



Dichotomous keys

Dichotomous keys are one of the most powerful identification tools available to field botanists. In this session, you will learn how to write a dichotomous key to a few objects. Once you know how to write a dichotomous key, you will be able to start using them. An alternative approach would be to start using them before starting to try and write one. Eventually, BKS will offer both approaches.

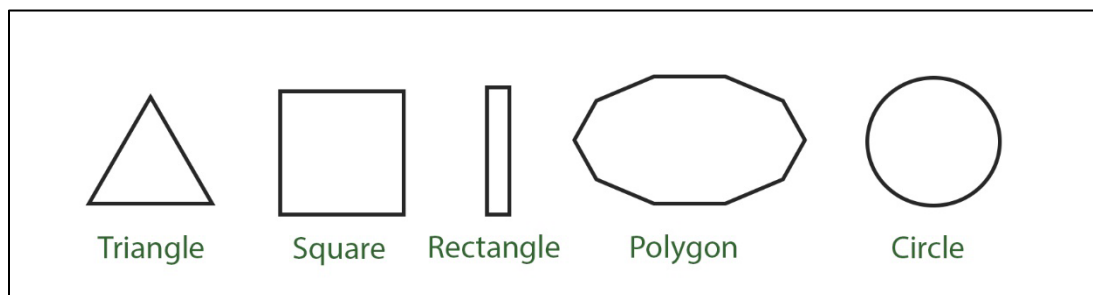
What is a dichotomous key?

A dichotomous key consists of a series of steps. At each step, the user must decide between **two** choices. At the end of each step, either each choice contains only one object or one or both leads to a group with more than one object. Any group that contains more than 1 object must be divided into two groups again, and this must be repeated until each choice results in a group of 1 object. The number of steps required depends on the number of plants/objects to be identified and the choices made. “Di-“ in dichotomous refers to this restriction to two choices.

One **must** follow the steps of a key in the order they are presented. Jumping around is fatal!

Getting started

In class, you will work in small groups. Each group will be given 5 different plants. The group’s task is to write a key for identifying them. The instructions below walk through the process using 5 shapes instead of 5 plants. The shapes, and their names, are shown in the box below.



Step 1

Decide how to divide the five shapes into two sets and then write two SHORT statements describing which shapes go into each set.

There are many ways the five shapes can be divided into two groups. Two examples are described below.

Example 1

Choices: Group 1- Triangles
Group 2: Squares, Rectangles, Polygons, Circles

Statements: Group 1 Shapes with 3 straight sides
Group 2: Shapes with more than 3 straight sides or with no straight sides

Example 2

Choices: Group 1: Triangles, Squares, Rectangles
Group 2: Polygons, Circles

Statements: Group 1: Shapes with 3 or 4 straight sides
Group 2: Shapes with more than 4 straight sides or no straight sides

Converting these statements into the first step of a key is straightforward. Each pair forms the first lead of the key so each of the two statements will be numbered "1" (some printed keys use 1a and 1b or 1 and 1'). They appear below as they would be written in a key.

Example 1

- 1 Shapes with 3 sides Triangles
- 1 Shapes with more than 3 straight sides or no straight side [4 shapes, need another lead]

Example 2

- 1 Shapes with 3 or 4 straight sides [3 shapes, need another lead]
- 1 Shapes with more than 4 straight sides or no straight sides [2 shapes, need another lead]

Step 2

Any group that includes more than one shape must be divided into two groups again and again until each group includes only one member. Each pair of choices is called a lead. Each half of a lead EITHER takes you to a single answer OR tells you which the next lead is that you should go to. The explanation below shows how this would work for example 1. Here is how the key starts:

- 1 Shapes with 3 sides Triangles
- 1 Shapes with more than 3 straight sides or no straight side [4 shapes, need another lead]

There is one group of 4 objects that needs to be divided into 2 groups. Again, there are many ways this could be done. The following is 1 way:

Choices: Group 1: Squares, Rectangles, Polygons
Group 2: Circles

Statements: Group 1: Shapes with some straight sides [Squares, Rectangles, Polygons]
Group 2: Shapes with no straight sides [Circles]

The first group is going to need to be divided again because it includes more than one shape but first, let's look at how to add this second step to the key. We have the first set of leads. Now the second set needs to be added. Each part will start with the number "2". The key will look like this:

- 1 Shapes with 3 sides Triangles

- 1 Shapes with more than 3 straight sides or no straight side..... [4 shapes, need another lead]
- 2 Shapes with no straight sides.....Circles
- 2 Shapes with some straight sides[3 shapes, needs another lead]

The statement that leads to a group with 1 member, Circles, is listed first because it is easier to add the additional statements needed to sort out the group of 3 at the end.

One more change should be made before dividing the group of 3. In the first lead, the choice that says the second choice leads to 4 shapes and needs another lead should be replaced with the number of the next lead, 2. The key will now look like this:

- 1 Shapes with 3 sides Triangles
- 1 Shapes with more than 3 straight sides or no straight side..... 2
- 2 Shapes with no straight sides.....Circles
- 2 Shapes with some straight sides[3 shapes, needs another lead]

Now to split that group of three. Let's pull out the Polygons as one "group", leaving the other two for the next lead.

- 1 Shapes with 3 sides Triangles
- 1 Shapes with more than 3 straight sides or no straight side..... 2
- 2 Shapes with no straight sides.....Circles
- 2 Shapes with some straight sides[3 shapes, needs another lead]
- 3 Shapes with more than 4 straight sides Polygons
- 3 Shapes with 4 straight sides[2 shapes, needs another lead]

Replace the "[3 shapes, needs another lead]" with 3, the lead with the next pair of choices and then add lead 4, the choices that will separate "Square" from "Rectangle". It will be lead 4. Leads always increase by 1. The result is shown below.

- 1 Shapes with 3 sides Triangles
- 1 Shapes with more than 3 straight sides or no straight side..... 2
- 2 Shapes with no straight sides.....Circles
- 2 Shapes with some straight sides 3
- 3 Shapes with more than 4 straight sides Polygons
- 3 Shapes with 4 straight sides 4
- 4 Shapes with all 4 straight sides of the same lengthSquares
- 4 Shapes in which the straight sides are of 2 or more different lengths Rectangles

Notice that there are three parts to each lead: a number, a statement, and an answer OR the number of the next lead to go to. Notice also that each statement starts by stating what to look at. This becomes important when writing keys for plants and other organisms which are more complicated than the simple shapes used in this explanation.

Question: How would the key above work with this shape?



Example 2

In example 2, both halves of the first lead (pair of choices) led to a group with more than one member. This means each half of the lead will have to direct the user to at least one more lead. It is customary to place the choice leading to the smallest group first, sort it out, and then go to the second choice of the first lead and sort it out. Here is the first lead, rewritten to put choice leading to the smaller group first. I have also listed the names of the shapes in each group, just for convenience.

- 1 Shapes with more than 4 straight sides or no straight sides [2 shapes, Polygons, Circles]
- 1 Shapes with 3 or 4 straight sides..... [3 shapes, Triangles, Squares, Rectangles]

Separating 2 items into two groups of 1 item each is easy but notice the numbering of the leads. This will become slightly tricky when sorting out the group of 3

- 1 Shapes with more than 4 straight sides or no straight sides 2
- 1 Shapes with 3 or 4 straight sides..... [3 shapes, Triangles, Squares, Rectangles]
- 2 Shapes with more than 4 straight sides Polygons
- 2 Shapes with no straight sides..... Circles

The next lead will start the process of splitting up the group of three. It will be lead number 3. It cannot be numbered 2 because there is already a lead with that number. It is also important to tell the user who selects the second choice of lead 1 that they need to go next to lead 3, NOT lead 2. The key below shows how this is done.

- 1 Shapes with more than 4 straight sides or no straight sides 2
- 1 Shapes with 3 or 4 straight sides..... 3
- 2 Shapes with more than 4 straight sides Polygons
- 2 Shapes with no straight sides..... Circles
- 3 Shapes with 3 straight sides Triangles
- 3 Shapes with 4 straight sides [2 shapes, need another lead]

Now one more lead is needed to separate the two shapes that come out on the second of lead 3's two choices. The number of the lead will be the next unused number, 4. This is how the finished key will look.

- 1 Shapes with more than 4 straight sides or no straight sides 2
- 1 Shapes with 3 or 4 straight sides..... 3
- 2 Shapes with more than 4 straight sides Polygons
- 2 Shapes with no straight sides..... Circles
- 3 Shapes with 3 straight sides Triangles
- 3 Shapes with 4 straight sides 4
- 4 Shapes with 4 sides of equal length Squares
- 4 Shapes with sides of two different lengths Rectangles

EXERCISE

Think of yet other ways to make the first split of the 5 shapes. How many ways can it be done (the mathematically inclined may know the answer)?

Which do you think is the best initial lead? Why?