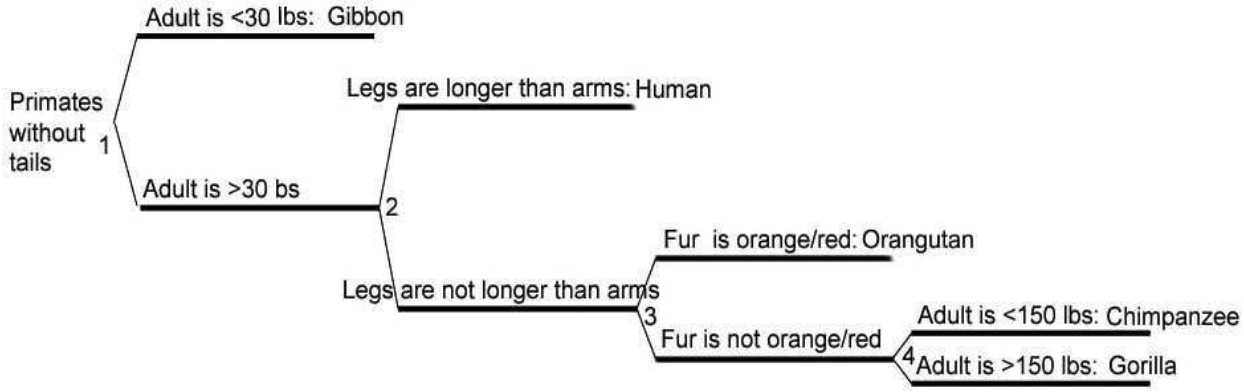
Using a Dichotomous Key to Identify Flowers (and the murderer)

Adapted and Excerpted from "Constructing a Dichotomous Key" by Margaret Bankhead of Robert A. Black Magnet School, "Making a Dichotomous Key" in Johnson and Raven's Biology, 2002, and "Flowers for Freddy" © 2001 Carolina Biological Supply Company by Dr. Jennifer Doherty and Dr. Ingrid Waldron, Department of Biology, University of Pennsylvania © 2010[1]

In this activity, you will first learn how to make and use a dichotomous key and then use a dichotomous key for flowers to identify who murdered the crime boss, Tony.

When a biologist wants to identify a plant or animal they have found, they often use an identification key which contains the major characteristics of groups of organisms. A **dichotomous key** is one type of identification key. The term dichotomous means "divided into two parts or categories". Dichotomous keys are constructed of pairs of descriptions that contrast two categories of a characteristic such as size or color. After each category description, the key either directs the user to another pair of descriptions or identifies the plant or animal.

Below is an example of a dichotomous key for the primate species most closely related to humans, the primates without tails. The diagram of the key shows the sequence of dichotomies that allows identification of each group of these primates.



The list shown below is another way of presenting the same dichotomous key.

1. Adult is <30 lbs.....**Gibbon**
1. Adult is >30 lbs.....Go to 2
  2. Legs are longer than arms .....**Human**
  2. Legs are not longer than arms.....3
    3. Fur is orange/red .....**Orangutan**
    3. Fur is not orange/red.....4
      4. Adult is <150 lbs.....**Chimpanzee**
      4. Adult is >150 lbs.....**Gorilla**

A dichotomous key is just a convenient way to identify which specific animal or plant you have. It does not indicate evolutionary relationships. For example, you should not interpret this key to mean that chimpanzees are most closely related evolutionarily to gorillas. On the contrary, chimpanzees and humans have a more recent shared

[1] Teachers are encouraged to copy this student handout for classroom use. A Word file, which can be used to prepare a modified version if desired, and Teacher Preparation Notes are available at http://serendip.brynmawr.edu/sci_edu/waldron/.

evolutionary ancestor than chimpanzees and gorillas.
A dichotomous key can be written for any group of objects. You will work with members of your group to design a dichotomous key for shoes.

1. Everyone should take off one shoe and place it in the center of the table. As a group, divide the shoes on the table into two piles that differ in some obvious characteristic that distinguishes the shoes in one pile from the shoes in the other pile. (The piles do not have to have exactly equal numbers of shoes.)

   After you agree on the distinguishing characteristic, record the two categories of the distinguishing characteristic on the first two horizontal lines on the chart on page 3.

2. Push one pile of shoes to the side. For the other pile, choose a second distinguishing characteristic to divide this pile into two distinct piles. Record the categories of the second distinguishing characteristic on the chart.

   Continue the procedure of dividing the shoes into two distinct piles and adding the information to the chart until you reach a category that has only one shoe. This shoe is now identified; add the owner's name to the chart. Continue until each shoe in the first pile has been identified and entered in the chart.

3. Divide the second pile of shoes in the same manner as the first pile until all the shoes have been identified.

4. Dichotomous keys usually appear in an equivalent, more compact list form, as shown on the bottom of page 1. The shoe chart you constructed can be easily converted by adding numbers to the fork of each characteristic used and creating a list of description pairs. Label the chart in numerical sequence following the same order the characteristics were written down. In the space provided on page 4, create a list dichotomous key for the shoes.

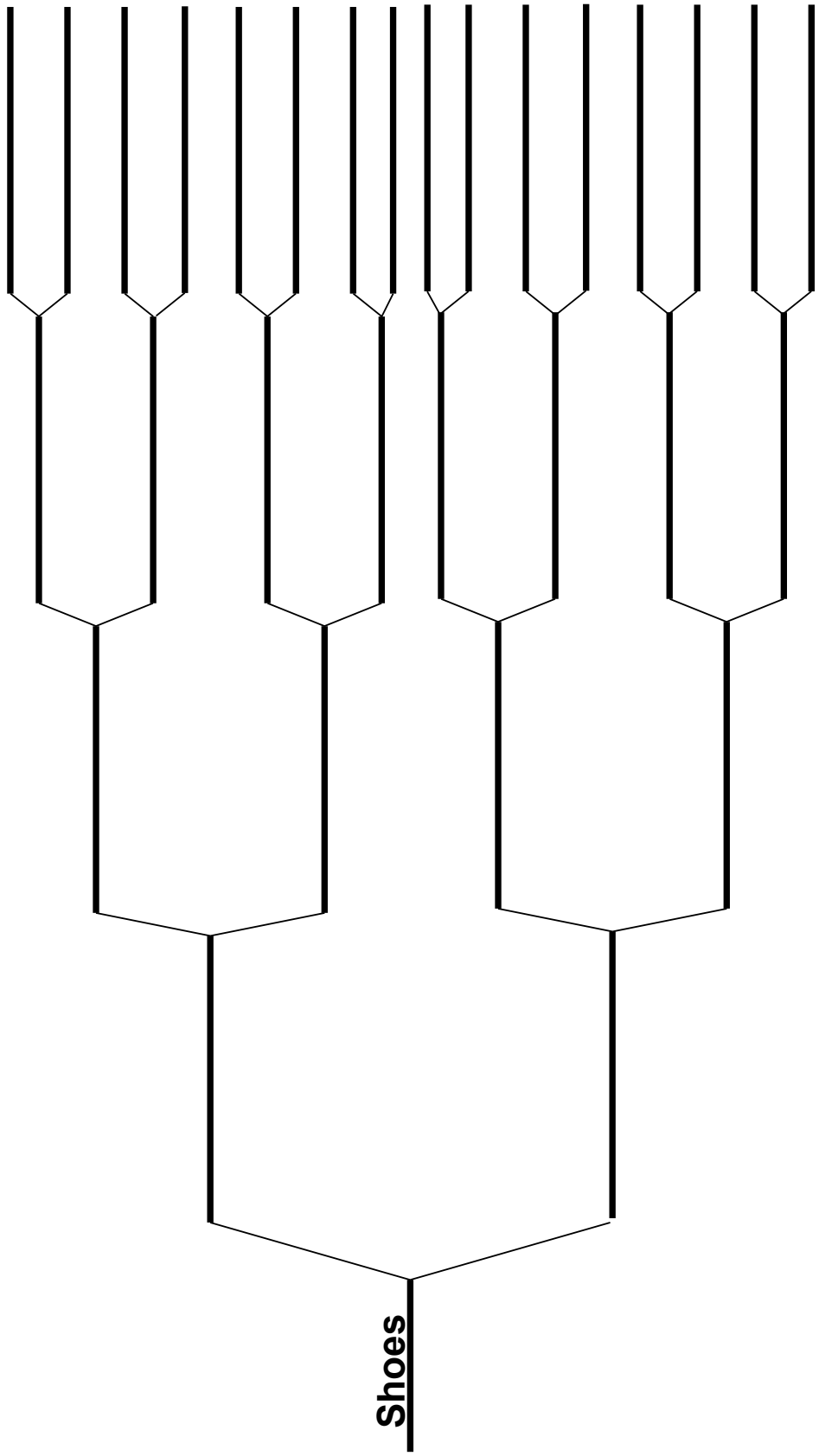
5. Push all the shoes back together in one pile. Grab a shoe randomly from the pile. Use the key to identify who the shoe belongs to and return it to its owner.

6. Obtain a shoe from another group. Try to identify who's shoe it is using the key you created. Can you correctly identify an item that was not used in a key's original construction?

   Why is this so?

   There are more than 90,000 species of insect in the United States. Do you think it would be more difficult to create a dichotomous key for all the insects in the United States than it was for the shoes in your group? Why do you think so?

   Do you think it is important to be able to identify all the insects in the United States? Why or why not?


Shoes

Shoe Identification Key

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Who murdered Tony?

Tony Turnip, a local crime boss, was found dead in the locked service area behind his restaurant. When the police detectives arrived, the victim was found on his back, hands placed over his abdomen in a position of repose, like a body in a casket. The lack of blood and the statements of witnesses who heard no gunshots suggest that the crime was committed elsewhere.

Several local business owners had keys to the service area because they sold supplies to the restaurant, and several also owed Tony large amounts of money. Tommy Ato grows and supplies fresh fruits and vegetables. Carl VonLinne runs a greenhouse/flower shop and supplies centerpieces. Juan Esperanza runs a nursery and recently redid the tree and shrub landscaping at the restaurant.

A Crime Scene Investigator found a number of flowers under the victim and in his clothing. Our forensics lab has been asked to examine and identify the flowers and to determine the likely location of his shooting death, in the hope that this information will implicate one of the suspects.

You and your partner will examine the flower specimens carefully and use the identification key and flower descriptions to evaluate the suspects. Keep one flower whole to serve as a reference while dissecting the other. Your teacher will tell you how many different species of flower you will dissect and identify.

1. Measure the length (cm) of your flower and record the information in the table below.

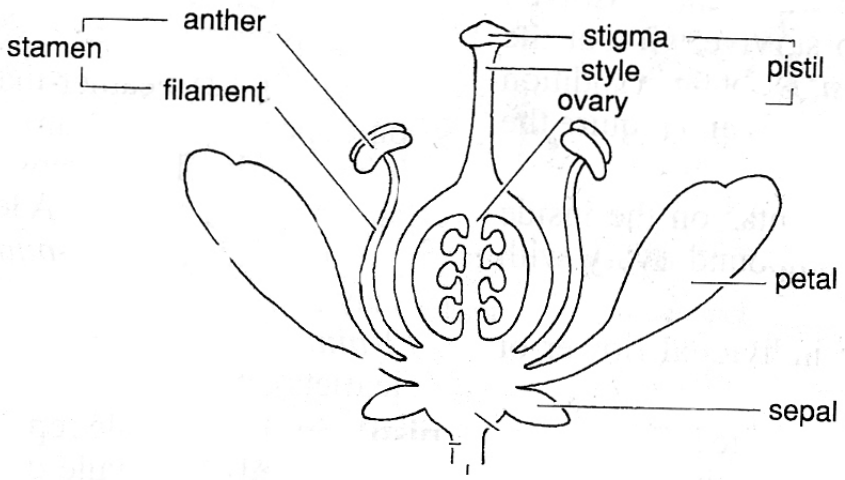
2. **Sepals** are the outer leaf-like structures of a flower. They are usually green but sometimes they are similar in color to the petals. Gently remove each of the sepals and record the number in the table below. You can refer to the labeled figure below for help in identifying structures.

3. **Petals** are the inner leaf-like structures of a flower. They are usually showy. Continue with the petals, treating them as you did the sepals. Gently remove each of the petals and record the number in the table below. If the petals are fused into a tube, slit the tube and try to remove it in as few pieces as possible. Why do you think flowers have petals?

4. **Stamens** are the male reproductive organs of a flower. The top of the stamen is called the **anther**. The anthers produce **pollen**, the male gametes, and are held up by stalks called **filaments**. Gently remove each of the stamens and record the number in the table below.

5. The remaining part(s) in the center should be the **pistil(s)**. The pistil is the female reproductive organ of the flower. Pollen lands on top of the pistil, which is called the **stigma**. The stigma is held up by the style. The bottom portion of the pistil, where seeds develop, is called the **ovary**. The ovary can usually be identified by following the style towards the stem. The ovary is the swelling at the bottom of the style. Record the number of pistils.

Flower Species	1	2
Length of Flower (cm)		
Number of Sepals		
Number of Petals		
Number of Stamens		
Number of Pistils		



6. Use the Flower Identification Key below to identify the genera of the flowers that were found on Tony's body.

7. Use the Flower Genera Descriptions on page 7 to determine if these flowers would most likely have come from a nursery for trees and shrubs, a vegetable farm, or a greenhouse/flower shop. Write a brief report for the Crime Scene Investigator explaining the identification of the flowers and the implications with regard to any of the suspects.

Flower Identification Key Be sure to consider all the options before choosing the one that best reflects the flower under consideration.

1. The flowers have 3, 6, or 9 petals and sepals 2
1. The flowers have other than 3, 6, or 9 petals and sepals 7
  2. The flowers have many stamens ..... **Podophyllum**
  2. The flowers have 6 or fewer stamens 3
    3. The flowers are <2 cm long ..... **Allium**
    3. The flowers are >2 cm long 4
      4. The filaments are as thick as the anthers ..... **Yucca**
      4. The filaments are much thinner than the anthers 5
        5. The stamens are >6 cm long ..... **Hemerocallis**
        5. The stamens are <6 cm long 6
          6. The flower is <10 cm long ..... **Alstroemeria**
          6. The flower is >10 cm long ..... **Amaryllis**
7. The petals are fused together a least in part, to form a tube 8
7. The petals are completely free from one another ..... **Opuntia**
  8. The petal tube is radially symmetrical 9
  8. The petal tube is bilaterally symmetrical 12
    9. The flowers are imperfect, having only stamens or only pistils ..... **Cucumis**
    9. The flowers are perfect, having both stamens and pistils 10
      10. The petal tube has 4 lobes or sections ..... **Oenothera**
      10. The petal tube has 5 lobes or sections 11
        11. The petal tube is hairy ..... **Nicotiana**
        11. The petal tube has no hairs ..... **Ipomoea**
          12. There are exactly 5 anthers ..... **Rhododendron**
          12. There are more than 5 anthers enclosed in fused petals ..... **Pisum**
          12. There are 4 anthers 13
            13. The anthers are free of the tube, and the flower is >1 cm long **Antirrhinum**
            13. At least 2 anthers are attached to the tube, flower is <1 cm long .. **Prunella**

Flower Genera Descriptions

Allium. Onion; a plant grown for the edible, fleshy underground leaves.
Alstroemeria. Peruvian lily; a plant grown for its showy flowers.
Amaryllis. Amaryllis; a plant grown for its showy flowers.
Antirrhinum. Snapdragon; a plant grown for its distinctive flowers.
Cucumis. Cucumber; a vine grown for its fruit.
Hemerocallis. Daylily; an plant grown for its showy flowers.
Ipomoea. Morning-glory; a vine sometimes grown for the showy flowers, but also a common weed along edges of fields.
Nicotiana. Tobacco; this genus includes both the cultivated tobacco and some ornamental flowers.
Oenothera. Evening-primrose; some species are grown for flowers, others are weeds.
Opuntia. Prickly-pear cactus; a succulent grown as an ornamental and for the fruit.
Podophyllum. May-apple; a plant found in forests.
Prunella. Heal-all; a plant that commonly grows as a weed.
Rhododendron. Rhododendron, azalea; a shrub grown as a landscape ornamental.
Yucca. Yucca; a tree that is commonly grown as a landscape ornamental.

Glossary

Anther. The portion of the stamen that contains the pollen.
Bilateral. Symmetrical in only one longitudinal plane, e.g., a human.
Dichotomous. Branching in two directions.
Filament. The portion of the stamen that supports the anther.
Fused. Describes flower parts that have grown together.
Genus (plural is genera). Level of classification that comes after family and that contains similar species
Imperfect. Describes a unisexual flower, one that lacks either stamens or pistils.
Ovary. The bottom portion of the pistil where seeds develop, generally swollen in comparison to the style.
Perfect. Describes a bisexual flower, one that has both stamens and pistils.
Petal. One of the inner leaf-like structures, usually showy.
Pistil. The female organ of a flower, comprised of the ovary, style, and stigma.
Radial. Symmetrical in more than one longitudinal plane, often circular; e.g., daisy.
Sepal. One of the outer leaf-like structures, usually green.
Stamen. The male organ of a flower, comprised of the filament and anther.
Stigma. The exposed end of the pistil to which the pollen adheres; may be lobed or divided.
Style. The portion of the pistil that supports the stigma, through which the pollen tubes grow.
Succulent. Describes plants that are very fleshy; e.g. cactus