

# LESSON 4: DETERMINING CANOPY COVERAGE FROM BELOW – Part 1

## Learning the Appropriate Process Skills

Satellites can only see the top part of a canopy from their position in space. For accuracy it is important to use ground truthing. This is a term used in remote sensing and refers to data collection on the ground. Ground truthing of the image data students collected and analyzed allows it to be related to on-the-ground features and to verify what is being sensed. As part of the ground truthing process, students will not only measure canopy coverage, but will make additional observations, calculating tree height and circumference, and determining tree species. They will then use technology to input the data.

As a Part 1 Lesson, students will learn how to do the appropriate process skills to ground truth the trees in their section. They will do this by observing data collection of one tree. Once data is collected, they will observe how to use online tools to determine trees species, and input the data into TreeMapLA to generate tree benefits. Finally, they will learn how to calculate the canopy coverage for their section. See Teacher Preparation on page 17.

### Procedure - Outside Session

1. Discuss with students what it means to “ground truth” and that they will be working in their teams to gather data on the trees in their section. The data that will be collected:
  - Pictures of the tree to help determine its species
  - Tree height
  - Tree circumference
  - Tree canopy
2. Take students outside to the tree, and using the *Tree Data Collection Worksheet*, demonstrate the following:

#### Photographing to Determine Tree Species

- Using a camera or phone, show students what images to take of the tree that will help them in determining its species. This includes:
  - Bark (texture)
  - Leaves (top, underside, attachment to branch, width)
  - Fruit and/or flowers

#### MATERIALS

- Computer or other device with access to internet
- Square piece of paper
- Measuring tape
- Camera/phone
- Tree Data Collection Worksheet (Figure F)
- Tree Benefits Worksheet (Figure G)
- Tree Canopy Area Calculation worksheet. (Figure H)

Lesson 4

#### TIME

- This lesson could take 1 - 2 class sessions:
  - 1 session to demonstrate data collection methods
  - 1 session to demonstrate using the computer to determine tree species and input data in TreeMapLA.



## TEACHER PREPARATION

Plan to demonstrate the various process skills needed to collect the tree data.

- Choose one tree for the demonstration that was outlined in the last lesson.
- Be sure to have the materials needed ahead of time.
- Create a Log In ID for TreeMapLA. See Sidebar below for instructions.
- Videos are available through TreeMapLA for instructions on measuring tree circumference/diameter, and height. Use these as a guide, if necessary. See Sidebar on page 24.

### CREATE A LOG IN ID FOR TREEMAPLA

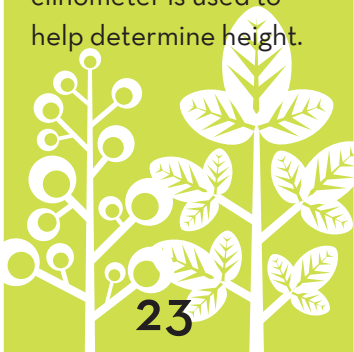
#### Lesson 4

- Go to <https://www.opentreemap.org/latreemap/>
- Click on "Sign Up" in the upper right corner.
- Fill out the information to generate Log In information.
- For Username and Organization, use the name of the classroom, EcoClub or other name for the group.

### CLINOMETER

A clinometer is an instrument used for measuring the angle or elevation of slopes.

A homemade clinometer is used to help determine height.



### Measuring Tree Height

- Demonstrate to students how, if the tree is short enough, they can use a measuring tape to determine the height by measuring the tree from the ground up to the highest point.
- If the tree is too tall, demonstrate to the students how to calculate the height using a handmade clinometer. To do this they must first measure the length of their natural walking step:
  - With a measuring tape mark 20 feet on the ground.
  - Walk the distance and note how many steps it takes. (For example: It took 10 steps to walk 20'.)
  - Divide the distance (20') by the number of steps. (For example:  $20' / 10 \text{ steps} = \text{Every step is } 2'$ .)
  - For the best results, repeat a couple of times and take the average.
- Demonstrate to students how to make a "clinometer".
  - Pass out a square piece of paper.
  - Fold the paper into an isosceles triangle.
- Demonstrate to students how to use their pace and the clinometer to measure tree height:
  - Walk away from the tree to a point where you can see the top.
  - Use the clinometer to find the top of the tree by holding the paper up at eye level so that the right triangle (the square corner) is pointing away from you and the long length of the triangle (the hypotenuse) goes from your eye and is pointed upward toward the tree.
  - Make sure the bottom of the triangle is parallel to the ground.
  - Adjust your position to the place where you can look up the long leg of the triangle and just see the top of the tree.

- Demonstrate how to calculate the height of the tree by doing the following:
  - Walk toward the tree and count your steps to calculate the distance.
  - The distance (steps) plus your height at eye level is equal to the height of the tree.
- Add this information to the data sheet.

### Measuring Tree Circumference

- Demonstrate to students how to use a tape measure to determine where 4 feet 6 inches is from the ground up, on their body.
  - This is the height at which the group will take the measurement of all the trees.
  - This is to make the process of measuring more than one tree efficient.
- Demonstrate to students how to determine tree circumference by doing the following:
  - At the determined height (4 feet, 6 inches), wrap the tape measure around the tree to get the measurement.
  - For a multi-trunk tree, take measurements for each trunk of the tree.
  - For short trees, take the measurement at the point where the branches begin to flare out.
- Add this information to the data sheet.

### Measuring Tree Canopy

- Demonstrate to students how to measure tree canopy. Have the team do the following:
  - Using a tape measure, measure the longest axis from one edge of the tree canopy (branches) to the opposite edge, touching the trunk of the tree as the tape measure stretches across the ground. Measure the distance in centimeters.
  - Take a second measurement perpendicular to this first line, touching the trunk of the tree as the tape measure stretches across the ground. Measure the distance in centimeters.
- Add this information to the data sheet.

4. Head back to the classroom with the data collected.

### HOW-TO VIDEOS

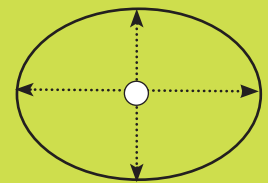
If possible, share with students the following TreeMapLA videos for:

#### How to Map a Tree

<http://www.youtube.com/watch?v=P8b8D9aNwD4>

#### How to Measure Tree Height

<http://youtu.be/BM1y-aP52Zql>



## TREE BENEFITS

TreeMapLA calculates the economic benefits and environmental impacts use i-Tree software provided by the USDA Forest Service's Urban Ecosystems and Processes team.

For more specifics on the algorithms used, go to the lesson introduction on page 32.

## Procedure - Inside Session

- As a class demonstrate how to use the photographs to help determine the tree species by doing the following:
  - Go to **urbantreekey.calpoly.edu**
  - Follow the instructions by clicking on the appropriate images to determine the species of the tree.
  - Add the information to the *Tree Data Collection Worksheet*.
- As a class demonstrate how to input the data into TreeMapLA and generate tree benefits by doing the following:
  - Go to <https://www.opentreemap.org/latreemap/>
    - Log In for the class.
    - Click on "Add A Tree".
    - Input the site's address in "Search by Location" in upper right.
    - Click on "Satellite" in the upper right corner of map.
    - Set the trees location by placing the tree symbol on the map.
    - Click "Next" in lower right corner.
    - Using the information on the Tree Data Collection Worksheet input tree species, diameter and height. Then, click "Next".
    - Check "Add Another Tree With New Details" to continue adding trees. Click "Done" each time to continue.
    - Once complete, check "I'm Done!" and click "Done".
    - To view the tree benefits, click on the tree. The benefits and the economic savings for the tree will appear to the right.
    - Add this information to the *Tree Benefits Worksheet*.
- As a class, demonstrate how to use the *Tree Canopy Area Calculation* worksheet.
  - Calculate the area of the tree using the canopy data:
    - Divide the two measurements by two to get the average canopy diameter.
    - Divide the canopy diameter by two to get the radius of the tree canopy.
    - Calculate the area of the canopy using  $\pi R^2$ .
  - Explain to students that once the class has the area calculation for all the trees in their section, they will add the data to the *Canopy Calculation Chart* to determine canopy coverage.



# TREE DATA COLLECTION WORKSHEET

Student Name(s): \_\_\_\_\_ Date: \_\_\_\_\_

Go to the numbered trees in your section. Follow the instructions below and record the results on page two.

## Tree Species

1. Take several pictures of the tree.
  - Be sure to keep track of which photos belong with each numbered tree.
  - Make sure to get shots of the bark, leaf, and any other features.

## Tree Height

1. If the tree is short enough, use a measuring tape to determine the height by measuring up from the ground to the tallest point on the tree.
2. For taller trees, make sure that a group member knows the length of their natural walking step. (For example: every step is 2 feet).
3. Walk to a point to view the top of the tree. Use the clinometer to find the top by holding the paper up at eye level so that the right triangle (the square corner) is pointing away from you and the long length of the triangle (the hypotenuse) goes from your eye and is pointed upward toward the tree.
4. Make sure the bottom of the triangle is parallel to the ground.
5. Adjust your position to a place where you can look up the long leg of the triangle and just see the top of the tree.
6. Calculate the height of the tree by doing the following:
  - Walk toward the tree and count your steps to calculate the distance.
  - The distance (steps) plus your height at eye level is equal to the height of the tree.

## Tree Circumference

1. Have one member of your group use a tape measure to determine where 4 feet 6 inches is from the ground up, on their body.
  - This is the height at which your group will take the measurement of each tree.
2. At the determined height, wrap the tape measure around the tree to get the measurement.
  - For a multi-trunk tree, take measurements for each trunk of the tree.
  - For short trees, take the measurement at the point where the branches begin to flare out.

## Tree Canopy

1. Using a tape measure, measure the longest axis from one edge of the tree canopy (branches) to the opposite edge, touching the trunk of the tree with the tape measure as it stretches across.
  - Measure the distance in centimeters.
2. Take a second measurement perpendicular to this first line, touching the trunk of the tree with the tape measure as it stretches across.
  - Measure the distance in centimeters.

Tree # \_\_\_ Species\_\_\_\_\_

Height: \_\_\_ feet                      Circumference: \_\_\_ inches

Canopy measurements: \_\_\_\_\_ cm    \_\_\_\_\_cm

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Tree # \_\_\_ Species\_\_\_\_\_

Height: \_\_\_ feet                      Circumference: \_\_\_ inches

Canopy measurements: \_\_\_\_\_ cm    \_\_\_\_\_cm

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Tree # \_\_\_ Species\_\_\_\_\_

Height: \_\_\_ feet                      Circumference: \_\_\_ inches

Canopy measurements: \_\_\_\_\_ cm    \_\_\_\_\_cm

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Tree # \_\_\_ Species\_\_\_\_\_

Height: \_\_\_ feet                      Circumference: \_\_\_ inches

Canopy measurements: \_\_\_\_\_ cm    \_\_\_\_\_cm

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Tree # \_\_\_ Species\_\_\_\_\_

Height: \_\_\_ feet                      Circumference: \_\_\_ inches

Canopy measurements: \_\_\_\_\_ cm    \_\_\_\_\_cm

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Tree # \_\_\_ Species\_\_\_\_\_

Height: \_\_\_ feet                      Circumference: \_\_\_ inches

Canopy measurements: \_\_\_\_\_ cm    \_\_\_\_\_cm