

## NATIONAL SCIENCE STANDARD

- Personal and Social Perspectives: Science and technology in local challenges  
Ecology

## OBJECTIVES

The student will:

1. define sustainable farming.
2. identify methods of sustainable farming.

## BACKGROUND

The agricultural industry is the one group whose livelihood depends on the environment. Farmers rely on the land to produce food to feed the growing population. Not only is the environment a farmer's lifeblood, it also represents his or her family's future.

According to a poll by the America Farm Bureau Federation, 97.2% of young farmers plan to farm for life, and nearly all of them hope their children will follow in their footsteps. Keeping the farm in the family provides some strong incentive for today's farmers to protect and preserve the natural resources of their land.



## WORD POWER

**buffers** *n.* Something that softens a blow.

**conservation** *n.* The protection of valuable things, especially forests, wildlife, and natural resources.

**cover crop** *n.* Crops grown in the off season that add nutrients back into the soil.

**erosion** *n.* The gradual wearing away of a substance by water or wind.

**sustain** *v.* To keep something going.

**till** *v.* To prepare land for growing crops.

**refuge** *n.* A place that provides protection or shelter.

Farmers recognize that certain conventional farming practices have had a detrimental effect on the soil, water and wildlife.

## Sustainable Agriculture

Sustainable agriculture offers new techniques to protect the environment. Sustainable agriculture involves practices that allow a farm to produce food, improve the natural resources upon which agriculture depends while making enough money to keep the farm in operation.



## BACKGROUND, CONTINUED...

Some of the many techniques being employed by today's farmer are:

### Cover Crops

Growing plants such as rye, clover, or vetch in the off season after harvesting a grain or vegetable crop can add nutrients back into the soil, prevent weed growth and prevent soil erosion.

### Conservation Tillage

Tilling prepares the soil for planting by digging and turning the soil that exposes topsoil and its nutrients to wind and weather that will wash the topsoil away. Conservation tillage is a method of tilling that requires minimum soil disturbance. By leaving the soil undisturbed, natural biological activity increases organic matter and improves the soil quality.

### Conservation Buffers

The planting of grass and/or trees between cropped areas and waterways. The purpose of these "buffer strips" is to stop water runoff from the fields into the water source. This protects our water supply from chemicals and soil. A buffer provides shelter for wildlife.

### Wildlife Refuge

Many farmers plant special food plots for birds and animals and have special areas for wildlife to live.

## INSTRUCTIONAL PROCEDURE

1. Review the background materials.
2. Do Activity 1.



## ASSESSMENT

Is the class able to identify the difference between sustainable and non-sustainable agriculture?

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## ACTIVITY 1: THE FUTURE OF THE FARM

Sustainable agriculture means to farm in a manner that the farm can exist for a long time. It requires actions that allow for the farm to preserve its natural resources while also bringing in enough money to keep the farm in operation. This requires balancing the use of chemical and non-chemical farming methods.



### For each pair of statements

- Put an **S** (for sustainable) by the statement that is a practice that would help a farm exist for a long time.
  - Put an **N** (for not sustainable) by the statement that would not help the farm to exist for a long time.
- A.    \_\_\_\_\_ Cover the field with a plant that will add nutrients back to the soil and prevent weeds from growing when a field is not being used for food crops.  
      \_\_\_\_\_ Let the weeds grow and kill them with a chemical when it is time to plant a crop.
- B.    \_\_\_\_\_ Turning the soil to get rid of weeds can cause soil to wash into the water source.  
      \_\_\_\_\_ Use the correct amount of chemical to prevent weed growth to avoid tilling the topsoil.
- C.    \_\_\_\_\_ Use a chemical to control insects just because the insect was a problem last year.  
      \_\_\_\_\_ Plant a crop that does not attract the insect that was a problem last year.
- D.    \_\_\_\_\_ Use all the land for crops so that animals don't have a natural food supply.  
      \_\_\_\_\_ Provide an area on the farm where wildlife can live and eat without destroying crops.
- E.    \_\_\_\_\_ Use chemicals only when needed and in the proper amounts.  
      \_\_\_\_\_ Avoid the use of all chemicals even if it results in the loss of half of the all crops to weeds and insects.
- F.    \_\_\_\_\_ Plant green areas with trees between fields and water sources so that chemicals and soil cannot get into the water.  
      \_\_\_\_\_ Avoid green space on the farm so that more crops can be planted.

## BIODEGRADABLE PACKING PEANUTS SUPPLIES

- PACKAGE OF FROZEN CORN
- IODINE
- TABLESPOON
- TEASPOON
- PIECE OF CHEESECLOTH
- WATER
- PAPER CUPS
- SLOTTED SPOON
- POTATO MASHER

## SOY CRAYONS SUPPLIES

- 600 ML BEAKER
- HOTPLATE
- CANDY MOLDS
- 166 G (ABOUT 1 ½ CUPS)
- FULLY HYDROGENATED SOYBEAN OIL (SOYFLAKES)
- 14 G (4 TEASPOONS) PIGMENT

## BIODEGRADABLE PLASTIC FROM CORN SUPPLIES

- CORNSTARCH
- PAPER CUP OR PLASTIC BAG
- CORN OIL
- FOOD COLORING



NAME \_\_\_\_\_

## RECIPE 1: BIODEGRADABLE PACKING PEANUTS

### DIRECTIONS

1. Thaw a package of frozen corn and place in bowl.
2. Crunch up the corn with a potato masher and cover with water. Let stand for 24 hours.
3. Remove from bowl with slotted spoon. Allow water to stand for another 15 minutes.
4. Gently pour off the water through a piece of cheesecloth, allowing the starch to become trapped in the cloth.
5. See and feel the starches left in the cloth. Use a small portion of the cheesecloth to demonstrate the presence of starch. Place a drop of iodine on that portion. If starch is present, the iodine changes from reddish-brown to blue-black. Allow the remainder of the cheesecloth to dry overnight.

### SUPPLIES

- PACKAGE OF FROZEN CORN
- IODINE
- TABLESPOON
- TEASPOON
- PIECE OF CHEESECLOTH
- PAPER CUPS
- SLOTTED SPOON
- POTATO MASHER
- STIR STICK



6. The starch has now dried overnight and turned into powder. Feel and taste the powder. Now mix 1 tablespoon cornstarch and 1 teaspoon water in a paper cup. Stir with a stick until it forms a workable paste. If you microwave the mixture on high for 15 seconds, it will provide a more consistent product for examination. You have made a biodegradable packing peanut!

7. Study your peanut and compare it to a Styrofoam peanut by putting both in separate glasses of water. Watch what happens. Which peanut would be best for the environment and why? Also try burying them in soil and compare results.

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## RECIPE 2: BIODEGRADABLE PLASTIC FROM CORN\*

### DIRECTIONS

1. Place a tablespoon of cornstarch in a paper cup or plastic bag.
2. Add 2 drops of corn oil to the cornstarch.
3. Add a tablespoon of water to oil and cornstarch.
4. Stir.
5. Add 2 drops of food coloring to the mixture and stir.
6. Microwave your plastic for 20-25 seconds on high.
7. Form your plastic into a ball and describe what it will do!

### SUPPLIES

- CORNSTARCH
- PAPER CUP OR PLASTIC BAG
- CORN OIL
- FOOD COLORING

\*Recipe Courtesy of the Illinois  
Farm Bureau: [www.ilfb.org](http://www.ilfb.org)



NAME \_\_\_\_\_

### RECIPE 3: SOY CRAYONS\*

#### DIRECTIONS

Soy Crayons are similar to regular crayons, except they are made from biodegradable and renewable soy oil!

In fact, soy crayons are 85% soybean oil. Most crayons are made from paraffin, which is a petroleum product.

Follow the recipe below to make your own soy crayons!

1. Fill the beaker with 166 g fully hydrogenated soybean oil.
2. Place the beaker on the hot plate on the low setting.



3. Allow the solid oil to liquefy while stirring occasionally.
4. Add 14 g of pigment after the oil is liquefied. Stir until it is evenly distributed in the oil.
5. When the pigment is evenly distributed, remove the beaker from the heat.
6. Pour into candy molds.
7. Cool ½ hour.
8. Remove the crayon.

Note: Soyflakes may be found at many major craft and hobby stores.

\*Recipe Courtesy of the Illinois Farm Bureau:  
[www.ilfb.org](http://www.ilfb.org)

#### SUPPLIES

- 600 ML BEAKER
- HOTPLATE
- CANDY MOLDS
- 166 G (ABOUT 1 ½ CUPS) FULLY HYDROGENATED SOYBEAN OIL (SOYFLAKES)
- 14 G (4 TEASPOONS) PIGMENT

## NATIONAL SCIENCE STANDARD

- Personal and Social Perspectives: Science and technology in local challenges

## OBJECTIVE

The student will identify the environmental benefits biotechnology has to offer.

## BACKGROUND

Plant biotechnology enables farmers to conserve natural resources.

### Promotes Land Conservation

Biotech crops allows for higher yields on less land. Improved farm productivity results in less impact on prairies, wetland and forests that wildlife habitats depend upon.



Biotechnology helps produce plants that grow in extreme heat, dry or poor soil, thus making use of land that may have been considered unfit for farming.

### Decreases soil erosion

Some biotech crops require less tilling helping to preserve precious topsoil and reduce farm run-off into streams and rivers. (improved water quality)

Biotech crops allowing farmers to leave their fields untouched which leaves more plant residue on the ground to replenish nutrients and hold topsoil in place.

### Decreases fuel use

Biotech crops require fewer pesticide applications, which results in fewer trips across the field with fuel-powered equipment.



### Improves Air Quality

The use of no-till farming practices reduces the release of greenhouse gas emissions, which may help slow global warming.

(In contrast, when cultivated soil is exposed to air, organic matter is oxidized, releasing carbon dioxide--an ozone depleting gas--into the atmosphere.)



### Improves wildlife diversity

Biotech cotton has been documented to have a positive effect on the number and diversity of beneficial insects in US cotton fields. In addition, the use of no-till farming methods creates wildlife habitat for birds and other wildlife.

## WORD POWER

**biotechnology** *n.* Using scientific discoveries about living things to solve problems

**genetically modified seed** *n.* Seeds from plants that have been enhanced by inserting genes from another plant to achieve a plant with a desired trait.



## BACKGROUND, CONTINUED...

### **Reduces need for pesticides**

Biotechnology develops disease-resistant plants that reduce the need for pesticides.

Biotechnology is helping to make hardier strains of staple crops such as sweet potato, cassava, papaya, rice and corn that provide better protection against insects and disease. For example, researchers are developing sweet potatoes that are resistant to the sweet potato feathery mottle virus, which can destroy between 20 to 80 percent of a sweet potato crop.

### **Improves food quality**

Biotechnology helps to develop enriched food like enriched Cassava, a staple in many poorer regions of the world. Cassava now contains 35-45% more protein which promises to aid in multiple health problems of these regions.

### **Feeds the growing population**

To preserve the environment, some argue for a simpler, organic style of farming. However, organic farming yields are much lower than yields using modern farming methods.

Two hundred thousand people are being added to the population every day. An additional 4 billion acres will need to be farmed by 2050 to feed all these people if there is no increase in farm productivity. That's more than twice the size of the continental United States.

Biotechnology helps farmers grow more food while protecting their farmland from deteriorating, as well as protecting prairies, forests and other natural areas from cultivation.

## INSTRUCTIONAL PROCEDURE

1. Review the background materials.
2. Have the students do Activity 1 and Activity 2.

## ASSESSMENT

Discuss how the students' opinions on biotechnology changed after having more complete and accurate information about biotechnology. Discuss whether or not having correct information influenced the way survey participants thought about biotechnology.

## ADDITIONAL RESOURCES

### **Council for Biotechnology Information** **[www.whybiotech.com](http://www.whybiotech.com)**

This site has an excellent section for teachers and students. Articles include:

- "Environmental Benefits: More Studies Show How Biotech Crops Help Wildlife, Environment"
- "Resistance to New Foods Has Been the Norm"

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## ACTIVITY 1: BIOTECH CROPS

### LISTING

Soybeans, corn, and cotton are the main biotech crops in America.

Crop	Number of acres grown in the United States	% of crops that are biotech crops
Soybeans	72.7 million acres	85%
Corn	72.7 million acres	45%
Cotton	13.1 million acres	75%



List products (food or non-food) from each one of these major crops. Discuss what impact these products have in the student's daily lives. Discuss the likelihood that biotech crops were used in these products.

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## ACTIVITY 2: BIOTECH SURVEY

### SURVEYING THE SITUATION

Have the student choose 5 benefits of biotech crops. Divide the class into groups of approximately 5 students each, and have them practice explaining these benefits to each other.

Outside the classroom, have the students survey 10 people about the use of biotech crops using the question below:

1. Do you think farmers should use seeds that have been genetically modified by scientists? (Putting a gene from one plant into another to give the new plant the desired trait.)



Person surveyed	YES	NO	Did their opinion change?

### DISCUSSION

How did knowledge about the benefits of biotech crops affect the person's opinion? Can you think of other products that people feared when first introduced? What helps people change their views about these products?

## NATIONAL SCIENCE STANDARD

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## OBJECTIVE

The student will chart the process of pest management using a flow chart.

## BACKGROUND

Pesticides were introduced in the 1950s. In the past 50 plus years, many advances have been made to make the use of pesticides safer and more environmentally sound. A farmer will benefit only from conscientious use of pesticides. A healthy environment sustains agricultural production and the livestock and humans living there. A degraded environment with depleted soil resources, poor water and air quality, and destroyed wildlife habitat does not.

## Integrated Pest Management

Farmers use Integrated Pest Management (IPM). This is a systematic approach that combines several different practices to control pests.



Before treatment is deemed necessary, IPM looks at many factors.

### Proper Identification

Not all insects are pests; some are natural predators that help control pest species. Farmers treat only pests that damage crops.

### Monitoring

Rather than routine administration of

insecticides, IPM uses scouting practices to detect pests and determine if action is needed. A farmer will actually walk the fields and determine the number of pests per determined area.

### Pest Threshold Levels

To justify treatment, pest damage has to exceed a threshold. Thresholds have been developed as the result of many years of research.



## WORD POWER

**pest** *n.* Any insect or animal that causes damage to a crop that will result in a significant decrease in yield to cause a monetary loss.

**integrated pest management** *n.* A systematic approach to pest control that uses a combination of multiple different practices.

## **BACKGROUND, CONTINUED...**

Once a pest problem is identified, IPM treatment involves balancing treatment with effects on beneficial organisms, the environment with crop yields. The process involves tactics like these.



### **Biological**

Introduce natural pest predators (ladybugs are an example)

### **Physical**

Use barriers or traps.

### **Chemical**

Use pesticides specifically for the pest identified and apply at the lowest effective rate. The pesticide should be short lived in the environment, least toxic to good organisms, and alternated with other chemical agents to prevent development of resistant pest populations.

To prevent a reoccurrence of a pest infestation IPM involves considering changes for the next year's planting to prevent a repeat of the problem.

### **Varying Planting Time**

Plant a crop so that it does not coincide with the pest's lifecycle.

### **Crop Rotation**

Plant a different crop that is not susceptible to the same pests.

### **Genetic Options**

Choose a plant resistant to the pest if one is available.

## **INSTRUCTIONAL PROCEDURE**

Integrated Pest Management is a process. A flow chart makes it easier to follow and understand a process or a sequence of events. Have the student flow chart the process for IPM.

## **ASSESSMENT**

Do the students understand the sequence of events and how one choice leads to another?

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### ACTIVITY 1: GO WITH THE FLOW TO MANAGE PESTS

Is pest resistant plant material available?

Can you plant a different crop in the field?

Plant crop

Monitor for pests

Has pest population exceeded threshold?

YES

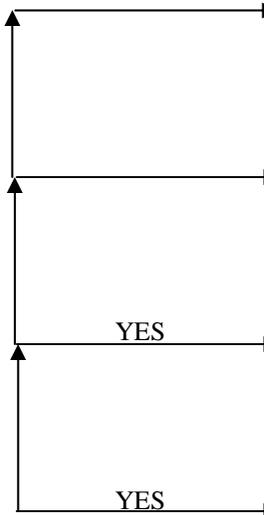
Is there a natural predator to introduce?

NO

Can the pest be trapped?

NO

Administer a pesticide targeted to identified pest at minimum dose.



**INTEGRATED  
PEST  
MANAGEMENT  
ORGANIZATIONAL  
CHART**

