Biodegradable water bottles from brown seaweed - Years 8/9

What is green chemistry?

Green Chemistry aims to change the mindset and practices associated with everyday chemistry, to be safe, sustainable, environmentally friendly, re-used and non-toxic.

Seaweed for the future

A biomass such as seaweed (Figure 1), is one of the most promising and versatile materials that chemists, biologists, engineers, and medical industries are trying to use to improve our future. It contains a carbohydrate called alginate that turns into a gel. Its properties can then be changed by using a crosslinker, like calcium in solution. It binds more alginate together, making it stronger. Below is a diagram of alginate with a calcium solution, and its product, calcium alginate, which encapsulates the liquid (Figures 2 and 3).

Did you know?

Alginate can be eaten, its not harmful to our body, but some do have allergies to seaweed, so please DO NOT EAT OR HANDLE if you have a known seafood allergy.

Figure 1. Brown seaweed from South Australia

Figure 2. Blue water encapsulated with alginate

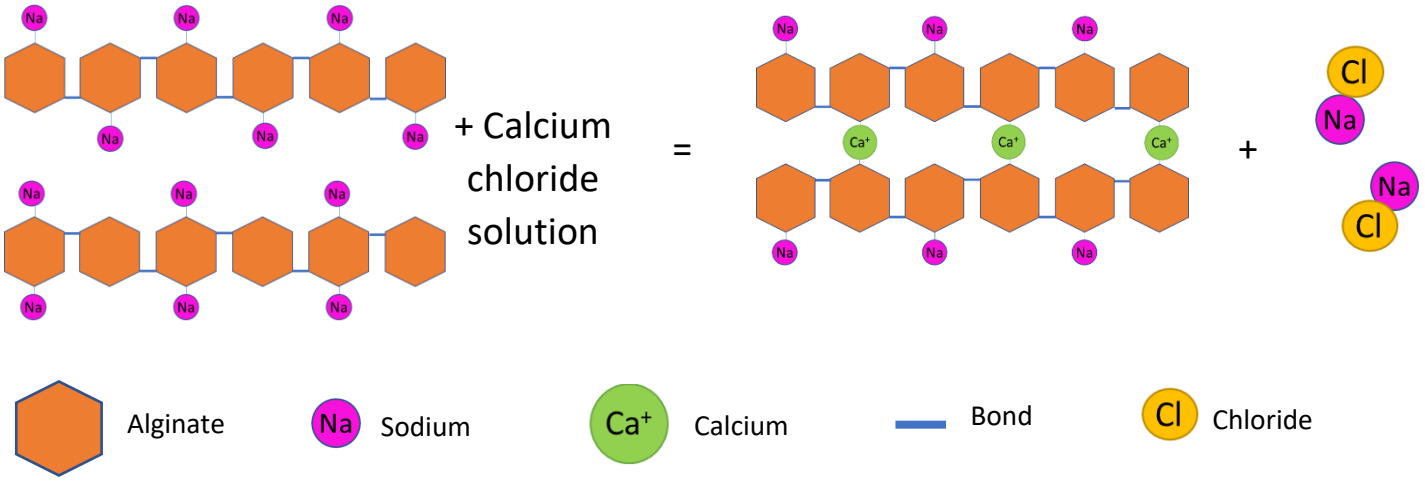

Figure 3. Alginate mixed with a crosslinker to form calcium alginate

In this experiment, you will crosslink alginate to encapsulate a liquid, like a water bottle, and see if the pH of different liquids affects this process. Think about how you can use this for different applications and what could be changed to improve the process.

Materials

- 4 clear cups
- 1 plastic pipette
- 3 wooden stirrers
- 3 x 10mL of alginate solution
- 1 spoon – to scoop out the biodegradable water bottles from the calcium chloride solution.

The pH of each liquid will be tested as a class. The pH indicator chart is on our website https://tcgcm.com.au/outreach.

Method

1) Read through the experiment and questions first before starting.
2) Collect all materials. Label your cups so you don't get confused about which liquid is in which cup.
3) In a small beaker, mix 1.5 g of calcium chloride into 100ml of water. Mix until dissolved. Label your beaker.
4) Measure approx. 10ml of each household liquid and place separately into the clear cups. As a class, test and record the pH of each solution.
5) Add approx. 10 ml of alginate to each liquid and stir (ratio 1:1). As a class, record the pH of the solutions containing orange juice and milk again.
6) Use a pipette to drop the alginate mix into the calcium chloride solution.
7) Remove each water ball using the spoon.
8) If there is alginate solution remaining, try the reverse. Mix different liquids with calcium chloride instead and try adding this mix to the alginate solution.

Results

Group members: _____

Solution name	pH (stick or draw pH test strip here)		Write observations	Stick photo or draw diagram here
	Before	After		

Discussion questions

a. Observe the reaction. What happened? Can this be used for a water bottle? Why/why not?

b. Explain why using seaweed is a sustainable source of material?

c. Did the pH effect the ability for alginate to gel? Why/why not?

d. How could you improve this experiment? What was its limitations?

Extension questions

e. How else could you use the properties of alginate to follow green chemistry principles?

f. What is the word equation for the reaction between sodium alginate and calcium chloride?

g. What is the chemical equation?