

# Grain Science

## Lesson 2: Harvest, Cleaning, Tempering



<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:**

- Wheat or No Wheat PowerPoint
- Wheat Harvest video: <https://www.youtube.com/watch?v=wmhg1qyhvvs>
- Wheat Cleaning: What, Why, How worksheet
- Tempering: Wheat, sieve or colander, large bowl, water, scale or balance, rubber mallet or rolling pin, safety glasses

<b>Instructor Directions &amp; Estimated Time</b>	<b>Content Outline and/or Procedures</b>
<b>Objectives</b>	<ol style="list-style-type: none"> <li>1. Evaluate the presence of wheat in various food products.</li> <li>2. Analyze the wheat production process from harvest to milling, including understanding the importance of wheat as a crop, its significance in Kansas and the United States, and the steps involved in wheat harvesting on a real family farm.</li> <li>3. Investigate the necessity and methods of wheat cleaning, including identifying the reasons for cleaning, the types of impurities removed, and the techniques used in the cleaning process.</li> <li>4. Describe the purpose, impact, and significance of wheat tempering</li> </ol>

Instructor Directions & Estimated Time	Content Outline and/or Procedures
<p><b>Feed the Sourdough</b></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> <li>• <i>Remember, not every student needs their own starter. One student can feed the starter for the whole class.</i></li> </ul>
<p><b>Wheat or No Wheat Slides</b></p> <p>~ 3 minutes</p> <p><i>There are 12 slides with products — some contain wheat, and some do not. As you click through the slide a “yes” or “no” will appear after students make their guess.</i></p>	<p><b>Does it contain wheat?</b></p> <ol style="list-style-type: none"> <li>1. Chocolate Chip Cookie Dough – yes</li> <li>2. Bread – yes</li> <li>3. Tomato soup – yes</li> <li>4. Honey smacks cereal – yes</li> <li>5. Sour Punch Straws – yes</li> <li>6. Raisins – no</li> <li>7. Rotel Diced Tomatoes &amp; Green Chiles – no</li> <li>8. Purina One Dog Food – yes</li> <li>9. Cream of Chicken soup – yes</li> <li>10. Gluten Free Tortillas – no</li> <li>11. Cream of Mushroom soup – yes</li> <li>12. Charcoal – yes</li> </ol> <p>Discuss the diversity of wheat as a product. Wheat can be used for more than baking bread and cookies. Wheat is an important crop and commodity in Kansas and the United States. It is the second most produced cereal grain in the country, with Kansas leading all other states. In this lesson we will explore the process of wheat from harvest up to milling, which is the process of cleaning, tempering, and grinding cereal grains into flour and other milled grain products.</p>
<p><b>Instructor Directions &amp; Estimated Time</b></p>	<p><b>Content Outline and/or Procedures</b></p>
<p><b>Wheat Harvest Video</b></p> <p>~ 6 minutes</p> <p><i>Write the questions on the board for students to listen for as they watch the video.</i></p> <p>Wheat Harvest on a Real Family Farm in Kansas – Peterson Farm Brothers  <a href="https://www.youtube.com/watch?v=wmhg1qyhvvs">https://www.youtube.com/watch?v=wmhg1qyhvvs</a></p> <p>The video can be ended at 4:36</p>	<p>Harvest is the first step in the process of wheat out of the field before it is milled into flour and other products. In this video, you will see how a Kansas family harvests wheat on their farm. As you watch, listen for</p> <ol style="list-style-type: none"> <li>1. How does wheat change before it is ready to harvest?</li> <li>2. How does a farmer know when wheat is ripe enough to cut?</li> <li>3. What does the combine do with the wheat?</li> <li>4. Where does the wheat go after it leaves the field?</li> </ol> <p>Discuss the questions at the conclusion of the video.</p>

Instructor Directions & Estimated Time	Content Outline and/or Procedures
<p><b>Cleaning What, Why, How</b></p> <p>~ 2 minutes</p> <p><i>This can be read in class, students can read it individually or with a partner.</i></p>	<p>When wheat is harvested, there are many things that might accompany it from the field – dust, sand, and weeds to name a few.</p> <p>On your lab sheet read about the “What, Why and How” of Wheat Cleaning.</p> <p><b>What</b></p> <p>Before wheat can be turned into a product through the milling process, the seeds must be cleaned. Wheat samples arrive at the mill with non-millable grain that is dusty, shrunken, shriveled, small, broken, insect damaged or infested or low density. The samples may also contain foreign materials that are non-wheat like corn seeds, straw, or even rodents.</p> <p><b>Why</b></p> <p>Aside from removing non-millable grain and foreign materials, dust control and sanitation is an important component of wheat cleaning. Dust can cause product degradation or loss and can endanger the plant facilities and human health. Grain dust, like that from wheat, is a combustible dust that acts as a fuel and can cause explosions in mills. Because dust is always present from wheat during the cleaning process, housekeeping is important.</p> <p><b>How</b></p> <p>Wheat is separated and sorted by size, shape, weight and even color. To sort by size, screens will remove what is larger or smaller than wheat seeds. A cylinder separator is used to sort wheat by shape and removes weed seeds. Vibration and air stream cleans materials lighter than wheat while electronic eyes and pneumatic air jets sort wheat by color. This process is the first step in wheat purification.</p>
<p><b>Wheat Sieving</b></p> <p>~ 7 minutes</p> <p><i>Obtain a sample of uncleaned wheat from a local elevator or farmer. Any grain will work for this activity if you are unable to obtain wheat. The grain used for this will also be used for the next activity as well.</i></p> <p><i>Students can complete as a group or with a partner depending on available materials.</i></p> <p><i>If unclean wheat is unavailable, the teacher can add material to the sample – small rocks, beads, other grain.</i></p>	<p>In this activity, students will clean a wheat sample. To complete this you will need the following materials:</p> <p><b>Materials (per group)</b></p> <ul style="list-style-type: none"> <li>• 2 cups wheat sample</li> <li>• Sieves or colanders of various size openings (Sieves can be purchased for between \$20-\$32 from Amazon)</li> <li>• Bowl or container to collect waste</li> </ul> <p><b>Process:</b></p> <ol style="list-style-type: none"> <li>1. Record the weight of the sample.</li> <li>2. Begin with the initial sample of wheat and pour into sieve. Shake the sample in a reciprocating motion to “knock” the dust and other foreign materials loose. Place a bowl, container, or paper under the sieve to collect the waste.</li> <li>3. Pour your sample of wheat into another size of sieve to remove another size of waste using the same method.</li> <li>4. If you are unable to remove waste with the sieve due it being the same size as the wheat, remove it by hand.</li> <li>5. Record the weight of the sample after cleaning.</li> <li>6. Calculate the percent of the sample that was foreign material.</li> </ol> <p><b>Observations:</b></p> <p>List the foreign materials that were removed from the wheat sample during cleaning.</p>

Instructor Directions & Estimated Time	Content Outline and/or Procedures
<p><b>Tempering: What, Why, How</b></p> <p>~3 minutes</p> <p><i>This can be read in class, students can read it individually or with a partner.</i></p>	<p>After wheat has been cleaned, it is tempered. On your lab sheet read about the “What, Why and How” of Tempering.</p> <p><b>What</b></p> <p>Tempering wheat allows water to absorb into the kernels. It adds up to seven percent moisture in one tempering step.</p> <p><b>Why</b></p> <p>Tempering mellows, or softens, the endosperm of the seed. This increases flour extraction, reduces power consumption, noise level of the roller mills and flour ash content. Through tempering, the bran is toughened and breaks up less while remaining in bigger pieces. Larger bran flakes can effectively have flour removed without grinding the bran.</p> <p><b>How</b></p> <p>Tempering is accomplished through conditioning, measuring dry and clean wheat moisture content, measuring wheat for water, measuring, and adding water, and mixing and allowing water to absorb. Temper time is dependent on wheat and environmental characteristics. Refer to the list below for the impact on temper time.</p> <p><b>Impact on Temper Time</b></p> <ul style="list-style-type: none"> <li>• Harder wheat = longer temper time</li> <li>• More vitreous = longer temper time</li> <li>• Cold wheat = longer temper time</li> <li>• Cold room = longer temper time</li> <li>• Low starting moisture content = longer temper time</li> <li>• High target moisture content = longer temper time</li> </ul> <p><b>Analysis Question</b></p> <p>Which classes of wheat would have longer temper times?</p> <p><b>Wheat Class Temper Times</b></p> <p>Show chart on slide 9</p>

Instructor Directions & Estimated Time	Content Outline and/or Procedures
<p><b>Tempering Wheat</b></p> <p>~ 20 minutes</p> <p><i>Students will use the wheat samples that they cleaned in the previous activity.</i></p> <p><i>Students should observe that untempered wheat will shatter into smaller pieces upon impact. The tempered wheat is less likely to shatter, but may instead deform or break into larger chunks.</i></p>	<p>You will temper the wheat you cleaned in the previous activity. Follow the instructions below.</p> <p><b>Materials (per group)</b></p> <ul style="list-style-type: none"> <li>• ¼ cup wheat</li> <li>• Bowl</li> <li>• Strainer</li> <li>• Scale</li> <li>• Rubber mallet or rolling pin</li> <li>• Safety glasses</li> </ul> <p><b>Process:</b></p> <ol style="list-style-type: none"> <li>1. Weigh wheat before submerging in water. Record initial weight on table 2.</li> <li>2. Place wheat in cup and submerge with water. The amount of time your wheat is submerged will be the temper time. Each group will complete 15 minutes.</li> <li>3. Remove wheat with strainer and place on paper towel.</li> <li>4. Weigh wheat after removing from water. Record weight on the table 2.</li> <li>5. To observe the effect of tempering, you will place the tempered wheat on a hard surface like a concrete floor.</li> <li>6. Wearing safety glasses, hammer the tempered wheat and non-tempered wheat. Record your observations of the kernels after it has been hit by the mallet in table 3.</li> <li>7. Clear the surface and repeat with untampered wheat. Record observations on table 3.</li> </ol>
<p><b>Closure</b></p> <p>~ 4 minutes</p>	<p><b>Conclusion questions</b></p> <ul style="list-style-type: none"> <li>• How have modern harvest practices improved the flour production process in the last century years?</li> <li>• What are the consequences of no cleaning grain?</li> <li>• Why is it important to temper wheat prior to milling?</li> </ul>

	State Standards
<p><b>Language Arts</b></p>	<ul style="list-style-type: none"> <li>• <b>RI.9-10.2.</b> Determine a central idea of a text and analyze its development over the course of the text; provide an objective summary of the text.</li> <li>• <b>SL.9-10.1a.</b> Be prepared to discuss, having read and researched material; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.</li> <li>• <b>WHST.6-8.9.</b> Draw evidence from informational texts to support analysis, reflection, and research. (<b>MS-PS4-3</b>) (common core)</li> </ul>
<p><b>Science</b></p>	<ul style="list-style-type: none"> <li>• <b>MS-LS1-5.</b> Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.</li> <li>• <b>MS-LS4-5.</b> Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.</li> <li>• <b>HS-ETS1-1.</b> Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</li> </ul>



	<b>State Standards</b>
<b>Math</b>	<ul style="list-style-type: none"><li>• <b>S.MD.2. (+).</b> Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.</li><li>• <b>K.MD.A.1.</b> Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. (K-PS2-1)</li><li>• <b>N.Q.2. (all).</b> Define appropriate quantities for the purpose of descriptive modeling.</li></ul>

**Resources:**

Pre-Milling Grain Cleaning Process and What to Know:

<https://millermagazine.com/blog/pre-milling-grain-cleaning-process-and-what-to-know-2250>

## Lesson 2: Harvest, Cleaning, Tempering

### *Cleaning and Tempering Worksheet*

#### Wheat Cleaning: What, Why, How

##### What

Before wheat can be turned into a product through the milling process, which is the process of grinding cereal grains into flour and other milled grain products, the seeds must be cleaned. Wheat samples arrive at the mill with non-millable grain that is dusty, shrunken, shriveled, small, broken, insect damaged or infested or low density. The samples may also contain foreign materials that are non-wheat like corn seeds, straw, or even rodents.

##### Why

Aside from removing non-millable grain and foreign materials, dust control and sanitation is an important component of wheat cleaning. Dust can cause product degradation or loss and can endanger the plant facilities and human health. Grain dust, like that from wheat, is a combustible dust that acts as a fuel and can cause explosions in mills. Because dust is always present from wheat during the cleaning process, housekeeping is important.

##### How

Wheat is separated and sorted by size, shape, weight and even color. To sort by size, screens will remove what is larger or smaller than wheat seeds. A cylinder separator is used to sort wheat by shape and removes weed seeds. Vibration and air stream cleans materials lighter than wheat while electronic eyes and pneumatic air jets sort wheat by color. This process is the first step in wheat purification.

#### **Activity: Wheat Sieving**

In this activity, you will clean a wheat sample.

##### Materials (per group)

- 2 cups wheat sample
- Sieves or colanders of various size openings
- Bowl or container to collect waste

##### Process

1. Record the weight of the sample.
2. Begin with the initial sample of wheat and pour into sieve. Shake the sample in a reciprocating motion to “knock” the dust and other foreign materials loose. Place a bowl, container, or paper under the sieve to collect the waste.
3. Pour your sample of wheat into another size of sieve to remove another size of waste using the same method.
4. If you are unable to remove waste with the sieve due it being the same size as the wheat, remove it by hand.
5. Record the weight of the sample after cleaning.
6. Calculate the percent of the sample that was foreign material.

**Table 1.**

Weight of Sample before Cleaning	Weight of the Sample After Cleaning
Percent of Sample that was Foreign Material	

**Observations**

List the foreign materials that were removed from the wheat sample during cleaning.

**Tempering: What, Why, How?**

**What**

Tempering wheat allows water to absorb into the kernels. It adds up to seven percent moisture in one tempering step.

**Why**

Tempering mellows, or softens, the endosperm of the seed. This increases flour extraction, reduces power consumption, noise level of the roller mills and flour ash content. Through tempering, the bran is toughened and breaks up less while remaining in bigger pieces. Larger bran flakes can effectively have flour removed without grinding the bran.

**How**

Tempering is accomplished through conditioning, measuring dry and clean wheat moisture content, measuring wheat for water, measuring and adding water, and mixing and allowing water to absorb. Temper time is dependent on wheat and environmental characteristics. Refer to the list below for the impact on temper time.

**Impact on Temper Time**

- Harder wheat = longer temper time
- More vitreous = longer temper time
- Cold wheat = longer temper time
- Cold room = longer temper time
- Low starting moisture content = longer temper time
- High target moisture content = longer temper time

**Analysis Question**

Which classes of wheat would have longer temper times?



## Activity: Wheat Tempering

You will temper the wheat you cleaned in the previous activity. Follow the instructions below.

### Materials (per group)

- ¼ cup wheat
- Bowl
- Strainer
- Scale
- Hammer or mallet or rolling pin
- Safety glasses

### Process

1. Weigh wheat before submerging in water. Record initial weight on table 1.
2. Place wheat in cup and submerge with water. The amount of time your wheat is submerged will be the temper time. Each group will complete 15 minutes.
3. Remove wheat with strainer and place on paper towel.
4. Weigh wheat after removing from water. Record weight on the table 2.
5. To observe the effect of tempering, you will place the tempered wheat on a hard surface like a concrete floor.
6. Wearing safety glasses, hammer the tempered wheat and non-tempered wheat. Record your observations of the kernels after it has been hit by the mallet in table 3.
7. Clear the surface and repeat with untampered wheat. Record observations on table 3.

**Table 2. Weight**

Initial Weight of Wheat Sample	Weight after 15 Minutes Submerged

**Table 3. Characteristics of Tempered vs. Non-Tempered Wheat**

Tempered wheat	Non-tempered wheat

### Conclusion

1. How have modern harvest practices improved the flour production process in the last century years?
2. What are the consequences of not cleaning grain?
3. Why is it important to temper wheat prior to milling?

## Authors

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Grain Science lessons are posted at:

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

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July 2024