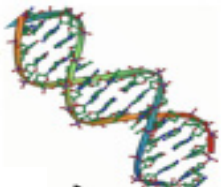
Wheat Germ DNA Extraction


Wheat


Flour →


Bread


Wheat Germ →


DNA

Science Standards LS3 A & B Inheritance and Variation of Traits

BRIEF DESCRIPTION

What is the genetic makeup of plants that produce our bread?

PURPOSE OF LESSON

• This lesson takes a very abstract subject and brings it to a level that kids can see, work with and relate to.
DNA is something that can be difficult to grasp because it cannot be seen. Kids are just told that it is there, making up everything that lives. It is what our body and all living things are made up of, but we can't see it, so how do we know it's really there??? This exercise brings it down to a more understandable visual level, while showing kids that even things that seem simple, like bread, are actually pretty complex when you break it down.
(adapted from Kansas Farm Bureau, Breaking Down Bread lesson plan)

REPURPOSING GENETICS

• When farmers are making decisions about what varieties of wheat to plant, they are thinking about DNA. Each kind of wheat has DNA that gives it certain characteristics to help it grow better in a particular region, season, etc. When a farmer chooses to use a variety that is genetically changed through natural selection that is drought or pest resistant, or has some other desirable quality, he/she is using wheat that is drought or pest resistant, or has some other desirable quality; he/she is using wheat that has had its DNA purposefully altered. So, as you can see, DNA is important in many ways, including the improvement of crops that become the food to feed a hungry world. Currently there is no genetically modified variety of wheat available to farmers.

MATERIALS NEEDED

- Water
- 1 beaker
- Raw wheat germ (not cooked)
- Liquid soap
- Spoon
- Stirrer
- Baking soda
- Meat Tenderizer
- Test tube
- Eyedropper

DIRECTIONS

1. Pour 100 ml of warm water into a cup/beaker
2. Add one spoonful of raw wheat germ and stir a few times
3. Add one squirt of liquid soap, stir a few more times, but not so hard that you generate bubbles
4. Add 1 tsp baking soda and 1/8 tsp meat tenderizer; stir for 5-10 minutes, then let solids settle to the bottom
5. Draw off some of the clear liquid at the top with eyedropper, you do not want solids at the bottom, put into a test tube
6. Fill the test tube 1/3 full of liquid.
7. Add denatured alcohol slowly with eyedropper and watch the DNA strands appear at the interface between the wheat germ slurry and the alcohol

Source: Saint Louis Science Center

Norman Borlaug and the Green Revolution

STANDARDS - LANGUAGE ARTS READING AND COMPREHENSION

Read *The Boy Who Changed The World*, by Andy Andrews

You will discover the importance of Norman Borlaug's research in creating a wheat variety that withstood disease and drought so more people could grow it on marginal land. Therefore, more people were fed. Norman Borlaug made his amazing wheat breeding progress using traditional plant selection methods. Though he was ahead of his time in creating varieties that caused the green revolution, he supported the idea of using genetically modified seeds to produce super varieties that would increase production of grain or food for a hungry world.[1] Read the entire editorial to get the context of the message.

The book traces the importance of taking action and connects three historic figures to the final goal of feeding the hungry; George Washington Carver, Henry Wallace, and Norman Borlaug.

Teachers can order the book and/or download it onto ipods for convenience of their students. A 54 page educator guide can be ordered online to facilitate reading and discussion. This book is a great connection to the importance of traditional plant breeding as well as the need for genetic engineering to allow us to feed a rapidly growing population on the same land base we have now!

Free downloadable school curriculum to compliment *The Boy Who Changed The World*
2010
ISBN 978-1-4003-1605-2 (hardcover)
www.AndyAndrews.com/Education

MORE RESOURCES

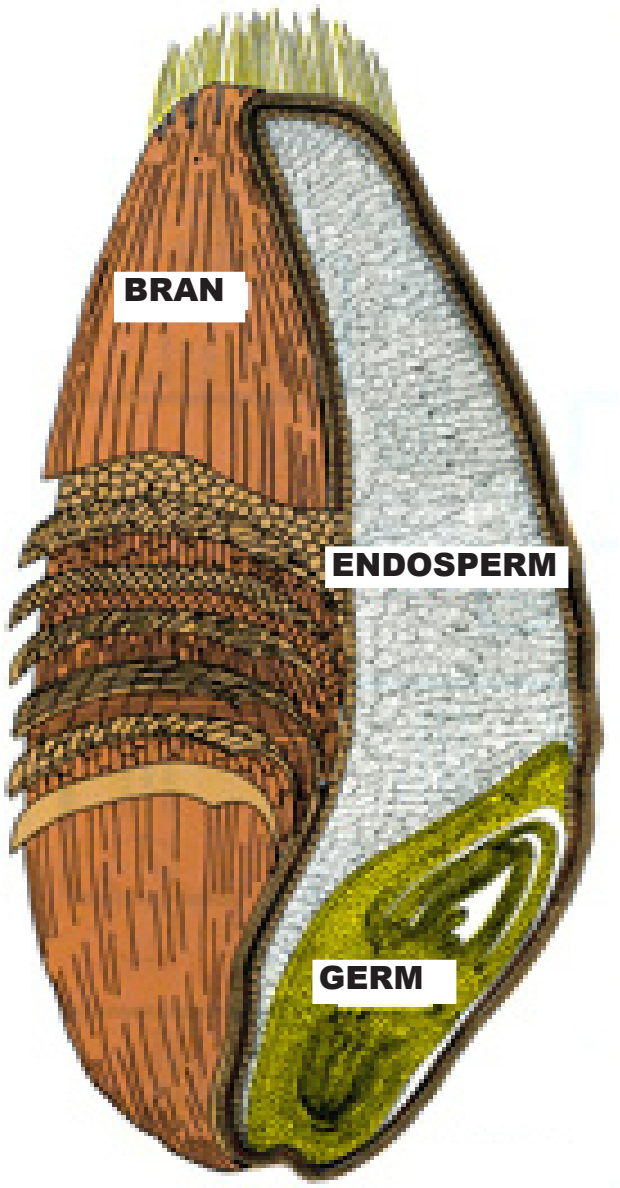
Wheat lesson plans at www.ksagclassroom.org

Kernel Kids - Wheat Germination - Plant Growth and Development - Wheat Posters - Plant Posters - Growth and Development Cycle of Winter Wheat

Exploring Plants, KS Crops Educator Guide (order online)
Wheat pp. 123-124; 42-43
Biotechnoloy pg. 32

[1]To read an editorial by Norman Borlaug in 2007, two years prior to his death, go to www.sciencemag.org. Science Vol 318 19October2007.

A Kernel of Wheat



The Kernel of Wheat

...sometimes called the wheat berry, the kernel is the seed from which the wheat plant grows. Each tiny seed contains three distinct parts that are separated during the milling process to produce flour.

Endosperm

...about 83 percent of the kernel weight and the source of white flour. The endosperm contains the greatest share of protein, carbohydrates and iron, as well as the major B-vitamins, such as riboflavin, niacin, and thiamine. It is also a source of soluble fiber.

Bran

...about 14 1/2 percent of the kernel weight. Bran is included in whole wheat flour and can also be bought separately. The bran contains a small amount of protein, large quantities of the three major B-vitamins, trace minerals, and dietary fiber - primarily insoluble.

Germ

...about 2 1/2 percent of the kernel weight. The germ is the embryo or sprouting section of the seed, often separated from flour in milling because the fat content (10 percent) limits flour's shelf-life. The germ contains minimal quantities of high quality protein and a greater share of B-complex vitamins and trace minerals. Wheat germ can be purchased separately and is part of whole wheat flour.

Source: Wheat Foods Council

Wheat's genetic story

Genes or genetic code in cells is made up of a chemical called DNA or Deoxyribonucleic acid. This is a type of weak acid that naturally forms a long twisted ladder shape called a double helix.

A gene is a section of a chromosome containing a special sequence of DNA.

Humans have 23 pairs of chromosomes in each cell.

Wheat (Triticum aestivum) is the most important crop in the temperate zone. The oldest traces of wheat cultivation are from the seventh pre-Christian millennium in the Middle East. With its subsequent spread to Europe, North Africa and Asia, wheat became an important crop for ancient cultures and civilizations.

"Einkorn" wheat (T. monococcum) is the oldest form of cultivated wheat; some wild forms still exist today.

The most commonly grown form of wheat in Europe is Triticum aestivum - bread wheat. Other forms of local interest are durum wheat (Triticum durum) and spelt (Triticum spelta, German wheat). Wheat forms like Triticum turgidum, "emmer" (Triticum dicoccum), or "Einkorn" (Triticum monococcum) can still be found on occasion.

The bread wheat genome is classified as a hexaploid genome. This means that it has six copies of each of its seven chromosomes; the complete set numbering 42 chromosomes. In contrast, the human genome is diploid, with 23 pairs of chromosomes and a total of 46 chromosomes.

To put the huge size of the bread wheat genome into context, its constituent number of paired DNA bases, or nucleotides, totals 17,000,000,000 base-pairs (17 Gb). This is about five times the amount of DNA in the human genome.

Source: Science Daily, November 28, 2012

Currently, there is no genetically modified wheat seed available to farmers. Though double haploid research at Kansas Wheat Innovation Center uses a process to speed up genetic progress by several years.

Modern technology allows plant breeders to make precise genetic changes and 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.

Agricultural biotechnology efforts focused first on increasing pest resistance, disease resistance, and herbicide tolerance (reducing competition for nutrients between crops and weeds). These efforts have allowed significant increases in food production without expanding the acreage devoted to crop production. Researchers are also developing crops that contain enhanced nutrients, are resistant to drought or other environmental conditions, and are allergen-free.

Today, it is estimated that at least 70 percent of the processed foods available in the U.S. grocery stores contain at least one ingredient derived from plants enhanced through biotechnology. Foods and plants developed using biotechnology are thoroughly tested and scrutinized before receiving regulatory approval for use. Agricultural biotechnology, the technology used by plant breeders to add beneficial traits to plants, is regulated by three agencies in the United States: the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS), the Environmental Protection Agency (EPA), and the Food and Drug Administration's Center for Food Safety and Nutrition.

Globally, the adoption of agricultural biotechnology is increasing food production particularly in areas with less than ideal growing conditions. In 2009, 14 million farmers in 25 countries used agricultural biotechnology. Ninety percent (13 million) of those were resource-poor farmers in developing countries. By increasing resistance to disease, pests, and imperfect growing conditions, biotechnology is protecting plant health around the world.

Source: Myths & Facts: Plant Biotechnology Council for Biotechnology Information, 2010

Vocabulary

Chromosome - long thin strands of DNA.

DNA - Deoxyribonucleic acid - a weak acid that forms a long twisted ladder shape called a double helix.

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.

Genome - The complete set of genes for a particular species.

Genome Mapping - working out the complete sequence of bases in an entire genome.

Genetic Engineering - making changes to the genes of DNA of a particular species in order to make it grow and live differently.

Genetic Modification- Another word for genetic engineering. A shortened version, GM is often used to describe genetically engineered plants and animals used for food.