Join Sam the Soy Biodiesel Semi on a discovery journey that helps children learn all about soybeans.

Explore • Read • Play • Have Fun!
The Pod to Plate website/DVD is a comprehensive resource that will help your students learn all about soybeans in particular... and agriculture in general.

The website/DVD provides a context for both learning and teaching. Students can explore the content on a self-guided learning journey, and you can expand upon their newfound knowledge by using related teacher resources.

This Pod to Plate Teacher’s Guide is designed to provide an overview of the website/DVD, as well as answer keys for Pod to Plate worksheets.

GETTING STARTED
Here is the welcome message students will see when they arrive at the website/DVD home page:
Welcome to soy country!
Take a look around. Catch a glimpse of how soybeans are produced, processed, consumed and transported within the country and around the world.
Explore the many destinations, click around for fun and a few surprises, and discover the story behind the soybean.
Be sure to show off your soybean knowledge and take the short trivia quizzes along the way.
So start your journey, and – most importantly – have fun!
CURRICULUM OBJECTIVES

The Pod to Plate curriculum was created for students in grades 3-8. The content covers key concepts related to five specific themes: Soy Production, Soy Transportation, Soy Processing, Soy Products, and Export Soy Abroad.

PRODUCTION

Take a tour through the farm, research lab and grain elevator.

This section covers what is involved in planting, growing and harvesting soybeans. Students should be able to understand and recognize aspects of the soybean growth cycle, the essential elements for healthy plants, the problems modern soybean farmers face and the solutions available. Students also will learn how science and research technology is used to develop better soybean plants to aid soybean production.

TRANSPORTATION

Trains, barges and trucks!

This module outlines how soybeans get from one place to another – the three primary ways soybeans travel around the United States and their respective advantages. Students should be able to identify the characteristics of these forms of transportation and how they are utilized to carry soybeans as freight. Students will begin to learn about the importance of fuel in transportation and how soybeans might be fueling their own transportation.

PROCESSING

Here you really get inside soybeans.

This area covers the process involved to separate a soybean into smaller, essential parts. Students will learn about the different types of facilities that process soybeans and why these modifications are necessary. They should be able to identify where soybeans go to be processed, understand how they are modified and describe the finished products.

PRODUCTS

Soybeans are in products you regularly use and where you least expect them!

This destination explores soybeans as a resource, which results in products that we use every day. Students will gain an understanding of which soy parts make certain products. They also will learn about the overall versatility and array of products for which soy is used. They will be able to identify products at school or home that are made with soy.

EXPORTS

Go around the world with soybeans.

This section addresses soybeans’ popularity around the world. Students will learn about countries that import soybeans from the United States and the varied uses for soybeans in those countries. Students will focus on the humanitarian organization WISHH and its dedication to alleviating hunger in foreign countries. This section is a good place to inspire fresh and progressive ideas about how to help and improve the world.
CURRICULUM COMPONENTS

Pod to Plate is a comprehensive curriculum that features:

An interactive website/DVD that includes:
- A self-guided, interactive adventure — one that allows students to explore and discover information about soybeans and how they affect the world.
- Creative activities and a few hidden surprises to engage students and make education fun.
- Quizzes to challenge minds and help with retention.

Printable worksheets that conform to Illinois Learning Standards. These can be found under “Teacher Resources.”

A Pod to Plate poster — A fun way to promote learning and it's free! This 18" x 24" poster is a visual presentation of the themes covered in the Pod to Plate website/DVD. Post this on a wall in your classroom to:
- serve as a visual reminder of the Pod to Plate curriculum
- direct students to the website address (www.podtoplate.org)
- use as a visual aid for related activities and discussions
**Curriculum Components (continued)**

**Illustrated Characters** Throughout Pod to Plate, Sam the Soy Biodiesel Semi appears as a recurring character. He is joined by other illustrated characters that correspond to the Production and Transportation themes (e.g., a tractor, a combine, a train, a barge).

![Illustrated Characters](Image)

- Sam
- Hank
- Dixie
- Rocky
- Toby
- Carl
- J. J.
- Alice

**Other Visual Aids** You can use visual aids to supplement the Pod to Plate curriculum. Here are some items you may want to consider gathering:

- Soybean plants
- Dried soybeans
- Soyfoods – such as soymilk, soy cheese, soynuts, tofu
- Food items that contain a soy ingredient – pancake mix, baby food, chocolate bars, salad dressing
- Items printed with soy ink (most newspapers would work)
- Soy crayons
- Soy candles
Pod to Plate Website/DVD Content Overview

• Home Page
  —When students visit the home page, they will see a colorful ILLUSTRATED SCENE that captures the essence of the Pod to Plate content. Various elements of this scene will pop out or change as the cursor is moved over the illustrations. Sam the Soy Biodiesel Semi will be seen moving along the roadway... and simplified animations will appear occasionally around the buildings and other objects.

  —Students also will see time passing gradually as the sun moves overhead and sets in the distance. Throughout the “day” they will see different details (farmer harvesting, school in session, etc.) than at “night” (city lights coming on, etc.). This day-to-night transformation will encourage students to look around and interact with the scene.

  —THE HILLS REPRESENT DESTINATIONS. Students can click on any of the five hills to reach a destination. When a hill is selected, a zoom-in view appears and more details are visible. Here’s where the real learning takes place: Many items are clickable and generate pop-up text for the student to read.
Destinations
— After a student explores a destination, a short, interactive QUIZ can be completed (with Easy or Hard options). If it is completed successfully (with two out of three random questions answered correctly), the student earns a golden TOKEN for that destination. The earned token replaces that destination’s symbol in the navigation bar. The goal is to earn five tokens.

If the student does NOT complete the quiz successfully, the QUIZ BUTTON can be clicked again and three different random questions will appear. This step can be repeated as often as necessary until the student earns a token.

— The BACK BUTTON allows students to return to the home page scene (main menu).

— The NAVIGATION BAR (shown below) makes it easy to move between destinations and encourages exploration. Each destination is represented with a symbol. Each symbol is replaced with a token when its corresponding quiz is completed successfully. The scroll bar will always be present so that the student knows exactly how many tokens have been earned... and for which destinations.
Teacher Resources: Worksheets

The Pod to Plate website/DVD includes a Teacher Resources section filled with engaging learning tools. In this section, you will find printable worksheets grouped by grade and subject. Covered subjects include Language Arts, Mathematics, Science and Social Studies. Some worksheets cover more than one subject.

Three types of worksheets are offered:

Activity-based Worksheets
for hands-on educational learning

Discussion-starter Worksheets
for spurring class-wide or group discussions

Student-completion Worksheets
to be completed by the student (in class or at home) and then graded

A Closer Look

• Each worksheet features the Pod to Plate logo to make it easily identifiable.
• Specific learning goals are cited.
• All original Pod to Plate worksheets adhere to Illinois teaching standards.

Note:
Some worksheets have been adapted for Pod to Plate in cooperation with other soybean associations. Thanks to all!
Answer Keys

for original Pod to Plate worksheets appear on the following pages.
Farmer Joe is an average Illinois Soybean Farmer. His farm has 368 acres for soybean planting. Soybeans are weighed by the bushel. The crop yield is how many bushels Joe can grow per acre. Joe sells his bushels of soybeans at the grain elevator. The price for a bushel of soybeans varies from year to year. The crop yield can also vary. The charts below show the average soybean crop yields and the average price per bushel for the years 1984-2009. Use these charts to answer the questions about Joe’s 368-acre farm.

**Worksheet Questions**

Joe’s first year of farming his soybean field was 1992. On average, how many bushels did Joe produce and how much money did he make that year?

13,836.8 bushels  $76,932.61

Did Joe have a better year in 1997 than 1992? What was the difference?

In 1997 Joe made $15,686.73 more than in 1992.

Between 2002-2009, which year was the best year for Joe? How much money did he make?

2007 was Joe’s best year. He made $157,680.64.

Between 2002-2009, which year was the worst year for Joe? How much less did he make than his best year?

2002 was Joe’s worst year. He made $80,349.12 less than in 2007.
**Biodiesel, the EARTH LOVING FUEL**

**ACROSS**

1. Fuel that cannot be easily made or renewed. It is used up.
2. A blend of 20 percent biodiesel with 80 percent petroleum diesel.
3. Fuel that can be renewed or easily made.
4. A substance that is not toxic or poisonous.
5. A waste by-product of the biodiesel making process.

**DOWN**

1. The process of removing glycerin from soybean oil.
2. Pure biodiesel fuel.
3. A black liquid fossil fuel found deep in the Earth. Gasoline and most plastics are made from this.
4. How a liquid is resistant to flow; thickness or thinness.
5. An environmentally safe, low polluting fuel for most diesel internal combustion and turbine engines.

There is a soybean cargo load that weighs 1,200 tons that needs to be moved from Rock Island, IL to a port in Louisiana to export to other countries. Using the transportation information sheet, explain which method of transportation you would choose to move this cargo and why you chose that method.

Student should choose a barge because this is the cheapest method to move a cargo of this size, Rock Island is on the river, and the barge can go straight down the river to Louisiana. Student’s answers should be in complete sentences.

There is a soybean cargo weighing 20 tons that needs to be moved from the grain elevator in Rockford, IL to a biodiesel processing plant in Freeport, IL. Using the transportation information sheet, explain which method of transportation you would choose to move this cargo and why you chose that method.

Student should choose a semi-truck because of the size of the cargo and because it is flexible enough to take it the distance between the two places in Illinois. Student’s answers should be in complete sentences.

There is a 199,500-lb. cargo of soybeans that needs to be moved from Illinois to a grain elevator in Nebraska. Using the transportation information sheet, explain which method of transportation you would choose to move this cargo and why you chose that method.

Student should choose a hopper car on a train because of the size of the cargo and because it needs to be transported a long distance and a river is not accessible between the two points. Student’s answers should be in complete sentences.
ACROSS
1. Fuel that cannot be easily made or renewed. It is used up.
2. A blend of 20 percent biodiesel with 80 percent petroleum diesel.
3. Fuel that can be renewed or easily made.
4. A substance that is not toxic or poisonous.
5. A waste by-product of the biodiesel making process.
6. A discharge or something that is given off; generally used in regard to discharges into the air.
7. Fuels that result from the compression of ancient plant and animal life formed over millions of years.
8. A colorless, odorless, highly poisonous gas, CO, formed by incomplete combustion of a carbon or a carbonaceous material, such as gas.

DOWN
1. The process of removing glycerin from soybean oil.
2. Pure biodiesel fuel.
3. Any organic (plant or animal) material that is available on a renewable basis.
4. How a liquid is resistant to flow; thickness or thinness.
5. An environmentally safe, low polluting fuel for most diesel internal combustion and turbine engines.
6. A colorless, odorless noncombustible gas with the formula CO₂ that is present in the atmosphere.
7. Capable of being decomposed by the action of biological agents, especially bacteria.

There is a soybean cargo load that weighs 8,000 tons that needs to be moved from Rock Island, IL to a port in Louisiana to export to other countries. Using the transportation information sheet, explain which method of transportation you would choose to move this cargo and explain concrete reasons why you chose this method.

Student should choose a barge because this is the cheapest method to move a cargo of this size. Rock Island is on the river and the barge can go straight down the river to Louisiana. Students should write a paragraph containing at least four sentences and use concrete reasoning to explain their choice.

There is a soybean cargo weighing 25 tons that needs to be moved from the grain elevator in Rockford, IL to a biodiesel processing plant in Freeport, IL. The processed biodiesel, 15,000 gallons, then needs to be moved from the processing plant to a buyer in Nebraska. Using the transportation information sheet, explain which method, or methods, of transportation you would choose for the different parts of the journey. Use concrete reasoning to explain your choices.

Student should choose a semi-truck for the first part of the problem because it is the most flexible method for this size load and for the destination it is going to. For the second part of the journey, students should choose a tanker car of a train because of the type, size, and destination location of the cargo. Students should write a paragraph containing at least four sentences and use concrete reasoning to explain their choice.
Saving the Planet with SOYBEANS!

The U.S. Dept. of Energy and the U.S. Dept. of Agriculture determined in a 1998 study that using biodiesel reduces the net carbon dioxide (CO₂) emissions by 78 percent compared to petroleum diesel. This is due to biodiesel's closed carbon cycle. Growing plants, which are later processed into fuel, recycle the CO₂ released into the atmosphere when biodiesel is burned. Substituting just one gallon of gasoline or diesel with biodiesel can save up to 20 pounds of CO₂ emissions into the atmosphere!

WORKSHEET QUESTIONS

If you filled up your car’s gas tank with 15 gallons of biodiesel fuel once a week instead of regular gasoline, how many pounds of CO₂ emissions would be saved in one year just from you?

15,600 pounds of CO₂

What if 15 people in your neighborhood did the same thing? How many pounds of CO₂ emissions would be saved in a year?

234,000 of CO₂

If one bushel of soybeans yields 1.5 gallons of biodiesel, how many bushels of soybeans would it take to fill up your 15-gallon gas tank each week? Each year?

10 bushels per week, 520 bushels per year
The SOYBEAN JOURNEY

There is a soybean cargo load that weighs 25 tons that needs to be moved from Princeton, IL to the river terminal in Rock Island, IL. At the terminal, the cargo will be sold and joined with a cargo of 9,000 tons. This larger cargo will need to be moved to a port in Louisiana to export to other countries. Using the transportation information sheet, explain the best methods of transportation to get this cargo from the beginning to the end destination. Explain your choices and give concrete reasoning as to why you chose them.

Student should choose a semi-truck to transport from Princeton to Rock Island. This is the best choice based on the distance needed to travel and the size of the load. In Rock Island, the cargo should be transferred to a barge for the journey to Louisiana. A barge is the best choice due to the load size, distance and destination of the soybeans. Students should write a paragraph containing at least six sentences and use concrete reasoning to explain their choices.

There is a soybean cargo load that weighs 22 tons that needs to be moved from a farm in DeKalb, IL to a soy oil processing plant in Quincy, IL. After the soybeans have been processed into oil, the 19,500 gallons of oil need to be transported to a buyer in South Carolina. Using the transportation information sheet, explain the best methods of transportation to get this cargo from the beginning to the end destination. Explain your choices and give concrete reasoning as to why you chose them.

Student should choose a semi-truck to transport from DeKalb to Quincy. This is the best choice based on the distance needed to travel and the size of the load. After processing in Quincy, the cargo should be placed into a tanker car on a train for the journey to South Carolina. A train is the best choice due to the load size, the form of the cargo (oil), and the distance. Students should write a paragraph containing at least six sentences and use concrete reasoning to explain their choices.
Turning Soybeans *into* MONEY!

Soybeans are often called the miracle crop. They are a very valuable food source due to their high nutritional content. Soybeans are also valuable for use in many other industries. You can find products made from soybeans in your home, school, and even in your car’s gas tank!

Farmer Joe is an average Illinois soybean farmer. He farms his soybeans and then sells them to the grain elevator after harvest. Joe needs to know the weight of his crop in order to determine the price he will be paid. Soybeans are weighed by the bushel. One bushel of soybeans = 60 lbs.

**WORKSHEET QUESTIONS**

The average amount of bushels to an acre of farmland is 44 bushels. If Joe harvested 44 bushels, how many pounds of soybeans did he have?

2,640 lbs. of soybeans

The grain elevator agreed to pay Joe $9.55 per bushel for his 44-bushel crop of soybeans. How much money was Joe paid?

$420.20

If Joe had two times the amount of soybeans, 88 bushels, how much money would the grain elevator pay him for his crop? How many pounds of soybeans did he have?

$840.40
5,280 lbs. of soybeans

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Many products are made out of soybeans. One of the most fun is soy crayons! Soy crayons have the following advantages over regular crayons:

- Soy crayons are easier to use: They glide smoother and don’t flake.
- The colors of the soy crayons are brighter.
- They are safer for children (less toxic).
- Soy crayons are better for the environment. Soy crayons are completely biodegradable and are made from renewable resources.

Below are 10 steps in the journey from soybean to crayon. These steps are written out of order. Number the steps in the proper order and rewrite them in a paragraph titled: From Bean to Crayon.

**FROM BEAN TO CRAYON**

1. Farmers plant the soybean seeds in their fields in the spring.
2. The farmer harvests his soybean crop in the fall.
3. Soybeans are transported to the plant and stored until ready to be processed.
4. The soybeans are cleaned and broken into smaller pieces.
5. The small pieces of soybean are heated and rolled into thin flakes.
6. Soy oil is extracted from the flakes by washing with a solvent.
7. Impurities are removed from the oil through a filtration process.
8. Soy wax is made from partially hydrogenated soy oil.
9. Pigments are added to the soy wax.
10. The soy wax and pigment mixture is placed in crayon shaped molds.

**FINISHED PARAGRAPH:**

Soybeans have quite a journey from soybean to crayons. First farmers plant the soybean seeds in their field in the spring. Then the farmer harvests his soybean crop in the fall. Next, soybeans are transported to the plant and stored until ready to be processed. Then soybeans are cleaned and broken into smaller pieces. The small pieces of soybean are heated and rolled into thin flakes. Next, soy oil is extracted from the flakes by washing with a solvent. Impurities are removed from the oil through a filtration process. Next, soy wax is made from partially hydrogenated soy oil. Then pigments are added to the soy wax. Finally, the soy wax and pigment mixture is placed in crayon shaped molds.
From Biodiesel to SOAP!

Once soybean oil arrives at a soy biodiesel plant, it will undergo a process called transesterification. Transesterification is the process that will turn the soybean oil into fuel. This process removes a substance called glycerin from the soybean oil. Glycerin is a valuable by-product (a product made during the manufacture of something else) of soybean oil. Glycerin has thousands of uses. Glycerin is a powerful degreaser, which makes it wonderful for use in bar soap. (Note: Glycerin must be purified before it is made into soap.)

The yield of glycerin from the transesterification process is 20 percent. This means for every 100 liters of biodiesel, you get 20 liters of glycerin. For every 20 liters of glycerin, you can make 100 bars of soap! Use this information to help you solve the problems below.

**WORKSHEET QUESTIONS**

Matt has 300 liters of biodiesel. How much glycerin will be created?

60 liters of glycerin

How many bars of soap can Matt make with his glycerin?

300 bars of soap

Jessica made 200 bars of soap. How much glycerin did she have? How much biodiesel?

40 liters of glycerin and 200 liters of biodiesel
Soybeans = STRONGER MUSCLES

There are over 630 muscles in your body. Muscles move you! Without muscles, you wouldn’t be able to open your mouth, speak, walk, or run.

EXPERIMENT

Do a sit-up and feel your stomach as you do it. Lift a hand weight. What happens to your upper arm when you lift it?

The muscle moves.

What are you feeling when you do these exercises? What happens to the muscle during the exercise?

You feel the muscles move.

Your muscles are made of many cells. Your muscles need energy to work. Muscles get this energy from food, especially protein. Without food, particularly protein, your muscles wouldn’t have the energy to move! Protein is one of the most important fuels for our body. Protein is the building block for bones, muscles, skin, and blood.

Soybeans are often called the miracle crop and are one of the world’s best providers of protein and oil. Soybeans are high in protein.

Soybeans contain all three of the main nutrients needed for good nutrition: complete protein, carbohydrates and fat, as well as vitamins and minerals. Soybeans are the only vegetable that contains complete protein.
Soybeans = STRONGER MUSCLES

CLASS DISCUSSION QUESTION

What do you think would happen to your muscles and body if you did not eat enough protein?

Through a teacher led discussion, students should come to the conclusion that their muscles would shrink and they would not grow as big as they could.

We are lucky that here in the United States we have many available forms of protein from both animals and plants to keep us healthy. There are many countries around the world that are not as fortunate. Afghanistan is one of those countries. The people of Afghanistan have some of the poorest nutrition in the world. According to UNICEF, more than half of all children under age 5 suffer from moderate or severe slowed growth rates. Twenty-five percent of children die before reaching their fifth birthday. That is, 1 in 4 kids die due to lack of good nutrition like protein!

Several U.S. state soybean groups created the World Initiative for Soy in Human Health (WISHH) Program in 2000. Their goal is to create long-lasting solutions for the protein needs of people in poor countries like Afghanistan by making U.S. soy products available. Nutrition scientist Dr. Steven Kwon has seen the impact of adding soy to the diet in his 28 trips to Afghanistan. “After one month, the children’s faces go from looking sick to normal,” Kwon says. “In three months, we see healthy and happy looking children — all because of soy.”

CLASS DISCUSSION QUESTION

Exporting soybeans to countries like Afghanistan obviously helps them in so many nutritional ways. How can the increasing demand for soybean use through groups like WISHH help the American farmer?

Through a teacher led discussion, students should come to this conclusion: The more soybeans are needed to send to other countries, the more soybeans farmers will need to grow, which will help their business.

ENDING ACTIVITY

Create Strawberry Banana Soy Fruit Smoothies (Protein Smoothie):
3 cups plain or vanilla soymilk
1 cup of frozen strawberries
1 ripe banana
Mix in a blender until smooth. Makes 4 cups.
Soybeans Around the WORLD

The United States currently exports 55 percent of the yearly soybean crop, which amounts to 1.56 billion bushels of soybeans a year.

The chart below shows the top countries to which the United States exports soybeans and soybean products. Use this chart to answer the questions below.

### Top 10 U.S. Export Customers $ Million 2009

<table>
<thead>
<tr>
<th>Soybean Exports</th>
<th>Soybean Meal Exports</th>
<th>Soybean Oil Exports</th>
</tr>
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<tbody>
<tr>
<td>China + Hong Kong</td>
<td>$9,213</td>
<td>Mexico</td>
</tr>
<tr>
<td>Mexico</td>
<td>$1,348</td>
<td>Canada</td>
</tr>
<tr>
<td>Japan</td>
<td>$1,096</td>
<td>Philippines</td>
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<td>European Union-27</td>
<td>$770</td>
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<tr>
<td>All Others</td>
<td>$1,401</td>
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<tr>
<td>Total</td>
<td>$16,454</td>
<td>Total</td>
</tr>
</tbody>
</table>

What percentage of the total soybean exports did China/Hong Kong have?

56 percent

How much more soybean meal did the United States export to Indonesia than Korea?

$49 million more

Mexico, Morocco and India were the top three exports of soybean oil. What was the percentage of the total soybean oil exports to the top three countries?

40 percent

How much money was made in total from exporting soybeans and soybean products? What is the percentage of soybeans, soybean meal and soybean oil of the total?

$21,006 million, Soybeans 78 percent, Soybean Meal 17 percent, and Soybean Oil 5 percent.
Soybeans are most commonly exported in three forms: whole soybeans, soybean meal, and soybean oil. The chart below shows the top 10 countries that import the three different forms of soybean products from the United States.

Using this chart, calculate the top five individual countries that import all forms of soybeans from the United States. Create a new chart that shows your data.