SC Farm Bureau
Ag in the Classroom
Post Office Box 754
Columbia, SC 29202

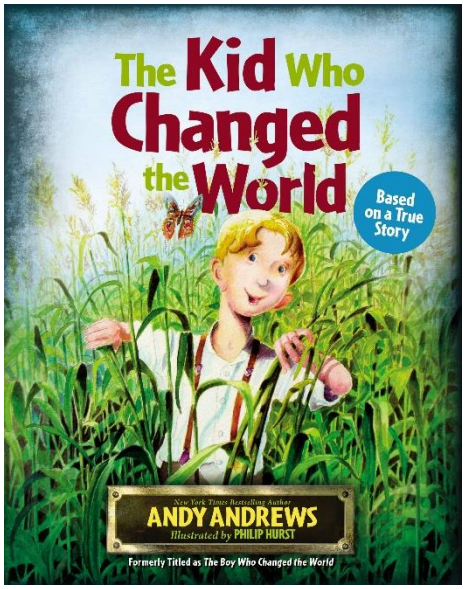
803.936.4237
SC Ag in the Classroom
@SCagintheclass

August 2021 Book of the Month

The Kid Who Changed The World

By: Andy Andrews

This book tells the story of Nobel Laureate, Norman Borlaug. Norman grew up as an average farm boy, but later his work as a plant scientist reached far and wide to help improve the growth of wheat, rice, and corn all over the world. It also explains the work of other important figures in the world of agriculture. This book highlights the benefits of emerging science, but also has an underlying message to teach students that, "Every choice you make, good or bad, can make the difference." [1]



Did You Know? (Ag Facts) [2]

- Wheat was first planted in the United States in 1777 as a hobby crop. Today, wheat is grown in 42 states across the country.
- Besides flour and bread, other products form the wheat plant include straw particle board (wood) that is used in many kitchen cabinets, paper, hair conditioners, postage stamp adhesives, medical swabs, charcoal, and biodegradable plastic eating utensils.
- Norman Borlaug's research was instrumental in the creation of faster-growing wheat varieties and other grains that withstood disease and drought. These varieties were introduced to people all over the world.

Discussion Questions

- Why did Norman decide to "change the world" as a boy?
- How were the choices of the people in the story important?

Grade Level(s): 3-6

Purpose: Students will explore the life and contributions of Nobel laureate Norman Borlaug as well as identify the parts of a wheat plant and wheat kernel.

Vocabulary:

- **biotechnology:** the use of living systems and organisms to develop or modify products or processes
- **bran:** the multi-layered, hard outer covering of a kernel of cereal grain
- **DNA:** deoxyribonucleic acid - a molecule that carries the genetic instructions used in the growth, development, functioning, and reproduction of all known living organisms
- **embryo:** a tiny young plant within a seed
- **endosperm:** nutritive matter formed within a seed in seed plants
- **gene:** a section of a chromosome that acts as a code for making a particular substance
- **genetic trait:** a feature or quality that is passed on from one generation to the next in genes
- **genetically modified:** an organism or crop containing genetic material that has been artificially altered so as to produce a desired characteristic
- **germ:** the embryo of a seed in the seed of a cereal grain
- **gluten:** a tough, elastic protein substance in flour, especially from wheat, that holds together dough and makes it sticky
- **grain:** the edible seed or seed-like fruit of grasses that are cereals
- **Green Revolution:** scientific technology that allowed researchers to create plants that will grow in marginal areas
- **mill:** a machine used in treating (by grinding, crushing, stamping, cutting, or finishing) raw material
- **photosynthesis:** the process through which a green plant turns water and carbon dioxide into food when the plant is exposed to light
- **plant breeder:** a scientist that changes the traits of plants in order to produce desired characteristics

Background Agricultural Connections: [3]

When farmers make decisions about which varieties of wheat to plant, they are thinking about genetics. Each variety of wheat has **DNA** (deoxyribonucleic acid) that gives it certain **genetic traits**. In the wheat kernel, the DNA is located in the germ, which is the **embryo** or sprouting section of the seed. Some varieties of wheat grow better in drought conditions while others are better at resisting certain pests. Some wheat varieties have a higher moisture content or contain higher percentages of protein. These traits are important when considering the types of products that can best be produced by the flour of different classes of wheat.

The wheat plant has four basic parts—roots, stem, leaves, and head. The *roots* anchor the plant in the soil, absorbing water and nutrients and transporting them to the stem.
The *stem* supports the head and helps transport nutrients and water throughout the plant.
The *leaves* are responsible for **photosynthesis**. The *head* of the wheat plant contains the wheat seeds, also referred to as kernels or berries.

Wheat flour is made from the kernels of the wheat plant. The kernel is the seed from which the wheat plant grows. A wheat kernel contains three distinct parts—the **bran**, **germ**, and **endosperm**. The *bran* is the multi-layered, hard outer covering of the kernel. Bran consists of important antioxidants, B vitamins, and fiber. The *germ* is the embryo or sprouting section of the kernel. It is the part of the wheat kernel that will sprout and grow into a new wheat plant. During the milling process, the germ is often separated from the flour because its fat content limits the flour's shelf-life. The germ contains B vitamins, protein, minerals, and healthy fats. The *endosperm* is the germ's food supply. In its natural state, the endosperm provides essential

energy to the young wheat plant, allowing the plant to send roots down into the soil to absorb water and nutrients and shoot sprouts up for sunlight.

American farmers grow six main classes of wheat—Hard Red Winter, Hard Red Spring, Soft Red Winter, Soft White, Hard White, and Durum. In addition to the time of year in which they are harvested, wheat classes are also determined by the hardness, shape, and color of the kernels. Hard wheats contain high levels of protein. Protein develops gluten which gives elasticity, structure, and strength to dough and creates a chewy texture in the finished product. These characteristics are important to the bread-making process. Soft wheat flour is ideal for making cakes, pastries, cookies, and crackers. The low protein levels create a flaky texture in the finished product. Durum wheat is a botanically separate species from the hard and soft wheat varieties. Its high protein content and gluten strength make it ideal for making pasta. The gluten levels make the dough firm and allows the pasta to hold its shape until it dries. Spring wheat is planted in the spring and harvested in the late summer or early fall. Winter wheat is planted in the fall and harvested in the spring.

Farmers decide which varieties to grow based on growing conditions in their area. They consider factors such as rainfall, temperature, soil condition, and customer preferences. Soft wheats grow best in humid areas where temperatures remain elevated throughout the night. Hard wheats require low humidity, hot daytime temperatures, and cool temperatures at night.

Norman Borlaug was a **plant breeder** who developed wheat varieties to help people get more food from their land. Borlaug's research was instrumental in the creation of faster-growing wheat varieties and other grains that withstood disease and drought. He introduced these varieties to people all over the world and taught them how to implement farming practices. Norman Borlaug received the Nobel Peace Prize in 1970 for his work that saved over a billion people from starvation in developing countries like Mexico, India, and Pakistan. Borlaug used traditional plant selection methods in his breeding programs. He was ahead of his time in creating varieties that caused the **Green Revolution**. His leading research achievement was the development of Dwarf Spring Wheat. Borlaug found that plants with stalks that were short and of equal length would receive equal amounts of sunlight when they did not have to compete with taller-stalked plants. Nature favors genes for tall stalks because, in nature, plants must compete for sunlight. Borlaug's dwarf wheat uses its energy to grow valuable grain rather than using its energy to grow tall stalks with no food value. Stout, short stalks also support wheat kernels better. Tall-stalked wheat may bend over at maturity, making it difficult to harvest.

Modern technology allows plant breeders to make precise genetic changes in order to address disease, insect, or environmental challenges more rapidly. Agricultural **biotechnology** is an advanced technology that allows plant breeders to identify the specific **genes** responsible for individual traits and transfer only the desired traits between plants. Currently, there is no **genetically modified** wheat seed available to farmers in the US.

The Kid Who Changed The World [2]

Materials:

- *The Kid Who Changed The World* by Andy Andrews

Procedures:

1. Discuss the importance of wheat as a staple food product. Explain that wheat can be successfully grown in many different areas of the world and can provide needed nourishment for many people.
2. Read the book, *The Kid Who Changed the World* by Andy Andrews.
3. Discuss the contribution Norman Borlaug made to the worldwide efforts against hunger. Use the following questions to guide the discussion:
    a. How did Norman Borlaug change the world? (*He created special seeds that grew into super plants that could feed more people around the world.*)
    b. How many people did the work of Norman Borlaug save from starvation? (*two billion people*)
    c. Why was it important for Norman Borlaug to learn everything he could about plants and the genetic traits of crops? (*Norman Borlaug needed to know about plants and genetic traits so that he could create seeds that had specific traits to grow fast, avoid disease, and grow in different areas of the world.*)
4. If students need more information on Borlaug, have them watch the following documentary: https://www.youtube.com/watch?v=Lg9-HTtgFOk
5. Have students answer the following journal prompt: How can I change the world?

Wheat Kernel Dissection Model [4]

Materials:

- Loaf of white bread or photo
- Loaf of whole wheat bread or photo
- Wheat kernels
- White flour
- Whole wheat flour
- Anatomy of a Wheat Plant Diagram, 1 per student
- White Bread vs. Whole Wheat Grain video
- 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
- Wheat Kernel Dissection Image, 2 per student
- 8 1/2" x 11" piece of lined paper, 3 per student
- Brads, 1 per student
- Glue sticks
- Scissors
- Hole punches

*Jewel bags are available for purchase from agclassroomstore.com.

Procedures:

1. Show the students a loaf of white bread and a loaf of wheat bread, or use the attached photos. Draw a Venn diagram on the board. Label one circle "White Bread" and the other circle "Whole Wheat Bread."
2. 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.
3. 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 the 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 anatomy of a wheat kernel.

4. 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.
5. Tell the 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.
6. 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.
7. 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." Using the information from the *Background Agricultural Connections* section of this lesson, discuss the three parts of the wheat kernel and have the students take notes about each part on their paper.
8. 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.
9. Provide each student with two copies of the Wheat Kernel Dissection Image, three pieces of lined paper, a brad, scissors, and a glue stick. Have them cut out both of the *Wheat Kernel Dissection Images*. Trace one of the images onto three pieces of lined paper, cut each lined kernel out, and number each page. Set one of the *Wheat kernel Dissection Images* aside and cut the bran, germ, and endosperm apart from the other.
10. Glue the bran image on page 1 of the lined kernels, the germ on page 2, and the endosperm on page 3.
11. Using their notes, have the students write a description of each part of the wheat kernel on the corresponding page.
12. Layer the wheat kernel model with the jewel bag of wheat seeds on top followed by the intact *Wheat Kernel Dissection Image*, page 1, 2, and 3. Punch a hole in the top of the packet and attach with a brad.

Extension Activities:

- Visit the *Interactive Map Project* website and view the map representing Wheat Production in the United States. Identify the states that produce the most wheat and then find where your state ranks for wheat production.
- View the video Norman Borlaug & the Green Revolution to learn more about Norman Borlaug's work with wheat.
- Read and discuss the Biotechnology Ag Mag to learn more about agricultural biotechnology.

- View the video How It's Made Flour to learn more about how wheat kernels are milled into flour.

Suggested Companion Resources:
- How to Extract DNA from Anything Living
- Bread Comes to Life
- Bread Lab!
- Everybody Bakes Bread
- From Wheat to Bread
- The Boy Who Changed the World
- The Wheat Doll
- Strawberry DNA Necklace
- Wheat Bundle
- Wheat Germ DNA Necklace
- Wheat Kernel Samples
- Amazing BREAD Processing- How It's Made Inside a Factory
- America's Heartland: Wheat Harvest
- Biotechnology Ag Mag
- Garden Genetics: Teaching With Edible Plants
- DNA Learning Center

Sources/Credits:

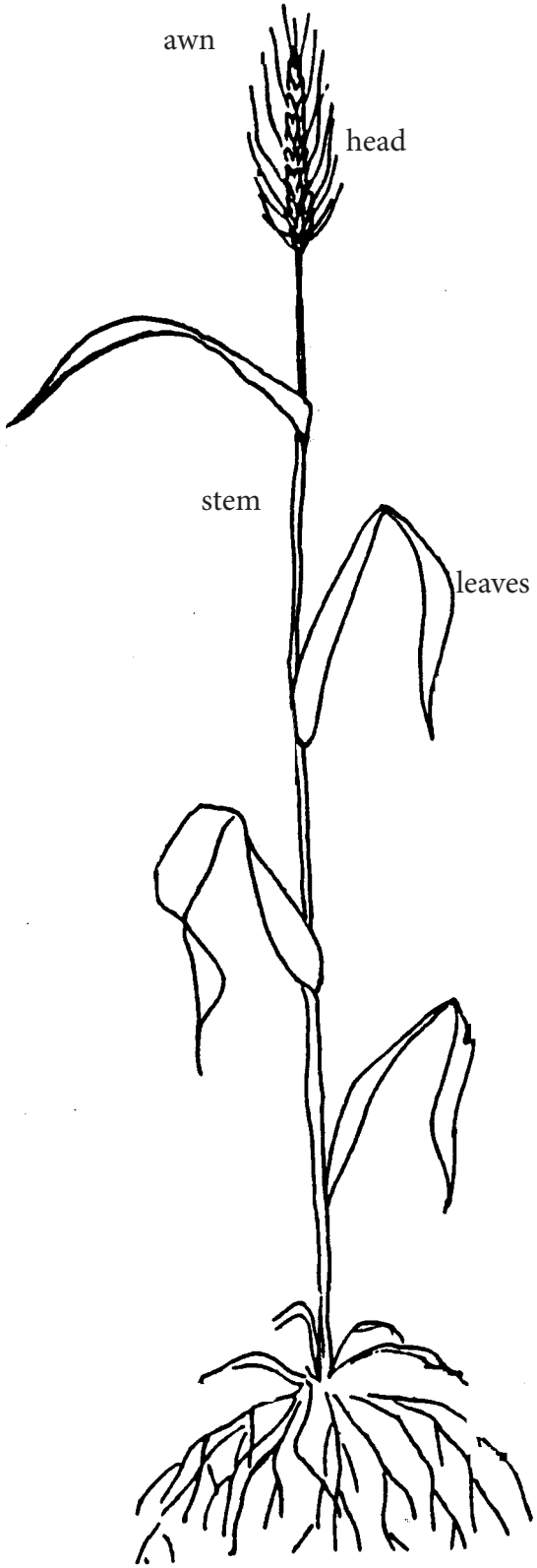
1. Andrews, Andy. *The Kid Who Changed The World*, Thomas Nelson, 2014.
2. NC Ag in the Classroom
3. Kansas Foundation for Agriculture in the Classroom
4. Oklahoma Agriculture in the Classroom

Suggested SC Standards Met:

English/Language Arts:
- 3.RI.5.1 Ask and answer literal and inferential questions to determine meaning; refer explicitly to the text to support inferences and conclusions.
- 3.RI.8.1 Explain how the author uses words and phrases to inform, explain, or describe.
- 3.RI.8.2 Use knowledge of appendices, timelines, maps, and charts to locate information and gain meaning; explain how these features contribute to a text.
- 3.RI.10.1 State the author's purpose; distinguish one's own perspective from that of the author.
- 4.RI.5.1 Ask and answer inferential questions to analyze meaning beyond the text; refer to details and examples within a text to support inferences and conclusions
- 4.RI.8.1 Determine how the author uses words and phrases to shape and clarify meaning.
- 4.RI.8.2 Apply knowledge of text features to gain meaning; describe the relationship between these features and the text.
- 5.RI.8.1 Analyze how the author uses words and phrases to shape and clarify meaning.
- 6.RI.5.1 Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
- 6.RI.7.1 Integrate information presented in different media or formats to develop a coherent understanding of a topic or issue.

Science:
- 3.L.5: The student will demonstrate an understanding of how the characteristics and changes in environments and habitats affect the diversity of organisms.
- 4.L.5: The student will demonstrate an understanding of how the structural characteristics and traits of plants and animals allow them to survive, grow, and reproduce.
- 5.L.4: The student will demonstrate an understanding of relationships among biotic and abiotic factors within terrestrial and aquatic ecosystems
- 6.L.5: The student will demonstrate an understanding of the structures, processes, and responses that allow protists, fungi, and plants to survive and reproduce.

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.

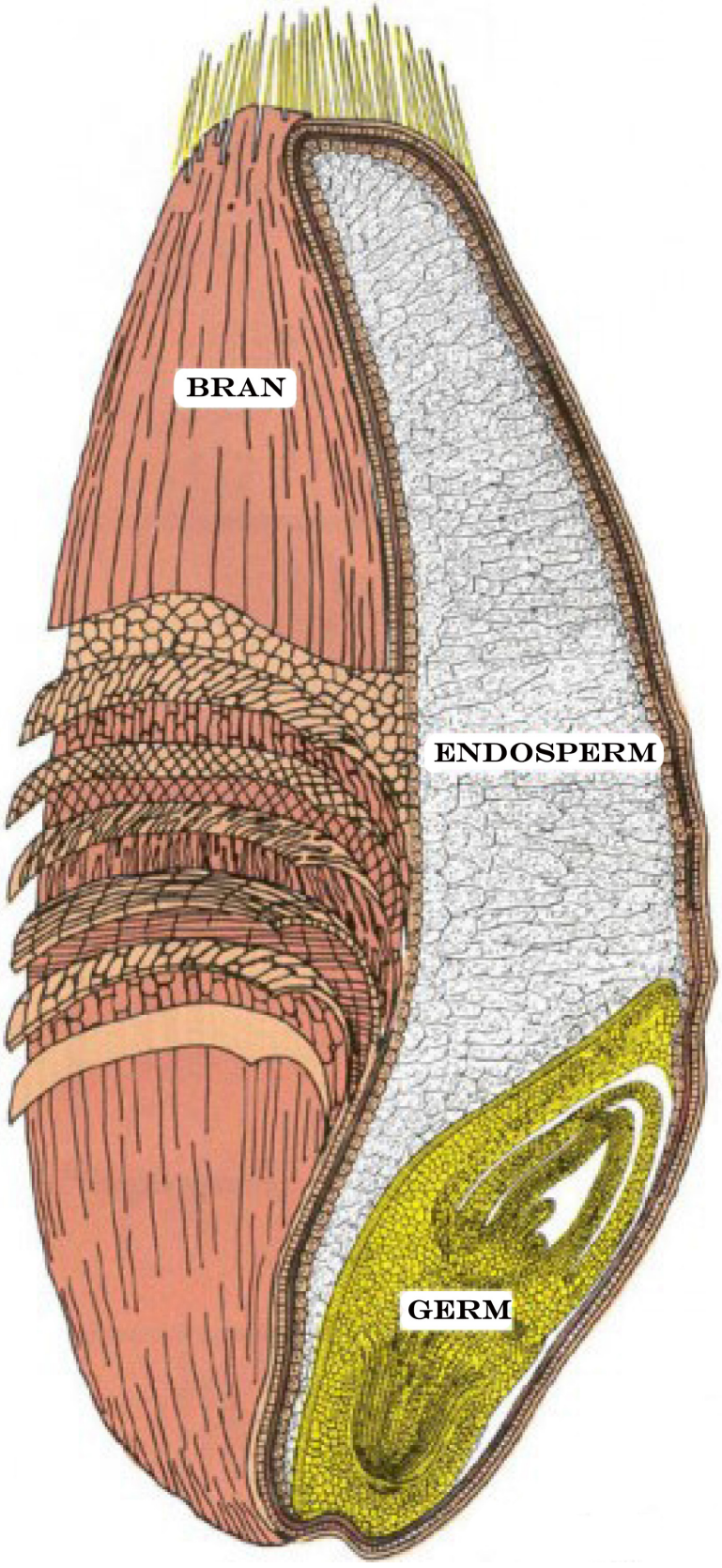
The **awn** is a slender, bristle-like attachment of a wheat plant, such as those found at the tips of the spikelets in many grasses.

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.


BRAN
ENDOSPERM
GERM