

Grain Science

Lesson 1: Introduction to Wheat



Unit:	Grain Science
Estimated Time:	50 Minutes
Age of Learners:	9th-12th Grade
Equipment, Supplies, References, and Other Resources:	
<ul style="list-style-type: none"> • Sourdough bread (to sample) • Natural Yeast Sourdough Starter: Bread flour, water, glass jar or plastic container, wax paper or cheese cloth, large bowl, plastic gloves, measuring cups • Introduction to Wheat PowerPoint • Wheat Graphic Organizer • Wheat seed samples (Soft White, Soft Red Winter, Hard Red Winter, Hard White, Hard Red Spring, Durum) • Kahoot for Review: https://create.kahoot.it/details/3bf0a611-7146-4ce5-92f0-91c3f30a8db0 	

Instructor Directions & Estimated Time	Content Outline and/or Procedures
<p>Objectives</p>	<ol style="list-style-type: none"> 1. Demonstrate the process of creating a sourdough starter, including the role of natural yeast, fermentation, and the ongoing maintenance required for sourdough culture. 2. Classify the major classes of wheat based on their visual characteristics and explain their respective purposes and uses in food production. 3. Analyze the relationship between protein content in wheat and its applications in various baked goods.
<p>Interest Approach</p> <p>~ 4 minutes</p> <p>~ 8 minutes if sampling bread</p> <p>Optional interest approach: <i>Bring in sourdough and white bread for students to sample. Discuss the differences as a class before introducing the Sourdough Starter.</i></p> <p><i>Handout Sourdough Starter Worksheet</i></p>	<p>Have you ever wondered what makes bread rise or what gives it a unique flavor and texture? <i>*pause to let students comment*</i></p> <p>In our modern society, the act of purchasing a loaf of bread from the grocery store seems almost effortless. However, the accessibility of grocery stores is a relatively recent luxury. Ancient civilizations found that combining flour with water and exposing it to open air initiated a natural fermentation process, causing the bread to rise. This transformed the bread, now known as sourdough, into a staple due to its extended shelf life. In fact, during the Roman Empire, soldiers carried a small amount of sourdough on their campaigns so they could make bread as needed.</p> <p>Sourdough Starter: Today, you will put on your chef’s, or in this case baker’s, hat as you will whip up a Sourdough Bread Starter. Sourdough bread is different from other bread – you must feed it! Sourdough bread starts in a warm environment with the growth of natural yeast that’s airborne and found in grain and flour. The yeast buds as it ferments. As the carbon dioxide gas escapes, bubbles are created to leaven the dough.</p> <p>What we start today will be an ongoing project for the next two weeks. Next week, we are going to make sourdough bread. Between now and then, you will learn about the many aspects of the grain science industry. When we complete the sourdough starter today, we will learn about the main ingredient of bread – wheat. To make the sourdough starter, you will follow the instructions on the handout. <i>Remember, students are working as a class or group to make one starter!</i></p>
<p>Sourdough Starter</p> <p>~ 10 minutes</p> <p><i>This activity can be conducted in groups or as a class. Keep in mind that the sourdough will grow as you feed it each day. We do not recommend having each student make a sourdough starter — it will take too long to feed each day, it will incur additional costs, and you will have more than you need!</i></p>	<p>Day 1 Sourdough Starter</p> <p>Ingredients and Materials (per group)</p> <ul style="list-style-type: none"> • 1 cup (115 grams) bread flour • ½ cup (115 grams) water • Large bowl • Container (1 quart or larger) • Wax paper, cheese cloth or plastic wrap to cover container • Plastic glove

	<p>Instructions</p> <ul style="list-style-type: none"> • Place ingredients in bowl. • Wear gloves to mix ingredients by hand. • Store starter in a plastic container (with not very tight lid) or glass jar covered with wax paper or cheese cloth. Can be stored at room temperature. <p><i>If the sourdough begins to mold throughout the process, consider the following steps:</i></p> <ul style="list-style-type: none"> • If there is a lot of mold on the starter, throw it away and start over. If only a small amount of mold is present, you can scrape it off. • Use a clean jar in a clean environment. The starter should be stored away from other fermenters or anything moldy. • Keep the starter between 70 and 75 degrees Fahrenheit.
<p>Instructor Directions & Estimated Time</p>	<p>Content Outline and/or Procedures</p>
<p>Wheat Graffiti Wall</p> <p>~ 3 minutes</p> <p><i>To transition from the sourdough starter to wheat, use this activity to segue into the next section. You can omit this if you are short on time.</i></p>	<p>On a white board, create two sections labeled “What I Know About Wheat” and “What I Want to Know About Wheat.”</p> <p>Give students two minutes to record in each section their current knowledge of wheat and what they want to learn about wheat.</p>
<p>Instructor Directions & Estimated Time</p>	<p>Content Outline and/or Procedures</p>
<p>Introduction to Classes of Wheat: Slides 1-3</p> <p>~ 3 minutes</p> <p><i>The teacher will present the “Introduction to Wheat” slides 1-3</i></p>	<p>The Six Major Classes of Wheat: <i>Soft White, Soft Red Winter, Hard Red Winter, Hard White, Hard Red Spring, Durum</i> on slides 1-3.</p> <p>Wheat classes are designated by color, hardness, and growing season. The map on slide 3 shows where the six major classes of wheat are grown in the United States. In Kansas, Hard Red Winter wheat is the most predominant class.</p>
<p>Classes of Wheat Graphic Organizer</p>	<p>Each group or set of partners will have samples of wheat seeds. On the Classes of Wheat graphic organizer, each student will record visual characteristics of each seed.</p>
<p>~ 8 minutes</p> <p><i>Divide students into groups and hand out the Classes of Wheat Graphic Organizer.</i></p> <p><i>Option — print graphic organizer on card stock and glue seeds on appropriate sections.</i></p>	<p><i>Characteristics that might be recorded are:</i></p> <ul style="list-style-type: none"> • Soft White: light tan grain, shorter in length and plumper than hard wheats • Soft Red Winter: prominent brush, rounded cheeks, orange color • Hard Red Winter: long, narrow kernel, narrow cheeks, dark brown color, hard vitreous • Hard White: similar to HRW but lighter in color • Hard Red Spring: reddish-brown color and bullet shaped • Durum: long kernel, humped back, amber color, and translucent

<p>Purposes of Wheat Classes: Slides 4-9</p> <p>~ 8 minutes</p>	<p>Purposes of Different Wheat Classes: Slides 4-9 Wheat Graphic Organizer</p> <p>While the teacher presents slides 4-9 to discuss the purposes and uses of the six classes of wheat, students will record notes from the slides on the Wheat Graphic Organizer.</p>
<p>Gluten</p> <p>~ 3 minutes</p> <p><i>If time allows, discuss Celiac Disease (gluten allergy) and gluten intolerance. Do you know anyone who has either? How does that impact their life?</i></p>	<p>Gluten content was mentioned on several classes of wheat, but what is gluten?</p> <p>First, it is important to understand that wheat flour possesses a distinctive capability to create a cohesive and flexible dough. This attribute arises from the presence of unique proteins called gluten, which is not only found in wheat but also in barley and rye. The gluten in wheat flour enables the formation of dough while retaining gas. Moreover, gluten plays a key role in enhancing the texture, flavor, and moisture in various products like bread, bagels, and pastries.</p> <p>Which classes of wheat had high gluten content? (<i>Hard Red Spring, Durum</i>)</p> <p>What kind of products were made from these classes of wheat? (<i>Bagels, artisan hearth breads, pizza crust, hamburger/hot dog buns, pasta</i>)</p> <p>Keep this in mind as we move onto our analysis questions.</p>
<p>Analysis</p> <p>~ 5 minutes</p>	<p>With the same group or partner from before, students will analyze their notes to form conclusions about the correlation between protein and applications of wheat. Students will write their conclusion at the bottom of the Wheat Graphic Organizer.</p> <p>Students should find that lower protein and gluten content wheat is used for softer, sometimes crumblier, applications or baking products like cakes while higher protein is used for harder or “stronger,” less “fluffy” products like pasta.</p>
<p>Kahoot Review</p> <p>~ 5 minutes</p>	<p>To test your knowledge about the classes of wheat and their uses, we will now play a Kahoot. The Kahoot will show a picture of a product and you will identify which class of wheat is used for that application.</p> <p>https://create.kahoot.it/details/3bf0a611-7146-4ce5-92f0-91c3f30a8db0</p>
<p>Conclusion</p> <p>~ 2 minutes</p>	<p>To review, ask the following:</p> <p>So far,</p> <ul style="list-style-type: none"> • Were any items you said you knew about wheat confirmed? • Have you learned anything you wanted to learn? <p>Preview the next class:</p> <ul style="list-style-type: none"> • Remember, the sourdough starter is a two-week process. What do you think will happen to the sourdough starter by tomorrow?

	State Standards
Language Arts	<ul style="list-style-type: none"> • RI.9-10.2. Determine a central idea of a text and analyze its development over the course of the text; provide an objective summary of the text. • SL.9-10.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. • SL.9-10.1a. 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.
Science	<ul style="list-style-type: none"> • HS-PS1-5. 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. • HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials. • HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction (based on the outermost electron states of atoms, trends in the periodic table,) and knowledge of the patterns of chemical properties.
Math	<ul style="list-style-type: none"> • N.Q.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities • N.Q.2. (all). Define appropriate quantities for the purpose of descriptive modeling. • N.Q.1. (all). 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.

Resources:

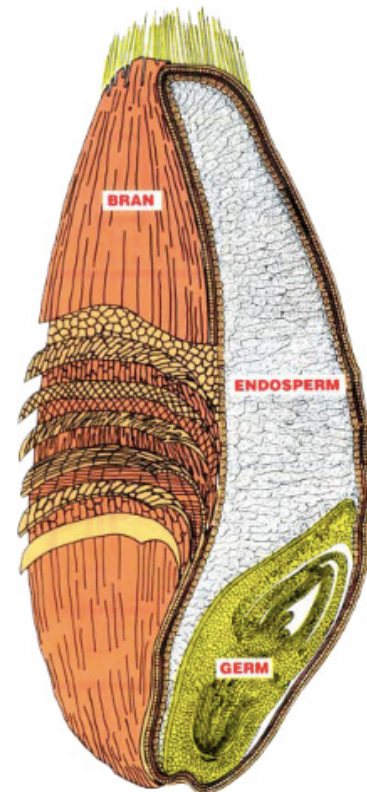
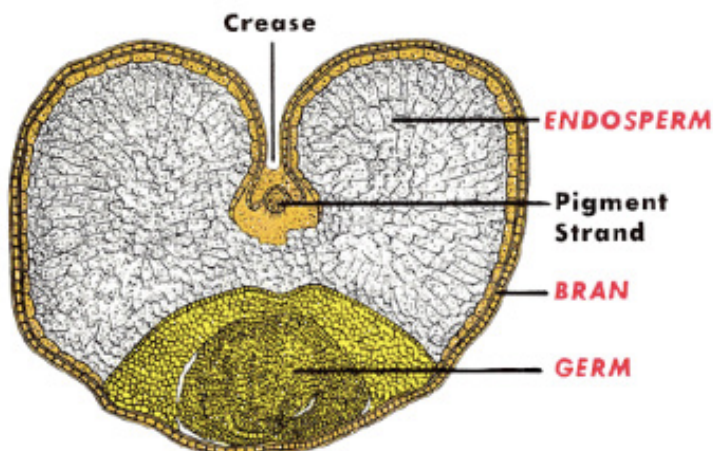
- <https://www.kfb.org/WebsitePageFile/File/A4999F31-C619-4FB6-BF22-074DA6143FC1/WheatFunFactGuide.pdf>
- <https://www.uswheat.org/working-with-buyers/wheat-classes/>
- 2021 Crop Quality Report: U.S. Wheat Associates
- K-State Grain Science
- Sourdough on the Rise: Kansas State University
- <https://www.ksre.k-state.edu/news/stories/2023/12/agriculture-gene-editing-gluten-wheat.html>
- <https://www.lingonberrycafe.com/s/stories/the-history-of-sourdough>

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Parts of a Wheat Kernel

- **83% endosperm**
 - Starch
 - Provides nutrition to embryo
 - Provides humans protein, carbohydrates, iron, B-vitamins
 - The endosperm provides nutrition to seed's embryo. That nutrition, when made into white flour, provides human consumers with protein, carbohydrates, iron and B-vitamins.
- **14.5% bran**
 - Outermost layer
 - Fiber
 - The bran is the outermost layer of the kernel, making up about 14.5 percent of total kernel weight. The bran is an excellent source of insoluble fiber, which makes its inclusion in whole wheat flour valuable to improving digestive health for the end consumer. Fun fact: White wheat bran contains less tannins, which makes the end flour product naturally sweeter
- **2.5% germ**
 - Embryo of the wheat plant
 - Fat, protein, minerals, fiber
 - The germ is the embryo of the wheat plant. Germ is often separated from flour during milling because the germ's high fat content can limit the shelf life of flour.

<https://www.youtube.com/watch?v=QRFH19Qs4b8&t=42s>



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Wheat Graphic Organizer

<p>Soft White</p> <p>Characteristics:</p> <p>Protein:</p> <p>Moisture:</p> <p>Gluten:</p> <p>Applications:</p>	<p>Soft Red Winter</p> <p>Characteristics:</p> <p>Protein:</p> <p>Moisture:</p> <p>Gluten:</p> <p>Applications:</p>	<p>Hard Red Winter</p> <p>Characteristics:</p> <p>Protein:</p> <p>Moisture:</p> <p>Gluten:</p> <p>Applications:</p>
<p>Hard White</p> <p>Characteristics:</p> <p>Protein:</p> <p>Moisture:</p> <p>Gluten:</p> <p>Applications:</p>	<p>Hard Red Spring</p> <p>Characteristics:</p> <p>Protein:</p> <p>Moisture:</p> <p>Gluten:</p> <p>Applications:</p>	<p>Durum</p> <p>Characteristics:</p> <p>Protein:</p> <p>Moisture:</p> <p>Gluten:</p> <p>Applications:</p>

Analysis: Analyze your notes to form conclusions about the correlation between protein and applications of wheat.

Lesson 1: Introduction to Wheat

Sourdough

Today you will put on your chef, or in this case baker's, hat as you will whip up a Sourdough Bread Starter. Sourdough bread is different from other bread – you must feed it!

Sourdough bread starts in a warm environment with the growth of natural yeast that's both airborne and found in grain and flour. The yeast buds as it ferments. As the carbon dioxide gas escapes, bubbles are created to leaven the dough.

Day 1 | Sourdough Starter

Ingredients and Materials

- 1 cup (115 grams) bread flour (for each day)
- ½ cup (115 grams) water (for each day)
- Large bowl
- Container (1 quart or larger)
- Wax paper, cheese cloth, or plastic wrap to cover container
- Plastic glove

Instructions

- Place ingredients in bowl.
- Wear gloves to mix ingredients by hand.
- Store starter in a plastic container (with not very tight lid) or glass jar covered with wax paper or cheese cloth.

Day 2 – Day 7 | Feeding the Starter

- Start feeding by removing the starter from the container.
- In a bowl, mix 1 cup (115 grams) flour and 1/2 cup (115 grams) water with the starter, mixing by hand until smooth.
- Clean original container before replacing the starter. Cover and store.

If the sourdough begins to mold, consider the following steps:

- If there is a lot of mold on the starter, throw it away and start over. If only a small amount of mold is present, you can scrape it off.
- Use a clean jar in a clean environment. The starter should be stored away from other fermenters or anything moldy.
- Keep the starter between 70 and 75 degrees Fahrenheit.



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Sourdough Starter and Observation

	Day 1	
Date	Observation Looks like ... Smells like ...	I think tomorrow it will look like ...
	Day 2	
Date	Observation Looks like ... Smells like ...	I think tomorrow it will look like ...
	Day 3	
Date	Observation Looks like ... Smells like ...	I think tomorrow it will look like ...
	Day 4	
Date	Observation Looks like ... Smells like ...	I think tomorrow it will look like ...
	Day 5	
Date	Observation Looks like ... Smells like ...	I think tomorrow it will look like ...
	Day 6	
Date	Observation Looks like ... Smells like ...	I think tomorrow it will look like ...
	Day 7	
Date	Observation Looks like ... Smells like ...	I think tomorrow it will look like ...

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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