

## Hong Kong Student Science Project Competition 2023

Template of Extended Abstract (Investigation Design Proposal)

(Word Limit: 1,600 words, Pages: 3 pages only)

**Team Number:**

**Project Title: Investigating the Waterproof Effects in Hydrophobic Plants**

**Project Type: Investigation Design Proposal**

*To our best knowledge, there are\* similar works in the field; (if there are, ) related research links are as below:*

<https://www.sciencedirect.com/science/article/pii/S2405451816300125>

**The enhancement our project proposed / the difference with related research are:**

**We chose some other leaves for our project. Moreover, we study the waterproof effect using a 2 different approaches which makes our investigation more comprehensive.**

*\*Please delete if not applicable. The competition values the originality of works. Students must do enough literature research to ensure that their works are unique and list relevant reference materials before starting research or invention.*

### I. Background

- Provide background information of project and/or state the problem to tackle
- Provide highlights of the **literature review** with the support of pertinent and reliable references
- Provide an overview of work and mention the **research gap that the project is trying to fill**

Recently, more products in our daily lives have been made with the need to be waterproofed. Water can be a threat to many things, a major example is 3C products; with components like gears and batteries, they can hardly function when in contact with water. Products like remote boats can move around in water while preventing water infiltration.

With all the questions in our mind, we have done some research on the related topics. In nature, one of the most prominent examples of waterproofing "materials" is lotus leaves, as the contact area between droplets with underlying substrates are reduced, and droplets can easily bounce off owing to the presence of the trapped air layer.

The above phenomenon is called the "lotus effect". These superhydrophobic plants have some of the highest hydrophobic properties in the botanical world and are perfect for water repelling. We believe it would be a great idea to investigate further in these plants as they are not so well-known yet.

### II. Objective(s)

- State the **aim(s)** of project

III. To find out the factors behind the plants being waterproof

IV. To find out what makes the leaves more waterproof

V. To find out if the presence of the waxy cuticles make the leaf more waterproof

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## VI. Hypothesis

- Propose an explanation for a phenomenon and stating how the **hypothesis** can be **tested** by experiments

We anticipate that a layer of thin wax is covered on the leaf. That being said, the thicker the wax the more waterproof the leaf is.

A rougher surface may also contribute to the waterproof effect as there are more gaps between the leaf and the water molecules, making them easier to slide.

We will be conducting the waterproof test with four types of leaves. This includes lotus leaf, nasturtium leaf, taro leaf, and ginkgo leaf. For each plant we will prepare 6 leaves respectively, 3 with the wax scratched off in order to see if that affects their waterproof ability.

## VII. Methodology

- List out the materials to be used
- Describe the **experimental protocol** including the set-up of **control experiment** (if any), **repeated experiment** (if any), and its scientific theory
- Indicate with the support of reasons, the **analysis** to be used in the investigation

1 slow motion camera

24 lotus leaf, nasturtium leaf, taro leaf, and ginkgo leaf (6 each)

Dropper and a beaker of water

Optical tensiometer

Electron microscope

1. Scrape off the waxy substances of 3 leaves of each plant respectively.
2. Add a droplet of water to each piece of leaf from a fixed height of 10 centimeters, 30 centimeters and 1 meter. Record the process using the camera.
3. Compare the results and find out the most water repellent plant.
4. Study their structure, both the ones with wax and without, under an electron microscope and find out their structure.

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## VIII. Expected Results and Impact of research

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- Describe the **expected results** with the selected approach
- Discuss **limitation** and compare with existing related works (if any)
- Discuss the importance or impact of the research and how it is applicable to real problems

It is expected that the higher we drop the water from, the more prominent the splashing effect will be. The droplets will spread further and smaller droplets will be formed. Although it is unknown that which leaf will be the most hydrophobic, we expect that the structure of the leaf would be more complex and the surface would be rougher. This should be because of the small gaps between the water molecules and the waxy cuticle that provide leaves a waterproof effect.

We expect to see a much weaker water-repellent effect from those leaves that have their waxy cuticle scratched off, due to the lack of wax, the small gaps do not exist anymore and the surface would be much smoother.

Gingko leaf is known as a less waterproof leaf, so we expect its structure to be smoother and less gaps can be seen.

Due to our knowledge being quite limited on this topic, we are unsure if this would work as intended.

However, if we apply this knowledge into our daily lives, manufacturers can replicate the structure of waxy cuticles and attach it to products that cannot be infiltrated by water. This newly attached layer provides the waterproof effect and maintains a product's functionality, despite being in contact with water.

**IX. If your team will compete the Sustainable Development Award, please indicate the specific sustainable development goal the project is related to, and provide justification for competing for this award. (Word limit: 300 words)**

**X. If your team will compete the Social Innovation Award, please list the target group or social issue the project focuses on, and provide justification for competing for this award. (Word limit: 300 words)**

## **XI. Conclusion**

- Make a conclusion of the design project and the way forward of the research

**We believe that this investigation can help us study more about the importance of the waxy cuticles, as well as the effect of waterproof in different plants due to their structure. If possible, we would love to conduct the experiment in real life instead of just keeping it as a theory.**

