

# Grain Science

## Lesson 4: Other Grains



<b>Unit:</b>	Grain Science
<b>Estimated Time:</b>	50 Minutes
<b>Age of Learners:</b>	9th-12th Grade

**Equipment, Supplies, References, and Other Resources:**

- “Will it Pop?” Variety of grains (examples: sorghum, rice, wheat, quinoa, dent corn), Brown paper bags, Masking tape, Salt or seasoning of choice, Microwave, colored pencils
- “Will it Pop?” Worksheet
- Other Grains PowerPoint
- For supplemental activity: electric skillet, medium-sized bowl, wooden spoon, spatula, cloth, masa harina, unsalted butter, salt, store-bought tortillas

Instructor Directions & Estimated Time	Content Outline and/or Procedures
<p><b>Objectives</b></p>	<ol style="list-style-type: none"> <li>1. Investigate the science behind popcorn popping by understanding the physical properties of popcorn kernels and how heat triggers the popping process, and experiment with different grains to determine which ones can pop.</li> <li>2. Analyze the milling process of various grains, including corn, rice, sorghum, and oats, by examining the different milling techniques employed and the resulting products such as flour, meal, and animal feed.</li> <li>3. Compare and contrast the milling processes of corn and wheat by identifying similarities and differences in the milling techniques and end products.</li> <li>4. Evaluate global grain production and trade patterns by studying a map and graph depicting the top producers and importers of cereal grains like corn, rice, wheat, and oilseeds, and discussing the factors influencing cereal grain consumption and production in different regions of the world.</li> </ol>
<p><b>Feed the Sourdough</b></p> <p>~3 minutes</p> <p><i>Only one student needs to feed the class starter.</i></p>	<ul style="list-style-type: none"> <li>• Start feeding by removing the starter from the container.</li> <li>• In a bowl, mix 1 cup (115 grams) flour and 1/2 cup (115 grams) water with the starter, mixing by hand until smooth.</li> <li>• Clean original container before replacing the starter. Cover and store.</li> </ul>
<p><b>Interest Approach: Will it Pop?</b></p> <p>~ 20 minutes</p> <p><i>Examples of grain to pop sorghum/milo, rice, wheat, quinoa, dent corn. If you only have one microwave, it is recommended to have one group pop one grain. If you have multiple microwaves available, each group could experiment with multiple grains.</i></p>	<p><b>Will it Pop?</b></p> <p>Popcorn is a favorite snack of Americans. In fact, Americans consume 14 billion quarts of popcorn each year. But what makes popcorn pop? There is a small amount of water stored inside a circle of soft starch in the kernel of popcorn. As the kernel heats up, the water expands and builds pressure against the hard outer surface. Eventually, the outer layer gives way causing the popcorn kernel to explode. The soft starch becomes inflated and bursts, the kernel turns inside out, and the steam is released.</p> <p>Is popcorn the only grain that will pop? In this activity you will experiment with different grains to determine which grains will pop and which grains will not.</p> <p><b>Materials</b> (per group)</p> <ul style="list-style-type: none"> <li>• 25 kernels of grains (sorghum/milo, rice, wheat, quinoa, dent corn)</li> <li>• Brown paper bag</li> <li>• Salt or seasoning of choice</li> <li>• Microwave</li> </ul> <p><b>Directions</b></p> <p>Mix 25 kernels in a bowl with a few drops of oil and stir. Place 25 kernels of grain in a brown paper bag. Roll and crimp the open end of the bag OR place in a glass bowl with a microwave-safe lid. Place in the microwave for 2-3 minutes on 50% power. Once the popping begins to slow, remove the bag from the microwave. Add salt or seasoning of choice on the grain in microwave. Remove the grain if it is not popping to prevent burning. Record your observations of each grain in the table below.</p> <p><b>Conclusion</b></p> <p>What characteristics of certain grain seeds made them pop better than others?</p>

Instructor Directions & Estimated Time	Content Outline and/or Procedures
<p><b>Corn Milling</b></p> <p>~ 8 minutes</p> <p><i>Students can read the section about corn on their lab sheet individually or with a partner.</i></p> <p><i>After students read the handout, use the PowerPoint, slides 2-6 to discuss corn and corn milling and show the Masa Production video.</i></p>	<p>Read about the four grains below, how they are milled and what is produced.</p> <p>Corn is the most widely grown grain in the United States. There are several varieties including <b>sweet, dent, popcorn, waxy, and flint</b>. Yellow dent corn, also referred to as field corn, is the most used in the grain industry. There are three types of corn milling: <b>dry, wet, and masa</b>.</p> <p><b>Dry milling</b> is used to make flour or meal for food and is also used in ethanol production. In this process, kernels are hammer milled into a medium-to-fine grind meal.</p> <p><b>Wet milling</b>, also used for ethanol production, makes livestock feed and high fructose corn syrup. The process begins with the corn kernels being soaked in large tanks called steep tanks in a dilute aqueous sulfur dioxide solution. The softened kernel is then processed to remove the germ which is further processed to remove the high-value corn oil. The Germ Meal remaining after the oil is extracted and marketed for animal feed use.</p> <p>The third type of milling, <b>masa</b> is used to make dough flour. The corn is soaked in a water and lime mixture and then milled into a dough. It can be used to make products like corn tortillas.</p> <p>As you watch the video about masa and corn tortilla production, compare the process to that of wheat milling.</p> <p>What are the similarities and differences?  <a href="https://www.youtube.com/watch?v=NgSL_CvX9cQ">https://www.youtube.com/watch?v=NgSL_CvX9cQ</a></p>
<p><b>Other Grain Milling</b></p> <p>~ 6 minutes</p> <p><i>Students can read the sections about sorghum, rice, and oats on their lab sheet individually or with a partner.</i></p> <p><i>After students read the sections about sorghum, rice, and oats, use the PowerPoint, slides 7-12 to discuss other types of grain and milling and show the Milling Rice video.</i></p>	<p>There are many grains milled around the world and in the United States aside from wheat and corn. <b>Sorghum</b>, also called milo, is a cereal grain that is milled like corn and can be turned into similar products like flour, ethanol, and feed.</p> <p><b>Rice</b> is the most widely produced grain in the world. The first steps of rice milling process are different than those of wheat, corn, and sorghum. The whole rice kernel with the hull, or husk, still intact is called paddy rice. After the hull has been removed, but the bran, or brown outer layer, is still intact, it is called brown rice. White rice, also called milled rice, which you typically buy in stores and use for cooking, is what is left when the hull and bran have been removed. This final product is accomplished by polishing the rice.</p> <p>From the milling process, rice accounts for 70-75 percent of the product. Rice that is further milled is made into flour for cooking and baking for breakfast cereals, baby foods, noodles, rice cakes, and more. The remaining products from the milling process are rice husks which are used for bedding materials, fuels sources, animal feed and rice bran, and bran oil.</p> <p><b>Oats</b> are a grain like rice. The seed has a hull that is removed. Oats with hulls removed are called groats. Oats are milled for human and livestock consumption as flakes, bran, and extrusion flour.</p>

<b>Instructor Directions &amp; Estimated Time</b>	<b>Content Outline and/or Procedures</b>	
<p><b>Global Grain and Oil Seed Producers and Importers</b></p> <p>~ 8 minutes</p> <p><i>Students could use colored pencils to shade in the countries on the map to identify where grains are produced and imported.</i></p>	<p>On the map below, identify the countries that are the top producers and importers of each of the following crops:</p> <p><b>Corn</b></p> <p><b>Top producers:</b></p> <ul style="list-style-type: none"> <li>• USA</li> <li>• China</li> <li>• Brazil</li> </ul> <p><b>Rice</b></p> <p><b>Top producers:</b></p> <ul style="list-style-type: none"> <li>• China</li> <li>• India</li> <li>• Indonesia</li> </ul>	<p><b>Wheat</b></p> <p><b>Top producers:</b></p> <ul style="list-style-type: none"> <li>• EU-27</li> <li>• China</li> <li>• India</li> </ul> <p><b>Oilseeds</b></p> <p><b>Top producers:</b></p> <ul style="list-style-type: none"> <li>• USA</li> <li>• Brazil</li> <li>• China</li> </ul>
<p><b>Global Aspect Discussion</b></p> <p>~5 minutes</p> <p><i>Students can use the internet to answer to research the discussion questions or could work with a partner.</i></p>	<p>Study the map and graph on your lab sheet and answer the discussion questions.</p> <p><b>Discussion Questions:</b></p> <ol style="list-style-type: none"> <li>1. Why is cereal grain consumption higher in certain regions than others?</li> <li>2. Why do you believe corn is the most produced cereal grain?</li> </ol>	
<p><b>Supplemental Tortilla Activity</b></p> <p>~ 30 minutes</p> <p><i>If time allows, explore how corn tortillas are made by conducting this supplemental activity. Students will make tortillas and compare taste, appearance, texture, smell, shelf-life and other characteristics to store-bought tortillas.</i></p>	<p><b>Materials needed:</b></p> <ul style="list-style-type: none"> <li>• electric skillet or cast-iron griddle (if using stove)</li> <li>• medium sized bowl</li> <li>• wooden spoon</li> <li>• cloth</li> <li>• spatula</li> <li>• 2 cups masa harina (instant)</li> <li>• ¼ teaspoon salt</li> </ul> <p>Follow the directions on the Tortillas Worksheet and then use the comparison chart on the next page to record your observations.</p>	



	<b>State Standards</b>
<b>Language Arts</b>	<ul style="list-style-type: none"> <li>• <b>WHST.9-12.2.</b> Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS2-6) (common core)</li> <li>• <b>RI.9-10.1.</b> Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.</li> <li>• <b>W.9-10.9.</b> Draw evidence from literary or informational texts to support analysis, reflection and research.</li> </ul>
<b>Science</b>	<ul style="list-style-type: none"> <li>• <b>HS-PS1-5.</b> Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs</li> <li>• <b>HS-PS3-4.</b> Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).</li> <li>• <b>HS-PS4-4.</b> When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-ray s, gamma ray s) can ionize atoms and cause damage to living cells.</li> </ul>
<b>Math</b>	<ul style="list-style-type: none"> <li>• <b>N.Q.1. (all).</b> Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</li> <li>• <b>N.Q.2. (all).</b> Define appropriate quantities for the purpose of descriptive modeling</li> <li>• <b>N.Q.3. (all).</b> Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</li> </ul>

## Lesson 4: Other Grains and Pop Grains

### Will it Pop?

Popcorn is a favorite snack of Americans. In fact, Americans consume 14 billion quarts of popcorn each year. But what makes popcorn pop? There is a small amount of water stored inside a circle of soft starch in the kernel of popcorn. As the kernel heats up, the water expands and builds pressure against the hard outer surface. Eventually, the outer layer gives way causing the popcorn kernel to explode. The soft starch becomes inflated and bursts, the kernel turns inside out, and the steam is released.

Is popcorn the only grain that will pop? In this activity you will experiment with different grains to determine which grains will pop and which grains will not.

### Materials (per group)

- 25 kernels of grains (sorghum/milo, rice, wheat, quinoa, dent corn)
- Brown paper bag
- Masking tape
- Salt or seasoning of choice
- Microwave

### Directions

Place 25 kernels of grain in a brown paper bag. Roll the open end of the bag and secure it with masking tape. Place in the microwave for 2-3 minutes on 50% power. Once the popping begins to slow, remove the bag from the microwave. Add salt or seasoning of choice.

It is important to keep a close eye on the grain in microwave. Remove the grain if it is not popping to prevent burning.

Record your observations of each grain in the table below.

Grain	Number of Kernels Popped	Number of Kernels Unpopped	Description of Grain After Cooking

### Conclusion

What characteristics of certain grain seeds made them pop better than others?

## Milling of Other Grains

### Corn

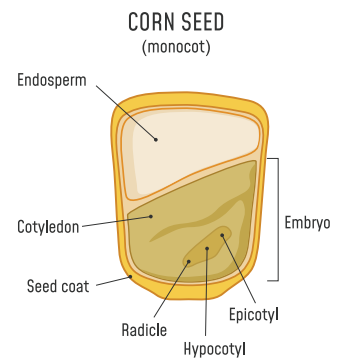
Corn is the most widely grown grain in the United States. There are several varieties including **sweet**, **dent**, **popcorn**, **waxy**, and **flint**. Yellow dent corn, also referred to as field corn, is the most used in the grain industry. There are three types of corn milling: **dry**, **wet**, and **masa**.

**Dry milling** is used to make flour or meal for food and is also used in ethanol production. In this process, kernels are hammer milled into a medium-to-fine grind meal.

**Wet milling**, also used for ethanol production, makes livestock feed and high fructose corn syrup. The process begins with the corn kernels being soaked in large tanks called steep tanks in a dilute aqueous sulfur dioxide solution. The softened kernel is then processed to remove the germ which is further processed to remove the high-value corn oil. The Germ Meal remaining after the oil is extracted and marketed for animal feed use.

The third type of milling, **masa** is used to make dough flour. The corn is soaked in a water and lime mixture and then milled into a dough. It can be used to make products like corn tortillas.

As you watch the video about masa and corn tortilla production, compare the process to that of wheat milling. What are the similarities and differences?



### Sorghum

There are many grains milled around the world and in the United States aside from wheat and corn. Sorghum, also called milo, is a cereal grain that is milled like corn and can be turned into similar products like flour, ethanol, and feed.

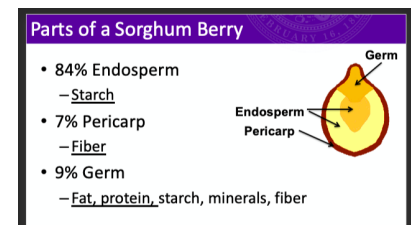
### Rice

Rice is the most widely produced grain in the world. The first steps of rice milling process are different than those of wheat, corn, and sorghum. The whole rice kernel with the hull, or husk, still intact is called paddy rice. After the hull has been removed, but the bran, or brown outer layer, is still intact, it is called brown rice. White rice, also called milled rice, which you typically buy in stores and use for cooking, is what is left when the hull and bran have been removed. This final product is accomplished by polishing the rice.

From the milling process rice accounts for 70-75 percent of the product. Rice that is further milled is made into flour for cooking and baking for breakfast cereals, baby foods, noodles, rice cakes and more. The remaining products from the milling process are rice husks which are used for bedding materials, fuels sources and animal feed and rice bran, used for animal feeds and bran oil.

### Oats

Oats are a grain like rice. The seed has a hull that is removed. Oats with hulls removed are called groats. Oats are milled for human and livestock consumption as flakes, bran and extrusion flour.



## Global Grain and Oil Seed Producers

To visualize the global production of grains and oilseeds, write the name of the following crops on the countries that are the top producers of each on the map below.

### Corn

#### Top producers:

- USA
- China
- Brazil

### Rice

#### Top producers:

- China
- India
- Indonesia

### Wheat

#### Top producers:

- EU-27
- China
- India

### Oilseeds

#### Top producers:

- USA
- Brazil
- China

# World Map With Countries

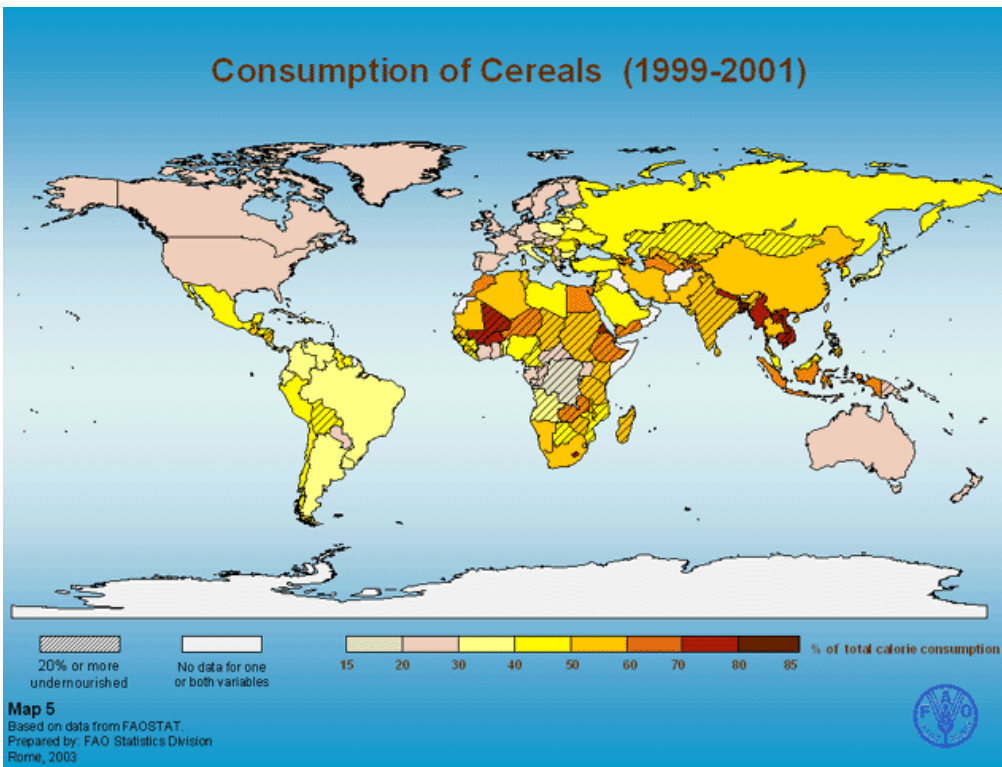




## Global Aspect

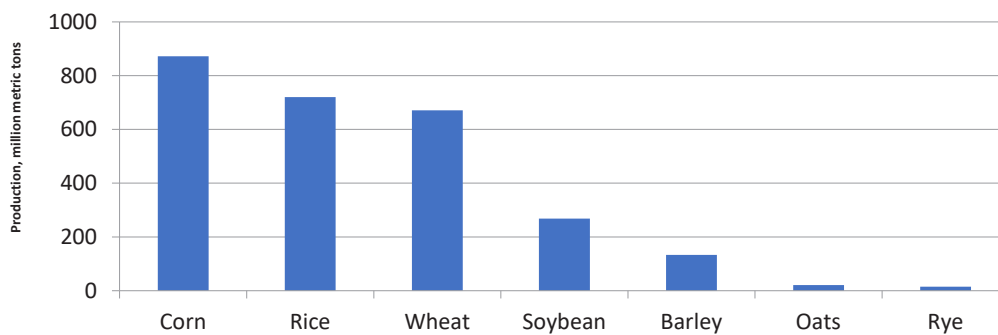
Study the map and graph below and then answer the discussion questions.

### Global Cereal Grain Consumption



### Global Cereal Grain & Oilseed Production

## Global Cereal Grain & Oilseed Production



### Discussion Questions:

1. Why is cereal grain consumption higher in certain regions than others?
2. Why do you believe corn is the most produced cereal grain?

# Grain Science

## Lesson 4: Tortillas Worksheet

### Materials

- electric skillet or cast-iron griddle (if using stove)
- medium sized bowl
- wooden spoon
- cloth
- spatula
- 2 cups masa harina (instant)
- ¼ teaspoon salt
- 2 tablespoons unsalted butter at room temperature
- 1 ½ cups water (warm)
- store-bought tortillas



### Directions

1. Measure the masa harina and salt into a large bowl.
2. Cut the butter into tablespoon-sized pieces and work it into the dry ingredients using the back of a wooden spoon.
3. Add the water and mix with a wooden spoon or with your hands until a soft dough forms.
4. Cover the dough with a clean cloth and let rest for 5 minutes.
5. Divide the dough into 12 pieces and roll each piece into a ball.
6. Roll into a round about 8" in diameter. Keep the remaining dough covered while you work.
7. Cook for about 30 seconds or until the bottom of the tortilla becomes golden. Flip the tortilla and press lightly with a spatula, which will make the tortilla puff slightly. Cook the other side for 30 seconds or until the tortilla appears to be done.

## Comparison

Compare the homemade tortillas to the tortillas that were purchased from the store in the table below. For the shelf-life observation, find a safe place in the classroom, or even an incubator to expedite the process, to observe which tortilla has the longest shelf-life.

	<b>Homemade Corn Tortillas</b>	<b>Store-Bought Corn Tortillas</b>
Taste		
Appearance		
Texture		
Smell		
Other		
Other		
Shelf-Life		

Tortilla recipe at <https://www.myplate.gov/recipes/supplemental-nutrition-assistance-program-snap/corn-tortillas>

## Authors

**Elisa Karkle**, *Ph.D., assistant professor, Department of Grain Science and Industry*

**KaCee James**, *doctoral student, Department of Communications and Agricultural Education*

**Brandie Disberger**, *Ph.D., teaching associate professor, Department of Communications and Agricultural Education*

---

**KANSAS STATE**  
**UNIVERSITY**

Grain Science  
and Industry

Grain Science lessons are posted at:

<https://www.grains.k-state.edu/educator-resources/untitled.html>

Contents of this publication may be freely reproduced for educational purposes. All other rights reserved. In each case, credit K-State Department of Grain Science, *Grain Science: Lesson 4*, Kansas State University, July 2024.

### **Kansas State University Notice of Nondiscrimination**

Kansas State University prohibits discrimination on the basis of race, color, ethnicity, national origin, sex (including sexual harassment and sexual violence), sexual orientation, gender identity, religion, age, ancestry, disability, genetic information, military status, or veteran status, in the university's programs and activities as required

by applicable laws and regulations. The person designated with responsibility for coordination of compliance efforts and receipt of inquiries concerning the nondiscrimination policy is the university's Title IX Coordinator: the Director of the Office of Institutional Equity, [equity@k-state.edu](mailto:equity@k-state.edu), 220A Kedzie Hall, 828 Mid-Campus Drive, Kansas State University, Manhattan, Kansas 66506. Telephone: 785-532-6220 | TTY or TRS: 711. The campus ADA Coordinator is the Director of Employee Relations and Engagement, who may be reached at [charlott@k-state.edu](mailto:charlott@k-state.edu) or 111 Dykstra Hall, 1628 Claffin Rd, Kansas State University, Manhattan, Kansas 66506, 785-532-6277 and TTY or TRS 711.

July 2024