

Corn Plastic

Activity Level: 4-6 Grade | Time: 60 minutes

PURPOSE

Students will examine the growth of corn, discuss renewable and non-renewable resources, and complete a hands-on exploration of bioplastics made from corn.

NEBRASKA STATE STANDARD CONNECTION

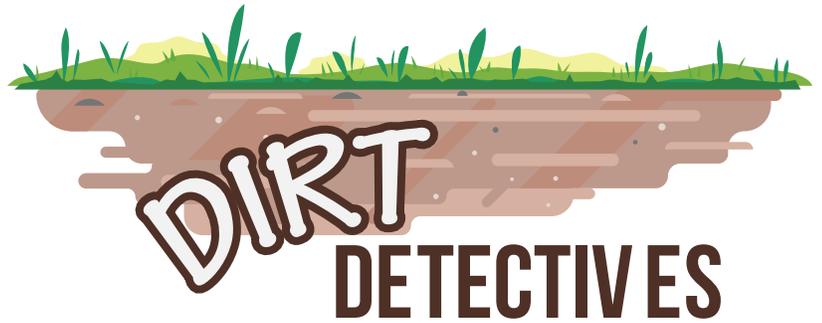
- SC.4.13.4.D Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
- SS 4.3.5.c Classify resources as renewable or nonrenewable resources.
- SC.5.13.4.C Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
- SC.6.4.1.B Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principle and potential impacts on people and the natural environment that may limit possible solutions.

ACTIVITY SNAPSHOT

1. Organize and Prepare Supplies
2. Read Background Information
3. Dirt Detectives: Corn Plastic PowerPoint
 - a. Corn or Corn Free Activity
 - b. Corn Plastic Activity

MATERIALS

- Dirt Detectives: Corn Plastic PowerPoint
- Corn/Corn-Free Product List naitc-api.usu.edu/media/uploads/2016/03/30/Corn_CornFree_Products.pdf
- Sandwich-size resealable plastic bags
- Cornstarch
- Corn oil
- Water
- Food coloring
- Tablespoons
- Microwave
- Making Bioplastic activity sheet naitc-api.usu.edu/media/uploads/2018/03/27/Bioplastic_Worksheet.pdf



WHAT'S THE CONNECTION TO AGRICULTURE?

Crops are considered a renewable resource. Farmers can produce crops each year. Corn as well as other crops are used in by-products that we use each day. Corn can be used to create a bioplastic which is biodegradable and a renewable resource.

PROCEDURES:

1. Organize and Prepare Supplies

See “Materials” on cover page.

Prepare supplies and set up PowerPoint.

2. Background Information

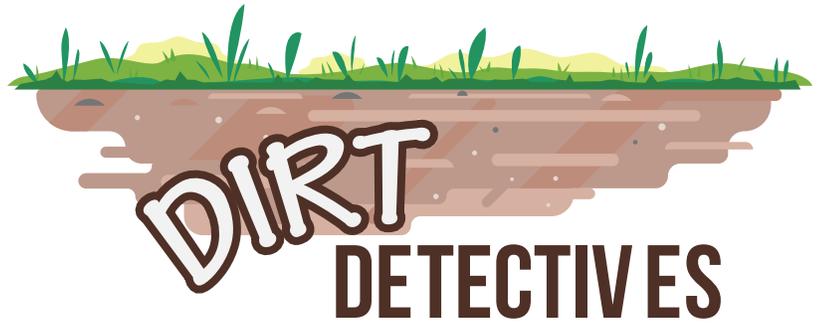
Source: Oregon, Utah, and Illinois Agriculture in the Classroom

Advances in technology allow us to use more components of the processed corn kernel than ever before. One hundred years ago, starch was the main product used from refined corn, while the rest of the kernel was thrown away. Today, there are uses for every part of the kernel—even the water in which it is processed. The corn seed (kernel) is composed of four main parts: the endosperm, the pericarp, the germ, and the tip cap. The endosperm makes up most of the dry weight of the kernel and provides the source of energy for the seed. The pericarp is the hard, outer coat that protects the kernel both before and after planting. The germ is the living embryo of the corn kernel. It contains genetic information, vitamins, and minerals that the kernel needs to grow. The tip cap is where the kernel is attached to the cob and is the major entry path into the kernel for water and nutrients.

Corn is a versatile crop. It is the major grain grown for livestock feed by farmers in the United States, leading all other feed crops in value and volume of production. Corn is a major component in foods like cereals, peanut butter, and snack foods, and it is also processed into a wide range of industrial products, including ethanol. The kernel is used as oil, bran, starch, glutamates, animal feed, and solvents. The silk is combined with other parts of the corn plant to be used as part of animal feed, silage, and fuels. Husks are made into dolls and used as filling materials. The stalk is used to make paper, wallboard, silage, syrup, and rayon (artificial silk).

Corn can also be used to make a type of plastic known as bioplastic. Commonly, plastic is made from petroleum, a fossil fuel that is a nonrenewable resource. In contrast, bioplastic is made from biological materials—plant starches, cellulose, oils, or proteins. Unlike petroleum-based plastics, bioplastics are made from renewable resources such as corn, potatoes, tapioca, and casein (milk protein). One example of a bioplastic application is packing peanuts—the loose fill that goes all over when you open a package. Some packing peanuts are made of polystyrene (Styrofoam), which is a petroleum-based plastic. Corn-based packing peanuts are made of over 99 percent cornstarch and a very small percentage of food-grade oil. These packing peanuts are non-toxic, biodegradable, and compostable.

It is important to note that there are pros and cons to both bioplastics and petroleum-based plastics.



There are also some common misconceptions about the differences between these groups of plastics. For example, both bioplastics and petroleum-based plastics can be biodegradable, meaning that over time they break down into compounds like carbon dioxide, water, and methane when exposed to naturally occurring microorganisms like bacteria, fungi, and algae. Also, some bioplastics are recyclable. The ability of a plastic to be recycled or to biodegrade depends on the chemical structure of the plastic, not whether the plastic is made from renewable or nonrenewable materials. In addition, many people are unaware that the raw materials used to make petroleum-based plastics are the by-products of refining crude oil for fuel. If these by-products were not used to make plastics, they would be industrial waste that would need to be disposed of.

3. PowerPoint

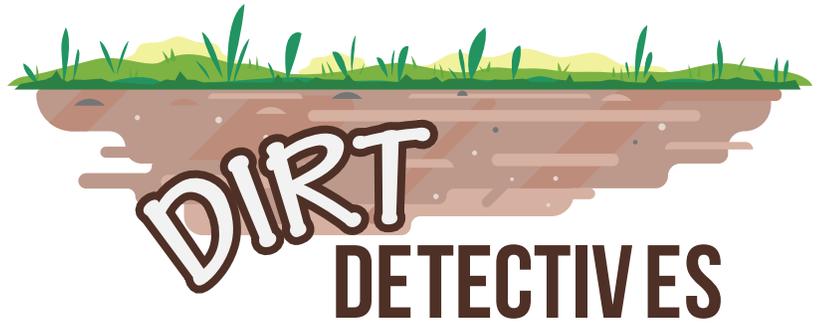
Slide 1: Dirt Detectives Lesson 7: Corn Plastic

Slide 2: Review the lessons covered so far.

- Lesson 1: Our World and Soil – Technology Advances
- -Lesson 2: Soil Types – Sand, silt, and clay; which is ideal for growing crops? *A mixture of all three which is called loam. All have their advantages and disadvantages*
- -Lesson 3: Traits – Why are traits important? *They provide a variety and different choices when selecting plants and animal genetics.*
- -Lesson 4: Choices – How can genetically modified seeds help farmers be more efficient? *Insect and herbicide resistant, drought tolerant seeds allow farmers to use less weed and insect repellent and less water if seeds are drought tolerant.*
- -Lesson 5: Germination & Seeds – What are the different uses for seeds? *Food, animals, clothing, fuel, reproduction.*
- Lesson 6: Pollination – Pollination is essential in order for seeds to reproduce and to provide us with food, clothing and feed for animals. What are some example of pollinators? What is cross-pollination, what is self-pollination? *Self-pollination has both the female and the male parts of the flower to selfpollinate, where cross-pollination requires a pollinator to help pollinate the flower to produce the fruit that we can eat.*

Slide 3: Corn or Corn Free Activity

1. Provide each student with the Corn/Corn-Free Product List and project the photograph of the corn and corn-free products on the classroom screen. Every item shown in the photograph comes from agriculture. Circle each item on the list that you think contains corn.
2. After the students have finished circling the items, tell them that only one of the items does not contain corn. Ask the students to tell you which item they think does not contain corn.
3. Reveal to the class that the only item on the list that does not contain corn is the pasta. It contains wheat flour, not corn flour. Refer to the list below to explain what form of corn each remaining item contains.



Aspirin – cornstarch
Baking Powder – cornstarch
Batteries – cornstarch (insulation)
Bubble Gum – corn syrup
Coke – corn syrup
Corn Tortillas – corn flour
Crayons – corn oil
Crunch Berries – corn syrup

Diaper – cornstarch
Gain Detergent – cornstarch
Matches – cornstarch (match head)
Pasta – does not contain corn
Shoelaces – cornstarch (for smooth tying)
Snickers Bar – corn syrup

Slide 4: Different corn varieties are grown to meet various food and production needs. Corn is classified by its kernel type.

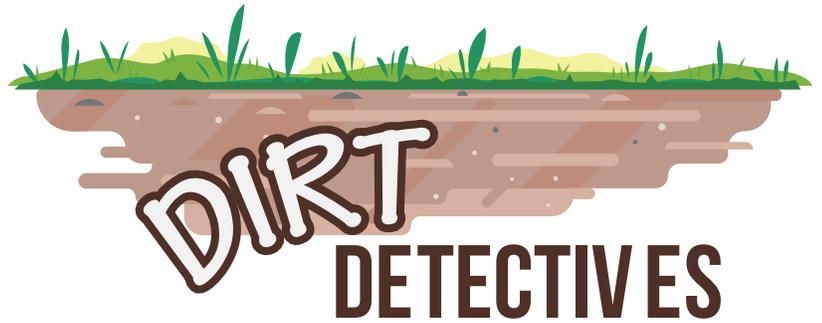
- **Dent Corn**, the kernel is hard on the sides and soft in the middle where the dent forms. Dent corn, also known as field corn, is the most widely grown corn in the United States. It is very starchy, giving it a bland flavor and a mealy texture. It is used for animal feed and processed and refined to make corn syrup, fuel, biodegradable plastics, and many other products.
- **Sweet Corn**, the kernel is mostly sugary when harvested. Sweet corn is harvested during its immature, milk stage when the kernels are tender and before the normal conversion of sugar into starch can take place. It is eaten fresh off the cob or can be canned or frozen for future use.
- **Popcorn**, the kernel is mostly hard with a small, soft center. Popcorn has a dense, soft starch surrounded by a hard, moisture-resistant shell. When popcorn is heated, the moisture inside the kernel expands, building up enough pressure for the kernel to explode. Popcorn is thought to be one of the oldest surviving types of corn. Nebraska is the number one popcorn producer in the United States.
- **Flour Corn**, the kernel is mostly soft. Sometimes known as food grade corn. Flour corn is used in baked goods. The entire kernel of flour corn is soft. Once the kernel is dried, it can be easily ground. Flour corn is not common in the United States but can be found growing in some home gardens and in other countries. The use of flour corn can be traced back to the Aztecs and Incas.
- **Flint Corn**, the kernel is mostly hard. Flint corn has a hard kernel that can be ground and used for cooking. It is not grown in large quantities in the United States but may be found in home gardens or local markets. Many ornamental or “Indian” corns are flint types, but other types of corn may also be grown for ornamental purposes.
- There are many varieties of corn. Each variety has a purpose.

Slide 5: Cross Section of a Corn Kernel

- A corn kernel has four parts, the tip cap, germ, endosperm, and pericarp.

Slide 6: Corn Kernel Structure

- The pericarp is the outer, protective covering of the kernel. It resists water and water vapor and is undesirable to insects and microorganisms.
- The endosperm represents approximately 75 to 80 percent of the kernel’s dry weight. It is the source of



energy (starch) and protein for the germinating seed. There are two types of endosperm, soft and hard. In the hard endosperm, the starch is loose. When the dent corn dries in the field before harvest, the moisture loss causes the soft endosperm to collapse and form a dent in the top of the kernel.

- The germ is the living embryo of the corn kernel. It contains the essential genetic information, enzymes, vitamins, and minerals for the kernel to grow into a corn plant. About 25 percent of the germ is corn oil. Corn oil is the most valuable part of the corn kernel because it is high in linoleic fatty acid (polyunsaturated fat) and it has a mild taste.
- The tip cap is the only area of the kernel not covered by the pericarp. It was the attachment point of the kernel to the cob and the major entry path into the kernel for water and nutrients.

Slide 7:

- Now that we know the varieties of corn, we need to know what renewable vs. nonrenewable means.
- What is the difference between renewable and nonrenewable?
- **Nonrenewable resources** are made naturally by the earth but do not renew themselves fast enough for people to count on having the resource for an indefinite period of time. Some resources are considered nonrenewable because access to the resource is limited. For example, glass and metal are nonrenewable resources. The elements and minerals used to make glass and metal are found in the structure of the earth's crust, but we are limited to what we can access through mining.
- **Renewable resources** are either naturally reproduced at a sustainable rate or they can be produced in agriculture at a rate equivalent to the demand or need. For example, corn can be used for ethanol fuel, and a new crop of corn can be grown and harvested each year. Corn is a renewable resource.

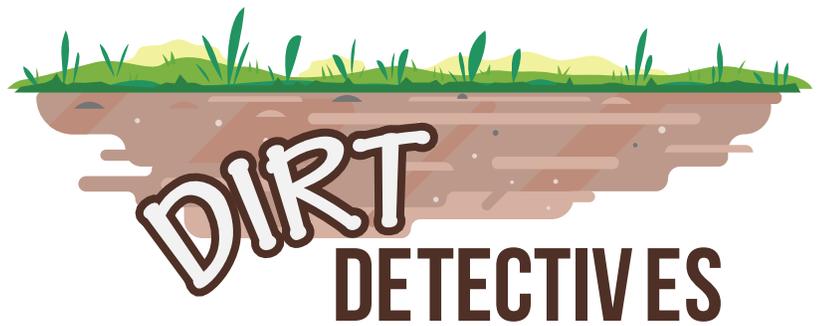
Slide 8: Corn Plastic Video

- How do you think they turn corn into plastic?
- This video will show how scientist turn corn into plastic by using those different parts of the corn
- Which parts of the corn kernel are used to make plastic?

Slide 9: Corn Plastic Activity

1. Discuss the word "bioplastic." "Bio" means that it comes from a living thing. "Bioplastic" is plastic that comes from a living thing.
2. To make bioplastic, combine 1 tablespoon (14 g) of cornstarch, 2 drops of corn oil, 1 tablespoon (15 mL) of water, and 2 drops of food coloring in the plastic bag.





3. Seal the bag and mix the ingredients by rubbing the outside of the bag with your fingers until the ingredients are thoroughly combined.



4. Complete part one on your Making Bioplastic activity sheet.
5. Open the bag slightly, making sure it can vent, and place it into a microwave oven on high for 20-25 seconds.



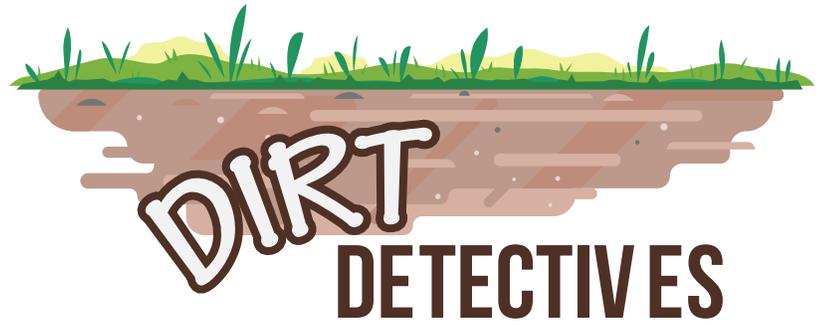
6. Carefully remove the bag from the microwave, and let it cool for a few minutes. While it is still warm, form the plastic into a ball.



7. Complete part 2 on your Making Bioplastic activity sheet and discuss your observations as a group.
8. Explain that corn is used as a bioplastic. Corn is a renewable resource so we can grow more of it year after year.
9. Can you think of any other crops we might be able to use as a renewable resource? Ford Motor Company used crops in their vehicles. Every 2011 and newer vehicle has soybean foam seats. Ford continues to research methods of utilizing crops to make useful products that are renewable resources.

Slide 10: Next Lesson

- We will review our lessons and create a strategy to help solve our problem.



Review

- Ask students to get out their scientific journal.
- What have you learned from today's lesson? Write down key concepts and ideas that will help us solve our problem: how we grow more food with less land?
- Brainstorm new ideas and ways to solve this problem and write it in the ideas box.