Classifying Leaves

Background

Over the centuries, people who study the natural world have tried to sort, or classify, organisms into groups whose members show a logical relationship to each other. The science of classification is called taxonomy.

One of the products of taxonomy is the development of classification keys. A classification key is an organized list of characteristics that can be used to identify organisms. Such keys have been made for almost every group of organisms in the world.

Objectives

In this activity you will:
1. Identify structural characteristics of leaves and find differences between leaves.
2. Construct a classification key based on the characteristics of leaves.

Materials

paper
pencil

Procedures and Observations

PART I. STUDYING LEAF STRUCTURE

In this lab you will observe the leaves of a number of plants, and learn the meanings of some of the terms used to describe leaf characteristics. You will make use of these terms when you construct a key in Part II.

1. Look at Figure 1, which shows a leaf from a willow tree and a leaf from a chestnut oak tree. Compare the shapes of these leaves. Notice that the willow leaf is long and pointed, while the chestnut oak leaf is oval.

2. Compare the edges of the two leaves shown in Figure 1. Notice that the edges of the willow leaf are notched, while the edges of the chestnut oak leaf are wavy. Some other kinds of leaves have edges that are lobed, or deeply indented. Still other leaves have smooth edges.

3. Compare the patterns of the veins of the two leaves shown in Figure 1. As you can see, they are similar: both leaves have a network of small veins that branch off a single, main vein. Compare this pattern of veins, called pinnate-netted, to the two other vein patterns shown in Figure 2.
Notice that the veins in a *palmate* pattern start at the base of the leaf and extend outward, as fingers extend outward from the palm of the hand. The terms palmate and pinnate also refer to other leaf characteristics. Leaves that are lobed show one of two patterns, palmate or pinnate.

4. Compare the leaves of the sweet gum and the post oak, shown in Figure 3. Notice that the sweet gum leaf is palmately lobed, and the post oak is pinnately lobed.
Classifying Leaves (continued)

Figure 3

So far in this lab activity, you have observed simple leaves, or leaves that are in one piece. Sometimes leaves are divided into smaller segments, called leaflets. A leaf that is divided in this way is called a compound leaf. Compound leaves show one of two patterns, palmate or pinnate.

5. Look at the leaflets of the clover and tick trefoil, shown in Figure 4. Notice that the clover leaf is palmately compound and the tick trefoil leaf is pinnately compound.

Figure 4

PART II. CONSTRUCTING A KEY

Classification keys are used in biology to find the classification or the name of a particular organism. By following a series of descriptions, various other organisms are eliminated. At the end of the process, the organism is identified.
A classification key is made up of a series of steps. Each step has two statements that divide the items being classified into two groups. Each statement is then followed by a direction to go to another step or by the name of that group or item.

To make a key, you start with two statements that divide all the items being classified into just two groups. Each of those groups must then be divided into two more groups, continuing to divide groups until all items have been identified. The characteristics used and the order of the steps is chosen by the person constructing the key. Thus there are many possible keys for any group of items.

1. To practice making a key, complete this simple classification key of four items: a pencil, a pen, a shoe, and a glove.

   1a. Used for writing  ____________________________  go to Step 2
   1b. Worn on the body  ____________________________  go to Step 3
   2a. Contains ink  _________________________________  pen
   2b. Contains graphite  _____________________________  pencil
   3a. ________________________________
   3b. ________________________________

2. In order to construct a key of leaves, you will need to differentiate between the leaves. Using what you learned in Part I, answer the questions about the leaves shown in Figure 5.

   a. What is the vein pattern of leaf A?

   b. How are the leaflets arranged in leaf D?

   c. What is the pattern of lobes in leaf F?

3. The key that you write should make it possible for someone to identify the seven leaves shown in Figure 5. An outline for the key is provided. Notice that a possible first step has been written for you.

   d. What leaf characteristic is used in Step 1 for dividing the leaves into two groups?

4. Plan how you will divide the group of compound leaves in Step 2.

Remember that all steps will contain two contrasting statements. Use the leaf characteristics you learned in Part I to write the statements for each step. If a statement in any step leads you to more than one leaf, you will need further steps to separate those leaves. For these cases, indicate the number of the next step. If a statement in any step leads you to only one leaf, you have identified that leaf. Write the genus name of the plant. When you have identified and written in the names of all seven plants, you have finished your key.
Classifying Leaves (continued)

A. Hosta
   (plantain lily)

B. Fagus
   (beech)

D. Rosa
   (rose)

E. Syringa
   (lilac)

C. Quercus
   (oak)

F. Acer
   (maple)

G. Aesculus
   (horse-chestnut)

Figure 5
5. Write the statements for Step 2 in the blanks provided. This step should separate the two different compound leaves in Figure 5.

6. Complete your key. You may not need all the lines provided. If you need more lines, use a separate sheet of paper to write them.

1a. leaves simple  
1b. leaves compound  
2a.  
2b.  
3a.  
3b.  
4a.  
4b.  
5a.  
5b.  
6a.  
6b.  
7a.  
7b.  
8a.  
8b.  
9a.  
9b.  

go to Step 3  
go to Step 2

7. To check your key, select one of the seven leaves and see if your key leads you to the correct identity.

Analysis and Interpretations

1. You used genus names in constructing your key. If your key divided organisms into smaller groups, what would those groups be?

2. Of the seven leaves shown in Figure 5, only one was pinnately compound. What characteristics might you have used if there had been more than one pinnately compound leaf?

For Further Investigation

1. Try to write a different key for the leaves in this activity. Choose a different starting point, and try to use different characteristics.

2. Collect a few leaves from trees and other plants that you see every day. Before you start collecting, learn to identify, and thus avoid, poison ivy and poison oak. Use a key to leaves of common plants to identify the leaves in your collection. You may find a key in your library.
19-C Leaf Shape

Skills: Literal, Interpretive, Use of graphic aids
In your textbook, read about the shapes of leaves (Section 19.2).

The chart below describes several different kinds of leaves and gives an example of each. Read each description and example. Examine the diagrams carefully. Then write the letter of the leaf type example on the blank by the diagram that it best matches.

<table>
<thead>
<tr>
<th>Shape</th>
<th>Other traits</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan</td>
<td>Edges have teeth.</td>
<td>Ginkgo (a)</td>
</tr>
<tr>
<td>Heart</td>
<td>Edges are smooth. Tip is very pointed.</td>
<td>Cottonwood (b)</td>
</tr>
<tr>
<td>Heart</td>
<td>Edges are smooth. Tip is not very pointed.</td>
<td>Catalpa (c)</td>
</tr>
<tr>
<td>Heart</td>
<td>Edges are smooth.</td>
<td>Redbud (d)</td>
</tr>
<tr>
<td>Oval</td>
<td>Edges are smooth.</td>
<td>Magnolia (e)</td>
</tr>
<tr>
<td>Oval</td>
<td>Edges have a few large teeth.</td>
<td>Holly (f)</td>
</tr>
<tr>
<td>Oval</td>
<td>Edges have many small teeth.</td>
<td>Elm (g)</td>
</tr>
<tr>
<td>Needle</td>
<td>Needles are in twos.</td>
<td>Virginia pine (h)</td>
</tr>
<tr>
<td>Needle</td>
<td>Needles are in threes.</td>
<td>Pitch pine (i)</td>
</tr>
<tr>
<td>Needle</td>
<td>Needles are in fives.</td>
<td>White pine (j)</td>
</tr>
<tr>
<td>5-part</td>
<td>All leaflets attach at same point.</td>
<td>Buckeye (k)</td>
</tr>
<tr>
<td>5-part</td>
<td>Three leaflets attach at top, two near bottom.</td>
<td>Shagbark hickory (l)</td>
</tr>
<tr>
<td>More than 5-parts</td>
<td>Edges have teeth.</td>
<td>Sumac (m)</td>
</tr>
<tr>
<td>More than 5-parts</td>
<td>Edges are smooth. Leaves attach opposite.</td>
<td>White ash (n)</td>
</tr>
<tr>
<td>More than 5-parts</td>
<td>Edges are smooth. Leaves are staggered.</td>
<td>Hackberry (o)</td>
</tr>
<tr>
<td>Wavy lobed</td>
<td>Lobes are pointed.</td>
<td>Pin oak (p)</td>
</tr>
<tr>
<td>Wavy lobed</td>
<td>Lobes are rounded.</td>
<td>White oak (q)</td>
</tr>
</tbody>
</table>