Biodegradable Plastic

Description: *Students will create a simple version of biodegradable plastic from corn and other ingredients to demonstrate that agricultural byproducts means that agricultural is everywhere.*

Grade Level: 1, 2, 8

Indiana Academic Standards:
Examples of select academic standards possibly met during this activity. Additional academic standards may be achieved with added enrichment activities.

Physical Science: 1.1; 2.1.2;
Earth and Space Science: 8.2.7; 8.2.8

Time: 30 minutes, plus set-up.

Materials:
Microwave
1 tablespoon cornstarch
resealable plastic bag
2 drops 100% corn oil
1 tablespoon water
2 drops food coloring, optional
medicine/eye dropper
measuring spoons

Materials Needed for 30 students:
Microwave
2 cups cornstarch
¼ cup 100% corn oil
2 cups water
30 resealable plastic bags
2 pkgs. Food coloring, optional
medicine droppers
measuring spoons

Recommended Reading:
Corn Ag Mag
Corn Terra Nova Reader

Objectives:

- List the basic ingredient elements needed to create biodegradable plastic.
- Describe environmental reasons for using corn in the production of plastics.
- Explain what a byproduct is.

Background:
Source: Michigan Ag in the Classroom
Plastics made from nonrenewable oil products last for thousands of years in our environment because they don't break down or disintegrate. Because they do not break down, experts feel the landfills in the United States will reach maximum capacity by the year 2020.

To help alleviate this problem, researchers have invented a biodegradable plastic made with cornstarch. Plastics made with cornstarch will break down and not take up space in landfills. Plus, the added benefit is that biodegradable plastic is made with a renewable resource-corn! Corn is produced every year, unlike oil. Oil is a nonrenewable resource because we only have a certain amount of it. Once we have depleted our oil reserves it will be gone. Corn can be grown every year and is used to make more biodegradable plastic products.

Corn is the major feed grain grown by farmers in the U.S., leading all other crops in value and volume of production. Corn is also a major component in main foods like cereals, peanut butter and snack foods. An ear of corn averages 800 kernels in 16 rows. A pound of corn consists of approximately 1,300 kernels. An acre (about the size of a football field) of corn yielding 100 bushels produces approximately 7,280,000 kernels. Most of the weight of a bushel of corn is the starch, oil, protein and fiber, with some added natural moisture.

Farmers grow corn on every continent of the world except Antarctica. Hybrid varieties have been developed to adapt to specific growing conditions and locations worldwide. America exports nearly one-third of our nation's corn crop and produces over one-third of the world's corn crop.

One hundred years ago, starch was basically the only product coming from corn refining-the rest of the kernel was thrown away. Today, there are uses for every part of the kernel and even the water in which it is processed. Photographic films are made from the starch portion of corn. Corn oil and cornstarch are used to make biodegradable plastic. Corn can be made into fuel, abrasives, solvents, charcoal, animal feed, bedding for animals, insulation, smoked meat, adhesives, etc. The kernel is used as oil, bran, starch, glutamates, animal feed and solvents. The silk is used as part of animal feed, silage and fuels. Husks are made into dolls and as filling materials. The stalk is used to make paper, wallboard, silage, syrup and rayon.

What is a by-product? A by-product is a secondary or incidental product made from the manufacturing process and is not the primary product or service being produced. By-products serve as source materials for other industries, including pharmaceuticals, chemicals, and textiles.

Activity Directions:

1. Place 1 tablespoon cornstarch in one corner of a small resealable plastic bag, seal.
2. Add 2 drops corn oil to the cornstarch, reseal bag. Using your fingers, knead the oil into the cornstarch to blend moderately.
3. Add water to the oil/cornstarch mixture, reseal bag. Knead together using fingers to a uniform consistency.
4. Optional: add food coloring to the mixture and knead to blend in.

Observations:

1. What do you notice about your biodegradable plastic?
2. Is your biodegradable plastic the same as other students' plastic?
3. What could you make with this plastic if you let it harden?
4. What products can you think of that are made from a similar plastic?

Take it further:

Microwave your plastic for 20 to 25 seconds on high.
(Caution: will be HOT)

a. What happens to the plastic?
b. Form your plastic into a ball and describe what happens.

For Discussion:

1. Why is oil a nonrenewable resource?
2. Why is corn a renewable product that we can make plastic out of?
3. What three ingredients do we need to make biodegradable plastic?
4. Name the uses of corn.

Corn

Whole Corn Products

Cob & Kernel

Food
baby corn
pickled baby corn
boiled sweet corn
canned corn
frozen packaged

Industrial
decorative items
(pod & Indian corn)

Whole Kernel Products

Food
popcorn
snack food
corn nuts
posole
canned corn
soup mixes
canned hominy
frozen packaged

Feed
livestock feed
wild animal feed

Cob or Stover

Industrial
polishing media
furfural (chemical feedstock)
liquid spill recovery media
dust adsorbent
construction board
cosmetic powders

Alkali Cooked

Food
tortilla flours
hominy
corn chips
tortilla chips
taco shells
sopapillas
atoles
posole
menudo
tostados

Dry Grind Ethanol

Fermentation

Industrial & Fuel
fuel ethanol
distillers dried grains
with solubles

Fractionated Products

Dry-milled Corn

Grits & Cones

Food
breakfast cereals
fortified foods
pinole
snack foods
maize porridges
alkali cooked products
breads & bakery products
fermented beverages
unfermented beverages
pet foods
corn bread

Industrial
wallpaper paste
floor wax
hand soap
dusting agents

Flour

Food
bakery products
masa flour
snack foods
baby foods
baking mixes
batters
desserts
pie fillings
gravies & sauces
salad dressings
frozen foods
meat extenders
non-meat extenders
thickening agents

Industrial
fermentation media
explosives
gypsum wallboard
paper products
briquettes
foundry binders
ore refining
drilling fluids
label adhesives
edge paste
pharmaceuticals

Hominy Feed

Feed
livestock feed

Germ

Oil

Pharmaceutical & Food
vitamin carriers
lecithin
cooking oil
margarine
mayonnaise
potato chips
salad dressings
sauces
shortenings
soups

Industrial
lecithin
soluble oils
insecticides
linoleum
printing inks
rubber substitutes
rust preventatives
soaps
tanning agents
textiles

Meal

Industrial & Feed
livestock feed
amino acids
fur cleaner

Wet-milled Corn

Steepwater

Industrial & Feed
steepwater (feed)
antibiotics
chemicals
pharmaceuticals
yeast culture

Germ

Same uses as dry-milled germ

Gluten Feed

Feed
cattle feed

Gluten Meal

Feed
poultry feed
zein
production

Modified Starch

Food
baby foods
bakery products
chewing gum
retortable thickeners
puddings & custards
prepared desserts
salad dressings
baking mixes
pie & pastry fillings
gum candies
snack foods
sauces & gravies
condiments
icings & glazes
dehydrated foods
instant tea
instant breakfast foods
low-cal sweeteners
nougats
pan coatings

Industrial
adhesives
book-binding agents
candles
ceramics
casting (mold) binders
dyes
printing inks
insecticides
insulation & fiberglass
labels
leather products
incendiary compounds
fireworks
ore separation compounds
poster paints
paper products
plastic molding
plywood & wallboard
sandpaper
textiles
wallpaper
shade cloth

Native Starch

Food
baby foods
bakery products
baking powder
brewed beverages
chewing gum
chocolate drinks
puddings & custards
prepared desserts
snack foods
salad dressings
meat products
baking mixes
prepared condiments
pie & pastry fillings
precooked & frozen meals
prepared soups
powdered sugar
canned vegetables
candies

Industrial
abrasive papers
adhesives
dry cell batteries
composite binders
paperboard products
boiler compounds
bookbinding
briquettes
clay binders (ceramic)
chemical precursor
fermentation feedstock
detergents & cleaners
coatings
paper color carriers
paper products
textile color carriers
cord sizing & polishing
cork products
crayon & chalk binders
dispersion agents
dye component

fiberglass sizing
fireworks
powdered insecticides
insulating materials
lubricating agents
oilcloth
well drilling mud
ore refining
paints
fillers & caulks
cleaning compounds
molded plastics
printing inks
colloid emulsions
textile finishing
ceiling tiles
rubber tires
wallboard
wallpaper
water treatment

Pharmaceutical & Cosmetic
antibiotic products
antibiotic production
aspirin
powdered cosmetics
liquid thickener
dietary formulations
soaps
disinfectants
surgical dressings

Sweeteners

Glucose

Pharmaceutical & Food
baby foods
medicinal syrups
bakery products & mixes
beverages
breakfast foods
prepared cereals
cheese spreads
chewing gum
coffee whiteners
cordials & liqueurs
desserts
prepared egg products
extracts & flavors
frostings & icings
fruit jams & butters
prepared soups & sauces
salad dressings
pickled products
frozen seafood
peanut butter

Industrial
adhesives
chemicals
dyes & inks
explosives
leather tanning
metal plating
paper products
plasticizers
shoe polish
rayon
textiles
theatrical makeup
tobacco products

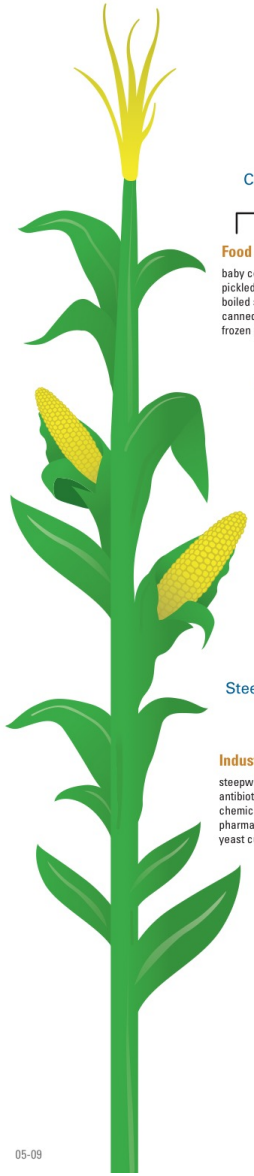
Fructose

Food
bakery products
canned fruits
canned juices
condiments
confections
frozen desserts
soft drinks
wine products
yeast production
fruit jams & preserves

Fermentation

Food & Feed
alcoholic beverages
acidulants
flavor enhancers
soft drinks
amino acids (feed)

Industrial & Fuel
industrial alcohols
engine fuel
fuel octane enhancers
oxygenate in engine fuels
plastics
solvents
carpeting
textiles
food packaging



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Biodegradable Plastic
adapted from Kentucky Corn Growers Association and Michigan Farm Bureau AITC
INAITC
www.inaitc.org