Teacher Guide: Dichotomous Keys

Learning Objectives

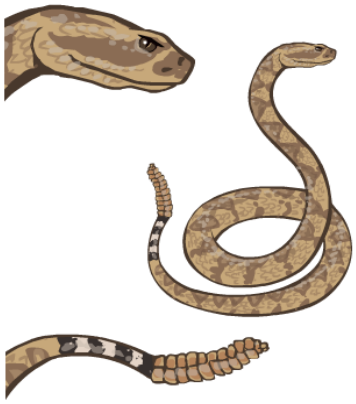
Students will …

- Use five different dichotomous keys to identify a variety of organisms.
- Explain how dichotomous keys are used to identify organisms.
- Construct a dichotomous key that can be used to identify a group of organisms.

Vocabulary

dichotomous key, genus, organism, scientific name, species, trait

Lesson Overview



Scientists estimate there are about 9 million different species in the world. So, as you can imagine, it is impossible for any one person to recognize every species they come across. As a result, scientists have developed several different tools that can be used during field investigations to identify unknown organisms. One common tool is a dichotomous key. The *Dichotomous Keys* Gizmo™ allows students to practice observing unfamiliar organisms and using dichotomous keys to identify them.

The Student Exploration sheet contains three activities:

- Activity A – Students learn how to use a dichotomous key.
- Activity B – Students use dichotomous keys to identify buttercups, venomous snakes, evergreens, and cartilaginous fish.
- Activity C – Students design their own dichotomous keys to identify sets of organisms.

Suggested Lesson Sequence

1. **Pre-Gizmo activities** (15 – 30 minutes)

   Tell students you are going to play a game of twenty questions. Place a common classroom object, such as a pencil, stapler, or book, in an opaque box. Tell students they can ask you up to 20 yes/no questions in an attempt to identify the object.

   After playing the game and revealing the object, discuss with students how they used their questions to help identify the object. Help students recognize that they used traits the object potentially had to narrow down the possibilities. This is very similar to how dichotomous keys use sets of yes/no questions or statements to identify an organism.

   In addition to the above activity, you may want to present students with several sets of photos of two different, but similar, species. For each set of photos, have students compare and contrast the organisms pictured. Discuss how specific traits can be used to distinguish each species.

2. **Prior to using the Gizmo** (🕒 10 – 15 minutes)
Before students are at the computers, pass out the Student Exploration sheets and ask students to complete the Prior Knowledge Questions. Discuss student answers as a class, but do not provide correct answers at this point. Afterwards, if possible, use a projector to introduce the Gizmo and demonstrate its basic operations. Demonstrate how to take a screenshot and paste the image into a blank document.

3. **Gizmo activities** (🕒 15 – 20 minutes per activity)
Assign students to computers. Students can work individually or in small groups. Ask students to work through the activities in the Student Exploration using the Gizmo. Alternatively, you can use a projector and do the Exploration as a teacher-led activity.

4. **Discussion questions** (🕒 15 – 30 minutes)
As students are working or just after they are done, discuss the following questions:

   - How can a dichotomous key be used to identify an organism?
   - Did you have any difficulties using the dichotomous keys? If so, describe how you overcame those issues.
   - Why is it important to be able to identify venomous snakes?
   - What do you think are some limitations of dichotomous keys? Do you think a dichotomous key would be useful to use on a group containing several hundred organisms?
   - Do you think a dichotomous key can tell you how closely related species are to one another? [Dichotomous keys may sometimes organize closely related species into the same group, but this is not the purpose of a dichotomous key. Usually, the traits used by dichotomous keys are not indicative of how closely related species are to one another.]
   - What are some other ways that could be used to identify unfamiliar organisms?

5. **Follow-up activities** (🕒 variable)
Have each student choose a set of 10–20 organisms found in a local ecosystem. The set should be comprised of similar organisms such as wildflowers, freshwater fish, hardwood trees, songbirds, butterflies, etc. Make sure students do not replicate organisms included in another student's set. Ask students to create a dichotomous key that could be used to identify all the organisms in their set. Combine all the students' dichotomous keys together into a printed or electronic field guide for your local ecosystem. Organize students into groups. Take the class to a park or natural area and instruct each group to try to identify as many organisms as possible using the class field guide. They should take a photo of each identified organism. Give a reward to the group that identifies the most species.

   If you want to give students further practice using dichotomous keys, obtain several owl pellets and have your students separate out the bones found in the pellets. Students then can use a dichotomous key to identify the remains of each type of animal. You can find a dichotomous key for mammalian bones typically found in owl pellets in the **Selected Web Resources** on the next page.

Scientific Background

The word *dichotomy* means to divide something into two parts or groups. Thus, a *dichotomous key* is a tool used to divide organisms into smaller and smaller groups until an individual organism can be identified. This division is done by using a series of paired statements or questions. Each statement is mutually exclusive, meaning only one of the two statements can apply to an organism. For example, a statement pair might be:

The organism has wings.
The organism does not have wings.

Only one of these statements will be correct for any organism you are examining. When you select the statement that correctly describes the organism in question, either you will be given a set of instructions, such as "Go to statement set 2," or you will be given the correct identity of the organism. Here is an example of a simple dichotomous key:

Types of Vertebrates

1	a. The organism has jaws.	Go to 2.
	b. The organism lacks jaws.	Lamprey or hagfish
2	a. The organism's skeleton is composed of cartilage.	Shark, ray, or skate
	b. The organism's skeleton is composed of bone.	Go to 3.
3	a. The organism has gills.	Bony fish
	b. The organism has lungs.	Go to 4.
4	a. The organism reproduces using an amniotic egg.	Go to 5.
	b. The organism reproduces using jelly-like eggs.	Amphibian
5	a. The organism lays eggs with shells.	Go to 6.
	b. The organism has hair.	Mammal
6	a. The organism has scales.	Reptile
	b. The organism has feathers.	Bird

Dichotomous keys are very important tools to most biological field investigations. In order to study organisms, communities, and ecosystems, scientists must be able to identify and classify individual organisms. Often, identifying a particular organism is a difficult task. Many closely related species, such as the 60+ species of opossums found in South America, look almost identical. In addition, many species practice mimicry in order to resemble a poisonous or aggressive species. In situations such as these, dichotomous keys are particularly useful for positively identifying an organism found in the wild.

Selected Web Resources

Dichotomous key information:
http://www.mdsg.umd.edu/programs/education/interactive_lessons/key/index.htm
Dichotomous key activities: http://sciencespot.net/Media/sillysci.pdf,
http://www.lnhs.org/hayhurst/ips/dichot/
Dichotomous key for trees, insects, etc: http://dnr.wi.gov/org/caer/ce/eek/veg/treekey/index.htm,
http://www4.uwsp.edu/cnr/leaf/Treekey/tkframe.htm, http://www.insectidentification.org/insect-key.asp, http://www.kidwings.com/teacher/owlpellets/dichotomouskey.htm,
http://www.amnh.org/learn/biodiversity_counts/ident_help/Text_Keys/arthropod_keyA.htm