

SECTION 1:

PLANT IDENTIFICATION

TARGET QUESTIONS:

Why are plants important?
How do you identify plants?

PREREQUISITES:

Team Plot Selection



CORE ACTIVITIES:

LESSON 1

Beginning with Plants

LESSON 2

**Observing and Collecting Plants/
Measuring Environmental Factors**

Field Trips

- Close Observations
- Measuring Environmental Factors

LESSON 3

Identifying and Preserving Plants



ASSESSMENTS:

Baseline Observational Skills

Checkpoint



WEB COMPONENTS:

FOR TEACHERS

- Guide to Finding Local Specialists
- Who Are the Plants?
- A Listing of Herbaria

FOR STUDENTS

- Dichotomous Keys
- Some Clues to Describing and Understanding Organisms
- Plant Report/Weather Report (available online as a PDF)
- Types of Oak Leaves (available online as a PDF)
- Plant Identification*

* All Web reading selections for students are available both online and as PDFs.

OVERVIEW OF SECTION 1

As preparation for identifying plant specimens in the field, students discuss the important characteristics of plants, work at developing observational skills, and become familiar with resources that will help them with identification. They learn about the system of binomial nomenclature in common use and how to use a dichotomous key.

The fieldwork focuses on two activities: making close observations and measuring abiotic and environmental factors.

BACKGROUND INFORMATION FOR THE TEACHER

Why begin with plants? Plants hold a primary place in the world of living organisms because of their ability to manufacture their own food from simple inorganic materials (carbon dioxide and water). This process, called photosynthesis, is powered by energy that plants capture from the sun. Thus plants feed not only themselves, but are food for herbivorous animals and indirectly for the carnivores that feed on the herbivores. They also produce virtually all of the oxygen in the atmosphere, since they give off oxygen as a by-product of photosynthesis.

In many ways, plants determine the numbers and kinds of other organisms that can live and thrive in an area. In addition to food, they supply protection from the elements, nesting sites, and homes for small creatures. They are host to a wide range of mammals, birds, fish, worms, arthropods, fungi, and bacteria.

Finally, plants are enormously important to human welfare. They are a source of food, clothing, housing materials, medicines, and dyes. They replenish the air we breathe, cool the atmosphere that surrounds us, hold our soils in place, and please our senses. They contribute not only to our physical but also to our emotional well-being.



CLASSIFICATION: GETTING TO THE SPECIES LEVEL

Biological scientists around the globe are working to discover, describe, and classify species. In order to communicate clearly with one another, they all use the same hierarchical classification system and the same naming system (binomial nomenclature).

Classification System

Animals	Plants
Kingdom	Kingdom
Phylum	Division
Class	Class
Order	Order
Family	Family
Genus	Genus
Species	Species

As you move through the categories from kingdom to species, each category contains fewer organisms, and the organisms in each category have more features in common. The fundamental unit of all biology is the species; thus, every individual can be described as belonging to a distinct species. Scientific research on biodiversity focuses primarily on species and it is the unit that scientists use to discuss biodiversity. Identification to the species level is a difficult process and may require special equipment.

BINOMIAL NOMENCLATURE

In binomial nomenclature, an organism is given two Latin or latinized names. Latin is the recognized language of science. It has the advantage of being a language that belongs to no single country or culture and one that is no longer changing. The first name of the organism (a noun) is its genus, always capitalized. The second name (an adjective) is its species, always written in lower case. Both are usually italicized but are sometimes underlined or written in bold type. Most conventional keys and identification guides use this system.

For example, the white willow belongs to the genus *Salix*, along with more than 200 other species such as the weeping willow, the crack willow, and the black willow. Its full name, *Salix alba*, distinguishes it from the other willows in the genus by adding the species name *alba*, or white. (Not all species names are so conveniently descriptive.)

It is a challenge to identify plants all the way to the species level (and even more challenging to identify arthropod species). But it is important that students engage in the process. They will become more familiar with the language of science, and they will be working the same way that scientists do to describe and identify organisms.

USING DICHOTOMOUS KEYS

A dichotomous key (from the Greek *dicho* meaning “two” and *tomous* meaning “to cut”) is a system for identifying organisms based on a series of choices between two alternative descriptions. It is an extremely useful tool for identification. Unfortunately, keys do not exist down to the species level for all the plants or for all the arthropods your students may discover, and there is much work yet to be done in that field. You will find some dichotomous keys to conifer genera and arthropod orders on the Web site in the Resources Area. They may be used on-line or printed out and placed in plastic sheet protectors for students to carry into the field.

Keys are fun to use—and quite simple, once you get the idea. It’s like solving a mystery from the clues. No two species are exactly alike, so by following a series of clues and eliminating suspects along the way, you can arrive at a positive identification (most of the time).

Please see [How to Use a Dichotomous Key on the Web](#) for more information. Most standard biology textbooks also have information on dichotomous keys.

Morphospecies

A morphospecies may be described as a group of organisms that, based on external form and structure, appears to be distinct from other groups of organisms. The group of individuals is recognized solely on the basis of similarities in external characteristics.

When faced with a bewildering array of organisms, it is useful to begin by sorting them into groups based on their observable characteristics. At the most basic level, species may be defined as a unique entity. This entity, or population of individuals, is genetically distinct, and its genetic distinctions are reflected by form and structure (or morphology). In fact, new species are described because they demonstrate observable and inheritable differences in morphology or shape.

Thus, the amateur or student scientist may legitimately begin the process of classification by sorting organisms into categories based on what they look like. Using observable attributes such as shape, color, size, texture, numbers of structures, and the absence or presence of structures, students can make a good start on the road to identification. Later, as more data are collected, the original identification may be either verified or disproved.

In the process of sorting, students will have to observe the organism in great detail in order to discover how it is similar to or different from the others—a useful exercise in itself. Even if the observation does not lead to identification of the species, it may well lead to identification at a higher taxonomic level, such as order or family. This is a real accomplishment!



TEACHING TIP: IDENTIFICATION IS A CHALLENGE

It is not always possible to reach the species level of identification—for students or scientists. Recognize that it will be a challenging task and that students may often be frustrated in their attempts. While identification to the species level is important, it is not the main objective of the study.

On the Web, you will find a wealth of resources aimed at helping students identify the plants and arthropods they discover in their plots. Help students get into the habit of consulting the on-line resource sections often. Some areas that you and your students will find useful are the external links to botanical gardens, education programs, environmental organizations, entomological societies, herbaria, natural history museums and science centers, national parks, and zoological parks.

Your most important resources may be local specialists. Many organizations are quite willing to help students on a project such as this. If you haven't already done so, contact a nature center, museum, university, botanical garden, botanical society or garden club, or conservancy group. Most states also have a Natural Heritage office with a botanist trained to help with specimen identification. Please see the article called *Guide to Finding Local Specialists* in the Resources Area on the Web.

Do the best you can to direct students to multiple resources, but when it becomes obvious that they have reached an impasse, help them to decide on an alternate naming scheme for the unknowns. They may have to use alternatives such as the genus followed by something like mystery species #1 or genus species #1, or if they identify a plant to genus, *Salix* species #1, for example. They may also use the common name of a plant like grass, or a temporary made-up name that describes the plant.

MEASURING ENVIRONMENTAL FACTORS

Much of what scientists do is look for patterns in nature. They may look for patterns of plant and arthropod distribution, patterns of evolutionary relationships, or correlations between one variable and another to try to understand the factors that determine biodiversity.

Scientists have observed that the occurrence of many plants and arthropods is determined by environmental factors. There is a correlation between the presence of a particular plant, for example, and the environmental conditions that favor its survival. These conditions include temperature range, light levels, soil composition, and average rainfall.

By recording these environmental factors over a long period of time, we could expect to see patterns that show which factors are important to a species.

1 LESSON

LESSON 1

BEGINNING WITH PLANTS

TIME

2 class sessions

MATERIALS

- ☐ 1 copy of the “Types of Oak Leaves” activity sheet per team
- ☐ Reference materials such as field guides and keys to identification
- ☐ Some Clues to Describing and Understanding Organisms

WEB COMPONENTS

Dichotomous Keys

Parts of Plants

Plant Identification

Some Clues to Understanding
and Describing Organisms

Types of Oak Leaves

1. *Explain to the class that they will begin a study of the plants at their site. Ask why plants are a good starting point for a study of biodiversity.*
2. *To review students' prior knowledge of plants, ask some of these questions:*

Questions	Possible Responses
<i>What factors determine the number and kinds of plants you will find at the site?</i>	Factors include: Rainfall, humidity, temperature, soil composition, hours of sunlight, activities of people and other animals.
<i>How do plants provide for the needs of other living things?</i>	They provide food, shelter, homes, nesting places.
<i>How can you tell one plant from another? What features could you look for?</i>	By leaf or needle size and shape, arrangement of plant parts on the stem, smell, texture, vein patterns, flower and bud types, bark, seeds, cones fruits, or overall growth patterns.

3. *Ask students what tools and equipment they will need to take measurements of the environmental factors at their site. Ideally, they should plan to use thermometers, a soil test kit, a light meter, and a rain gauge.*
4. *Distribute copies of Some Clues to Describing and Understanding Organisms to your students and go over it to help prepare for the field activities.*

CLASSIFICATION AND BINOMIAL NOMENCLATURE

1. *Ask students to explain what they already know about how to classify plants. (Note: Their level of understanding may be limited at this point.)*

Use this exercise to help students understand the binomial system of classification that is used most commonly in keys and identification guides. Show the “Types of Oak Leaves” illustration and ask:

- What is the common name for all of these types of leaves? (oak)
- Point out a few of the leaves and ask students to recall their full common names, such as turkey oak, willow oak, post oak.
- Write out the following: *Quercus laevis* (turkey oak), *Quercus phellos* (willow oak), *Quercus stellata* (post oak). Ask: Why do you think scientists prefer to use this system of naming?

(Students might mention that scientists need a common language to communicate no matter what their native language, and that some plants are known by more than one common name.)

- Look at the names themselves and point out that all the oaks share the same “surname” or genus, *Quercus*. Within that genus there are 450 different species, like *laevis*, *phellos*, *stellata*, and no two species are exactly alike.
2. *Have students use field guides and identification keys to find other examples of the genus and species names of common plants (such as dandelion, crabgrass, and cattail) in your area. They may also be able to identify some plants in their plots based on the drawings and descriptions they have already recorded in their journals.*
 3. *Encourage students to become familiar with the resources for plant identification available on the Web. Have them work with the Dichotomous Keys and read the selection “Plant Identification.”*

2

LESSON



LESSON 2

OBSERVING AND COLLECTING PLANTS/MEASURING ENVIRONMENTAL FACTORS

TIME

2 or more field sessions

NOTE

Two activities are recommended for field trips: Close Observations and Measuring Environmental Factors. You may decide to have the class focus on just one activity per trip, or use the activities in various combinations. Another option is to have team members divide up the tasks, with each focusing on a different one. They can later combine their information. The two activities and the materials they require are described separately below.

Before all trips, check that students have the equipment they need. Review and add to the safety rules as necessary.

FIELD TRIP A

FIELD TRIP	CLOSE OBSERVATIONS
MATERIALS	<input type="checkbox"/> Journals <input type="checkbox"/> Hand lenses <input type="checkbox"/> 2m ² frames or markers <input type="checkbox"/> Some Clues to Describing and Understanding Organisms <input type="checkbox"/> Camera and drawing materials <input type="checkbox"/> Field guides and keys to identification

1. Tell students that they are to make close observations of at least one plant each. If possible, they should try to identify the plant. Have them use the “Some Clues to Describing and Understanding Organisms” to guide their observations. Ask them to record their observations by drawing and writing in their journals.
2. Circulate among the teams as they work and use some of the questions on the next page to prompt them to make more detailed observations.
3. While still in the field, encourage students to use field guides and keys to try to identify their plants. Later they may use additional on-line resources as well. In many cases, students will be able to identify only fertile specimens.
4. Continue the process until students have recorded all the plants in their plot and identified them to the best of their ability. Identification is an ongoing process, and although students may not be able to identify a specimen right away, they may be able to do so at a later date.



Tasks	Focus Questions
<i>To prompt students to use more than one sense to make observations</i>	Which of your senses have you used to observe? Have you touched the plant, smelled it, looked at it with a hand lens?
<i>To seek patterns</i>	What patterns have you noticed on the plant? How are the leaves or needles arranged along the stem? What patterns do the veins make? Do all the blossoms have the same shape and the same number of petals?
<i>To encourage measurement</i>	Have you measured the plant? What parts have you measured?
<i>To focus on plant processes</i>	What is the plant doing right now? Is it producing buds, seeds, fruits, leaves, or blossoms?
<i>To look for relationships</i>	Do you think the plant may have an ecological relationship to another plant, or to an animal? Why do you think so?
<i>To ensure record keeping</i>	Where have you recorded your observations? Have you included written descriptions, measurements, and drawings?
<i>To measure and record environmental factors</i>	What environmental factors are you measuring? What tools are you using to take the measurements?

The task and focus questions on the following page can be copied and distributed to students.

TASKS AND FOCUS QUESTIONS

SECTION 1

LESSON 2

FIELD TRIP A

CLOSE OBSERVATIONS

Tasks	Focus Questions
<i>To prompt students to use more than one sense to make observations</i>	Which of your senses have you used to observe? Have you touched the plant, smelled it, looked at it with a hand lens?
<i>To seek patterns</i>	What patterns have you noticed on the plant? How are the leaves or needles arranged along the stem? What patterns do the veins make? Do all the blossoms have the same shape and the same number of petals?
<i>To encourage measurement</i>	Have you measured the plant? What parts have you measured?
<i>To focus on plant processes</i>	What is the plant doing right now? Is it producing buds, seeds, fruits, leaves, or blossoms?
<i>To look for relationships</i>	Do you think the plant may have an ecological relationship to another plant, or to an animal? Why do you think so?
<i>To ensure record keeping</i>	Where have you recorded your observations? Have you included written descriptions, measurements, and drawings?
<i>To measure and record environmental factors</i>	What environmental factors are you measuring? What tools are you using to take the measurements?

FIELD TRIP B

FIELD TRIP

MEASURING ENVIRONMENTAL FACTORS

MATERIALS

- ☐ Journals
- ☐ Thermometers
- ☐ Soil test kit
- ☐ Light meter
- ☐ Rain gauge
- ☐ Humidity indicator

1. Ideally, students should measure and record the environmental factors every time they go out into the field.
2. After students have measured the environmental and abiotic factors, have them record their findings in their field journals.
3. Remind students to continue entering new questions in their journals. Prompt them to think about how the environmental and abiotic factors influence the plants in their plot.



3 LESSON

LESSON 3

IDENTIFYING AND PRESERVING PLANTS

TIME 1 or more class sessions

MATERIALS

- ☐ Journals
- ☐ Reference materials such as field guides and identification keys

WEB COMPONENTS

Dichotomous Keys

Plant Report

Weather Report

- 1. Students will need additional time in the classroom to work on identifying the plant species in their plots. If, after using all the resources available, they are still unable to identify a plant down to the species level, the class will need to decide on some alternative strategies.*

Ask for their ideas on how to treat the unidentified plant(s). These might include simply calling the plant by its common name (e.g., daisy), or giving the plant a temporary name such as Unknown #1, followed by a complete description of the plant. For example, the plant might be described as 2 feet tall with pink blossoms having four petals, alternating leaves, and growing in full sun. This kind of description will make it possible for students to conduct a search on the Web and to ask other students or botanists for help in identification. They should continue to observe the unknown plant. Sometimes identification becomes possible later as the plant continues to grow and develop in the field.



TEACHING TIP: IDENTIFICATION HELP

This is a crucial time to call on plant specialists for help with identification. Help may be available from local and regional experts.

- 1. Ask students to enter their data in the Plant Reports and Weather Reports for the day. For each field trip, make sure that the journal entry/observation date for that day's Weather Report correlate with the journal entry/observation date of all Plant and/or Arthropod Reports filled out on the same day. This information can be used later to analyze data generated by your class.*