The Invasive Shoe!

Create and Use a Dichotomous Key

Summary

Students take their shoes off to team-up and design dichotomous keys. An "invasive" shoe adds a twist to their work to teach about non-native aquatic species in Vermont.

Objectives

- To differentiate parts of a whole for identification purposes.
- To discover why dichotomous keys are essential tools for scientists.
- To apply dichotomous keys to identify native and non-native species.
- To understand why non-native, aquatic invasive species pose problems for Vermont lakes.

Vermont Standards

7.13 The Living World

7.16 Natural Resources and Agriculture

3.9 Sustainability

Chapter Connections: *All About Vermont Lakes*, Chapter 5, *How Our Lakes Are Changing*

Background

Taxonomy is the area of biological sciences that classifies living things according to apparent common characteristics, such as grouping plants apart from animals. Taxonomy starts with very general characteristics and becomes more and more specific. Dichotomous keys are used to identify plants and animals down to the species level. A species is a group of organisms at the base of the biological classification system that look alike, are capable of interbreeding, but are not able to breed with members of another species.

Scientists developed dichotomous keys to determine the type of and name of all living species. Additionally, scientists rely on dichotomous keys to determine the origin of a species. Dichotomous keys lead to the name of a species by asking questions about that species that have only one of two answers. The word dichotomous means "divided or dividing into two sharply distinguished parts." A dichotomous key uses characteristics of a species to single out its identification.

An excellent aquatic plant manual, designed as a dichotomous key, that can be used to identify species found in Vermont lakes is *Aquatic and Wetland Plants of Northeastern North America* by Garrett E. Crow and C. Barre Hellquist. This book is a revision of Norman Fassett's *A Manual of Aquatic Plants* and written for multiple users, including students as well as professional scientists. These manuals show helpful pictures, but follow the dichotomous key premise in having to choose between two possible characteristics to narrow down the true species identity. Vegetative and sometimes flowering and fruit parts must be examined to distinguish slight differences that ultimately belong to differing species.

The terms **exotic** and **non-native** are used interchangeably. Non-native refers to species that were not living in Vermont before European settlement, about 400 years ago or since the 1600s. Once North America was discovered by the Europeans, trade routes were established and with trade and travel came the introduction of new species, including apple trees and earth worms. These species, like many other non-natives do not compete with the native species and have not threaten Vermont's ecology.

Nuisance species cause trouble in our daily lives. These species often interfere with recreation, have negative economic impacts, and cause health issues. Native and non-native species can be considered nuisance species. For example, common waterweed, *Elodea canadensis,* is native to Vermont lakes but can grow fast and form thick mats that interfere with boating, fishing and swimming activities. When a species is both non-native and a nuisance we consider it an **invasive species**.

In many instances invasive species take over wide areas and disrupt the natural ecosystem. Some invasive aquatic plants in Vermont, like Eurasian watermilfoil, *Myriophyllum spicatum*, and water chestnut, *Trapa natans*, have caused severe changes to the ecology and recreational enjoyment of lakes.

Although the impact from "life styles" is very different, sometimes native and invasive species can look remarkably similar. Under the classification of the estimated 5 million living species on earth, dichotomous keys are used to help correctly identify one species from another, especially when they can look alike, but behave so differently.

Today in Vermont, may non-profit groups like the Lake Champlain Basin Program and the Nature Conservancy partner with locals and the state to prevent or reduce the environmental and socio-economic impacts of aquatic invasive plant and animal species. The species that pose the greatest threat to our beautiful lakes in Vermont are shown on the right.

Waterchestnut (*Trapa natans*) is a glossy, green, triangular-leaved plant that chokes the waterbodies it invades; out-competes native plants; and reduces oxygen levels which can increase the potential for fish kills. Dense, nearly impenetrable water chestnut growth can make fishing, hunting, swimming, boating, and other recreational activities impossible. Its sharply spined fruits wash ashore and can hurt if stepped on.

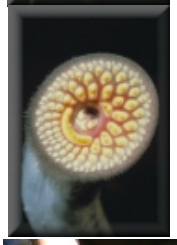
Variable-leaved watermilfoil (*Myriophyllum heterophyllum*) is a rooted, submerged perennial plant that was first confirmed in a Vermont water in 2008. Like its cousin Eurasian watermilfoil, variable-leaved watermilfoil is aggressive and grows rapidly.

Eurasian watermilfoil (*Myriophyllum spicatum*) is a stringy, submerged plant that quickly proliferates. It is highly invasive and aggressively competes with native plant communities reducing biodiversity. Dense mats clog propellers; impair swimming; restrict boating and fishing accesses; and affect water quality.

Rusty crayfish (*Orconectes rusticus*) can be identified by their robust claws with black bands on the tips, and dark, rusty spots on each side of their carapace (body). They can out-compete native species, forcing native crayfish from daytime hiding areas and destroying aquatic plant beds. They have likely been spread into numerous waterbodies in Vermont by anglers using them for bait.

Zebra mussels (*Dreissena polymorpha*) are small barnacle-like mollusks. They have caused some very serious economic and environmental problems in many areas. They are highly prolific and able to form dense colonies out-competing native species. They feed by filtering plankton out of the water which impacts water clarity and alters the food web.

Alewife (Alosa pseudoharengus) is a marine fish from the herring family capable of surviving in freshwater. They reproduce quickly and can soon become the most dominant fish species in a lake. They are very efficient feeders and consume huge quantities of zooplankton which enable them to out-compete other species.



Lamprey (*Petromyzon marinus*) is a parasitic fish resembling an eel. It is negatively impacting recreational fisheries in Lake Champlain.

Spiny waterflea (Bythotrephes cederstroemi) is a half inch long crustacean with a long, sharp, barbed tail spine. It's likely to compete for zooplankton food with young perch and other small fish.

Didymo or "rock snot" (*Didymosphenia geminata*) is a non-native algae (diatom) species capable of forming thick nuisance mats on river and stream bottoms with potentially significant impacts to fisheries and other habitat. It also could potentially impact lakeshore waters.

The Activity

Materials Needed:

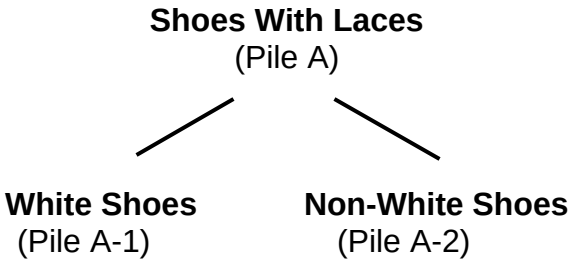
- shoes
- white board or flip chart
- markers

Get started

Start with all students sitting around in a circle. Ask the kids to take off their right shoe. Pile all the shoes in the middle of the circle. Ask one of the students to be the writer on the board. Have the students divide the pile of shoes in half based on an obvious characteristic that everyone agrees on. For example, in one pile place all the shoes with laces and in the other pile, put all the remaining shoes. Record the characteristic used to separate the two piles on the board.

Pile A——— Shoes With Laces
Pile B——— Shoes Without Laces

Now return to one of the piles and divide it into two piles based on another obvious characteristic. For example, if using color, the shoes that are white versus non-white can be divided into two piles. Once again, record the characteristic used on the board.



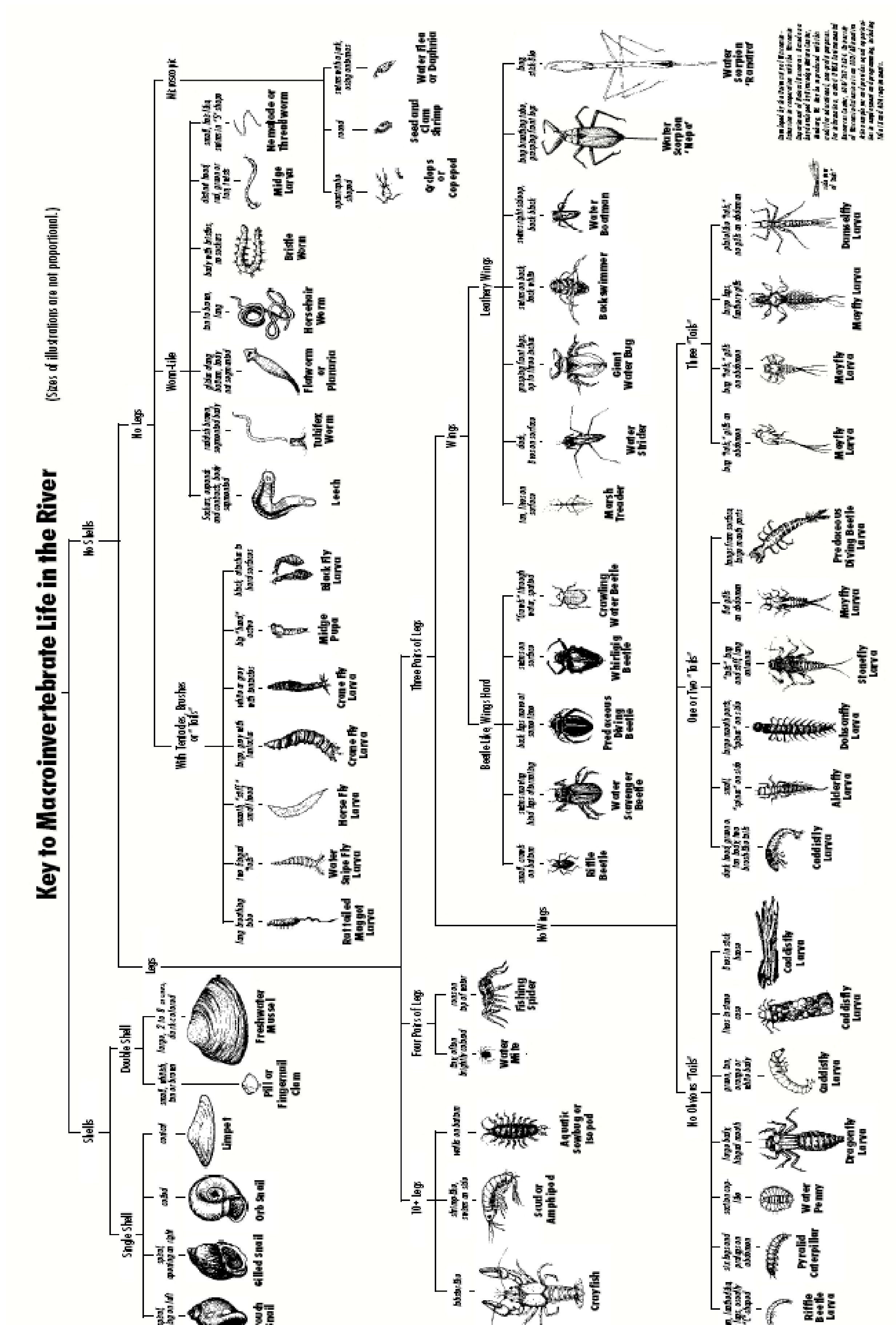
Continue dividing the shoes from all piles. It may work best to split students into two groups, where one group takes Pile B shoes and the other Pile A shoes. The shoes get divided by specific characteristics until all have been "classified" according to their own unique features (rubber soles, leather, laces, stripes, sandals, sneakers, velcro, etc.). When there is only one shoe left, then it is time to "name" that shoe.

Name the last shoe by its owners name. Then name all the other shoes by their owner's name. The chart should list all the names of the students under a specific characteristic. This is a completed dichotomous shoe key!

To check if the dichotomous key works, have the two groups swap their charts and piles of shoes and test them out by following the charted questions. If students could identify whom the shoes belong to, then the dichotomous keys were well written.

To understand more about invasive species, throw your shoe in the pile! When the students go through the identification process they will not find a name for this shoe. Explain how this is the "invasive shoe" and how there are invasive species in Vermont lakes that are non-native and have huge impacts on our waters.

An example of a scientific dichotomous macroinvertebrate key is shown on the following page. This key is used to identify the macroinvertebrate species living in a river or along a lake shore. The more diverse the macroinvertebrate composition is, the better water quality. Dichotomous keys not only help identify species, but also are tools used to help assess the biodiversity and overall ecological health of the environment.



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