Bio-plastics

There are big concerns about the use of plastics in packaging and finding sustainable and degradable alternatives is of huge interest. Researchers from the John Innes Centre developed new bioplastic produced from peas, your challenge is to test different plants to see if they will produce a reliable and useful product.

Plastics can be made by modifying starch. This is a material produced by many plants and one which is quite easy to obtain.

The method is the same for each plant.

Extraction

To extract the starch you must grind the plant, mix it with water and then separate the mixture.
You will need:

- A food sample. Potato, rice, pasta or dried peas
- Grater
- Sieve
- Distilled water
- Pestle and mortar
- Spatula
- Stirring rod
- cup
- pan

Method

Grate the potato and grind with 100cm^3 water.

Pour through a sieve into a cup.

Add another 100cm3 of water to the potato, stir and sieve again. Repeat this until you have extracted all the starch.
Leave the cup to stand for 10 minutes, the starch should sink to the bottom
Carefully decant the water and scrape the starch back into your clean pan

Modification

You will need:

- Your pan of starch
- Stove
- Glycerine
-
- vinegar
- Greaseproof paper

Method

Add 25cm3 of water to your starch. Add 2 teaspoons of vinegar and 1 teaspoon of glycerine.

Bring it carefully to the boil and then boil it gently for 10 minutes. Make sure it does not boil dry – if it looks like it might, then stop heating.

Gently pour the mixture onto a piece of greaseproof paper. Spread it into an even thin layer and leave to dry. Make sure you label your sample.

Testing

Carefully remove your plastic sheets from the paper.

They should have dried into thin films.

Test the flexibility and strength of each sample by gently pulling, stretching and rolling each one.

Test the solubility of the plastic by soaking a small piece in a beaker of water.

Make some notes about each sample in the table below.

	Strength	flexibility	Water resistance
Rice			
Potato			
Pasta			
Peas			

Did you notice any difference between your two samples?

Starch is water soluble, did you notice any change in your plastic after it was left to soak?

Does it matter if the material breaks down over time?

Notes:
Plastics are polymers - long chain molecules made from repeating units called monomers. Because the chains line up these materials are usually flexible. Most plastics use polymers made from oil derivatives. You have made your plastic from starch. The starch in plants is composed of 2 polymers.

Amylose is a useful straight chain polymer made from glucose monomers.

Amylopectin is similar but has many branched units.

The branches on Amylopectin mean that the plastic produced is not so flexible. The hydrochloric acid breaks down the amylopectin to stop its branches getting in the way.

Glycerol is a 'plasticiser' the molecules get between the long polymers and stop interactions between them. This should make the material more 'plastic'