Cornell Institute for Biology Teachers

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Title: **Plant Anatomy and Classification**

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Appropriate Level: Grades 4-6

Elementary Science Core Curriculum (NYS): Standard 1: Analysis, Inquiry, Design (Mathematical Analysis): Key Idea 1: M1.1a,c; Key Idea 2: M2.1b; Key Idea 3: M3.1a. (Scientific Inquiry): Key Idea 1: S1.1a; Key Idea 3: S3.1, S 3.2a, S3.3a.
Standard 6: Interconnectedness: Common Themes: Key Ideas 1, 5
Standard 7: Interdisciplinary Problem Solving, Key Idea 2.
Standard 4: The Living Environment: Key Idea 3: 3.1c

Abstract:

Materials:

Time Requirement:

Additional Teacher Information

Objectives

- Students will be able to identify basic plant structures.
- Students will be able to create their own dichotomous key for a sample of local plants.
- Students will be able use a standard dichotomous key to identify representative plants.
- Students will be able to use the *Tree Finder* book to identify local trees, either in the field or with classroom samples.
- Students will be able to press, mount and identify plant specimens.

Activity One

A typical leaf consists of a flat blade and a stalk that connects the blade to the plant's stem. Leaves come in a variety of shapes. Although some leaves have smooth outside edges, most are not completely smooth; many have lobes and/or teeth. A lobe has a primary vein, whereas a tooth has only a secondary vein. Sometimes, you can find a tooth within a larger lobe on a leaf.

Leaves are divided into two main types: simple and compound. A simple leaf usually has one blade, a stalk and a bud at the base of the stalk. A compound leaf has two or more leaflets and a bud at the base of a single stalk. To figure out whether you have a leaf or a leaflet, check the bud; a leaf always has a bud at its base, a leaflet does not. Also, a leaf will always have a circular or semicircular base to surround the bud, whereas a leaflet won't. The sycamore tree with its hollow petiole that encloses next year's bud is an exception to this rule.

Leaves play an important role in determining a plant's outline, particularly a tree's shape. Some trees have only a thin sprinkling of leaves, which means you can easily see the branches. In other trees, the leaves form a solid barrier, concealing most of the branches. When these trees shed their leaves for winter, they can look very different.

The leaf terms and diagrams are from the *Leaf Identification Kit*, Young Naturalist Co., 1900 N. Main St., Newton, KS 67114.

Activity Two

Give each student group (groups of two to four) a subset of labeled leaves from Activity One. The set of leaves should only have about five or six leaves. Try to include good representative types in each group. It will be more interesting if different groups have different sets of leaves.

Activity Three

A dichotomous key is based on the idea of making a choice between two alternatives. The word "dichotomous" comes from two Greek words that together mean "to divide into two parts." Each pair of phrases in the leaf key provided describes different features. However, only one of the phrases correctly describes the leaf being keyed out. As they are keying out their leaves, each student will need to pick out which phrase applies to the particular leaf that he or she is trying to key out. The correct phrase will either guide the students to the next pair of phrases or state the name of the tree from which the leaf came.

The leaf key is from the *Leaf Identification Kit*, Young Naturalist Co., 1900 N. Main St., Newton, KS 67114.

Activity Four

This activity is designed to help develop observation techniques in the field. The students have already used and created a dichotomous key. They are now ready to use a dichotomous key in the field to key out their own local trees. Trees to be identified can be street trees, schoolyard trees or park trees. Try to avoid trees that have already been identified in class. Try to avoid exotic ornamental trees that might not be in the *Tree Finder* book. Ideal trees would be those with low hanging leaves so students can observe them close up. Be sure to conduct a "dry run" yourself and only select trees that have been identified in the *Tree Finder* book.

Tree Finder: A Manual for the Identification of Trees by their Leaves by: May Theilgaard Watts. 1963, 1991 Nature Study Guild, Rochester, NY

Activity Five

Students will make a labeled collection of local trees. Assign a reasonable number of specimens to be collected and identified. Ten different trees would be appropriate for students in fourth grade. A good tree sample should contain three or four leaves attached to a section of stem and a fruit or seed if possible. The specimens should be pressed in a plant press or between sheets of newspaper weighed down with books. One of the leaves should be twisted so that its lower surface is facing up. Check the samples every two or three days until they appear to be quite dry. When the samples are completely dried, they are ready to be mounted on a sheet of heavy white paper (heavy bond paper is best). Be sure to use a non-casein glue (casein glue is made from milk and bugs will be attracted to it). Use a plastic-based glue or if the students are careful, a "hot glue" gun. Use small amounts of glue along the stem and on each leaf. You don't want big "globs" of glue. A small label should be filled out for each sample when it is identified. The label should contain the type of tree, the date collected, the location collected and the name of the collector. Older students might be required to include the scientific name of the tree. Mounting labels can be purchased through scientific companies or they can be "home-made." The collection can be stored in a manila folder and kept in a dry cabinet in the classroom.

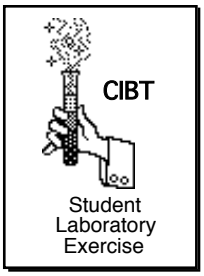
Extension Activities

1. Plant Growth: Trees, flowers, bushes and grasses are constantly growing. Have each student "adopt" a plant to watch for a few minutes each day. Focus on something that will grow and change fairly obviously (flower, bud, etc.). Write down how the plant looks on the first day. Look at its physical characteristics (size, leaf shape, color, etc.). Count the number of leaves, branches, shoots, etc. Each day, add a bit more information to the plant's description. Measure any growth that occurs. Keep a journal of the plant's changes.

2. Edible Plants: Most people are amazed when they realize how many wild plants are edible. The very young leaves of dandelions are great as salad greens or as cooked greens. The new, leafy stems and young shoots of milkweed are good as cooked vegetables. But before you get into edible plants, learn which plants and plant parts are poisonous. For example, the petiole on the rhubarb is edible, but the leaf is poisonous.

3. Tree Puzzles: Make puzzles out of branches that have fallen from trees naturally or during pruning. Saw a branch into four or five pieces. In order to realign the pieces, you must use both bark and ring formation as clues. You can also make mini-puzzles using twigs.

Activity One



Student Information

Deciduous plants have leaves that come in many different shapes and sizes. You will learn the terms used for classification of leaves and will examine leaves of some of the plants that grow in your area.

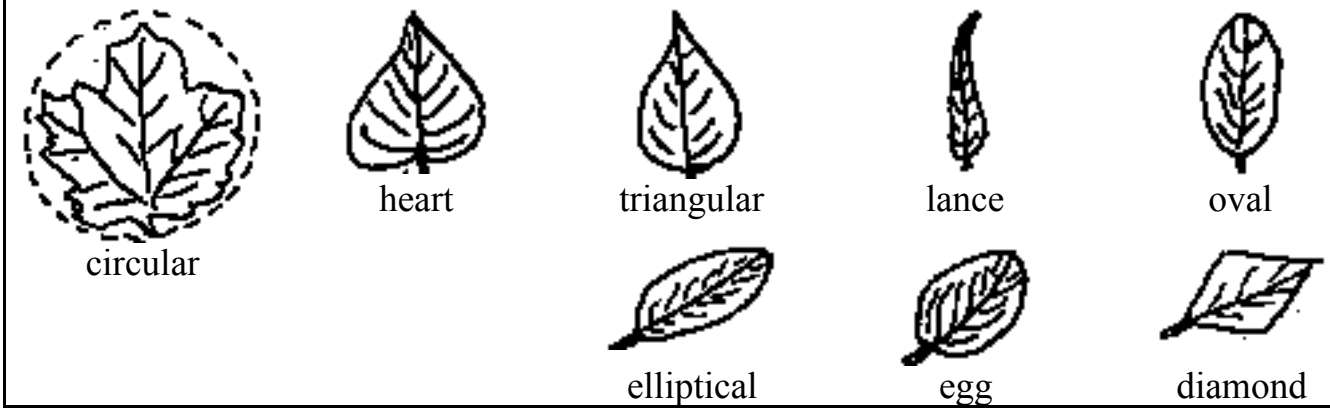
Materials

- Leaves to be identified
- Diagrams of leaf types and terms
- Leaf Key
- Ruler
- Paper
- Pencil

Procedure

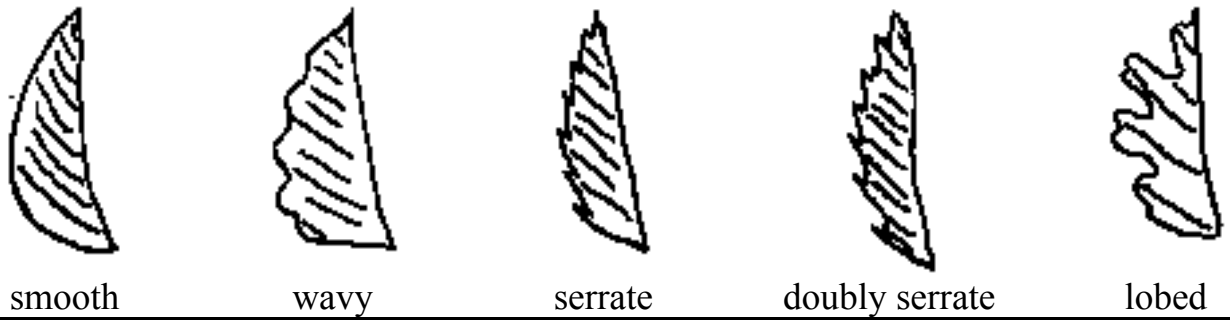
1. Examine the illustrations showing common leaf shapes and edges.
2. Examine the leaves that have been collected. For each different leaf type, describe the shape and the type of edges.
3. Measure the lengths and widths of different leaves. Are the leaves as wide as they are long? Which lengths and widths are most common? Why are leaves different lengths and widths?
4. Examine the illustrations showing simple and compound leaves.
5. Go back to the leaf collection. Describe for each whether it is simple or compound. For compound leaves, decide what kind of compound structure it has (palmate or pinnate).
6. Go for a field trip outside your school or house. Examine the leaves of the plants growing there.

Some Common Leaf Shapes

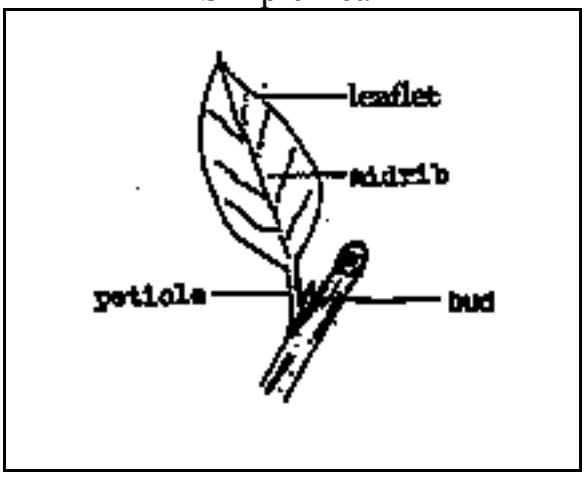


Leaf Arrangements on a Twig

Common Types of Leaf Margins

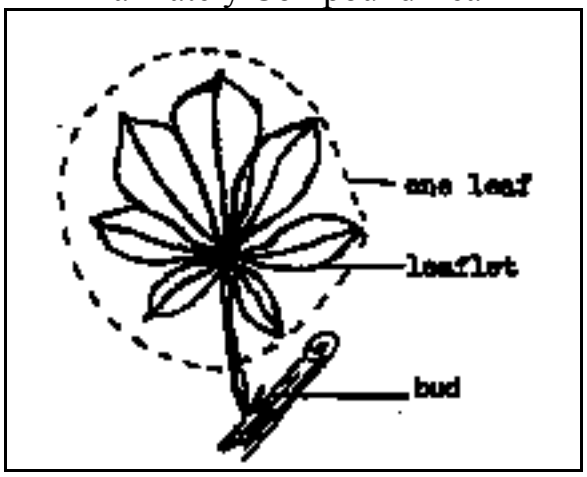


Simple Leaf



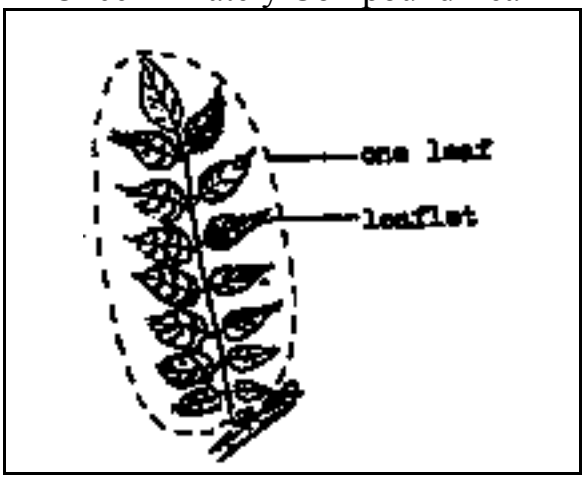
A simple leaf usually has one leaflet, a petiole, and a bud at the base of its petiole.

Palmately Compound Leaf



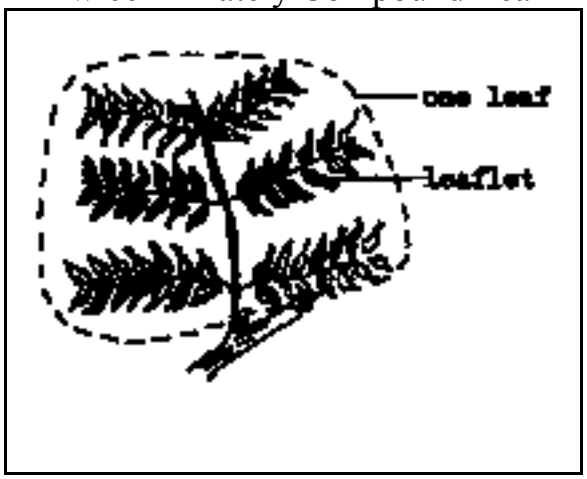
A compound leaf has two or more leaflets and a bud at the base of its petiole. Note that there is NOT a bud at the base of the leaflets.

Once Pinnately Compound Leaf



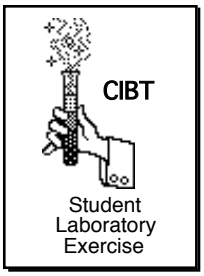
A once pinnately compound leaf has one main petiole and the leaflets are arranged pinnately on each side of the petiole.

Twice Pinnately Compound Leaf



A twice pinnately compound leaf has one main petiole and then secondary petioles arranged on each side of the main petiole.

Activity Two



Student Information

A dichotomous key is based on the idea of making a choice between two alternatives. The word "dichotomous" comes from two Greek words that together mean "to divide into two parts." In a dichotomous key, you work your way from general characteristics to the more specific and hopefully end up with the correct identity of the object you are "keying out." At each step of the way, you are given two choices. You have to pick the choice that more closely fits the object you are trying to identify. Each of the two choices then leads you to the next set of choices to consider. For example, suppose you wanted to make a dichotomous key to allow someone to identify the students in your class. Part of the key might look like the following.

1a. Girl ..... go to section 2
1b. Boy ..... go to section 3

2a . Hair long ..... go to section 4
2b. Hair short ..... go to section 5

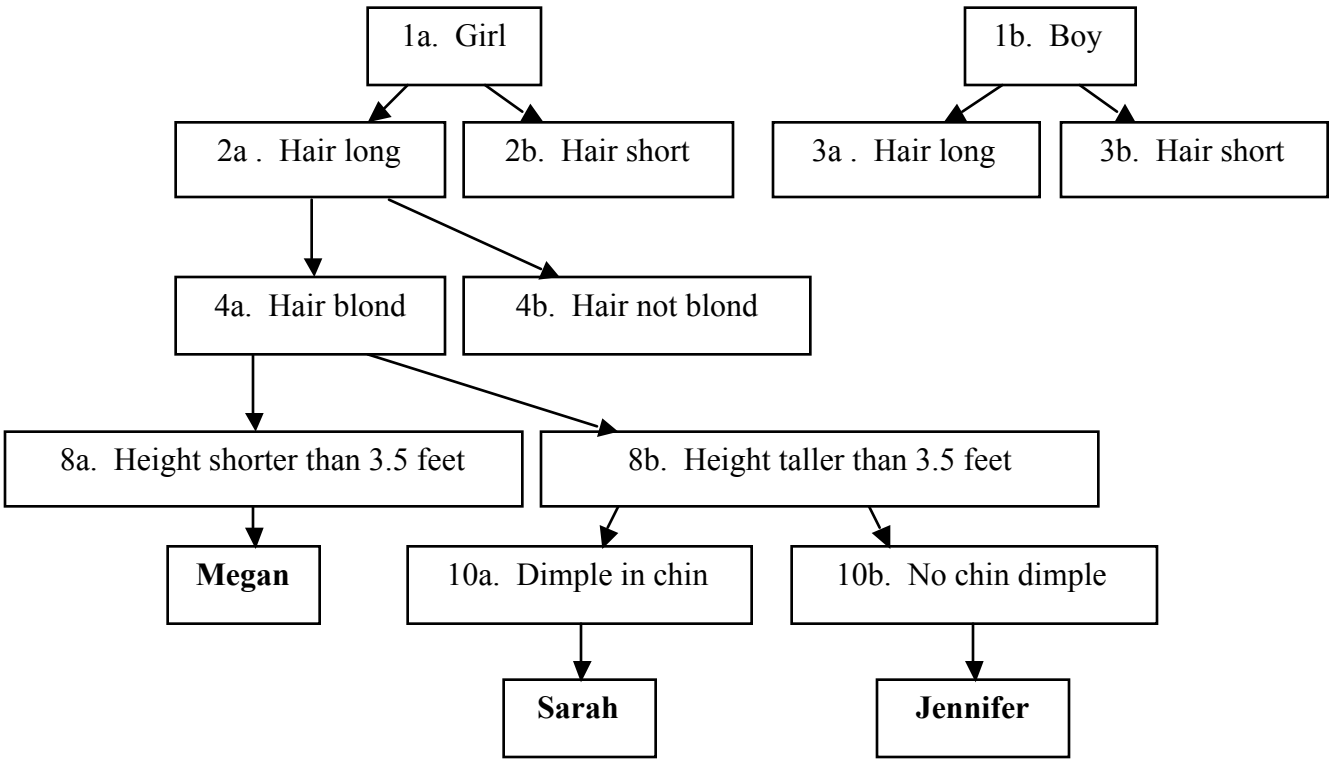
3a. Hair long ..... go to section 6
3b. Hair short ..... go to section 7

4a. Hair blond ..... go to section 8
4b. Hair not blond ..... go to section 9

8a. Height shorter than 3.5 feet ..... **Megan**
8b. Height taller than 3.5 feet ..... go to section 10

10a. Dimple in chin ..... **Sarah**
10b. No chin dimple ..... **Jennifer**

Another way to think of doing a dichotomous key is to make a diagram like the one sketched below (only the sections listed above are shown).



It is important to note that each dichotomous key is based on the particular specimens being studied. If you were making a key to the students in a high school class, you would need a different key than the one above.

You will devise an appropriate key for the set of leaves you are given.

Materials

Each group of four students will be given a set of about five or six leaves; each leaf has a letter on it and the students get a list showing the name of the leaf that corresponds to each letter, paper, and pencil.

Procedure

1. Look over the whole set of leaves. Examine each leaf and make a list of its physical characteristics.

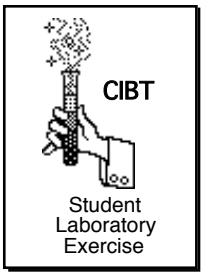
2. Find a general characteristic to divide the group into the first split, comparable to considering girls versus boys in the example above.

3. Continue defining characteristics until each leaf is defined.

4. Make that information into a dichotomous key.

5. Now switch leaves with another group (do NOT let them see the list identifying the leaves). Give them your key and see if they can correctly identify each leaf in the group using your key.

Activity Three



Student Information

You are going to use a dichotomous key to identify a number of sample leaves. The key has been created to identify the leaves you are working with.

Materials

- Leaves to be identified
- Leaf key
- Paper
- Pencil

Procedure

1. Each team of students receives a leaf sample.
2. Use the key to identify the leaf.
3. Write down the number of the sample leaf and the type of tree you think it came from.
4. Check with your teacher to see if you are correct; if not – try again.
5. Exchange your sample with another. Key out all of the sample leaves.

Leaf Key

When you look at the key below, you will see two different descriptive statements under the same numerical heading, but with different letters. You are to choose the one statement that best applies to the leaf you are trying to identify. The number to the right of the statement you have chosen indicates where to go to look at the next set of characteristics you will consider. Continue in this manner until you end up with the name of the tree your leaf came from.

1a. Leaves needlelike or scalelike 2
1b Leaves not at all needlelike or scalelike 3

2a. Leaves small, scalelike, close together and overlapping ..... Red Cedar
2b. Leaves not scalelike, long and narrow, needlelike in twos united at the base to form bundles ..... Scotch Pine

3a. Leaves opposite 4
3b. Leaves alternate 5

4a. Leaves simple, deeply five-lobed like fingers on a hand ..... Silver Maple
4b. Leaves compound, pinnately compound ..... Green Ash

5a. Leaves simple 6
5b. Leaves compound 12

6a. Leaves lobed 7
6b. Leaves unlobed 8

7a. Outline of leaf elliptical or broadest above the middle ..... Bur Oak
7b. Outline of leaf circular or nearly so ..... Sycamore

8a. Leaf margin smooth, not toothed in any way 9
8b. Leaf margin toothed 10

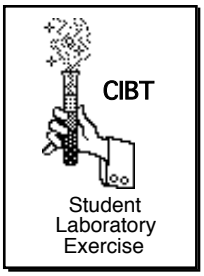
9a. Leaves two to five inches long, one to three inches wide, ovate-lance shaped with narrow pointed tip ..... Osage Orange
9b. Leaves heart shaped or kidney shaped ..... Redbud

10a. Leaf margin with sharp double teeth, leaf shape elliptical, leaf distinctly lopsided at base ..... American Elm
10b. Leaf margin with single teeth, either finely toothed or rounded 11

11a. Leaf margin with rounded teeth, leaf triangular in outline ..... Cottonwood
11b. Leaf margin finely toothed, leaf lance shaped in outline ..... Black Willow

12a. Leaf twice compound ..... Honeylocust
12b. Leaf once compound ..... Black Walnut

Activity Four



Student Information

You and your partner will be using the *Tree Finder* book to identify a group of sample trees. For each sample tree, begin on page 5 of the *Tree Finder* book. The book is like a dichotomous key, plus it has drawings to help you identify your samples. Write the number of the sample on your paper and work through the book until you have reached the name of the sample tree. Write the name next to the number and go on to the next sample. When you have identified all of the samples, ask your teacher to check your identifications.