

ECOS Inquiry: Lewis and Clark Team -- PLANT IDENTIFICATIONDate of implementation: Wednesday October 5th and 12th, 2005

1. General goal: -- To gain understanding and proficiency in identifying plants by using a simplified key designed for the ODC (Outdoor Discovery Core) garden. 1st and 2nd graders will be expected to learn the four life forms listed in the inquiry; 5th graders will key out several tree/shrub species.
2. Specific Objective:
 - a. *Academic*: -- learning basic life-forms (tree, shrub, forb, and graminoid) and parts of plants: root, stem, leaves, inflorescence (the flowering part of plant); also, some basic botanical terms will be shared with the students.
 - b. *Experimental*: -- field work in the garden, using a key to identify plants
 - c. *Procedural/technical*: -- observational skills
 - d. *Social*: -- work in teams
 - e. *Communication*: -- each team will discuss how they determined what type of plant they were assigned.
3. Context:
 - a. *For Teachers*: In order for scientists to communicate information about plants it is essential to learn how to identify common species. Moreover, it is beneficial to develop skill in identifying plants by foliage rather than by fruit or flower characteristics, since the latter are not always available to use. This inquiry will be used to begin training young botanists in this important area of study. A **dichotomous key** is a guide that allows you to distinguish plants based on an “either/or” principle. For example, a tree either has evergreen leaves that remain on the branches or deciduous leaves that fall off seasonally; this characteristic can be used to separate the two classes of trees. Further delineation using a dichotomous key narrows the characteristics to the specific family, genus, and species of the plant in question. **Also, see appendix for further explanation.**
 - b. *For Students*: First, I would stress that the classification of plants into well-defined groups (called life-forms) is only meant to aid scientists in general identification and is not always black and white. For instance, students should not become too confused with trying to distinguish a shrub from a sub-shrub (the definition is often subjective, anyway). A forty-foot tall bamboo looks more like a tree or shrub, but is technically a grass. Point out that plant characteristics are often hard to determine, even for experts, and the experts disagree on classification sometimes. In summary, taxonomy—the science of classifying species—changes as scientists learn more about the history and genetics of organisms.
 That said, we still need a way to identify individuals as we see them in the field, and so we use life-forms and structural characteristics of the plant to distinguish differences.

4. Vocabulary: -- **Life form**: for our purposes we will define 4 categories of life forms—Tree, shrub, forb, and graminoid.
Dichotomous (die-cot-uh-mus—rhymes with hippopotamus!) **key**: a guide that allows you to distinguish plants based on an “either/or” principle.
For First/Second graders and Fifth graders:
 TREE: a woody plant that has a single dominant stem, often taller than 30 feet.
 SHRUB: a woody plant that has many branchlike stems, usually no more than ten feet tall.
 FORB: a plant that grows all of its aboveground tissue each year, or if it’s evergreen does not have any aboveground woody tissue.
 GRAMINOID (**gram**-eh-noyd): like a forb, but has grass-like leaves and small inconspicuous flowers and fruits. Graminoids are members of the sedge, rush, or grass families.
For Fifth graders only:
 NODE: the point on the stem where leaves or branches originate.
 OPPOSITE LEAVES: leaves grow opposite each other at the same node of a stem.
 ALTERNATE LEAVES: leaves grow singly from the node of a stem.
 DORMANCY: the period consisting of a certain number of days below a particular temperature necessary before a tree can leaf out again. (Note the possible misconception here!—a tree is actually quite active during “dormancy” as are bulbs and seeds).
 DECIDUOUS: losing leaves each year
 EVERGREEN: maintaining leaves over winter
 COMPOUND LEAVES: leaf is divided into many leaflets. NOTE: compound leaves are often mistaken for opposite leaves. A good example of a compound leaf is the mountain ash which has *alternate leaves*, but each leaf is a *compound leaf*, and may appear to be a stem with opposite leaves.
5. Grade/age level: -- scaled down version for 1st and 2nd graders; full version for 5th graders.
6. Duration: -- two 45 minute sessions
7. Motivation/Incentive: --
8. Materials: Preparation: --
9. Methods/Procedures: --
Introduction: life forms
 Begin by asking the students why there is a need to group plants into different categories. What you’re looking for are answers like: 1) because sizes are different; 2) because different life forms may have different functions (e.g. the upper canopy of trees provides shade which can lower ground temperature, grasses can prevent erosion, shrubs make good habitat for small birds and mammals, etc.); 3)
 Once students have established and recognized the importance of classification, the teacher can pose the question, “how do we go about creating a

system to characterize plant types?” Or, to put it simply, “which plants look alike and what do they have in common?”

Continue the dialog until the focal terms emerge; in this case, wooden versus soft (herbaceous) stem is a great characteristic difference between trees and forbs. Another key concept is height, as this often differentiates trees from shrubs. Some characteristics are difficult to readily see; the fact that forbs’ stems die back each winter cannot be seen except through months of observation, although this is a basic definition of a forb.

Introduction: dichotomous key

A dichotomous key is simply a key that has a yes-or-no format. For instance in our simplified Lewis and Clark key that we’ll use for this inquiry, the first question is: does the plant have a single woody stem or a height greater than 15 feet? If the answer is yes, then follow the same line to the right and you find the word tree. If the answer to 1a is no, then you go to 1b, which asks if the plant has multiple stems (note: multiple stems could be herbaceous—that is, soft and pliable, or woody). If the plant has this characteristic, then proceed to the right of that line to the number 2 in bold. This indicates that you need to continue to number 2, in order to identify your plant. At the same time, this means your plant is probably not a tree. Now is a good time to mention to students that keys are not always correct. Ask if anyone can think of a situation where the key might be wrong. One instance might be if a tree is young it might be mistaken for a shrub or forb. Another instance might be if the plant is a fern or a moss it won’t key out, since neither is covered by our Lewis and Clark key.

Continue through the key until you’ve identified the plant. For the 1st/2nd graders this will be as far as you need to go. For the 5th graders, the life form can be further investigated to the genus or species level by using Key number 2. For our inquiry we will only key out trees or large shrubs, to keep it simple and to achieve our objective in the time allotted.

10. Safety issues: -- none
11. Assessment: -- the knowledge gained from this inquiry will be used in future inquiries requiring plant identification.
12. Extensions: -- this inquiry would be suitable for establishing a baseline which could be extended into many advanced lessons in botany and field work.
13. Scalability: -- dependent on depth of definitions and application; younger students will be asked to memorize fewer terms and the field applications will be abbreviated (i.e. less developed key.)
14. References: -- dictionary or flora
15. Experts and Consultants: -- none

KEY 1

For all ages:

*Dichotomous **life-form** key for Lewis and Clark Outdoor Discovery Core. Follow the numbers until you arrive at the life-form of the plant you're looking at.*

- 1a. Plant has a single stem or height greater than 15 feet... **tree***
- 1b. Plant has multiple stems or is less than 15 feet high..... **2***
 - 2a. Plant has many woody stems..... **shrub***
 - 2b. Plant has soft (herbaceous) stems..... **3***
 - 3a. Plant has long grass-like leaves..... **graminoid***
 - 3b. Plant does not have grass-like leaves... **forb***

KEY 2

For 5th graders:

Dichotomous key for selected plants at the Lewis and Clark Outdoor Discovery Core. After using the life-form key, student can identify plant to the family, genus, or species level. Follow the key until you arrive at selected plant.

- 4a. Tree has needles for leaves (conifer)..... **5***
- 4b. Tree does not have needles for leaves.....**6***
 - 5a. Needles longer than 2 inches..... **pine***
 - 5b. Needles shorter than 2 inches.....**spruce***
 - 6a. Leaves alternate.....**7***
 - 6b. Leaves opposite..... **8***
 - 7a. Leaves are heart-shaped..... **aspen***
 - 7b. Leaves are compound..... **western mountain ash***
 - 7c. Stems have thorns on them..... **Douglas Hawthorne***
 - 8a. Leaves are not compound..... **Rocky Mountain Maple***

Appendix. SUPPLEMENT TO THE INQUIRY, downloaded from the internet (reference unknown)

The word *dichotomous* comes from the Greek words *dikha*, “in two,” and *temnein*, “to cut.” Thus, it’s meaning: “division into two contradictory parts.” A *key* is a table glossary, or cipher, for decoding or interpreting. A *dichotomous key* is a branching decoder, which forks into two approximately equal and contradictory divisions that lead to only one correct outcome. It is like a mouse maze. For the mouse to escape, it must make successive choices between two directions, one correct and one incorrect. The mouse will get out only after making all the correct choices. To use a dichotomous key we, too, must choose correctly between two options in a series of contradictory options. We use our five senses (sight, hearing, touch, taste, and smell) to determine the correct choices. Here is a simple example of how we might choose what type of shoe we are wearing. Assume you are wearing a pair of canvas running shoes. The first choice in the key asks if the shoes are made of leather or canvas. Since they are made of canvas, not leather, you follow the “path” to “CANVAS.” Here you are asked if your shoes have lightweight soles and are low-cut or if they have heavy soles and are high-cut. Yours are lightweight and low-cut, so you have identified them as canvas running shoes. Note that *all* dichotomous keys have inherent limitations. In this example, only six types of shoes are included. Even very extensive and technical keys omit some possible choices. This is especially true of exotic vegetation species that have been introduced into an area. Many dichotomous keys only include native species. If the plants you are trying to identify aren’t native or your dichotomous key isn’t complete enough, you may need to seek expert help.

A second limitation of many dichotomous keys is their use of imprecise terminology (e.g. “low-cut,” “lightweight,” etc.). Sometimes it is not clear what the authors of the key mean by these terms. The best keys are those that use objective, measurement-based characteristics rather than subjective options.