



Innovation for the Future of Agriculture

Middle School Food and Agricultural Literacy Curriculum

Precepts

- C. Vision
 - C1. Contemplate the future
 - C2. Conceptualize ideas

National Standards

- BS.01.01.02.a. Investigate current applications of biotechnology in agriculture.
- CS.01.03.01.b. Utilize visioning skills to develop a plan.
- CS.01.03.02.a Use various conceptualizing tools.
- NL-ENG.K-12.12 – Applying Language Skills
- NS.5-8.3 – Life Science
- NS.5-8.5 – Science and Technology

Student Learning Objectives

- As a result of this **unit** the students will...
- Discuss technologies and methods relating to plant production.
- As a result of this **lesson** the students will ...
- Explore technologies and resulting impacts on plant production.

Content Outline

Objective 1. Explore technologies and resulting impacts on plant production.

- A. How do American farmers produce enough to feed the world?

Innovation is critical for the advancement of any industry. **Innovation** is the ability and desire to introduce new ideas and technologies to create change. Change and **innovation** are often the result of creative and dedicated farmers and researchers who apply knowledge of basic life sciences (chemistry, physics, and biology) to everyday problems to increase yield, mitigate environmental effects, and produce the safest, most affordable, and most abundant food supply in the world.

- B. Examples of innovative technologies in agriculture.

Time

Instruction time for this lesson: 45 minutes.

Resources

National FFA Organization. (2009). LifeKnowledge Online. Retrieved July 9, 2009, from — <http://agedlearning.org> — National FFA Organization. (2003). LifeKnowledge Precepts and Signs of Success. — United States Department of Energy. (2008). Human Genome Project Information. Retrieved July 9, 2009, from http://www.ornl.gov/sci/techresources/Human_Genome/elsi/gmfood.shtml

Tools, Equipment, and Supplies

Overhead projector/transparencies
Nature soundtrack (crickets, birds, etc.)
CD player
Poster paper
Construction paper
Markers, crayons, or colored pencils
Scissors and glue
MS.PS.5.1.TM.A – one per teacher
MS.PS.5.1.TM.B – one per teacher
MS.PS.5.1.TM.C – one per teacher
MS.PS.5.1.TM.D – one per teacher
MS.PS.5.1.AS.A – one per student
MS.PS.5.1.ASSESS.A – one per student

Key Terms

The following terms are presented in this lesson and appear in **bold italics**:

Innovation

GPS

Genetically modified organisms (GMO)

Hydroponics

1. Precision Agriculture:

"Precision agriculture is a process of using technology to create an exact science so that a farmer receives the greatest crop yields at the lowest cost to reap the maximum profit, all the while reducing waste and maintaining the integrity of the environment." (Adrian, 2009) One of the most important components of most precision agriculture practices is ***GPS***. ***GPS*** stands for global positioning systems. These computers use satellites in the earth's orbit to triangulate their exact position on the ground. By using ***GPS***, farmers can plow, harvest, fertilize, and apply pesticides to their crops all without turning a wheel or pressing a button. By using robotic tractors (***GPS*** navigated tractors) farmers are able to harvest crops more efficiently, use less water, and prevent chemical



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runoff as fertilizer and pesticides are applied more systematically and accurately. See the following video and news article for more details: <http://www.ocala.com/article/20090925/OBIZ/909259973/1357/obiz?Title=Agriculture-Ancient-practice-gets-an-ultramodern-boost>

2. Hydroponics:

Many plant producers are beginning to realize the benefits of **hydroponics** (the practice of growing plants in the absence of soil). Many plants, such as strawberries, grow very well in a greenhouse in the absence of soil. This method saves water because the water goes directly to the root (usually through plastic tubes) and does not run off through the soil.

3. Genetically Modified Crops:

Genetic modification refers to altering an organism's (a living plant, animal, or bacteria) genes to reach a desired effect. Today, there are over 300 million acres of crops planted that are **genetically modified** in some way. Many of these are altered to resist diseases or attacks from pests. Others are made to live even when sprayed with herbicides.

These herbicide-resistant crops are useful because farmers can then spray the whole crop to kill pesky weeds without killing their plants. Many fruits and fleshy vegetables (tomatoes, for example) are being modified to prevent over ripening so that they can be stored and transported over longer distances. Today researchers are working to genetically modify crops that will increase the health of consumers. Fruits that contain healthy fatty acids and bananas that contain vaccines (medicines that prevent viruses) are scientific **innovations** that we may see in the next five years.

Interest Approach

Before this lesson prepare **MS.PS.5.1.TM.A-D** to use with a projector. Make copies of **MS.PS.5.1.AS.A** for student use later in the lesson. The students will also need easy access to art supplies such as: large poster board, construction paper, makers, crayons, colored pencils, scissors, and glue.

Good morning, class! I am so happy to see all of your smiling faces in class today! I hope everyone brought their thinking cap and their creativity pens because today we are going to help change the world.

That's right, by the end of the class period, you and your classmates will develop ideas that may impact the future of agriculture forever!

Place **MS.PS.5.1.TM.A** on the projector for students to view. This picture is of a farm in the 1930s with a horse or mule pulled plow, many farm hands, and tools from the era.

Take a look at the picture on the screen. This is a picture of a typical family farm 80 years ago in the 1930s. Take a few minutes to look at the details in this picture. What would it be like to live on this farm? What do you think your daily routine would be like?

Allow one to three minutes for students to look at the picture and ponder how life would be different 80 years ago.

Now think about how this farm would look different today, seven decades later. How would living on it today be different from living on the farm in the 1930s? Would there be more work or less? What do you think would change in this picture? Turn to your neighbor and share these thoughts with them.

Allow the students a minute or two to share their thoughts with their neighbors. Then discuss these thoughts as a class.

If you can hear me, clap once.

Clap.

If you can hear me, clap twice.

Clap, Clap.

What are your thoughts? What do you think would change? How would things look different?

Students should share their thoughts. Possible thoughts may be that there would be more mechanized farm equipment to replace the mule; there may be less work and fewer farm workers.

You are all right! Agriculture has changed tremendously over the years. Agriculture is still the leading industry in America today. American farmers produce enough food to feed the population of the United States and still have extras to export to other countries. Every year, new technological inventions and innovative farming practices increase the amount of food farmers can produce and help to protect the environment.



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Summary of Content and Teaching Strategies

Objective 1. Explore technologies and resulting impacts on plant production.

The majority of this lesson will be student-focused as the students work to brainstorm and create new technologies they feel will improve the plant production by increasing yield, reducing negative effects on the environment, or improving quality and durability of America's food supply. Therefore, as the teacher, provide students with the three prepared examples of technologies that are already being implemented and developed today.

Use **MS.PS.5.1.TM.B**, **C**, and **D** to help enhance the discussions. Then allow students the remaining class period to create their own innovative inventions. This project will take at least 30 minutes and may be extended for one or two additional class periods.

How do American farmers produce enough to feed the world? Innovation is critical for the advancement of any industry. Innovation is the ability and desire to introduce new ideas and technologies to create change. Change and innovation are often the result of creative and dedicated farmers and researchers that apply knowledge of basic life sciences (chemistry, physics, and biology) to everyday problems to increase yield, minimize environmental effects, and produce the safest, most affordable, and most abundant food supply in the world.

Today you will each have the opportunity to use your innovative minds to develop new products and farming methods that could change agriculture as we know it today. But first, let's discuss a few technologies that are being used commonly today that have helped to transform plant production.

In general, farmers and agricultural researchers are working to create an exact science so that a farmer receives higher crop yields with less input for an increased profit, while reducing negative effects agriculture may have on the environment. This exact science is called precision agriculture. One of the most important components of most precision agriculture practices is **GPS**. **GPS** stands for global positioning systems.

Display **MS.PS.5.1.TM.B** using the projector to show students examples of GPS units and GPS navigated farm equipment.

These computers use satellites in the earth's orbit to calculate their exact position on the ground. By using **GPS**, farmers can plow, harvest, fertilize, and apply pesticides to their crops all without turning a wheel or pressing a button. By using robotic tractors (**GPS** navigated tractors) farmers are able to harvest crops more efficiently, use less water, and prevent chemical runoff as fertilizer and pesticides are applied more systematically and accurately. Watch how these real-world farmers are using this technology to run their family farm.

If Internet is available, use the link to show the students the video: <http://www.ocala.com/article/20090925/OBIZ/909259973/1357/obiz?Title=Agriculture-Ancient-practice-gets-an-ultramodern-boost>.

Another exciting **innovation** that has altered the way many farmers grow fruits and vegetables is called **hydroponics**. Do you know what **hydroponics** is (hint: pay close attention to the root of the word: hydro).

Allow students to share their thoughts as a class.

Many plant producers are beginning to realize the benefits of **hydroponics** which is the practice of growing plants in the absence of soil. Many plants, such as strawberries, grow very well in a greenhouse in the absence of soil.

Display **MS.PS.5.1.TM.C** for students to view examples of hydroponics.

What do you think are some of the benefits of growing plants using **hydroponics** rather than planting the same fruits and vegetables in large fields in soil?

After allowing the class 15-30 seconds to ponder the question, ask three or four students to share their thoughts with the class. You may wish to ask for responses from one student per table. Or try a new method: place each student's name on a Popsicle stick and use these to randomly choose students to respond to questions or share their opinions. By setting aside the students who have been called on, you can ensure that all of the students have an opportunity to participate.



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Those were all great ideas! **Hydroponics** saves water because the water goes directly to the root (usually through plastic tubes) and does not run off through the soil. Also growing fruits and vegetables through **hydroponics** reduces the struggle to control weeds, viruses, disease, and other pests as the roots are placed in a sterile environment.

Now let's discover another amazing technological **innovation** that has changed agriculture drastically in the past 40 years, **GMO's**. Do you know what a **GMO** is? On your notebook sheet of paper, write what you think G-M-O stands for.

Allow the students about one minute to think about and record what the abbreviation GMO stands for.

GMOs are **genetically modified organisms**. Genetic modification refers to altering an organism's (a living plant, animal, or bacteria) genes to reach a desired effect. Many of these are altered to resist diseases or attacks from pests. Others are made to live even when sprayed with herbicides. These herbicide-resistant crops are useful because farmers can then spray the whole crop to kill pesky weeds without killing their plants. Many fruits and fleshy vegetables (tomatoes, for example) are being modified to prevent over ripening so that they can be stored and transported over longer distances.

Today researchers are working to genetically modify crops that will increase the health of consumers. Fruits that contain healthy fatty acids and bananas that contain vaccines (medicines that prevent viruses) are scientific **innovations** that we may see in the next five years. But what does a **genetically modified organism** look like? Take a look at the following pictures. Can you tell which tomato is **genetically modified** and which is **organic** and non-modified? Take a minute to look closely and determine the difference.

Display **MS.PS.5.1.TM.D** to allow students to view pictures of genetically modified fruits and vegetables and to see if the students can tell the difference between non-modified foods and genetically modified foods. Then, discuss how common genetically modified foods are in neighborhood grocery stores.

What do you think?

Call on students to share their thoughts with the class.

Believe it or not, both of these tomatoes have been genetically modified. Many of the fruits and vegetables you eat every day have been genetically modified. These foods look, smell, feel, and most importantly, taste just like other non-modified foods.

Utilize the *Hieroglyphics e-Moment*®.

Let's review what we've just discussed. When you hear the word GO, draw a hieroglyphic or icon to represent each of the terms we have talked about so far: GPS, hydroponic, and genetically modified that you have in your notes. You will have two minutes to draw the three icons. What questions are there? GO!

Allow students to draw their icons.

Pencils down in 5, 4, 3, 2, 1! Great job! Please share your hieroglyphics with the person beside you.

Now that we have discovered technologies that are already in use to help improve agriculture, it is your turn to make a difference.

Distribute **MS.PS.5.1.AS.A** and allow students to review the directions.

Take a look at this worksheet. Read the directions carefully, then we will discuss your mission as a class.

Allow students to read the directions silently for a minute or two.

Now, let's review the assignment. First, place your name and today's date on the top of the worksheet. Today is _____.

Continue reading directions.

Innovation is the spirit and drive for change. Your mission is to use your imagination and knowledge of the agricultural industry to create a new agricultural technology. This technology can be a new piece of equipment, planting or harvesting techniques, or even a **genetically modified** plant that you feel will benefit the agricultural industry and our consumers. First, what is the name of your invention? Create a catchy phrase or name that will explain what the invention is and catch a potential buyer's attention.



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For question number two, be very specific. Explain how this invention will *improve* the plant production industry. What does it do? Who will it benefit? Will this invention help farmers make a larger profit, save time, protect the environment, or simply grow better products?

After answering questions one and two, draw a sketch of the item you created in the box provided. Then, using the poster board I have provided, design a poster that will express the importance of your wonderful new invention and convince consumers to purchase this product or adopt the new agricultural production technique. This poster should be colorful, neat, and informative.

This is a very exciting project because you have the freedom to use your imagination. You will have 30 minutes to complete this activity. What questions are there?

Very good! Please begin.

Review/Summary

As the students work, monitor their activity. Walk around the room and ensure students are following directions and working productively. This is an individual assignment; therefore, reduce the amount of chatter and distractions by standing closer to those students who tend to get off task. Provide assistance for students who do not understand. For students who finish early, ask them to practice their proposal with you. Point out any weaknesses in the plan or presentation for students to consider revising or rehearsing. Give the students a warning when half of the time has elapsed (10 minutes) and when five, three, and one minute remains. Then, refocus their attention back to the front. Review today's lesson as the students share their thoughts.

Everyone please reach a good stopping point and focus your attention to the front.

Allow five to ten seconds for students to settle down and focus.

Now, we will all share our ideas with the class. When I call your name, please stand up and share your invention with the class. Tell us what your invention does, how it could change and improve agricultural production, which group of people it will help the most, and what gave you the idea to invent it.

Call student names in order of seating, birthday, or by using Popsicle sticks with their names to randomly choose students. After all students have presented, end the lesson.

Wow! I am so impressed with everyone's inventions! I am so proud to know you are the future of our country. Think back one more time to this picture from agriculture from decades ago.

Display **MS.PS.5.1.TM.A**.

Just as agriculture has progressed so much since this picture, in 50 years, students will be sitting in the classroom looking at a picture of agriculture from now and be amazed at the advances in agriculture that were all made possible by innovative thinkers like you!

That is all the time we have for today, but please remember, that as future consumers of agricultural products, by being innovative and creative, you really can make a difference— in your life and for others.



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Application

Extended classroom activity:

To extend further study of plant production technologies, students will continue developing their idea or invention. The students will script and perform a commercial for radio or television, which will educate consumers and farmers about their innovative product or production technique. Invite local farmers to the class to judge the students' work and to choose the most innovative and useful project.

FFA activity:

Invite a speaker to the next FFA meeting to talk about emerging technology that they use.

SAE activity:

This lesson can be used to introduce the many opportunities students have to pursue a Supervised Agricultural Experience Program in crop production or start a research SAE around plant production technology.

Evaluation

MS.PS.5.1.ASSESS.A

Answers to Evaluation

1. B
2. C
3. F
4. A
5. E
6. D



Library of Congress, Prints & Photographs Division, FSA-OWI Collection, [reproduction number, e.g., LC-USF35-1326]



RTK AutoSteer helps farmers reduce fuel costs, decrease driver fatigue, and eliminate overlap. Pictured here are GPS system antennas roof-mounted on a farming tractor and the touchscreen controls for the GPS guidance system installed in the cockpit.



Fruits and vegetables growing using hydroponics (in the absence of soil)



MS.PS.5.1.TM.D





Agricultural Innovation

Name: _____

Directions: Innovation is the spirit and drive for change. Your mission is to use your imagination and knowledge of the agricultural industry to create a new agricultural technology. This technology can be a new piece of equipment, planting or harvesting techniques, or even a **genetically** modified plant that you feel will benefit the agricultural industry and our consumers.

1. What is the name of your invention? _____
2. How will this invention improve the agricultural industry? What does it do? Who will it benefit? Will this invention help farmers make a larger profit, save time, or simply grow better products?

3. Draw a sketch of your invention.

4. On a sheet of poster paper, design a poster that will express the importance of your wonderful new invention and convince consumers to purchase this product or adopt the new agricultural production technique. This poster should be colorful, neat, and informative.



Name _____

Directions: Match the key term with the correct definition.

- | | |
|-------------------------------------|--|
| 1. _____ Innovation | A. A science so that a farmer receives higher crop yields with less input for an increased profit, while reducing negative effects agriculture may have on the environment |
| 2. _____ GPS | B. The ability and desire to introduce new ideas and technologies to create change |
| 3. _____ Hydroponics | C. Global positioning systems: computers that triangulate position by referencing satellite signals from the earth's orbit |
| 4. _____ Precision Agriculture | D. Crops whose genes have been modified to improve yield, nutrition, or production |
| 5. _____ Organic | E. Agricultural production that does not use synthetic chemicals as fertilizers or pesticides |
| 6. _____ Genetically Modified Crops | F. The process of growing plants in the absence of soil |