LESSON PLAN – GROWING FIELD CORN

Episode one 401 – Indiana Agriculture (Life Science)

Indiana often gets labeled as "The Corn State" -- but, as one Indiana amusement park has stated, "There's More Than Corn in Indiana". That's true, there's soy, tomato and popcorn – just to name a few. WFYI's newest program, The Science of Agriculture, gives you an in-depth look at how some of the products you have in your pantry or refrigerator are made right here in the Hoosier state. We're going to take you to Eldwood and go inside the Red Gold plant to see how ketchup is made, along with a trip to Cousin Willie's Popcorn operation in Ramsey, Indiana. We'll also take you inside one of the POET Biorefining plants to show you how ethanol is created.

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Growing Field Corn

Adapted from
Center for Agriculture and Environmental Research and Training, Inc.
Indiana Animal, Plant, and Soil Science Lesson Plan Library
http://www.caert.net/

Overview

The following lesson contains six different lesson and objectives that provide a comprehensive understanding of the corn production. The lessons are designed to understand the process of growing field corn.

Background Information

Information for each learning objective is embedded in the following lesson.

Connections to the Indiana Academic Core Standards for Science, Grades 6 – 12

Growing Field Corn
Indiana's Ag Area. PS.P: Plant and Soil Science: Students shall analyze the impact of several factors on the selection of a cropping system and cultural practices. Indiana's
Ag Standard. 2: Describe the factors that must be considered when selecting a crop.
5: Analyze how conservation is affected by cropping systems and cultural practices. Identify and evaluate two specific cropping systems used in Indiana.
Indiana's Ag Area. PS.Q: Plant and Soil Science: Students shall investigate the harvesting of crops in Indiana.
Indiana's Ag Standard. 1: Relate the history of the development of three specialized types of harvesting equipment used in Indiana to the crop each is used to harvest.

2: Discuss the relationship of planting technique with harvesting loss in corn. Determine the optimum economic procedure.
3: Explain characteristics that determine harvest maturity for corn and soybeans.
4: Discuss the economic impact of delayed harvesting of crops in the fall.
5: Describe problems involved with the storage and transportation of major Indiana crops. Address how these relate to the placement of towns, rivers, and railroads historically.
Indiana's Academic Standard. B.1.19: Recognize and describe that metabolism consists of the production, modification, transport, and exchange of materials that are required for the maintenance of life.

Science Process Skills

- Classifying
- Communicating
- Hypothesizing and predicting
- Inferring
- Measuring
- Posing questions

Estimated Time Requirement

Three 60 - minute sessions

Materials

- Transparencies from TM worksheets
- Copies of student lab sheets
- A variety of products made from corn

Objectives

Students will be able to:

1. Identify corn and its uses.
2. Identify areas where corn is grown.
3. Describe the different types of corn.
4. Describe the soil and climatic requirements of corn plants.
5. Explain the cultural practices of corn production.
6. Explain the relationships of marketing and technology to corn production.

Lesson Procedure: Growing Field Corn

Anticipatory set:

- View the *The Science of Agriculture* Indiana Expeditions segment
- Visit the website: www.IndianaExpeditions.org

Preparation prior to the lesson: Growing Field Corn

Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. Two possible approaches are included

here. Bring in a variety of products made with corn. This can include (but is not limited to) corn tortillas, corn flakes, corn oil, canned corn, corn chips. You may also want to include nonfood items such as face powder and biodegradable packing peanuts. Have students compare the items. Ask them to consider what they have in common. Explain that corn is used in many products, not just what we eat. Bring popcorn, canned corn (or fresh corn-on-the-cob), and seed corn to class. Ask students which one(s) they'd like to eat. Why? Have them compare the types of corn based on the appearance of the kernels. Cook the first two products and have students compare the differences between the cooked and non-cooked kernels.

Vocabulary

The following terms are presented in this lesson:

- Aflatoxin
- Climate
- Crown
- Cultural practices
- Embryo
- Endosperm
- Fertilizer
- Grain
- Grain marketing
- Grain technology
- Growing degree day
- Hilum
- Husk
- Hybrid
- Integrated pest management
- Kernel
- Palatable
- Plant population
- Prop roots
- Seed coat
- Silk
- Tassel
- Variety

Summary of Content and Teaching Strategies

Lesson 1 Objective: Identify corn and its uses.

Anticipated Problem: What is corn and what are its uses?

Corn is one of the most valuable cereal grain crops grown in the U.S. and the world. A grain is a seed of the cereal grain plant. Corn, or Zea mays, is a versatile crop. It is used for both human and animal consumption and its by-products can be used to make numerous non-food products.

A. As a livestock feed, corn is used for fattening. It is also the most palatable, or good tasting, of the cereal crops. Corn can be used in high concentrations in dairy cattle feed and is also used in poultry mash. The kernel is high in starch, which is a carbohydrate, and a good source of energy.

B. A kernel is the part of the individual grain within the seed coat. Corn kernels are enclosed in a seed coat. A seed coat is the outer covering of a seed. Inside the seed are the embryo and endosperm. An embryo is an undeveloped seedling.

C. Corn kernels contain two types of endosperm: starchy and flinty. The endosperm is the food for the seedling inside the seed. Starchy endosperm is soft. Flinty endosperm is hard. The amount of each type determines how the corn can be used.

D. The ends of the corn kernel are referred to as the crown and the hilum. The crown is the outer end of the corn kernel. The hilum is the point of attachment on the seed.

E. Humans are also consumers of corn and corn products. Common human food products include corn meal, corn hominy, corn flakes, corn chips, corn starch, corn oil, corn syrup, and corn sugar. And don't forget about popcorn!

F. A number of by-products can also be made from the corn plant. The stalks can be processed into paper, insulation, and cardboard. The cobs can be processed into pipes, methanol, tar, and plastic. The cob grit can be used to clean and polish buttons and jewelry. Corn cob dust can be made into face powder.

G. Cereal grain plants are members of the grass or Gramineae family. Corn plants have fibrous root systems and are supported by smaller roots called prop roots. Prop roots are above ground roots that aid in keeping plants erect. The corn kernels grow on ears that vary in size, shape, and color dependent on variety. Corn ears are enclosed in husks. A husk is the leafy, protective covering that surrounds ears of corn on the plant. The silk and tassel are the female and male reproductive parts of the corn plant. The silk is the female reproductive part of the corn plant. The tassel is the male reproductive part of the corn plant. Take a few minutes to highlight the products in your classroom that are made from corn. Bring some in if you don't already have some. Explain that even though things don't look like corn or smell like corn, they still have corn products in them. You may want to include a discussion on value added products.

Use TM: C9–1 A to review products made from corn, TM: C9–1B to identify the parts of the corn kernel, and TM: C9–1C to identify the parts of the maturing and fully mature corn plant.

Lesson 2 Objective: Identify areas where corn is grown.
Anticipated Problem: Where is corn grown?
Corn was domesticated in Mexico around 9000 B.C. It is the most important grain crop in the United States and is one of the leading grain crops world-wide. Corn is commonly grown throughout the Midwest. However, with sweet corn and other varieties becoming more

common in gardens, corn is grown in just about every state. The top five states are Iowa, Illinois, Nebraska, Minnesota, and Indiana.

See TM: C9–1D to review this information. Pointing out these states on a map may also help students see where corn in commonly grown.

Lesson 3 Objective: Describe the different types of corn.
Anticipated Problem: What are the different types of corn?
There are six common types of corn. Corn types are classified based on kernel characteristics. These characteristics are amount, quality, and arrangement. The six most common types of corn are dent corn, flint corn, floury corn, popcorn, sweet corn, and pod corn.

A. Dent corn, *Zea mays indentata,* is the most common type of corn grown in the U.S. It is referred to as field corn. The crowns of the kernel are dented, giving the corn its name. This denting occurs when the starch at the end of the crown shrinks during drying. Dent corn can be yellow, white, or red in color. The length of the growing period varies by cultivar.

B. Flint corn, *Zea mays indurata*, is a popular source of corn meal. Most cultivars mature fairly quickly, even under poor conditions. Flint corn is resistant to many insects and can be shipped overseas because of its kernel hardness. This hardness is due to the makeup of the kernel. The center is made up of only a small amount of soft starch surrounded by a thick layer of hard starch. Flint corn comes in many colors, including white, yellow, red, and blue.

C. Floury corn, Zea mays amylacea, is also called soft corn. Soft corn kernels are made up primarily of soft starch with a thin covering of hard starch. The lack of a thick hard starch layer makes this type of corn a good choice for flour production. Flint corn comes in several colors, including white and blue.

D. Popcorn, Zea mays everta, cultivars are divided into two classes, pearl and rice. This division is based on the shape of the kernel. Popcorn kernels are smaller than flint corn kernels and are made up of a hard, flinty starch. Some cultivars have a soft starchy center.
The kernels are usually white or yellow but may be red, blue, or brown. When popcorn is "popped" the moisture inside the kernel is heated until it becomes steam. This causes pressure that causes the kernel to explode. The white or yellow flaky material is the starch from inside of the kernel.

E. Sweet corn, *Zea mays saccharata,* is most commonly grown for human consumption. Sweet corn is picked while still immature to retain the high sugar content. Sweet corn kernels are white or yellow and may be wrinkled or become caramelized in color when fully mature.

F. Pod corn, *Zea mays tunicata,* has little commercial importance and is commonly grown as a specialty item. Pod corn kernels are enclosed in a husk or pod and the ear is surrounded by a large husk.

Bring in samples of as many of these types of corn as you can find. Point out the differences between the kernels. Refer to TM: C9–1E to review the spelling of the scientific names.

Lesson 4 Objective: Describe the soil and climatic requirements of corn plants.
Anticipated Problem: What soil and climatic conditions do corn plants require?
Climate is the average weather condition over a long period of time. Grain crops, such as corn, require moderate rainfall, frost-free temperatures, warm weather, and sunshine. Medium textured soils will also help to provide optimum corn yields.

A. The variety grown should match the climate of the area. The optimum temperatures for corn growth are 70 to 86° Fahrenheit. Adequate rainfall is also important. Frosts are detrimental to the production of a quality corn crop. Early frosts cause damage to the plant by damaging leaves and delaying growth. However, late season frosts may cause more damage by causing severe leaf injury or death.

B. Cereal grains require fertile soil for growth. Specific nutrient requirements vary by cultivar. Soil pH should be between 5.0 and 8.0.
Using newspapers or local news broadcasts have students make a chart of the upcoming weather conditions.

After a week, compare the predicted weather to the actual weather. Discuss the importance of proper climatic conditions on corn growth. Use TM: C9–1F to reinforce this objective.

Lesson 5 Objective: Explain the cultural requirements of corn production.
Anticipated Problem: What are the cultural practices of corn production?
Cultural practices are the procedures used in producing a crop. Cultural practices include selecting a variety, planting, fertilizing, pest control, and harvesting. Irrigation is also considered a cultural practice. These practices will vary with the crop being produced; they may also vary with the type and variety of the crop.

A. In the U.S., all varieties of corn sold for commercial grain production are hybrids. A hybrid is an offspring from genetically different parents. Hybrids are produced through human manipulation. Hundreds of hybrids are available for planting; many are bred for use in local areas. A variety is a plant cultivar that is cultivated and retains its features when reproduced.

B. A variety should be chosen that matures according to the date of the first local frost.
Days to maturity range from 50 to 330 days.

C. Besides days to maturity, corn varieties also vary in height and number of ears per stalk. Corn plants are commonly 6 to 8 feet tall but can grow from 2 to 20 feet tall. On the average, corn plants will produce 1 to 3 ears.

D. Planting should occur after the danger of frost has passed. Soil temperature should be above 50° Fahrenheit at 2 inches deep. Germination and rapid growth is related to the amount of growing degree days.

E. A growing degree day (GDD) is a measure of the temperature requirements for best corn growth.

1. The GDD is figured by adding the maximum temperature and the minimum temperature in a day, divided by two, and subtract 50.
2. 50 is a constant because corn grows very little at 50° F. The maximum temperature used is 86. This is because temperatures above 86° F do not increase the rate of growth. Temperatures above 86 are counted as 86.

F. Corn should be planted in a prepared seedbed. A seedbed can be prepared by plowing with a chisel or moldboard plow followed by a disk harrow or do-all. Plowing and disking reduces soil clods and prepares a fine seedbed.

G. Corn is planted in rows 20 to 40 inches apart and 1 to 2 inches deep. Yields per acre increase with narrower rows. A planter is used to open the seed drill and place the seed.

H. Planters can be set to achieve a desired plant population. Plant population is the number of plants growing in one acre. Plant populations may range from 24,000 to 32,000 plants per acre.

I. Plant population is easy to calculate. First, determine the row width. Divide the width in feet into 43,560 (square feet per acre) to determine the total length of all rows in an acre. Divide the number of plants into the row length to calculate the distance between seed.

J. No-till planting requires different techniques and different equipment than a prepared seedbed. Vegetation is cut and often controlled with chemicals. Seeds are planted deeper in no-till planting; however, there is less soil covering the seed.

K. A healthy corn plant requires a good fertilizer. A fertilizer is a material added to the soil to provide nutrients to increase plant growth, yield, or nutritional value of the plant. In order to yield 150 bushels per acre, a corn crop will require 170 pounds of N, 35 pounds of P O , and 175 pounds of K O.

L. Integrated pest management (IPM) is a pest management strategy that uses a combination of measures to reduce pest damage with the least disruption to the environment.
Common corn pests include weeds, insects, nematodes, and diseases. Besides IPM, planting resistant varieties can help reduce pest and disease problems.

M. Corn can be harvested with a picker or combine. Corn harvesting should be timed for maximum yield. Grain corn should be harvested at 20 percent to 28 percent moisture.
Higher moisture corn requires increased artificial drying. Corn should be dried to approximately

15.5 percent. However, corn in more humid area may need to be dried to 11 percent. The increased drying should help avoid aflatoxin buildup. An aflatoxin is a highly poisonous substance caused by the fungi Aspergillus florus in grain. Aflatoxins in animal feed can be deadly.

Use LS: C9–1A to reinforce the math formula used to figure growing degree days.
TM: C9–1G highlights the cultural practices discussed in this objective.

Lesson 6 Objective: Explain the relationships of marketing and technology to corn production.
Anticipated Problem: How do marketing and technology relate to corn production?
Marketing and technology are key aspects in the production of all crops. Grain marketing includes all processes that connect the producer with the consumer. Grain technology is the use of science in the production of a grain crop.

A. There are two main reasons to grow grain crops. One is to sell them. The other is to feed them to livestock. Either way, the grain is eventually marketed. Income gained from the sale of grain crops is dependent on a good market. Not only should the market be good, it should be close. Transportation costs will decrease the income of selling the crop. Grain is commonly sold by cash marketing. Grain crops can also be sold by using futures markets and forward contracting.

B. Examples of ways in which science is used in grain technology include improved seed and pest control methods. Science is also responsible for improved equipment technologies such as global positioning systems and variable rate technology. Invite a local grain merchandiser to your class to give a presentation on the variety of ways to market grain. Use TM: C9–1H to review this objective.

Resources

Biondo, Ronald J. and Jasper E. Lee. Introduction to Plant and Soil Science and Technology. 2nd Edition. Danville, Illinois: Interstate Publishers, Inc. 2003 (Textbook and Workbook, Chapter 17)

Delorit, Richard J., et al. Crop Production. 5th Edition. Englewood Cliffs, New Jersey: Prentice Hall, Inc. 1984

Source of Lesson

Center for Agriculture and Environmental Research and Training, Inc.
Indiana Animal, Plant, and Soil Science Lesson Plan Library
http://www.caert.net/

Review/Summary

Summarize the lesson by asking students to explain the content of each objective. Reinforce the key terms and concepts.

Application
Students can apply the information learned in this lesson to the following worksheet: LS: C9–1A Calculating Growing Degree Days

Suggested Student Assessment/Evaluation
Student comprehension of these objectives can be measured with the attached sample test.

Answers to Sample Test:
Part One: Matching
1 = b, 2 = e, 3 = h, 4 = f, 5 = d, 6 = c, 7 = a, 8 = g

Part Two: Completion
1. plant population
2. grain marketing
3. Integrated pest management
4. growing degree day
5. Grain technology

Part Three: Short Answer
1. Hilum, embryo, seed coat, crown, soft endosperm, hard endosperm.
2. Prop roots, ear, silk, tassel, leaf, stem, roots.

Growing Field Corn **Name_____**

Part One: Matching
Match the term with the correct response. Write the letter of the term by the definition.

a. Aflatoxin
b. Embryo
c. Hybrid
d. Kernel
e. Grain
f. Palatable
g. Silk
h. Tassel

_____ 1. An undeveloped seedling.
_____ 2. A seed of the cereal grain plant.
_____ 3. The male part reproductive part of the corn plant.
_____ 4. A grain that tastes good.
_____ 5. The part of the individual grain within the seed coat.
_____ 6. An offspring from genetically different parents.
_____ 7. A highly poisonous substance caused by the fungi *Aspergillus florus* in grain.
_____ 8. The female reproductive part of the corn plant.

Part Two: Completion
Provide the word or words to complete the following statements.
1. _____ _____ is the number of plants growing in one acre.

2. _____ _____ includes all processes that connect the producer with the consumer.

3. _____ _____ _____ is a pest management strategy that uses a combination of measures to reduce pest damage with the least disruption to the environment.

4. A _____ _____ _____ is a measure of the temperature requirements for best corn growth.

5. _____ _____ is the use of science in the production of a grain crop

Part Three: Short Answer
Provide information to answer the following questions.
1. Identify the parts of a grain seed.
2. Identify the parts of a mature corn plant.

TM: C9–1A

PRODUCTS MADE FROM CORN

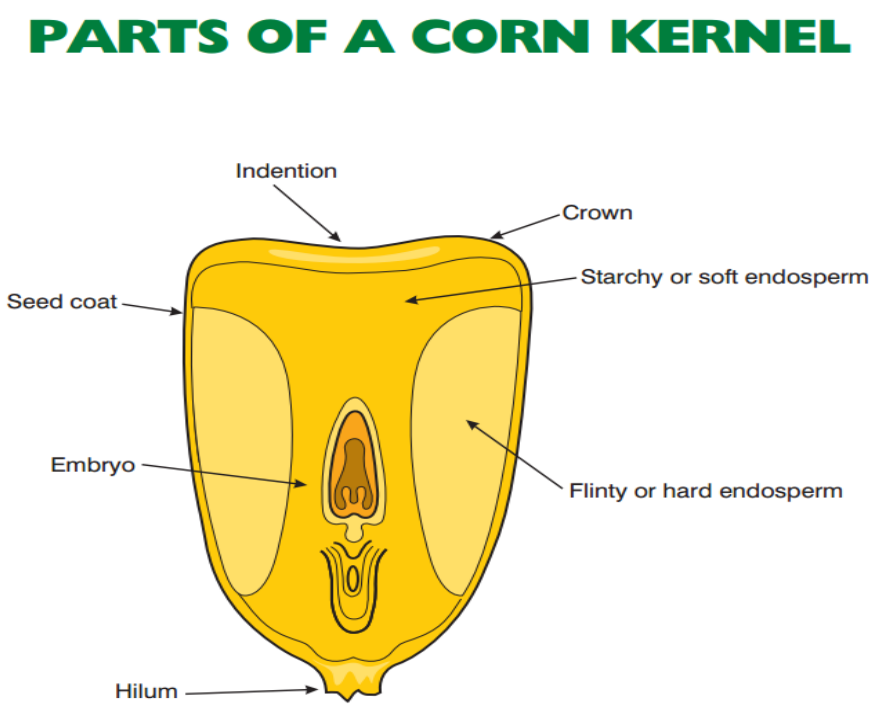
- Animal Feed
- Corn Meal
- Corn Hominy
- Corn Flakes
- Corn Chips
- Corn Starch
- Corn Oil
- Corn Syrup
- Corn Sugar
- Paper
- Insulation
- Cardboard
- Methanol
- Tar
- Face Powder

TM: C9–1B

PARTS OF A CORN KERNEL

- Indention
- Crown
- Seed coat
- Starchy or soft endosperm
- Flinty or hard endosperm
- Embryo
- Hilum

TM: C9–1B

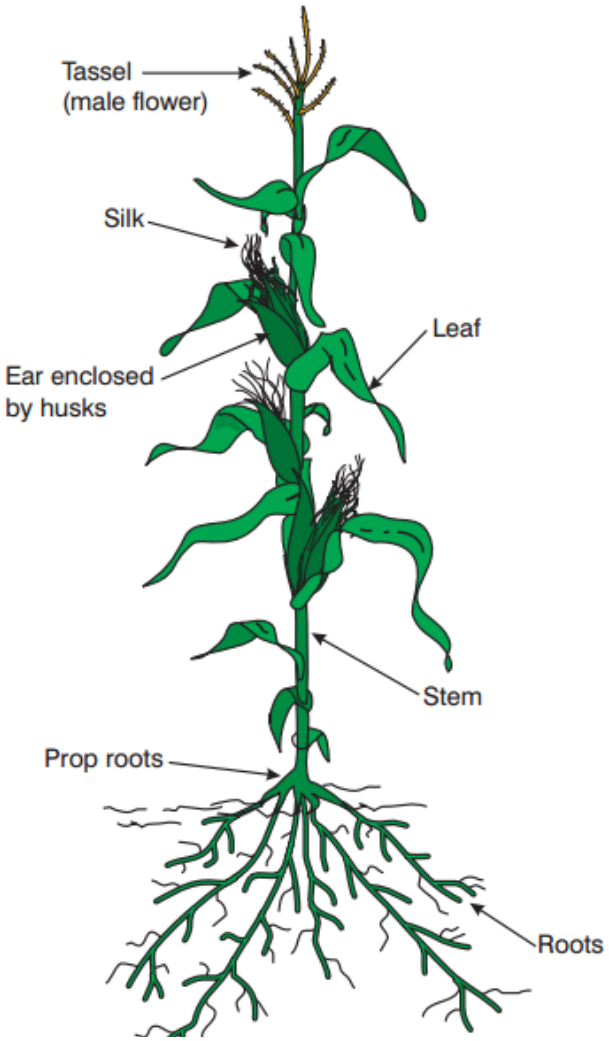


TM: C9–1C
THE GROWING
CORN PLANT

Tassel (male flower)
Silk
Leaf
Ear enclosed by husks
Stem
Prop roots
Roots

TM: C9–1C

THE GROWING CORN PLANT



TM: C9–1D
WHERE IS CORN GROWN?
Top Five States

- Iowa
- Illinois
- Nebraska
- Minnesota
- Indiana

TM: C9–1E
MOST COMMON TYPES OF CORN

- Dent Corn—*Zea mays indenta*
- Flint Corn—*Zea mays indurata*
- Flour Corn—*Zea mays amylacea*
- Popcorn—*Zea mays everta*
- Sweet Corn—*Zea mays saccharata*
- Pod Corn—*Zea mays tunicata*

TM: C9–1F
CLIMATE:
Average weather conditions over a long period of time
Corn plants require:

- Moderate rainfall
- Frost-free temperatures
- Warm weather
- Sunshine

TM: C9–1G
CULTURAL PRACTICES:
Procedures used in producing a crop

- Selecting a variety
- Planting
- Fertilizing
- Pest control
- Harvesting
- Irrigation

TM: C9–1H
MAJOR CATEGORIES IN
GRAIN PRODUCTION
Grain marketing:

- Includes all processes that connect the producer with the consumer

Grain technology:

- The use of science in the production of a grain crop

LS: C9–1A
Calculating Growing Degree Days **Name_____**
Lab Sheet

Instructions: Use the following formula and example to help calculate the growing degree day (GDD) problems.
Show all your work! Don't forget that 50 is a constant and 86 is the maximum highest temperature figured.

Ex. Low temperature = 68° F, high temperature = 84° F
68 + 84 = 152/2 = 76 – 50 = 26 GDD

1. Low temperature = 52° F, high temperature = 88° F
2. Low temperature = 58° F, high temperature = 80° F
3. Low temperature = 50° F, high temperature = 82° F
4. Low temperature = 76° F, high temperature = 94° F
5. Low temperature = 80° F, high temperature = 104° F

LS KEY: C9–1A
Lab Sheet Key
Calculating Growing Degree Days
1. 52 + 86 = 138/2 = 69 – 50 = 19 GDD
2. 58 + 80 = 138/2 = 69 – 50 = 19 GDD
3. 50 + 82 = 132/2 = 66 – 50 = 16 GDD
4. 76 + 94 = 170/2 = 85 – 50 = 35 GDD
5. 80 + 86 = 166/2 = 83 – 50 = 33 GDD