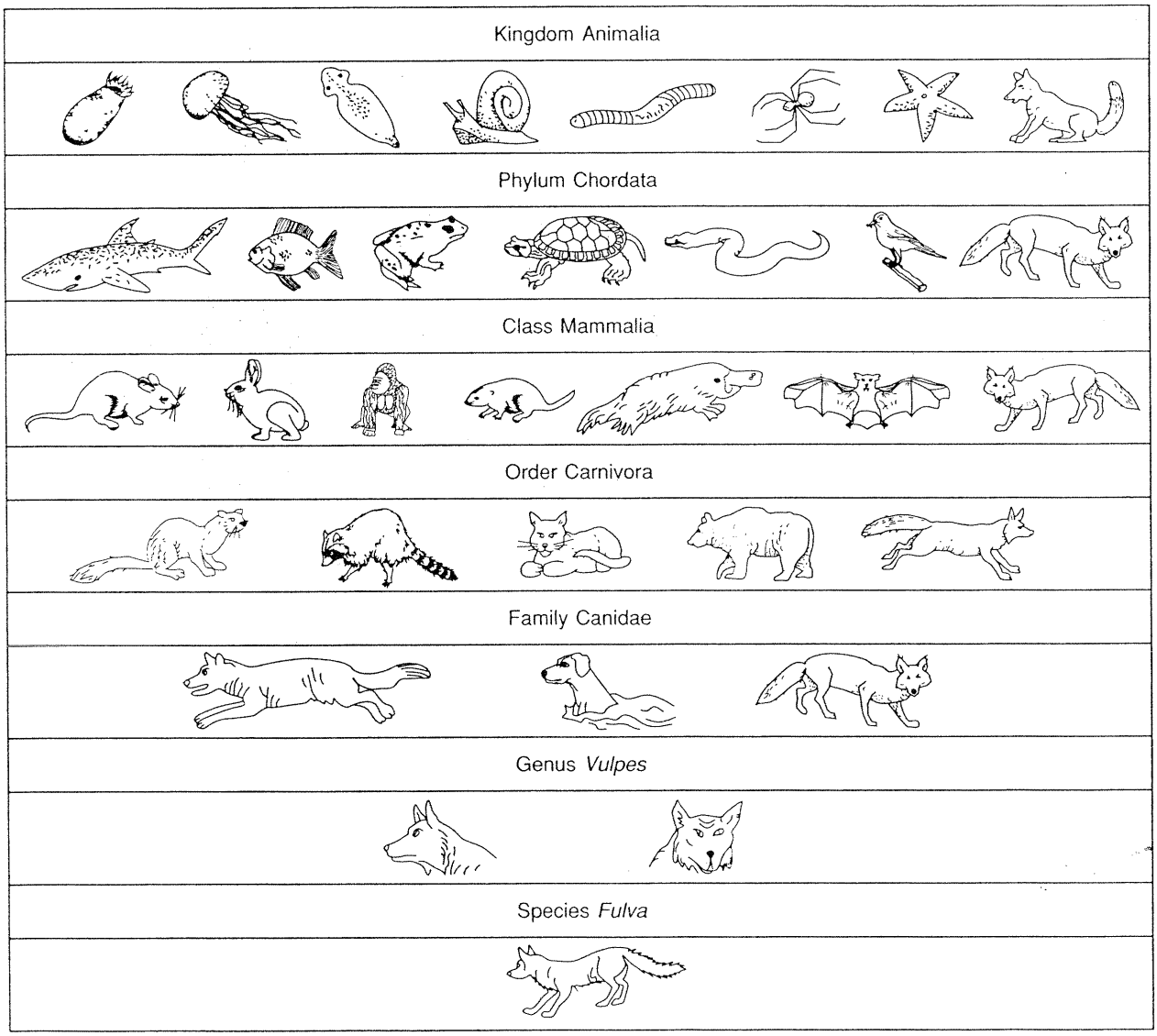
Analyzing Relationships Within a Classification System

The living world shows great diversity. There are a large number of different organisms, and each species has characteristics that are different from the others. In this activity you will identify and analyze the structure of a commonly used classification system.

The figure below shows a scheme used to classify animals.

Figure 1



1. List the common features of the animals in each group. _____

_____

_____

_____

_____

_____

2. Describe the major differences between each group. For example, the decision to classify an organism in either kingdom or phylum is that some animals have a spinal cord and others do not.

Phylum–Class _____

_____

Class–Order _____

Order–Family _____

Family–Genus _____

Genus–Species _____

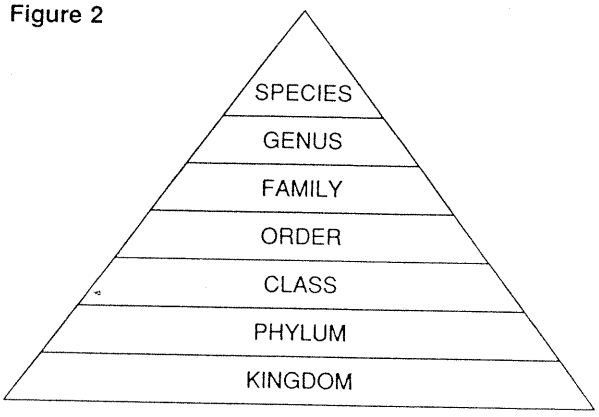
3. Describe what happens to the degree of diversity at both ends of the scheme, from the higher taxonomic levels to the lower taxonomic levels. _____

_____

_____

Classification systems have been represented by various models. The pyramid in Figure 2 is an example. It can be used to illustrate various aspects of the structure of a system, such as the number of organisms per level. Use this as a guide to draw a pyramid that includes the organisms shown in Figure 1.

Figure 2



Using and Constructing a Classification Key

Pre-Lab Discussion

Suppose you find a large colorful wildflower while walking through the woods. Chances are the flower has already been named and classified, but how can you learn its identity? As an aid to help others identify unknown organisms, biologists have developed classification keys.

Many classification keys have been developed to help identify wildflowers and many other kinds of plants and animals. Although these keys may vary in purpose and complexity, they have certain features in common. These classification keys are often called *dichotomous keys*. The word dichotomous comes from the word *dichotomy*, meaning "two opposite parts or categories." A dichotomous classification key presents the user with two opposite statements about some trait of an organism. By choosing the statement that best describes the unknown organism, the user is led to further pairs of statements. By going from one set of statements to another, the name of the organism or its classification group is finally determined.

In this investigation, you will use a classification key to identify several organisms. You will then write a classification key for another group of organisms.

Problem

How can a classification key be used to identify organisms?

Materials *(per student)*

No special materials are needed

Procedure

Part A. Using a Classification Key

1. Examine the drawing of salamander 1 in Figure 1.

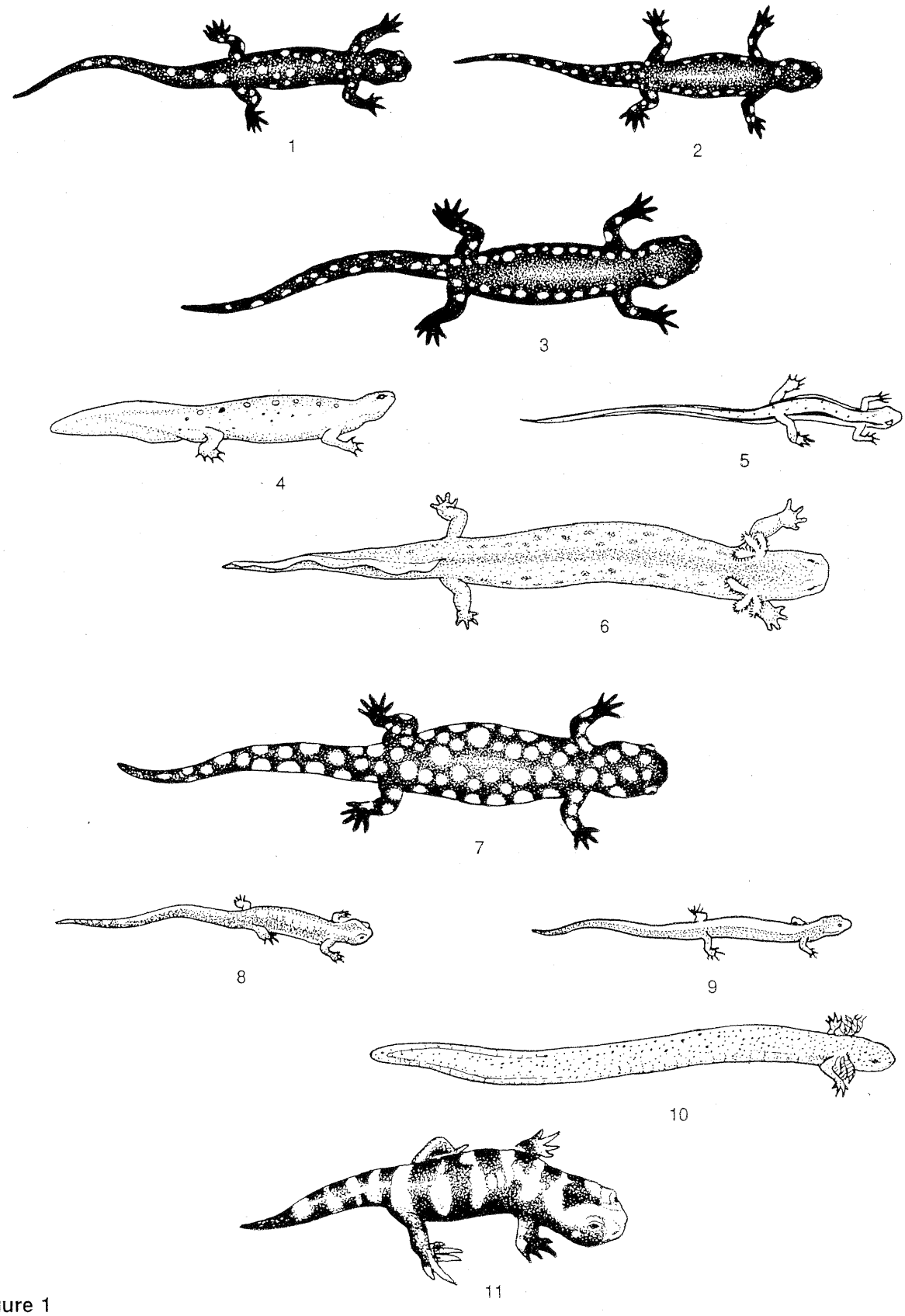


Figure 1

Name _____ Class _____ Date _____

2. Read statements 1a and 1b in the classification key in Figure 2. One of these statements describes salamander 1; the other statement does not. Follow the directions in the statement that describes salamander 1 and continue following the correct statement directions until salamander 1 has been identified.

1	**a** Hind limbs absent	*Siren intermedia*, siren
	b Hind limbs present	Go to 2
2	**a** External gills present in adults	*Necturus maculosus*, mud puppy
	b External gills absent in adults	Go to 3
3	**a** Large size (over 7 cm long in Figure 1)	Go to 4
	b Small size (under 7 cm long in Figure 1)	Go to 5
4	**a** Body background black, large white spots irregular in size and shape completely covering body and tail	*Ambystoma tigrinum*, tiger salamander
	b Body background black, small round white spots in a row along each side from eye to tip of tail	*Ambystoma maculatum*, spotted salamander
5	**a** Body background black with white spots	Go to 6
	b Body background light color with dark spots and/or lines on body	Go to 7
6	**a** Small white spots on a black background in a row along each side from head to tip of tail	*Ambystoma jeffersonianum*, Jefferson salamander
	b Small white spots scattered throughout a black background from head to tip of tail	*Plethodon glutinosus*, slimy salamander
7	**a** Large irregular black spots on a light background extending from head to tip of tail	*Ambystoma opacum*, marbled salamander
	b No large irregular black spots on a light background	Go to 8
8	**a** Round spots scattered along back and sides of body, tail flattened like a tadpole	*Triturus viridescens*, newt
	b Without round spots and tail not flattened like a tadpole	Go to 9
9	**a** Two dark lines bordering a broad light middorsal stripe with a narrow median dark line extending from the head onto the tail	*Eurycea bislineata*, two-lined salamander
	b Without two dark lines running the length of the body	Go to 10
10	**a** A light stripe running the length of the body and bordered by dark pigment extending downward on the sides	*Plethodon cinereus*, red-backed salamander
	b A light stripe extending the length of the body, a marked constriction at the base of the tail	*Hemidactylium scutatum*, four-toed salamander

Figure 2

3. Write the scientific name and the common name of salamander 1 on the appropriate line provided in Observations.

4. Repeat steps 1 through 3 with each salamander until all the animals have been identified.

Part B. Constructing a Classification Key

1. Study Figure 3, which shows some common North American wildflowers. As you study the drawings of various flowers, note different characteristics in flower shape, number of petals, and leaf number and shape.

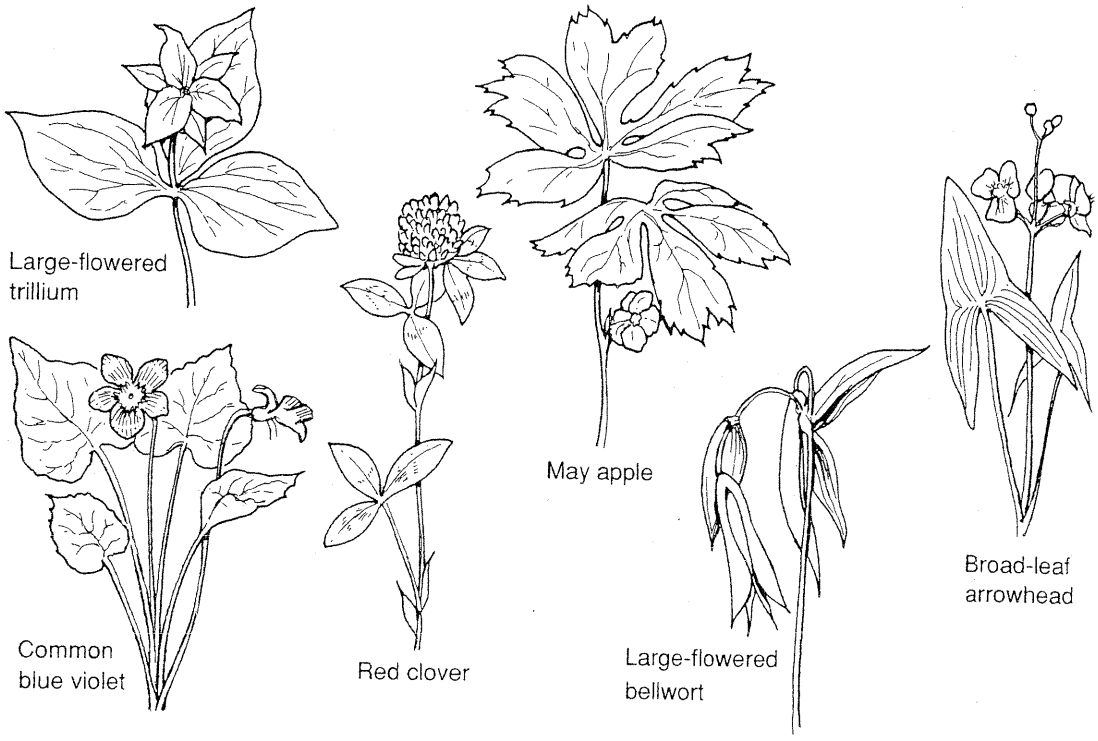


Figure 3

2. In the space provided in Observations, develop a classification key to identify each wildflower. Use the key to salamanders as a model for developing your wildflower key.

3. Check the usefulness of your wildflower key by letting another student see if he or she can use it to identify each pictured flower.

Observations

Part A. Using a Classification Key

Write the scientific and common names of each salamander in Figure 1 on the line that corresponds to its number.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Name _____ Class _____ Date _____

7. _____

8. _____

9. _____

10. _____

11. _____

Part B. Constructing a Classification Key

Use the space below to construct a wildflower classification key.

Wildflower Classification Key

Analysis and Conclusions

1. As you used the classification key to identify the salamanders, did you go from general to specific characteristics or from specific to general characteristics? _____

_____

2. What two groupings do the scientific names of the salamanders represent?

_____

3. Was the classification key you constructed exactly like those of other students? Explain why or why not. _____

_____

4. If you were using actual wildflowers, what other characteristics could you use to identify them? _____

_____

Critical Thinking and Application

1. Do you think that there may be some closely related species of organisms that cannot be identified with a classification key? Explain your answer. _____

_____

_____

_____

2. Why do you think biological classification keys always present two, rather than some other number, of choices at each step? _____

_____

_____

_____

3. What types of problems would scientists have today if Carolus Linnaeus had not developed his classification and naming system for organisms? _____

_____

_____

_____

4. Explain what is meant by the statement "Classification systems are the inventions of humans; diversity is the product of evolution." _____

_____

_____

Going Further

Use the key presented in this investigation as a model to construct a classification key to identify one or more of the following:

1. Instruments of a band or orchestra
2. Balls used in different kinds of sports (tennis ball, basketball, football, bowling ball, golf ball, and so on)
3. The students in your biology class

Name _____ Class _____ Date _____

Classifying Organisms Using Dichotomous Keys

One tool used to identify unfamiliar organisms is a dichotomous key. A dichotomous key is a series of paired statements that describe physical characteristics of different organisms. In this activity, you will use a dichotomous key to identify tree leaves.

Problem

How are dichotomous keys used and made?

Materials

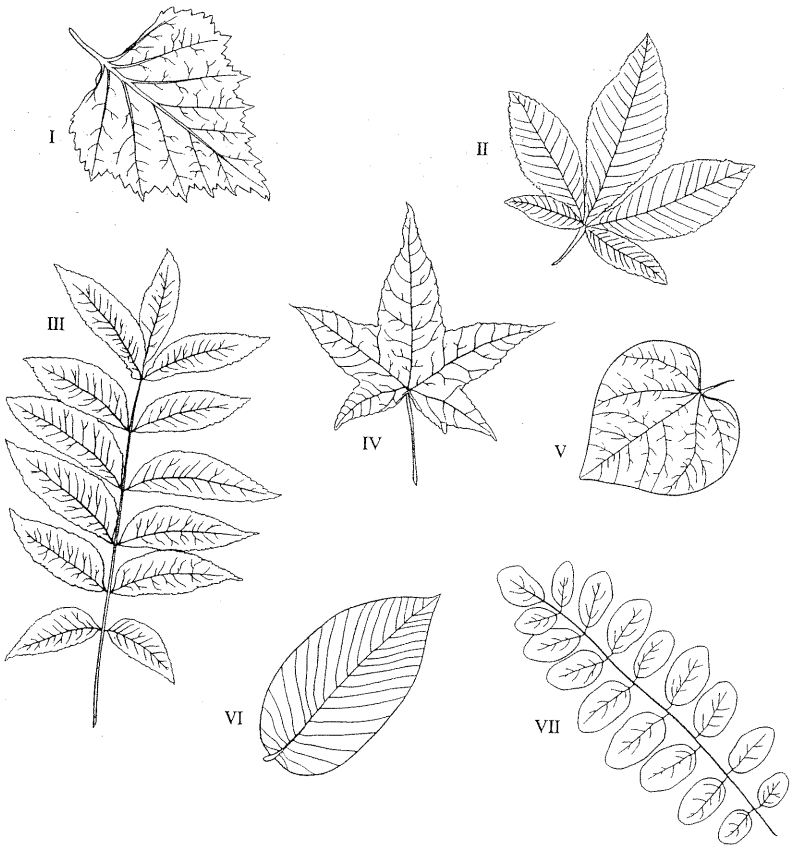
- 6–8 writing implements or other group of common items

Skills Observing, Classifying, Forming Operational Definitions

Procedure

Part A: Using a Dichotomous Key

1. To use the dichotomous key for leaves on page 231, begin by reading paired statements 1a and 1b. Notice that the statements are opposites.



Name _____ Class _____ Date _____

2. Carefully observe the leaf labeled I on page 230. Decide which statement, 1a or 1b, applies to this leaf. Then, follow the direction at the end of the statement. In other words, because the leaf is a simple leaf, go to step 4.
3. Continue reading the paired statements and following the direction at the end of the applicable statement until you determine the identity of leaf I. Include that information as part of your answer to question 1 on page 232.

Dichotomous Key for Leaves

1. Compound or simple leaf
   - 1a) Compound leaf (leaf divided into leaflets) .....go to step 2
   - 1b) Simple leaf (leaf not divided into leaflets) .....go to step 4
2. Arrangement of leaflets
   - 2a) Palmate arrangement of leaflets (leaflets all attached at one central point) .....*Aesculus* (buckeye)
   - 2b) Pinnate arrangement of leaflets (leaflets attached at several points) .....go to step 3
3. Leaflet shape
   - 3a) Leaflets taper to pointed tips .....*Carya* (pecan)
   - 3b) Oval leaflets with rounded tips .....*Robinia* (locust)
4. Arrangement of leaf veins
   - 4a) Veins branch out from one central point .....go to step 5
   - 4b) Veins branch off main vein in the middle of the leaf.....go to step 6
5. Overall shape of leaf
   - 5a) Leaf is heart-shaped.....*Cercis* (redbud)
   - 5b) Leaf is star-shaped .....*Liquidambar* (sweet gum)
6. Appearance of leaf edge
   - 6a) Leaf has toothed (jagged) edge .....*Betula* (birch)
   - 6b) Leaf has untoothed (smooth) edge .....*Magnolia* (magnolia)

4. Repeat steps 2 and 3 for leaves II through VII.

Part B: Constructing a Dichotomous Key

5. Examine the group of items your teacher gives you. List some characteristics that you could use to classify these items into groups.
6. Using the dichotomous key from Part A as a model, construct a dichotomous key for your group of items. You may wish to use some of the characteristics you listed in step 5 to construct your key. Make sure that the paired statements in your key are opposites.

Name _____ Class _____ Date _____

7. Once your dichotomous key is complete, test it with each item and revise your key, if necessary.
8. Exchange keys and items with a classmate. Use your classmate's key to identify his or her items. Then, suggest ways to improve that key.

Analyze and Conclude

1. **Classifying** In Part A, identify leaves I through VII.

2. **Applying Concepts** In Part B, how did you choose the characteristics for your key? How did you decide on the key's order?

3. **Evaluating and Revising** Based on your classmate's feedback, does the key you developed in Part B need to be revised? If so, how?

4. **Inferring** Why is it important that the paired statements in a dichotomous key be opposites?