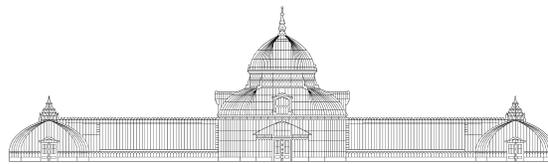


## Teacher Preparation Materials

### Adaptation! Plant Survivors



For their tour of San Francisco's historic Conservatory of Flowers, your students will be introduced to the tropical ecosystems of the rainforest and the plant adaptations that enable tropical plants to survive.

Your class will visit the Conservatory's three tropical environments: the Aquatic Gallery, which is home to the plants of the rivers, lakes, and bogs of the Amazon; the Highland Gallery where cool growing orchids and ferns thrive in the cloud forest; and the Lowland Gallery where towering palms have gigantic leaves and vines climb to the top of the Conservatory's iconic dome. Students will also visit the Potted Plants Gallery, which contains stunning flowers and unique tropical specimens. Depending on the time of year, the students may be led through the Special Exhibit Gallery. Check [ConservatoryofFlowers.org](http://ConservatoryofFlowers.org) for the current special exhibit.

The tour curriculum corresponds with the following Disciplinary Core Ideas From the NGSS: LS1.C, LS2.A, LS2.B, LS3.A, LS4.C and PS3.D.

Every student will receive a field guide notebook that their volunteer Jungle Guide will discuss with them. Teachers are encouraged to review the notebook with your students when you return to the classroom. Other things to keep in mind for your tour:

- Please arrive at 10:00 a.m. and plan to finish the tour at 11:15. Contact the Conservatory if you are a late start school and will arrive late.
- Your students will be paired with one Jungle Guide for every six students.
- The Conservatory requests that you recruit one chaperone for every six students.
- Our Jungle Guides always appreciate when students arrive wearing nametags.
- Jungle Guides will store jackets and backpacks during the tour.
- The Conservatory is the white Victorian greenhouse located at 100 John F. Kennedy Drive in Golden Gate Park.
- Tours happen rain or shine.

Contact Erika Frank, Director of Volunteers & Education, with further questions about your tour at [efrank@sfcfof.org](mailto:efrank@sfcfof.org) or (415) 637-4326. The staff and volunteers of the Conservatory of Flowers look forward to hosting your class!

## What are Adaptations? Background information for the teacher.

---

An adaptation is the way a plant species has changed over generations to better survive in its environment. Certain plants have special characteristics to help them survive in the wet, hot, and crowded tropics.

Students sometimes assume an adaptation develops over the lifespan of a single plant. We therefore avoid referring to a plant as “adapting”, which infers that the plant actually thinks about adapting and then takes action to do so. Instead, we talk about the adaptation as a characteristic or structure that has developed over many thousands of generations of plants.

Adaptations help meet the basic needs of a plant species. In the Conservatory’s Adaptation tours, these needs are referred to as “SWAN”:

- **S**unlight manufactures food energy through the process of photosynthesis.
- **W**ater, usually taken up through the roots, helps the plant move nutrients through the plant.
- **A**ir is necessary for the photosynthesis process. It allows the plant to take in carbon dioxide and release oxygen.
- **N**utrients from the soil and decaying plants and insects are absorbed through the roots and help the plant grow strong.

The Jungle Guides will discuss which of these needs are easily met in the tropics and which are not, and the resulting plant adaptation. Below are a few examples to discuss with your students. (Corresponding photos to show students are on pages 3 and 4.)

**Problem:** No access to ground water.

**Resulting Plant Adaptation:** Plant stores water.

The rain forest is so crowded that plants live anywhere there’s space. Some orchids are epiphytes, which means they live on other plants instead of on the ground. Because their roots are not in the soil they are unable to collect ground water. These orchids have an adaptation called a pseudobulb, which is a thick part of the stem that stores water. Water is drawn up from the roots, which are exposed rain and covered in a spongy material. Water is then stored in the pseudobulb for when water is scarce.

**Problem:** Lack of nutrients in soil.

**Resulting Plant Adaptation:** Carnivorous plants get nutrients through decaying insects.

The tropical pitcher plant lives in soil that has very little nutrients so this plant species gets their nutrients from insects. The adaptation is in the leaf structure. Over many thousands of years, the pitcher plant has developed modified leaves, called a “pitcher”, that insects fly or crawl into, but can not crawl out of. The inside of the pitcher is lined with tiny downward pointing hairs that make it too difficult for insects to climb out. The carnivorous plant then absorbs the nutrients of decaying insect.

## Orchid Pseudobulb



## Pitcher Plant



Photo: Steven Wright

## Vocabulary Words for Adaptation Tour

---

### **Adaptation**

An adaptation is the way a plant species has changed over generations to better survive in its environment.

### **Carnivorous Plant**

Plants that get nutrients by trapping and digesting insects and small animals.

### **Cloud Forest**

A tropical forest near mountains that is usually covered in clouds.

### **Environment**

The conditions that surround plants, animals, and people, including weather, soil, and light.

### **Epiphyte**

A plant that grows on other plants. In Latin, “epi” means “on” and “phyte” means “plant”.

### **Equator**

An imaginary line around the center of the earth that divides the Northern and Southern Hemispheres.

### **Humidity**

The amount of water vapor in the air.

### **Nutrients**

Elements that provide food for plants.

### **Pseudobulb**

The part of some orchids that stores water.

### **Rain Forest**

A tropical forest with very tall trees and over 100 inches of rainfall every year.

### **Temperature**

How hot or cold the air is.

### **Tropics**

The regions of the Earth that are near the Equator, between the Tropics of Cancer and Capricorn.

## Leaf Adaptation Experiment

---

Too much rain on a leaf can cause it to grow mold, algae, or fungus. When mold grows on a leaf, the plant can't get as much sunlight as it needs and the leaf may rot. Imagine leaving your wet sneakers outside for weeks. They'd probably start getting moldy! Some rain forest plants have a surface that repels water and helps them stay dry. In this experiment we'll compare three leaf surface adaptations - waxy, fuzzy, and uncoated - to see which best repels water.

### Supplies

*Students can do the experiment in groups and cut their own materials or you can cut one for the class in advance.*

- 8x10 inch piece of wax or parchment paper
- 8x10 inch piece of felt
- 8x10 inch piece of construction paper
- leaf template (provided on page 8)
- spray bottle with water (water can be dripped from a cup as an alternative)

### Discussion Questions

Q: What happens when rain falls on a leaf?

*Possible Responses: Water drops roll off. Water drops stay on the leaf.*

Q: Is either one an advantage to the plant? Why?

*Possible Responses: The leaves stay dry and are therefore not a good host for algae and fungi. When the water rolls off, it may go to the plant's roots.*

Q: (Distribute materials to students and ask them to touch surfaces.) Which surface do you think will best repel rainwater? Which will repel rainwater the worst?

Q: How could we test our predictions?

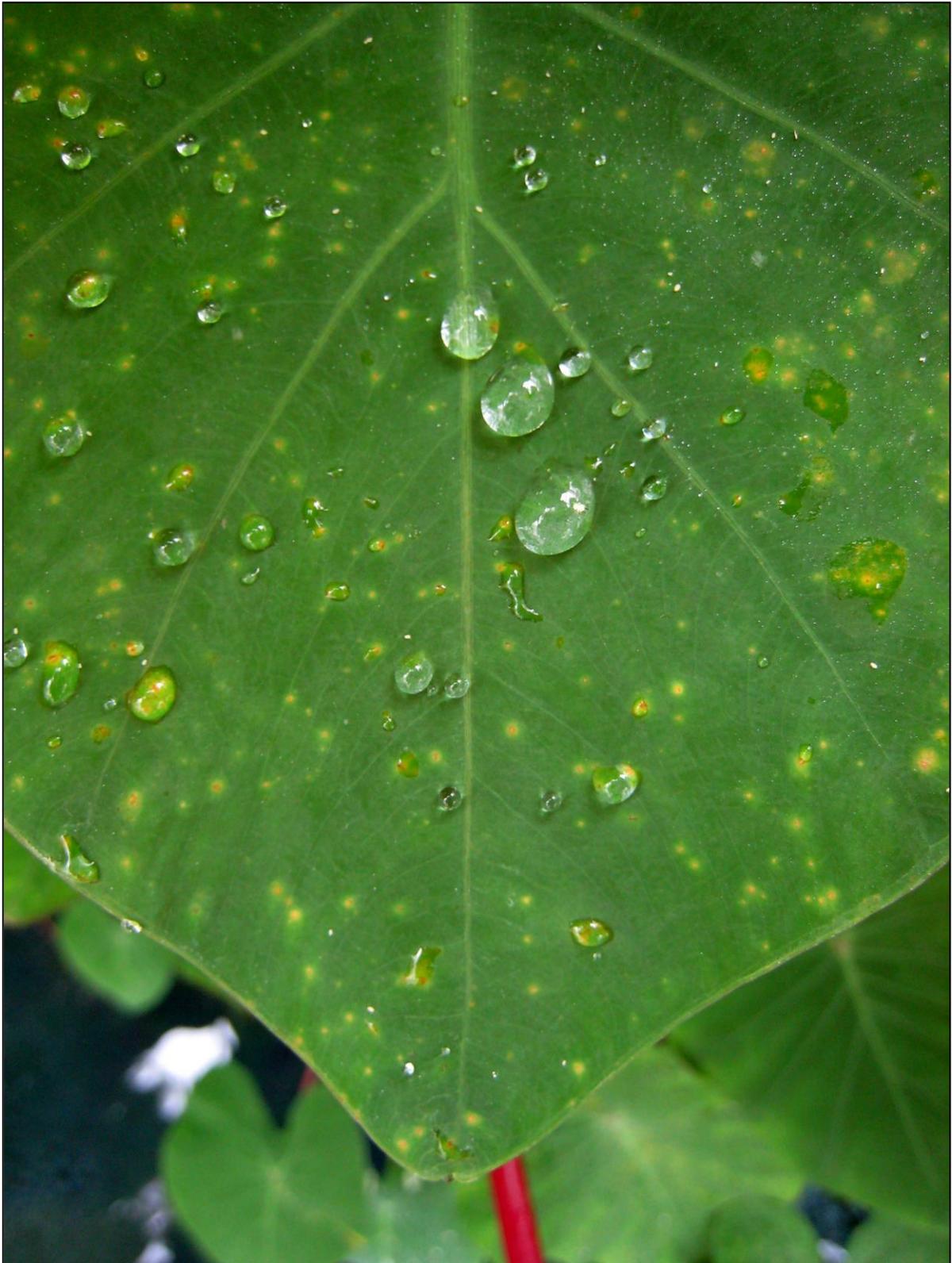
*Possible factors to consider include:*

- *the amount of water dripped or sprayed on the leaf;*
- *the amount of time to let the water sit on the leaf;*
- *if all leaves are held at the same angle or placed on flat on a table;*
- *scale to measure results, i.e. 1 to 5, 1 being very wet, 5 being very dry.*

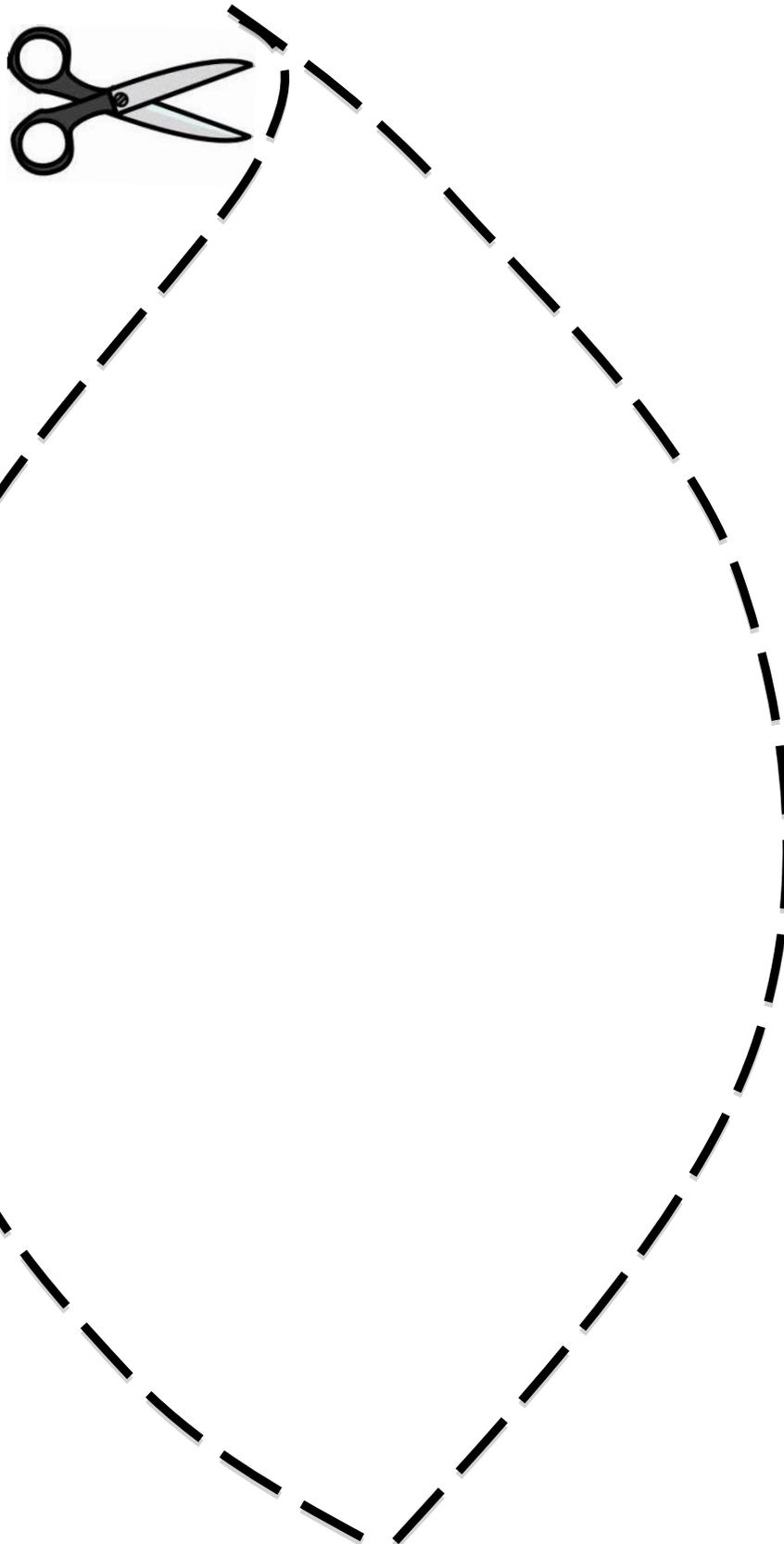
### Experiment Directions

- 1) Using leaf template on page 8, cut three identically shaped leaves, one of wax paper, one of felt, and one of construction paper.
- 2) Spray or gently drip equal amounts of water on each leaf. Let leaves sit until construction paper leaf begins to absorb water.
- 3) Lift up each leaf to let water drip off. Do not dry with a towel, as this won't represent what happens in the plant's habitat. Wax paper and felt should be dry with a few droplets on the surface. Construction paper should be wet.
- 4) Discuss which leaf surface does the best job as a "raincoat" for the plant. How does this compare to the student's predictions?
- 5) Discuss a real life example. Taro leaves have a coating that repels rain water, which beads and rolls off. Students will see examples of the taro at the Conservatory. (Photo on page 7)

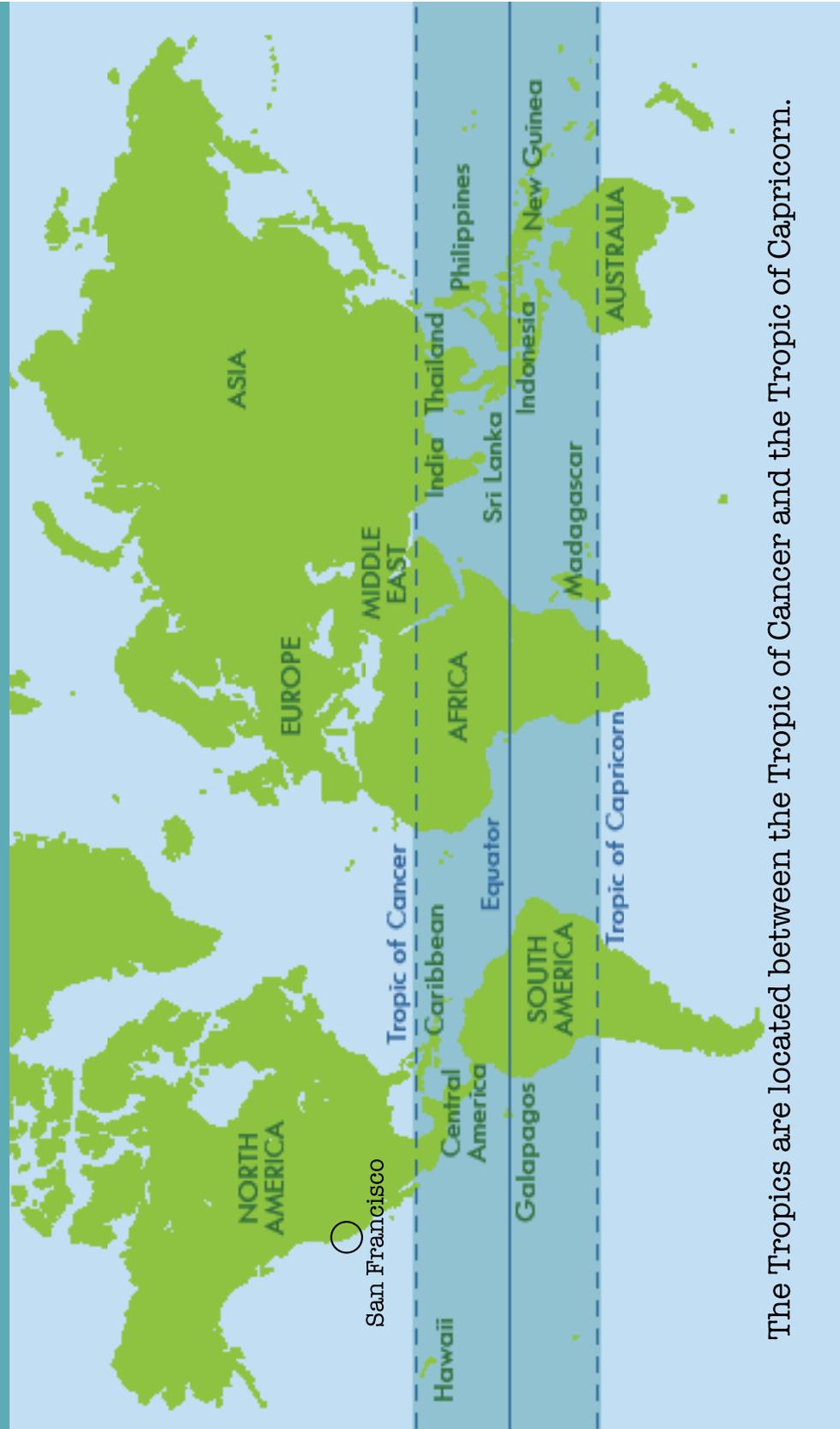
## Taro Leaf Showing Beading Water



# Leaf Adaptation Experiment Template



## Map of the Tropics



The Tropics are located between the Tropic of Cancer and the Tropic of Capricorn.