

Soybean Smash



Objectives: Students will learn about the nutrient content of a soybean and how we utilize these products in society through an activity called: Soybean Smash.

Oklahoma Academic Standards:

Science: 7.PS1.2; 7.PS1.3

Teacher Background:

Soybeans are an oilseed crop and serve as a high quality vegetable protein source for both animals and humans. Along with being used a food source, soybeans are also used as a petroleum replacement in many consumer products like tires, crayons, and paints! Perhaps one of the most well-known uses of soybeans is their role in the production of biodiesel, a cleaner-burning substitute or addition to petroleum diesel. Of the two billion gallons of biodiesel produced in the United States in 2020, about half was produced using soybeans. Through completing the Soybean Smash activity, students can see how a soybean is separated into various components and how those components are then used to create a vast array of important consumer products today.

Important Vocabulary:

Soybean: a widely cultivated plant of the pea family that produces edible seeds

Soybean Oil: a vegetable oil extracted from the seeds of soybean plant

Soybean Meal: the by-product of the extraction of soybean oil

Processing: perform a series of mechanical or chemical operations on (something) in order to change or preserve it.

Oilseed Crop: a seed or crop (such as flaxseed) grown mainly for oil

Biodiesel: a biofuel intended as a substitute for diesel.

Materials (per group OR for 1 class demonstration):

For Activity:

- ½ cup of soybeans
- 1 quart resealable bag
- 1 gallon resealable bag
- Brown paper sack
- Newspaper
- Mortar and Pestle
- Plastic Cup
- Spoon
- Access to hot water

Other:

- [Soybean Smash Slides](#)
- [Reflection Sheet](#)

Bioenergy: *From Field to Fuel*

Lesson:

1. Designate one side of your room as “True” and one side as “False. You can post signs, or explain it to students after your class opening.
2. Pull up the Soybean Smash slides. There are four true/false statements about soybeans on the slides.
 - a. Read a statement, allowing students to move to the side of the room they agree with (true or false).
 - b. Briefly discuss the answer to the statement, then continue to the next until all four are completed.
 - i. Note: links to the statistics sources are provided in the slide comments if you would like to do your own reading beforehand.
3. Mention that two different products related to soybeans have been mentioned: soybean oil and soybean meal. Ask students: “what is the difference between soybean oil and soybean meal?”
 - a. Accept all responses here.
4. Explain that after they are harvested, soybeans go through processing (a series of mechanical or chemical operations to preserve or change a product). During processing the soybean is separated into oil, and the remaining products which are dried and then called soybean meal. The oil is the fat from the bean. The meal is made up of protein, carbohydrates, and minerals. The remaining part of the bean was moisture and is removed during processing.
5. Tell students that they will be partially processing soybeans today!
6. For the activity:
 - a. Determine if you would like to complete this as a class demonstration, or allow students to work in groups of 3-4.
 - b. If students are completing this themselves, remind them of some basic lab safety rules/hints for the activity:
 - i. Be careful with a hammer (watch fingers, toes, etc).
 - ii. Use a hard surface to smash the soybeans (not wood or tile floors).
 - iii. Eliminate as much air from the bags as possible before smashing the beans.
 - iv. Add in any of your own lab safety rules here- you know your students!
7. Complete the activity as found on the next page.
8. Once complete, have students fill out their [reflection sheet](#) and complete one activity from the choice board. An explanation for results can also be found on the Soybean Smash slides if you would like to use them after the activity.



Bioenergy: *From Field to Fuel*

Soybean Smash Activity:

Materials:

- ½ cup soybeans
- 1 quart resealable bag
- 1 gallon resealable bag
- 1 brown paper sack
- Scrap newspaper/paper
- Mortar and Pestle
- Plastic Cup
- Spoon
- Access to hot water

Procedure:

1. Place soybeans in the 1 quart resealable bag, remove as much air a possible, then place inside the 1 gallon resealable bag.
2. Place the bag between sheets of newspaper/paper and slip into the brown paper sack.
3. Find a hard flat surface (with teacher approval), and use a hammer to break up the soybeans. Be very careful during this step.
4. Transfer the smashed soybeans to a mortar and pestle and grind until very fine.
5. Place your ground soybeans into the plastic cup and cover them with about 3 inches of hot water (100-110 degrees).
6. Stir your soybean/water mixture for a minimum of three minutes.
7. Allow to sit undisturbed for 5 minutes.
8. Examine mixture and complete your [reflection sheet](#).



Bioenergy: *From Field to Fuel*

Extensions:

- Make this an experiment and have students compare two or more different types of soybeans. Does the proportion of oil to meal change?
- Have students complete the activity with another biofuel crop (ex: corn). How does the oil content compare to soybeans?
- Use different temperatures of water and compare the results.

Information Sources:

Farm-Energy. (2019, April 12). *Soybeans for biodiesel production*. Farm Energy. Retrieved July 21, 2022, from <https://farm-energy.extension.org/soybeans-for-biodiesel-production/>

Goodyear. (2021, November 18). *Soybean oil and it's benefits in tires: Goodyear Tires*. Goodyear.com. Retrieved July 21, 2022, from <https://www.goodyear.com/en-US/learn/tire-technologies/soybean-oil>

Soybean composition. NOPA. (2016, June 14). Retrieved July 21, 2022, from <https://www.nopa.org/resources/datafacts/soybean-composition/#:~:text=Soybean%20Processing%3A%20Soybeans%20are%20cleaned,separated%20from%20the%20solvent%20mixture.>

USDA coexistence factsheets - soybeans. (n.d.). Retrieved July 22, 2022, from <https://www.usda.gov/sites/default/files/documents/coexistence-soybeans-factsheet.pdf>

Uses of soybeans. North Carolina Soybeans. (n.d.). Retrieved July 21, 2022, from <https://ncsoy.org/media-resources/uses-of-soybeans/>

What are soybeans used for? United Soybean Board. (2022, June 10). Retrieved July 21, 2022, from <https://www.unitedsoybean.org/hopper/what-are-soybeans-used-for/>

Image Sources:

Hammer Icon: Image by [Ciker-Free-Vector-Images](#) from [Pixabay](#)

Soybean Emergence: Image by [Julio César García](#) from [Pixabay](#)

This work is supported by the Oklahoma State University Sustainable Bioenergy Education grant no. 2017-67010-26733 from the USDA National Institute of Food and Agriculture.

Oklahoma State University, as an equal opportunity employer, complies with all applicable federal and state laws regarding non-discrimination and affirmative action. Oklahoma State University is committed to a policy of equal opportunity for all individuals and does not discriminate based on race, religion, age, sex, color, national origin, marital status, sexual orientation, gender identity/expression, disability, or veteran status with regard to employment, educational programs and activities, and/or admissions. For more information, visit <https://eeo.okstate.edu>.

