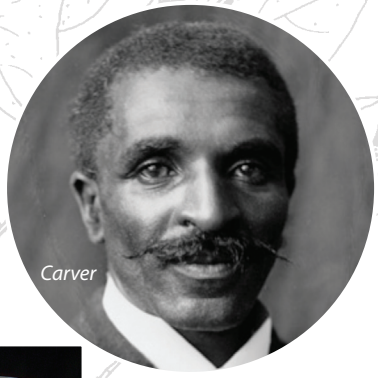
A Scientist and an Engineer Make Biobased Products

How did two good friends make car parts using soybeans? What parts of the plant did they use? Scientists and engineers are still experimenting and using technology to invent new biobased products.



Minimum Completion Time
45 minutes

Skill Level
Intermediate
Age 11-13

Learner Outcomes
- Recognizes skills used by scientists and engineers
- Creates new materials from an agricultural product

Science Skills
- Build/construct
- Design solutions
- Evaluate
- Observe

Life Skills
- Think creatively
- Reason

Educational Standards
- Understanding about science and technology
- Science as a human endeavor
- History of science

Success Indicator
- Uses materials creatively
- Makes soy protein plastic
- Describes the outcome process

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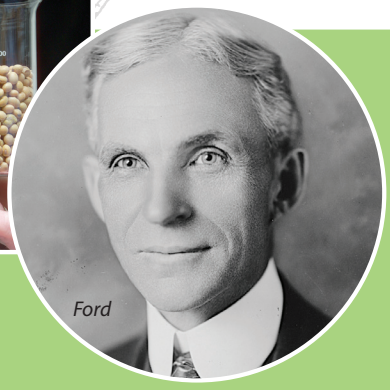
George Washington Carver and Henry Ford worked together to "industrialize" the use of agriculture products. They showed how oil and protein from plants could be turned into many products. Design some new products using junk from around your house. Then use soy protein to create a new biobased material.



Do • • • Be creative

1. **Collect a box of good "junk."** Put at least 10-15 things in it from around your house: tools (screwdriver, hammer, pliers), kitchen stuff (forks, spatula, cup, pizza cutter), school supplies (pencil, scissors, ruler, eraser), toys (car, robot, stuffed animal, notebook), and anything else you can find around.
2. Set a timer and make as many of the following things you can in 30 minutes. Keep a list or take pictures of what you have "invented" on the Observation Log. You can use the junk items over again.
   - a toy for a small child
   - something that can spin
   - a musical instrument
   - useful in measuring
   - used for communication
   - a trap for a pest
   - a container for mud
   - a shelter
3. What are the skills you need to be creative? Go to the Observation Log to record your ideas.

Learn More

- Henry Ford
- George Washington Carver
- Turning soy into soy polymers

Virtual Fun

- Soy bioplastic today
- The house that soy built
- History of biotechnology

News & Careers

- Ag engineering
- Nature and science together

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Make Biobased Product

1. Gather these materials: 4X4 inch piece of newspaper, plastic cup, 2 tablespoons silken tofu, stir stick, 1/4 cup water, microwave oven.
2. Take newspaper and tear into small strips. Place the pieces in a plastic cup.
3. Add water and stir until thick slurry forms.
4. Add tofu and mix until consistent mass is formed; add a little tofu if needed for consistency.
5. Remove mass from cup and squeeze out extra water. Shape into a ball.
6. Place ball in microwave and cook on high for 10 minutes. Check to see if ball is "hard." If not, continue cooking and checking for periods of 3 minutes.
7. Remove ball and cool.
8. Examine this lightweight product. How could it be used? Could George Washington Carver and Henry Ford have used biobased products in the automobile industry?

What's the science?

Heat coagulates protein. You have enjoyed coagulated protein when you eat a burger from the grill or a boiled egg. The same process of heating the soy protein in the tofu produces your biobased product.

Bite

Early engines used as agriculture product as fuel. The first diesel engine invented by **Rudolf Diesel** in 1894 ran on peanut oil.

Today, biodiesel is a clean burning alternative fuel, produced from plant resources such as soybean and canola oil. Biodiesel contains no petroleum, but it can be blended with petroleum diesel to create a biodiesel blend. Biodiesel is biodegradable, nontoxic and good for the environment

Records

Complete Observation Log

More Challenges

- Make larger amounts of soy protein plastic and use it to build something. Study durability, strength and appearance of the product.
- Research other products made from soybeans such as ink, crayons, adhesives, candles, alternative fuels, lip balm, and hand lotion.
- Research other agriculture projects that George Washington Carver worked on such as biofuels, crop rotation and soil improvements.

Glossary

bio-based—material or product derived from biological or renewable resources.

coagulate—change to a solid or semi-solid state

protein—organic compounds; polymer chains of amino acids linked together

tofu—coagulated soy protein made from soy milk

industrial uses for agriculture—crops used in non-food manufacturing including replacements for petroleum, newsprint, wood rosins, rubbers, and degradable plastics, often involving the starch, oil or protein of the commodity.

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Share

Describe the process for making your biobased product.

Reflect

What are the pros and cons of using materials made of tofu and newspaper?

Generalize

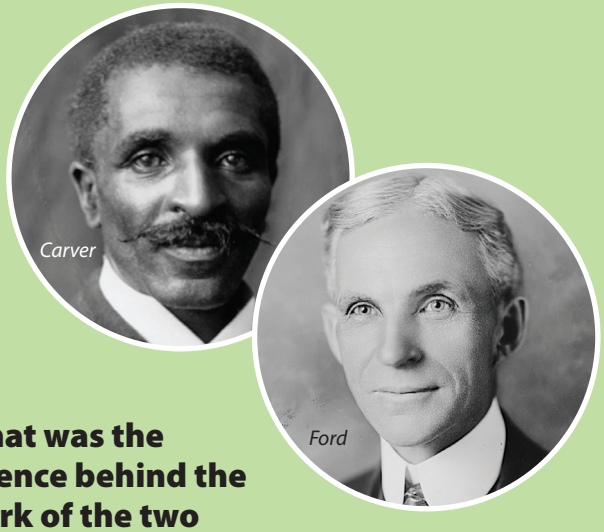
How could you test this product to see if it would stand up to many different uses?

Apply

What other agriculture products could be used to make useful, biobased products?

Background Information

Did you know that a scientist and an engineer invented a way to make car parts out of plants? Not using roots and stems and leaves. Instead they worked with the oil and protein from the seed.



George Washington Carver is a famous American scientist who began his research in his own backyard. He experimented with peanuts, cotton, soybeans and dozens of other plants. In 1904 George Washington Carver discovered that soybeans were a valuable source of protein and oil that could be used to make industrial products as well as food.

Henry Ford is a recognized industrialist and founder of the Ford Motor Company who is known for inventing the assembly line and for his famous automobile, the Model T Ford.

George Washington Carver shared his scientific discoveries with his good friend Henry Ford. Mr. Ford owned a large research facility. He came to the lab one day with a huge bag of soybeans. Dumping them out on the floor, he told a team of young scientists,

"You guys are supposed to be smart. You ought to be able to do something with these soybeans."

In time, Carver and the team of scientists in Ford's lab made a strong enough plastic for the gearshift knobs, horn buttons, window frames, accelerator pedals, light-switch assemblies and ignition-coil casings. They also fashioned the exterior of an automobile from "soybean plastic." It was the protein from the soybeans that under heat was made into the hard plastic parts for Ford's cars. By 1935 Mr. Ford was using one bushel of beans for every car he manufactured.
(60 pounds = 1 bushel)

What was the science behind the work of the two friends?

Biology and chemistry help explain the problems that Carver and Ford and the young scientists were trying to solve while they were working with the soybeans. George Washington Carver and Henry Ford experimented with heating the protein in soybeans to produce a biobased material, soy protein plastic, that was strong enough to be used to make car parts.

Observation Log

Name _____

Date _____

Records—Intermediate Level

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Be Creative—Junk Log

What new products were you able to create? Make a descriptive list, draw pictures or add photos to show what you were able to do with "junk."

What words describe someone who is creative? Choose words from the word box or add your own. Circle the ones that describe you.

WORD BOX							
	smart		tall		imagination		
	creative		intelligent		builder		
	tester		scientist		writer		
	runner		engineer				
	reader		problem solver				

Your Biobased Product

Examine this new material. What could it be used for? Make a list.

Choose one idea to think about _____

Think like an engineer. What characteristics will this product need to have in order to work properly? How could you test those characteristics? (For instance: If you think that your biobased product would make a good duck decoy, then it will need to float. What experiment can you design to see if tofu timber will float?)

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