies to improve agricultural efficiency?

   Talking points and anticipated responses:
   - Although a precise definition of "sustainable agriculture" is difficult to pin down, it broadly entails farming systems that not only maintain their productivity but also their usefulness to society indefinitely. According to the USDA, sustainable agriculture addresses a myriad of ecological, economic, social, and philosophical issues.
   - GMO means "genetically-modified organism" and refers to anything living that has been manipulated for a different set of genes. The term GMO is very general and may include aspects such as cross-bred plants.
   - Farmers face many challenges when growing crops. Some of those challenges come in the form of weather, fungus/disease, rodents, weeds or insects. In the past and even today, farmers use pest protections like insecticides- topically (over the top of the crop). The challenge with this is that the insecticide may have the unintended consequence of killing "non-target" insects. Scientists are always making observations and looking for new or better ways to solve problems.
   - Biotechnology produces GMOs that are more resistant to insects that would otherwise damage the roots and stalks.
   - Technological advancements help farmers improve agricultural efficiency. Using computer-based data, farmers can modify the amount of seed/nutrients, the type of seeds/hybrids, and the planting location to adapt to changing environmental conditions so no valuable resources are wasted.
   - Today farmers do not necessarily have to fire up their diesel equipment and drive back and forth to apply insecticide treatments because they have been able to instruct plants to do that for them. Furthermore, controlling a pest in the soil/stalk can be a really tricky business; therefore, applying topical treatments in those areas allows plants to confer protective resistance.
   - Bacteria and fungi, although they often get bad press, can play a beneficial role in agriculture. Exploiting these organisms for farming is a rapidly growing segment of agricultural biotechnology.

5. As individuals, pairs, or small groups (depending upon the number of internet connected devices available), direct students to research no till farming and other sustainable agricultural practices (e.g. cover crops, crop rotation). In addition, they should research different technological solutions used in sustainable agriculture (e.g. computer modeling, sensors, GPS). Students should record their findings on the Farming for the Future Capture Sheet and include the URL of the web site where the information was found (source).

   Suggested sites for research:
   - https://nifa.usda.gov/program/sustainable-agriculture-program
   - http://www.isaaa.org/resources/default.asp
   - http://www.fooddialogues.com/sustainability-infographics
   - http://www.fooddialogues.com/headlines/sustainability
   - https://nifa.usda.gov/topic/agriculture-technology

- https://www.ers.usda.gov/amber-waves/2016/december/precision-agriculture-technologies-and-factors-affecting-their-adoption/
- https://nifa.usda.gov/program/precision-geospatial-sensor-technologies-programs

6. Invite students to summarize their learning visually with a short caption using the Summarizer Capture Sheet. In the comment field, have students explain their illustration and include at least two hashtags to categorize their comments. Then, guide students to post their summarizer around the classroom and respond in the comments field using their own insights or hashtag to at least three classmates.

Take action!
Develop a proposal for designing a school garden for the future, one that can be sustained and thrive for many years to come. Some factors to consider in your site selection and design include, hours of sun exposure, irrigation, drainage, soil, access, and tool storage. Be sure to consider the economic impact of your design and to explain how each feature of your design contributes to the sustainability of the garden. Challenge yourself to include a feature that involves technology.

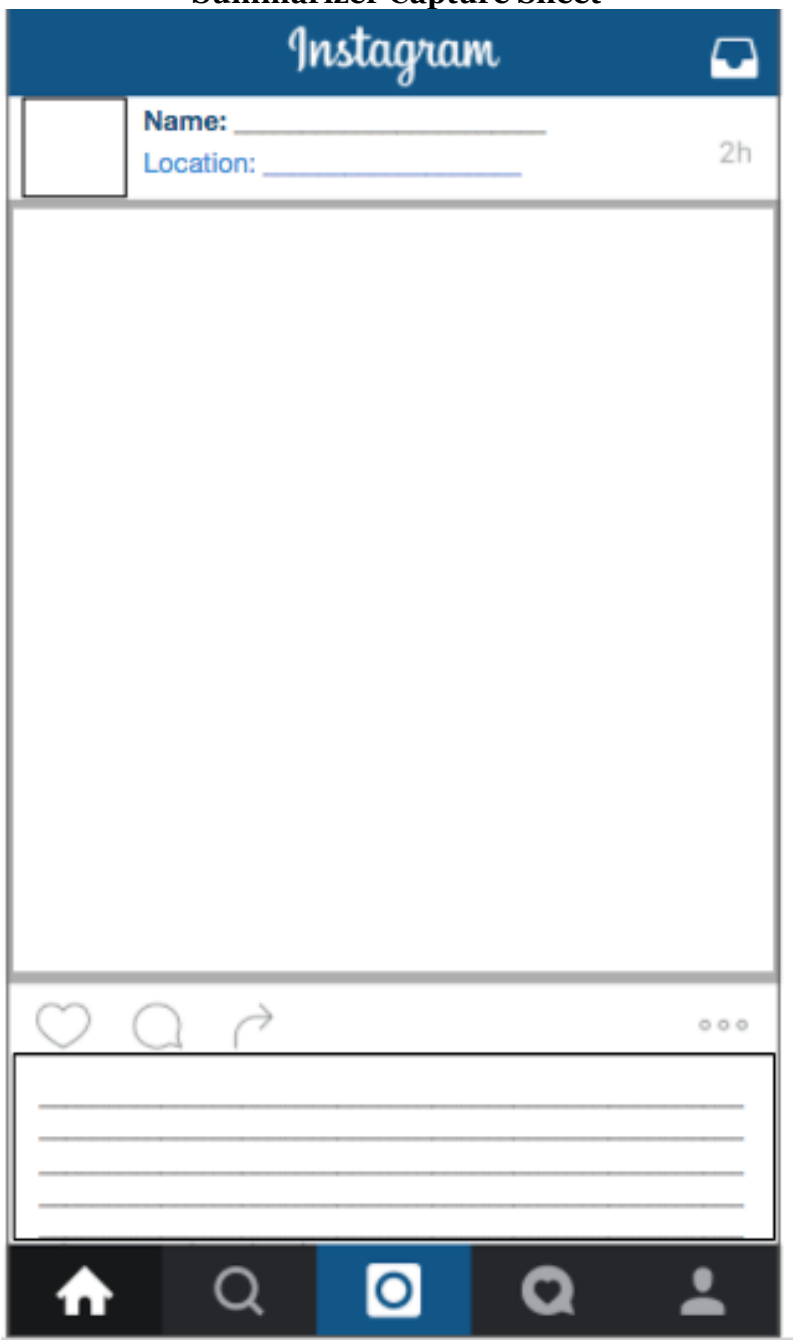
National Standards

Science	**Next Generation Science Standards** **HS-ESS3 - Earth and Human Activity** Students who demonstrate understanding can: **HS-ESS3-2:** Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. **HS-ESS3-4:** Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. **HS 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.

Research Capture Sheet

	Sustainable Agricultural Practices	**Technological Solutions in Sustainable Agriculture**
Practice/Technology #1		
How does this support sustainability?		
Source (URL)		
Practice/Technology #2		
How does this support sustainability?		
Source (URL)		
Practice/Technology #3		
How does this support sustainability?		
Source (URL)		

Summarizer Capture Sheet



Username	Comment