

# DIY Science – Corn Flour Bioplastic

Discover how to reduce petroleum-based plastic waste by making plastic from corn flour.

## Safety

An adult should carry out the steps that use a microwave oven, stove, or hotplate. Oven gloves should be used to transfer the bowl of hot mixture from the microwave oven to the work surface. Microwave cooking times may vary.

## What you need

Corn flour, vegetable oil, food colouring, white vinegar, glycerine, microwave-safe bowl with a flat base of diameter approximately 10 cm, measuring spoons, metal spoon for stirring, microwave oven, small saucepan, stove or hotplate, cookie cutter, cake rack, baking tray

## What to do

### Recipe A: Bioplastic shapes

1. To the bowl, add 2 tablespoons of corn flour, 1 tablespoon of water,  $\frac{1}{4}$  teaspoon of vegetable oil, and a few drops of food colouring. Stir with the metal spoon until thoroughly mixed.
2. Take the spoon out of the bowl and microwave the mixture on HIGH for 10 seconds. Open the door of the microwave and stir the liquid with the metal spoon.
3. Repeat Step 2. The liquid may start to thicken and look less cloudy.
4. Microwave the mixture in 5-10 second bursts, without stirring in between, until most of the cloudiness disappears. Do not overcook!
5. Leave to cool for at least 5 minutes before cutting shapes from the mixture using a cookie cutter. Place the shapes on the cake rack to dry for 1-2 days.



### Recipe B: Bioplastic film

1. To the small saucepan, add 1 tablespoon of corn flour, 4 tablespoons of water, 1 teaspoon of vinegar,  $\frac{1}{2}$  teaspoon of glycerine, and a few drops of food colouring. Stir with the metal spoon until thoroughly mixed.
2. Heat the mixture on the stove or hotplate. Stir the mixture with the metal spoon until the mixture starts to boil.
3. Reduce the heat and continue to heat the mixture and keep stirring for 2-3 minutes.
4. Pour the mixture onto the baking tray and spread it out to make a thin sheet.
5. Leave the sheet of bioplastic to cool and dry for 1-2 days.



NOTE: This recipe can also be used to make moulded shapes by pouring the hot mixture into silicone moulds (e.g. silicone ice-cube trays).

### Recipe C: Make your own recipe

Use some of the ingredients and methods from recipes A and B to create a new recipe for bioplastic. Can you make changes and improvements to create a bioplastic with useful properties? What happens to the texture of the bioplastic if you leave out the vegetable oil, vinegar, or glycerine?

#### **What's happening?**

The word 'plastic' refers to a substance that can be moulded or shaped. Most of the plastics used by people are made from oil or gas, including PET (polyethylene terephthalate) to make soft drink bottles, PP (polypropylene) to make heat resistant containers, and PE (polyethylene) to make a wide range of products, including plastic bags, plastic bottles, water pipes, and furniture. All of these plastics are 'polymers'. A polymer is a long molecule which is made up of lots of small molecules bound together. For example, polyethylene is made up of lots of ethylene molecules joined together in long chains. The bioplastic in this activity is also made up of polymers. Corn flour contains starch which is made up of 'amylose' and 'amylopectin' molecules which are both made up of glucose molecules. Heating corn flour with water causes some of the starch to form long chains. Vinegar affects the formation of the long chains. The vegetable oil and glycerine act as 'plasticisers' which are chemicals that can change the softness and pliability of a plastic.

#### **Results**

Describe the properties of three different types of bioplastic. For example: ability to be moulded, hardness, stretchiness, rigidity, strength, water solubility, water resistance Recipe Properties A B C

<b>Recipe</b>	<b>Properties</b>
<b>A</b>	
<b>B</b>	
<b>C</b>	

#### **Did you know?**

Plastics can be moulded into almost any shape, and made to be durable, heat resistant, and long lasting. This makes plastics very useful, but it presents a problem when they are thrown away. Many plastic products can be recycled, but most still end up in landfill. People around the world are looking for solutions to the plastic waste problem by increasing recycling and finding alternatives to traditional plastics. The bioplastic in this activity is 'compostable', which means that it will break down if placed in a compost heap or buried in the ground. 'Degradable' plastic is usually made from crude oil, and it will break down a lot faster than other types of plastic, but it just breaks down into smaller bits of plastic. 'Biodegradable' plastic can be broken down by living things, such as bacteria, but what is left behind varies depending on the plastic. Compostable plastic breaks down into carbon dioxide gas, water, and organic material that can safely go back into the soil.