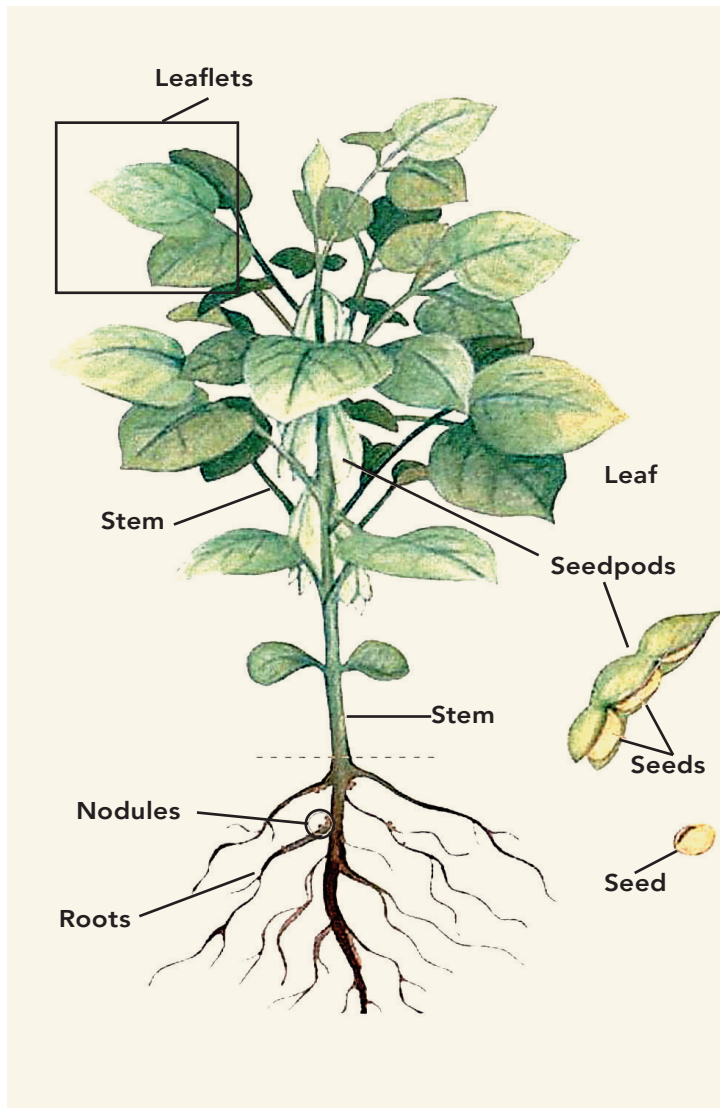


# SOYBEANS

**USES:** candy, cakes, cheeses, peanut butter, animal feeds, candles, paint, body lotions, biodiesel, furniture

## WHAT ARE SOYBEANS?

Soybeans are small round seeds, each with a tiny hilum (small brown spot). They are made up of three basic parts. Each soybean has a seed coat (outside cover that protects the seed), cotyledon (the first leaf or pair of leaves within the embryo that stores food), and the embryo (part of a seed that develops into a new plant, including the stem, leaves and roots). Soybeans, like most legumes, perform nitrogen fixation. Modern soybean cultivars generally reach a height of around 1 m (3.3 ft), and take 80–120 days from sowing to harvesting.



## VOCABULARY

**CULTIVAR:** a variety of plant that has been created or selected intentionally and maintained through cultivation.

**EMBRYO:** part of a seed that develops into a new plant, including the stem, leaves and roots.

**EXPORTS:** products or items that the U.S. sells and sends to other countries. Exports include raw products like whole soybeans or processed products like soybean oil or soybean meal.

**FERTILIZER:** any substance used to fertilize the soil, especially a commercial or chemical manure.

**HILUM:** the scar on a seed marking the point of attachment to its seed vessel (the brown spot).

**LEAFLETS:** sub-part of leaf blade. All but the first node of soybean plants produce leaves with three leaflets.

**LEGUME:** plants that perform nitrogen fixation and whose fruit is a seed pod. Beans, peas, clover and alfalfa are all legumes.

**NITROGEN FIXATION:** the conversion of atmospheric nitrogen into a nitrogen compound by certain bacteria, such as rhizobium in the root nodules of legumes.

**NODULES:** place on stem where leaves, branches and flowers are attached. Plant height is related to the number of nodes and the length of the distance between each node (internode). Each node produces three buds.

**RADICLE:** the lower part of the axis of an embryo, the primary root.

**SEED COAT:** outside cover that protects the seed.

**SEED PODS:** a structure that holds seeds. Each pod typically holds 3-4 beans.

**SOYBEAN OIL:** a pale yellow oil derived from soybeans by expression or solvent extraction. Used as a food and in the manufacture of soap, candles, inks, paints, varnishes, etc.

**TAPROOT:** a main root descending downward from the radicle and giving off small lateral roots.

**TRIFOLIATE:** having three leaflets.

# SOYBEANS

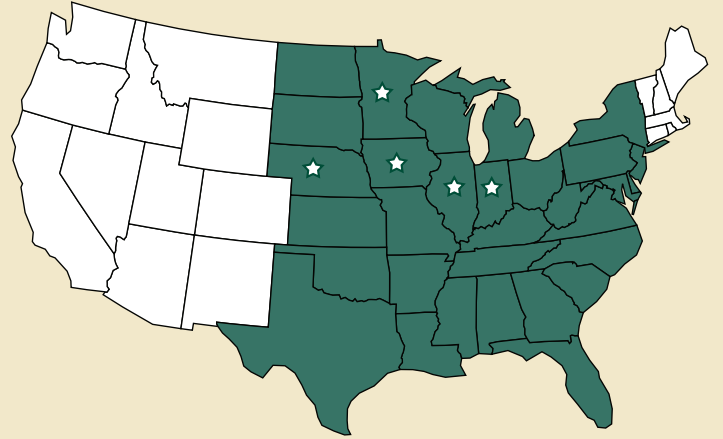
## UNITED STATES SOYBEAN PRODUCTION

### ■ Soybean producing states

Alabama, Arkansas, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Virginia, West Virginia and Wisconsin

### ☆ Top 5 soybean producing states

Iowa, Illinois, Minnesota, Nebraska and North Dakota



## SOYBEAN TIMELINE

Farmers in China began growing soybeans **MORE THAN 5,000 YEARS AGO.**

**1765** – Soybeans, or “Chinese vetches” as they were known, were introduced to North America.

**1804** – James Mease, a physician and amateur horticulturalist, reported that soybeans had adapted to Pennsylvania’s growing climate.

**1861-1865** – Soybeans were used to brew a hot drink for soldiers during the Civil War.

**1898** – The United States Department of Agriculture (USDA) introduced several varieties of soybeans from Asian countries and set up a system to keep track of the different kinds of seeds.

**1904** – George Washington Carver began studying soybeans at the Tuskegee Institute in Alabama. Carver discovered a method of extracting soybean oil and also invented a process

for making paints and stains from soybeans. Farmers in the South were encouraged to plant soybeans to keep the soil fertile for their cotton crop.

**1907** – William J. “Bill” Morse joined the USDA and devoted his life to studying soybeans. He was also the founder of the American Soybean Association and wrote more than 80 publications about soybeans.

**1920s** – Palemon Howard (P.H.) Dorsett and William Morse traveled to China and Korea collecting varieties of soybeans. Over 10,000 varieties were sent back to the United States from their excursions.

**1940** – Henry Ford took an ax to a car trunk made with soybean plastic to demonstrate its durability. This increased the popularity of soybeans and the United States began to export soybeans and soybean products.

**1950s** – Soybean meal became available to use as a livestock feed ingredient. It was high in protein and low-cost. This prompted a large increase in livestock and poultry production in the United States.

**1994s** – Soybean-based crayons win the first Indiana Soybean Development Council/Purdue University Soybean Utilization Contest.

**2002** – USDA’s Agricultural Research Service begins heating its buildings in Beltsville, Maryland, and fueling all its diesel vehicles, generators and equipment sterilizers with B20 made from soybeans.

**TODAY** – Farmers throughout the United States produce 3,500 million bushels of soybeans each year. Illinois alone produces 672 million bushels yearly making them 1st in soybean production.

One acre of soybeans can produce 82,368 crayons.

Soy ink is used in over 95 percent of America’s daily newspapers that circulate more than fifteen hundred copies per run.

Livestock are the largest consumers of soy meal.

A bushel of soybeans weighs about 60 pounds.

One and a half gallons of biodiesel and 48 pounds of soybean meal can be produced from one bushel of soybeans.

**DID YOU  
KNOW?**

# SOYBEANS

## CAREERS:

Nematologist, Fisheries Scientist, Biotechnologist, Soil Scientist, Farmer, Researcher, Entomologist

## SPOTLIGHT ON CAREERS:

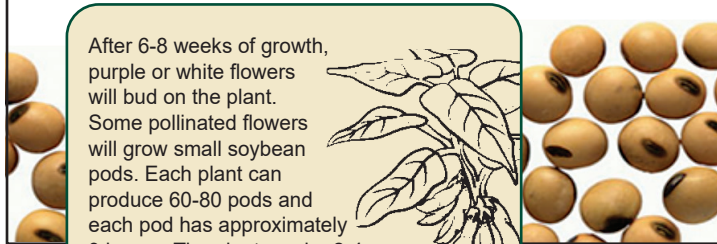
**FISHERIES SCIENTIST** – Fisheries scientists are dedicated to effective management, use and conservation of aquatic plants and animals. They use their expertise to protect and enhance recreational, commercial and aquacultural fisheries resources. Soy plays a significant role in feeding aquatic livestock.

**NEMATOLOGIST** – Soybean cyst nematodes are small plant roundworms that attack the roots of soybeans and can cause a decrease in yield. Nematologists study nematodes and their effects on plants. They also work with farmers on pest management.

## SOYBEAN USE IN THE UNITED STATES

A soybean seed takes about 4-7 days to begin growing. The radicle, an apostrophe shaped bud, will emerge from the seed. The primary root will form from the radicle. Tap roots will branch out from the lateral root. Above the ground, the cotyledon emerges from the soil.

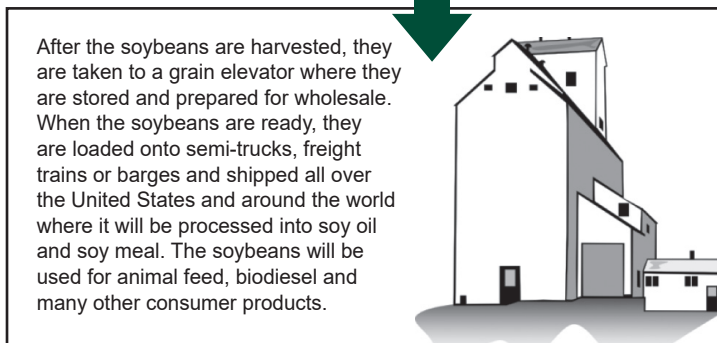
After 6-8 weeks of growth, purple or white flowers will bud on the plant. Some pollinated flowers will grow small soybean pods. Each plant can produce 60-80 pods and each pod has approximately 3 beans. The plant can be 2-4 feet tall and is covered with fuzzy, short hairs.



Sometime between late August and early October, the ripe bean pods change color and dry out. The farmer will harvest the plants with a combine. The combine will separate the beans from the rest of the plant and store the beans in the combine's tank.



After the soybeans are harvested, they are taken to a grain elevator where they are stored and prepared for wholesale. When the soybeans are ready, they are loaded onto semi-trucks, freight trains or barges and shipped all over the United States and around the world where it will be processed into soy oil and soy meal. The soybeans will be used for animal feed, biodiesel and many other consumer products.



## Watch It GROW

Farming is a year-round job. Planting and harvesting may only take 4-5 months, but there is a lot more preparation that goes into growing a great crop.

### SPRING

Farmers prepare the soil and plant the seeds.

### SUMMER

Farmers work to control weeds and insects and irrigate where necessary.

### FALL

The big harvest. Farmers collect the beans from the field and store them in grain bins.

### WINTER

Farmers mean business while they market the crop, order seeds and take care of machinery.

About four to seven days after the seeds are planted, the soybean plant begins to grow. As it grows, the plant changes.

- 1) The planted seed grows a little, tail-like root, called a radicle, which becomes the main root or tap root.
- 2) Soon smaller roots, called lateral roots, branch out from the taproot.
- 3) The plant pops out of the ground. A small round part of the plant

called the cotyledon peeks through the topsoil.

- 4) The leaves grow in groups of three called trifoliates.
- 5) Small purple or white flowers appear on the plant.
- 6) Many of the flowers grow into small pods of soybeans.

- 7) In the fall, the plants turn brown and the leaves drop off. The pods stick to the plant and the beans inside the pods get hard and dry. Each pod contains 3-4 beans.

This is when most farmers harvest the soybeans.



# SOYBEANS

## SOYBEANS FUN FACTS

The average American consumes nearly half a cup of soybeans in some form each day.

Soybean oil is the main edible oil used in the United States.

## SCIENCE AT HOME

### MIGHTY SEEDS

How strong are soybeans? This experiment shows how germinating soybean seeds can generate enough force to crack plaster of Paris.

#### What's the Word?

Observation, germinate, exothermic reaction

#### What You Need (per student or pair of students):

Clear plastic cup	Plastic spoon for mixing
5 tablespoons of plaster of Paris	Dropper
2 or more tablespoons of water	3 soybean seeds

#### What to Do?

Put the plaster of Paris in the plastic cup, add 2 tablespoons of water and mix. Continue to add drops of water until the mixture has the consistency of a very thick milkshake. Push the soybeans into the plaster until they are covered and then smooth the surface. What do you think will happen to the soybeans? Make regular observations. What happens? Why? The next day, add a tablespoon of water to the cup and continue to make observations. What happens? Why?

#### What's Going On?

Seeds require moisture and warmth to germinate. In this case, the seed absorbs moisture from the plaster mixture. As the seed absorbs water it increases in size and applies pressure to the surrounding plaster. This force, combined with the strength of the germinating sprout, causes the plaster to crack and allows the shoot to grow up through the plaster. The strength and ability to grow in adverse conditions allow plants to survive in a wide range of environments. You may also notice that when water is mixed with plaster the cup becomes warm. A chemical reaction that gives off heat like this is known as an exothermic reaction.

*Compliments of the Ohio Soybean Council*

## TRUCKS TRAINS AND SHIPS

Soybeans often travel long distances from where they are grown, to where they are processed, used, or consumed. Soybeans travel around the nation, and around the world and do so mostly by truck, train, or ships called barges.

For shorter distances, like from the field to a grain elevator for storage, soybeans travel in trucks. New innovations in trucking, like adding a sixth axle, can increase a truck's load by 183 bushels

To move across the country, rail lines make moving large loads of soybeans even easier. Illinois alone has 7,000 miles of railroads crisscrossing the state and 48 different rail lines moving cargo. A 110-car train can carry up to 403,000 bushels of soybeans. That's 84 billion soybeans!

Barges and ships carry the largest number of soybeans the longest distances. Because nearly 60% of Illinois Soybeans are exported, barges are used to carry the crop over any of Illinois's 1,100 miles of navigable waterways. These waterways move the beans from riverside grain elevators to distant sea ports like New Orleans, Louisiana. From there, huge ships, capable of carrying a whopping 2.1 million bushels, cross the oceans to some of the biggest importers of soybeans, like Taiwan.

*(Soy transportation Coalition)*

The Mississippi River is an important route for delivery soybeans to the Port of New Orleans.

On a national level, 50% of U.S. soybeans are exported.

DID YOU  
KNOW?

## BIODIESEL

Biodiesel is a clean-burning, renewable fuel produced from domestic resources like soybeans and other vegetable oils and animal fats. Biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create an alternative fuel for use in diesel engines with very few or no modifications.

Biodiesel helps reduce America's dependence on foreign oil while creating local job opportunities.

