

ELEMENTARY SCIENCE PROGRAM  
MATH, SCIENCE & TECHNOLOGY EDUCATION

A Collection of Learning Experiences  
**ENERGY FORMS AND  
INTERACTIONS**

Updated Winter 2011



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# ENERGY FORMS AND INTERACTIONS

## GRADE 3

### Unit Overview:

This unit utilizes a popcorn theme. It was developed to provide an opportunity for students to have enjoyable science experiences focused on Energy Forms and Interactions. This unit will help students recognize that energy and energy interactions cause many of the changes that happen around them. Students will participate in teacher directed experiences where several energy forms and interactions occur including the popping and sprouting of popcorn kernels. The science skills emphasized in the Energy Forms and Interactions kit are observing, collecting data, organizing data, interpreting data and discussing.

### Scheduling

This unit may take from five to seven weeks to complete depending upon the goals of the teacher and interests of the students. Use of the section included in this manual called More Ideas may extend the time span of this kit.

Materials to be  
obtained locally:

Please make **one** student activity book for **each** student.

chart paper  
felt-tip markers  
glue  
index cards  
shallow pan  
paper towels  
stapler  
tape  
oven

### Caution

Remind students to wash their hands after handling any of the materials in the kit. Keep the popcorn that has been handled by students separate from the unhandled popcorn. Dispose of the popcorn that has been handled by students. Enough popcorn kernels have been provided so you will have unpopped popcorn kernels remaining at the end of all the learning experiences. You are free to keep or use any remaining popcorn. Please do not return popcorn from this kit to BOCES.

## About the Format

Each learning experience is numbered and titled. Under each title is the objective for the learning experience.

Each learning experience lists materials, preparations, assessment and vocabulary.

The assessment is for the teacher to use when judging the students' understanding of the learning experience.

## Background Information

Included in this kit is the book, "Corn is Maize, The Gift of the Indians" by Aiki. Please read this book to your students during the Learning Experience #2. Also included in the Appendix of the manual are materials from The Popcorn Board, 401 North Michigan Ave., Chicago, IL 60611-4267, toll free, 1-877-POPALOT; <http://www.popcorn.org>

### Popcorn and Energy

There are many forms of energy involved in food production such as popcorn. Plants utilize the energy of the sun to help make food. Corn plants and sunlight interact to help the plant produce corn kernels.

Farmers use equipment and machinery that run on fossil fuels or electricity. Fossil fuels are considered to be those that were formed from the remains of dead plants and animals. Fossil fuels are crude oil, coal and natural gas.

Food processing plants also use energy to clean, reshape, condition and package food. Supermarkets use energy for storage and other needs. In our homes, we process and cook our food with energy. Food is also transported from the farm to the processing plant to the market to the home. Many foods travel long distances. Each movement of the food in the transportation system requires additional energy. Transportation of food is an example of chemical energy being transferred by other energy forms used by the transportation system.



## Energy

**Energy** is one of the most fundamental parts of our universe. Energy lights our cities. Energy powers our vehicles, trains, planes and rockets. Energy warms our homes, cooks our food, plays our music and helps provide images and sounds on television. Energy powers machinery in factories. When we eat, our bodies transform the food into energy to do work, run or walk. We "burn" food energy in our bodies. Cars, planes, boats and farm machinery also transform energy.

When something happens it is because energy interactions made it happen. When an interaction takes place in which a property of an object is changed, energy must have been present. For example, when popcorn is popped, the hard kernel changes into a softer form, the popped kernels. Energy, provided through the air popper, caused a change of property of the hard kernel.

The properties of an object are determined by its material and condition. Under particular conditions most materials are solids, liquids or gases. For example, water is ice at temperatures below freezing. By adding energy in the form of heat, ice becomes water as the ice reaches the melting point of water. By adding energy in the form of additional heat, water may be changed to a gas (vapor) at boiling point of water.

## Energy Forms

Energy exists in various forms: heat, electric, sound, chemical, mechanical and light. Each form often may be readily observed or sensed. Many forms may be transformed from one form to another. Below are some examples of energy transformations.

- Stored energy in a flashlight's batteries becomes electrical and then light energy when turned on.
- Sunlight is transformed to chemical energy in food through photosynthesis. Food contains energy stored as chemical energy. Your body uses the stored energy in food. Your body converts food to heat and motion. Popcorn is an example of stored energy of the sun.
- If you overeat, the food's energy is stored as potential energy in fat.
- When you talk on the phone, your voice is changed to electrical energy and sometimes light energy. The phone on the other end changes the electrical or light energy into sound energy.
- A car uses stored chemical energy in gasoline to move. The engine changes the chemical energy into heat and mechanical to power the car.

- An air popper changes electrical energy into heat energy and mechanical energy.
- Heat energy from an air popper changes hard kernel to soft and releases sound energy.
- A television changes electrical energy into light and sound energy.
- Mechanical energy is changed to sound energy with a drum or the ringing of a church bell.

### Taking Its Place in American History

Archaeologists have uncovered proof that popcorn had been around long before the arrival of the Europeans in the New World. Excavations in the Bat Cave of West Central New Mexico turned up popcorn ears nearly 5,600 years old according to radiocarbon tests. An 80,000-year-old fossil pollen found 200 feet below Mexico City has been identified as corn pollen. In tombs in Peru, researchers uncovered 1,000-year-old grains of popcorn so well preserved they still pop.

- In 1492, before Columbus discovered Arawak and Carib Indians, the Indians were using popcorn for decorations and food in the West Indies
- In 1519, before Cortez found the Aztecs in Mexico, the Aztecs were adorned in popcorn necklaces and ceremonial headdresses
- Before the French explorers in the Great Lakes region watched Iroquois popping corn in pottery crocks with heated sand
- Before Quadequina, brother of the Wampanoag chief, Massoit, brought a gift of popped popcorn to the first Thanksgiving feast
- Popcorn was growing in the Americas and providing pleasurable eating for the natives

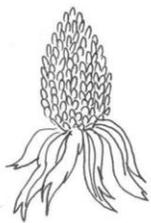
Other treasures have turned up to validate popcorn's place in the past – pottery popcorn poppers dating back to pre-Inca cultures in Peru; an old (300 A.D.) funeral urn in Mexico depicting a Maize god with a popcorn decorated headdress. In fact, research has proven that the ancestors of most Native American tribes enjoyed popcorn even before the birth of Christ.

Corn, squash and beans were once known as the “Three Sisters” by Indian people. Sisters who should never be apart. Sisters who should be planted together. These three plants were important sources of food. In fact, corn was very important to the survival of the first English colonists during their first winters in north-eastern America. The survival of the early colonists depended on what corn they could obtain from the native peoples plus what they were able to grow under their guidance. Today corn cannot survive without human cultivation.

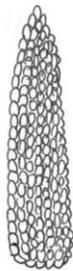
## The Three Sisters – Beans, Corn and Squash



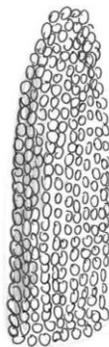
Corn belongs to the grass family. History suggests that at one time each individual kernel was covered by its own floral parts similar to the kernels of oats and barley, and that the cob readily broke down into small segments. It is believed that this has allowed corn as a species to survive. The husk and cob as we know them today were gradually developed from wild varieties by the native populations from South or Central America. These native populations eventually developed the major classes of corn that we recognize today. The major classes of corn are pop, sweet, flour, flint, dent and pod corns.



Pop



Sweet



Flour



Flint



Dent



Pod

### Just How Popular is Popcorn?

Americans consume 1,124,600,000 pounds of popcorn every year. Seventy percent of that is purchased at retail stores in both raw and popped form and eaten at home. The National population is about 283,500,000. Each person in the United States averages eating about four pounds of popcorn per year.

The remainder pops up almost any place associated with fun, food and fitness -- movie theaters, sporting events, entertainment arenas, amusement parks and other recreational centers. Kids love popcorn because it tastes good, and adults favor popcorn for its nutritional value.

### Where is it Grown?

Popcorn is grown extensively in the corn belt states of the United States. Many different types of corn may be grown. The common types are pop, sweet, flour, flint, dent and pod. The majority of popcorn sold worldwide is produced in the corn belt. States with the highest production of corn are Iowa, Illinois, Nebraska, Minnesota, Wisconsin and Ohio.

Popcorn resembles corn-on-the-cob in appearance and cultivation although only popcorn kernels have the ability to pop. Popcorn can be ear-harvested where the whole ear of corn is cut and stored for eight to 12 months until the moisture levels in the kernels reach the best levels. At this point, the kernels are stripped from the cobs and graded to eliminate ones that are too small to pop well.

The sun is a major source of energy for the growing of popcorn. Other energies that contribute to the growth of popcorn are human labor, fuels for farm equipment, electricity and energy used to produce fertilizers and pesticides. To process, package and transport the popcorn, energy in the form of fuel, electricity, heat and human labor are also used.

From its original use as a food for people, corn now yields over 100 by-products for the home and industry. A few of the by-products are dyes, paints, ethanol fuel, oilcloth, oil for soaps, corn syrups, corn starches, corn oils, corn cereals, vegetable substitutes for lard and butter, corn cellulose in press boards and insulating materials, and various chemicals. The livestock industry continues to be the largest user of corn grown.

### What Makes it Pop?

Popcorn's ability to pop lies in the fact that the kernels have a hard outer shell and contain a small amount of water (moisture) stored inside the soft starch. When the water is heated enough, it changes to steam. The steam creates pressure within until eventually the hard outer casing gives way and the kernel explodes. The popping allows the moisture to escape as steam turns the kernels inside out.

Some Indians told stories about why popcorn popped. Some thought that a spirit inside got angry and pushed its way out when it was heated. Most people think the Indians discovered accidentally some corn popped when it was heated. No one knows for certain.

Although the early Indian corn carried no popping guarantee, popcorn brands today vow at least 99 percent of the kernels will pop. The key is a constantly improved product. Throughout the years, popcorn producers have conducted research to continually improve their product.

## Plants

Plants use the sun's energy to combine carbon (from carbon dioxide in the air) with hydrogen (from water). The results are carbohydrates (starches or sugars) stored in the plant's leaves, stems, roots and seeds. The effect is that the sun's energy is stored in a chemical form. This process is called **photosynthesis**. Photosynthesis means "put together using light." Plants use the sun to turn carbon dioxide from air and water into food. Plants also store other substances necessary for the life of plants and animals. These substances are minerals from the soil and vitamins formed in the plant. It is primarily the carbohydrates in the plants that give animals, including humans, the energy they need. Carbohydrates are actually stored chemical energy. Plants are a major way that the sun's energy is transformed through interactions. The popcorn in this unit is an example of stored energy from the sun.

## Food Webs and Energy

Food webs provide energy for all living things to survive. Energy is needed by all organisms to carry out daily activities. There are four main parts of a food web, and plants are one part of it. All green plants are called **producers**. The sun provides energy for everything on the planet; however, plants are the only things on earth that turn sunlight into food. Most organisms are dependent on plants for oxygen. Oxygen is considered a waste product of photosynthesis.

The second part of the food chain is made up of the **consumers**. A consumer is an organism that eats something else. There are 4 types of consumers. Herbivores are consumers that eat only plants ("herbi" = plant). They are also the primary consumers. Some examples of herbivores are many birds, rabbits, lizards and insects. **Carnivores** are another type of consumer. These animals only eat other animals ("carne" = meat). Some examples of carnivores are lions, dogs, sharks and foxes. **Omnivores** eat producers, herbivores, carnivores and other omnivores. For example, humans, apes, lizards, and some birds fall into the omnivore category.

**Scavengers** feed on dead organisms and give the nutrients from the dead bodies back to the environment. Vultures, many insects, and sometimes hyenas and coyotes fall into the scavenger category. **Decomposers**, like bacteria and fungi, convert dead matter into gases (carbon, nitrogen) to be released back into the air, soil or water. Without decomposers,

producers would run out of nutrients to grow. The decomposers recycle the nutrients to be used again by the producers.

The human food web starts with energy from the sun, which is stored as chemical energy in plants. Animals consume plants and convert the stored energy to heat, motion and new chemical combinations. The food web is an energy web from the sun to the point of use.

# Learning Experience 1: What Do You Know About Popping Corn?

Objectives: Students will record their current knowledge, make observations, and describe properties of popcorn kernels, air popcorn popper and popped popcorn.

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## Materials:

For each group of three students:

3 Energy Forms and Interactions Student Activity Books

3 double-lens magnifiers

2 9 oz. plastic tumblers

Cardboard tray

For the class:

Popcorn

Popcorn packet

Air popper

Stopwatch

Electrical outlet strip

Measuring cup

Popcorn tub

Gloves

Chart paper\*

Felt tip markers\*

\*provided by the teacher

## Preparation:

### Session 1:

Read aloud to the class the background information on pages 3–8 titled Popcorn and Energy, Energy and Energy Forms. Students should follow along in their student activity book for Learning Experience #1 in the Energy Forms and Interactions Student Activity Book. When using popcorn kernels, use a cardboard tray to prevent the popcorn from falling on the floor. Tell the students that they will be observing the properties of popcorn through their four senses: sight, hearing, smelling and touching. Gloves have been provided for the teachers use when handling the popcorn.

### Session 2:

You will need access to an electrical outlet in your classroom. Use the switchable plug provided for you. Plug the air popper into the switchable plug-in outlet, and use the switch to control

the time the air popper is switched on. A stopwatch has been provided to determine the length of time the air popper has been on.

### Session 3:

Save the popcorn from this session for use during Learning Experience #3.

A small amount of water inside the kernel turns to steam when sufficiently heated. The water molecules spread apart and move faster. The molecules have nowhere to go because the popcorn kernel covering is so hard that it prevents steam from escaping. The resulting pressure inside the kernel becomes so great that the kernel explodes. The pressure forces the white starchy insides out of the kernel with a pop or small explosion. The pop releases the pressure formed by the steam.

### Assessment:

Students will contribute to the KWHL work chart.

### Vocabulary:

kernel	corn	observing
seed	steam	husk
Columbus	Cortez	properties
Incas	cob	

### Learning Activities:

#### Session 1:

Using the KWHL Strategy, students will explore their understandings about popcorn kernels, air poppers and popped popcorn during the sessions below. Brainstorm all that the students already **know** about popcorn kernels, air poppers and popped popcorn. Record their ideas on a class-size KWHL chart.

Ask students what more they would like to know concerning popcorn kernels, air poppers and popped popcorn, and record their ideas under the **"want to know"** column. Now that the students have decided what they want to know, they need to think about **"how they are going to find out"** the answers to the questions they have. After the hands-on activities, maintaining journals and discussions, students can then record information in the **"what we learned and still want to learn"** column. This process can also be done in cooperative groups where students gather information in small groups, and share their ideas with the class.

Place 10 kernels of unpopped popcorn into a 9 oz. plastic tumbler. Pass out the 9 oz tumblers with the kernels to each group of three students. Pass out the double-lens magnifiers and cardboard trays for each group of three students to observe. Direct each group to

observe the properties of the unpopped popcorn with all their senses. During the students' observations, remind the students to ask themselves, "What do I see? What do I hear? What do I smell? What do I feel?" The students should be told that these are the basis of observation. Direct the students to record their observations on the activity sheet for Learning Experience #1 in the Energy Forms and Interactions Student Activity Book. Create a combined list of students' observations on a KWHL Chart. Include in "what we know".

KWHL sample chart.

KWHL Strategy- Kernels			
What we know	What we want to know	How are we going to find out	What we learned and still want to learn

**Session 2:**

Instruct students to remain silent. Explain the importance of complete silence as a condition necessary for some of the new observations they will be making. Ask the students to observe with all their senses. Instruct the students that they are to write or draw to help them recall their observations. During the students' observations, remind them to ask themselves, "What do I see? What do I hear? What do I smell? What do I feel?"

Do not add popcorn to the air popper. Turn on the air popcorn popper by using the switch on the electrical strip. Time the popcorn popper with the stopwatch provided in this kit for 60 seconds. Turn the popper off. Direct the students to record their observations on their activity sheet for Learning Experience #1 in the Energy Forms and Interactions Student Activity Book. Create a combined list of students' observations on a KWHL Chart. Include in "what we know".

KWHL sample chart.

KWHL Strategy - Air Popper			
What we know	What we want to know	How are we going to find out	What we learned and still want to learn

**Session 3:**

Turn on the air popcorn popper by using the switch on the electrical strip. Time the popcorn popper for 60 seconds with the stopwatch. Turn the popper off. Using a measuring cup, add 50 cc of popcorn kernels to the air popper. Turn on the air popper, and pop the corn kernels into the paper popcorn tub. Pop for 180 seconds. During the demonstration, remind the students to ask themselves, “What do I see? What do I hear? What do I smell? What do I feel?” Ask the students to record their observations in Energy Forms and Interactions Student Activity Book.

Students should not eat popcorn during this unit. When the corn has popped, separate the popped popcorn into the ten 9 oz tumblers. Pass out popcorn until each group of three students have it to observe. Direct the students to observe the properties of the popped popcorn. Pass out the double-lens magnifiers to each student. During the students’ observations, remind the students to ask themselves, “What do I see? What do I hear? What do I smell? What do I feel?”

Direct the students to record their observations in Energy Forms and Interactions Student Activity Book. Create a combined list of students’ understandings on a KWHL Chart. Save the popped corn for Learning Experience #3.

KWHL sample chart.

KWHL Strategy – Popped Kernels			
What do we know	What we want to know	How are we going to find out	What we learned and still want to learn

**Extension:**

Additional information and activities are included in the popcorn packet. The information and activities are Highlights of Popcorn History in the Americas, It's a Fact, A Poppin Good Time, The Popcorn Program and 5 Popcorn Brochures.

WHAT DO YOU KNOW ABOUT POPPING CORNPopcorn and Energy

There are many forms of energy involved in food production such as popcorn.

Plants utilize the energy of the sun to help make food. Corn plants and sunlight interact to help the plant produce corn kernels.

Farmers use equipment and machinery that run on fossil fuels or electricity. Fossil fuels are considered to be those that were formed from the remains of dead plants and animals. Fossil fuels are crude oil, coal and natural gas. Food processing plants also use energy to clean, reshape, condition and package food. Supermarkets use energy for storage and other needs. In our homes, we process and cook our food with energy. Food is also transported from the farm to the processing plant to the market to the home. Many foods travel long distances. Each movement of the food in the transportation system requires additional energy. Transportation of food is an example of chemical energy being transferred by other energy forms used by the transportation system.



## Energy

Energy is one of the most fundamental parts of our universe. Energy lights our cities. Energy powers our vehicles, trains, planes and rockets. Energy warms our homes, cooks our food, plays our music and helps provide images and sounds on television. Energy powers machinery in factories. When we eat, our bodies transform the food into energy to do work, run or walk. We "burn" food energy in our bodies. Cars, planes, boats and farm machinery also transform energy. When something happens it is because energy interactions made it happen. When an interaction takes place in which a property of an object is changed, energy must have been present. For example, when popcorn is popped, the hard kernels change into softer forms, the popped kernels. Energy, provided through the air popper, caused a property of the hard kernel to change. The property of an object is determined by its material and condition. Under particular conditions most materials are solids, liquids or gases. For example, water is ice at temperatures below freezing. By adding energy in the form of heat, ice becomes water as the ice reaches the melting point of water. By adding energy in the form of additional heat, water may be changed to a gas (vapor) at boiling point of water.

## Energy Forms

Energy exists in various forms: heat, electric, sound, chemical, mechanical and light. Each form may often be readily observed or sensed. Many forms may be transformed from one form to another.

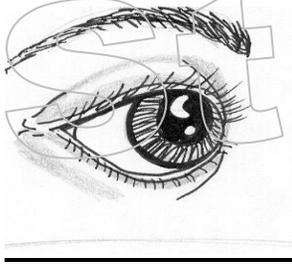
Below are some examples of energy transformations.

- Stored energy in a flashlight's batteries becomes electrical and then light energy when turned on.
- Sunlight is transformed to chemical energy in food through photosynthesis. Food contains energy stored as chemical energy. Your body uses the stored energy in food.

Your body converts food to heat and motion. Popcorn is an example of stored energy of the sun.

- If you overeat, the food's energy is stored as potential energy in fat.
- When you talk on the phone, your voice is changed to electrical energy and sometimes light energy. The phone on the other end changes the electrical or light energy into sound energy.
- A car uses stored chemical energy in gasoline to move. The engine changes the chemical energy into heat and mechanical energy to power the car.
- An air popper changes electrical energy into heat energy and mechanical energy.
- Heat energy from an air popper changes hard kernels to soft and releases sound energy.
- A television changes electrical energy into light and sound energy.
- Mechanical energy is changed to sound energy with a drum or the ringing of a church bell.

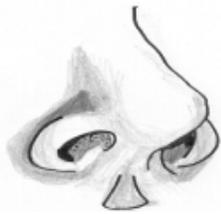
SESSION 1 – WHAT DO YOU KNOW ABOUT KERNELS?



Seeing



Hearing

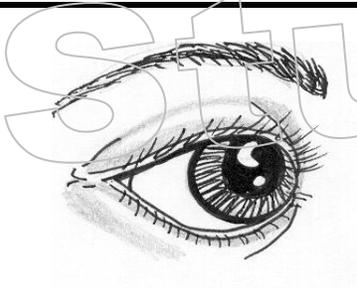
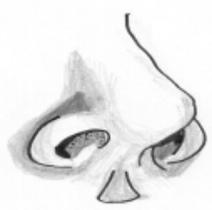


Smelling

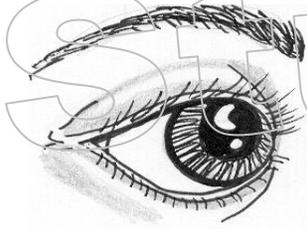


Touching

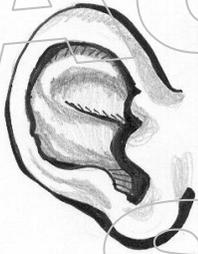
SESSION 2 - WHAT DO YOU KNOW ABOUT AIR POPPERS?

 <p>Seeing</p>	
 <p>Hearing</p>	
 <p>Smelling</p>	
 <p>Touching</p>	

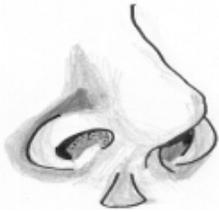
SESSION 3 – WHAT DO YOU KNOW ABOUT POPPED KERNELS?



Seeing



Hearing



Smelling



Touching

## Learning Experience 2: Corn is Maize

Objectives: Students will develop an understanding of the history of corn (maize) and its uses.

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### Materials:

For each student:

Energy Forms and Interactions Student Activity Book

For the class:

Book – Corn is Maize

### Preparation:

Read aloud to the class the book Corn is Maize by Aki. Read and discuss the book in sections, 1–7, 8–21 and 22–33. Students will respond in the appropriate part of the Energy Forms and Interactions Student Activity Book.

### Assessment:

Students will listen and respond in writing to questions posed after the teachers have read aloud to the class.

### Vocabulary:

kernel	tassels
corn	pollen
seed	husks
corn silk	cobs

### Learning Activities:

#### Session 1:

Students are to complete the activity sheet for Learning Experience #2 in the Energy Forms and Interactions Student Activity Book. Students should answer each item in their student activity book as the teacher reads and discusses each section of the book, pages 1–7, 8–21 and 22–33.

#### Discussion Questions:

- Where does the energy come from that is used in the transformations that cause the corn to grow?
- What new things do you now know about corn and popcorn?

- What new things do you want to now know about corn and popcorn?
- Where or how might you find answers to your questions?
- What facts did you enjoy learning about most?
- What kind of research do you think that the author had to do to write the book?

**Extension:**

Have students do a research project on the Native American groups that used popcorn. Ask them to report different ways corn or popcorn was used. How many varieties did each tribe use? Have them report their findings in class. Have students draft a chronological study on the uses of popcorn from the early days of the Indians to the number of places and ways popcorn is used today.

## Activity Sheet for Learning Experience #2 – Answer Sheet

### Pages 1 – 7

A corn seed is often called a kernel.

Sunshine and rain soften the hard seeds and help them sprout.

Corn silk is the female part of the plant.

The tassels are the male flowers.

Pollen travels down the corn silk.

A kernel of corn will grow at the end of each strand of silk.

### Pages 8 – 21

Corn cannot grow without the help of man.

All grains are grass plants.

Indians found that eating corn made them stronger than just eating beans and squash.

Some Indian tribes learned to bury rotted fish in each hill, and this made good soil.

Some of the ways the Indians used corn for food were corn on the cob, popcorn, tortillas and tacos.

### Pages 22 – End

Christopher Columbus called corn maize.

The word corn means grain.

The Pilgrims called maize Indian corn.

The Pilgrims stuffed mattresses with husks.

The Pilgrims burned cobs for fuel.

Some other uses of corn are to make corn starch, corn oil, corn syrup and corn cereal.

CORN IS MAIZE

Pages 1 - 7

A corn seed is often called a \_\_\_\_\_.  
\_\_\_\_\_ and \_\_\_\_\_ soften the hard seeds and help them sprout. \_\_\_\_\_ is the female part of the plant. The \_\_\_\_\_ are the male flowers. \_\_\_\_\_ travels down the corn silk. A \_\_\_\_\_ of corn will grow at the end of each strand of silk.

Pages 8 - 21

Corn cannot grow without the help of \_\_\_\_\_. All grains are \_\_\_\_\_ plants. Indians found that eating corn made them stronger than just eating \_\_\_\_\_ and \_\_\_\_\_. Some Indian tribes learned to bury rotted \_\_\_\_\_ in each hill, and this made good soil. Some of the ways the Indians used corn for food were \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.

Pages 22 - End

Christopher Columbus called corn \_\_\_\_\_. The word corn means \_\_\_\_\_. The Pilgrims called maize \_\_\_\_\_. The Pilgrims stuffed mattresses with \_\_\_\_\_. The Pilgrims burned \_\_\_\_\_ for fuel. Some other uses of corn are to make \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.

# Learning Experience 3: Measuring Corn (Linear Measurement)

Objectives: Students will make and compare linear measurements of popcorn kernels and popped popcorn.

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## Materials:

For each group of 3 students:

3 Energy Forms and Interactions Student Activity Books

Centimeter ruler

Medicine cup

9 oz. plastic tumbler

Glue\*

3 3 x 5 index cards\*

For the class:

Unpopped popcorn

Popped popcorn from Learning Experience #1.

## Preparation:

### Session 1:

Read aloud to the class from the background information on Page 5 titled Taking Its Place in American History. Students should follow along in their student activity book for Learning Experience #3 in the Energy Forms and Interactions Student Activity Book. Fill one medicine cup to the 25 cc mark with popcorn for each group of three students. When using popcorn kernels, use a cardboard tray to prevent the popcorn from falling on the floor.

### Session 2:

Read aloud to the class from the background information on Page 7 titled Just How Popular is Popcorn? And Where is it Grown? Students should follow along in their student activity book for Learning Experience #3 in the Energy Forms and Interactions Student Activity Book. Provide a sample of popped corn from the previous Learning Experience in 9 oz. tumblers.

### Session 3:

Read aloud to the class from the background information on Page 8 titled What Makes it Pop? Students should follow along in their student activity book for Learning Experience #3 in the Energy Forms and Interactions Student Activity Book. Have students measure to the nearest whole centimeter. Students should complete the evaluation on their activity sheet for Learning Experience #3 in the Energy Forms and Interactions Student Activity Book.

## Assessment:

Student will successfully respond to questions based on the reading from this learning experience.

## Vocabulary:

archaeologist	kernel
Mexico	corn
Peru	bean
Columbus	squash
Cortez	seed
Aztecs	corn belt

## Learning Activities:

### Session 1:

Students are to complete the activity sheet for Learning Experience #3 in the Energy Forms and Interactions Student Activity Book. This learning experience requires three 3 x 5 index cards for each group of three students.

Students should prepare the three index cards by folding each card in half as if intended to hold a hot dog. Two of the index cards should be joined together by overlapping 5 cm of the card and gluing. The two cards should form what looks like a long roof shape.

Have students place the single index card on their desk with the opening of the fold up. The card should look like an inverted roof or hot dog bun. Place a line of glue in the groove formed by the index card. Place 10 unpopped kernels of corn end to end in the glue. Have the students begin at the edge, and place the kernels so that they touch. Allow the glue to dry.

### Discussion Questions:

- What type of scientist thinks that popcorn was grown in America long before the Europeans traveled there?
- What are the “three sisters”?
- What are some uses of corn today?

### Session 2:

Have students place the extended index card (two cards glued together) on their desk with the opening of the fold up. The card should look like an inverted roof or hot dog bun. Place a line of glue about 1 cm wide along the groove formed by the index card.

Place 10 kernels of popped corn end to end in the glue. Have the students begin at the edge and place the kernels so that they touch. Allow the glue to dry.

### Discussion Questions:

- What energy transformations are involved in the growing and producing of popcorn?
- How much popcorn does the average person eat per year?
- What is the corn belt?
- What are some of the corn belt states?

### Session 3:

Students should measure the length of the popped and unpopped corn on the index cards. Measure to the nearest centimeter and record the measurement on the activity sheet for Learning Experience #3 in the Energy Forms and Interactions Student Activity Book.

### Discussion Questions:

- What makes popcorn pop?
- What energy transformations are involved in the popping of popcorn?
- How many centimeters long are 10 unpopped kernels?
- How many centimeters long are 10 popped kernels?
- How many centimeters long do you think 20 unpopped kernels would be?
- How many centimeters long do you think 20 popped kernels would be?
- How many centimeters long do you think 100 unpopped kernels would be?
- How many centimeters long do you think 100 popped kernels would be?

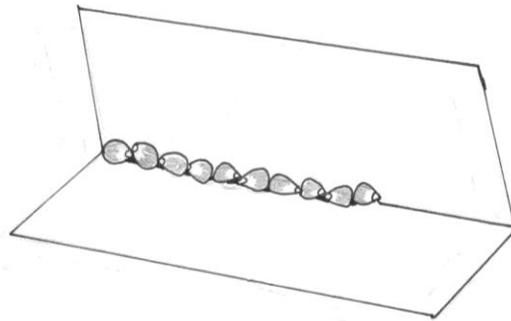
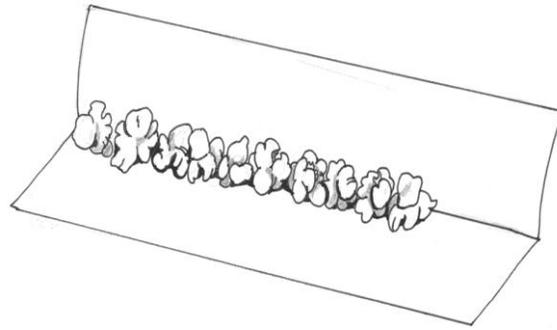
### Extensions:

Provide the students with a list of geographic locations that have played a part in popcorn's history. Ask them to locate these places on a map.

Have students research the major corn-producing states. Ask them to report why popcorn grows so well in these areas. Ask them to locate these places on a map.

Divide the class into groups. Have students find out where popcorn is sold in different states both as kernels and as ready-popped corn. List the available range of flavors. Devise a questionnaire to find out when and where people eat popcorn and their favorite flavors. Write a report on your findings.

Have your students contact popcorn growers and interview them about the process of planting popcorn. If possible, have them keep a journal of an actual crop from planting time, harvesting, and processing.



MEASURING CORN (LINEAR MEASUREMENT)Taking Place in American History

Archaeologists have uncovered proof that popcorn had been around long before the arrival of the Europeans in the New World. Excavations in the Bat Cave of West Central New Mexico turned up popcorn ears nearly 5,600 years old, according to radio-carbon tests. An 80,000-year-old fossil pollen found 200 feet below Mexico City has been identified as corn pollen. In tombs in Peru, researchers uncovered 1,000-year-old grains of popcorn so well preserved they still popped.

- In 1492, before Columbus discovered Arawak and Carib Indians, the Indians were using popcorn for decorations and food in the West Indies,
- In 1519, before Cortez found the Aztecs in Mexico, the Aztecs were adorned in popcorn necklaces and ceremonial headdresses,
- Before the French explorers in the Great Lakes region watched Iroquois popping corn in pottery crocks with heated sand,
- Before Quadequina, brother of the Wampanoag chief, Massoit, brought a gift of popped popcorn to the first Thanksgiving feast,
- Popcorn was growing in the Americas and providing pleasurable eating for the natives.

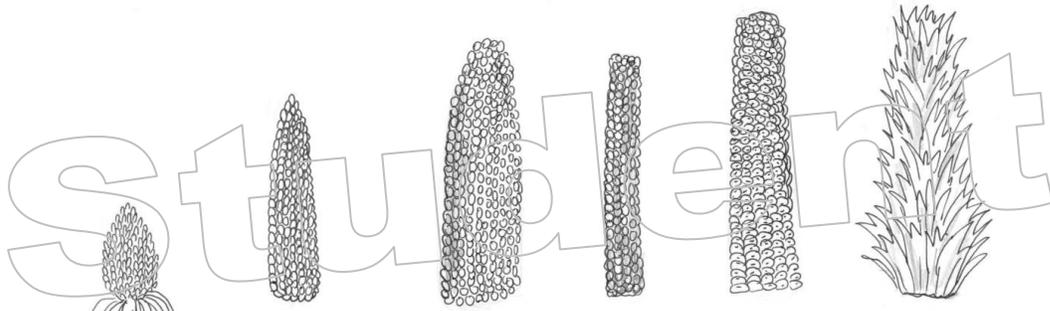
Other treasures have turned up to validate popcorn's place in the past – pottery popcorn poppers dating back to pre-Inca cultures in Peru; an old (300 A.D.) funeral urn in Mexico depicting a Maize god with a popcorn decorated headdress. In fact, research has proven that the ancestors of most Native American tribes enjoyed popcorn even before the birth of Christ. Corn, squash and beans were once known as the “Three Sisters” by Indian people. Sisters who should never be apart. Sisters who should be planted together. These three plants

were important sources of food. In fact, corn was very important to the survival of the first English colonists during their first winters in north-eastern America. The survival of the early colonists depended on what corn they could obtain from the native peoples plus what they were able to grow under their guidance. Today corn cannot survive without human cultivation.

### The Three Sisters, Beans, Corn and Squash



Corn belongs to the grass family. History suggests that at one time, each individual kernel was covered by its own floral parts similar to the kernels of oats and barley and that the cob readily broke down into small segments. It is believed that this has allowed corn as a species to survive. The husk and cob as we know them today were gradually developed from wild varieties by the native populations from South or Central America. These native populations eventually developed the major classes of corn that we recognize today. The major classes of corn are pop, sweet, flour, flint, dent and pod corns.



Pop

Sweet

Flour

Flint

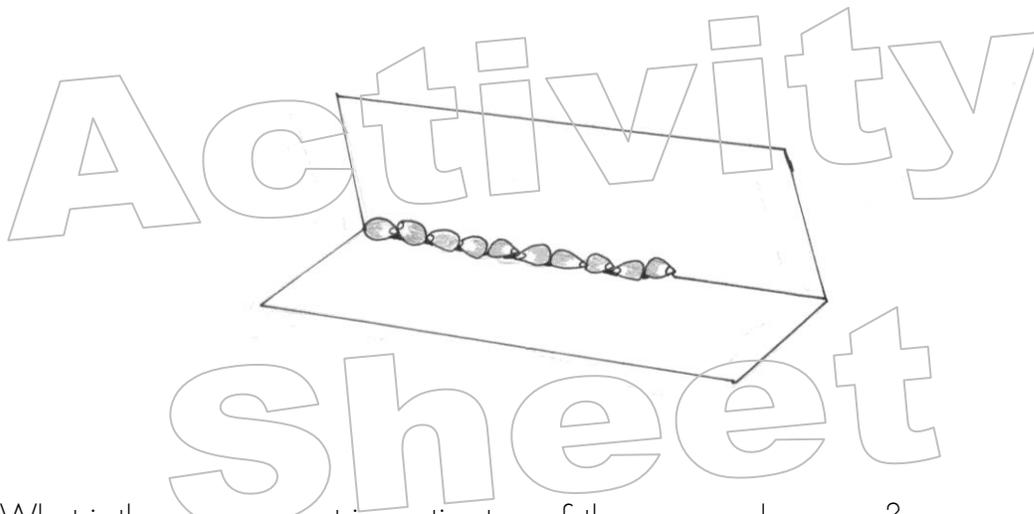
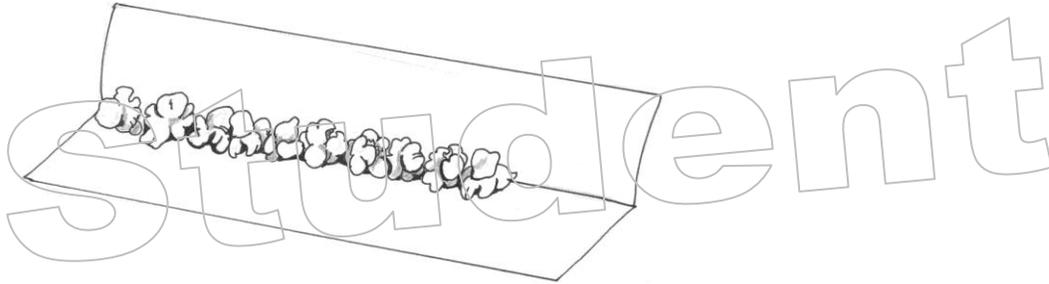
Dent

Pod

# Student Activity

# Sheet

MEASURING CORN (LINEAR MEASUREMENT)



1. What is the measurement in centimeters of the unpopped popcorn? \_\_\_\_\_
2. What is the measurement in centimeters of the popped popcorn? \_\_\_\_\_
3. How many centimeters long do you think 20 unpopped kernels would be? \_\_\_\_\_
4. How many centimeters long do you think 20 popped kernels would be? \_\_\_\_\_
5. How many centimeters long do you think 100 unpopped kernels would be? \_\_\_\_\_
6. How many centimeters long do you think 100 popped kernels would be? \_\_\_\_\_

Just How Popular is Popcorn?

Americans consume 1,124,600,000 pounds of popcorn every year. Seventy percent of that is purchased at retail stores in both raw and popped form and eaten at home. The national population is about 283,500,000. Each person in the United States averages eating about four pounds of popcorn per year. The remainder pops up almost any place associated with fun, food and fitness – movie theaters, sporting events, entertainment arenas, amusement parks and other recreational centers. Kids love popcorn because it tastes good, and adults favor popcorn for its nutritional value.

Where is it Grown?

Popcorn is grown extensively in the corn belt states of the United States. Many different types of corn may be grown. The common types are pop, sweet, flour, flint, dent and pod. The majority of popcorn sold worldwide is produced in the corn belt. States with the highest production of corn are Iowa, Illinois, Nebraska, Minnesota, Wisconsin and Ohio. Popcorn resembles corn-on-the-cob in appearance and cultivation although only popcorn kernels have the ability to pop. Popcorn can be ear-harvested where the whole ear of corn is cut and stored for eight to twelve months until the moisture levels in the kernels reach the best levels. At this point, the kernels are stripped from the cobs and graded to eliminate ones that are too small to pop well. The sun is a major source of energy for the growing of popcorn. Other energies that contribute to the growth of popcorn are human labor, fuels for farm equipment, electricity and energy used to produce fertilizers and pesticides. To process, package and transport the popcorn, energy in the form of fuel, electricity, heat and human labor are also used. From its original use as a food for man, corn now yields over 100 by-products for the home and industry. A few of the by-products are dyes, paints, ethanol fuel, oilcloth, oil for soaps, corn syrups, corn starches, corn oils, corn cereals, vegetable

substitutes for lard and butter, corn cellulose in press boards and insulating materials, and various chemicals. The livestock industry continues to be the largest user of corn grown.

### What Makes it Pop?

Popcorn's ability to pop lies in the fact that the kernels have a hard outer shell and contain a small amount of water (moisture) stored inside the soft starch. When the water is heated enough, it changes to steam. The steam creates pressure within until eventually the hard outer casing gives way and the kernels explode. The popping allows the moisture to escape as steam turns the kernels inside out. Some Indians told stories about why popcorn popped. Some thought that a spirit inside got angry and pushed its way out when it was heated. Most people think that the Indians discovered accidentally some corn popped when it was heated. No one knows for certain. Although the early Indian corn carried no popping guarantee, popcorn brands today vow at least 99 percent of the kernels will pop. The key is a constantly improved product. Throughout the years, popcorn producers have conducted research to continually improve their product.





Evaluation Questions:

1. Describe what happens to popcorn when it pops.

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2. Why does it do this?

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3. List five words that describe popcorn.

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4. What did you learn about popcorn?

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5. Describe one difference between an unpopped kernel and a popped kernel.

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Number these sentences in the correct order from 1-5:

\_\_\_\_\_ Water (moisture) turns to steam.

\_\_\_\_\_ Small amount of water (moisture) is stored inside the kernel.

\_\_\_\_\_ The kernel explodes allowing moisture to escape and turning it inside out.

\_\_\_\_\_ Each popcorn kernel begins to get hot.

\_\_\_\_\_ Steam creates pressure inside the kernel.

Student  
Activity

Sheet

# Learning Experience 4: Measuring Mass

Objective: Students will assemble and use a double-pan balance to measure the mass of quantities of popcorn.

---

## Materials:

For each group of three students:

3 Energy Forms and Interactions Student Activity Books

Balance stand

Balance arm

Pin for balance

Balance base

2 baskets for balance

2 paper clips

Modeling clay

2 medicine cups

Gram centimeter cubes

For the class:

Unpopped popcorn

## Note:

The gram centimeter cubes are designed to have a mass of one gram each. In turn, they measure one centimeter on each side ( $1\text{ cm} \times 1\text{ cm} \times 1\text{ cm} = 1\text{ cm}^3$ ). Therefore, they have a mass of one gram and a volume of one cubic centimeter or 1 cc or  $1\text{ g/cm}^3$ .

## Preparation:

Demonstrate to the students how to set up of the double-pan balance and its calibration with modeling clay.

## Assessment:

A group of three students will assemble a double-pan balance using the materials provided and level their double-pan balance by using the clay provided.

## Vocabulary:

level

calibrate

mass

zeroing

gram centimeter cubes

balance

modeling clay

## Learning Activities:

### Session 1:

Provide students the activity sheet for Learning Experience #4 in the Energy Forms and Interactions Student Activity Book that illustrates the assembly of the double-pan balance. After assembling the double-pan balance, students may discover one side of the balance is higher than the other. Discuss with students that the balance must be leveled or calibrated before it can be used to measure objects. Provide students with a piece of modeling clay to help level the double-pan balance. Emphasize that this process is called “calibration.” It also is referred to as “zeroing the balance.”

### Discussion Questions:

- Why do you think that the double-pan balance should be level?
- What do you think the clay does to the unbalanced side of the double-pan balance when it is added?

### Session 2:

Begin this session by demonstrating for students how to use the balance by finding the mass of one medicine cup filled to the 30 cc mark with popcorn kernels. Use the gram centimeter cubes to determine the mass of popcorn kernels by placing the gram centimeter cubes in one medicine cup and the popcorn in the other medicine cup. Use of the medicine cup in each basket eliminates the effect of the mass of the medicine cup. Provide student groups with the gram centimeter cubes, medicine cups and popcorn. Have students measure the mass of 15, 30, 45, 60, 75 and 90 kernels of popcorn by placing one medicine cup in each basket of the double-pan balance.

Students should record all measurement on their activity sheets for Learning Experience #4 in the Energy Forms and Interactions Student Activity Book.

### Discussion Questions:

- Why do you think you obtained a different measurement for each number of popcorn kernels?
- How did the masses for the various quantities of popcorn compare with other groups?

### Extension:

Give each student five nickels. Demonstrate to students with the balance that the nickels' mass is 5 grams. Hand out the balances, centimeter cubes, modeling clay and nickels to the groups. Tell them to duplicate what they just saw. This activity helps students learn how to calibrate a balance with modeling clay.

## Learning Experience 5: Measuring Popcorn (Mass)

Objectives: Students measure and compare various masses of unpopped popcorn kernels and popped popcorn.

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### Materials:

For each group of 3 students:

3 Energy Forms and Interactions Student Activity Books

Double-pan balance

3 medicine cups

3 9 oz plastic tumblers

Cardboard tray

Gram centimeter cubes

For the class:

Air popper

Electrical outlet switch

Stopwatch

Aluminum foil

3 popcorn tubs

Regular popcorn

Dried popcorn

Moistened popcorn

2 ziplock bags

Measuring cup

Shallow pan\*

Oven\*

\*provided by teacher

### Preparation:

Keep all popcorn sealed in a plastic ziplock bag. Moisture will be gained or lost by the popcorn if the popcorn is left unsealed for long periods of time.

### Session 1:

Keep regular popcorn sealed until you are ready to use. Fill one medicine cup to the 25 cc mark with unpopped popcorn for each group of students. The air popper will be used to pop the combined sample from the groups.

### Session 2:

Aluminum foil should be used to line the baskets of the double-pan balance when measuring the popped corn. Balances will need to be zeroed or calibrated by the student groups.

### Session 3:

Prepare the dried popcorn kernels the day before this session. Preheat an oven to 180 degrees F. Use a measuring cup to measure 300 cc of popcorn. Spread the popcorn kernels in a single layer in a shallow pan and bake for approximately 90 minutes. Allow the kernels to cool and seal in a plastic ziplock bag. You could also just leave kernels uncovered in a very warm area for three to five days. Keep popcorn in a sealed plastic ziplock bag until you are ready to use. Fill one medicine cup to the 25 cc mark with the dried popcorn for each group of three students.

### Session 4:

Prepare the moistened popcorn kernels several days before this session. Use a measuring cup to measure 300 cc of popcorn. Place the popcorn in a ziplock bag. Add 15 cc of water to the bag, and seal the ziplock bag. Wait at least 24 hours before using. Keep popcorn in a sealed plastic ziplock bag until you are ready to use. Fill one medicine cup to the 25 cc mark with popcorn for each group of three students.

## Vocabulary:

kernel

corn

seed

mass

difference

moist

## Learning Activities:

### Session 1:

Students are to complete the activity sheet for Learning Experience #5 in Energy Forms and Interactions Student Activity Book.

Each student group should count 100 kernels of regular popcorn into a 9 oz. plastic tumbler. Each group of three students should measure the mass with the gram centimeter cubes and record the mass. Three group samples should then be combined. Each combined amount should contain 300 kernels.

### Discussion Questions:

- How did the mass for the 100 kernels of popcorn compare with other groups?
- What was the total mass for the 300 kernels?

### Session 2:

The teacher will now pop the combined samples from Session 1. Turn on the air popcorn popper by using the switch on the electrical strip. Time the popcorn popper for 60 seconds with the stopwatch. Turn the popper off. Add the 300 kernels of popcorn kernels to the air popper.

Turn on the air popper and pop the corn into the paper popcorn tub. Pop the kernels for 180 seconds. The total mass of the popped and unpopped kernels should now be determined with a double-pan balance. Record the total mass in Energy Forms and Interactions Student Activity Book.

After recording the total mass of the popped and unpopped kernels, separate the popcorn on to the cardboard tray. Students should now count the number of kernels that popped and those that did not. The total number of popped and unpopped kernels should be counted and combined for each set of groups. Ask the students to record their observations on the activity sheet for Learning Experience #5 in Energy Forms and Interactions Student Activity Book.

### Discussion Questions:

- For each set of groups, how many of the 300 kernels popped?
- For each set of groups, how many of the 300 kernels were unpopped?
- Is there a difference in the mass found in session one for the 300 kernels and the mass found in Session 2 for the 300 kernels after popping?
- What could account for the difference?

### Session 3:

Each student group should count one hundred kernels of dried popcorn into a 9 oz. plastic tumbler. Each group of three students should measure the mass with the gram centimeter cubes and record the mass. Three group samples should then be combined. Each combined amount should contain 300 kernels.

### Discussion Questions:

- How did the mass for the 100 dried kernels of popcorn compare with other groups?
- What was the total mass for the 300 dried kernels?

#### Session 4:

The teacher will now pop the combined samples from Session 3. Each combined sample should contain 300 kernels from each group. Turn on the air popcorn popper by using the switch on the electrical strip. Time the popcorn popper for 60 seconds with a stopwatch. Turn the popper off. Add the 300 kernels of popcorn kernels to the air popper. Turn on the air popper and pop the corn into the paper popcorn tub. Pop the kernels for 180 seconds. The total mass of the popped and unpopped kernels should now be determined with a double-pan balance. Record the total mass in Energy Forms and Interactions Student Activity Book.

After recording the total mass of the popped and unpopped kernels, separate the popcorn on to the cardboard trays. Students should now count the number of kernels that popped and those that did not pop. The total number of popped and unpopped kernels should be counted and combined for each set of groups. Ask the students to record their observations under dried kernels on the activity sheet for Learning Experience #5 in the Energy Forms and Interactions Student Activity Book.

#### Discussion Questions:

- For each set of groups, how many of the 300 kernels from the dried sample popped?
- For each set of groups, how many of the 300 kernels from the dried sample were unpopped?
- Is there a difference in the mass found in session one for the 300 dried kernels and the mass found in Session 3 for the 300 dried kernels after popping?
- What could account for the difference?

#### Session 5:

Students are to complete the activity sheet for Learning Experience #5 in the Energy Forms and Interactions Student Activity Book. Each student group should count 100 kernels of moistened popcorn into a 9 oz. plastic tumbler. Each group of three students should measure the mass with the gram centimeter cubes and record the mass. Three group samples should then be combined. Each combined amount should contain 300 kernels.

#### Discussion Questions:

- How did the mass for the 100 moistened kernels of popcorn compare with other groups?
- What was the total mass for the 300 moistened kernels?

#### Session 6:

The teacher will now pop the samples from the combined groups. Each combined sample should contain 300 kernels from the group. Turn on the air popcorn popper by using the switch on the electrical strip. Time the popcorn popper for 60 seconds. Turn the popper off. Add the 300 kernels of popcorn kernels to the air popper. Turn on the air popper and pop the corn into the paper popcorn tub. Pop the kernels for 180 seconds. The total mass of the

popped and unpopped kernels should now be determined with a double-pan balance. Record the total mass on the activity sheet for Learning Experience #5 in the Energy Forms and Interactions Student Activity Book.

After recording the total mass of the popped and unpopped kernels, separate the popcorn on to the cardboard trays. Give one tray to each original group that provided the 300 kernels. Students should now count the number of kernels that popped and those that did not. The total number of popped and unpopped kernels should be counted and combined for each set of groups. Ask the students to record their observations on the activity sheet for Learning Experience #5 in the Energy Forms and Interactions Student Activity Book.

#### Discussion Questions:

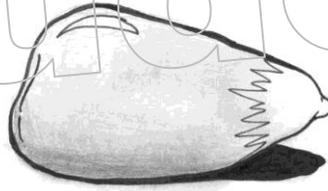
- For each set of groups, how many of the 300 kernels from the moistened sample popped?
- For each set of groups, how many of the 300 kernels from the moistened sample were unpopped?
- Is there a difference in the mass found in session one for the 300 moistened kernels and the mass found in Session 3 for the 300 dried kernels after popping?
- What could account for the difference?

#### Extension:

Ask students to research different kinds of popcorn poppers. When were they invented? Who used these poppers? How do they pop popcorn? How do they compare to today's poppers?

MEASURING POPCORN (MASS)

Student



Activity

What is the mass of 100 kernels of popcorn? \_\_\_\_\_

How did the mass of 100 kernels of popcorn compare with other groups?

\_\_\_\_\_

What is the mass of the combined 300 kernels of regular popcorn? \_\_\_\_\_

How many of the 300 kernels of regular popcorn were unpopped? \_\_\_\_\_

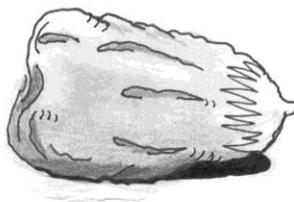
If you subtract the unpopped kernels, how many kernels must have popped? \_\_\_\_\_

What was the total mass of the 300 popped kernels and unpopped kernels after popping?

\_\_\_\_\_

What was the difference between the total mass of the original unpopped kernels before popping and the total mass after popping? \_\_\_\_\_

What could account for the difference? \_\_\_\_\_



What is the mass of 100 dried kernels of popcorn? \_\_\_\_\_

How did the mass for the 100 dried kernels of popcorn compare with other groups? \_\_\_\_\_

What was the mass of the combined 300 dried kernels? \_\_\_\_\_

If you subtract the unpopped kernels, how many kernels must have popped? \_\_\_\_\_

How many of the 300 kernels from the dried sample were unpopped? \_\_\_\_\_

What was the difference between the total mass of the dried unpopped kernels before popping and the total mass after popping? \_\_\_\_\_

What was the difference between the mass of the popped and unpopped dried kernels? \_\_\_\_\_

What could account for the difference? \_\_\_\_\_

\_\_\_\_\_



What is the mass of 100 moist kernels of popcorn? \_\_\_\_\_

How did the mass for the 100 moist kernels of popcorn compare with other groups? \_\_\_\_\_

What was the mass for the 300 moist kernels? \_\_\_\_\_

How many of the 300 kernels from the moistened sample were unpopped? \_\_\_\_\_

If you subtract the unpopped kernels, how many kernels must have popped? \_\_\_\_\_

What was the difference between the mass of the popped and unpopped moistened kernels? \_\_\_\_\_

What could account for the difference?

\_\_\_\_\_

## Learning Experience 6: Popcorn as a Seed

Objective: Students will compare the germination of popcorn seeds that are placed in sunlight with those that are placed in darkness.

---

### Materials:

For each group of students:

3 Energy Forms and Interactions Student Activity Books

8 popcorn kernels

2 ziplock plastic bags

For the class:

Paper towels\*

Stapler\*

Tape\*

\*provided by the teacher

### Preparation:

Read aloud to the class the background information titled Plants and Food Webs and Energy. Soak the corn kernels in water for 24 hours prior to this learning experience. One germination bag should be placed in sunlight if possible. Place the other bag in a dark place, perhaps in a drawer or desk. On a daily basis, students should make a drawing of a corn kernel from each of the germination bags. Students should observe the germination bags for several days. Students should observe that seeds in both germination bags will sprout. Sunlight is not necessary for sprouting because the seed has stored energy from the sun that enables it to sprout without direct exposure to the sun. Warmth is important, however.

Sprouting is very limited or does not occur at low temperatures. If mold develops, dispose of germination bag.

### Caution:

After 30 hours of soaking the seeds, they may begin to rot.

### Assessment:

Students will describe why seeds that are in dark locations may sprout without direct exposure to sunlight.

## Vocabulary:

germination

root

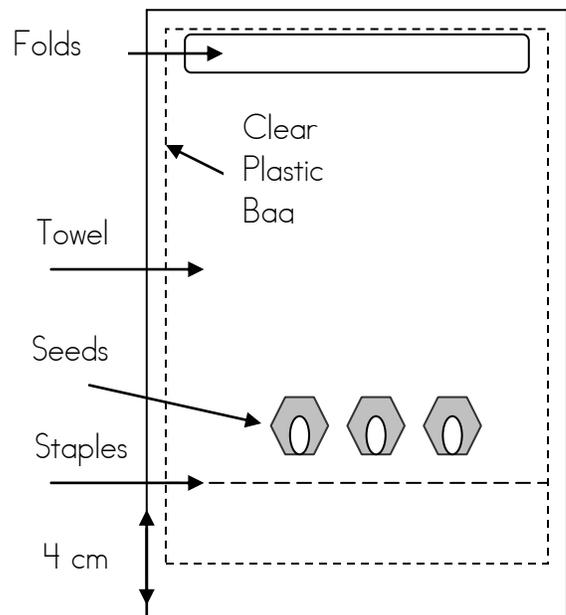
sprout

## Learning Activities:

### Session 1:

Discuss with students the experiences they have had previously about growing seeds.

Students are to set up two germination bags with four popcorn kernels in each bag. Students are to take one layer of paper towels and place it in a plastic bag. Place the four kernels in a row on the paper towels in the plastic bag and staple the bag 4 cm from the bottom. Seal the bag. Tape the bag to a wall near a window facing sunlight. Place the other bag in a dark place, perhaps in a drawer or desk. Observe the kernels daily. Add water to the paper towel if needed. In the Energy Forms and Interactions Student Activity Book, students should draw what their kernels look like on each day they observed their germination bag.



### Discussion Questions:

- What changes might you see in the corn kernels each day?
- What do you see coming out of the kernel that you observed in your germination bag?
- In which germination bag did the seeds seem to grow the fastest?
- Did the germination bag that was placed in the dark location need sunlight to cause the seed to sprout?

POPCORN AS A SEED

Draw your observations of your germination bag.

<p>Date _____</p> <p>_____</p> <p>_____</p>	<p>Date _____</p> <p>_____</p> <p>_____</p>	<p>Date _____</p> <p>_____</p> <p>_____</p>
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<p>Date _____</p> <p>_____</p> <p>_____</p>	<p>Date _____</p> <p>_____</p> <p>_____</p>	<p>Date _____</p> <p>_____</p> <p>_____</p>
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Date \_\_\_\_\_

Student

Activity

Sheet

\_\_\_\_\_

Date \_\_\_\_\_

Student

Activity

Sheet

\_\_\_\_\_

Date \_\_\_\_\_

Student

Activity

Sheet

\_\_\_\_\_

Date \_\_\_\_\_

\_\_\_\_\_

Date \_\_\_\_\_

\_\_\_\_\_

Date \_\_\_\_\_

\_\_\_\_\_

Name: \_\_\_\_\_

Date: \_\_\_\_\_

### Energy Forms and Interactions Student Assessment

Directions: Read the question carefully and answer based on your knowledge about energy forms and interactions. Circle the correct answer.

1.) Imagine that you have two ears of corn. One ear is rotten. The other has been chopped into small pieces. You want to decide which of the two ears of corn has gone through a chemical change. What information will help you decide?

- A.) The shape of the chopped ear has changed.
- B.) Both ears have changed texture.
- C.) The chopped ear feels rougher than before.
- D.) The smell and the color of the rotten ear are different than before.

2.) When you are running, your body has to change the \_\_\_\_\_ energy of food into mechanical energy.

- A.) Light
- B.) Motion
- C.) Chemical
- D.) Electrical

3.) \_\_\_\_\_ fuels are crude oil, coal and natural gas.

- A.) Fossil
- B.) Solar
- C.) Hydroelectric
- D.) Corn

4.) A corn plant utilizes the energy of the \_\_\_\_\_ to make food.

- A.) Battery
- B.) Sun
- C.) Air popper
- D.) Fat

5.) A car uses the stored \_\_\_\_\_ energy in gasoline to move.

- A.) Chemical
- B.) Electrical
- C.) Mechanical
- D.) Heat

6.) Mechanical energy is changed to \_\_\_\_\_ energy in a drum or with the ringing of a church bell.

- A.) Chemical
- B.) Electrical
- C.) Heat
- D.) Sound

7.) An air popper changes \_\_\_\_\_ energy into heat energy and mechanical energy.

- A.) Chemical
- B.) Electrical
- C.) Sound
- D.) Light

8.) A television changes electrical energy into \_\_\_\_\_ energy.

- A.) Light and sound
- B.) Heat and mechanical
- C.) Mechanical and sound
- D.) Heat and light

9.) \_\_\_\_\_ is stored in the body as potential energy when you overeat.

- A.) Fat
- B.) Heat
- C.) Sweat
- D.) Candy

10.) In 1492 when Columbus arrived in the West Indies, \_\_\_\_\_.

- A.) He brought popcorn to the natives to trade for fur.
- B.) He told the Aztecs the story of the "Three Sisters".
- C.) Popcorn had been used to decorate his ships.
- D.) Popcorn had been growing in the America's for thousands of years.

11.) The corn plant belongs to the \_\_\_\_\_ family.

- A.) Grass
- B.) Fruit
- C.) Herb
- D.) Bean

12.) Today corn cannot survive without \_\_\_\_\_.

- A.) Butter and salt
- B.) Native populations
- C.) Electrical energy
- D.) Humans

13.) Which of the following is probably not needed in order to process, package and transport popcorn?

- A.) Mechanical energy
- B.) Fuel energy
- C.) Electrical energy
- D.) Sound energy

14.) Popcorn's ability to pop lies in the \_\_\_\_\_, which is contained inside each kernel.

- A.) Moisture
- B.) Oil
- C.) Soap
- D.) Fuel

15.) When popcorn kernels pop \_\_\_\_\_.

- A.) The spirits inside each kernel have become angry and pushed their way out.
- B.) The oil in the popper has become hot enough to create pressure.
- C.) The steam inside the kernel creates pressure causing the explosion.
- D.) The air around the kernel becomes heated, causing the explosion.

## Energy Forms and Interactions Student Assessment Key

1. D
2. C
3. A
4. B
5. A
6. D
7. B
8. A
9. A
10. D
11. A
12. D
13. D
14. A
15. C

## MORE IDEAS

### Language Arts

- ◆ Read any of the books listed under resources. Review the meanings of new vocabulary. Read about popcorn kernels. Discuss what kernels are made of and why they pop or don't pop.
- ◆ Write descriptive paragraphs about popcorn, popcorn stories and popcorn history.
- ◆ Have your students research what it takes to go from the processing company to the stores and movie theaters that sell popcorn. Identify the major processing companies and largest retailers.
- ◆ Have students visit a grocery store and pick out three different types of popcorn. Ask them why they picked the ones they did: brand name, packaging, advertising, etc.
- ◆ Ask students to find advertisements for popcorn in magazines and on television. Discuss what they liked and disliked about the ads. What motivates them to want a particular brand/product?
- ◆ Have students locate retail outlets that sell popcorn. Do they advertise? How much, if at all, has advertising increased sales?
- ◆ Divide the class into groups, and have them do a marketing campaign for a new popcorn product. The campaign should include choosing a flavor and a name and creating a logo and package design.
- ◆ Plan an advertising campaign for the new product. Decide which groups of people are most likely to eat it, then develop ideas based on these groups -- the "target market." Write down the ideas and decide which media -- magazine, newspapers, posters, television, radio or cinema or a combination -- to use.
- ◆ Have students develop and plan the advertisements. Write the words and design the page for a press advertisement, write the script or words for a jingle or produce a storyboard (small pictures that outline the plan of the film) for television.
- ◆ Consider promotional ideas to help sell the product -- t-shirts, hats, buttons, etc. -- to tie-in with your theme. Where would these items be offered? Have students make plans and designs of their ideas.

Book Suggestions:      Aiki. (1976). *Corn Is Maize: The Gift of the Indians*. New York: HarperCollins Children's Books.

                                 dePaola, Tomie. (1984). *The Popcorn Book*. New York: Holiday House.

                                 Thayer, Jane. (1953). *The Popcorn Dragon*. New York: Morrow Junior Books.

## Art

- ◆ Make drawing of popcorn artifacts, Indian culture or illustrations for stories or to record observations.

## Social Studies

- ◆ Read about and discuss the history of popcorn.
- ◆ Identify locations on a map that grow the most popcorn in the USA, Sumatra, China or India.

## Math

- ◆ Conduct taste test and surveys. Graph the results of the tests.
- ◆ Divide the class into teams and compare "regular" popcorn and microwave popcorn (i.e., taste, cost, popping procedures, etc.) What makes the two different? Which is considered "better" or "more nutritious"?
- ◆ Hold a contest in the classroom to find the perfect popcorn. Create different categories for winners, i.e., most nutritious, most indulgent, most creative, etc. Pick a panel of judges to determine the winners.
- ◆ One quart of popped popcorn costs only 4–9 cents, making popcorn one of the most economical snacks around. Ask your students to compare other favorite snack foods by cost and determine which are the best bargains.

## Science

- ◆ Discuss popcorn nutrition. Compare popcorn's nutrition with that of other popular snacks.
- ◆ Discuss environmental issues relating to packaging materials and their disposal. Which are considered the "best" and "worst" from an ecological standpoint?
- ◆ Ask students to make a list of popular snack foods. Have them check those snacks they feel are most nutritious and star the ones they feel are most caloric. Analyze the nutritional value and calorie count of each snack on the list with your students.
- ◆ Have students locate actual fitness and healthy eating plans that recommend popcorn as a nutritious and low-calorie snack.
- ◆ Let your students act as reporters. Have them contact nutritionists, dieticians and members of the American Dietetic Association and interview them. Find out why they feel popcorn is a smart snack choice and how they would incorporate it into their diet. Report the findings to the class.

## INQUIRY AND PROCESS SKILLS

Classifying	Arranging or distributing objects, events or information in classes according to some method or system.
Communication	Giving oral and written explanations or graphic representations of observations.
Creating Models	Displaying information by means of graphic illustrations or other multi-sensory representations.
Formulating Hypothesis	Constructing a proposition or assumption of what is thought likely to be true based on reasoning, which serves as a tentative, testable theory.
Gathering & Organizing	Collecting information about objects and events which show a specific situation.
Generalizing	Drawing general conclusions from information.
Identifying Variables	Recognizing the characteristics of objects or events which are constant or change under different conditions.
Inferring	Making a statement or conclusion based on reasoning or prior experience to explain an observation.
Interpreting Data	Analyzing information that has been collected and organized by describing apparent patterns or relationships in the information.
Making Decisions	Choosing an alternative from among several and basing the judgment on defensible reasons.
Manipulating Materials	Handling or treating materials, equipment or procedures skillfully and effectively.
Measuring	Making quantitative observations by comparing to a standard.
Observing	Becoming aware of an object or even by using any of the senses to identify properties.
Predicting	Making a forecast or estimate of what future events or conditions may occur.

## GLOSSARY

archaeologist:	a person who specializes in or studies archaeology, the scientific study of materials and objects that remain as evidence of the life and culture of prehistoric or ancient peoples, such as artifacts, structures and settlements.
Aztecs:	members of Native American people of Mexico: a member of a Native Middle American people whose powerful empire dominated central Mexico during the 14th and 15th centuries. The Spanish, under Cortés, defeated them around 1520.
balance:	an instrument for determining mass typically consisting of a bar attached to a central support so that it has free horizontal movement, with a pan or tray suspended from each end of the bar. If a substance of unknown mass is placed on one tray, its mass can be determined by the amount of known mass that must be placed on the other tray in order to bring the two into exact horizontal alignment.
calibrate:	to determine a measured value by adjusting for error in the pan balance (for this series of learning experience).
carbohydrates:	starches or sugars, stored chemical energy.
carnivores:	consumers that eat only meat.
cob:	the hard core to which individual kernels of corn are attached.
consumer:	organism that eats something else.
corn:	a tall cereal plant widely cultivated in many varieties in North America and elsewhere for use as a food crop, for animal feed, and as a source of oil, syrup and other such products. It is also called maize (especially in British use) and Indian corn (because it was first grown by the American Indians and introduced to European use by them).
corn belt:	the area of the Great Plains and the Midwest where corn and soybeans are the principal crops.

corn silk: the tuft of silky fibers growing at the tip of an ear of corn.

decomposers: convert dead matter into a form to be released in soil, water or air.

energy: the capacity to do work. Energy is used to perform useful functions for humans, such as heating or cooling buildings and enclosures, powering vehicles and machinery, cooking foods and so on.

energy forms: Energy exists in various forms: heat, electric, sound, chemical, mechanical and light.

energy interactions: a transformation of one form of energy to another, For example:

- Stored energy in a flashlight's batteries becomes electrical and then light energy when turned on.
- Sunlight is transformed to chemical energy in food through photosynthesis. Food contains energy stored as chemical energy. Your body uses the stored energy in food. Your body converts food to heat and motion. Popcorn is an example of stored energy of the sun.
- If you overeat, the food's energy is stored as potential energy in fat.
- When you talk on the phone, your voice is changed to electrical energy and sometimes light energy. The phone on the other end changes the electrical or light energy into sound energy.
- A car uses stored chemical energy in gasoline to move. The engine changes the chemical energy into heat and mechanical to power the car.
- An air popper changes electrical energy into heat energy and mechanical energy.
- Heat energy from an air popper changes hard kernel to soft and releases sound energy.
- A television changes electrical energy into light and sound energy.
- Mechanical energy is changed to sound energy with a drum or the ringing of a church bell.

fossil fuels:	any carbon-containing fuel, for example, coal, peat, petroleum and natural gas, derived from the decomposed remains of prehistoric plants and animals.
germination:	the beginning of growth or development in a seed, spore or zygote, especially after a period of dormancy.
husk:	the dry, often membranous outer covering of some seeds and fruit, as on an ear of corn.
Incas:	a member of a Native South American people whose huge empire, based in Peru and covering the entire Andean region, flourished from the 12th century AD until the mid-16th century. The Incas were sophisticated engineers, architects and artists who had a highly complex social structure.
kernel:	a whole seed grain, as of corn.
pollen:	the microspores of seed-producing plants, tiny granules that contain mature or immature male gametophytes; released from the anthers of flowers to fertilize the pistils
mass:	a fundamental property of an object, generally regarded as equivalent to the amount of matter in the object.
maize:	any plant variety of the species <i>Zea mays</i> , especially the colored ornamental variety known as Indian corn, occurring as large ears on a tall cereal grass.
moisture:	water or other liquid that is dispersed through a gas or a solid, or condensed on a solid, as a vapor or as very fine droplets.
omnivores:	consumers that eat producers, herbivores, carnivores and other omnivores.
photosynthesis:	the fundamental chemical process in which green plants (and blue-green algae) utilize the energy of sunlight or other light to convert carbon dioxide and water into carbohydrates, with the green pigment chlorophyll acting as the energy converter. Photosynthesis means “put together using light”.

producers:	all green plants.
property:	a characteristic quality, capability, function, or the like. Objects and events have distinctive properties. The properties of an object are determined by its material and condition. Some properties of an object are dependent upon the material from which the object is made. Different kinds of materials have different properties. Some examples are color, texture, hardness, brightness reflectiveness (mirrors) to light and sound when struck.
root:	in vascular plants, the underground organ that serves to anchor the plant in the soil and to absorb and store moisture and nutrients from the soil; it typically develops from the radicle and lacks nodes and internodes.
scavengers:	feed on dead organisms.
sprout:	new or young growth from a plant; a shoot or bud or young growth from a plant; a shoot or bud.
steam:	water vapor, especially such vapor having a temperature above the boiling point of water.
seed:	an embryonic spore of a plant formed from a fertilized ovule and enclosed within a protective seed coat, which forms a new plant upon germination.
tassels:	something resembling a tassel, especially the tuft of male flowers at the top.
validate:	prove the truth of.

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### Media Net

Please use the BOCES MediaNet Web site to check out the media (books, models, movies, Distance Learning opportunities, etc.) available on this science topic at <http://medianet.caboces.org>. Call the media library to order media materials and to check on new materials that are available. The number to be reached is (716)376-8212.

### Digital Resources

Please visit our Web site at [www.mstkits.org](http://www.mstkits.org) to access links to Web sites and other digital resources that correlate with this science topic.