

Making Plastic and Goop from Crops

BACKGROUND INFORMATION

Thanks to researchers there are now thousands of new and different nonfood uses for Kansas crops. Many of these products can replace others that are harmful to the environment.

BIODEGRADABLE PETROLEUM SUBSTITUTE

Petroleum is the fuel source for many products that make our society mobile. Additionally petroleum and its derivatives are found in plastics, paint, building materials and cloth and are used to produce electricity. The world's petroleum reserves are rapidly decreasing so researchers are developing replacements for petroleum products in the products that we use daily. Chemists say there is nothing currently made from petroleum (non-biodegradable) that cannot be produced from biodegradable plant materials.

PLASTICS

Most plastics use materials that come from petroleum. New biodegradable plastic products such as garbage bags, car parts and packing peanuts are being made from plant starches that are most commonly derived from grain sorghum and corn. Plastic bottles are stronger and lighter when made from 15 percent cornstarch.

Starch is a major component in the production of biodegradable plastics. Plastic bags made from a starch base will biodegrade 10 - 20 times faster than plastic bags made from petroleum products.

Another biodegradable product that has been developed is loose fill packaging material with a plant starch base. This product replaces the Styrofoam™ packing peanuts that are used to fill empty spaces in boxes. This packing material decomposes upon contact with water whereas the petroleum-based Styrofoam™ can take up to 20 years to decompose in a landfill.

LEVEL: Grades 3-6

SUBJECTS: English Language Arts; RI - Informational reading Command of vocabulary Foundation skills of phonics, word recognition and fluency.

Science: Matter and it's Interactions Mixing Two Substances = new substance; earth Systems - Renewable resources Human Impacts on Earth Systems

SKILLS: Classifying, developing vocabulary, organizing, preparing mixtures, measuring, analyzing information to form a perspective

Biodegradable plastics provide more benefits besides reducing the need for petroleum-based raw materials. They are not expensive and can be composted to be used as a carbonrich soil supplement.

OTHER ENVIRONMENTALLY-FRIENDLY PRODUCTS

Ethanol, cornstarch, paper, windshield washer fluid, printing ink and Hydrosorb are more Kansas crop products. Ethanol is a high performance fuel for vehicles that is made from wheat, grain sorghum and corn. It's safer than gasoline for the environment, reducing air pollutants by more than 50 percent because it burns much cleaner. Cornstarch is a major component of paper, corrugated cardboard and other paper packaging materials. There are 28 pounds of cornstarch in each ton of paper produced! Hydrosorb is a super absorbent cornstarch, discovered in one of U.S. Department of Agriculture's regional laboratories. It absorbs 300 times its weight and is used in some baby diapers and engine fuel filters. America's Solution, a green windshield washer fluid, is an ethanol-based solvent made from cornstarch and replaces traditional blue windshield washer fluids, which are made from methanol, a petroleum derivative.

Plant starches and oils can be found in adhesives, batteries, detergents, crayons, matches, plywood, antibiotics and chewing gum. New technologies with crops allow us to produce goods that were once made from limited natural resources or substances that could be harmful to the environment.



Worksheet 1 Vocabulary

Directions: Read the following paragraphs and locate the **bold** words in the word search below.

There are many nonfood uses for Kansas crops. The **starches** or stored carbohydrates from Kansas crops are used to make new **biodegradable** plastic products such as garbage bags, car parts and packing peanuts. **Ethanol**, cornstarch, paper, windshield washer fluid and printing ink are more products made from Kansas crops instead of other **raw materials**. Plant starches and oils can be found in adhesives, batteries, detergents, crayons, matches, plywood, antibiotics and chewing gum.

Crops are **renewable** resources. We can use all of this year's crop and we'll be able to plant another crop next year and use it. We will never run out of crops because we can always grow more. **Non-renewable** resources — such as water, soil and petroleum — cannot be produced again. Once we use them, they are gone. One benefit of using Kansas crops instead of **petroleum** to produce plastic products is that we will never run out. Another benefit is that plastics made from Kansas crops are biodegradable.

Soil is an important part of the biodegradation process. Soil contains living organisms that **decompose** organic materials into nutrients. Kansas crops are organic materials that can enrich the soil.

Word Bank

Starches
Biodegradable
Ethanol
Raw materials
Renewable
Nonrenewable
Petroleum
Decompose



Vocabulary

Biodegradable: (of a substance or object) capable of being decomposed by bacteria or other living organisms.

Byproduct: an incidental or secondary product made in the manufacture or synthesis of something else.

Decompose: make or become rotten; decay or cause to decay.

Ethanol: systematic chemical name for ethyl alcohol

Landfill: a place to dispose of refuse and other waste material by burying it and covering it over with soil, especially as a method of filling in or extending usable land.

Nonrenewable: (of a natural resource or source of energy) existing in finite quantity; not capable of being replenished.

Petroleum: a liquid mixture of hydrocarbons that is present in certain rock strata and can be extracted and refined to produce fuels including gasoline, kerosene, and diesel oil; oil.

Process: a series of actions or steps taken in order to achieve a particular end.

Raw material: the basic material from which a product is made.

Renewable: (of a natural resource or source of energy) not depleted when used.

Starch: an odorless tasteless white substance occurring widely in plant tissue and obtained chiefly from cereal grains and potatoes. It is a polysaccharide that functions as a carbohydrate store and is an important constituent of the human diet.

Value-added: the amount by which the value of an article is increased at each stage of its production, exclusive of initial costs.

Waste: use or expend carelessly, extravagantly, or to no purpose.



BRIEF DESCRIPTION

Students will prepare goop or biodegradable plastic from cornstarch. They will learn about environmental issues.

OUTCOMES

The students will

- Identify five nonfood uses for Kansas crops.
- Differentiate between renewable and nonrenewable resources.
- Create plastic or another product similar to commercial products produced with biodegradable ingredients from Kansas crops.

ESTIMATED TEACHING TIME

15 minutes preparation

15 minutes discussion

TEACHER PREPARATION

MATERIALS NEEDED

- 4 copies of worksheet a, page 129 (one for each group)

Ingredients

- Cornstarch
- Two 1-lb. boxes of baking soda
- Water
- Corn or other vegetable oil
- Food coloring

Equipment

- 2 resealable plastic bags
- 2 large bowls
- Measuring cups
- Measuring spoons
- Use of microwave

ACTIVITY

1. Divide the students into four teams. Two teams will make Homemade Plastic, and the other two teams will make Goop for a Group.
2. Hand out worksheet a, page 129, to each group.
3. Point out that these products are very safe and are “biodegradables.”
4. Allow the groups to share their experiences with the other three groups.

DISCUSSION QUESTIONS

1. What are some things that are made from plastic?
2. Do you think these items could be made from Kansas crops? Why or why not?



Homemade Plastic

WHAT YOU NEED

Ingredients

- 2 tablespoons cornstarch
- 2 tablespoons water
- 4-5 drops corn or other vegetable oil
- 2-3 drops food coloring, optional

Equipment

Resealable plastic bag

Use of microwave oven

DIRECTIONS

1. Place cornstarch in resealable plastic bag.
2. Add water and vegetable oil.
3. For additional effect you may add food coloring.
4. Zip the bag closed and knead the bag for several minutes to mix.
5. Unzip a small opening in the top (to vent) and place in a microwave oven on high for 30-40 seconds.
6. Remove the bag and open as soon as it is cool to the touch.
7. Roll into a ball, and enjoy.

Goop for a Group

WHAT YOU NEED

Ingredients

- 1½ cups cornstarch
- 2 cups baking soda (1 lb. box)
- 1¼ cups water
- 2-3 drops food coloring, optional

Equipment

Mixing bowl

DIRECTIONS

Mix ingredients well in mixing bowl. Do not cook!

NOTE

This recipe results in a material that acts like a solid if it is stirred quickly, and like a liquid if stirred slowly. The ratio of water to starch is critical. If there is too much water, the starch will always flow easily, but if there is not enough water, the mixture will never flow easily.

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Read about a Researcher

Susan Sun, Ph.D., Associate Professor, Grain Science and Industry, Kansas State University

A NEW PIONEER FOR AGRICULTURE

Sun is a Professor of Grain Science and Industry at Kansas State University. Susan grew up in a small city in China. Her research has transformed Kansas cereal crops into starch that can be combined with polylactic acid with the right coupling agent to make agriculture based plastics. Susan is working to find the right chemistry to make the agriculture-based plastics more durable and water resistant.

“Petroleum resources are limited,” Susan explains. “Eventually, the price will be much higher. We can do something good for the earth and for humans with renewable resources – agricultural resources.” For example, “In space, you can grow plants to produce plastics instead of moving petroleum-based products there,” says Susan Sun. “Agricultural resources will be the only resources in space.” Crops are being used to make fast food utensils and containers, shampoo bottles, film containers and pens. There may even be carpet, clothing and construction materials made from crops such as corn, grain sorghum or wheat. “Eventually,” says Sun, “we will get there.”

How did Susan become a researcher? As a child, Susan first wanted to be a doctor. Then, during her teenage years, she found that she liked physics and decided she wanted to be a scientist. She was a serious student, and taught herself much about physics, science and chemistry. Susan was attending elementary and secondary school during China’s Cultural Revolution and spent three years on a farm in China during her teen years. Based upon that experience, Susan didn’t think that there was any research or science in agriculture. She realized at the University in China that agriculture is science.

Susan and her husband have two sons, Felix and George. She encourages her sons to learn about agriculture. The research Susan is doing may enable her sons to live in a world that is not dependent on energy and products made from fossil fuels.

ARE YOU CURIOUS?

Think of a crop research question and write a letter to one of the following groups.

Kansas Wheat
Commission
1990 Kimball Ave.
Manhattan, KS 66502

Kansas Grain Sorghum
Commission
P.O. Box 243
Paola, KS 66071

Kansas Corn
Commission
P.O. Box 446
Garnett, KS 66032

Kansas Soybean
Commission
1000 SW Red Oaks Place
Topeka, KS 66605

CHECK US OUT Other important researchers in agricultural history

Chief Massosoit (1600s)

Jethro Tull (1674-1741)

Thomas Jefferson (1743-1826) James
Small

Cyrus McCormick (1809-1884) George

Washington Carver (1860-1943)

Henry Ford (1863— 1947) www.hfmgv.org

Percy Lavon Julian William Morse

John Deere

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Resources

RESOURCE BOOKS

Mebane, Robert C. and Thomas R. Rybolt. *Plastics & Polymers*. 21st Century Books, Inc., 1995. (0805028439)

OTHER RESOURCES

KS Foundation for Agriculture in the Classroom www.ksagclassroom.org

Pg. 173 Exploring Plants, Kansas Crops Educator Guide order www.ksagclassroom.org

—Polymers. 15 min. Dr. Dad's PH3 produced by Louisiana Public Broadcasting.

RESEARCH WEB SITES

Kids Field Day. 2001. <<http://www.oznet.ksu.edu/fieldday/kids>>

K-State Research and Extension. <<http://www.oznet.ksu.edu>>

United States Department of Agriculture. USDA for Kids, Issues, or Search by topics. <<http://www.usda.gov>>

Kansas companies that produce bio-based plastics from agricultural products.

MGP Ingredients, Inc. Atchison and Onega, Kansas. Read more about it at: <http://money.cnn.com/news/newsfeeds/articles/globenewswire/199071.htm>

Learn more about compostable plastics

<http://www.worldcentric.org/biocompostables/bioplastics>.

What I Know About Nonfood Crop Products

1. Name five nonfood uses for Kansas crops.

2. What is the difference between renewable and nonrenewable resources?

3. Kansas crops are (mark all that apply):

biodegradable

petroleum

nonrenewable

filling up landfills

renewable

raw materials

4. Why is soil so important in the biodegradation process?

5. Name two benefits of using Kansas crops instead of petroleum to produce plastic products.

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