



MIDDLE SCHOOL  
CURRICULUM



# SOY SAVVY



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# I. Enduring Knowledge:

Because soybeans are a major agricultural crop in Wisconsin, students should know how they are grown and the many ways in which they contribute to the foods and products that they consume and use.

## Learning Targets:

1. Students should know the importance of soybeans to the Wisconsin economy.
2. Students should know that soybeans were raised and eaten in Asia several thousand years ago, and have only been consumed as food in North America for a few hundred years.
3. Students should know that George Washington Carver, an important agricultural scientist, discovered the important role of soybeans (legumes) in preserving soil by means of nitrogen fixation, which helps improve soil. By rotating crops with legume crops the soil is improved and overall production is enhanced.
4. Students should know that Henry Ford hired researchers to find industrial uses for soybeans. Today soybeans are the basis for a wide variety of industrial products.
5. Students should know that soybeans have many uses, including foodstuffs as well as industrial applications, and they should be able to name some of the products made with soybeans.
6. Students should know that soybeans provide significant protein nutrients not only for humans but also for farm animals, thereby increasing the production of protein sources worldwide.

# II. Teacher Background Materials:

Soybeans are a major agricultural crop in Wisconsin. As you drive around the state, most major cultivated farmland is producing either corn or soybeans.

## History

Soybeans have been cultivated and consumed for thousands of years in Asia. In the 18<sup>th</sup> century, because they were abundant and cheap, they were used as ballast in ships bringing goods to the North American continent from Europe. Over time it was discovered that soybeans could be cultivated successfully here. Early on, George Washington Carver, an agricultural scientist at Tuskegee Institute, discovered that soybeans were a solution to the soil depletion caused by monocultures—specifically, how growing cotton year after year in the same fields depleted the soil. By rotating soybeans, a legume that was capable of nitrogen fixation, the soil nutrients could be replenished. The many uses of soybeans followed this discovery. In the 1930s Henry Ford hired

research teams to discover uses for soybeans in car production for the now abundant soybeans — and the result was quite successful, finding ways to use soybeans in car paint, oils, even plastics. Thus, in addition to the many uses of soybeans in foodstuffs, like oil, soymilk, tofu, miso, etc., soybeans were found to be an essential ingredient in industrial applications.

Soybeans are very high in protein (38%) and, consequently, 85% of the world supply of livestock feed is derived from soybeans. Since soybeans also are 18% oil, that by-product can be removed before making the livestock feed, and put into other products, such as foodstuffs, as well as industrial products, including bio-diesel and polymers.

### How soybeans help the soil

Because soybeans are legumes, they form a symbiotic relationship (or beneficial partnership) with certain bacteria (Rhizobium bacterium) that convert atmospheric nitrogen into a form that plants can use. These bacteria enter the roots of the legume and form root nodules or bumps on the roots of the soybean. Inside the nodule, these tiny bacteria convert atmospheric nitrogen into ammonia, which is converted by other soil bacteria into forms of nitrogen the plants can use, like nitrate and nitrite. These bacteria need an oxygen-free environment to do their work, and the legume scoops up any oxygen that could slow down the work of the bacteria. So the legume gives the bacteria food with its roots and the right oxygen-free conditions inside the root nodule. In turn, the bacteria give the plant usable nitrogen so it can grow and reproduce. Some of the extra nitrogen even makes its way back into the soil surrounding the plant.

### Growing soybeans on the farm

Soy is generally planted around April 15, depending on the right temperature and moisture of the soil. The seeds begin to absorb the moisture and germinate, forming the first root (radical) within one to two days. Within a week to 10 days, the seedling emerges from the soil surface. Two weeks after the plants begin to grow, the Rhizobium bacteria will enter the roots and begin converting nitrogen into usable forms, which the soybean will use for growth. The plant reaches maturity within three to five months. Once the plant has 6 -10 leaves, it begins its reproductive phase and will produce white, pink, or purple flowers, which look like pea flowers. The flowers are self-pollinating, which means that insects aren't needed to transport pollen from one plant to another. One to two weeks after the flowers bloom the seed pods begin to form.

Each pod has three to four seeds and it will take about a month for seedpods to mature. Young seeds have high moisture content, but as they mature, the moisture decreases and the mature seed shrinks in size. As the pod matures it will change color from green to yellow or brown. The seeds themselves are yellow at maturity.

Soybeans are typically harvested between October and November. The seeds are removed from the pods, dried if need be and stored. Huge combines are used to harvest soybeans.



## Products made from or containing soy

Adhesives, antibiotics, asphalt, baby food, bee food, bread, candy, caulking, cereals, cookies, cooking oils, cosmetics, cow feed, creamers, diesel fuel, disinfectants, epoxy, fish food, fungicides, herbicides, inks, insecticides, insulation, noodles, margarine, mayonnaise, paints, particle board pesticides, pet food, pig food, plastics, plywood, polyester, poultry food, pharmaceuticals, putty, rubber, salad dressing, sandwich spread, shampoo, soap, soymilk, vegetable shortening, tape, textiles, tofu, wallboard, whipped topping, yeast

This DVD also includes some interesting projects, including using time-lapse photography to watch a legume grow, using soybeans in recipes, and interviews with students who live on farms that grow soybeans.

## Vocabulary:

1. **aquaculture:** agriculture conducted in water; farm-raised fish are an example
2. **ballast:** heavy substance used to improve the stability and to control the draft of a ship
3. **bio-fuel:** a fuel derived from plant matter
4. **crop rotation:** the system of rotating crops in a single field; for example, raise cotton one year and the next year plant soybeans
5. **edamame:** a dish of green (immature) soybeans boiled or steamed in their pods
6. **germinate:** To begin to grow
7. **legumes:** plants that bear nodules on the roots that contain nitrogen-fixing bacteria; includes important food and forage plants, such as peas, beans, or clovers
8. **monoculture:** the cultivation of a single product to the exclusion of other uses of land
9. **nitrogen fixation:** the chemical processes by which atmospheric nitrogen is assimilated into organic compounds, especially by certain microorganisms as part of the nitrogen cycle
10. **polymer:** synthetic organic materials used as plastics or resins. An example, a “plastic” bag made of soy
11. **radical:** in this case, the first root of a legume plant
12. **Rhizobium bacteria:** microorganisms involved in nitrogen fixation; a rhizome is a plant that has a continuously growing underground stem
13. **self-pollinating:** those plants that do not rely on insects to become pollinated
14. **symbiotic relationship:** a mutually advantageous relationship between two dissimilar organisms

### III. Before Viewing the Video:

Have students speculate why soybeans are such an important agricultural product in Wisconsin. (The goal is to have them begin to recognize that soybeans are not just a human or animal food, but also an important ingredient in many of the products with which students are familiar.)

### IV. Viewing & Discussion Guide:

Note: Because the DVD includes several sections that touch on different topics, you may want to stop the DVD at the end of each section and discuss it with the students. Creating a guide sheet for notes with the headings and questions found below will help guide students in picking out significant information.

#### The history of soy:

1. How was soy originally brought to the U.S.? (as ballast on ships)
2. How did soy come to be an important agricultural crop in the United States?  
(the discovery of its importance to soil maintenance and the discovery of industrial uses of it)
3. Name two famous people who contributed to the discoveries of uses of soybean?  
(George Washington Carver and Henry Ford)

#### The science of legumes:

1. Name some plants that are legumes: (soybeans, clover, alfalfa)
2. How does nitrogen fixation work? (See teacher background notes.)
3. Why is this process so important to farmers?  
(It helps to preserve the nutrients in the soil year after year.)

#### How to grow soy:

1. When are soybeans planted and harvested? (Usually planted in mid-April if the soil is the right temperature and has the right moisture content. It is usually harvested in October or November after the crop has ripened.)
2. Select as many details as you can about growing soybeans. (Because there is a great deal of detail in this section, have students pick out what they can and then in discussion fill in the details. See teacher background.)

## Life on a soybean farm:

1. Would you like to live on a soybean farm? Why or why not? (Students can select details from this interview to make their own decision and support it with details.)

## The many uses of the soybean:

1. Make a list of some of the different products that are mentioned that are made from soy. (See teacher background)
2. What forms of soybeans have you personally tasted? (Most students will have tasted soy sauce, while many others may have eaten miso, tofu, edamame, etc. Have them talk about what they liked about the taste.)

## Cooking with soy:

1. Which of the dishes you saw in the DVD would you be interested in trying? (See extended learning below for suggestions on how students could build on this particular aspect of their knowledge of soybeans.)

## V. Evaluation:

1. An informal assessment can be made of students' notes and participation in discussion.
2. Activities can be assessed using rubrics based on good research, presentation, and material construction.

## Suggestions for extended learning:

1. The DVD describes in detail an experiment students could conduct about the germination of soybeans using time-lapse photography. You could do the experiment in the classroom or have several students conduct the experiment at home and present their process and findings to the class.
2. Have students research George Washington Carver and his many contributions to agricultural science.
3. Have students research Henry Ford. Be sure to have them focus especially on the soy related discoveries made by the Ford Motor Co. in addition to his general contributions to assembly line construction, etc. Find out about the Ford exhibit at the 1934 World's Fair.
4. Invite a farmer to talk to the class about raising soybeans.
5. Ask students to research and prepare dishes made with soy. Have them share their dishes with the class. Have them make a soy cookbook.

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6. Collect products that have ingredient labels that include soy in some form or another (e.g. oil, soy lecithin, etc.) and bring the packages to class to make a display. Be sure to have them check pet foods. See if they can find industrial products that contain soy as well.
7. Have students create a poster with pictures of some of the major soy uses: include both direct foods (soy nuts, soy milk, soy sauce) and indirect foods (animals that are fed soy protein, such as beef cattle and chickens).
8. Students could write and present a play about life on a soybean farm.
9. Students could make drawings of the process of nitrogen fixation and explain it in class.
10. Students could research the statistics related to soybean production in Wisconsin. They could make maps of where most of the soy is grown, processed, and consumed or statistical charts comparing historical production or comparing production with other states. They could also look into the export market for soybeans from Wisconsin.



The following Wisconsin Student Proficiency Standards can be met by teaching *Soy Savvy*:

**Geography:** “Students in Wisconsin will learn about geography through the study of the relationship among people, places, and environments.”

- **8th grade:** A.8.1, A.8.3, A.8.10, A.8.11

**History:** “Students in Wisconsin will learn about the history of Wisconsin ... examining change and continuity over time in order to develop historical perspective, explain historical relationship, and analyze issues that affect the present and the future.”

- **8th grade:** B.8.1, B.8.7, B.8.8

**Economics:** “Students in Wisconsin will learn about production, exchange, and consumption so that they can make informed economic decisions.”

- **8th grade:** D.8.3, D.8.4, D.8.7, D.8.11

## Wisconsin Teacher Standards which can be met with this curriculum, including rationale:

### **Standard 1: Subject matter**

This curriculum provides information not readily available in other forms. A teacher using this material will be well informed about the subject matter.

### **Standard 3: Adapt instruction**

This curriculum provides suggestions for learners with a variety of intelligences and levels of ability.

### **Standard 4: Instructional strategies**

The curriculum includes the use of technology to gain information and suggestions for using research in extending learning.

### **Standard 5: Individual and group motivation**

Both the use of prior knowledge and carefully designed group projects promote motivation for students to learn.

### **Standard 6: Verbal and nonverbal communications**

Instructional media and technology that promotes active learning are key parts of this curriculum.

### **Standard 7: Organizes and plans systematic instruction**

The curriculum is organized to support teacher knowledge, to draw on and motivate students to engage in active learning, and promotes active inquiry, collaboration, and supportive interaction in the classroom.

### **Standard 8: Formal and informal assessments**

Suggestions for a variety of assessments, both formal and informal, are offered in the curriculum.

### **Standard 10: Fosters relationships**

This curriculum could be used to create relationships with local soybean farmers through field trips or class speakers.