



Lesson number: MS.PS.4.2

Responsible Agriculture: Plants and Environmental Stewardship

Middle School Food and Agricultural Literacy Curriculum

Precepts

- F. Continuous Improvement
- F3. Use innovative problem solving strategies

National Standards

- PS.03.04.01.b. Describe sustainable agriculture practices and compare the ecological effects of traditional agricultural practices with those of sustainable agriculture.
- CS.01.06.03.a. Use problem solving strategies to solve a professional or personal issue.
- NL-ENG.K-12.12 – Applying Language Skills
- NS.5-8.6 – Science in Personal and Social Perspectives
- NSS-C.9-12.5 – Roles of the Citizen

Student Learning Objectives

- As a result of this **unit** the students will...
- Identify environmental impacts related to plant production.
- As a result of this **lesson** the students will ...
- Identify how plant production stewardship has a positive impact on the environment.

Content Outline

Objective 1. Identify how plant production stewardship has a positive impact on the environment.

- A. What is **environmental stewardship**?

Environmental stewardship is the name given to agricultural practices that consciously work to protect the environment from the potential harm that may result from agricultural production. Agriculture is the leading industry in the country and American farmers feed much of the world. As world leaders, American agriculturalists have the responsibility to be environmental stewards and ensure that the land that we rely on for food and fiber is protected. Below are two great examples of **environmental stewardship** practices that are gaining popularity in the field of plant production.

Plant Science: Plant Science and Anatomy

Time

Instruction time for this lesson: 45 minutes.

Resources

Disrude, Devin. (2004). *Water is Life*. Retrieved September 11, 2009, from <http://academic.evergreen.edu/g/grossmaz/DISRUDDJ/> Layton, Julia. (2009) "Is conservation agriculture better than organic farming?" Retrieved 27 September 2009 from HowStuffWorks.com. <http://science.howstuffworks.com/conservation-agriculture.htm> — National FFA Organization. (2009). *LifeKnowledge Online*. Retrieved July 9, 2009, from <http://agedlearning.org> — National FFA Organization. (2003). *LifeKnowledge Precepts and Signs of Success*.

Tools, Equipment, and Supplies

Overhead projector/transparencies
White paper – one per student
Markers or crayons
MS.PS.4.2.TM.A – one per teacher
MS.PS.4.2.TM.B – one per teacher
MS.PS.4.2.AS.A – one per student
MS.PS.4.2.AS.B – one per student
MS.PS.4.2.ASSESS.A – one per student

Key Terms

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

Environmental Stewardship

No-till Agriculture

Organic

Insecticide

Hydroponics

- B. Examples of stewardship practices in agriculture
 - 1. Low tillage farming
 - a. The problem: Conventional farming practices are often accused of being the largest cause of erosion problems in the United States because of the common practice of plowing up the soil and dead plants before planting new crops. Tilling the soil loosens the top layer making the soil more apt to run off in heavy rains. Also, tilling the soil requires mechanical plows which burn fuel releasing greenhouse gases into the air.
 - b. One solution: One increasing popular method of preventing erosion on cropland is called low-tillage or no-tillage farming. In no-tillage farming, new crops are



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Interest Approach

Before class pass out one piece of white paper to each desk. Be sure to prepare **MS.PS.4.2.TM.A** and **MS.PS.4.2.TM.B**, secure a projector, and make copies of **MS.PS.4.2.AS.A** and **MS.PS.4.2.AS.B** (front and back) for the entire class.

Good afternoon and welcome to class! I am so happy to see all of your smiling faces in class today. I hope everyone is ready to help save the world, because today we are going to help farmers think of new ways to help the environment. What struggles do humans have with nature? Or does nature have with humans? Ask yourself if we get along? Help or ever hurt one another?

Utilize the Picasso e-Moment®.

If you were an artist drawing a picture of the relationship between humans and the environment what would it look like? Take the next two minutes to draw a picture that represents this relationship. How do humans help and hurt the environment? What questions are there? GO!

Time is up! Now, turn to your neighbor and take one minute to share your drawings with each other.

If you can hear me, clap once.

CLAP.

If you can hear me, clap twice.

CLAP, CLAP.

Great! Now refocus your attention back to the front of the room. Let's discuss your drawings as a class.

Allow volunteers to share their drawings, or systematically call on pairs to conduct a class discussion. Some topics that may be covered: noise due to heavy equipment operation, animals moving from the area, pollution of the water, and smell from natural and synthetic fertilizers.

Very good, class! Today not only are we going to learn about the struggles that exist between agriculture and the environment, but we are going to work together to find ways to fix these problems. Are you ready to help save the environment?

planted directly in undisturbed soil using a drill or seed press. Because the topsoil is left intact, erosion is less severe and the soil is able to hold more CO₂ that would otherwise be released into the atmosphere.

2. Insects as natural pest control

- The problem: Another common issue with plant production is the necessary use of pesticides, specifically **insecticides**, which are used to kill or repel damaging insects. Critics say that overuse of chemical **insecticides** leads to chemical runoff into water streams which could affect entire ecosystems. Most **insecticides** used today are not pest-specific and will therefore potentially harm even harmless insects.
- The solution: A great way to safely and naturally detour pesky insects that many home gardeners and even large farm owners are beginning to recognize is the use of other insects and animals to naturally control insect infestations. For example, ladybeetles are a great tool to use against aphid problems (aphids are very small insects that kill plants by sucking the moisture from their leaves and stems). Also, toads will consume tons of insects from gardens. Farmers are even beginning to experiment using chickens as natural **insecticides** because they love to munch on pesky beetles, caterpillars, and snails.

3. Other **environmental stewardship** practices

- Organic** farming: **Organic** farming is a means of raising livestock or growing plants that does not use chemical fertilizer, pesticides, or hormones. **Organic** farmers use natural ingredients to reduce the effect farming may often have on the environment.
- 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.



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Summary of Content and Teaching Strategies

Objective 1. Identify how plant production stewardship has a positive impact on the environment.

Begin the lesson by defining **environmental stewardship** and introducing two examples of environmentally friendly agricultural practices that are being implemented today. Students should use **MS.PS.4.2.AS.A** to take notes during class discussion.

Before we start our work on saving the environment, I want to share with you two examples of **environmental stewardship** practices that are already being used in plant production in the United States. As we discuss these thoughts, follow along on your handouts and take notes. Raise your hands at any time if you fall behind or need help completing the worksheet.

Does anyone know what **environmental stewardship** means?

Take suggestions from class.

Environmental stewardship is the name given to agricultural practices that consciously work to protect the environment from the potential harm that may result from agricultural production. Be sure to record this definition on your handout.

Why is **environmental stewardship** so important for farmers and ranchers?

Allow students to share their thoughts.

Agriculture is the leading industry in the country and American farmers feed much of the world. As world leaders, American agriculturalists have the responsibility to be environmental stewards and to ensure that the land that we rely on for food and fiber is protected. Below are two great examples of **environmental stewardship** practices that are gaining popularity in the field of plant production.

Let's discuss a few examples of **environmental stewardship** by discussing the problem and the derived solution for two examples.

Listen closely to the first problem and record notes on your handout. Conventional farming practices are often accused of being the largest cause of erosion problems in the United States because of the common practice of plowing up the soil and dead plants before planting new crops. Tilling the soil loosens the top layer making the soil more apt to run off in heavy rains. Tilling the soil requires mechanical plows which burn fuel releasing greenhouse gases into the air.

What do you think is one solution the farmers could develop?

Take suggestions from the class.

Those were all very good ideas. One increasing popular method of preventing erosion on cropland is called low-tillage or no-tillage farming. In no-tillage farming, new crops are planted directly in undisturbed soil using a drill or seed press. Because the topsoil is left intact, erosion is less severe and the soil is able to hold more CO₂ that would otherwise be released into the atmosphere.

Be sure you have this information recorded on your handout. Raise your hand if you have questions.

Allow students time to catch up. You may also choose to display **MS.PS.4.2.TM.A** for students to record the information from. Then continue with the next example.

Another common issue with plant production is the necessary use of pesticides, specifically **insecticides**, which are used to kill or repel damaging insects. Critics say that overuse of chemical **insecticides** leads to chemical runoff into water streams which could affect entire ecosystems. Most **insecticides** used today are not pest-specific and will therefore potentially harm even harmless insects.

What do you think is one solution the farmers could develop?

Take suggestions from the class.

A great way to safely and naturally detour pesky insects that many home gardeners and even large farm owners are beginning to recognize is the use of other insects and animals to naturally control insect infestations.



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For example, ladybeetles are a great tool to use against aphid problems (aphids are very small insects that kill plants by sucking the moisture from their leaves and stems). Also, toads will consume tons of insects from gardens. Farmers are even beginning to experiment using chickens as natural **insecticides** because they love to munch on pesky beetles, caterpillars, and snails. Isn't that interesting!

Allow students a minute or two to finish recording notes on **MS.PS.4.2.AS.A**. Then, discuss **hydroponics** and **organic** farming. But first, determine how much students know about each of the two topics.

Has anyone ever hear of **organic** farming? Raise your hand if you have.

Observe hands.

Can anyone tell us what **organic** farming is?

Allow students to share their thoughts.

Very good! I am happy to see that you have a basic understanding of **organic** farming which is a means of raising livestock or growing plants that does not use chemical fertilizer, pesticides, or hormones. **Organic** farmers use natural ingredients to reduce the effect farming may have on the environment.

One last **environmental stewardship** practice we will discuss today is **hydroponics**. Does anyone know what **hydroponics** is? I will give you a hint: Think about the beginning of the word, hydro.

Allow students to share their thoughts.

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.

Students, how do you think planting crops directly in water could actually conserve water?

This method saves water because the water goes directly to the root (usually through plastic tubes) and does not run off through the soil. At this time, take a few minutes to complete your activity sheet with definitions and the problem-solution pairs.

Place MS.PS.4.2.TM.A on the projector and allow the students a few minutes to complete the assignment.

You have learned how other farmers, scientists, and environmentalists are working to reduce the negative effects plant production often has on the environment, and it is your turn to make a difference. Today your mission is to become a steward of the environment. After reading the scenario below, you will advise Farmer Joe on the best way to reduce the effects his farm is having on the environment and the community. Work to find a solution that will maintain crop production, appease the local community members, and protect the environment. This may include inventing a new product or simply changing Farmer Joe's current production methods.

Remember, this problem is very complex and will take an innovative thinker to solve. Answer the questions following the scenario to help get you started. Then prepare a 30-second presentation for Farmer Joe explaining your solution idea and convincing him the effort is worth the results. You will present this proposal to the class. You will have 20 minutes to complete this assignment. What questions are there?

Who are you trying to help?

Farmer Joe.

How long will your proposal be?

Thirty seconds.

How long do you have to work on this assignment?

Twenty minutes.

Very good! I will now read the scenario to you:

Farmer Joe is facing heavy criticism and pressure from local community members to reduce the amount of water he uses to irrigate his 40 acres of sweet corn fields. Farmville, the town they live in, is facing tightening water restrictions because the available water is projected to only be able to last six more months. The people are not even allowed to water their grass!

The farmers in the area fear that these restrictions may soon impact their ability to water their crops which would threaten their livelihood.



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The community insists that Farmer Joe uses more water than five families. Farmer Joe argues that irrigating (watering) his corn helps him to produce enough food to feed over 50 families. How can this problem be solved?

The use of water for agriculture has changed the production of crops dramatically in the 20th century. Agricultural use of water accounts for nearly 70% of the water used throughout the world, and the majority of this water is used for irrigation. An increase in irrigation development guarantees an increase in crop production in many countries. Irrigation allows the land that does not receive enough precipitation annually to become land that can be used for productive agriculture.

On the negative side, irrigation causes salinization of the land that is being irrigated, mostly in arid and semi-arid regions. Irrigation of cropland can increase the possibility fertilizers and pesticides will infiltrate into the groundwater or run off into nearby streams. Along with the irrigation of crops, the farmers who have livestock must provide clean water for the livestock to drink. With a growing world population, expected to increase by 2 billion people by the year 2030, agriculture needs to find a way to use less water or to use the water more efficiently.

GO!

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 5, 3, and 1 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 back up front.

Allow five to 10 seconds for students to settle down and focus.

Now we will all share our ideas with the class. When I call your name, stand up at your desk and in 30 seconds or less, describe your solution.

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.

Those were such wonderful ideas. The creativity and problem solving skills from this class have amazed me. I think we have definitely given Farmer Joe plenty of options to choose from to help solve his problem.

That is all the time we have for today. However, I want you to always remember that as long as humans and nature co-exist, there will be problems we must overcome. However, by being open-minded and creative, we can solve almost any problem thrown our way! Have a great day!



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Application

Extended classroom activity:

To extend further study of **environmental stewardship**, the class could work as a whole to create an **environmental stewardship** recognition program for local farmers in the community. This award would recognize one local farmer or rancher a year who is striving to reduce harm to the environment and create sustainable practices on their farm or ranch. Start by allowing the students to create the guidelines for the award. Then the class will work to advertise the award using flyers, posters, letters, newspaper, radio announcements, and visits to local farms. Next, the students would collect nominations from the community for farmers and ranches that exemplify responsible agricultural techniques that help mitigate and reduce the effects of crop production on the environment. Finally, the class will vote and choose one farmer to receive the award. This project should be continued from year to year and may even become a coveted community tradition.

FFA activity:

Students who enjoy this lesson may be interested in the agricultural marketing CDE in which students work with local businesses to improve the business's profits or business image through improved advertisement, novel methods of increasing production, or by growing value-added products such as **organically** or naturally grown fruits and vegetables.

SAE activity:

This lesson can be used to introduce the many opportunities students have to pursue a Supervised Agricultural Experience Program in crop production. Students can develop a novel way to produce fruits, vegetables, and grains in an environmentally friendly way. Or students may wish to begin an **organic** farm operation which will demonstrate **environmental stewardship** as well as provide value-added products for increased profit.

Evaluation

MS.PS.4.2.ASSESS.A

Answers to Evaluation

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



Environmental Stewardship Notes

ANSWER KEY

Define the following terms. Then, as we discuss the two examples of environmental stewardship practices, fill in the boxes below by describing the problem that farmers are facing, and then outlining the solution many are developing or practicing.

Environmental Stewardship: Agricultural practices that consciously work to protect the environment from the potential harm that may result from agricultural production

No-till Agriculture: New crops are planted directly in undisturbed soil using a drill or seed press.

Insecticide: Natural or synthetic chemicals that are used to kill or repel damaging insects

Organic: Organic farming is a means of raising livestock or growing plants that does not use chemical fertilizer, pesticides, or hormones.

Examples of Environmental Stewardship

<u>The Problem</u> Conventional farming practices are often accused of being the largest cause of erosion problems in the United States because of the common practice of plowing up the soil and dead plants before planting new crops. Tilling the soil loosens the top layer making the soil more apt to run off in heavy rains. Also, tilling the soil requires mechanical plows which burn fuel releasing greenhouse gases into the air.	<u>The Solution</u> One increasing popular method of preventing erosion on cropland is called low-tillage or no-tillage farming. In no-tillage farming, new crops are planted directly in undisturbed soil using a drill or seed press. Because the topsoil is left intact, erosion is less severe and the soil is able to hold more CO₂ that would otherwise be released into the atmosphere.
<u>The Problem</u> Another common issue with plant production is the necessary use of pesticides, specifically insecticides, which are used to kill or repel damaging insects. Critics say that overuse of chemical insecticides leads to chemical runoff into water streams which could affect entire ecosystems. Most insecticides used today are not pest-specific and will therefore potentially harm even harmless insects.	<u>The Solution</u> A great way to safely and naturally detour pesky insects that many home gardeners and even large farm owners are beginning to recognize is the use of other insects and animals to naturally control insect infestations. For example, ladybugs are a great tool to use against aphid problems (aphids are very small insects that kill plants by sucking the moisture from their leaves and stems). Also, toads will consume tons of insects from gardens. Farmers are even beginning to experiment using chickens as natural insecticides because they love to munch on pesky beetles, caterpillars, and snails.



Objective 1. Identify how plant production stewardship has a positive impact on the environment.

In most cases, human use and abuse of natural resources often leads to hefty consequences for the environment. In the case of crop production, environmental impacts often include: erosion, pesticide and fertilizer runoff, land clearing, wildlife habitat loss, and water misuse. Today however, there are many programs in the agricultural industry practicing environmental stewardship to help reduce and mitigate the effects of agriculture on the environment.

A. What is environmental stewardship?

Environmental Stewardship is the name given to agricultural practices that consciously work to protect the environment from the potential harm that may result from agricultural production. Agriculture is the leading industry in the country and American farmers feed much of the world. As world leaders, American agriculturalists have the responsibility to be environmental stewards and ensure that the land that we rely on for food and fiber is protected. Below are two great examples of environmental stewardship practices that are gaining popularity in the field of plant production.

B. Examples of stewardship practices in agriculture

1. Low tillage farming
 - a. The problem: Conventional farming practices are often accused of being the largest cause of erosion problems in the United States because of the common practice of plowing up the soil and dead plants before planting new crops. Tilling the soil loosens the top layer making the soil more apt to run off in heavy rains. Also, tilling the soil requires mechanical plows which burn fuel releasing greenhouse gases into the air.
 - b. One solution: One increasing popular method of preventing erosion on cropland is called low-tillage or no-tillage farming. In no-tillage farming, new crops are planted directly in undisturbed soil using a drill or seed press.

Because the topsoil is left intact, erosion is less severe and the soil is able to hold more CO₂ that would otherwise be released into the atmosphere.

C. Insects as natural pest control

1. The problem: Another common issue with plant production is the necessary use of pesticides, specifically insecticides, which are used to kill or repel damaging insects. Critics say that overuse of chemical insecticides leads to chemical runoff into water streams which could affect entire ecosystems. Most insecticides used today are not pest-specific and will therefore potentially harm even harmless insects.
2. The solution: A great way to safely and naturally detour pesky insects that many home gardeners and even large farm owners are beginning to recognize is the use of other insects and animals to naturally control insect infestations. For example, ladybeetles are a great tool to use against aphid problems (aphids are very small insects that kill plants by sucking the moisture from their leaves and stems). Also, toads will consume tons of insects from gardens. Farmers are even beginning to experiment using chickens as natural insecticides because they love to munch on pesky beetles, caterpillars, and snails.

D. Other environmental stewardship practices

1. Organic farming: Organic farming is a means of raising livestock or growing plants that does not use chemical fertilizer, pesticides, or hormones. Organic farmers use natural ingredients to reduce the effect farming may often have on the environment.
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.



Environmental Stewardship Notes

Name: _____

Directions: Define the following terms. Then as we discuss the two examples of environmental stewardship practices, fill in the boxes below by describing the problem that farmers are facing, and then the solution many are developing or practicing.

Environmental Stewardship

No-till Agriculture _____

Insecticide _____

Organic _____

Examples of Environmental Stewardship:

<u>The Problem</u>	<u>The Solution</u>
<u>The Problem</u>	<u>The Solution</u>



Environmental Stewardship

FARMER JOE'S PROBLEM

Name: _____

The Problem

Farmer Joe is facing heavy criticism and pressure from local community members to reduce the amount of water he uses to irrigate his 40 acres of sweet corn fields. Farmville, the town they live in, is facing tightening water restrictions because the available water is projected to only be able to last six more months. The people are not even allowed to water their grass! The farmers in the area fear that these restrictions may soon impact their ability to water their crops which would threaten their livelihood. The community insists that Farmer Joe uses more water than five families. Farmer Joe argues that irrigating (watering) his corn helps him to produce enough food to feed over 50 families. How can this problem be solved?

The Bigger Picture

The use of water for agriculture has changed the production of crops dramatically in the 20th century. Agricultural use of water accounts for nearly 70% of the water used throughout the world, and the majority of this water is used for irrigation. An increase in irrigation development guarantees an increase in crop production in many countries. Irrigation allows the land that does not receive enough precipitation annually to become land that can be used for productive agriculture. On the negative side, irrigation of land causes salinization of the land that is being irrigated, mostly in arid and semi-arid regions. Irrigation of cropland can increase the possibility fertilizers and pesticides will infiltrate into the groundwater or run off into nearby streams. Along with the irrigation of crops, the farmers who have livestock must provide clean water for the livestock to drink. With a growing world population, expected to increase by 2 billion people by the year 2030, agriculture needs to find a way to use less water or to use the water more efficiently.

2. Who are the two opposing parties in this situation?

3. Why does Farmer Joe need to water his land?

4. How does excessive water use hurt the environment?

Students, your mission today is to serve as an environmental steward and advisor to Farmer Joe. Use your critical thinking skills and imagination to create a solution to the problem (this could mean inventing a new product, creating educational materials for the public, or simply changing the way Farmer Joe grows corn) and prepare a proposal for Farmer Joe. Together, you and Farmer Joe can ensure the future is bright for both his farm and the environment.

The Solution

Remember, your proposal should be no more than 30 seconds in length and will be presented to your classmates at the end of class.



Name _____

Directions: Match the following key terms with the letter that corresponds with the correct definition.

- | | |
|------------------------------------|--|
| 5. _____ Environmental Stewardship | a. New crops are planted directly in undisturbed soil using a drill or seed press. |
| 6. _____ Hydroponics | b. Agricultural practices that consciously work to protect the environment from the potential harm that may result from agricultural production. |
| 7. _____ Insecticide | c. Natural or synthetic chemicals that are used to kill or repel damaging insects. |
| 8. _____ No-till Agriculture | d. A means of raising livestock or growing plants that does not use chemical fertilizer, pesticides, or hormones. |
| 9. _____ Organic | e. Plants are grown in the absence of soil, usually with roots submerged in water. |