SHADE OUR SCHOOLS: LEAVES ARE COOL!
PROTOCOL

In partnership with:

STUDY PERIOD: NOVEMBER 2019 – FEBRUARY 2020

I. COLLECTING AND IDENTIFYING LEAVES

- Have students collect leaves from trees and shrubs located on your school grounds on a sunny day. Thermal measurements must be taken on the same day as when the leaves are collected.
- Have students **record date, time, and ambient temperature** on the provided data sheets before starting the leaf temperature measurements.
- Have students collect temperature measurements for 3 different leaf variables: size, color, and shape. Students should collect 3-10 leaves for each variable.
- Students must remove the stem of the leaf prior to collecting temperature measurements. Leaves should be freshly cut and not collected from the ground. Leaves should appear healthy.

A. LEAF SIZE

One set of leaves will be used to analyze the relationship between leaf temperatures and SIZE. **Students should collect leaves of different sizes from the SAME species**. The scientific or common name of the species should be recorded in the data sheets. Students may use iNaturalist or PlantSnap app to identify species name.

adapted from: https://www.cleanpng.com

B. LEAF SHAPE

Another set of leaves will be used to analyze how SHAPE influences leaf temperatures. Students should collect leaves with various shapes **(trying to keep size and color constant)** and **leaves should come from DIFFERENT species**. Students should follow the key provided to identify the different leaf shapes. The scientific or common name of the species should be recorded in the data sheets.

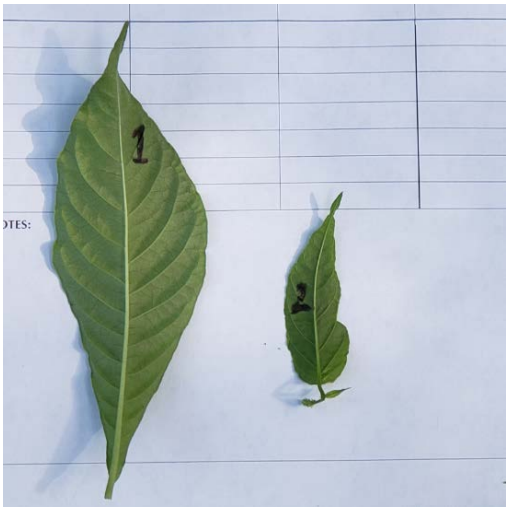
adapted from: http://www.expertsmind.com

C. LEAF COLOR

The last set of leaves will be used to assess differences in leaf temperature that are attributable to COLOR. **Students may select leaves from DIFFERENT species.** The scientific or common name of the species should be recorded in the data sheets.

adapted from: https://gallery.yopriceville.com

Once collected, students should number the back of the leaves by using a black permanent marker.



II. TEMPERATURE MEASUREMENTS

- Leaves will be placed flat on the ground in a spot where they are fully exposed to the sun.
- Students will place a **reference material** that will be provided by Fairchild next to the collected leaves. The reference material is a dark green scouring pad with a standard size of 3″x2″ (7.62 cm x 5.08 cm)

- Allow leaves to sit in the sun for **7 minutes**. After 7 minutes start recording leaf temperature (Celsius) using an infra-red thermometer that will be provided by Fairchild at a distance of 0.5m. They should make sure they are not taking any measurements outside the leaves!

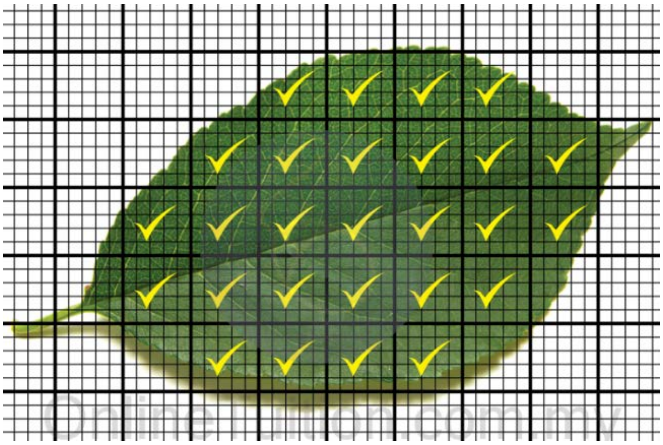
- Students will conduct several measurements for each leaf but should only record the **highest value** for each, including the reference material.
- Each leaf maximum temperature value should be recorded in the data sheet, specifically in the row that corresponds with the leaf number they are measuring. Leaf number was previously assigned and written on the back of the leaves using a black marker.
- Students **MUST** take notes of their observations and provide clear descriptions of any other plant features or processes that may be influencing leaf temperatures

III. LEAF AREA MEASUREMENTS

A. Centimeter Graph Paper

Print the 1 cm grid paper (https://www.hand2mind.com/pdf/gridpaper.pdf) and follow these instructions:

1. Outline the leaf on a centimeter graph paper
2. Count the complete and more than half area squares within the margins of the leaf
3. Neglect the squares that are less than half inside the margins of the leaf
4. The area of the leaf is the total of full squares + the squares with more than a half area inside the margin of the leaf, and the unit of measurement is cm^2



adapted from: http://pmrscience.onlinetuition.com.my

Students may measure leaf area inside the classroom by using the following apps:

B. For iPhone-Leafscan app

1. Download and print background with reference markers (four dots).

(http://www.leafscanapp.com/wp-content/uploads/2018/12/Leafscan-User-Guide.pdf).

2. Verify that the distance between the markers is 10 cm and enter this number in the app as the "reference length"
3. Place the leaf on the reference sheet
4. Take a picture and make sure all the reference markers are visible
5. You will see the calculated area displayed below the photo

C. For Android-Easy Leaf Area Free

1. Students should cut a 4 cm^2 red scale area and place it parallel and at the same distance from the camera than the leaf
2. Move sliders to adjust leaf scale and identification (leaf surface should look bright green)
3. Use a white background for the image to improve leaf detection
4. Area values will be displayed

D. Students should record area values in the data sheet, specifically in the row that corresponds with the leaf number they are measuring.

IV. DISCUSSION

By analyzing the data, students should be able to answer the following questions:

-Why do you think some leaves are cool and some leaves are hot?

-Are bigger leaves hotter than smaller leaves?

-Are unlobed leaves hotter that lobed leaves?

-Are darker leaves hotter than lighter leaves?

-What are other characteristics that may affect leaf temperatures?