



# BIODIVERSITY



# Welcome!

Welcome to Fairchild Tropical Botanic Garden! We ask that you please read the following rules to your group before you begin your tour.

- Stay with your group during your entire visit.
- Respect our wildlife; do not touch, chase, or feed the animals.
- Walk only on designated paths or grass.
- Do not climb trees or pick flowers or fruits from plants.
- Keep your voices low to respect other guests.
- Self-guided groups are not allowed at the Garden Cafe, in the Gift Shop or on the Tram.

In your backpack, you will find the materials needed for this program. Before leaving the Garden, we ask you to please ensure that all the materials are back in this backpack. At the end of your visit, return this backpack to the Visitor Center. If any materials are lost or damaged, the cost will be deducted from your deposit.

## **ACTIVITY SUPPLIES:**

- 7 Biodiversity Program booklets

### Plot

- Flags - 32
- Pieces of string - 8
- Measuring tapes - 8
- *Biodiversity Plant Inventory for Quadrat Plot* worksheets - 8

### Transect

- Flags - 32
- Pieces of string - 8
- Measuring tapes - 8
- *Biodiversity Plant Inventory for Line Transect* worksheets - 8

### Butterfly Count

- Butterfly guides - 15
- *Biodiversity Butterfly Count* worksheets - 15

# Get Started

1. Review the biodiversity introduction, vocabulary list, activities descriptions, and biodiversity field guides included in the backpack.
2. Using the map, choose your first activity and proceed to that location in the Garden.
3. While there, complete the corresponding worksheet.
4. Using the map, travel through each activity area, completing the corresponding worksheets.

Before leaving the Garden, don't forget to:

1. Look for the survey that is inside the backpack. Your feedback is appreciated and it helps us improve our program! Please make sure to complete the survey and put it back in the program backpack.
2. Return the backpack to the Visitor Center entrance where you picked it up.

## **Program Objectives**

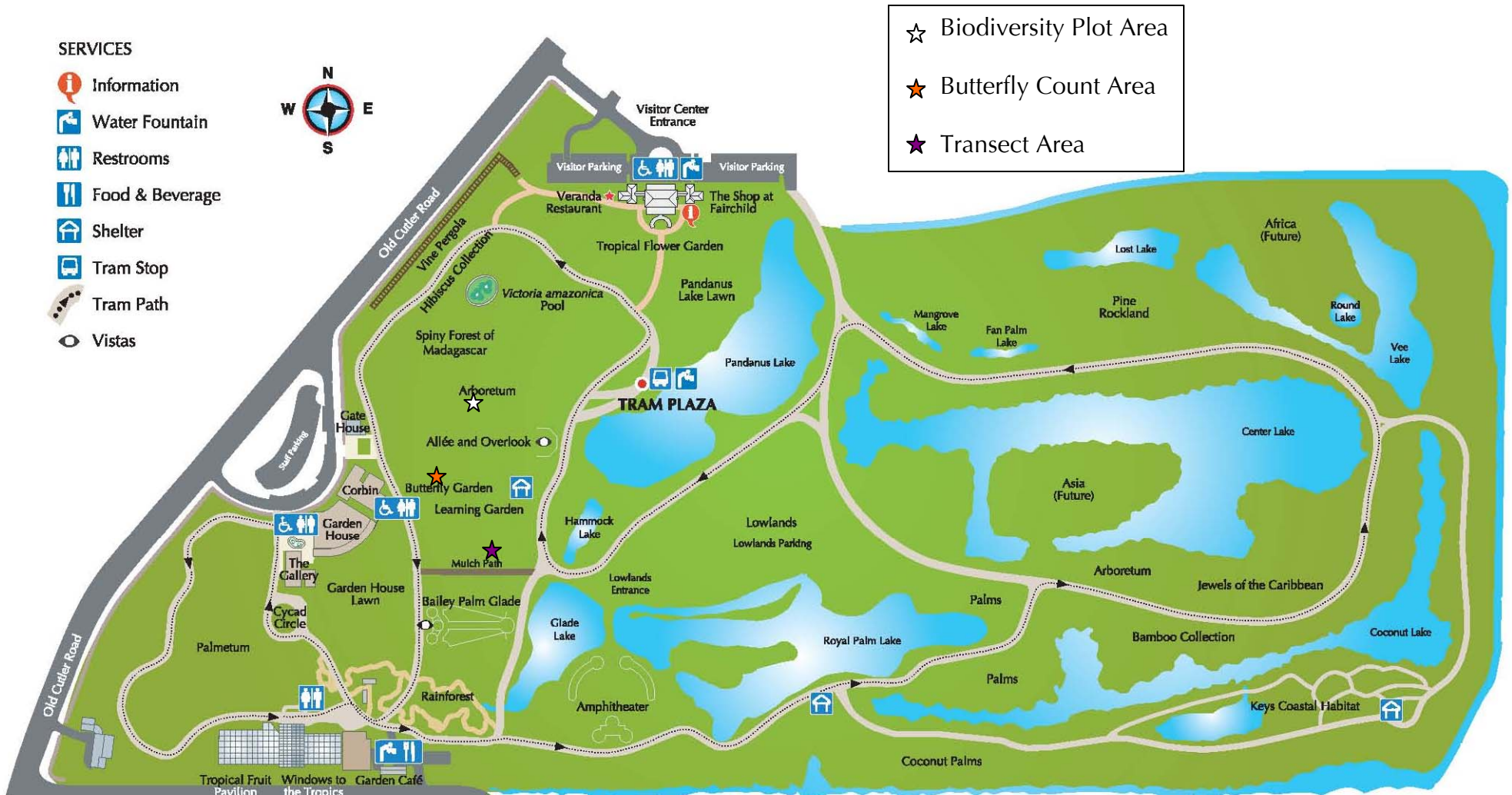
- Students learn what biodiversity is and its importance.
- Students use different methods scientists use to measure biodiversity.
- Students identify common native butterflies.
- Students record scientific data.
- Students are introduced to botanical terminology and use it to describe scientific observations.



## How to use the map?

Orient your map to the location where you are at. As your group is walking, try to pay attention to any landmarks found around you and try to locate them on the map.

We have pre-selected areas in the Garden that are suited for the activities in this packet. These areas are designated on the map with a color-coded star. However, if you would like to use other areas of the Garden to do the activities, you are welcomed to.



# Introduction

Today you will learn about biodiversity, its importance and how scientists study biodiversity. The hands-on activities found in this packet will immerse you in the world of real scientists and how they measure biodiversity in the field.

## **Introduction**

### ***What is biodiversity?***

Biological diversity - or biodiversity - is a term we use to describe the variety of life on Earth. It refers to the wide variety of ecosystems and living organisms: animals, plants, their habitats and their genes. Biodiversity also encompasses two important factors: genetic diversity which is the variability within a species population, and the variety of ecosystems across a geographic area. Tropical forests and coral reefs are the two most biodiverse ecosystems and are home to many species. However, other ecosystems with fewer species are important as well, because of the ecosystem services they provide.

It is important to think about biodiversity in a comprehensive manner; just as much as species need many different environmental factors to survive, different ecosystems make various contributions to the overall health of the earth.

Let's think about our local natural environment in Florida. The Everglades provides important ecosystem services to us, such as drinking water. Wetlands found in the Everglades filter out nutrients and reduce flooding by temporarily storing storm water and slowly releasing it. The Everglades also replenishes the aquifer, as water percolates down. As this example illustrates, components both living (biotic) and non-living (abiotic) within an ecosystem are interconnected and ensure a dynamic balance. Biodiversity has an incredibly important role in making sure that all ecosystem services in an ecosystem and the Earth as a whole are taken care of.

### ***Why is biodiversity important?***

Ecological health depends on maintaining a diversity of life forms. Biodiversity makes an ecosystem resilient giving it the ability to adapt, face and recover from challenges such as pests, diseases, temperature changes, floods, droughts, and hurricanes. In this way, biodiversity can be thought of as an insurance policy that protects ecosystems by buffering them against various stresses that can lead to species loss and ecosystem disturbance.

Biodiversity also creates the opportunity for different species to fulfill and perform the same role making the ecosystem stronger. For example, if a species is lost and not able to perform its functional role such as a leaf litter decomposer, other species present that perform the same function may be able to take their place. Therefore the functionality of an ecosystem is critically dependent on the species and populations biodiversity.

# Vocabulary

**Biodiversity:** the variety of life on earth or in a particular habitat or ecosystem, or the number of species in a given area.

**Biodiversity Plot:** piece of land where biodiversity measurements are taken.

**Canopy Cover:** the uppermost spreading layer of a forest. consisting largely of branches.

**Cone:** the fruit of pines and their relatives.

**Diameter at Breast Height (dbh):** measure of the diameter of a tree usually taken at 1.3 meters from the ground.

**Ecosystem:** a biological community consisting of all the living (biotic) organisms in an area and the non-living (abiotic) components of the environment that they interact with.

**Ecosystem Service:** the goods, products and material and non-material benefits obtained from ecosystems, as well as the fundamental life-support processes necessary for life, such as the maintenance of air, soil and water quality, climate regulation, pollination, erosion control, etc.

**Flower:** the seed-bearing part of a plant.

**Frequency Rate:** the number of times something repeats itself in a unit of time.

**Fruit:** the product of a plant that contains one or more seeds.

**Habitat:** a place where animals, plants and humans are found.

**Herbaceous:** fleshy plants that do not have a permanent woody stem.

**Herbivory:** the consumption of plants.

**Leaf Arrangement:** the arrangement of leaves on a plant stem.

**Leaf Shape:** any of the various shapes that leaves of plants can assume.

**Resilience:** the capacity of an ecosystem to respond to disturbance.

**Shrub:** a woody perennial plant usually less than 20 feet tall and often with several woody stems rather than a single trunk.

**Species:** organisms capable of interbreeding.

**Species Diversity:** a combination of species richness and species evenness.

- o Species richness is the total number of species present in the community.

- o Species evenness is the relative distribution of individuals among the species present in a community.

**Tree:** a woody perennial (living for multiple years) plant, typically having a single trunk growing to a considerable height and bearing lateral branches at some distance from the ground.

**Vegetation Cover:** the collective term for vegetation (especially low-growing plants) covering the ground.

# Biodiversity Meter Square Plot Sample

Are you ready to explore the Garden while learning scientific methods to measure biodiversity? In this packet, you will find a detailed description for three different ways scientist use to measure biodiversity: plot sampling, transect sampling and butterfly counts.

## METER SQUARE BIODIVERSITY PLOT SAMPLE

In this activity, you will use a small, 1-meter sampling square to explore the herbaceous vegetation (green plants).

### Supplies

- Flags - 32 (4 flags per plot)
- Pieces of string - 8
- Measuring tapes - 8
- *Biodiversity Plant Inventory for Quadrat Plot* worksheets - 8

### Procedure

1. Ask students what biodiversity plot is and why it is important to measure biodiversity. Discuss what factors might affect biodiversity (ie amount of sunlight, soil type, etc.) Refer to the *Biodiversity Vocabulary* list in your packet for more information.
2. Divide students in small groups of approximately four students and give each group a *Biodiversity Plant Inventory for Quadrat Plot* worksheet, twine or rope, a measuring tape and 4 flags.
3. Have each group create a square plot of 1 meter by 1 meter using the measuring tape, the flags and the rope. Remind students that each side of the square should measure 90 degrees.
4. Ask students to record their observations in the *Biodiversity Plant Inventory for Plot Quadrat* worksheet.
6. At the end, bring all the small groups together and ask each group to share highlights of what they found.

# Biodiversity Transect Sample

Line Transects are the best approach to measure clumped populations and substantially more ground can be covered compared to the plot sampling method.

## Supplies

- Flags - 32
- Pieces of string - 8
- Measuring tapes - 8
- *Biodiversity Plant Inventory for Line Transect* worksheets - 8

## Procedure

1. See #1 in Biodiversity Meter Square Plot Sample Activity and discuss/review as necessary.
2. Divide students in small groups of at least 4 students and distribute to each group one measuring tape, flags, rope/twine, and a *Biodiversity Plant Inventory for Line Transect* worksheet.
3. To set up the transect line, one student holds one end of the measuring tape and another student holds the other end to measure 5 meters on the ground. Then mark the total distance of 5 meters using flags and rope. You can always extend your transect to record more data.
4. Students will record observations every meter for each plant that intersects the transect line. Only plants that intersect the transect line should be included.
5. Give students time to complete and record the data on their worksheets. If you have time, students can repeat the transect line process more times making sure that a different student performs a different task each time (for example: placing the rope or recording measurements).
6. At the end, bring all the small groups together and ask each group to share highlights of what they found.



# Biodiversity Butterfly Count

In this activity, students will select a sample area and measure the biodiversity of butterflies observed. Students will also observe and record abiotic factors such as temperature and cloud cover because butterfly activity is influenced by these factors.

## Supplies

- Butterfly guides - 15
- *Biodiversity Butterfly Count* worksheets - 15

## Procedure

1. Explain to the students that they will be recording how many butterflies they see in a particular area. This is a measurement used by scientists to record biodiversity and it is known as a Butterfly Count.
2. Divide the group into pairs or teams of up to 4 students and distribute one *Biodiversity Butterfly Count* worksheet and one laminated Butterfly Field Guide to each group.
3. Ask each group to select a plant or area of plants that will be used for the butterfly count. Make sure students understand the boundaries of the area that they will sample. Only butterflies seen inside that area should be included in the butterfly count.
4. Give students a set amount of time to observe their butterfly sampling area and complete their worksheets. If unable to identify the butterfly group or species, important features can be recorded in the field worksheet such as pattern, shape and size.
5. At the end, bring all the small groups together and ask each group to share highlights of what they found.

## Program Conclusion

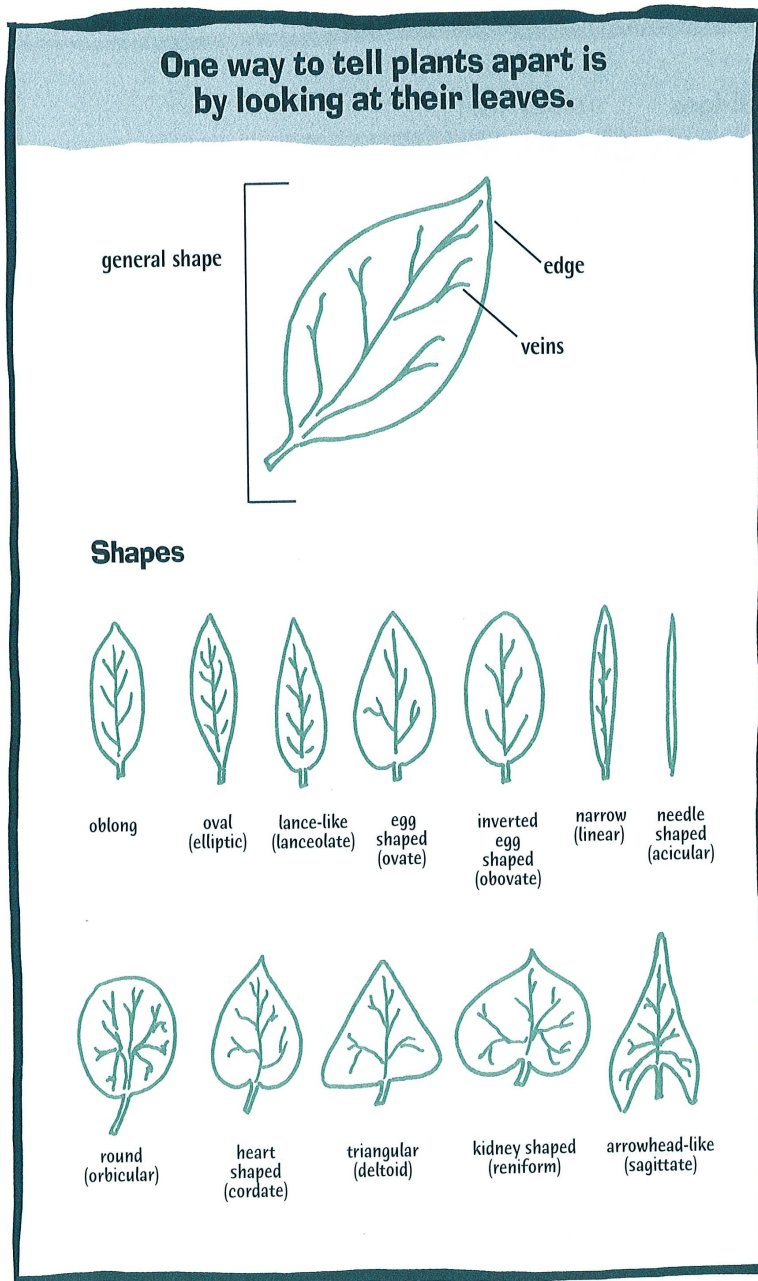
You have now learned what biodiversity is and different methods scientists use to measure it. Think about all the activities you did and all the places you visited at the Garden today to answer the following questions:

- What is biodiversity? Why is it important?
- Did you find more or less plants than you expected in the plot activity?
- Do you think that all dbh measures are taken at 1.3 meters? Why?
- What are some characteristics you can look for when identifying butterflies?

Thank you for coming to Fairchild Tropical Botanic Garden! We hope that you enjoyed your visit and that you will come back to keep exploring and learning about tropical plants.

Before you leave, please remember to put back all the materials inside the backpack, fill out the survey and return the backpack to the Visitor Center.

# Biodiversity Field Guide



Source: Windows on the Wild: Biodiversity Basics (WWF)

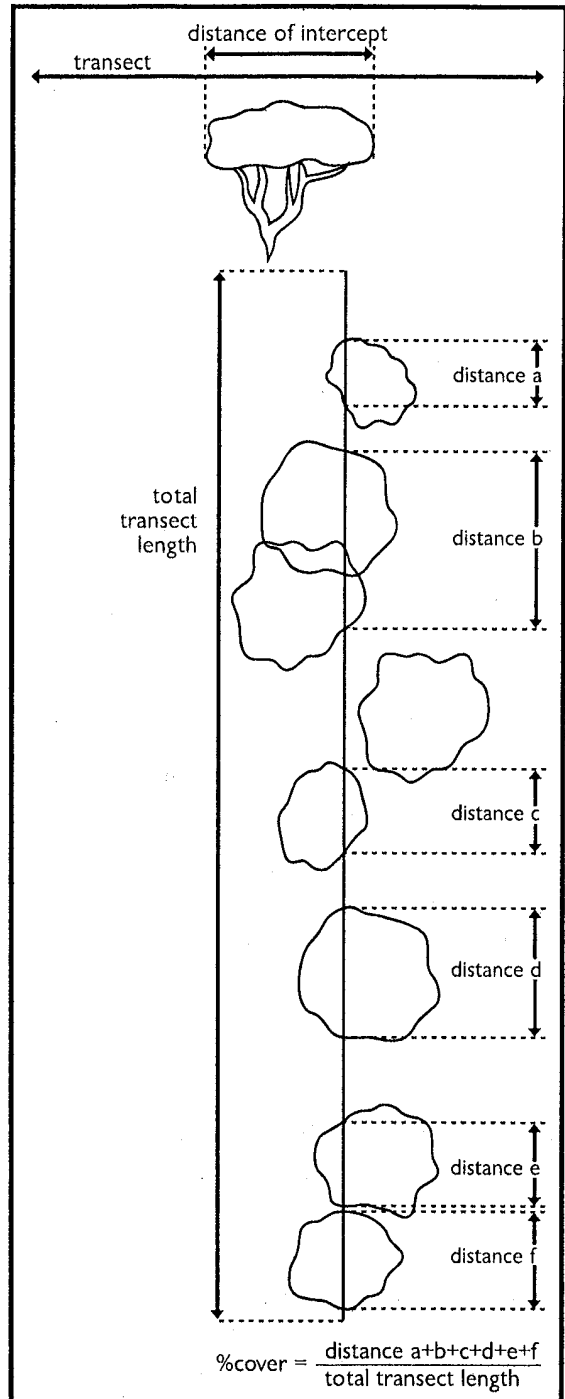
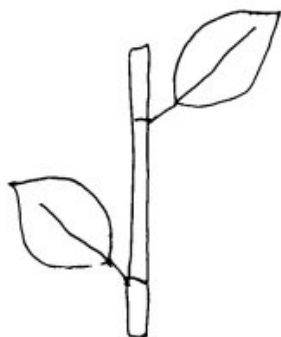


FIGURE 8.9. Line intercept method of measuring cover for a single shrub species.

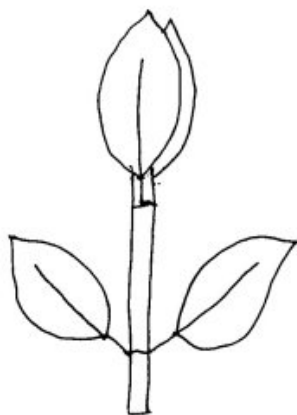
Source:  
 Measuring and Monitoring *Plant Populations*  
 Caryl L. Elzinga, Daniel Salzer, John Willoughby

# Biodiversity Field Guide

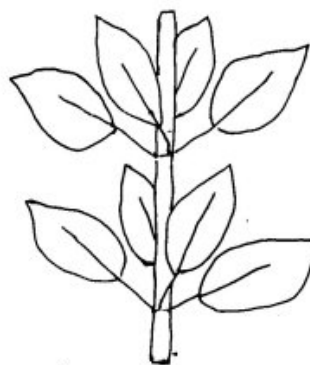
## Leaf Arrangement



alternate



opposite



whorled

## Growth Form

**Tree:** a woody perennial (living for a long time) plant, typically having a single trunk growing to a considerable height and bearing lateral branches at some distance from the ground.

**Shrub:** a woody perennial plant usually less than 20 feet tall and often has several woody stems rather than a single trunk.

**Herbaceous:** fleshy plants that do not have a permanent woody stem.

## Diameter at Breast Height (DBH)

DBH is the measure of the diameter of a tree taken at 1.3 meters from the ground.

To take a dbh measurement, begin by measuring 1.3 meters aboveground level. Then, using the calibrated dbh side of the measuring tape go around the trunk of the tree to measure the diameter. Record your measurement on the transect worksheet.

## Soil Types

**Clay:** sticky fined-grained earth, typically yellow, red or bluish-gray. It is the smallest of soil particles. It can be molded when wet.

**Coarse:** large sand particles, rough or loose in texture.

**Gravel:** composed of unconsolidated rock fragments. Gravel soils have a good drainage, but poor fertility. Plants growing in this type of soil must penetrate deeply to find nutrients in the subsoil.

**Humus:** organic constituent of soil which has reached a point of stability. It is formed by the decomposition of plants and leaves and has a dark black or brown color.

**Sand:** predominantly made of sand particles which are usually large, dry and nutrient poor. It has excellent drainage.

**Silt:** sediments whose particles are between clay and sand in size.

## Checking for Signs of Disease

- Underdevelopment or overdevelopment of tissues and organs
- Death of plant parts
- Alteration of normal appearance

# FAIRCHILD TROPICAL BOTANIC GARDEN

Exploring, Explaining and Conserving the World of Tropical Plants

## Biodiversity Plant Inventory for Plot

Date: \_\_\_\_\_ Time: \_\_\_\_\_

Site Location and Habitat Description: \_\_\_\_\_

Temperature: \_\_\_\_\_ Weather Description: \_\_\_\_\_

| Common and/ or Scientific Name | General Description (size, color, shape)         | Leaf Shape and Arrangement (opposite, alternate and whorled) | % of Vegetation Cover | Growth Form: tree, shrub, herbaceous (non-woody), vine | Reproductive Status: flower, fruits, cones, no reproductive structures present | Signs of Disease (leaf spots, unusual coloration ...) | Observed Visitors (butterfly, bird, bee, beetle, fly, moth...) |
|--------------------------------|--|--|-----------------------|--|--|---|--|
| <i>Grass #1</i>                | <i>Small bright green grass with waxy leaves</i> | <i>Narrow alternate leaves</i>                               | <i>30%</i>            | <i>Herbaceous</i>                                      | <i>Small white flowers</i>   | <i>None</i>   | <i>Ant</i>   |
|                                |  |  |                       |  |  |   |  |
|                                |  |  |                       |  |  |   |  |
|                                |  |  |                       |  |  |   |  |

### Habitat Description and Biodiversity Calculations

What does the soil look like? (sand, humus, clay, coarse, fine, gravel, smooth, powder-like, heavy, light, sticky...) \_\_\_\_\_

What does it smell like? Is the soil dry, moist? \_\_\_\_\_

Is it sunny or shady? \_\_\_\_\_

Species Richness =  $S$  = Total Number of Different Species Observed in your plot: \_\_\_\_\_

Percentage of plot covered by vegetation: \_\_\_\_\_



# FAIRCHILD TROPICAL BOTANIC GARDEN

Exploring, Explaining and Conserving the World of Tropical Plants

## Biodiversity Plant Inventory for Quadrat Plot

Grade: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_

Temperature: \_\_\_\_\_ Weather Description: \_\_\_\_\_

| Meter Location | Common and/or Scientific Name        | General Description (size, color, shape) | Leaf Shape and Arrangement (opposite, alternate and whorled) | Number of Individuals (estimated) | Growth Form: tree, shrub, herbaceous (non-woody), vine | DBH    | Reproductive Status: flower, fruits, cones, no reproductive structures present | Signs of Disease (leaf spots, unusual coloration ...) | Observed Visitors (butterfly, bird, bee, beetle, fly, moth...) |
|----------------|--------------------------------------|--|--|-----------------------------------|--|--------|--|---|--|
| 1.5 m.         | Live oak / <i>Quercus virginiana</i> | Brown rough bark, spreading branches     | Oval alternate leaves  | 1                                 | Tree   | 4.2 m. | Green and brown acorns found on the ground                                     | None  | None   |
|                |                                      |  |  |                                   |  |        |  |   |  |
|                |                                      |  |  |                                   |  |        |  |   |  |
|                |                                      |  |  |                                   |  |        |  |   |  |
|                |                                      |  |  |                                   |  |        |  |   |  |

### Habitat Description

What does the soil look like? (sand, humus, clay, coarse, fine, gravel, smooth, powder-like, heavy, light, sticky...) \_\_\_\_\_

What does it smell like? Is the soil dry, moist? \_\_\_\_\_

Is it sunny or shady? \_\_\_\_\_

Species Richness = S = Total number of different species observed in your transect: \_\_\_\_\_

Estimated total number of individuals observed in your transect: \_\_\_\_\_

# FAIRCHILD TROPICAL BOTANIC GARDEN

Exploring, Explaining and Conserving the World of Tropical Plants

## Biodiversity Butterfly Count

Date: \_\_\_\_\_ Time: \_\_\_\_\_ Weather Description: \_\_\_\_\_  
Temperature: \_\_\_\_\_

| Common and/ or Scientific Name                         | Number of Butterflies Observed | General Description: (size, color, shape)                      | Where did you observe the butterfly? (leaf top, leaf bottom, branch, stem, flying...) | Did you observe any interesting butterfly behavior? (basking, puddling, patrolling, perching, mating...) Were the wings folded or unfolded? | Draw your butterfly |
|--|--------------------------------|--|---|---|---------------------|
| <i>Zebra longwing/<br/>Heliconius<br/>charithonius</i> | 12                             | <i>Black medium<br/>size butterfly with<br/>yellow stripes</i> | <i>Flying</i>   | <i>Wings were unfolded</i>  |                     |
|  |                                |  |   |   |                     |
|  |                                |  |   |   |                     |
|  |                                |  |   |   |                     |
|  |                                |  |   |   |                     |

Habitat Description

Is it sunny or shady? \_\_\_\_\_



**O**ur mission is to save tropical plant diversity by exploring, explaining and conserving the world of tropical plants; fundamental to this task is inspiring a greater knowledge and love for plants and gardening so that all can enjoy the beauty and bounty of the tropical world.



Accredited by the American Association of Museums, Fairchild Tropical Botanic Garden is supported by contributions from members and friends, and in part by the State of Florida, Department of State, Division of Cultural Affairs, the Florida Council on Arts and Culture, the John D. and Catherine T. MacArthur Foundation, the National Endowment for the Arts, the Institute of Museum and Library Services, the Miami-Dade County Tourist Development Council, the Miami-Dade County Department of Cultural Affairs and the Cultural Affairs Council, the Miami-Dade County Mayor and Board of County Commissioners, and with the support of the City of Coral Gables.

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