

The background features a white space with several colorful circles and dashed lines. In the top left, there is a large teal circle with a white center, a smaller teal circle, and a dashed teal circle. In the top right, there is a large lime green circle, a smaller green circle, and a dashed green circle. In the bottom left, there is a large green circle with a white center, a smaller orange circle, and a dashed yellow circle. In the bottom right, there is a large yellow circle, a smaller orange circle, and a small pink circle. A dashed grey line curves through the center of the page.

“Artificial Leaf”

Ng Man Wai Zita (Age 15)

Shing Katarina Cheuk Yan (Age 15)

Ma Cheuk Ying Rachel (Age 15)

St. Paul’s Convent School



Self Introduction

Ng Man Wai Zita

- F4 student
- Studying physics, chemistry, biology
- Enjoys doing experiment

Shing Katarina Cheuk Yan

- F4 student
- Studying physics, chemistry
- Aspires to be an environmentalist and global social leader

Ma Chuek Ying Rachel

- F4 student
- Studying physics, biology
- Environment and animal lover



Introduction

- ⦿ Inspired by large population of algae that remains after algal bloom, we decided to prepare an artificial leaf to solve the problem of both global warming and algae blooms.

- ⦿ Global warming

- ⦿ When CO₂ and other greenhouse gases trap heat that would otherwise escape Earth's atmosphere, the planet's temperature rises.
- ⦿ That's called **global warming**, which causes **climate change**.

- ⦿ Our artificial leaf

- ⦿ It is made of sodium alginate, algae, water and calcium chloride
- ⦿ It carries out photosynthesis like a normal leaf, but with a faster rate.
- ⦿ It absorbs carbon dioxide and relieves the global warming

Safety Precaution

- ⦿ Heat the solution under the guidance of adults
- ⦿ Stir the solutions gently
- ⦿ Handle the solutions with care
- ⦿ Avoid direct contact with the chemicals

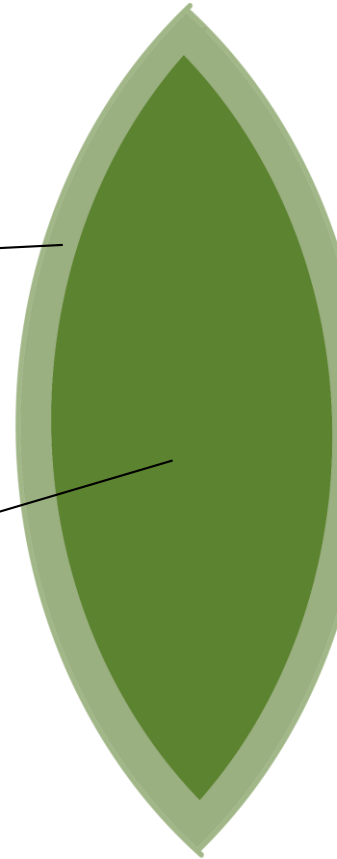
Materials

- ⦿ Water
- ⦿ Algae
- ⦿ Sodium Alginate
- ⦿ Calcium Chloride
- ⦿ Hydrogencarbonate indicator

To increase the concentration of algae, we set the algae for 24 hours, allowing algae to sink to the bottom in the form of sedimentation

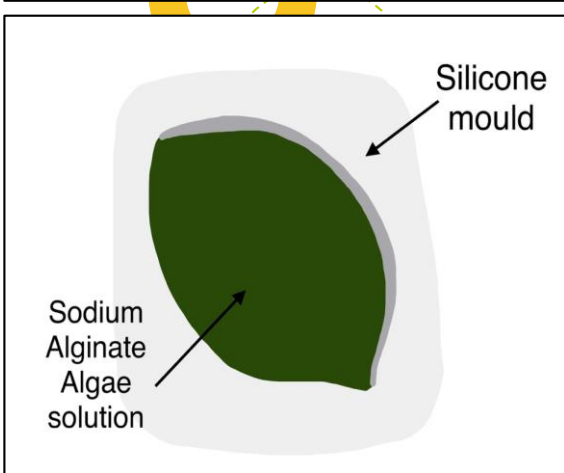
Design

- ⦿ **Insoluble layer**
 - ⦿ By the reaction between sodium alginate and calcium chloride
- ⦿ **Immobilized algae**
 - ⦿ By mixing sodium alginate solution with algae culture



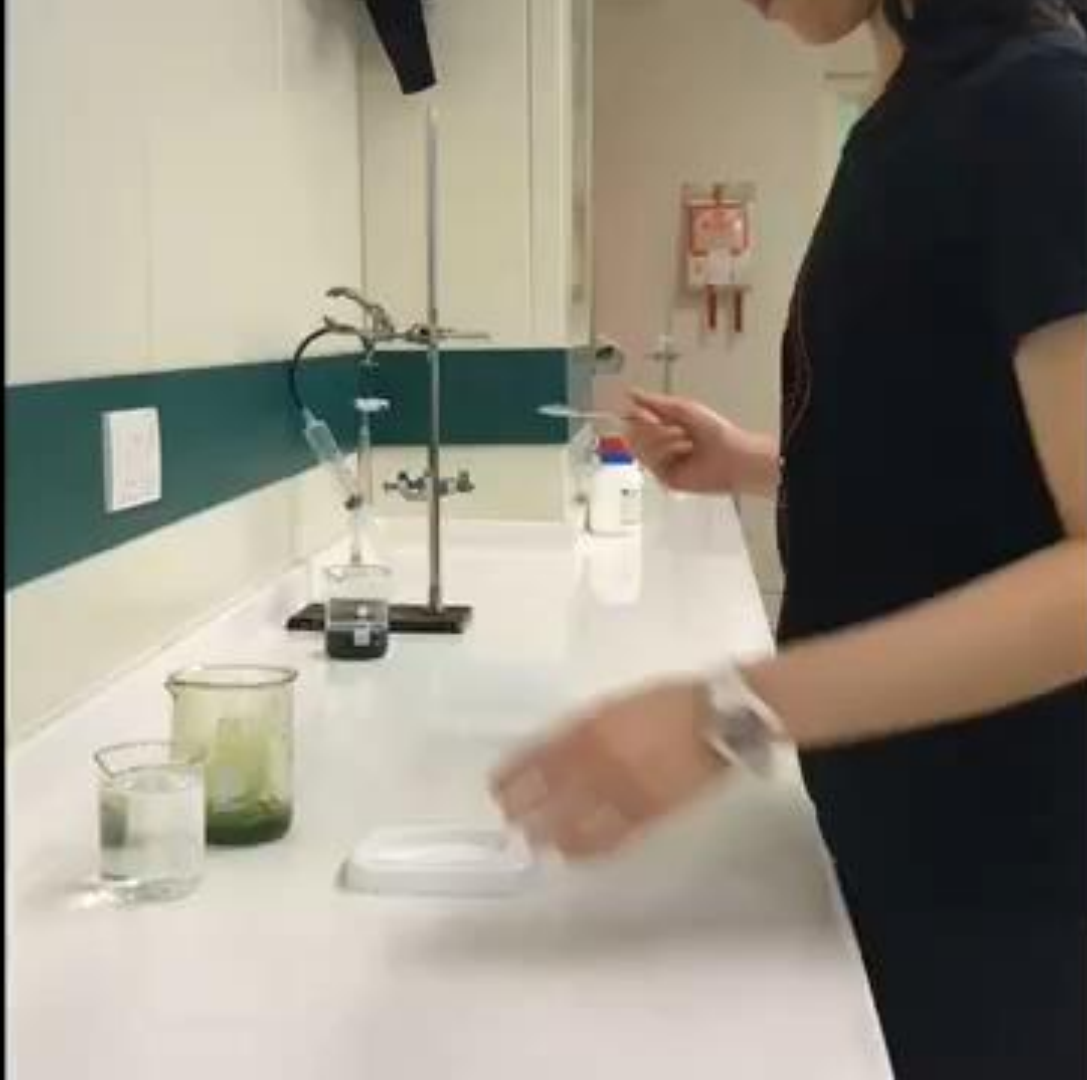
Procedures

1. Mix 10g of sodium alginate with 90cm³ of water until the sodium alginate dissolves
2. Mix 100cm³ of algae culture with the alginate solution
3. Pour the solution into the leaf-shaped mould
4. Mix 5g of calcium chloride with 20cm³ of water until the calcium chloride dissolves
5. Pour the calcium chloride solution into the leaf-shaped mould
6. Remove the leaf from the mould
7. Put the artificial leaf in a beaker containing hydrogencarbonate indicator
8. **OBSERVE THE COLOUR CHANGE!!!!**





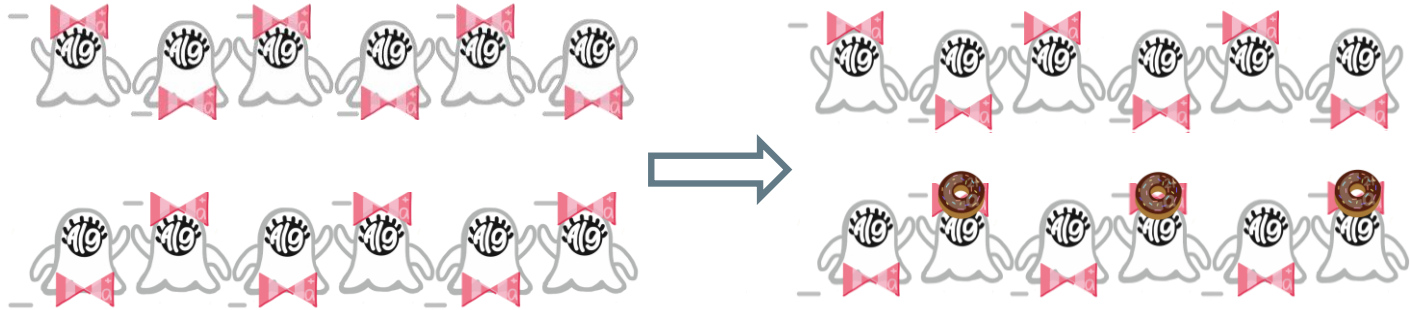
Age group: 10-12 years old



Explain the reaction between sodium alginate and calcium chloride.

How the insoluble layer is formed?

Calcium ions - doughnuts
Sodium ions – ribbons
Alginate polymer – ghosts



Two sodium alginate polymer chain

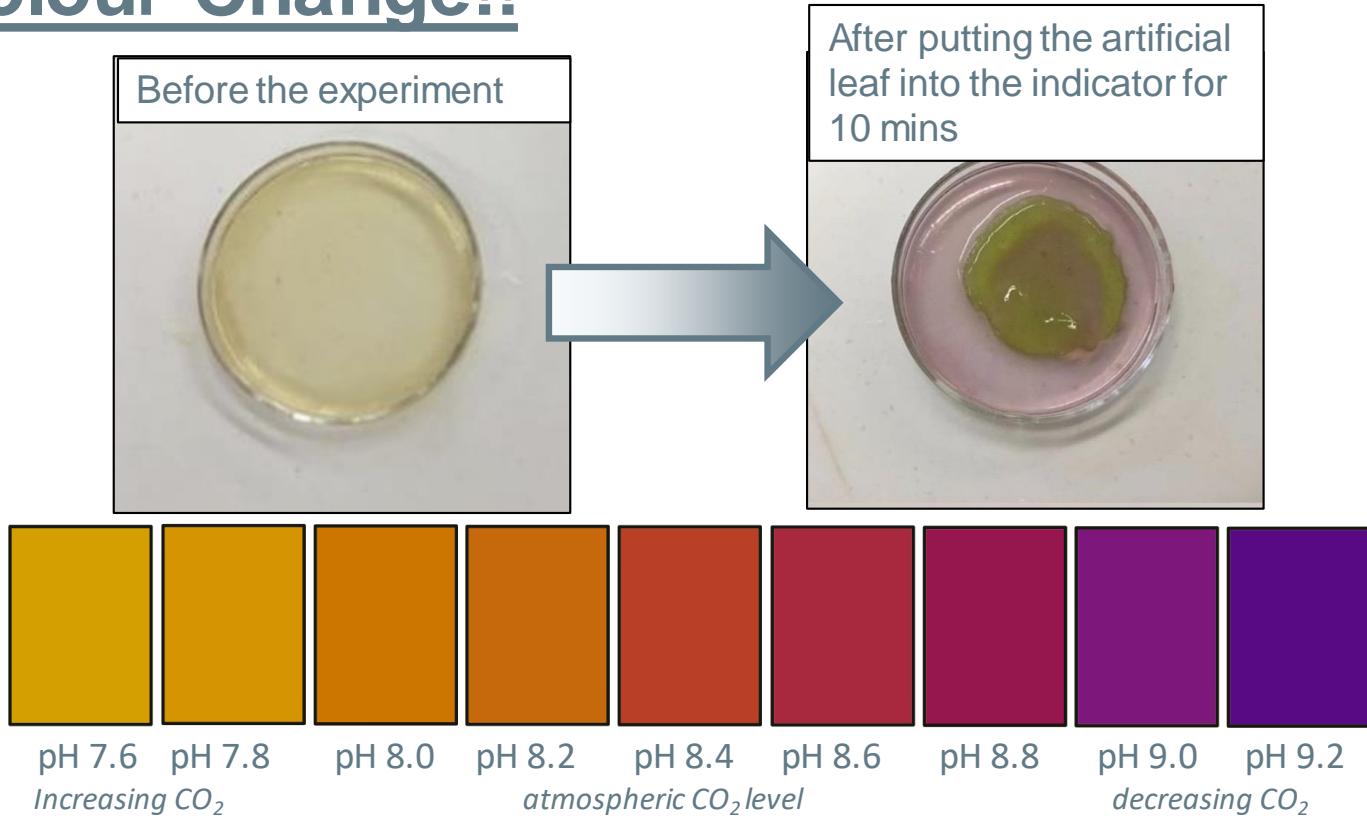
Free to move in the solution.
They are soluble

After adding calcium chloride

Polymer chains are linked by calcium ions.
They become larger and insoluble

© The calcium ions (*doughnuts*) displace the sodium ions (*ribbons*) that are attached to the alginate polymer (*ghosts*) to form an insoluble layer to hold the algae.

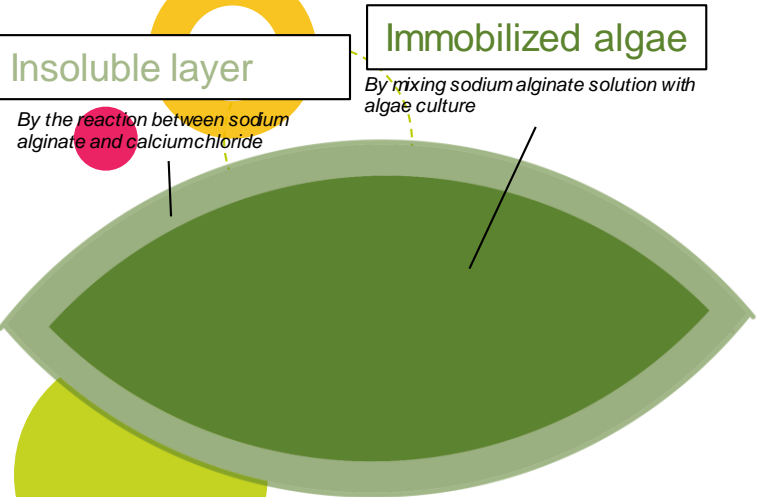
The Colour Change!!



- ⊙ The hydrogencarbonate indicator measures the carbon dioxide levels
- ⊙ It becomes more magenta/purple with decreased carbon dioxide levels

Why is there a change in the color of the hydrogencarbonate indicator after putting the artificial leaf into the solution?

Cross section of the artificial leaf



- ◎ The leaf carries out photosynthesis like normal leaf (*there are immobilized algae!!!*)
- ◎ $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
- ◎ During the reaction, carbon dioxide is absorbed into the leaf.
- ◎ The level of carbon dioxide in the hydrogencarbonate indicator decreases.

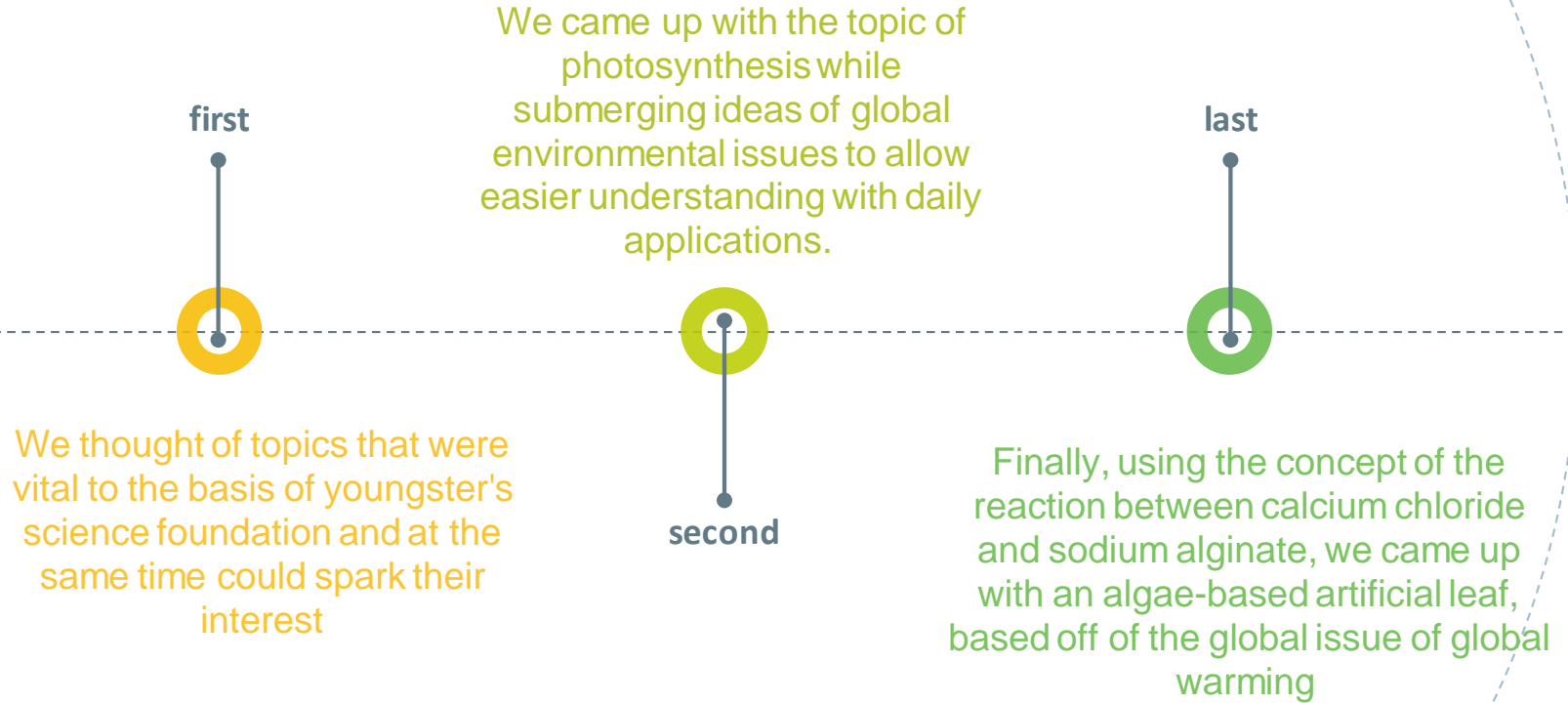
Benefits of artificial leaf

- ◎ We have also tested that our artificial leaf has a ***faster rate of photosynthesis*** than normal leaves.
- ◎ It ***reduces the amount of carbon dioxide*** in the atmosphere. It absorbs CO₂ during photosynthesis, and releases O₂

It helps to reduce the amount of green house gas, thus ***relieving global warming***

- ◎ The sodium alginate **traps** the algae from the algal bloom to **prolong the lifespan of algae**
- ◎ Our leaf takes a **shorter period** of time to create when compared to growing a real plant.

How We Co-Create!



“ With Artificial Leaf, Our Earth Will Be In Great Relief! “

Reflection

- ◎ Since this is our first time working with little kids, we have learnt to simplify complex scientific knowledge into something that is easy and accesible to everyone. We hope to continue improving our experiment and nurture the love of science and knowledge for younger children and aspire them to make a change for the environment with what they have learnt