Corn Field Math and Science

Objective

Students will use corn to solve math problems. They will also use corn starch to participate in a polymerization experiment.

Background

Corn is a grass, native to the Americas. The exact origin is unknown, but tiny ears of corn have been discovered at ancient village sites and in tombs of early Americans. Evidence of corn in central Mexico suggests it was used there as long as 7,000 years ago, where it was domesticated from wild grass. Cultivated corn is known to have existed in what is now the southwestern US for at least 3000 years. In the United States, many of the various Native American tribes have traditionally grown corn—also known as maize—and used it for both food and utilitarian purposes. Eastern tribes shared their knowledge of corn production with early European settlers, an act which saved many from starvation.

Early American colonists dried corn and ground it as meal for flour. They used the ground corn in porridge, cake and bread. Fresh, or sweet corn, the kind we like to eat as corn on the cob, was not developed until the 1700s. Before then corn was only used in its dried form.

Along with wheat and rice, corn is one of the world's major grain crops. It is the largest grain crop grown in the US. About 9 percent of all the corn grown is used to produce food for humans. These foods include corn meal and other food products such as cooking oils, margarine, corn syrups and other sweeteners (fructose). Sixty four percent of all corn grown is used as feed for livestock.

Corncobs have been used in the manufacturing of nylon fibers and as a source for producing degradable plastics. Ethanol, a renewable fuel made from corn, has become a major renewable fuel for the world's automotive industry. Corn starch is a natural polymer made from corn. Corncobs have been used in the manufacturing of nylon fibers and as a source for producing degradable plastics. Nylon and plastic are synthetic polymers.

Corn can be produced in much of Oklahoma, but primary production is in the Panhandle area. In Oklahoma, corn is harvested for either grain or silage, with most of the grain going to dairies, animal feeding operations, and poultry operations. In an average year, around 25 million bushels are grown for grain in oklahoma, with a yield of 130 bushels per acre. One bushel of corn is equal to 56 pounds.

Corn is pollinated by wind and is typically planted in 30-inch rows. A single seed (or kernel) of corn may produce a plant which yields more than 600 kernels of corn per ear. On one acre of land, anywhere from 22,000 to 35,000 individual plants may be grown.

Hybrid corn is developed to produce from one to two ears per plant. Ears per plant is often determined by moisture availability. Through better soil conservation practices, fertilizer use, better seed quality, and water availability, corn yields have increased 125 percent since 1950.

Oklahoma Academic Standards

GRADE 5
Number and Operations: 1.4.
Geometry & Measurement: 2.3; 3.3
Physical Science: 1-4

GRADE 6
Number & Operations: 1.4; 3.3,4; 4.1,4. Algebra: 2.1; 3.1,2. Geometry & Measurement: 3.1,2
Physical Science: 1.4

GRADE 7
Number and Operations: 2.3,5. Algebra: 2.2,3; 3.3; 4.1
Physical Science: 1-2

GRADE 8
Algebra: 4.1,2,3;
Physical Science: 1-3,5

Materials

computers and/or resource materials

calculators

graph paper

rulers

compasses

protractors

corn starch

zipper bags

small plastic cups

water

ingredients for popcorn balls (See recipe, included with this lesson.)

Math

1. Read and discuss background vocabulary.
2. Bring dried corn on the cob to class. Provide one per student or divide the class into groups and provide one per group.
   —Students will estimate how many kernels are on the ear of corn.
   —Students will count the kernels.
   —According to the background, an ear of corn can have more than 600 kernels of corn per ear. Does your ear have more or less kernels than 600?
   —Students will determine what percentage of the ears of corn had more kernels than 600 and what percentage had less.
3. Students will solve this word problem: If the kernels from your ear of corn were all planted and each kernel produced an ear of corn with the same number of kernels as the original ear of corn, how many kernels of corn will your ear of corn produce?
4. Hand out the worksheet for students to complete.
   —Students will work in pairs or groups to solve the math problems.
   —Students will check answers after completing the first two before continuing.
   —In a class discussion, students will agree or disagree with the reasoning of other classmates and explain their positions.

Science

1. Students will make Oobleck to explore corn polymerization.
   —Hand out the "What is Oobleck?" worksheet included in this lesson
   —Students will work in pairs and use the worksheets to list the properties for a liquid, a solid and a gas.
   —Lead a class discussion and list the properties on the board.
2. Provide materials to make Oobleck.
   —Based on the ingredients provided, students will hypothesize if they will be creating a solid or a liquid. Students will write their hypthoses on the worksheets
   —Students will work in pairs to make Oobleck, as described on the Oobleck Instruction Sheet.
3. Students will experiment with the Oobleck before answering the questions on the instruction sheet and recording their answers.

EXPLAIN: Oobleck is a non-Newtonian fluid. That is, it acts like a liquid when being poured, but like a solid when a force is acting on it. You can grab it and then it will ooze out of your hands. Make enough Oobleck and you can even walk on it! Other non-Newtonian fluids include molasses, ketchup and toothpaste. Provide an assortment of Newtonian and non-Newtonian fluids and let students work in pairs to decide which is which.

4. Discuss polymerization as explained on the instruction sheet. Use popped popcorn to demonstrate how small molecules (monomers) combine to make polymers. Students will make popcorn balls to represent polymers.
5. Provide students with copies of the vocabulary page. Students will follow the instructions and use context clues to place the correct word in

each numbered blank.

Extra Reading

Fussell, Betty, *Story of Corn*, University of New Mexico, 2004.

hunger, Sally M., and Joe Allen, *Four Seasons of Corn: A Winnebago Tradition (We Are Still Here),* Lerner, 1996.

Johnson, Sylvia, *Tomatoes, Potatoes, Corn, and Beans: How the Foods of the Americas Changed Eating Around the World,* Atheneum, 1997.

Nielsen, Michelle L., *The Biography of Corn (How Did That Get Here?),* Crabtree, 2007.

Vocabulary

cultivate—to prepare land for the raising of crop

domesticated—adapted to living with human beings and serving their purpose

ethanol—a colorless, volatile, pungent liquid made from corn which can be burned as a fuel

hybrid—an offspring of parents with different genes especially when of different races, breeds, species, or genera

maize—Native American name for corn. Also called Indian corn.

monomer— molecule that can combine with others to form a polymer

Newtonian fluid— a fluid whose viscosity does not depend on gradients in flow speed. Gases and low-molecular weight liquids are usually Newtonian fluids.

non-Newtonian fluid— a fluid whose viscosity changes when the gradient in flow speed changes. Colloidal suspensions and polymer solutions like ketchup and starch/water paste are non-Newtonian fluids.

natural— not made or changed by humans

nylon—high strength, resilient, synthetic (manmade) polymer

pollinated—pollen placed on the stigma of a plant for the purpose of creating seeds, flowers, fruit

polymer— a chemical compound or mixture of compounds that is formed by combination of smaller molecules (monomers) and consists basically of repeating structural units

polymerization—process of chemically bonding monomers to form polymers.

porridge—a soft cereal or mealboiled in water or milk until thick

silage—the entire aboveground portion of the corn plant (including ear) that is harvested by cutting and chopping the plant before it reaches maturity. It is stored in silos or packed into above-ground pits and used for feed.

soil conservation—a protection from loss, waste, etc. of soil through efficient farming methods

synthetic— of, relating to, or produced by chemical synthesis

utilitarian—the quality or property of being useful

Cornfield Math

Use your calculator and other mathematical tools to solve the following problems. Compare your methods with a partner.

1. a)An acre of land is 43,560 sq. ft. How long is one side of a square acre?

   b)If the rows are 2.5 ft. apart, how many rows are there?

   c)How many corn plants will be in each row if there are 22,000 plants in a square acre?

2. Each corn plant produces one ear of corn. There are 600 kernels per ear. How many kernels are produced on 1 acre of land?

WAIT: CHECK YOUR ANSWERS TO THE FIRST TWO PROBLEMS BEFORE CONTINUING.

3. There are 135 bushels of corn produced per acre. How many kernels of corn are in a bushel?

4. A farmer has 640 acres planted in corn. How many bushels of corn will this yield if each plant produces two ears?

5. Corn is selling for $2.40 a bushel. Farmer A's plants produce two ears per plant, while Farmer B's plants produce one. Compare their earnings per acre.

6. The yield has increased by 125% or by a factor of 2.25 since 1950. It is 135 bushels today. What was it in 1950? explain in writing how you completed your answer.

7. The farmer decided to plant his 320 acres in three different varieties of corn. Use graph paper to construct a model of the farmer's land. Label each section, and complete the calculations. Show your work. Discuss your work on this question with a partner or in a cooperative group.

   a)Variety A produces one ear per plant. the farmer planted 1/3 of his 320 acres in Variety A. How many bushels of corn can he expect from Variety A?

   b)Variety B produces two ears per plant. the farmer planted half of his 320 acres in Variety B. How many bushels of corn can he expect from Variety B?

   c)Variety C produces 1ear per plant. The farmer planted the rest of his acreage in Variety C. How many bushels of corn can he expect from Variety c?

   d)What is the total yield the farmer can expect for the entire 320 acres?

   e)How much would the farmer receive from the sale of his corn at $2.40 a bushel?

Oklahoma Ag in the Classroom is a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education.

Cornfield Math (answers)

1. An acre of land is 43,560 sq. ft.
2. a) How long is one side of a square acre?

   √43,560 = 208.71 ft per side

   b)If the rows are 2.5 ft. apart, how many rows are there?

   208.71 ÷ 2.5 = 83.48 or 83.48 + 1 = 84.48 rows of corn (if you add a row on each side rather than start from the edge, so the side of the field counts as one row.)

   c)How many corn plants will be in each row if there are 22,000 plants in a square acre?

   22,000 ÷ 83.48 = 263.54 or 22,000 ÷ 84.48 = 260.42

3. Each corn plant produces one ear of corn. There are 600 kernels per ear. How many kernels are produced on 1 acre of land?

   22,000 x 600 = 13,200,000

4. There are 135 bushels of corn produced per acre. How many kernels of corn are in a bushel?

   13,200,000 ÷ 135 = 97,777.78

5. A farmer has 640 acres planted in corn. How many bushels of corn will this yield if each plant produces two ears?

   640 x 135 = 86,400 x 2 = 172,800 (2 ears per plant)

6. Corn is selling for $2.40 a bushel. Farmer A's plants produce two ears per plant, while Farmer B's plants produce one. Compare their earnings per acre.

   Farmer A: $2.40 x 270 = $648 per acre; Farmer B: $2.40 x 135 = $324 per acre

7. The yield has increased by 125% or by a factor of 2.25 since 1950. It is 135 bushels today. What was it in 1950? Explain in writing how you completed your answer.

   x + (125%)x = 135; 2.25x = 135; 135 ÷ 2.25 = 60; x = 60 bushels

8. The farmer decided to plant his 320 acres in three different varieties of corn. Use graph paper to construct a model of the farmer's land. Label each section, and complete the calculations. Show your work. Discuss your work on this question with a partner or in a cooperative group.

   a) Variety A produces one ear per plant. the farmer planted 1/3 of his 320 acres in Variety A. How many bushels of corn can he expect from Variety A?

   1/3 x 320 = 106.66 acres x 135 bushels = 14,399.1 bushels

   b) Variety B produces two ears per plant. the farmer planted half of his 320 acres in Variety B. How many bushels of corn can he expect from Variety B?

   1/2 x 320 = 160 acres x 270 bushels = 43,200 bushels

   c) Variety C produces 1ear per plant. The farmer planted the rest of his acreage in Variety C. How many bushels of corn can he expect from Variety c?

   (1 - 1/3 - 1/2) x 320 = 53.33 acres x (135 x 1.5) = 10,799.325 bushels

   d) What is the total yield the farmer can expect for the entire 320 acres?

   14,399.1 + 43,200 + 10,799.325 = 68,398.425 bushels

   e) How much would the farmer receive from the sale of his corn at $2.40 a bushel?

   68,398.425 x $2.40 = $164,156.22

Oklahoma Ag in the Classroom is a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education.

Name_____

Corn Science: What is Oobleck?

Problem

A liquid and a solid are mixed together in a plastic bag. Using your senses (except taste), determine if the substance is a liquid, a solid or a gas.

Research

List three properties of solids, liquids and gases.

Solid

_____

_____

_____

Liquid

_____

_____

_____

Gas

_____

_____

_____

Hypothesis

I think the substance will be a _____

Oklahoma Ag in the Classroom is a program of the Oklahoma Cooperative Extension Service 4-H, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education.

Name_____

Oobleck Instruction Sheet

OOBLECK

Oobleck gets its name from the Dr. Seuss book *Bartholomew and the Oobleck*. In the story, a gooey green substance, Oobleck, falls from the sky and wreaks havoc in the kingdom. Work with a partner to make Oobleck. (Oobleck will keep in a baggy for 3-4 days. When finished throw it away. DO NOT pour it in a sink.)

Ingredients Needed(for each pair of students):

1/2 cup corn starch	small plastic cup	water
Zip-closing plastic bag	plate	stop watch

1. Dump ½ cup corn starch into a zipper bag.
2. Fill a small plastic cup with water.
3. Slowly mix the water into the corn starch a little at a time until you get a gooey mixture. Don't add too much water. If the mixture is too runny add more cornstarch to thicken. If it is too thick or crumbly, add a few drops of water to thin.
4. Design their own experiments. Record your results and share them with the class.

Questions

—What happens when you push the Oobleck away from you slowly? Quickly?

—Can you roll the Oobleck into a ball? If so, use a timer to see how long it takes to spread out when you set the ball on a plate.

—Will the ball bounce on the table? (DO NOT bounce on the floor.)

—What happens to the Oobleck when you hold it above the plate and let it hang?

—What happens if you push an object, such as your finger or a spoon, slowly into the Oobleck?

—What happens if you push the same object with more pressure?

—What happens if you try to stir the Oobleck slowly? Quickly?

—What happens to the Oobleck if you pour it into various shaped containers? Does it keep its own shape or take on the shape of the container?

—Is Oobleck a liquid or a solid? Support your answer with information you gathered during your experiment.

A polymer is a chemical compound or mixture of compounds that is formed by combination of smaller molecules and consists basically of repeating structural units. Polymers play an important in our everyday lives. They range from familiar synthetic plastics such as styrofoam to natural biopolymers such as DNA and proteins that are fundamental to biological structure and function. Corn starch is a natural polymer made from corn.

Polymers, both natural and synthetic, are created by polymerization. Polymerization is the name of the process that takes place when the smaller molecules are combined.

Oklahoma Ag in the Classroom is a program of the Oklahoma Cooperative Extension Service 4-H, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education.

Popcorn Ball Polymers

A polymer is formed when several small molecules (monomers) combine. It consists of repeating structural units. Students will create their own models of polymers by making popcorn balls.

(makes 12 popcorn balls)
1/2 cup corn syrup
1 cup sugar
1/4 cup butter
1/2 teaspoon salt
1 teaspoon vanilla
1/2 teaspoon baking soda
3 quarts (12 cups) warm popped corn

1. Combine sugar, corn syrup, butter and salt in a heavy 2-quart saucepan.
2. Grease a large mixing bowl and put in popped popcorn. Grease a mixing spoon. Set aside.
3. Combine molasses and sugar in a saucepan. Stirring constantly, bring to a boil over medium heat. Continue stirring and boil 2 minutes.
4. Remove syrup mixture from heat; stir in vanilla and baking soda.
5. Pour syrup over popcorn, stirring to coat well.
6. Let the mixture cool a little while students wash their hands.
7. Students will work quickly to press the popcorn into balls to make “popcorn polymers.”
8. Cool completely before eating.

Name_____

Vocabulary Page

Read the following passage. Use the Word Bank below to fill in the blanks with one of the three words provided for each numbered blank. Use the word that makes the most sense. Remember to use context clues that come before and after the blanks.

Matter can be described and identified by physical and chemical properties. Physical (1)_____ have to do with appearance. You can observe many physical properties with your senses and by measuring the length, (2)_____, height, mass and density of a substance. (3)_____ properties include color, shape, smell, texture, taste and size. The state of matter (whether it's a solid, (4)_____, or gas) and the (5)_____ at which the substance boils, melts or freezes are also physical properties. Magnetic properties are physical properties as well.

(6)_____ properties, on the other hand, have more to do with the atomic or molecular composition of matter. Chemical properties deal with how substances react with other (7)_____ such as water, air or fire.

A physical change has occurred when a substance changes color, size, shape, temperature or state. A (8)_____ change has occurred when a substance has changed into something new or (9)_____ so that the original substance is gone. Digestions, combustion, and radioactive decay are examples of chemical changes. A chemical change takes place in a (10)_____ to produce electricity when you turn on a flashlight.

Word Bank

1.	chemicals	properties	substances	textures
2.	width	density	height	property
3.	chemical	matter	described	physical
4.	water	molecule	liquid	atom
5.	time	temperature	design	cylinder
6.	chemical	physical	substance	gaseous
7.	properties	physicals	degrees	substances
8.	temperature	physical	chemical	color
9.	similar	different	familiar	original
10.	battery	bulb	change	switch

Source for this activity: Thomas Jefferson National Accelerator Facility—Office of Science Education— http://education.jlab.org