Cornell Institute for Biology Teachers

Lab Issued: April 2015

Title:	**Mollusk Dichotomous Key Activity**
Author:	Florianna Blanton, CIBT, Cornell University, Ithaca, NY.
Appropriate Level:	Grades 5-8, but can be modified to be appropriate for most grade levels.
NYS Standards:	*Intermediate Level Science, Core Curriculum Grades 5-8.* Standard 4: *Key Idea 1:* PI 1 (1.1h). Standard 4 Process Skills: 6
Abstract:	In this lab, students will be introduced to the concept of a dichotomous key through the use of preliminary activities modeled by the teacher. They will then learn about the ecology and biology of selected marine mollusks, before putting their dichotomous key-reading skills to the test on 8 or 12 corresponding seashells. Finally, students demonstrate their new knowledge by creating their own dichotomous key to classify even more shells.
Special Materials:	CIBT Mollusk Dichotomous Key Kit
Time Requirement:	Approximately four 40-minute class periods.

Teacher Section Table of Contents

Introduction

In order to better understand how life on Earth is organized, and how organisms are related to each other, scientists have developed different ways to organize, or classify, all the different living creatures. One of these systems is a tool called a 'dichotomous key.' The word ***dichotomous*** means "divided into two parts".

A dichotomous key is a tool that provides the reader with two statements (choices) that describe characteristics about items or living organisms. They usually come from direct observations of the subject. These statements help the reader to classify and identify the items or organisms in question. With a dichotomous key, you choose between two clear physical characteristics that the organism possesses or not, and move down a chart, tree, or list until you finally can identify it. In order for the key to work, the characteristics must be constant, directly observable, and/or quantitative.

New York State Learning Standards

Intermediate Level Science, Core Curriculum Grades 5-8

Standard 4: Science—Living Environment

Key Idea 1: Living things are both similar to and different from each other and from nonliving things.

- **Performance Indicator 1.** Compare and contrast the parts of plants, animals, and one-celled organisms.
    - **1.1h.** Living things are classified by shared characteristics on the cellular and organism level. In classifying organisms, biologists consider details of internal and external structures. Biological classification systems are arranged from general (kingdom) to specific (species).

Process Skills Based on Standard 4

6. Develop and use a dichotomous key.

Materials

The CIBT Mollusk Dichotomous Key Kit contains the following materials:

- 10 **purple** laminated "Marine Mollusks: A Dichotomous Key (8 specimens)" handouts – 2 pages each
- 10 **yellow** laminated "Marine Mollusks: A Dichotomous Key (12 specimens)" handouts – 2 pages each
- 5 color-coded, laminated sets of shell ecology information cards – 18 cards each
- 10 color-coded sets of miscellaneous animals to classify – 2 large laminated sheets and 6 small, laminated corresponding cards each
- 1 laminated Pasta Types handout
- 1 light blue laminated Answer Key to "Marine Mollusks: A Dichotomous Key" handout
- 12 red plastic trays

Shells numbered 1-8 for use by all students:

- 10 Giant Atlantic Cockles (#1)
- 10 Florida Fighting Conches (#2)
- 10 Lightning Whelks (#3)
- 10 Atlantic Moon Snails (#4)
- 10 Apple Murexes (#5)
- 10 Calico Scallops (#6)
- 10 Banded Tulips (#7)
- 10 Lettered Olives (#8)

Shells numbered 9-12 for use by ***more advanced students***:

- 10 Prickly Cockles (#9)
- 10 Buttercup Lucines (#10)
- 10 Quahogs (#11)
- 10 Kitten's Paws (#12)

Shells numbered 13-18 for student use in developing their own dichotomous keys:

- 5 Turrets (#13)
- 10 Cowries (#14)
- 5 Fusinus (#15)
- 10 Dosinias (#16)
- 10 Slipper Shells (#17)
- 10 Carditas (#18)

Other required materials NOT included in CIBT Kit:

- Copies of student handouts, enough for whole class
- Rulers, scales, or other measuring equipment

Sources and Additional Resources

General Mollusk Resources:

Bailey-Matthews National Shell Museum: A Natural History Museum
http://shellmuseum.org/

Conchologists of America, Inc.
http://www.conchologistsofamerica.org/home/

EcoKids Canada Eco-Field Guide (limited but great, kid-friendly resource for learning about animals!)
http://www.ecokids.ca/pub/eco_info/topics/field_guide/index.cfm

Exploring Cone Snails and Science
http://www.theconesnail.com/

The Living World of Mollusks
http://www.molluscs.at/index.html

- Gastropod Shell Morphology: http://www.molluscs.at/gastropoda/index.html?/gastropoda/morphology/shell.html

Mrs. DeBias's Living Environment Course: Dichotomous Key Notes
http://lecoursedebiase.com/Dichotomous.html

Phylum Mollusca Listings from the Smithsonian Marine Station at Fort Pierce
http://www.sms.si.edu/irlspec/Phyl_Mollus1.htm

Project Oceanica at the College of Charleston, SC

- Commonly Found Marine Mollusks of the Southeastern United States Species Comparison: http://oceanica.cofc.edu/shellguide/comparisonframeset.htm
- Dichotomous Keys Exercise: http://oceanica.cofc.edu/shellguide/dichotomous%20keys%20activity.pdf

Shells of Aquarius – "one of the largest shell and sealife sources on the net"
http://www.shells-of-aquarius.com/

- Murex Shells: http://www.shells-of-aquarius.com/murex-shells.html
- Shark Eye Shells: http://www.shells-of-aquarius.com/shark_eye_shells.htm

Organism-Specific Resources:

Banded Tulip: http://web.fscj.edu/David.Byres/tulip/tulip.htm

Banded Tulip Shell: A Softly-Rounded Beauty:
https://www.mitchellspublications.com/guides/shells/articles/0072/

Fighting Conch: http://www.aquaticcommunity.com/SwSnails/FightingConch.php

Lightning Whelk: http://tpwd.texas.gov/huntwild/wild/species/lwhelk/

Atlantic Moon Snail:
http://www.ecokids.ca/pub/eco_info/topics/field_guide/underwater/moon_snail.cfm

Lettered Olive: http://encyclopaedia-dictionary.blogspot.com/2014/02/oliva-sayana-lettered-olive.html

Cowry: http://www.theconesnail.com/meet-the-snails/cowries

Prickly Cockle: http://www.sms.si.edu/IRLFieldGuide/Trachy_egmont.htm

Broad-Ribbed Cardita: http://angelo52.hubpages.com/hub/broad-ribbed-cardita-florida-beach-shell

DICHOTOMOUS KEY STUDENT HANDOUT

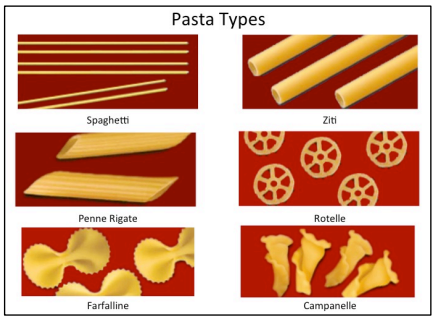
Part 1: *Pasta Feast*

Time: Approximately 20 minutes

Purpose

Model how to use a dichotomous key to identify and sort various types.

Procedure



1. Pass out a copy of the Dichotomous Key Student Handout to everyone. Divide class into small groups of 3 or 4 students. Pass around one Pasta Types Handout to all the groups. Instruct each group to quickly choose a pasta type they like and write it down—keeping it a secret from you—and then cross out the name so that no other group chooses it.

2. Display the Pasta Dichotomous Key (shown below) to the class as you use it to determine the name of one of the groups' chosen pasta type. You can ask each item in the form of a question. For example, ask the group: "Is the shape of your pasta straight?" If so, move on to Item #2. If not, move on to #4. Repeat the process with another group. Make sure the students are paying attention, because they will soon be doing this on their own!

    1. The shape of the pasta is straight……Go to #2
       The shape of the pasta is not straight……...Go to #4

    2. The pasta is hollow..……Go to #3
       The pasta is not hollow..……**spaghetti**

    3. The pasta is smooth……..**ziti**
       The pasta is not smooth……...……**penne rigate**

    4. The pasta is round……..……**rotelle**
       The pasta is not round……..Go to #5

    5. The pasta has two lobes……..**farfalline**
       The pasta does not have two lobes…….……....**campanelle**

3. Now have the remaining groups quiz each other the same way, using the pasta dichotomous key to determine each other's pasta types.

4. After the activity is over, instruct students to answer the questions on Page 2 of their handout.

Part 2: *Dichotomous Keys*

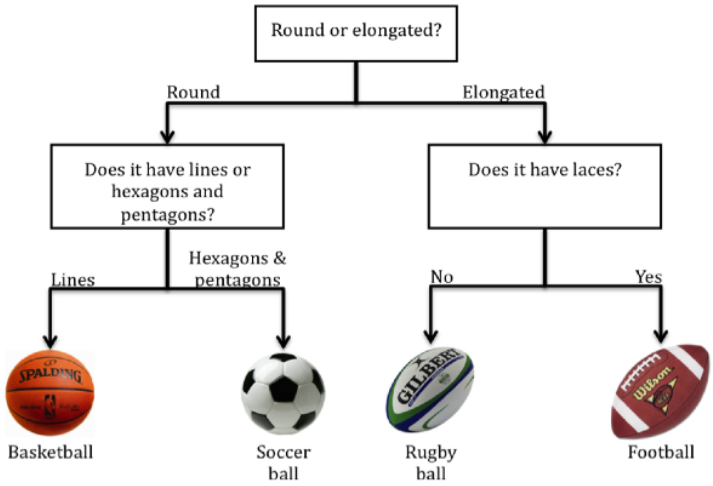
Time: Approximately 20 minutes

Purpose

Introduce the concept of a dichotomous key to students.

Procedure

Help students read and answer questions on Pages 2-3 of their handout. In this section of the lab they will be looking at a 'classification tree' and a dichotomous key for different balls used to play different sports (see below).



1a. Ball is perfectly round and spherical……..……go to (2)
1b. Ball is not round and spherical……...……go to (3)

2a. Ball has hexagons and pentagons on it……...……...**soccer ball**
2b. Ball doesn't have hexagons and pentagons on it…….…….....…...**basketball**

3a. Ball has one side with laces……...……**football**
3b. Ball has no laces…….……**rugby ball**

Answer Key

Classification Tree

What is the major group to which all these items belong? What makes them be grouped into a single category? *They are all balls used to play sports.*

In this example, what separates them into two major groups? *Their overall shape: round or elongated.*

According to this classification tree, list three characteristics that differentiate a soccer ball from a football.

1. *It is round.*
2. *It does not have laces.*
3. *It has hexagons and pentagons.*

Dichotomous Key

Using this list, write down two characteristics that differentiate a rugby ball from a basketball.

1. *It is not perfectly round and spherical. It is elongated.*
2. *It does not have lines on it.*

Part 3: *Making Your Own Dichotomous Key*

Time: Approximately 20 minutes

Purpose

Students will demonstrate their new knowledge of dichotomous keys by making one.

Procedure

1. Divide class into groups if desired. It may be helpful for younger students to pool their knowledge this way. Have each student or group choose one of the 2 color-coded, large laminated sheets of animals, and the 6 small corresponding cards.
2. For younger students, pass out one oversize piece of paper and a ruler to each group. Older students can use a blank sheet of regular-sized paper.
3. Instruct students to make a classification tree like the one in Part 2 (sports balls) for the 6 organisms on their card. Remind them of the following:
    - Use *constant characteristics* rather than ones that disappear or change due to environmental factors. For instance, classifying a snowshoe hare as white would NOT be a good idea, because their coats turn brown during the summer months.
    - Use characteristics that can be *directly observed*. For example, it would be better to classify a cow as hooved than as having a four-chambered stomach, because hooves are readily observable.
    - Use *quantitative measurements*, like "4 or more legs" rather than vague terms like "many legs."
4. Help students turn their classification tree into a list—a dichotomous key.
    - Remind them to write "go to # ____" when necessary.

Regents Questions

If students will be taking a NYS Regents Exam in the near future, it may be helpful for them to review their dichotomous key knowledge in the format of the test. We have included four questions from Regents review books in the student handout for them to practice answering, or discuss as a class.

MOLLUSK INTRODUCTION LAB

In this activity, students will look at shells from marine snails and bivalves, learn about the animals that made and lived in these shells, and identify them using a dichotomous key.

Part 1: *Your Mollusk*

Time: Approximately 20 minutes

Purpose

Introduce ecology and classification of mollusks.

Materials

For this part of the lab, you will need:

- Sets of shell ecology/information cards
- Sorting trays

All shells, #1-18:

- 10 Giant Atlantic Cockles (#1)
- 10 Florida Fighting Conches (#2)
- 10 Lightning Whelks (#3)
- 10 Atlantic Moon Snails (#4)
- 10 Apple Murexes (#5)
- 10 Calico Scallops (#6)
- 10 Banded Tulips (#7)
- 10 Lettered Olives (#8)
- 10 Prickly Cockles (#9)
- 10 Buttercup Lucines (#10)
- 10 Quahogs (#11)
- 10 Kitten's Paws (#12)
- 5 Turrets (#13)
- 10 Cowries (#14)
- 5 Fusinus (#15)
- 10 Dosinias (#16)
- 10 Slipper Shells (#17)
- 10 Carditas (#18)

Procedure

1. Set up 18 stations around the classroom with one type of shell and the corresponding ecology cards at each.
2. Pass out a copy of the Mollusk Introduction Lab to everyone, and have them read the first page. This gives a general introduction to the phylum *Mollusca*. It is duplicated below:

   You may think that squids seem very different than the snails that you sometimes see on the sidewalk, but the two organisms actually belong to the same grouping of animals. Squids and snails are both in the phylum **Mollusca**. Mollusks are a diverse group of **invertebrates** that includes animals living in many habitats and with many different lifestyles. All mollusks have a soft body, although some are also covered by a **hard shell**. They all have a muscular foot that serves a variety of different purposes depending on the specific animal's lifestyle.

   The phylum **Mollusca** includes six classes, but the three main classes are: **gastropods, bivalves, and cephalopods**. **Gastropods** are the most numerous with at least 75,000 species, including snails and slugs. These gastropods can live in the ocean, in fresh water, and on land. **Bivalves** ('two-valves') live in the ocean and have two shells held together by a hinge. Animals that are bivalves include clams, oysters, mussels, and scallops. The

cephalopods ('head-foot') include squid and octopuses. These organisms have more sophisticated brains and sense organs than the other classes.

3. Instruct students to walk around the classroom and take a look at the different shell stations. Each student will choose one that seems interesting, and read the ecology card about it.
4. Have students fill out Page 2 of the handout with the information from the ecology cards, as well as their own quantitative and qualitative observations. For quantitative observations, students could measure the length/height of their shell, measure other distances on the shell, weigh the shell, count some feature such as spines, etc. For qualitative observations, students could describe the texture of the shell, the color of the shell, etc.

Part 2: *Marine Mollusk Cards Scavenger Hunt*

Time: Approximately 20 minutes

Purpose

Introduce ecology and classification of mollusks.

Materials

For this part of the lab, you will need:

- Sets of shell ecology/information cards
- Sorting trays

All shells, #1-18:

- 10 Giant Atlantic Cockles (#1)
- 10 Florida Fighting Conches (#2)
- 10 Lightning Whelks (#3)
- 10 Atlantic Moon Snails (#4)
- 10 Apple Murexes (#5)
- 10 Calico Scallops (#6)
- 10 Banded Tulips (#7)
- 10 Lettered Olives (#8)
- 10 Prickly Cockles (#9)
- 10 Buttercup Lucines (#10)
- 10 Quahogs (#11)
- 10 Kitten's Paws (#12)
- 5 Turrets (#13)
- 10 Cowries (#14)
- 5 Fusinus (#15)
- 10 Dosinias (#16)
- 10 Slipper Shells (#17)
- 10 Carditas (#18)

Procedure

Set up 18 different stations around the room (one for each type of shell). Give students an allotted amount of time (based on ability level) to find each of the 10 kinds of mollusk listed on Page 3 of the student handout.

Answer Key

1. A mollusk that has 2 shells (bivalve): *calico scallop, giant Atlantic cockle, disc dosinia, buttercup lucine, prickly cockle, cardita clam, quahog*

2. Mollusk that lives on top of each other: ___*slipper snail*___

3. A mollusk that is part of a food chain: ___*any*___

4. A mollusk that eats other mollusks: *apple murex, lettered olive, banded tulip, lightning whelk, Atlantic moon snail*

5. A mollusk that has some defense mechanism against predators: *prickly cockle, fighting conch*

6. A mollusk that feeds by filtering water: *calico scallop, giant Atlantic cockle, slipper snail, cardita clam, buttercup lucine, quahog*

7. A mollusk that humans eat: *quahog, scallops, giant Atlantic cockle, prickly cockle, cardita clam*

8. A snail that is a cannibal (eats its own kind): *banded tulip, Atlantic moon snail*

9. A mollusk that humans use for something other than food: *apple murex, cowry, quahog*

10. A mollusk that has a radula (rough tongue): *lightning whelk, Atlantic moon snail, Florida fighting conch*

Part 3: *Mollusks Dichotomous Key*

IMPORTANT:
Shells must remain on the trays AT ALL TIMES, except when students are handling them!

Time: Approximately 20 minutes

Purpose

Use knowledge about marine mollusks and dichotomous keys to identify the common names of 8 or 12 different seashells.

Materials

For this part of the lab, you will need:

- "Marine Mollusks: A Dichotomous Key (8 specimens)" purple handouts OR "Marine Mollusks: A Dichotomous Key (12 specimens)" yellow handouts – 2 pages each, with pictures
- "Marine Mollusks Dichotomous Key" purple or yellow (corresponding) handouts
- Sorting trays

Shells numbered 1-8:
- Giant Atlantic Cockles (#1)
- Florida Fighting Conches (#2)
- Lightning Whelks (#3)
- Atlantic Moon Snails (#4)
- Apple Murexes (#5)

- Calico Scallops (#6)
- Banded Tulips (#7)
- Lettered Olives (#8)

Shells numbered 9-12, **for more advanced students**:

- Prickly Cockles (#9)
- Buttercup Lucines (#10)
- Quahogs (#11)
- Kitten's Paws (#12)

Procedure

1. Decide whether your class will be working with 8 or 12 shells for the remainder of the lab. We recommend using 12 shells for more advanced students.
2. Organize shells so that there is a complete set of shells #1-8 or 1-12 in each red sorting tray. We recommend taking the larger specimens out of the baggies and keeping the baggies together inside the corresponding box. You may want to keep the smaller specimens inside the baggies so they are easier to keep track of.
3. Divide students into small groups of 2 or 3. Each group will receive one of the 10 laminated "Marine Mollusks: A Dichotomous Key" handouts (with pictures), one of the "Marine Mollusks Dichotomous Key" handouts (just words, in list format), and one sorting tray with a set of 8 or 12 shells.
4. Instruct students to use the Dichotomous Key provided to identify all of their shells– in other words, they will be filling in the blanks on the laminated "Marine Mollusks: A Dichotomous Key" handout. They will record their results in the spaces on Page 3 of the student handout.

Answer Key

1. *Giant Atlantic Cockle*
2. *Florida Fighting Conch*
3. *Lightning Whelk*
4. *Atlantic Moon Snail*
5. *Apple Murex*
6. *Calico Scallop*
7. *Banded Tulip*
8. *Lettered Olive*

9. *Prickly Cockle*
10. *Buttercup Lucine*
11. *Quahog*
12. *Kitten's Paw*

Part 4: *Making Your Own Mollusk Dichotomous Key*

Time: Approximately 30 minutes

Purpose

Use knowledge about marine mollusks and dichotomous keys to create a new dichotomous key for 8 or 12 shells.

Materials

For this part of the lab, you will need:

- Sorting trays
- "Marine Mollusks: A Dichotomous Key (8 specimens)" purple handouts OR "Marine Mollusks: A Dichotomous Key (12 specimens)" yellow handouts – 2 pages each, with pictures
- "Marine Mollusks Dichotomous Key" purple or yellow (corresponding) handout
- Sets of shell ecology/information cards

Shells numbered 1-8:

- Giant Atlantic Cockles (#1)
- Florida Fighting Conches (#2)
- Lightning Whelks (#3)
- Atlantic Moon Snails (#4)
- Apple Murexes (#5)
- Calico Scallops (#6)
- Banded Tulips (#7)
- Lettered Olives (#8)

Shells numbered 9-12, **for more advanced students**:

- Prickly Cockles (#9)
- Buttercup Lucines (#10)
- Quahogs (#11)
- Kitten's Paws (#12)

Shells numbered 13-18 for use in creating dichotomous keys:

- 5 Turrets (#13)
- 10 Cowries (#14)
- 5 Fusinus (#15)
- 10 Dosinas (#16)
- 10 Slipper Shells (#17)
- 10 Carditas (#18)

Procedure

1. Divide students into small groups of 2 or 3, or keep the same groups as Part 3. Give each group a tray.
2. Instruct groups to choose 4 shells from the ones they have already identified (1-8 or 1-12), and place them in their tray.
3. Have them choose 4 more shells they have *not* yet identified—these can be shells #9-12 (for younger students) or shells #13-18 (for everyone)—and put them in their tray.
4. Help students create their own dichotomous key to sort the new set of 8 or 12 shells using the template on Page 4 of their handout. They will do this on their own separate sheet of paper, using their "Marine Mollusks Dichotomous Key" handout as a reference/example, as the four shells they chose in Step #1 have already been identified for them. Students can use the shell ecology/information cards to pick out identifying traits. Remind them of the guidelines they

used to make their first dichotomous keys, in Part 3 of the DICHOTOMOUS KEY STUDENT HANDOUT:

- Use *constant characteristics* rather than ones that disappear or change due to environmental factors. For instance, classifying a snowshoe hare as white would NOT be a good idea, because their coats turn brown during the summer months.
- Use characteristics that can be *directly observed*. For example, it would be better to classify a cow as hooved than as having a four-chambered stomach, because hooves are readily observable.
- Use *quantitative measurements*, like "2 ears" or "presence of hinge line" rather than vague terms like "many concentric lines," or "several digit-like ridges."