



The Book Planter



Ag in the Classroom

Post Office Box 27766 | Raleigh, NC 27611 | (919) 782-1705
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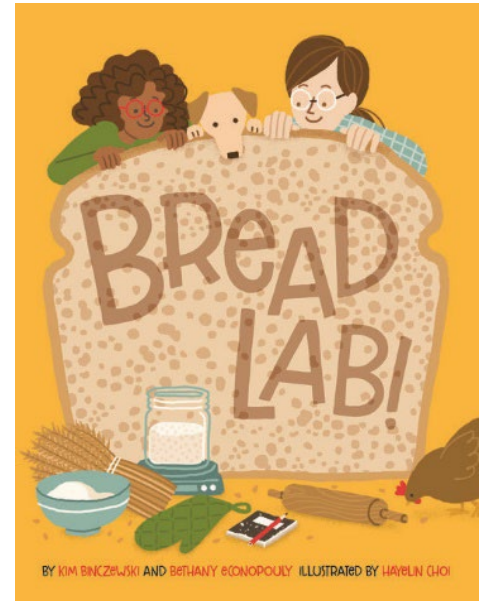
March 2021: *Bread Lab!*

Written by:

Kim Binczewski and Bethany Econopouly

Illustrated by: Hayelin Choi

Iris loves her aunt—“Plant Mary” as she calls her—and she is coming to visit! Today Aunt Mary wants to experiment with making whole wheat sourdough bread from scratch! As the family kitchen transforms into a bread lab, Iris is surprised that bread needs only four ingredients—flour, water, salt and starter. She also learns about the invisible microbes that make the dough rise, and how flour comes from wheat grown by farmers. It all seems magical, but it is really science.¹



Fun Facts

- Did you know The Bread Lab is a real place? Based at Washington State University, Mount Vernon, The Bread Lab focuses on the science of bread making by connecting it back to plant breeding and production (More information at the end of the book and in **Links** section). In fact, Kim Binczewski, one of the authors of *Bread Lab!* is the managing director!
- Bread making always starts with two ingredients: flour and water.²
- There are many different types of flour. Flour is made by grinding up wheat kernels.³
- 80% of North Carolina-grown wheat is used for livestock feed, and the rest is used for human consumption to make flour.³
- One bushel of wheat can make 45 loaves of bread.³
- North Carolina wheat farmers mainly grow Soft Red Winter Wheat which is planted in the fall, grows in the winter and is harvested in late spring.³

***Bread Lab!* Discussion Questions**

1. What is a “starter?”
2. What does the starter “Flora” eat?
3. Explain the process that gives bread its texture.
4. What did Iris say the sourdough mix smelled like? Why do you think this is what it smelled like?
5. What are the four ingredients needed to make bread?
6. What does Aunt Mary mean when she says the dough needs to rest?
7. Find the example of a homophone in the book. (Need/Knead) What do these two words mean?

8. What does it mean to fold the dough? Explain the motions that Aunt Mary and Iris use.
9. How does Aunt Mary, a plant scientist, help farmers? What does plant science have to do with food?
10. What happened that almost ruined the bread?
11. How did Iris describe the taste of the bread?
12. Describe how the process of Iris and Aunt Mary baking bread was like a scientific experiment in a lab.

Interest Approach – Engagement⁴

1. Show students the [Time Lapse – Pizza Dough Rising Video](#). (Links section for full link)
2. Ask students, “What is causing this pizza dough to rise? (Yeast)”

Activity 1: What makes bread dough rise? A class demonstration⁴

Materials Needed:

- Sandwich-sized Ziploc bags
 - Yeast
 - Warm water
 - Sugar
 - 1 tablespoon measuring spoon
1. Introduce yeast by passing around small Ziploc bags of yeast or displaying one at the front of the room. Ask students if they know what it is and what it is used for. If no one knows, explain that it is yeast and that our primary use for it is in cooking.
 2. Provide a class demonstration of how yeast works using the following steps:
 - a. Fill a quart or sandwich sized Ziploc bag with 1 tablespoon of yeast.
 - b. Add 1 tablespoon of sugar to the bag.
 - c. Place 1/2 cup of warm water in the bag and mix the contents thoroughly with your fingers.
 - d. Push the air out of the bag and seal tightly.
 - e. Place the bag in a central area for observation.
 3. It will take about 20 minutes for the Ziploc bag to inflate. However, exact time will vary depending on the temperature of your classroom. Note: be sure to open the bag before it pops.

Activity 2 Wheat Kernel Dissection⁴

Materials Needed:

- Wheat stem, 1 per student (Wheat stems can be obtained from a local farmer or [Wheat Bundles](#) are available for purchase from [agclassroomstore.com](#).)
- Jewel bag*, 1 per student
- 8 1/2" x 11" piece of paper, 1 per student

1. Provide each student with the Anatomy of a Wheat Plant Diagram, a wheat stem, and a jewel bag. Use the diagram to discuss the main parts of a wheat plant and have the students locate the parts on the wheat stem.
2. Tell students to thresh their wheat to separate the seeds from the plant. Refer to the [Wheat Grinding Tutorial Video](#) for instructions on how to thresh wheat by hand. The students should collect the wheat seeds in their jewel bags.
3. Explain to the students that each kernel of wheat has three main parts—the bran, germ, and endosperm. All-purpose flour, used to make white bread, is made from the endosperm of the wheat kernel. The endosperm is separated from the bran and the germ and ground into flour. Whole wheat flour contains the whole kernel—the bran, germ, and endosperm.
4. Pass out a piece of paper to each student. Instruct them to fold the paper into thirds and label the sections "Bran," "Germ," and "Endosperm."
5. Show the students the video [White Bread vs. Whole Wheat \(Grain\)](#) and have them take additional notes about the three parts of the wheat kernel.

Activity 3: Where does flour come from?

Materials Needed:

- Tools for grinding grain (two stones, mortar and pestle, coffee grinder, spice grinder, pepper grinder, hand or electric wheat grinder, etc.)
 - A [Wheat Grinder Kit](#) is available for purchase from [agclassroomstore.com](#).
 - Wheat seeds (Hard red wheat seeds can be purchased from the grocery store.)
 - Bowls
 - [Wheat Milling](#) video (full link in **Links** section)
1. Say to students, "We know that we use flour to make bread, but where does flour come from?" Allow students to answer.
 2. Explain that flour comes from wheat.
 3. Show the students a loaf of white bread and a loaf of wheat bread, or use pictures. Ask the students, "Which of these did Iris and Aunt Mary make in the book *Bread Lab*?" (Iris and Aunt Mary made a whole wheat sourdough bread.) Draw a Venn diagram on the board. Label one circle "White Bread" and the other "Whole Wheat Bread."
 4. Ask the students to explain what is the same and different about the two loaves of bread, and record the responses in the appropriate spots of the graphic organizer.
 5. Show the students a bowl of wheat kernels, a bowl of white all-purpose flour, and a bowl of whole wheat flour. Point out that the white flour was used to make white bread and the whole wheat flour was used to make the whole wheat bread, but both types of flour were made from wheat kernels. Explain to the students that they will be exploring the process of making flour, known as milling, to understand how different types of flour are made from wheat kernels.
 6. Choose a minimum of three tools for grinding grain and place them on tables around the room with a bag of wheat kernels and a bowl to collect flour at each station.

7. Have students try their hands at milling flour with the different tools by allowing them to circulate through the stations.
8. After every student has had a turn at each station, invite the class to describe their experiences with each tool. Ask students which method they thought was the most effective and if they can think of any better ways to grind wheat.
9. Explain that thousands of years ago, people used stones to crush grain into flour. Over time, more productive machines were invented. Show the students the video [Wheat Milling](#) to view a modern flourmill at work.
10. Explore more with the [History of Flour Milling timeline](#).

Activity 4: Bread in a Bag⁵

Materials Needed:

- 2 cups all-purpose flour
- 2 cups whole wheat flour
- Warm water
- 2 tablespoons sugar
- 1 package yeast or 2-1/4 teaspoons (quick rise yeast will speed things along)
- 1-2 teaspoons salt
- 1 tablespoon oil
- Plastic wrap
- Cooking oil spray
- Heavy-duty Ziploc bag
- Food handlers gloves (available from restaurant supply stores or school cafeteria)
- Various measuring cups and spoons
- Cookie sheets
- Oven



1. Making bread is an art and a science. Prepare for making "bread-in-a-bag" by obtaining enough ingredients for each loaf. It is best to divide your students into groups of two, but groups of four will also work.
2. Heavy-duty Ziploc bags will ensure that you will not have rips or tears causing a mess. Also the bag keeps the process neat and fairly sanitary. If you are making bread as a microorganism experiment, vary the yeast, sugar, salt, or water temperature for interesting results. The only time your students will touch the dough is when it is placed on the cookie sheet. (A cookie sheet is what is most readily available in school

cafeterias, and kids can make different shaped loaves for identification. You won't need 15 bread pans!) Only one student needs to place the dough on the cookie sheet. Cheap food handlers gloves sprayed or coated with vegetable oil work great for this transfer.

3. The observations of the dough can be made throughout the kneading process. Doughs with extra sugar will seem quite a bit wetter, while those with extra yeast will seem quite hard. Students should record their observations while making the bread, while it rises (compare quick rise yeasts with regular yeasts), and then again after the bread is baked (texture, flavor, etc.).
4. In a one-gallon (heavy-duty) Ziploc bag, mix: 1/2 cup all purpose flour 1 pkg. or 2-1/4 teaspoons yeast 1/2 cup warm water 2 tablespoons sugar.
5. Close the bag and knead it with fingers until the ingredients are completely blended.
6. Leave the bag closed, with the contents in the corner, and let rest 10 minutes. You can eliminate this wait by using instant yeast.
7. Then add: 2 cups whole wheat flour 3/4 cup warm water 1 tablespoon vegetable oil 1-2 teaspoons salt Mix well. Add enough all-purpose flour to make a stiff dough, about 1 or 1-1/2 cups.
8. Close the bag and knead it (you may need to remove some air in the bag). Add more flour until dough no longer sticks to the bag.
9. Spray the hands or gloves (food handlers gloves) with oil so there will be no sticking.
10. Open the bag and allow the dough to fall out onto clean or gloved hands.
11. Form the dough into a loaf, and place in a loaf pan or onto a cafeteria cookie sheet. Remember the dough will grow 1-1/2 times larger, so leave space between loaves if baking on a cookie sheet.
12. Cover the loaves with oil sprayed plastic wrap and allow to rise 30 (quick rise yeast) to 45 minutes.
13. Bake for 30-35 minutes in a 350 degree oven.
14. Now that's "real world" science! Students can actually figure out what yeasts need to live and what they produce as wastes, gas bubbles, or wonderful bread aroma.

Links

- The Bread Lab
<https://thebreadlab.wsu.edu/>
- Time Lapse video – Pizza dough rising
<https://www.youtube.com/watch?v=kqa6TnKMP8k>
- Sourdough Starter recipe
<https://www.kingarthurbaking.com/recipes/sourdough-starter-recipe>
- Bread in a Bag Activity
<https://www.agclassroom.org/matrix/resource/50/>
- Wheat Milling video

<https://www.youtube.com/watch?v=8wjG38UPFw8&index=7&list=PLYA8jFF7RfxuR9YOc7Csh873sZ6irx9IL>

- History of Flour Milling
<https://time.graphics/line/10302>
- Wheat Grinding Tutorial video
<https://youtu.be/Rer8bszlGHc>
- White Bread Vs Whole Wheat (Grain) video
<https://www.youtube.com/watch?v=418KSrmpMwc>

Sources

1. <http://www.readerstoeaters.com/our-books/bread-lab>
2. Binczewski, Kim and Bethany Econopouly. *Bread Lab!* Readers to Eaters, 2018.
3. <https://secureservercdn.net/198.71.233.47/004.28f.myftpupload.com/wp-content/uploads/2020/02/NCSGGA-Consumer-Handout.pdf>
4. <https://www.agclassroom.org/matrix/lesson/77/>
5. <https://www.agclassroom.org/matrix/resource/50/>

K-5 Subject Areas

Reading, Writing, Speaking and Listening, Science, Social Studies, and Math

NC Standard Course of Study

Reading

- **RL.K.1** With prompting and support, ask and answer questions about key details in a text.
- **RL.K.2** With prompting and support, retell familiar stories, including key details.
- **RL.K.3** With prompting and support, identify characters, settings, and major events in a story.
- **RL.1.1** Ask and answer questions about key details in a text.
- **RL.1.2** Retell stories, including key details, and demonstrate understanding of their central message or lesson.
- **RL.2.1** Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text.
- **RL.2.3** Describe how characters in a story respond to major events and challenges.
- **RL.3.1** Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
- **RL.4.1** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
- **RL.5.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text
- **RI.K.1** With prompting and support, ask and answer questions about key details in a text.
- **RI.K.2** With prompting and support, identify the main topic and retell key details of a text.
- **RI.1.1** Ask and answer questions about key details in a text.
- **RI.1.2** Identify the main topic and retell key details of a text.
- **RI.2.1** Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text.
- **RI.3.1** Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
- **RI.3.2** Determine the main idea of a text; recount the key details and explain how they support the main idea.
- **RI.4.1** Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
- **RI.4.2** Determine the main idea of a text and explain how it is supported by key details; summarize the text.
- **RI.5.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.

Writing

- **W.K.6** With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question
- **W.1.6** With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.
- **W.2.6** Recall information from experiences or gather information from provided sources to answer a question.
- **W.3.6** Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.
- **W.4.5** Conduct short research projects that build knowledge through investigation of different aspects of a topic
- **W.5.5** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.

Speaking and Listening

- **SL.K.1** Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups.
- **SL.K.2** Confirm understanding of a text read aloud or information presented orally or through other media by asking and answering questions about key details and requesting clarification if something is not understood.
- **SL.K.3** Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
- **SL.K.4** Speak audibly and express thoughts, feelings, and ideas clearly.
- **SL.1.1** Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.
- **SL.1.2** Ask and answer questions about key details in a text read aloud or information presented orally or through other media.
- **SL.2.1** Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.
- **SL.2.2** Recount or describe key ideas or details from a text read aloud or information presented orally or through other media.
- **SL.2.4** Tell a story or recount an experience with appropriate facts and relevant, descriptive details, speaking audibly in coherent and complete sentences.
- **SL.3.2** Determine the main ideas and supporting details of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.
- **SL.3.4** Report on a topic or text, tell a story, or recount an experience with appropriate facts and relevant, descriptive details, speaking clearly in complete sentences at an understandable pace.
- **SL.4.2** Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.
- **SL.4.4** Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; adjust speech as appropriate to formal and informal discourse.
- **SL.5.2** Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.
- **SL.5.4** Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; adapt speech to a variety of contexts and tasks.

Science

- **1.E.2** Understand the physical properties of Earth materials that make them useful in different ways.
- **1.L.1** Understand characteristics of various environments and behaviors of humans that enable plants and animals to survive.
- **1.L.2** Summarize the needs of living organisms for energy and growth.
- **3.L.2** Understand how plants survive in their environments.
- **4.L.1** Understand the effects of environmental changes, adaptations and behaviors that enable animals (including humans) to survive in changing habitats.
- **5.L.2** Understand the interdependence of plants and animals with their ecosystem.

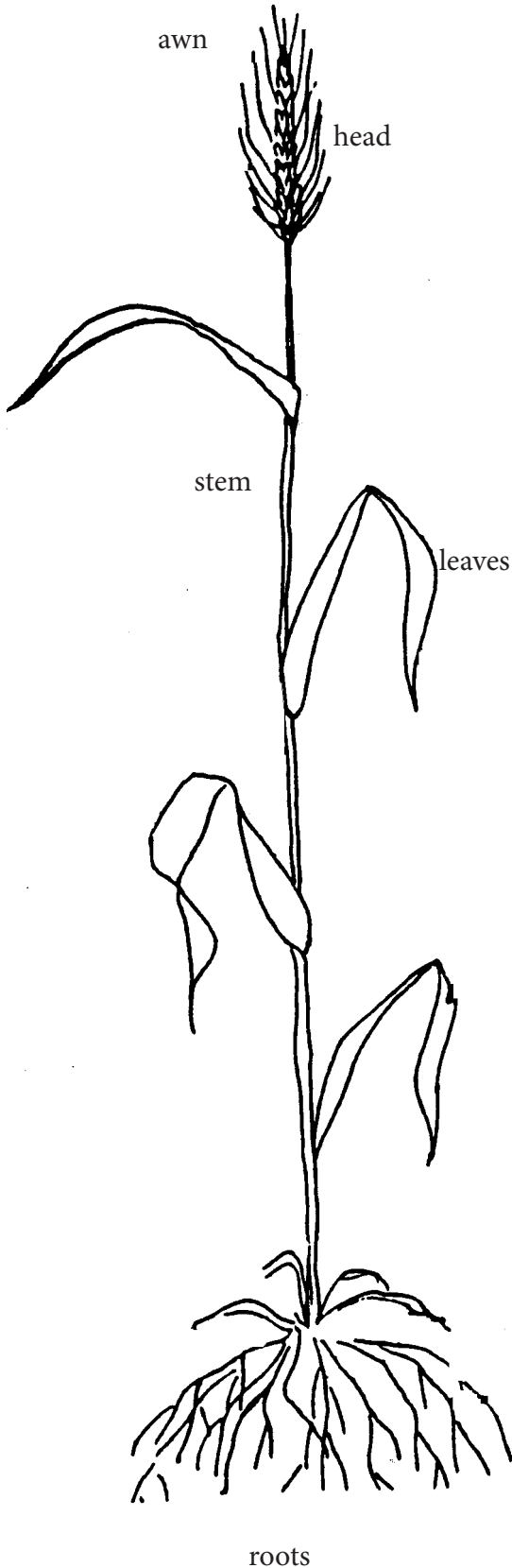
Social Studies

- **K.H.1** Understand change over time.
- **K.G.1** Use geographic representations and terms to describe surroundings.
- **K.G.2** Understand the interaction between humans and the environment.
- **1.H.1** Understand that history tells a story of how people and events changed society over time.
- **1.G.1** Use geographic representations, terms and technologies to process information from a spatial perspective.
- **1.G.2** Understand how humans and the environment interact within the local community.
- **2.H.1** Understand how various sources provide information about the past.
- **2.G.1** Use geographic representations, terms and technology to process information from a spatial perspective.
- **2.G.2** Understand the effects of humans interacting with their environment.
- **3.H.1** Understand how events, individuals and ideas have influenced the history of local and regional communities.
- **3.G.1** Understand the earth's patterns by using the 5 themes of geography: (location, place, human environment interaction, movement and regions).
- **3.E.1** Understand how the location of regions affects activity in a market economy.
- **4.G.1** Understand how human, environmental and technological factors affect the growth and development of North Carolina.
- **5.G.1** Understand how human activity has and continues to shape the United States.

Math

- **3.OA.3** Represent, interpret, and solve one-step problems involving multiplication and division.
- **3.OA.6** Solve an unknown-factor problem, by using division strategies and/or changing it to a multiplication problem.
- **3.NBT.2** Add and subtract whole numbers up to and including 1,000.
- **3.MD.3** Represent and interpret scaled picture and bar graphs.
- **4.OA.3** Solve two-step word problems involving the four operations with whole numbers.
- **4.MD.4** Represent and interpret data using whole numbers.

Anatomy of a Wheat Plant



The wheat plant has four basic parts: the head, stem, leaves and roots. Wheat plants grow to be about 2-4 feet tall.

The **awn** is a slender, bristle-like attachment of a wheat plant, such as those found at the tips of the spikelets in many grasses.

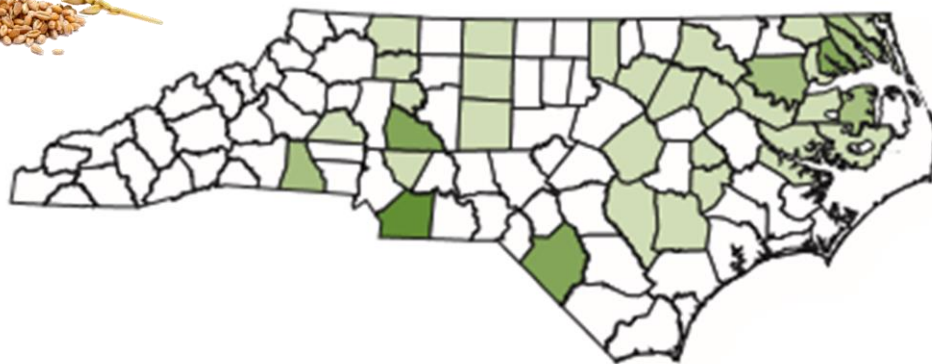
The **head** contains kernels or the wheat seeds.

The **stem** supports the head and helps transport nutrients and water throughout the plant.

The **leaves** are responsible for photosynthesis, the process in which green plants produce simple carbohydrates by using carbon dioxide, hydrogen and a light source, usually the sun.

The **roots** anchor the plant in the soil and absorb water and nutrients from the soil and transport them to the stem.

North Carolina Wheat Facts



Bushels

	Under 100,000
	100,000 to 249,999
	250,000 to 499,999
	500,000 to 999,999

- There are 6 classes of wheat grown in the United States. North Carolina wheat farmers primarily grow Soft Red Winter Wheat which is planted in the fall, grows in the winter and is harvested in late spring.
- There are many different wheat seed varieties the farmer can plant. In choosing the right variety farmers must consider: weather tolerance, variety adaptability, test weight, protein level, high yield, and resistance to diseases, pesticides, & weeds.
- 80% of NC wheat grown is used for livestock feed, 20% is used for human consumption to make flour.
- On average, North Carolina grows 500,000 acres (+ or -) of wheat every year throughout the state.
- The average farm size in North Carolina is 250 acres. The average yield per acre is 69.5 bushels. A bushel is 60 lbs. of wheat seed (seed = grain, berries, kernel)
- 1 bushel of wheat can make 45 loaves of bread. The farmer receives approximately \$5.00 per bushel, while the grocery store receives \$140 for 45 loaves of bread. THANK A FARMER.
- There are no commercially-available wheat varieties in the world today that have been Genetically Modified.
- Gluten is a protein found in wheat, rye, and barley. Gluten provides structure for baked products requiring volume such as bread. There is no caloric or nutritional advantage to eating Gluten-free foods.



ncwheat.com

About Us: The North Carolina Small Grain Growers Association is a nonprofit organization established to encourage, promote, and develop more efficient small grain marketing and production practices. Our goal is to participate in all matters relative to the interest of small grain producers in North Carolina. We promote applied research in production, efficient management practices, and variety development. We also promote educational programs for the progress of small grains in North Carolina and work with individuals, organizations, and governmental agencies toward the achievement of increased profits from small grain production in North Carolina. We are funded through a farmer approved assessment program receiving \$.005 of total money collected on Wheat, Oats, Rye, Barley, Canola, Rapeseed, and Grain Sorghum in the state.

Ingredients

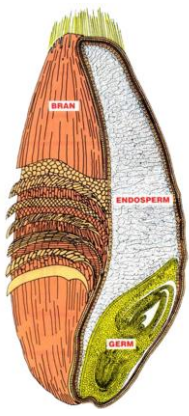
3/4 cup granulated sugar
3/4 cup packed brown sugar
1 cup butter or margarine, softened
1 teaspoon vanilla
1 egg
2 cups whole wheat flour
1 teaspoon baking soda
1/2 teaspoon salt
2 cups (12oz. pkg.) semisweet chocolate chips

Whole Wheat Chocolate Chip Cookies!



Instructions

Heat oven to 375°F. Mix sugars, butter, vanilla and egg in large bowl. Stir in flour, baking soda and salt. Stir in chocolate chips. Drop dough by rounded tablespoonfuls about 2 inches apart onto ungreased cookie sheet. Bake 8 to 10 minutes or until light brown (centers will be soft). Cool slightly; remove from cookie sheet. Cool on wire rack.



What's the Difference???

Whole Grains vs. Enriched Grains / Flour 101

The Wheat Kernel consists of three components:

- **BRAN** - The bran (outer layer) contains the largest amount of fiber.
- **ENDOSPERM** - The endosperm (middle layer) contains mostly protein and carbohydrates along with small amounts of B vitamins.
- **GERM** - The germ (inner part) is a rich source of trace minerals, unsaturated fats, B vitamins, antioxidants and phytonutrients.

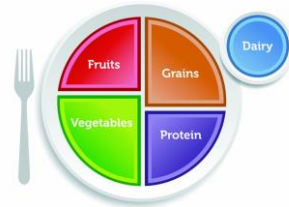
Whole Grain

Whole grain flour is made with the whole kernel of grain (Bran, Endosperm, and Germ). Whole grains are a rich source of a wide range of phytonutrients with anti-carcinogenic properties. Many of the phytonutrients concentrated in grains have shown promising results against cancer, heart disease, and diabetes.

Enriched Grain

Enriched white flour is the finely ground endosperm of the kernel. The assumption that everything good has been "stripped" away is a fallacy. Many of the nutrients that have been milled out are replaced through enrichment or fortification. Enriched White flour is a great source of Iron, B Vitamins, Folic Acid and Complex Carbs.

*According to the US Dietary Guidelines the recommended daily intake of grains for adults is about 6 ounces, 3 of which should be whole grains. Since wheat is a grain we encourage you to eat wheat every day! After all, the last three letters in wheat is **EAT**!*



Did you know Flour is made by grinding up Wheat Kernels?

There are many different types of flour too! Soft, low protein wheats are used for cakes, pastries, cookies, and crackers, while hard, high protein wheats make excellent breads.

Whole wheat flour This flour is milled from the entire kernel of hard red wheat either by grinding the whole-wheat kernel or recombining the white flour, germ and bran that have been separated during milling. The presence of bran reduces gluten development, therefore, items baked with whole wheat flour tend to be heavier and more dense than those made from white flour. The insoluble fiber content is higher than in white flours.

White flour

The finely ground endosperm of the wheat kernel.

Self-rising flour Self-rising flour is a convenience product made by adding salt and leavening to all-purpose flour. It is commonly used in biscuits and quick breads, but is not recommended for yeast breads. One cup of self-rising flour contains 1½ teaspoons baking powder and ½ teaspoon salt. Self-rising can be substituted for all-purpose flour by reducing salt and baking powder according to these proportions.

All-purpose flour White flour milled from hard wheats or a blend of hard and soft wheats. It gives the best results for a variety of products, including some yeast breads, quick breads, cakes, cookies, and pastries.. All-purpose flour is usually enriched and different brands will vary in performance. Protein content varies from 8-11 percent.

White whole wheat flour This flour is milled exactly like whole wheat flour and is nutritionally equivalent to whole wheat flour as well. The only difference is that whole white wheat flour is made with a white, not red wheat variety. The bran of white wheat is lighter in color and has a milder flavor than red wheat and therefore the flour has these properties as well.

Gluten flour Usually milled from spring wheat and has a high protein (40-45 percent), low-starch content. It is mixed with other non-wheat or low-protein wheat flours to produce a stronger dough structure. Gluten flour improves baking quality and produces a high-protein bread.

Cake flour Fine-textured, silky flour milled from soft wheats with low protein content. It is used to make cakes, cookies, crackers, quick breads and some types of pastry. Cake flour has a greater percentage of starch and less protein, which keeps cakes and pastries tender and delicate. Protein varies from 7-9 percent.

Pastry flour Has properties intermediate between those of all-purpose and cake flours. It is usually milled from soft wheat for pastry-making, but can be used for cookies, cakes, crackers and similar products. It differs from hard wheat flour in that it has a finer texture and lighter consistency. Protein varies from 8-9 percent.

Bread flour White flour that is a blend of hard, high protein wheats and has greater gluten strength and protein content than all-purpose flour. Bread flour is milled primarily for commercial bakers, but is available at most grocery stores. Protein varies from 12-14 percent.