

Crop Swap: Rotating Crops for Sustainability

Grade Level: 4-8

Lesson Overview

Just as humans extract nutrients from the foods we eat, crops extract nutrients from the soil. When we run short on nutrients, we eat more food. But what happens to soil when its nutrients are depleted? This lesson addresses one of several important tools farmers can use to sustain the soil and maximize crop health.

Student Objectives

1. Describe the practice and benefits of crop rotation.
2. Define legumes and explain how they benefit the soil.
3. Experience the agricultural decision-making process, balancing environmental and economic concerns.

Materials

Part 1

- ✓ A History of Crop Rotation
- ✓ Crop Rotation Worksheet
- ✓ Video: "Conservation Crop Rotation," found at <https://youtu.be/wgRh6pNBObw>

Part 2

- ✓ The Great Corn Rootworm Tragedy script
- ✓ student signs: farmer, corn field, soybean field, Western corn rootworm: adult, Western corn rootworm: larva (one sign per student with class evenly divided into five groups)
- ✓ masking tape
- ✓ open area in which to conduct a skit (move desks out of the way)

Vocabulary

- **Agricultural Revolution** - a period of time from 1750-1900 during which crop yields increased dramatically due to improved farming practices.
- **crop rotation** - growing a series of different crops in the same location over multiple growing seasons.
- **fallow** - cropland that is left unplanted for a season.
- **fertility** - the amount of plant nutrients available in soil.
- **green manure** - a crop which is plowed into the soil instead of being harvested, serving as a source of soil nutrients for the subsequent crop.

- **Integrated Pest Management** - pest control program based on understanding of a pest's lifecycle and behavior that is also economical and acceptable to society.
- **legumes** - crops belonging to the legume family of plants which increase nitrogen in soil; includes clover, alfalfa, soybeans, and peanuts.
- **manure** - animal droppings rich in soil nutrients.
- **soil nutrients** - substances such as minerals that are necessary for plant growth.
- **Western Corn Rootworm** - a devastating pest of corn crops in the Midwest; the larvae feed on corn roots and adult beetles feed on silks of the corn ear
- **yield** - amount of a crop harvested in a given area of land.

Background Information

See the History of Crop Rotation student information sheet and Great Rootworm Tragedy script included with this lesson.

Procedure

Part 1 – Crop rotation basics

1. Open a class discussion by asking students, “Why do we eat?” Establish the idea that we eat to obtain the nutrients we need to survive and to grow.
2. Continue the discussion. “So we eat in order to grow and stay healthy. What about plants? What do they do in order to grow?” Once students recognize that plants obtain their nutrients from the soil, ask, “So if plants get their nutrients from the soil, where does the soil get its nutrients?”
3. Distribute copies of A History of Crop Rotation and give students time to read it. Once they are finished reading, allow time for students to discuss key points of the reading with a partner.
4. Have students complete the Crop Rotation Student Worksheet.
5. Show and discuss the short video (1 min., 47 sec.) “Conservation Crop Rotation,” found at <https://youtu.be/wqRh6pNBObw>.

(For explanation of legumes’ ability to fix nitrogen, show the segment from 1:24 to 2:13 of the video “Soybean Emergence” at <https://youtu.be/krOa3qrgowY>.)
6. Discuss crop rotation as an important tool farmers can use to sustainably produce food for a growing population.

Part 2 – The Great Corn Rootworm Tragedy

1. Read aloud the following poem:

Ode to the Western Corn Rootworm

by Stacy Disney Walker

Farmers think I am a pest
Munching on roots throughout the Midwest

Eggs are deposited in the hot summer sun
My new life cycle has just begun.

In the soil my eggs will stay
May comes 'round and larvae come to play.

We wiggle around and snack on roots
Robbing water and minerals we starve the shoots.

When my belly is full I begin to molt
A black and yellow beetle will soon bolt.

The beetle feeds on silks, kernels, and pollen
The farmer sprays and soon we'll be fallin'.

I will be back without hesitation
The only way to control me is crop rotation.

2. Review the benefits of crop rotation: increased crop yields, decrease in plant diseases, improvement of soil texture, and better control of pests. Tell students that they are going to be actors in a skit about crop rotation and pests.
3. Create or move to an open area large enough to conduct a skit that includes all the students. Use masking tape to mark the floor identifying Field A and Field B.
4. Divide students equally into the following five groups and give each student the appropriate sign:
 - a. farmers
 - b. corn field
 - c. soybean field
 - d. Western corn rootworm adults
 - e. Western corn rootworm larvae
5. Show students where “onstage” and “offstage” will be. Explain that as you read the narrative, they should listen carefully for whether their group is onstage and acting, or offstage and waiting. Practice briefly by calling on each group to move onstage and offstage at random.
6. Conduct the skit and classroom discussion using The Great Corn Rootworm Tragedy script.

Extension Activities

1. Create a card game in which players earn points by creating successful crop rotation sequences.
2. Read more about crop rotation and the Agricultural Revolution.
3. Find library books on George Washington Carver, Charles Townshend, and the history of agriculture.
4. Research Western Corn Rootworm and the methods of biotechnology used to combat it.

Additional Resources

- Conservation Choices: Crop Rotation
<https://www.nrcs.usda.gov/wps/portal/nrcs/detail/null/?cid=nrcseprd414440>
- *In the Garden with Dr. Carver* by Susan Grigsby, ISBN 978-0807536308

Standards

Illinois Social Science Standard

SS.G.2.6-8.LC Explain how humans and their environment affect one another.

Illinois English Language Arts Standard

RI 3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.

The **M**ultidisciplinary **A**gricultural **I**ntegrated **C**urriculum (mAGic) was created in 2004 under the leadership of the Illinois State Board of Education (ISBE) and the Facilitating Coordination in Agricultural Education Project (FCAE). Funding was made available through the FCAE grant budget from the agricultural education line item of the ISBE budget. This revision, as printed, was developed in April 2021.



These mAGic lessons are designed to bring agriculture to life in your classroom. They address the Illinois Learning Standards in math, science, English language arts and social studies.

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A History of Crop Rotation

In the early days of human history, people roamed the land to hunt and gather their food. Once they learned to plant and grow food crops, people could stay in one place. These places became the first villages.

Every year, these first farmers planted the same crops in the same fields. Over time, they found their crops becoming smaller and producing less food. They came to understand that soil could be “worn out.” Land was plentiful and people were few. So when one field wore out, they simply cultivated a new field.

As the population grew, however, good cropland became harder to find. Farmers had to find ways to make their existing fields fertile again. They knew that spreading manure from their livestock would improve the soil, but this wasn't enough.

In the 1700s, Charles Townshend of England experimented with a practice called crop rotation, which had previously been used in Egypt, Asia, and Rome. This method of farming “rotated” the crops planted in a given location. Instead of planting the same crop in a field year after year, different crops would be planted each year. Using crop rotation, yields increased, plant diseases decreased, and soil texture improved. Crop rotation also allowed farmers to gain better control over pests and weeds.

Word of Townshend's success spread, and farmers in Europe and America began to rotate their crops. Sometimes they rotated in two year plans, others in three or four. The results were amazing. So much more food was produced from 1750 to 1900 thanks to crop rotation and other practices that this time period became known as the Agricultural Revolution.



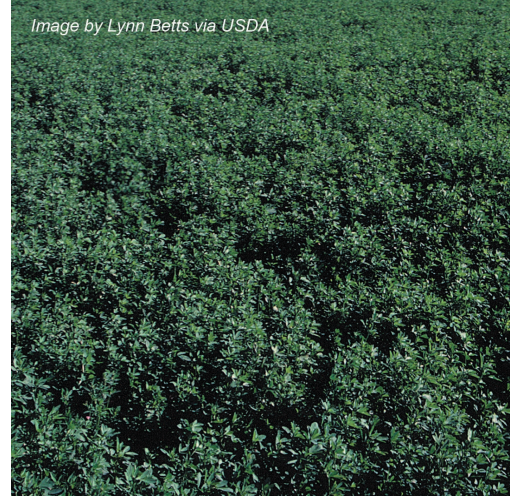
Soybean plants ready for harvest

Sometimes part of the rotation meant leaving a field unplanted, or fallow, for a year. Another pattern would include a year of clover, alfalfa, or rye grass, and livestock would be allowed to graze in that field all year. This allowed manure from the animals to enrich the soil while the animals had access to feed during the growing season as well as in winter. The next spring, the crop could be plowed into the soil, providing a nutrient source known as green manure.

In the early 1900s, George Washington Carver's work with soybeans from China and peanuts from South America played a significant role in the improvement of the American agricultural industry. Carver promoted the idea that rotating crops with soybeans or peanuts could improve soil quality. In time, farmers began rotating soybeans with corn in the Midwest. In the South, they planted peanuts in fields worn out by years

of cotton farming. As a result of these changes, soil fertility improved and farmers found new market opportunities.

Crop rotation also played an important role in agriculture's recovery from the Dust Bowl. During the 1930s, farmers were taught to use crop rotation to help with drought, erosion, and poor soil quality. Because of their ability to restore nitrogen, a critical plant nutrient, legume crops such as beans, peas, clover, and alfalfa were especially encouraged.



Field of alfalfa

Crop Rotation in the Corn Belt	Crop Rotation in a Home Garden
<p>Farmers choose their crops based on factors such as climate, soil type, and pests. Almost all crop rotation plans include a legume.</p> <p>The following is an example of a crop rotation used by farmers in the Corn Belt.</p> <p>First year:</p> <ol style="list-style-type: none"> 1. Plant corn in spring. 2. Harvest corn in fall. 3. Fallow over winter. <p>Second year, same field:</p> <ol style="list-style-type: none"> 1. Plant soybeans in the spring. 2. Harvest soybeans in fall. 3. Plant winter wheat in the fall immediately after soybean harvest. <p>Third year, same field:</p> <ol style="list-style-type: none"> 1. Harvest winter wheat in the summer. 2. Plant soybeans (or clover) immediately after wheat harvest in summer. 3. Harvest soybeans in the fall. 4. Fallow over winter. 	<p>Gardeners face many of the same challenges as farmers, but on a much smaller scale. Gardeners also generally plant many more types of crops, so instead of rotating individual crops, they may group and rotate plants within the same plant family.</p> <p>The following is an example of a planting rotation used by home gardeners.</p> <p>First year:</p> <p>Plant tomatoes and potatoes in one area of the garden. These two crops are in the nightshade family.</p> <p>Second year, same area:</p> <p>Plant peas and bush beans (pea family) where the tomatoes and potatoes were the year before; move the tomatoes and potatoes elsewhere.</p> <p>Third year, same area:</p> <p>Plant cucumbers and pumpkins (gourd family) where the peas and beans were the year before; move peas and bush beans to where the tomatoes and potatoes were previously.</p>

Name _____

Crop Rotation Worksheet

Agricultural field crops can be divided into two groups, legumes and grains. The following are examples of each.

Legumes

alfalfa
beans/soybeans
chickpeas
clover
cow peas
peanuts

Grains

barley
corn
oats
rye
sorghum
wheat

1. If you plant soybeans this year, which crops could you plant in the same field next year? Why?
2. If you plant corn this year, what crops could you plant in the same field next year? Why?
3. What is a legume and what does it do to enrich soil? Name at least one legume.
4. Define crop rotation.
5. List three benefits of crop rotation.
 - 1)
 - 2)
 - 3)

Crop Rotation Worksheet ANSWER KEY

Agricultural field crops can be divided into two groups, legumes and grains. The following are examples of each.

Legumes

alfalfa
beans/soybeans
chickpeas
clover
cow peas
peanuts

Grains

barley
corn
oats
rye
sorghum
wheat

1. If you plant soybeans this year, which crops could you plant in the same field next year? Why?

Answer should be a grain crop from the list provided. [Why?] Grain crops perform better when they are planted the year after a legume crop.

2. If you plant corn this year, what crops could you plant in the same field next year? Why?

Answer should be a legume crop from the list provided. [Why?] Legumes help to replace nitrogen in soil, which the grain crop depletes.

3. What is a legume and what does it do to enrich soil? Name at least one legume.

A legume is a plant in the bean, or legume family. Its roots have the ability to increase nitrogen in soil. Examples of legumes include clover, alfalfa, soybeans, and peanuts.

4. Define crop rotation.

Crop rotation is a farming practice where a different crop is planted in a field from one year to the next. Farmers can alternate two crops or use a pattern of three or more crops. Crop rotation almost always includes a legume crop.

5. List three benefits of crop rotation.

Answers may include increased nutrients in soil, decreased disease and weed problems, better soil condition, and pest control.

The Great Corn Rootworm Tragedy

*Adapted from a lesson created by Dennis Bowman,
University of Illinois Extension Crop Systems Educator*

Introduction

This is an interactive tale of life, death, rejoicing, and tragedy in a corn field. This skit is based on a challenge with the Western Corn Rootworm that Illinois farmers deal with every year. Along the way, you will learn about natural selection, adaptation, and how farmers use environmentally-safe methods to protect their crops. You will also explore the biological processes of seed germination and insect life cycles.

Scenario 1 Illinois Farm (circa mid 1960s)

NARRATOR – In the mid-1960s a new insect showed up in Illinois.

First Season

1. Farmers plant a corn field and a soybean field. (Direct corn field students to Field A and soybeans to Field B. Crops begin as seeds, so they should begin in the fetal position.)
2. Corn and Soybeans grow. (Discuss what it takes for the seeds to germinate: moisture and heat. Discuss what else plants need to continue growth: light, space, air, and time.)
3. Adult rootworm beetles fly into corn field.
4. Adult rootworm beetles feed but cause insignificant damage.
5. Farmers show concern until they realize no significant damage is occurring. Adult rootworm beetles lay eggs (larvae curled up) in the corn field.
6. What happens to most insects after they reproduce? Adults die happy.
7. Farmer harvests crop and rejoices.
8. Everyone off-stage except for larvae.

Second Season (larva still in field A)

1. Farmers plant a corn field and a soybean field (in same places as First Season).
2. Plants grow.
3. About the time corn gets knee high, (on an adult) early June, rootworm eggs hatch into larvae. Larvae hatch and feed, nibble on corn roots.
4. Corn plants fall down.
5. Farmer is sad.
6. Everyone off-stage.

Discussion – What could the farmers have done differently?

- Have participants summarize what happened.
- Ask for suggestions about what farmers should do differently. If necessary, provide hints to direct students into suggesting the farmer rotate his fields.
- Why is crop rotation better than using a pesticide?
- Explain Integrated Pest Management: A pest control program that is based on understanding a pest's lifecycle and behavior, and which is economical for the farmer while being acceptable to society.

If time permits, replay the Second Season (larva still in field A)

1. Farmers plant a corn field and a soybean field, but this time corn is planted in Field B and soybeans in Field A.
2. Plants grow.
3. Larvae hatch in soybeans.
4. Larvae starve and die.
5. Farmer harvests crop and rejoices.

Scenario 2 Illinois Farm (circa mid-1990s)

NARRATOR – After 30 years of successful rootworm management, crop rotation worked TOO WELL...

First Season

1. Farmers plant a corn field and a soybean field.
2. Plants grow.
3. Adult rootworm beetles fly in (have some of the adults to move back and forth between the corn and soybean fields).
4. Adult rootworm beetles feed but cause insignificant damage.
5. Adult rootworm beetles lay eggs (larvae curled up) in the corn and soybean fields.
6. Adults die happy.
7. Farmer harvests crop and rejoices.

Second Season

1. Farmers plant a corn field and a soybean field (rotated).
2. Plants grow.
3. Larvae hatch.
4. Larvae in soybean field die.
5. Larvae in corn field eat roots.
6. Corn plants fall down.
7. Farmer is sad.

Discussion – Natural Selection

- Why did this happen? In rotated crops larvae hatching in soybean fields all die and never grow up to have lay eggs.
- What can farmer do now? Allow students to arrive at decision. (Return to using pesticides.)
- What if we could plant a type of corn that produced its own insecticide in its roots that would kill rootworm larvae that tried to eat them? Then farmers wouldn't have

to spray the crop. Many would agree that this might be a good idea.

- Through a process called biotechnology, plant scientists have done just that. The gene to produce the insecticide comes from a common soil bacteria. Is this corn safe to eat? It has been tested extensively and found not to be harmful to livestock or humans. However, it is important to realize that nothing is 100% safe, including riding a bicycle, or eating peanut butter—if you have a peanut allergy.

More discussion –yellow sticky traps

- Do you think every field needs pesticides every year?
- How can we tell if there are going to be larvae in a field?
- If there are no or very few beetles in a soybean field, do you think there will be many eggs?
- To measure whether or not there are many rootworm beetles in soybean fields farmers can use yellow sticky traps. The traps are a piece of cardboard coated on one side with a layer of an incredibly sticky substance. The trap is the same color as corn silk, one of the adult rootworm beetles' favorite foods. Farmers put the traps out in soybean fields. If there are beetles in the field, some will get stuck in the trap. If a farmer doesn't catch any beetles in a trap do you think she should use an insecticide next year?



Image by Dave Hansen via University of Minnesota Extension

FARMER



Photo courtesy of DeKalb County Farm Bureau

CORN FIELD



Photo courtesy of DeKalb County Farm Bureau

SOYBEAN FIELD

Photo courtesy of DeKalb County Farm Bureau

WESTERN CORN ROOTWORM ADULT



WESTERN CORN ROOTWORM LARVA

