



# Kansas Corn: Corn Plastic



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[kscorn.com](https://kscorn.com)

# Kansas Corn: Corn Plastic

## Grade Level: Middle School

### Overview

Plastic has shaped the world in ways that we could have never imagined. The importance of plastic in the modern world cannot be understated. Plastic is inexpensive, light-weight, and durable and can be molded into virtually any shape. Plastic is present in every aspect of our lives and largely responsible for the advancements in society that we take for granted each and every day.

Still, plastic has its drawbacks. Most plastic is manufactured from nonrenewable petroleum. It is so durable that it will take generations before it biodegrades. Single-use plastic products are commonplace because they are inexpensive and convenient. Plastic trash is becoming a global concern, and microplastics are even now showing up in the food chain.

An alternative product that has all the characteristics of petroleum-based plastic, but is made from a renewable, biodegradable resource, is in high demand. Plastic made from corn is one possible alternative. There are currently a multitude of plastic products being produced from corn and more are being developed each day.

This lab lets your students create a plastic polymer from cornstarch. Students can then adjust the quantities and proportions of each chemical to create plastics with different properties. Students can then try to come up with a practical, real-world application for the type of plastic they develop.

### Kansas College and Career Ready Standards

- **MS-ESS3-3.** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- **MS-ESS3-4.** Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

### Learning Objectives

- Learn about corn-based plastic.
- Adjust the materials to develop various corn plastics with different properties.
- Develop a real-world application for the use of their corn plastic.

### Materials

- Corn Plastic PowerPoint (available at [www.kansasscornstem.com](http://www.kansasscornstem.com))
- Materials made from corn plastic such as plastic utensils and cups
- Cornstarch
- Corn oil
- Water

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- Glycerin
- Vinegar
- Rubber spatula
- Glass bowls or glass beakers
- Hot plate
- Glass stirring rod
- Measuring spoons
- Plastic baggies
- Plastic molds such as decorative ice cube trays
- Safety goggles
- Lab coat or apron

### Safety Considerations

Students should wear safety goggles at all times during this activity. Students should also follow all class guidelines for using a hot plate safely and use appropriate safety equipment for handling hot glass and other hot materials. Lab coats or aprons should be used when heating the corn plastic in case of splattering.

### Procedures for Instruction

*Length of Time for Preparation:* 20 minutes

*Length of Time for Classroom Teaching:* 2-3 class periods

### Preparation Procedure

Set up your lab stations. Each lab station should include all materials necessary for each group to complete the lab.

### Background Information

Plastic is a material consisting of any of a wide range of synthetic or semi-synthetic organic compounds that are malleable so it can be molded into solid objects. Plastics are typically organic polymers of high molecular mass and often contain other substances. They are usually synthetic, most commonly derived from petrochemicals; however, they can be made from renewable materials such as corn or cellulose from cotton.

In this lab:

- Cornstarch – will be used as the polymer chains
- Glycerin – plasticizer that links the polymer chains together and allows them to slide past each other (can be replaced with sugar)

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- Vinegar – helps dissolve the cornstarch because it dissolves better with charged ions (can be replaced with salt)

### Classroom Discussion

Introduce the topic and assess students for prior understanding.

- What are some products that you use that are made from plastic?
- Why do we use plastic? What are the advantages of plastic?
- What are the drawbacks of plastic?
- What is most of the plastic we use today made from?

Let students discuss their ideas, and guide the discussion without telling them if they are right or wrong.

- How much of the plastic we use is made for a single use then discarded? List some examples.
- How is the use of plastic affecting our environment?
- What are alternatives for oil-based plastics?
- Can plastic be made from other materials other than oil?
- If you could create an alternative to plastic, what properties would it need to have?

### Procedure for Lab

This lab can be differentiated to fit a variety of student levels and classroom needs.

#### *Class Period 1*

After your class discussion, show them the plastics made from corn. Ask them which items they think were made from corn. Tell the students they will be able to make a type of plastic from corn. This will not be the same type of plastic used to make the cups and spoons but a polymer that can be safely made in a middle school lab.

Mix in glass bowl:

- 2 tbsp. water
- 1/4 tbsp. Glycerol
- 1/2 tbsp. cornstarch
- 1/2 tsp. of vinegar

Stir and heat on medium until the mixture becomes clear. Put the corn plastic in a plastic bag for immediate examination. The corn plastic can be put into molds. If you want the students to make a shape, then store it in plastic bags overnight.

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### *Class Period 2*

Have each group examine their plastic they made from the previous class period. Have them discuss the properties of their plastic.

The next goal is to see how each material affects the properties of the plastic. Assign each group a different component of the corn plastic:

- Group 1 an amount of water
- Group 2 an amount of glycerol
- Group 3 an amount of cornstarch
- Group 4 an amount of vinegar
- Group 5 adding a drop of corn oil
- Group 6 adding a drop of food coloring

Have the student groups make 2-4 different batches of corn plastic. Each batch should contain an incremental amount more or less of their given material. The teacher can assign the amount of materials to be changed, or the teacher can allow the students to make that decision. All other proportions of materials should stay the same.

*Example: How does increasing the amount of cornstarch by 1 tbsp. affect the properties of the corn plastic? How does decreasing the amount of cornstarch by 1 tbsp. affect the properties of the cornstarch?*

Put the corn plastic in a plastic bag for immediate examination. The corn plastic can be put into molds. If you want the students to make a shape, then store in plastic bags overnight.

### *Class Period 3*

Have each group examine their plastic they made from the day before. Have them discuss the properties of their plastic. Share with the class how the properties differed from the original procedure.

Using what they have learned, challenge the groups to create a new corn plastic. An example of a challenge could be: develop a corn plastic that can be molded and retain its shape. Have students keep track of exactly what proportions are used in each new batch created. The plastic can then be placed in a mold and allowed to dry overnight.

### **Teacher Tips**

Don't add food coloring until after the mixture becomes clear during the heating process. If you add the food coloring earlier, you will not be able to determine when the plastic turns clear and has finished heating. Cut up the plastic ice cube trays into individual molds.

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### Lab Analysis

Corn plastic can be compared to other types of polymers that can be made in the classroom. Properties used to compare polymers include but are not limited to: stretchiness, bounciness, stickiness and density.

### Reflection and Conclusion

Students should look for advantages and disadvantages of making plastic out of renewable/biodegradable sources compared to plastic made from fossil fuels.

### Assessments

Challenge students to come up with a real-world application for their corn plastic based off of the unique properties of each batch created.

### Take it Further

Have students see if they can compost the plastic and find out if and how long it takes to biodegrade. Consider setting up an experiment within your school to find results.

Have students research the current products being made from corn plastic. Use the research to write a letter to corporations, such as fast food chains, that use non-biodegradable plastics and persuade them to switch to corn-based plastic products.

### Science and Agriculture Careers

Kansas Corn funds research at Pittsburg State University that is replacing non-biodegradable products with corn. Products include flame retardant insulation for homes and rechargeable batteries. For more information, contact Ram Gupta at [rgupta@pittstate.edu](mailto:rgupta@pittstate.edu).

Note: To learn more about agriculture careers, visit [agexplorer.com](http://agexplorer.com). You can also find career profiles at [kansascornstem.com](http://kansascornstem.com).

### Sources

- <https://science.howstuffworks.com/environmental/green-science/corn-plastic.htm>
- <https://www.acs.org/content/dam/acsorg/education/resources/highschool/chemmatters/videos/chemmatters-april2010-bioplastics.pdf>
- <https://www.instructables.com/id/DIY-Bio-plastics/>

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Any educator electing to perform demonstrations is expected to follow *NSTA Minimum Safety Practices and Regulations for Demonstrations, Experiments, and Workshops*, which are available at <http://static.nsta.org/pdfs/MinimumSafetyPracticesAndRegulations.pdf>, as well as all school policies and rules and all state and federal laws, regulations, codes and professional standards. Educators are under a duty of care to make laboratories and demonstrations in and out of the classroom as safe as possible. If in doubt, do not perform the demonstrations.

## Corn Plastic:

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Lab Group: \_\_\_\_\_

**Essential Question:** How can we make plastics out of renewable and nonrenewable resources?

### Materials

- Cornstarch
- Water
- Glycerin
- Vinegar
- Rubber spatula
- Beaker
- Hot plate
- Measuring spoons
- Molds
- Food Coloring (optional)
- Corn Oil

### Procedure for Lab

1. Mix in glass beaker
  - a. 4 TBSP water
  - b. 1 ½ tsp glycerin
  - c. 1 TBSP cornstarch
  - d. 1 tsp of vinegar
2. Stir and Heat on medium until the mixture changes to a gel and starts to become clear. Add food coloring at this time
3. Wait for the mixture to cool for 2 minutes.
4. Put some of the plastic into a mold. Let it set in the mold for several until it starts to harden.
5. Change one material amount, leaving all other materials the same. Another option is to keep everything the same and add 2 drops of corn oil. In the box below, record what change you made to the original material amounts.



**Data:**

Substance	Cornstarch	Glycerin	Vinegar	First Polymer	Second Polymer
Color					
Viscosity					
Can it be stirred?					
Stickiness					
Bounciness					
Stretchability					
Other					

**Analysis:**

1. How do the physical properties of the final substance you made compare to the properties of the individual substances you started with?
2. What are two ways the materials engineers can vary the plastic they produce?
3. Is there any advantage or disadvantage to making plastic from corn, a renewable resource, versus making plastic from oil, a nonrenewable resource?