Plant Science

Soybean Science

Science, Technology

Materials
¼ cup frozen soybeans
Electric coffee bean grinder
Eye dropper
Microscope and glass slide with cover
Pyrex glass container: measuring cup or pie plate
Hot water (boiling temperature is best)
Absorbent brown paper/paper towel

Grade Level: 4

Time: 30 minutes + overnight

Standards:
Science

Overview
Soybeans are an important source of oil, and soybean oil is used in hundreds of products we use everyday. Soybean oil is widely used in cooking oil, bio-diesel fuel, crayons and printing ink. In this lesson, students will extract oil from soybeans.

Objectives
1. Students will extract oil from soybeans.

Background Information
Even though soybeans have been a major food crop in China for over 5000 years, they were not grown in our country until the 1800's. They were grown in the United States for animal forage until a scientist, George Washington Carver, began studying them in 1904. He found many ways to use soybeans that had never been discovered before. Today, soybeans are a valuable crop in our country because they possess oil and protein that can be used in many different products.

Soybeans are one of the top five crops grown in Kansas. Total U.S. soybean exports have almost doubled since 1984, from nearly 598 million bushels to over 1.1 billion bushels in 2005. Exports to China have more than doubled in the since 2004, from over 197 million bushels to over 432 million bushels. A bushel of soybeans weighs about 60 pounds. Each bushel can be turned into 11 pounds of oil and 48 pounds of protein-rich meal to be sold here in the U.S. and around the world.

Soybean oil is used in hundreds of products we use everyday. From foods to ink, from paints to plastics, soybeans are an important ingredient in our lives. Soybeans are often called magic beans because they can be made into so many products. Some of the products that include soybean oil or soybean protein are: cereal, chocolate, hot dogs, candy, baby food, flour, soup, ice cream, cookies, soap, shampoo, fabric softener, cosmetics, pet food and vitamins.

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Soybean oil is widely used in cooking oil, bio-diesel fuel, crayons and printing ink. Cooking oil made from soybeans is low in saturated fat and is used to help reduce fat and lower cholesterol in our diets. Diesel fuel made from soybean oil is biodegradable, sulfur-free, does not produce explosive vapors and emits a much lower amount of pollutants. "Prang Fun-Pro" crayons are made from soybean oil and provide brighter and smoother colors that don't flake. Printing ink used by newspapers and other commercial printers are often made with varying amounts of soybean oil. Soy ink is used because it prints more paper per pound and offers better color reproduction.

Preparation

Soybeans should be frozen prior to this lesson. You can ask a soybean farmer or a farmer's COOP for some untreated (no chemicals including insecticides) soybeans.

Instructional Format

1. Share background information with students.
2. Students will follow procedures for the activity. Lab safety rules should be taught and explained as they proceed through the lesson.
3. Upon completing the lesson, students will discuss the activity.

Procedures

1. Measure ¼ cup of frozen soybeans and place in an electric coffee grinder. Pulverize and grind to a fine powder.
2. Place the finely ground soybeans into a Pyrex glass container and carefully cover with boiling water. Use enough water that the mixture can separate into layers. Stir the mixture for approximately one minute and then let it sit.
3. Ask students what the mixture looks like. Also, ask students if the mixture has an odor.
4. Let the mixture sit – preferable overnight; at least until later in the day.
5. Ask students if the appearance of the mixture changed (i.e. any layers that can be seen).
6. Using an eyedropper, carefully extract a sample from the top layer of the mixture. Place a drop of the sample onto a slide with cover and place under a microscope. Beads of oil should be observable as students take turns looking through the microscope. You may need to draw on the board what they should look for.
7. Have a student barely touch the top layer of the mixture in the Pyres glass container with their finger. Have them rub their finger on the palm of their other hand. Have this student describe what it feels like. Have another student touch the top layer with their finger and then rub in on a piece of absorbent brown paper/paper towel. Have this student describe what it looks like.

Your students should be able to see and touch the results of crushing, stirring and soaking soybeans. The result is that oil is released from the soybeans and collects on top of the mixture because it is less dense than the other substances in the mixture. This oil is what the students saw under the microscope of felt or saw when they touched the top layer of the mixture. The soybean meal should settle to the bottom of the jar, while the middle layer is a solution of water and protein. The commercial process of extracting oil from soybeans is much more complex and involves a chemical solution.

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Conclusion Questions (Assessment)

1. Soybeans are an important source of what two things?
   Oil and protein

2. Soybeans are ingredients in what products?
   Cooking oil, printing ink, diesel fuel, etc.

3. Who did the first soybean research in the U.S.?
   George Washington Carver, 1904

Resources

Kansas Soybean Commission and Kansas Soybean Association (2009). http://www.kansassoybeans.org

Kansas Foundation for Agriculture in the Classroom. *Growth stages of Kansas soybean.* http://www.ksagclassroom.org

Additional Resources

Awesome Agriculture for Kids books. *Soybeans in the story of agriculture. Soybeans an A-to-Z book*. For more information, contact Kansas Soybean Commission, (800) 328-7390.

Want More? Extensions

Look for soybeans on product labels at home and bring the products to school to add to a display OR just add names of products found to an on-going discovery list kept on a bulletin board.