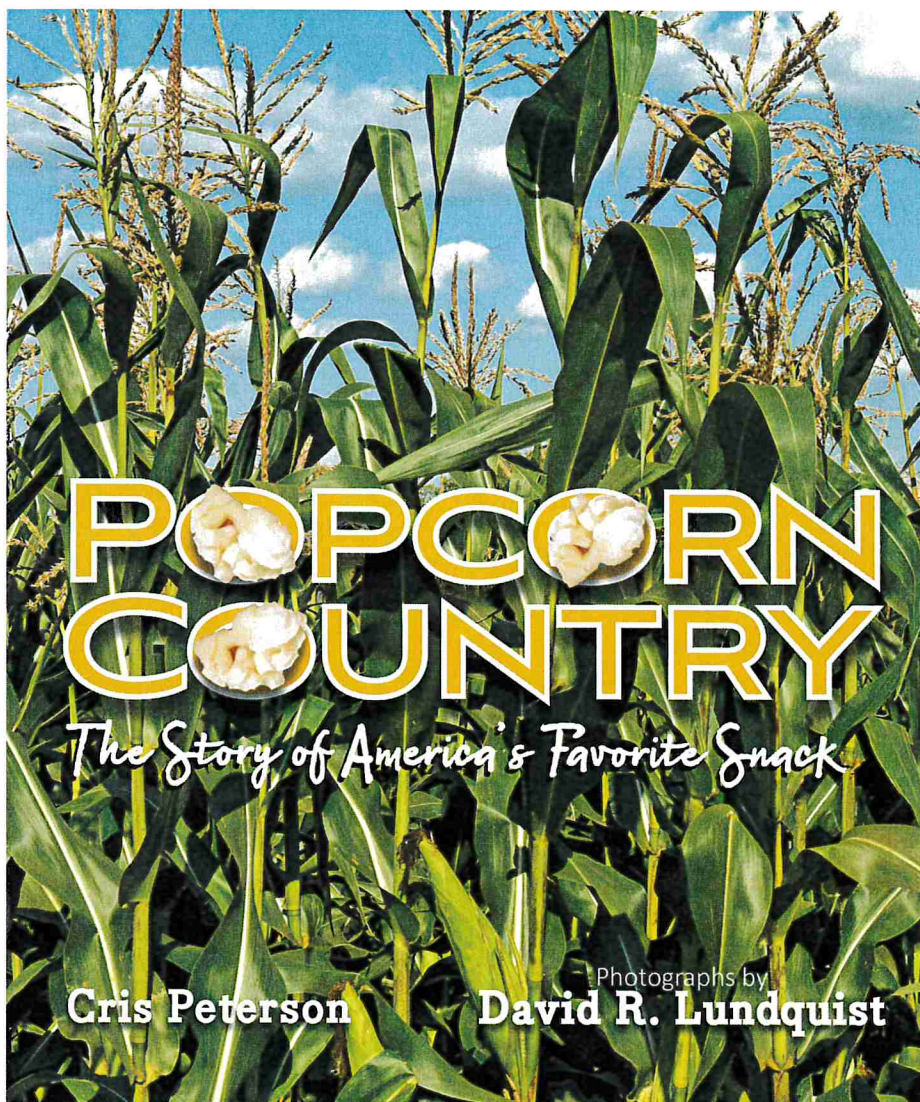


 **Indiana Farm Bureau®**
2020 Book of the Year



Educator Guide

Indiana Agriculture in the Classroom
An educational outreach program of Indiana Farm Bureau, Inc.

www.inaitc.org



Who is Indiana Agriculture in the Classroom?

In Indiana, the Ag in the Classroom program is coordinated by the Indiana Farm Bureau. Members of the organization who are interested in teaching our youth about agriculture serve as volunteers and are provided program materials and lessons to use within their counties. The Indiana Ag in the Classroom program offers lessons and materials to schools, community groups, and other non-profit organizations.

Each year, registered volunteers all across Indiana visit classrooms to teach more than 60,000 students about agriculture through in-class lessons, hands-on activities, educational events, on-farm experiences and field trips.

The Indiana Ag in the Classroom program offers standards-based lessons and materials; to schools, community groups, and other non-profit organizations that wish to integrate agriculture into their curriculum.

Our Mission

To increase agricultural literacy through K-12 education.

Our Vision:

Agriculture is valued by all.

Book of the Year Ag Literacy Program

Program Purpose:

To increase understanding, build awareness and develop a positive public perception of Indiana agriculture through education.

Student Goals:

- Understand how food, fiber and renewable resource products are produced
- Realize that science plays an important role in our food supply and that the scientific advancements in food production are safe, proven and necessary
- Acknowledge and consider career opportunities in the agriculture, food, fiber and renewable resource industries

What is Agricultural Literacy?

A person who understands and can communicate the source and value of agriculture as it affects our quality of life. (National Agricultural Literacy Logic Model, 2013)

The Importance of Ag Literacy

- An increased knowledge of agriculture and nutrition allows individuals to make informed personal choices about diet and health.
- Informed citizens will be able to participate in establishing the policies that will support a competitive agricultural industry in this country and abroad.
- Agriculture is too important of a topic to be taught only to the small percentage of students considering careers in agriculture and pursuing vocational agricultural studies.
- Agricultural literacy includes an understanding of historical and current economic, social and environmental issues that affect all Americans. This understanding includes being knowledgeable about food and fiber production, processing and domestic and international marketing. Employment opportunities abound in agriculture. Career choices include:
 - Agricultural Economist
 - Agronomist
 - Animal Nutritionist
 - Aquaculturist
 - Biochemist
 - Biological Engineer
 - Biometrician
 - Climatologist
 - Ecologist
 - Entomologist
 - Florist
 - Food Process Engineer
 - Food Scientist
 - Forest Engineer
 - Horticulturist
 - Hydrologist
 - Molecular Biologist
 - Nanotechnologist
 - Nematologist
 - Plant Pathologist
 - Remote Sensing Specialist
 - Soil Scientist
 - Toxicologist
 - Turf Scientist
 - Veterinarian
 - Viticulturist
 - Wildlife Biologist



Popcorn Country: The Story of America's Favorite Snack

Meet the author- Cris Peterson

Cris Peterson is a dairy farmer and writer from Grantsburg, Wisconsin. Born and raised in Minneapolis, Minnesota, she earned a B.S. in Education from the University of Minnesota before marrying her husband, Gary, and moving to the farm.

In partnership with their son, Ben, they have operated Four Cubs Farm near Grantsburg for the past 45 years. They milk 1000 cows with 16 robots. The farm has been in the Peterson family since 1877.

Cris has written twelve books for children. She also wrote a nationally syndicated newspaper column on literacy for Universal Press for eight years. An overriding theme of all her work involves proactively promoting agriculture and working to overcome public misperceptions about how food is produced.

Cris has chaired Wisconsin's Dairy 2020 Council, has served on the Wisconsin Dairy Business Association board, the International Dairy Foods Association advisory board and was named the 2004 National Dairywoman of the Year. Currently she serves on the University of Wisconsin System Board of Regents, is president of Grantsburg's scholarship foundation and treasurer of Grantsburg Revitalization Operation, working to develop strategies to revitalize her community.

For more information about Cris Peterson visit <http://crispeterson.com/>.

Popcorn Country: The Story of American's Favorite Snack

Glossary

Source: Popcorn Country & National Agriculture in the Classroom Curriculum Matrix.

Corn Belt: the area of the United States where corn is the predominant crop grown, twelve states make up the Corn Belt (Indiana, Illinois, Iowa, Ohio, Michigan, Wisconsin, Minnesota, South Dakota, Nebraska, Kansas, Missouri, Kentucky)

acre: the unit of measure for land in the United States, equals to 43,560 square feet or about the size of a football field

dent corn: (also called field corn) mainly grown to feed livestock

livestock: animals raised to produce commodities such as food and fiber (i.e. cattle, sheep and hogs)

ear(s): female part of a corn plant that contains the cob, the silks, and the eggs that will become kernels

kernel(s): the seed of a corn plant and the part that we eat

sweet corn: is the type of corn we eat right off the cob, for human consumption

flint corn: is a type of corn with a multitude of colors

popcorn: is a type of corn that must be popped before it can be consumed

roots: a plant part reaching into the ground pulling moisture and nutrients into the plant

nutrient: a substance that provides nourishment essential for growth and maintenance of life

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

husks: dry leaves covering the ears of corn

grain tank: collects the kernels once shelled from the cobs, located at the top of the combine

Popcorn Country: The Story of American's Favorite Snack Discussion Questions

Prior to reading

Connect: What is one fact you already know about popcorn?

Compare/Contrast: Have you ever read, watched or heard anything about popcorn?

Predict: What do you think the book will be about based on the title? What do you think the book will be about based on the pictures?

Evaluate: Why do you think popcorn is important to learn about?

During the reading

Summarize: What is the most interesting detail in the book? Why do you think it is interesting?

Connect: What is a fact that you have read within the book that you already knew about?

Compare/Contrast: Does the book remind you of any other books you have read? How is this book similar? How is this book different?

Visualize: Pick a picture from the book, why do you think the author chose to include it within the book?

Infer: What do you think the author believes but does not actually state within the book? What makes you think that she believes that?

Identify: Identify a word you are unfamiliar with. Use context clues to write a definition.

Evaluate: Can you find any opinions within the book, or is it just facts? Do you agree with this opinion? Why?

After the reading

Purpose: What was the author's purpose in writing this book? Do you think the author was persuading, informing, or entertaining?

Summarize: What is the main point of this book? (use one sentence)

Connect: How does the process of popcorn relate to your everyday life?

Compare/Contrast: What is another topic you have read that has something in common with Popcorn Country?

Predict: Form a question about popcorn; What would happen if...?

Infer: Why do you think it was important to read about popcorn?

Identify: Is there a problem identified by the author? What are some solutions to this problem?

Evaluate: What could be a new title for this book? Why do you think this new title would work for this book? If you could ask the author one question, what would it be?

Popcorn Country: The Story of American's Favorite Snack Related Activities

Activity: Scoot

Grade Level: 2nd – 4th grade

Goal: To review information gained from reading the book, *Popcorn Country: The Story of American's Favorite Snack*

Indiana Learning Standards:

2 nd Grade	3 rd Grade	4 th grade
English/Language Arts		
Reading: Nonfiction – Key Ideas and Textual Support 2.RN.2.1 Ask and answer questions about the main idea and supporting facts and details in a text to confirm understanding.	Reading: Nonfiction – Key Ideas and Textual Support 3.RN.2.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.	Reading: Nonfiction – Key Ideas and Textual Support 4.RN.2.2 Determine the main idea of a text and explain how it is supported by key details; summarize the text.
Social Studies		
Standard 4 — Economics 2.4.7 Define specialization and identify specialized jobs in the school and community. 2.4.8 Explain why people trade for goods and services and explain how money makes trade easier.	Standard 3 — Geography 3.3.2 Label a map of the Midwest, identifying states, major rivers, lakes and the Great Lakes. 3.3.9 Describe how climate and the physical characteristics of a region affect the vegetation and animal life living there. Standard 4 – Economics 3.4.2 Give examples of goods and services provided by local business and industry.	Standard 4 – Economics 4.4.1 Give examples of the kinds of goods and services produced in Indiana in different historical periods.

Materials:

- The book: *Popcorn Country: The Story of American's Favorite Snack*
- Scoot Recording Sheet (Print enough for students in class) (found in resource section)
- Scoot Recording Sheet (Answers) (found in resource section)
- Scoot Cards (found in resource section)

Directions: This is a fun class activity to review information gained from the reading of *Popcorn Country*! Students will be traveling in a rotation to different desks to answer questions.

1. Create, cut out, and laminate the Scoot cards. There are 24

- included, but use as many as you need for your class.
2. Make enough copies of the Scoot Recording Sheet for your students.
 3. Set one card on each student's desk or tape cards around the room! (the game runs smoother if the cards are laid out in order)
 4. Give each student a recording sheet. (Use clip boards to make it more official!)
 5. Explain to the students that they will be moving around the room to answer a question pertaining to the book, *Popcorn Country*. They record their answer by looking at the number on the card and matching it to the number on their Scoot Recording Sheet. So if a student starts with #10 question, they will record their answer in box #10. (This is why it's helpful to put the cards in order. It will be easier for them to record their answers if they know the next card is one number higher)
 6. After enough time has passed to allow students to answer the question on the card, you say "SCOOT" and the students will move to answer another question. (remind students, one student per question and don't move until you hear the word "Scoot")

**This activity was presented at the Indiana Farm Bureau State Convention by
District Education & Outreach Coordinator, Cindy Ramsey.**

Popcorn Country: The Story of American's Favorite Snack Related Activities

Activity: I Have Who Has

Grade Level: 2nd – 4th grade

Goal: To answer information and identify key vocabulary words gained from reading the book, *Popcorn Country: The Story of American's Favorite Snack*

Indiana Learning Standards:

2 nd Grade	3 rd Grade	4 th grade
English/Language Arts		
<p>Reading: Nonfiction – Key Ideas and Textual Support 2.RN.2.1 Ask and answer questions about the main idea and supporting facts and details in a text to confirm understanding.</p> <p>Reading: Vocabulary – Vocabulary Building 2.RV.2.1 Use context clues and text features to determine the meanings of unknown words</p>	<p>Reading: Nonfiction – Key Ideas and Textual Support 3.RN.2.1 Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.</p> <p>Reading: Nonfiction – Structural Elements and Organization 3.RN.3.1 Identify how a nonfiction text can be structured in indicate a problem and solution or to put events in chronological order</p> <p>Reading: Vocabulary – Vocabulary Building 3.RV.2.1 Apply context clues and text features to determine the meanings of unknown words</p>	<p>Reading: Nonfiction – Key Ideas and Textual Support 4.RN.2.1 Refer to details and examples in a text when explaining what a text says explicitly and when drawing inferences from the text</p> <p>4.RN.2.2 Determine the main idea of a text and explain how it is supported by key details; summarize the text.</p>

Materials:

- The book: *Popcorn Country: The Story of American's Favorite Snack*
- I Have Who Has Cards (found in resource section)

Directions:

1. This is an easy-to-play game that is a great way to review and learn more about Popcorn Country. As students match up the answers on their cards with questions on other student's cards, they get valuable practice with vocabulary and listening skills.
2. Hand a card to each student. Some students may need to have two cards depending upon how many are in a set. It is

- imperative to use all the cards in the set.
3. The student to go first should have the card "I Have...Popcorn Country. Now, they read Who Has an area of land from Ohio to Nebraska that grows corn?
 4. Then the student with the card that answers the question responds. Every card in the set is connected to a card before it and a card after it. To keep the game moving at a quick pace, all students need to pay attention to every question that is asked.
 5. Play continues in this fashion until all of the cards have been played. The game will end with the student who states "The End".

**This activity was presented at the Indiana Farm Bureau State Convention by
District Education & Outreach Coordinator, Jan Bohling.**

Popcorn Country: The Story of American's Favorite Snack Related Activities

Activity: Task Cards

Grade Level: 2nd – 4th grade

Goal: Discover more about the popcorn industry while using role play activities

Indiana Learning Standards:

2 nd Grade	3 rd Grade	4 th grade
English/Language Arts		
Speaking and Listening: Discussion and Collaboration 2.SL.2.3 Listen to others, take one's turn in respectful ways, and speak one at a time about the topics and text under discussion Speaking and Listening: Comprehension 2.SL.3.2 Ask and answer questions about what a speaker says to clarify comprehension, gather information, or deepen understanding of a topic or issue	Speaking and Listening: Discussion and Collaboration 3.SL.2.4 Ask questions to check understanding of information presented, stay on topic, and link comments to remarks of others.	Speaking and Listening: Discussion and Collaboration 4.SL.2.3 Demonstrate knowledge and use agreed-upon rules for discussions and carry out assigned roles

Materials:

- Task Cards (found in resource section)
- Props for reporter (camera, recorder, reporter's pad of paper, pen/pencil)
- Props for a popcorn farmer (hat, gloves)
- Props for a popcorn processor (hat, safety glasses)

Directions:

1. This is a role play activity where students will take upon the task as dressing as one of the characters listed (reporter, farmer, processor)
2. Student, who is acting as the reporter, will ask the questions listed on the task cards.
3. Student, who is acting as the farmer and/or processor, will follow

- the answers on the task cards.
4. Acting may or may not be added to enhance the overall presentation.
 5. Presentation may take place in-front of class or serve as a center station during the day.
 6. The purpose of these cards is to learn more about the process of popcorn as an extension of the book, *Popcorn Country*.

**This activity was presented at the Indiana Farm Bureau State Convention by
District Education & Outreach Coordinator, Janis Highley.**

Popcorn Country: The Story of American's Favorite Snack Related Activities

Activity: Popcorn, Pop Open The Taste Buds

Grade Level: 2nd – 5th grade

Goal: To survey students their favorite popcorn flavors and to create a graph to show results

Indiana Learning Standards:

2 nd Grade	3 rd Grade	4 th grade	5 th Grade
Mathematics			
<p>Data Analysis 2.DA.1 Draw a picture graph and a bar graph to represent a data set with up to four choices. Solve simple put-together, take-apart, and compare problems using information presented in the graphs.</p>	<p>Data Analysis 3.DA.1 Create scaled picture graphs, scaled bar graphs, and frequency tables to represent a data set – including data collected through observations, surveys, and experiments-with several categories.</p>	<p>Data Analysis 4.DA.1 Formulate questions that can be addressed with data. Use observations, surveys, and experiments to collect, represent, and interpret the data using tables, line plots, and bar graphs.</p>	<p>Data Analysis 5.DS.1 Formulate questions that can be addressed with data and make predictions about the data. Use observations, surveys, and experiments to collect, represent, and interpret the data using tables, line plots, bar graphs, and line graphs. Recognize the differences in representing categorical and numerical data.</p>

Materials:

- Samples of three varieties of popcorn (for example: kettle corn, cheddar cheese popcorn, white cedar popcorn, butter popcorn, simply popcorn, chocolate drizzle popcorn, plain popcorn)
- Three bags of popcorn labeled as #1, #2, #3 (keep a key to which flavor is associated with each bag)
- Small cups to serve samples
- Post-it notes or small pieces of paper to take tasting notes
- White board, large poster board or graph paper for students
- Optional: Apples to cleanse the palette after each favor

Directions:

This activity is designed for students to conduct a survey to discover their favorite flavor of popcorn.

Steps:

1. Introduce to the students how many different flavors of popcorn are available!
2. Instruct students of the two basic shapes of popcorn, snowflake and mushroom.
 - a. Snowflake is used in movie theaters and ballparks because it appears to be bigger in shape.
 - b. Mushroom is used for candy confections because of an increase in surface area which decreases the popcorn to crumble.
3. Choose three flavors (more if time allows).
4. Place chosen flavors into large plastic bags, label as Sample #1, Sample #2, Sample #3 (etc.)
5. Provide sample cups or place napkins out on student desks as samples are distributed.
6. Instruct students they are going to taste each sample. They will need to determine which flavor they enjoy the most, and then place as 1st, 2nd, and 3rd.
7. Pass out post-it notes or small pieces of paper. Instruct students to write down observations of each flavor (sweet, salty, crunchy, smooth, buttery, plain)
8. The use of an apple or apple slices serves as a cleansing agent to the palette in-between flavors. This does not have to be conducted but it does give the “tasting lab” a more scientific feel.
9. Pass out flavor #1. Taste. Observe
10. Repeat for flavors #2 and #3.
11. Instruct students to rank popcorn samples in order as 1st, 2nd, 3rd.
12. Take a poll from the entire classroom. Sample #1 total first place votes, Sample #2 total of first place votes, Sample #3 total first place votes.
13. Construct a graph to display the winning flavors within your classroom. The Y-axis will be labeled as number of first place

votes. The X-axis will be labeled as Sample 1, Sample 2, and Sample 3 (etc.).

14. Shade in the columns to show flavor choices.
15. Option: Have students build their own graphs at their tables.
16. Option: Take a survey on different methods of preparing popcorn (use the same variety of popcorn - microwave, kettle over stovetop, air-popped)
17. Option: Hold a classroom discussion about how different our taste buds prefer flavors. Is the flavor we choose more popular because of our previous experiences (only exposed to butter flavor at movie theaters, only certain flavors are served at home)
18. Option: Assign the students a writing activity to express their favorite popcorn flavor.
19. Option: Take a school-wide survey. Check out the Popcorn Pep Club Contest (<https://www.popcorn.org/Learn/For-Teachers/Popcorn-Pep-Club-Contest>).

**This activity was presented at the Indiana Farm Bureau State Convention by
District Education & Outreach Coordinator, Melba Loyd.**

Popcorn Country: The Story of American's Favorite Snack Related Activities

Activity: Dancing Popcorn

Grade Level: 2nd – 5th grade

Goal: To explore science experiment with popcorn and the reaction between a base and acid

Indiana Learning Standards:

2 nd Grade	3 rd Grade	4 th grade	5 th Grade
Science			
Physical Science 2.PS.1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.	Physical Science 3.PS.1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. Engineering 3-5.E.3 Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	Physical Science 4.PS.4 Describe and investigate the different ways in which energy can be generated and/or converted from one form of energy to another form of energy. Engineering 3-5.E.3 Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	Physical Science 5.PS.1 Describe and measure the volume and mass of a sample of a given material. Engineering 3-5.E.3 Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Materials:

- 1 clear drinking glass (glass or plastic) (glass pint canning jar works best)
- Water
- Popcorn kernels – enough to cover the bottom of the glass
- ½ cup white vinegar
- 1 tablespoon baking soda
- *A pan or dish to set the glass in. Liquid will rise above the top of the glass.

Directions:

Interest Approach

- What will happen when the popcorn is added to the glass of water?
 - (kernels will sink/float, kernels will swell/crack)
- What will happen when the vinegar is added to the glass?
 - (Will air-bubbles form? Will vinegar mix with the water?)
- What will happen when the baking soda is added?
 - (Is there a chemical reaction between vinegar and baking soda?)

Steps:

Experiment

1. Fill the glass cup/jar half full with water.
2. Pour the popcorn into the glass. Make sure you place enough popcorn kernels to cover the bottom of the glass cup. Observe.
3. Pour the vinegar into the glass. Observe.
4. Add the baking soda to the glass. Observe.

Teacher Notes:

There is no reaction in steps 1 & 2. When the vinegar is poured into the water and popcorn, the kernels will move around. But, there will not be an initial reaction. Vinegar is an acid and baking soda is a base, this will cause a reaction. Once the baking soda is added, you will quickly see a reaction. There are three things that will occur: acid, water and carbon dioxide. The carbon dioxide gets trapped under the popcorn kernels; it will stick to the kernels and make each kernel to rise. As the bubbles pop, the popcorn will descend until more gas is trapped under the kernel and causes it to rise again.

This reaction may continue for several minutes.

Additional Discussion Questions:

1. What are the variables within the experiment?
 - a. Possible variables - amount of water, amount or moisture % of popcorn, amount of vinegar, amount of baking soda, shape/size of container, temperature of water

2. How can you change the variables?
3. How can the variables make a difference in the reaction between the base/acid?

Additional Options:

Have students conduct the experiment within small groups while they change variables.

Have students record time reaction once the baking soda is added.

Have students keep an observation log.

Change the amount of water, vinegar or baking soda added.

**This activity was presented at the Indiana Farm Bureau State Convention by
District Education & Outreach Coordinator, Marla Storm.**

Popcorn Country: The Story of American's Favorite Snack Related Activities

Activity: Get Popping! (from National Ag in the Classroom; Get Popping lesson and kit)

Grade Level: 3rd – 6th grade

Goal: To explore how popcorn pops

Indiana Learning Standards:

3 rd Grade	4 th Grade	5 th grade
Science		
<p>Physical Science 3.PS.1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object</p> <p>Engineering 3-5.E.2 Construct and compare multiple plausible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5.E.3 Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</p>	<p>Physical Science 4.PS.4 Describe and investigate the different ways in which energy can be generated and/or converted from one form of energy to another form of energy. 4.PS.5 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.</p> <p>Engineering 3-5.E.2 Construct and compare multiple plausible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5.E.3 Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</p>	<p>Physical Science 5.PS.4 Describe the difference between weight being dependent on gravity and mass comprised of the amount of matter in a given substance or material.</p> <p>Engineering 3-5.E.2 Construct and compare multiple plausible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5.E.3 Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.</p>

Materials: (all materials can be purchased through the National Ag in the Classroom store with the Get Popping Kit)

- Get Popping Lesson found on the National Ag in the Classroom Matrix
- Get Popping! video
(<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 video
(<https://www.youtube.com/watch?v=FSZd33awqQk>)

Directions:

Safety Notes: There are risks involved when using an open flame and glass test tubes. Consider reviewing the [Get Popping! Video](#) before you demonstrate this activity with the students. The following safety procedures should be practiced when performing the investigations in *this lab*:

- 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

Steps

1. Students should have observed steam as part of the *Interest Approach – Engagement* activity found in the “Get Popping!” lesson plan. 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, a 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 at 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 students 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 balloon expand and eventually burst. (*As the water was heated and changed from liquid to gas (steam), the molecules in 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](#) 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 so 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 their 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.

This activity was presented at the Indiana Farm Bureau State Convention by District Education & Outreach Coordinator, Margaret Gladden and Julie Gollither.

Popcorn Country: The Story of American's Favorite Snack Related Activities

Activity: Can it Pop?

Grade Level: 3rd – 5th grade

Goal: To evaluate pop-ability of popcorn kernel samples

Indiana Learning Standards:

3 rd Grade	4 th Grade	5 th grade
Mathematics		
Measurement 3.M.1 Estimate and measure the mass of objects in grams (g) and kilograms (kg) and the volume of objects in quarts (qt), gallons (gal), and liters (l). Add, subtract, multiply, or divide to solve one-step real-world problems involving masses or volumes that are given in the same units	Measurement 4.M.2 Know relative sizes of measurement units within one system of units, including km, m, cm; kg, g; l ml; hr, min, sec. Express measurement in a larger unit in terms of a smaller unit within a single system of measurement. Record measurement equivalents in a two-column table.	Measurement 5.M.1 Convert among different-sized standard measurement units within a given measurement system, and use these conversions in solving multi-step real-world problems.
Science		
Engineering 3-5.E.2 Construct and compare multiple plausible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5.E.3 Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	Engineering 3-5.E.2 Construct and compare multiple plausible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5.E.3 Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	Engineering 3-5.E.2 Construct and compare multiple plausible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5.E.3 Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Materials:

- 100 popcorn kernels
- Glass beaker or canning jar
- Balance scale (for mass measurement principles)
- Data sheet (found in resource section)
- Air-popper or electric popper (some catalyst to pop kernels)
- Bowl

Directions:

This activity is designed to calculate the pop-ability of a sample of popcorn kernels

Steps:

1. Obtain 100 popcorn kernels
2. Obtain a glass beaker and determine mass of beaker. Record in Data Sheet
3. Place kernels into a clean, dry glass beaker
4. Determine the mass of the beaker and kernels. Record in Data Sheet
5. Place popcorn kernels into air-popper and start popping. Remember to have a bowl to collect popped popcorn.
6. Once popcorn has finished popping, turn-off popper.
7. Determine the number of popped and unpopped kernels. Record in Data Sheet
8. Determine the mass of unpopped kernels and beaker. Record in Data Sheet

Optional Steps:

1. Change the method of popping to determine if the air-popper is the best choice.
2. Use different brands of popcorn or compare between yellow and white popcorn kernels.
3. Calculate percentage of trials conducted within the classroom.
4. Try a pop-ability test on different kinds of corn like field corn or flint corn.

Teacher Discussion Questions:

1. Is the popping of corn a physical or chemical change?
2. Describe any changes observed in the kernels as a result of popping?
3. Based on your observations and the data you collected, develop a hypothesis explaining why popcorn pops.
4. How might kernels lose moisture? Can they gain moisture?
5. How might the popping ability of a cracked or punctured kernel be affected?

**This activity was presented at the Indiana Farm Bureau State Convention by
District Education & Outreach Coordinator, Sheryl Seib.**

Popcorn Country: The Story of American's Favorite Snack Related Activities

Activity: Simple Mixture

Grade Level: 2nd – 3rd grade

Goal: To observe mixture and how particle segregation affects placement of materials.

Indiana Learning Standards:

2 nd Grade	3 rd Grade
Science	
Physical Science 2.PS.1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. 2.PS.4 Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.	Physical Science 3.PS.1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

Materials:

- 1 6 oz glass jar and lid (16 mason jar, lid, and ring works best)
- 1 Cup table salt
- 1/4 Cup popcorn kernels
- See Simple Mixture picture in the Resources section located at the end of the educator guide

Directions:

1. Pour the salt & popcorn kernels into the jar and seal with the lid.
2. Roll the jar on a flat surface so the salt and popcorn mix together.
3. Turn the jar upright and gently tap in on a flat surface. Watch what happens to the popcorn.

Teacher Notes:

- Does the popcorn and salt stay mixed?
- What is Particle Segregation?
- Salt grains are smaller than popcorn kernels. Salt fills in the spaces between the popcorn kernels.
- The solution is the size of the material determines. Smaller grains (salt) can move more easily past the salt, but the larger grains (corn) cannot slip through the salt

**This activity was presented at the Indiana Farm Bureau State Convention by
District Education & Outreach Coordinator, Aleta Crowe.**

Popcorn Country: The Story of American's Favorite Snack

A guide for students to follow while they are reading through the book

<p>What is the first step in growing popcorn?</p>	
<p>What is required for popcorn to grow?</p>	
<p>Where do popcorn kernels go once they are harvested?</p>	
<p>What are the steps the kernel takes while in the processing plant?</p>	
<p>How does the popcorn kernel pop?</p>	
<p>What is the final step for popcorn?</p>	

Popcorn Country: The Story of American's Favorite Snack

A guide for students to follow while they are reading through the book

What is the first step in growing popcorn?	Possible answers: popcorn seeds are planted in April or early May. The seeds are placed in straight rows.
What is required for popcorn to grow?	Possible answers: Rainfall. Twenty-five inches of rainfall. Sunshine. Moisture. Nutrients.
Where do popcorn kernels go once they are harvested?	Possible answers: Giant mechanical harvesters collect kernels. Grain tank. Trucks haul to a processing facility.
What are the steps the kernel takes while in the processing plant?	Possible answers: Trucks unload into bins, popcorn is conditioned or dried, conveyor that shakes the broken kernels and pieces of corn cob, vibrating gravity table with fans, only "just right" kernels stay on the machine, electronic eye checks for color, pop-ability test, packing, shipping
How does the popcorn kernel pop?	Possible answers: The kernel is heated up in hot oil. The moisture turns into steam. The steam builds up inside the popcorn causing the popcorn to pop.
What is the final step for popcorn?	Possible answers: Shipped all over the world. Enjoyed as a favorite snack.

Popcorn Country: The Story of American's Favorite Snack

Related Lessons and Activities

Search the National Agriculture in the Classroom Curriculum Matrix for these great resources! www.agclassroom.org/teacher/matrix/ or click on the title of each if viewing online.

Popcorn Country: The Story of American's Favorite Snack

To learn more about author, Cris Peterson, visit her website:
<http://crispeterson.com/>

LESSONS

[Get Popping!](#) This lesson will allow students to discover how popcorn is grown and learn more about how popcorn pops.

[Inherited Traits in the Living Corn Necklace \(Grades 3-5\)](#) This lesson will provide students the opportunity to learn and observe the growth of corn.

[Inherited Traits in the Living Corn Necklace \(Grades 6-8\)](#) Students will discuss heredity and observe similarities and differences between two varieties of corn.

[Corn an A-maizing Plant: Food, Fuel, and Plastic](#) Students learn growth, plant parts, and uses of corn through reading activities.

Popcorn Country: The Story of American's Favorite Snack Suggested Reading & Companion Resources

BOOKS

Popcorn! By Elaine Landau

This book is full of popcorn information from history to the science of how it pops. It also contains recipes and cooking tips.

The Popcorn Book By Tomie dePaola

This is a story of two boys, Tiny and Tony, who are hungry for a snack. The boys are also brothers make popcorn and learn about how much popcorn is consumed on annual basis. There are two recipes included.

Popped Culture: A Social History of Popcorn in America by Andrew F. Smith

This is a very detailed culinary biography of popcorn. It covers popcorn history with well-documented of how popcorn was introduced and became a cultural icon.

The Popcorn Astronauts and other Biteable Rhymes by Deborah Ruddell

This is a book full of poems showcasing the seasons throughout the year. Students will enjoy each of the poems as they learn more about everyday food.

KITS

Popcorn on the Cob

This is a kit located at the National Ag in the Classroom store. The kit contains popcorn on the cob and a paper bag. This allows students to witness how popcorn pops right off the cob.

Get Popping!

This kit is highlighted within this educator guide. It is located at the National Ag in the Classroom store. The kit provides learners to investigate how popcorn pops!

Farming in a Glove (Corn Seeds)

This kit made available at the National Ag in the Classroom store. This will allow for students to watch corn sprouts grown. Great kit for observations!

Popcorn Country: The Story of American's Favorite Snack Resources

Scout Recording Sheet (Print enough for students in class)

Scout Recording Sheet (Answers)

Scout Cards

Name: _____

SCOOT RECORDING SHEET

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	

Name: _____

SCOOT RECORDING SHEET

1 Popcorn	2 Flint Corn	3 Dent Corn	4 Sweet Corn	5 Corn Belt
6 Acres of corn grown	7 True	8 April through May	9 Twenty-five inches	10 20 + 000 + 000
11 Combine	12 Husks	13 One hundred sixty million	14 An acre	15 Grain bins
16 Broken kernels and pieces of corn cob	17 Electronic eye	18 Pop-ability test	19 Converts into steam	20 Moisture or water
21 The kernel explodes	22 Movie theater	23 True	24 United States	

1 America's
Favorite
Snack

2 Type of corn
sometimes
called Indian
corn

3 Type of corn
mainly grown
for livestock
feed

4 Type of corn,
we eat for
dinner

5 Area of land
that stretches
from Ohio to
Nebraska

6 90 Million
Acres in the
United States

7 (*true or false*)
Popcorn is
grown like
other corn

8 Planting
Season of
Popcorn

9 Amount of
rainfall
required for
popcorn

10 Write the
expanded
form of twenty
million

11 Large machine
separating ears
of corn from
plant

12 Dry leaves
covering the
ears of corn

13

Write the
written form of
160,000,000

14

The size of a
football field

15

Large cylinder
shapes that hold
corn while it is
being dried

16

What can fall from
the screen as
popcorn travels
through the
processing room?

17 What tool is used
to check for
uniform popcorn
kernel color?

18 Test used to make
sure popcorn
contains the right
amount of moisture

19 What will
happen to water
when it is
heated?

20 Secret
ingredient inside
a popcorn
kernel

21 What happens
when pressure
builds and builds
inside a popcorn
kernel?

22 A popular
place that
sells buttery
popcorn.

23 *(true or false)*
Popcorn can be
packaged in
microwave bags.

24 What country
produces nearly
all the world's
popcorn?

I Have Who Has Cards:

I have

POPCORN
COUNTRY

Who has

an area of land from
Ohio to Nebraska that
grows corn?

I have

CORN BELT

Who has

amount of acres in
the United States that
is used to raise corn?

I have

NINETY
MILLION

Who has

the type of corn
mainly grown to feed
livestock?

I have

DENT CORN

Who has

the type of corn we
eat right off the cob?

I have

SWEET CORN

Who has

the type of corn
known for its
multitude of colors?

I have

FLINT CORN

Who has

the time period when
popcorn seeds are
typically planted?

I have

SPRING

Who has

the time period when
popcorn is harvested?

I have

FALL

Who has

a plant part reaching
into the ground pulling
moisture and nutrients
into the plant?

I have

ROOTS

Who has

the amount of rainfall
to grow a crop of
popcorn?

I have

TWENTY-FIVE
INCHES

Who has

a mechanical
harvester that
separates the ears of
corn from the plant?

I have

COMBINE

Who has

location which the
popcorn travels after
harvesting?

I have

PROCESSING
FACILITY

Who has

a tool where the corn
grain dances across
separating broken
kernels?

I have

SCREEN

Who has

a device that checks
for uniform color?

I have

ELECTRONIC
EYE

Who has

the outside of the
kernel?

I have

HULL

Who has

the secret ingredient
inside the popcorn
kernel?

I have

MOISTURE

Who has

the result of water
being heated?

I have

STEAM

Who has

the reaction of steam
building up inside the
kernel?

I have

PRESSURE

Who has

the answer to the
result of pressure
building up inside the
kernel?

I have

EXPLODES

Who has

the test popcorn
must pass?

I have

POP-ABILITY

Who has

an example of how
popcorn is packaged?

I have

ONE-TON
TOTE BAGS

Who has

a location where
totes are loaded onto
container ships?

I have

GREAT LAKES

Who has

a country where
nearly all the world's
popcorn is produced?

I have

UNITED
STATES

Who has

a result of a fresh
batch of popcorn
popping?

I have

IRRESISTIBLE
AROMA

Who has

a common location
where you can order
a bucket of buttery
popcorn?

I have

MOVIE
THEATER

Who has

the amount of
popcorn Americans
consume each year?

I have

FOUR AND A
HALF BILLION
GALLONS

Who has

one of America's
favorite snacks?

I have

POPCORN

Who has

THE END

Task Card

Interview Popcorn Farmer

Reporter Introduction: Hi, my name is _____. I am a reporter from News Channel 47. Today, we will be learning about popcorn from a local farmer.

Question #1: How is a popcorn plant different from other types of corn plants?

Answer: Popcorn plants do not get as tall as field corn plants. The tassel of a field corn plant will appear upright, while the tassel of a popcorn plant will appear to droop. The popcorn plant produces the smallest ear of all types of corn.

Question #2: Is the popcorn kernel different from the corn we eat?

Answer: The popcorn kernel shape looks like a tear-drop. The popcorn kernel is the smallest in size amongst the types of corn. Other corn types will appear to be flat and take a diamond shape. Field corn will also have a dent located at the top of the kernel. As field corn dries it becomes indented, this is why we call it dent corn. All corn kernels have three basic parts, the pericarp, the germ, and the endosperm. The pericarp is the hard, outer shell surrounding the kernel. Inside the kernel is the germ and endosperm. The germ is the seed embryo. The endosperm contains trapped water and starch. The popcorn kernel has a very hard pericarp. The popcorn kernel must hold at least 14% moisture (water) inside the endosperm in-order to pop.

Question #3: Do you use the same machinery for popcorn?

Answer: Yes, we use the same planter and combine. The planter in the spring is used to plant the seed. We do have to make adjustments to the planter as the popcorn seed is a different size. In the fall, we also have to make adjustments to the combine. We must take time to set machinery to reduce damage on the kernels during harvesting. If there is any damage such as a scratch on the kernels, they will not pop. We also have to take time to cleanout machinery because popcorn is a food-grade crop.

Question #4: Why do you raise popcorn?

Answer: We grow popcorn to add diversity to our farming operation. It provides a potential premium which means a higher income over field corn. It works great because we don't have to add any new equipment. It may take time with extra cleaning, but it is rewarding to see the final use. Don't you enjoy American's favorite snack, popcorn?

Task Card

Interview Popcorn Processor

Reporter Introduction: Hi, my name is _____. I am a reporter from News Channel 47. Today, we will be learning about how popcorn is processed from a plant manager.

Question #1: What are the steps that a kernel of popcorn takes once it reaches the processing facility?

- The popcorn kernel will be unloaded into a bin where it is conditioned to the right moisture. Conditioning is a drying process.
- Then the kernel travels by conveyor to the processing room where it is screened. This step will sort out things such as broken kernels and pieces of the cob.
- The next step for the kernel is to travel to the gravity table for additional cleaning and sizing.
- Now the kernel moves by an electronic eye that checks for any discolored kernels.

Question #2: Are there additional tests a popcorn kernel must pass before it can be packaged?

- One of the most important tests is for moisture. Moisture is checked again to make sure it is still at the correct moisture for popping.
- Another test is the Pop-ability test. The kernels are popped and then poured into a tube to measure volume and if there are unpopped kernels they must be counted.
- Once the kernels have passed all of the quality tests, they are ready to be packaged.

Question #3: What is an interesting fact about popcorn?

Answer: All popcorn is GMO Free. That means all popcorn is not genetically modified.

Question #4: Are there different shapes of popped popcorn?

Answer: Yes, there are snow-flake and mushroom shapes. The snow-flake shape is popular in movie theaters and microwave popcorn packages. The mushroom shape is used for candy drizzle or chocolate coatings.

Can it Pop?

Data Sheet

Student Name(s): _____

Provide the following information while conducting the experiment.

1. Mass of Beaker _____
2. Mass of Beaker and Kernels before Popping _____
3. Mass of Beaker and Kernels after Popping _____
4. Total Number of Kernels before Popping _____
5. Total Number of Popped Kernels _____
6. Total Number of Unpopped Kernels after Popping _____

Calculations:

1. Calculate the mass of the kernels before popping:

2. Calculate the mass of the kernels after popping:

3. Calculate the change in mass that resulted from popping the kernels:

4. Calculate the percentage of popped kernels:

Picture for Simple Mixture:



Jars from left to right

1. Popcorn mixed with salt
2. Popcorn mixed with corn meal
3. Popcorn mixed with powdered sugar
4. Popcorn mixed with oil dry or cat litter.