

## Popcorn Country

Wisconsin Ag in the Classroom Program shares lessons from the National Ag in the Classroom curriculum matrix (<https://www.agclassroom.org/matrix/> and The Popcorn Board (<https://www.popcorn.org/>) for the 2022 Book of the Year. Visiting [www.wisagclassroom.org](http://www.wisagclassroom.org) for additional resources. Order the book at <https://www.wisagclassroom.org/product-category/books/>.

### Meet the author- Cris Peterson

Cris Peterson, along with her husband Gary and son Ben, operates Four Cubs Farm, a dairy farm in Grantsburg, Wisconsin. Born and raised in Minneapolis, Cris earned a B.S. in Education from the University of Minnesota, before marrying Gary and moving to the farm.

Cris' writing career began when she gave mouth-to-mouth resuscitation to a newborn calf and knew it would make a great story. The calf, named Breathless, survived and the story did sell.

Since that unusual experience, farming and writing have become her dual careers. When she's not milking cows, feeding calves or staring at her computer screen, her favorite thing to do is speak to kids in schools and to parents and others about literacy and agriculture. Her goal in writing books about farming is to create a sense of wonder ... the "Wow, I didn't know that" reaction that connects with her readers.

*Extra Cheese, Please!* was her first book which was published in 1994. To date, more than 100,000 of her books have sold nationwide and garnered several state and regional awards.

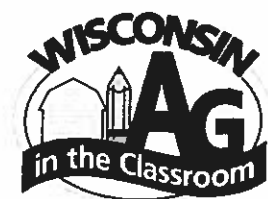
For eight years Cris wrote a national syndicated newspaper column reviewing children's books, appearing in the Chicago Tribune, St. Paul Pioneer Press, Dallas Morning News, Atlanta Constitution and the Sacramento Bee.

Features have appeared in The Chicago Tribune, Atlanta Constitution, Milwaukee Journal and the St. Louis Post-Dispatch. Articles and stories have been published in magazines including Highlights for Children, Cricket, Cooperative Partners, Hoard's Dairyman and many others.

**Source:** <http://crispeterson.com/aboutcris>

Contact Cris Peterson's website for more information about her books, Four Cubs Farm, speaking and presenting information. <http://crispeterson.com/>

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# Get Popping!

## Grade Levels

3 - 5

## Purpose

Students will discover how popcorn is grown and explore the phenomenon of how popcorn pops.

## Estimated Time

2 hours

## Materials Needed

### Interest Approach – Engagement

- Popcorn cob in a brown paper bag\*, Jiffy Pop popcorn, or a bag of microwave popcorn
- Hot plate or microwave
- Un-popped popcorn kernels, 1 per student
- Popped popcorn, 1 piece per student
- Hand lens (optional)

\*These items are included in the [Popcorn on the Cob! Kit](https://agclassroomstore.com/popcorn-on-the-cob/) (<https://agclassroomstore.com/popcorn-on-the-cob/>), which is available for purchase from [agclassroomstore.com](https://agclassroomstore.com).

### Activity 1: Anatomy of a Popcorn Kernel

- Un-popped popcorn kernel, 1 per student
- Popped popcorn, 1 piece per student
- [Before, During, After](https://cdn.agclassroom.org/media/uploads/2018/01/29/Before_During_After.pdf) ([https://cdn.agclassroom.org/media/uploads/2018/01/29/Before\\_During\\_After.pdf](https://cdn.agclassroom.org/media/uploads/2018/01/29/Before_During_After.pdf)) graphic organizer
- [Popcorn: Where Does It Come From and What is It Made Of?](https://cdn.agclassroom.org/media/uploads/2018/02/02/popcorn.pptx) (<https://cdn.agclassroom.org/media/uploads/2018/02/02/popcorn.pptx>) PowerPoint Slides (optional)
- [From Seed to Snack](https://youtu.be/MTdUfuu2CXU) (<https://youtu.be/MTdUfuu2CXU>) (optional)
- [How It's Made: Popcorn](https://www.youtube.com/watch?v=rIldiPSZffc) (<https://www.youtube.com/watch?v=rIldiPSZffc>) video (optional)

### Activity 2: Exploring How Popcorn Pops

- [Get Popping! video](https://www.youtube.com/watch?v=iAkSvFGFGn0&feature=youtu.be) (<https://www.youtube.com/watch?v=iAkSvFGFGn0&feature=youtu.be>)
- Safety glasses\*
- 2 test tubes 16 mm x 125 mm\* (we tested PYREX® ignition tubes)
- 4 boiling stones\*
- Centrifuge tube\*
- Small balloon\*
- Test tube clamp\*
- Heat-resistant glove (genuine leather, oven mitt, cooking glove, etc.)
- Alcohol lamp\*
- Denatured alcohol (fuel for the alcohol lamp)
- Multi-purpose lighter
- Vegetable oil\*, 1 drop
- Un-popped popcorn kernel\*
- Aluminum foil\*
- Test tube stand or glass container
- Circle-shaped sticky notes or circle-shaped paper die-cuts, 8 per group
- Playdough, 1 handful per student
- [Popping Popcorn in Ultra Slow Motion](https://www.youtube.com/watch?v=FSZd33awqQk) (<https://www.youtube.com/watch?v=FSZd33awqQk>) video

\*These items are included in the [Get Popping! Kit](https://agclassroomstore.com/get-popping/) (<https://agclassroomstore.com/get-popping/>), which is available for purchase from [agclassroomstore.com](https://agclassroomstore.com).

### Activity 3: Popcorn Nutrition

- Nutrition labels from various snack foods
- Air-popped popcorn, 3 cups
- Stick of butter

## Essential Files (maps, charts, pictures, or documents)

- [Before, During, After Graphic Organizer](https://cdn.agclassroom.org/media/uploads/2018/01/29/Before_During_After.pdf) ([https://cdn.agclassroom.org/media/uploads/2018/01/29/Before\\_During\\_After.pdf](https://cdn.agclassroom.org/media/uploads/2018/01/29/Before_During_After.pdf))
- [Popcom: Where Does it Come From and What is It Made Of? PowerPoint](https://cdn.agclassroom.org/media/uploads/2018/02/02/Popcom.pptx) (<https://cdn.agclassroom.org/media/uploads/2018/02/02/Popcom.pptx>)

## Vocabulary Words

**combine:** a machine that cuts crops (such as corn or wheat) and separates the seeds of the plant from the rest of the plant

**Corn Belt:** the area of the United States where corn is the predominant crop grown

**endosperm:** tissue formed within a seed that contains energy (starch) and protein for the germinating seed

**germ:** the living embryo of the corn kernel that contains the essential genetic information, enzymes, vitamins, and mineral for the kernel to grow into a corn plant

**germinate:** to begin to grow; sprout

**grain:** the edible seed or seed-like fruit of grasses that are cereals

**pericarp:** the outer, protective covering of the corn kernel

**pollination:** the transfer of pollen from the anther to the stigma of a plant

**whole grain:** contains the entire grain kernel

## Did You Know? (Ag Facts)

- Popcorn can pop as high as 3 feet in the air.<sup>1</sup>
- The peak period for home consumption popcorn sales is in the fall.<sup>1</sup>
- Popping popcorn is one of the most common uses for microwave ovens. Most microwave ovens have a "popcorn" control button.<sup>1</sup>

## Background Agricultural Connections

This lesson is easily nested into a storyline as an episode exploring the phenomenon of popcorn popping. In this episode, students investigate the question, "How does popcorn pop?" Keep in mind that phenomena-based lessons include storylines which emerge based upon student questions. Other lesson plans in the National Agricultural Literacy Curriculum Matrix may be used as episodes to investigate student questions needing science-based explanations. For more information about phenomena storylines visit [nextgenstorylines.org](http://www.nextgenstorylines.org) (<http://www.nextgenstorylines.org/what-are-storylines/>).

(<https://www.seedstorylines.org/>)

Popcorn is a "New World" food—it originated in the Americas and was unknown in the Eastern continents until after the voyage of Columbus. Just because it's called a "New World" food doesn't mean it's very new at all. In fact, the oldest ears of popcorn ever found were discovered at Bat Cave in west central New Mexico and are thought to be around 5,600 years old.<sup>2</sup> Native tribes from North and South America relied on popcorn as an important food staple but also used it as a decoration. Cortez noted this in 1519 when he came into contact with the Aztecs, who used it to create exquisite decorations like ceremonial headdresses, necklaces, and ornaments on statues.

Americans today consume 13 billion quarts of popcorn each year, more than any country in the world.<sup>3</sup> 13 billion quarts averages out to about 42 quarts (40 L) or 10.5 gallons per person. Imagine 10.5 gallon milk containers full of popcorn for every person in the United States. That's a lot of popcorn! The majority of the popcorn consumed worldwide is grown in the **Corn Belt** of the United States covering Iowa, Illinois, Indiana, southern Michigan, western Ohio, eastern Nebraska, eastern Kansas, southern Minnesota, and Missouri. Nebraska is the top producer of popcorn.

Popcorn is a type of maize (corn) scientifically known as *Setaria peruviana*. There are five different types of corn—sweet corn, popcorn, dent (field) corn, flour corn, and flint corn—but only one kind that pops...popcorn! Popcorn seeds are planted in the spring and take 7-10 days to **germinate**. The plant can grow to about 8 feet high and produce ears of corn covered in a green husk. Popcorn plants are wind **pollinated**. The pollen is located in the tassels at the top of the plant. The ears form silks that

catch the pollen as the wind blows. The pollen travels down a small tube in each silk and fertilizes the ovule at the base. After successful fertilization, a kernel develops and the silk detaches.

The popcorn is ready to harvest when the kernels become hard and the stalk and leaves of the plant are brown and dry. Typically, a **combine** is used to harvest the popcorn. The ears are stripped from the stalk, and the kernels are shelled from cob in the combine. The kernels are transported to a storage bin where they are dried until they reach the ideal moisture level of 14%. The kernels are then cleaned, polished, and packaged for distribution.

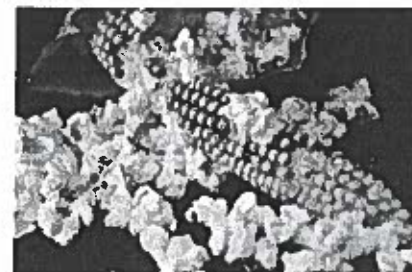
Popcorn is a **grain** composed of three parts—the **pericarp** (hull), **germ**, and **endosperm**. The pericarp is the hard outer shell surrounding the popcorn kernel. Inside the kernel is the germ, or seed embryo, and the endosperm. The endosperm contains trapped water and starch, which serves as food for the embryo during germination.

The popcorn kernel will pop when it is heated to an internal temperature of 400-460°F (204-238°C). When the kernel is heated, the moisture in the endosperm begins to boil and turns to steam. Because the pericarp is hard, pressure builds up inside the kernel. The starch gelatinizes and the moisture vaporizes until the pressure inside the kernel reaches 135 pound per square inch. At this point the kernel bursts open and the starch solidifies to form the white, puffy part of popped popcorn. As the kernel turns inside out, the steam escapes.

One serving of popcorn provides about 70% of the recommended individual daily intake of **whole grains**. Popcorn also contains fiber, iron, and a number of essential vitamins. Per cup, popcorn contains 31 calories when air-popped, 55 calories when oil-popped, and 133 calories when lightly buttered. Popcorn is a healthy and nutritious whole grain snack option.

## Interest Approach - Engagement

1. Show the class the popcorn cob. Ask them if they know what kind of corn it is? (If you do not have a popcorn cob, show the class a container of Jiffy Pop popcorn or a bag of microwave popcorn. Ask the students what they think is inside the packaging.)
2. Give each student an un-popped popcorn kernel to observe.
3. With your students, pop popcorn right off the cob. Place the cob in a paper bag, fold the top of the bag down twice to secure the top, place in the center of a microwave, and heat on high power for 1-1/2 to 3-1/2 minutes (time will vary with the wattage of the unit). Stop the microwave when fast popping slows to 1-2 seconds between popping. Carefully open the bag. The cob is very HOT! Note: some kernels may not pop due to uneven heat distribution in the microwave. (If you are popping Jiffy Pop over a hot plate or microwave popcorn, follow the directions on the packaging.)
4. Ask the students to describe what they observe. Discuss the steam that is present the moment the bag is opened.
5. Give each student a piece of the popped popcorn to observe. Ask the students what differences they observe between the un-popped and popped popcorn.
6. Ask the students, "How does popcorn pop?" After hearing their responses, let them know that this is a phenomenon worth investigating.



## Procedures



This lesson investigates the phenomenon of popcorn popping. Natural phenomena are observable events that occur in the universe that we can use our science knowledge to explain or predict.

**Phenomenon-Based Episode:** How Does Popcorn Pop?

**Disciplinary Core Ideas:** Structures and Properties of Matter (<https://www.nextgenscience.org/pe/5-ps1-1-matter-and-its-interactions>)

**National Agricultural Literacy Outcome Theme:** Food, Health, and Lifestyle (<https://cdn.agclassroom.org/nat/data/get/NALObooklet.pdf>)

Question	Science and Engineering Practices	Student Engagement in Practices	Explanation
1. What is a popcorn kernel made up of?	<ul style="list-style-type: none"> <li>Obtaining, Evaluating, and Communicating Information</li> </ul>	Students obtain, evaluate, and communicate information about the parts of a popcorn kernel.	A popcorn kernel is comprised of three parts—the pericarp, germ, and endosperm. The pericarp is the hard, outer shell surrounding the kernel. Inside the kernel is the germ, or seed embryo, and the endosperm. The endosperm contains trapped water and starch.
2. What happens to water when it is heated?	<ul style="list-style-type: none"> <li>Planning and Carrying Out Investigations</li> <li>Developing and Using Models</li> </ul>	Students carry out investigations and develop models to explore what happens to water when it is heated.	As water is heated and reaches the boiling point, it changes from a liquid to a gas (steam). The molecules in the steam move apart and take up any available space.



3. What happens to the water inside a popcorn kernel when the kernel is heated?	<ul style="list-style-type: none"> <li>• Planning and Carrying Out Investigations</li> <li>• Engaging in Argument from Evidence</li> </ul>	Students carry out investigations and engage in argument from evidence to explore and explain what happens to the water inside a popcorn kernel when the kernel is heated.	As the kernel heats up, the water inside boils and turns to steam. Because the pericarp is hard, pressure from the steam builds up inside the kernel. The pressure eventually becomes so great that the kernel bursts open.
4. How does popcorn pop?	<ul style="list-style-type: none"> <li>• Engaging in Argument from Evidence</li> <li>• Constructing Explanations and Designing Solutions</li> </ul>	Students engage in argument from evidence and construct explanations to describe how popcorn pops.	As the kernel heats up, the water inside boils and turns into steam. Because the pericarp is hard, pressure from the steam builds up inside the kernel. The starch gelatinizes and the pressure eventually becomes so great that the kernel bursts open, and the starch solidifies to form the white puffy part of the popcorn.

### Activity 1: Anatomy of a Popcorn Kernel (Episode Question 1)

1. Organize the students into small groups. Have the students bring their un-popped and popped popcorn from the *Interest Approach – Engagement* to their groups. Provide each student with a copy of the Before, During, After ([https://cdn.agclassroom.org/media/uploads/2018/01/29/Before\\_During\\_After.pdf](https://cdn.agclassroom.org/media/uploads/2018/01/29/Before_During_After.pdf)) graphic organizer.
2. Ask the students to discuss the following question with their group, "What do you think happens to popcorn before, during, and after popping?"
3. Instruct the students to record their ideas in the appropriate sections of the graphic organizer. Allow time for each group to share their ideas with the class.
4. Explain to the students that in order to understand how popcorn pops, it is helpful to know more about the parts of a popcorn kernel, how it is grown, and how it differs from other types of corn.
5. Choose from the following options to examine how popcorn is grown and the parts of a popcorn kernel.
  - Review the Popcorn: Where Does it Come From and What is it Made Of? (<https://cdn.agclassroom.org/media/uploads/2018/02/02/popcorn.pptx>) PowerPoint Slides.
  - Watch the From Seed to Snack (<https://youtu.be/MTdUfuu2CXU>) video.
  - View the How It's Made: Popcorn (<https://www.youtube.com/watch?v=rIldiPSZffc>) video.
6. Place the students back into their groups, and allow time for them to add to, revise, and/or question their original ideas on their graphic organizer. Share any additions, revisions, or questions with the whole group.

**Three Dimensional Learning Proficiency:** (<https://www.nextgenscience.org/three-dimensions>)  
Crosscutting Concepts



Students link different domains of science fields into a coherent and scientifically-based view of the world.

**Structure and Function:** (<https://ngss.nsta.org/CrosscuttingConcepts.aspx?id=6>) The way an object is shaped or structured determines many of its properties and functions.

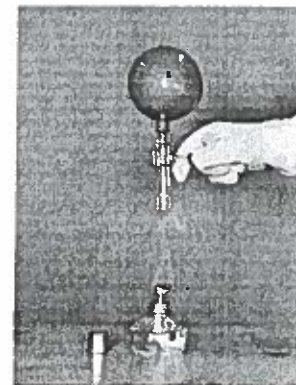
### Activity 2: Exploring How Popcorn Pops (Episode Questions 2-4)

**Safety Notes:** There are risks involved when using an open flame and glass test tubes. Consider reviewing the Get Popping video (<https://www.youtube.com/watch?v=iAkSvFGFGn0&feature=youtu.be>) before you demonstrate this activity with the students. The following safety procedures should be practiced when performing the investigations in *Activity 2*:

- Roll up long sleeves
  - Tie back long hair
  - Wear safety glasses (everyone in the room)
  - Keep work area clear
  - Inspect the test tubes for cracks or damage (do not use the test tube if it is damaged)
  - Make sure that the test tube glass is at room temperature before beginning the demonstration
  - Keep the test tube opening pointed away from yourself and students
  - Students should be at least 15 feet away from the demonstration
1. Students should have observed steam as part of the *Interest Approach – Engagement* activity. Ask the students, "How is steam created?" (*Steam is created when water is heated and liquid changes to gas—water vapor. When water vapor meets the colder air, it condenses into tiny water droplets suspended in air—steam.*)
  2. Ask the students to consider how to design an experiment to observe water changing to steam using a test tube, water, balloon, and a heat source. Discuss their ideas and guide the class until they come up with a procedure similar to the following.
  3. Put on safety glasses. Place four boiling stones into a test tube. Use the centrifuge tube to measure 3 mL of warm water and pour the water into the test tube.
    - **Safety Note:** To avoid boiling water entering the balloon and spraying out when the balloon pops, do not fill the test tube more than recommended. If boiling water begins to enter the balloon, immediately remove the test tube from the

heat.

4. Stretch out a small balloon by blowing it up a few times, and then stretch the balloon opening over the top of the test tube, pulling the balloon down over the top one inch of the tube. Light the alcohol lamp, put on a heat resistant glove, and use a test tube clamp to hold the test tube over, but not directly in, the flame of an alcohol lamp. Heat the water a slight angle. Ask the students to predict what they think will happen as the water heats up.
5. It will take about 45 seconds-1 minute for the water to begin to boil. At this point, hold the test tube straight up to allow the steam to enter the balloon. As the water reaches the boiling point, ask the students, "What are you observing?" (*The water is changing to steam. The steam is expanding and trying to escape, inflating the balloon with its pressure.*) Ask the students to predict what they think will happen to the balloon and why. (*Eventually, the steam will create enough pressure to explode the balloon.*) It will take about 1-1.5 minutes for the balloon to inflate and about 1.5-4 minutes or more for the balloon to pop.
6. Extinguish the lamp's flame and place the hot test tube in a test tube stand or glass container to cool.
7. Ask the students to diagram what they observed. Use the student diagrams to explain that all matter is made up of tiny parts called molecules. The arrangement of molecules differs in solids, liquids, and gases.
8. Model the arrangement of molecules in solids, liquids, and gases using one of the following options.
  - Have the students make fists with their hands, and push their fists tight together to demonstrate that the molecules in solids are tight together. Have the students rub their fists lightly together to demonstrate that molecules in liquids stick together, but can move around. Ask the students to think about what the steam was doing inside the balloon, and use their fists to demonstrate molecules in gases. The students should move their fists all over the place to demonstrate that molecules in gases move apart and take up any available space.
  - Place students in small groups and provide each group with 8 circle sticky notes. Have the students arrange the sticky notes so that they are touching each other tightly together to demonstrate that the molecules in solids are tight together. Have the students arrange the sticky notes so that they are lightly touching each other to demonstrate that molecules in liquids stick together, but can move around. Ask the students to think about what the steam was doing inside the balloon, and use the sticky notes to demonstrate molecules in gases. The groups should arrange the sticky notes so that they are not touching each other and taking up as much space as possible on the desk to demonstrate that molecules in gases move apart and take up any available space.
  - Provide each student with a handful of playdough. Ask the students to make 8 small balls of dough. Have the student arrange the playdough balls so that they are touching each other tightly to demonstrate that the molecules in solids are tight together. Have the students arrange the playdough balls so that they are lightly touching each other to demonstrate that molecules in liquids stick together, but can move around. Ask the students to think about what the steam was doing inside the balloon, and use the play dough balls to demonstrate molecules in gases. The students should arrange the playdough balls so that they are not touching each other and taking up as much room as possible on the desk to demonstrate that molecules in gases move apart and take up any available space.
9. After modeling the molecules in solids, liquids, and gases, ask the students to explain how the steam made the the balloon expand and eventually burst. (*As the water was heated and changed from liquid to gas (steam), the molecules the steam moved apart to take up any available space, filling up the balloon and eventually causing enough pressure to burst it.*)
10. Review the parts of a popcorn kernel, and remind the students that popcorn kernels contain water. Ask them to predict and explain what will happen if a kernel of popcorn is heated in a test tube.
11. After hearing the predictions and explanations, put on safety glasses, place one kernel of popcorn and a drop of vegetable oil in a dry test tube, and cover the top of the test tube with aluminum foil. Put on a heat resistant glove, and use a test tube clamp to hold the test tube over the alcohol lamp flame. Shake the test tube to avoid burning the kernel. (Keep the top of the test tube pointed away from you and the students!) It will take about 45 seconds-1 minute for the kernel to pop.
12. Extinguish the lamp's flame and place the hot test tube in a test tube stand or glass container to cool.
13. To view popcorn popping in slow motion, show the class the [Popping Popcorn in Ultra Slow Motion](https://www.youtube.com/watch?v=FSZd33awqQk) (<https://www.youtube.com/watch?v=FSZd33awqQk>) video.
14. Clarify that each kernel of popcorn contains water stored inside a circle of soft starch. Ask the students to explain what they observed. (*As the kernel heats up, the water inside the kernel boils and turns into steam. Because the pericarp is hard, pressure from the steam builds up inside the kernel. The starch gelatinizes and the pressure eventually becomes great that the kernel bursts open and the starch solidifies to form the white, puffy part of the popcorn.*)
15. Ask the students to use their fists to demonstrate the water molecules inside the popcorn kernel, and then the steam molecules when the kernel was heated.
16. Place the students back into their groups from *Activity 1*, and allow time for them to add to, revise, and/or question the original ideas on their graphic organizer. Share any additions, revisions, or questions with the whole group. Ask the students to share how their thinking changed and why. Use the completed graphic organizers to evaluate student understanding.



If you put a cob of sweet corn in a microwave, will the kernels pop like popcorn? It's important to understand that different corn varieties are grown to meet various food and production needs. There are five different



types of corn—dent corn, sweet corn, popcorn, flour corn, and flint corn—but only one kind that pops...popcorn. Sweet corn will not pop because, unlike popcorn, the kernels do not have a hard pericarp or the ideal moisture level inside. See the lesson [Corn: An Amazing Plant: Food, Fuel, and Plastic](https://agclassroom.org/matrix/lesson/141/) (<https://agclassroom.org/matrix/lesson/141/>) for more information about the different varieties of corn.



**Three Dimensional Proficiency:** (<https://www.nextgenscience.org/three-dimensions>) **Crosscutting Concepts**

Students link different domains of science fields into a coherent and scientifically-based view of the world. **Cause and Effect:** (<https://ngss.nsta.org/CrosscuttingConcepts.aspx?id=2>) Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.

### Activity 3: Popcorn Nutrition

1. Have the students bring in nutrition labels from their favorite snacks. Compare and contrast calories, fat, sugar, and vitamin content. Line the labels up in order of calorie content. Reorganize the labels in order of sugar content. Repeat with fat content. Ask the students to determine which snack food is healthiest overall.
2. Put three cups of air-popped popcorn into a bowl, show it to students, and write the calorie content (93 calories) on the board.
3. Hold up a stick of butter and write the calorie content (810 calories) on the board. Ask the students, "If you added one stick of butter to the popcorn, how many calories would that be in total?" (903 calories)
4. Remind students that they should be mindful of the calories when adding butter to popcorn. It is possible to turn a healthy snack into an overly caloric "junk" food item.
5. Explain to the students that popcorn is a whole grain, meaning it contains the entire whole grain kernel—the bran, germ, and endosperm. In contrast, a refined grain has been milled to remove the bran and germ which contain much of the dietary fiber, iron, and B vitamins. Popcorn can help you meet the recommendation to "make half of your grains whole."
6. Share the following popcorn nutrition facts with the students:
  - Per cup, popcorn contains 31 calories when air-popped, 55 calories when oil-popped, and 89 calories when lightly buttered.
  - Popcorn is a whole grain. It provides energy-producing complex carbohydrates.
  - Popcorn contains fiber, providing roughly the body needs in the daily diet.
  - Popcorn has no artificial additives or preservatives and is sugar-free.
  - Popcorn is ideal for between-meal snacking since it satisfies, but doesn't spoil, the appetite.
  - Three cups of popcorn equals one serving from the grain group.

Popcorn	Buttered	Oil popped	Air popped
Serving Size	1 cup (28g)	1 cup (28g)	1 cup (28g)
<b>Amount Per Serving</b>			
<b>Calories</b>	89	55	31
<b>% Daily Value*</b>			
<b>Total Fat</b>	11g	9g	9g
Saturated Fat	2g	1g	0g
<b>Cholesterol</b>	0mg	0mg	0mg
<b>Sodium</b>	0mg	0mg	0mg
<b>Total Carbohydrate</b>	23g	23g	23g
Dietary Fiber	4g	4g	4g
<b>Protein</b>	3g	3g	3g
<b>Vitamin A</b>	2%	0%	0%
<b>Iron</b>	2%	2%	0%

### Concept Elaboration and Evaluation

1. Ask the students the following questions:
  - Does steam have energy? (yes)
  - What evidence do we have to indicate that steam has energy? (*Steam inflated and burst the balloon. Steam caused the popcorn kernel to pop.*)
2. Ask the students to consider some ways that steam energy might be harnessed and utilized. Use the information in the [Engineering Expert Witness Blog](http://www.engineeringexpert.net/Engineering-Expert-Witness-Blog/heat-energy-within-the-power-plant-water-and-steam-cycle-part-1) (<http://www.engineeringexpert.net/Engineering-Expert-Witness-Blog/heat-energy-within-the-power-plant-water-and-steam-cycle-part-1>) to discover how steam energy is used in power plants.
3. Review and summarize the following key concepts:
  - Popcorn is a grain composed of three parts—the pericarp, germ, and endosperm. The endosperm contains water and starch.
  - When water is heated, the water turns from a liquid to a gas—steam. Gas molecules move around and take up any available space.
  - When a popcorn kernel heats up, the water in the endosperm boils and turns into steam. Pressure from the steam builds up inside the kernel, eventually becoming so great that the kernel bursts open.
  - Popcorn is a healthy and nutritious whole grain snack option.

## Enriching Activities

- Popcorn seeds can be used as food for people, but they can also be sprouted and grown into new plants if given the chance. Explore germination by sprouting corn seeds using the [Living Corn Necklace Kit](https://www.agclassroom.org/matrix/resource/83/) (<https://www.agclassroom.org/matrix/resource/83/>) or the [Farming in a Glove \(corn seeds\) Kit](https://www.agclassroom.org/matrix/resource/793/) (<https://www.agclassroom.org/matrix/resource/793/>).
- Learn about a small family farm that is growing popcorn and selling the cobs at farmers' markets in this [video](https://www.youtube.com/watch?v=RIBgVNVXhsA). (<https://www.youtube.com/watch?v=RIBgVNVXhsA>)
- Meet a popcorn farmer who lives on Popcorn Road by Popcorn Creek in Popcorn, Indiana in this [video field trip of a real popcorn farm](https://www.youtube.com/watch?v=SONkA2j-Asc). (<https://www.youtube.com/watch?v=SONkA2j-Asc>)

- Pop popcorn in an air popper. Beforehand, ask students to predict whether the popped popcorn will weigh more or less than the popcorn kernels. Weigh the kernels in a bowl before popping and the popcorn in the same bowl after popping. The popped popcorn will weigh slightly less than the kernels. Explain that this is because the moisture inside the kernel escapes as steam when the popcorn pops. Add a little butter and salt to the popcorn and enjoy as a class snack.

## Sources

1. <http://www.popcorn.org/Facts-Fun/Comy-Facts>
2. <https://specialcollections.nal.usda.gov/popcorn-exhibit#pop> (<https://specialcollections.nal.usda.gov/popcorn-exhibit#pop>)
3. <http://www.popcorn.org/Facts-Fun/History-of-Popcorn/Recent-Popcorn-History>

Storyline graphic from [seedstorylines.org](https://www.seedstorylines.org) (<https://www.seedstorylines.org/>).

Phenomenon chart adapted from work by Susan German.

German, S. (2017, December). Creating conceptual storylines. *Science Scope*, 41(4), 26-28.

German, S. (2018, January). The steps of a conceptual storyline. *Science Scope*, 41(5), 32-34.

Activity 3 was created for Utah Agriculture in the Classroom by Lyndi Perry.

## Suggested Companion Resources

- [Corn](https://www.agclassroom.org/matrix/resource/446/) (<https://www.agclassroom.org/matrix/resource/446/>)
- [Popcorn Country: The Story of America's Favorite Snack](https://www.agclassroom.org/matrix/resource/995/) (<https://www.agclassroom.org/matrix/resource/995/>)
- [Popcorn!](https://www.agclassroom.org/matrix/resource/871/) (<https://www.agclassroom.org/matrix/resource/871/>)
- [The Popcorn Book](https://www.agclassroom.org/matrix/resource/870/) (<https://www.agclassroom.org/matrix/resource/870/>)
- [Farming in a Glove \(Corn Seeds\)](https://www.agclassroom.org/matrix/resource/793/) (<https://www.agclassroom.org/matrix/resource/793/>)
- [Get Popping!](https://www.agclassroom.org/matrix/resource/878/) (<https://www.agclassroom.org/matrix/resource/878/>)
- [Living Necklace Kits](https://www.agclassroom.org/matrix/resource/83/) (<https://www.agclassroom.org/matrix/resource/83/>)
- [Popcorn on the Cob](https://www.agclassroom.org/matrix/resource/882/) (<https://www.agclassroom.org/matrix/resource/882/>)
- [How Stuff Works: Popcorn](https://www.agclassroom.org/matrix/resource/485/) (<https://www.agclassroom.org/matrix/resource/485/>)
- [Popped Secret: The Mysterious Origin of Corn](https://www.agclassroom.org/matrix/resource/568/) (<https://www.agclassroom.org/matrix/resource/568/>)
- [Phenomenon](https://www.agclassroom.org/matrix/resource/960/) (<https://www.agclassroom.org/matrix/resource/960/>)

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## It's a Fact!

### It Contains Carbohydrates!

Popcorn's nutritional value comes from the fact that, like other cereal grains, its primary function is to provide the body with heat and energy. Its carbohydrate content spares protein allowing the body to store much needed body fuel.

### It's Acclaimed!

The National Cancer Institute (NCI), the federal government's cancer prevention agency, suggests fiber in the diet to reduce the risk of some forms of cancer. The agency currently distributes two booklets that name popcorn as a food American's should eat more of. *Diet, Nutrition, & Cancer Prevention: a guide to food choices*, and *Good News*, cite popcorn for its high-fiber, low-fat content. The American Dental Association (ADA) includes popcorn on its list of recommended sugar-free snacks. The American Diabetes Association and the ADA permit popcorn as a bread exchange on weight-control diets, the Feingold Diet for hyperactive children permits popcorn because it contains no artificial additives, and many USDA Extension home Economists suggest popcorn as a satisfying family food that is kind to budgets and fun to make. The experts agree. Popcorn is an all-around "good" food — healthy, economical and tasty snack.

### It's Made of Water!

Well, not entirely. But water does play an important part in getting popcorn to pop. You see, water is stored in a small circle of soft starch in each kernel. As the kernel is heated, the water heats, builds up pressure, and eventually, the hard surface surrounding the starch gives way, causing popcorn to explode. The soft starch pops out, the kernel turns inside out, steam inside the kernel is release, and the corn pops.

### It's an Original!

Of the varieties of corn (sweet, dent, flint, pod and popcorn), popcorn is the only corn that pops. And although popcorn has a scientific name, *zea mays everta*, no two kinds of popcorn are alike, Kernels range in color from off-white to light gold, to red, black and many colors in between.

### It's a Bargain!

Besides being friendly to your taste buds, popcorn is friendly to your wallet. For as little as four cents, you can enjoy a quart of popcorn at home. For 13 cents, invite the entire family.

### It's Improved!

Research constantly improves the popcorn we eat! With advances in hybridization, harvesting and processing, today's popcorn pops up nearly double the size of the corn grown 40 years ago. Even though there are more than 100 strains of popcorn grown, the two most popular are snowflake and mushroom. Snowflake produces large, cloud-like kernels, commonly available for home and concession eating. The mushroom variety is smaller and pops into a ball-like shape. It's perfect for confections and coated popcorn treats.

### It's for Everyone!

Tell your friends about popcorn and enjoy it today! This easy-to-make, mouth-watering snack is perfect for all occasions. Enjoy it plain, mixed with dried fruit and nuts or sprinkled with spices. Anyway you top it, it's a winner! Have a creative way of eating popcorn? Share your recipes with the Board. New ideas keep popping up everyday about how to enjoy the tiny kernels loaded with a variety of nutrients and an explosion of great taste.

# A-maize-ing Popcorn

Unscramble these words about a very healthy snack.

- ngrai \_\_\_\_\_
- arstch \_\_\_\_\_
- ergyen \_\_\_\_\_
- uyymm \_\_\_\_\_
- nrcppoo \_\_\_\_\_

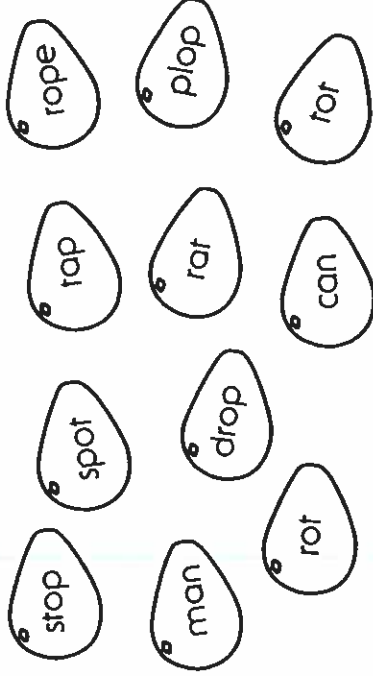
Put these popcorn words in Alphabetical order:

steam, water, hear, kernel, explode, oil, healthy, maize

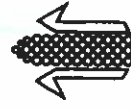
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_

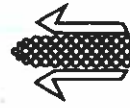
Answers to word scramble:  
woodpecker, energy, yumyum, popcorn grain, starch

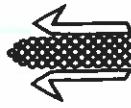
Popcorn pops because a tiny bit of moisture, or water, is inside every tiny kernel. When it gets really hot, BAM! Color all the popcorn pieces that rhyme with **pop** and **hot**.



## Did You Know ...

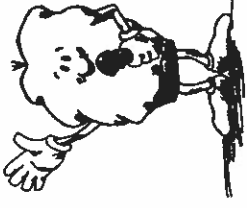
 Every person in America eats about 15 gallons of popped popcorn every year!

 The first breakfast cereal was made by pouring milk and sugar on popcorn. Yum!

 Popcorn only costs about 6¢ per 1 cup serving. Now that's a bargain!

## Jump rope Rhyme

Here's a jump rope rhyme for you to try at home or recess.



Popcorn, popcorn,  
in the pot.

Popcorn popcorn,  
piping hot!

When it's gone,  
please don't pout.

Just make sure that  
you jump out!

P-O-P-C-O-R-R-N

(Jump out when you get to N.)

Write about a time you had popcorn with your family or friends.

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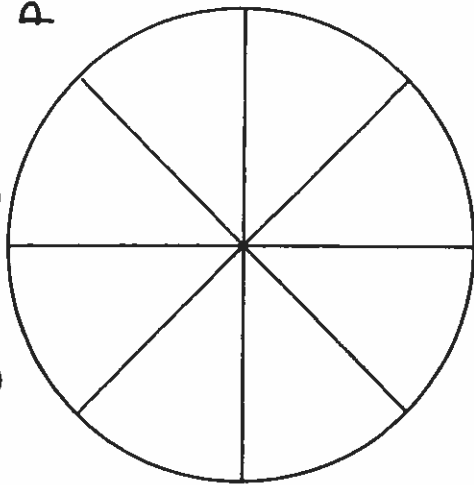
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# A Poppin' Good Time

## Popcorn Pie Graph



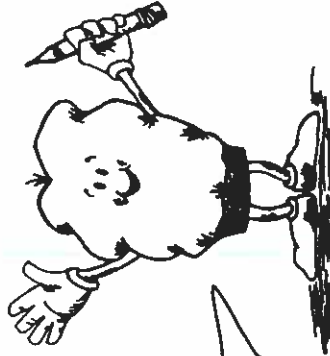
\_\_\_\_\_ = \_\_\_\_\_

\_\_\_\_\_ = \_\_\_\_\_

\_\_\_\_\_ = \_\_\_\_\_



Survey 8 children from your class to see what type of popcorn they like best. Create a graph by making a color-coded key and filling in the sections on the graph.



What kind of popcorn do you like best?

Now, take the results of your survey and write fractions for the numbers.

example:  $\frac{5}{8}$  like cheese popcorn the best.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Solve the problems and fill in the blanks to find out what popcorn kernels have inside.

$$\begin{array}{r} 61 \\ + 17 \\ \hline \end{array}$$

$$\begin{array}{r} 65 \\ - 24 \\ \hline \end{array}$$

$$\begin{array}{r} 83 \\ - 38 \\ \hline \end{array}$$

$$\begin{array}{r} 73 \\ - 48 \\ \hline \end{array}$$

$$\begin{array}{r} 460 \\ + 182 \\ \hline \end{array}$$

$$\begin{array}{r} 527 \\ - 188 \\ \hline \end{array}$$

$$\begin{array}{r} 642 \\ - 283 \\ \hline \end{array}$$

$$\begin{array}{r} 387 \\ - 128 \\ \hline \end{array}$$

$$\begin{array}{r} 749 \\ - 688 \\ \hline \end{array}$$

$$\begin{array}{r} 642 \\ - 559 \\ \hline \end{array}$$

$$\begin{array}{r} 821 \\ - 555 \\ \hline \end{array}$$

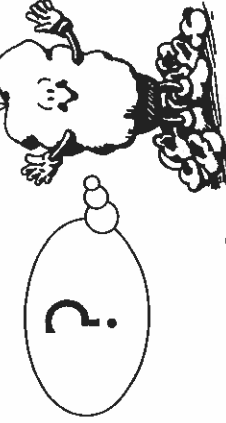
$$\begin{array}{r} 260 \\ - 195 \\ \hline \end{array}$$

65	85	74	61	84	73	64	83	41
T	C	N	S	P	H	L	R	A

Hint: you won't use all the letters.

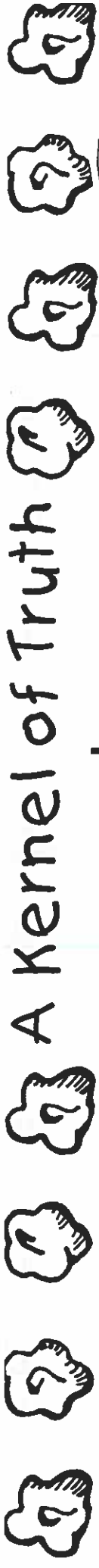
## Popcorn Problems...

- Each child in Mark's class ate 3 bowls of popcorn. There are 19 kids. How many bowls did they eat?
- Diego and four friends had \$20.00 altogether. They spent it on popcorn at the movies. How much did each person spend?
- Anna paid for a bag of popcorn at the movie with a \$5.00 bill. It cost \$2.75. How much was her change?



- Four children bought popcorn for \$2.75. How much did they spend?

3rd & 4th math

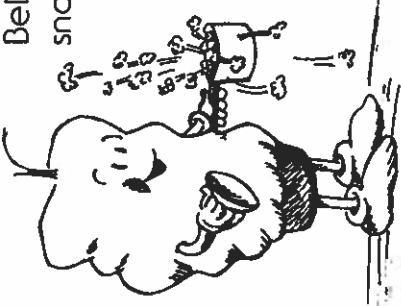


# A Kernel of Truth

Below is a recipe for a delicious popcorn snack. It makes enough for 4 people.

## Sugar Corn Snack

- 1/2 cup unpopped popcorn
- 3 tablespoons white sugar
- 1/4 cup vegetable oil



Heat oil in pan until hot. Add popcorn and sprinkle all of the sugar over it. Cover & shake it continuously until popped.

Now... rewrite the recipe for...

8 people

16 people

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Write 2 equivalent fractions for each amount:

$\frac{3}{4}c = \frac{\quad}{\quad} = \frac{4}{6}c = \frac{\quad}{\quad} =$

$\frac{2}{3}c = \frac{\quad}{\quad} = \frac{2}{8}c = \frac{\quad}{\quad} =$



## Popcorn Problems...

Show your work on the back.

- Dee spent 12.4 minutes making popcorn and 17.6 minutes eating it. How much time did she spend?
- If the sales tax is .06¢, how much would a box of popcorn cost at the movies if the price was \$1.75?
- If Marco goes to the store with \$20.00 and popcorn costs \$1.89, what will his change be?
- If you and your 3 friends each eat 1 3/4 cups of popcorn, how much is that altogether?

## ÷ Division with Remainders ÷

Solve the problems and fill in the blanks to find out what a popcorn hull is made of.

r5	r2	r4	r4	r6	r4	r0	r1	r2	
16÷6=	<input type="text"/>	22÷7=	<input type="text"/>	9÷2=	<input type="text"/>	12÷5=	<input type="text"/>	24÷8=	<input type="text"/>

Look at the remainders & find the matching letters below!

r4	r10	r0	r11	r5	r8	r1	r13	r2	r9	r7	r3	r12	r6
L	N	O	D	C	P	S	T	E	B	K	V	R	U

Hint: You won't use all the letters.

5th-6th math

