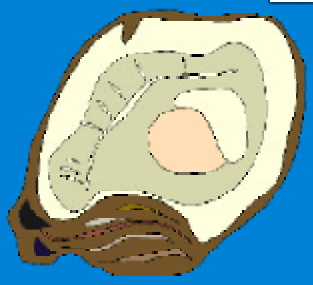
Education on the Halfshell



Creating A Dichotomous Key

by Cassie Zanca

GOAL

The students will explore the benefits of creating dichotomous keys as a means of identifying an organism or object.

OBJECTIVE

The student will create a dichotomous key to identify seashells.

BACKGROUND

A dichotomous key is a tool that allows the user to determine the identity of items and organisms in the natural world. It is the most widely used form of classification in the biological sciences because it offers the user a quick and easy way of identifying unknown organisms. Keys consist of a series of choices that lead the user to the correct name of a given item. "Dichotomous" means "divided into two parts." That is why dichotomous keys always give two choices in each step. In each step, the user is presented with two statements based on characteristics of the organism. If the user makes the correct choice every time, the name of the organism will be revealed at the end.

There are two kinds of descriptions that might be presented to the user of a dichotomous key: qualitative and quantitative descriptions. Qualitative descriptions concern the physical attributes, or qualities, of the item being classified. Examples of qualitative descriptions are such phrases as "contains green striations on top surface" or "feels slick on bottom surface." Quantitative descriptions concern values that correspond with the item being classified. Examples of quantitative descriptions are such phrases as "has 10 striations on top surface," "has 8 legs," or "weighs 5 grams". Knowing the difference between these two types of descriptions can be immensely beneficial for creators and users of dichotomous keys.

There are two ways to set up a dichotomous key. One way is to present the two choices together, and the other way is to group by relationships. When the dichotomous key is set up by presenting the two choices together, it is easy to distinguish between them. However, relationships between various characteristics are not emphasized. When the dichotomous key is grouped by relationships, the choices are separated, yet it is easy to see the relationships between them. While this method may prove to be more difficult to construct, many users prefer it because it gives them more information.

BENCHMARKS (Louisiana)

MIDDLE SCHOOL BENCHMARKS

SI-M-A1-A7
SI-M-B1-B7

HIGH SCHOOL BENCHMARKS

SI-H-A1-A6
SI-H-B1-B5
LS-H-C4,C6

NATIONAL SCIENCE STANDARDS

MIDDLE SCHOOL STANDARDS

UC&P- Systems, order & organization
LS - Diversity & adaptations of organisms

HIGH SCHOOL STANDARDS

UC&P - Systems, order, & organization

TEACHER PREPARATION

In this activity, the teacher will need or collect five to six oyster shells for each student or student group. If oyster shells are not readily available, download the pictures of the oyster shells from the website. Enclosing the pictures in sheet protectors may be a good idea. From these shells or pictures, the students can now create their own dichotomous keys.

STUDENT INSTRUCTIONS

You will create a dichotomous key in order to identify oyster shells or pictures of shells. Your teacher will provide you with the samples to identify. Before writing your dichotomous key, read the background information on shells provided by your teacher, as it will aid you in key construction. Continue to write the key until each individual shell can be identified. Make an answer key to accompany your dichotomous key.

ANSWER KEY

Each student or student group will submit a dichotomous key and answer key; therefore, each answer key will be different.

ALTERNATIVE ASSESSMENT IDEAS

- Create a concept map from the key.
- Students will design a dichotomous key using a particular item (examples: coke tabs, ketchup bottles, paper clips, other shells) and be graded on accuracy and completeness.

EXTENSION STARTERS

- Have students create a field guide using dichotomous keys to help with identification of a particular item (examples: plants on the school campus, or macro-invertebrates in a local stream, etc). Give students examples of field guides to generate ideas.
- Using the key they have created, develop an outline of the format used in their English class, that students will understand what the divisions in an outline represent and the relationships among the terms.

RESOURCES & WEBLINKS

Timme, Stephen, 1991, Association for Biology Laboratory Education website, How to Construct and Use a Dichotomous Key, accessed 02/16/01, http://www.zoo.utoronto.ca/able/volumes/vol-12/7-timme/7-timme.htm
Description: An excellent web-based activity on the construction and use of a dichotomous key that also describes the use of a dichotomous key in the field and provides a key for prairie plants.

Frontier High School, Red Rock, OK, The Dichotomous Key, accessed 02/16/01, http://pc65.frontier.osrhe.edu/hs/science/hbotkey.htm
Description: Provides instructions on the two methods of constructing a dichotomous key as well as several online dichotomous keys. Grade level: High School.

Detka, Jon , California State University at Monteray Bay, Designing and Using a Dichotomous Key, accessed 02/16/01, http://www.monterey.edu/students/Students_D-H/detkajon/world/ron/dichotdesign.html
Description: Students first construct a simple dichotomous key and then use a basic key to identify some of the native plants and the most unwanted invasive weeds of California. Grade level: 3-5.

Santa Cruz Productions, Wastewater Filamentous Bacteria Dichotomous Key, accessed 02/16/01, http://home1.gte.net/vsjslsk1/gramstainflowchart.htm
Description: A completely web-based dichotomous key designed to assist students in identifying wastewater bacteria.

MOLLUSKS AND THEIR SHELLS

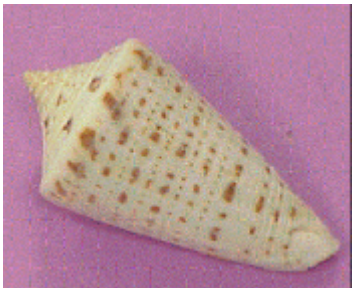
Shells are the hard exteriors of living organisms and are formed for two main purposes. Firstly, they protect the organisms from predators and environmental stressors. Secondly, they provide rigidity and shape. One well-known group of animals that secrete shells is called mollusks.

There are eight classes of mollusks grouped according to the characteristics of their shells. Single-shelled organisms are called **Gastropods**. A snail is a gastropod, with a single shell that spirals outward and to one side as it grows. The coiling may be either to the left or right. The coiling can be indicative of paleoenvironmental conditions. Global temperature changes are said to be the reason for reversal of the coiling; therefore, some gastropods can be important in the field of geologic dating.

The shelled animals that are studied in this unit are called **Bivalvia** and include oysters, clams, scallops, and mussels. They have two valves that enclose the soft tissue of the mantle and other internal organs. The shells are hinged together.

Another well known class is the **Cephalopoda,** which include octopus, squids, and nautilus. Most cephalopods have a reduced shell or are shell-less. The nautilus is the only one with a completely developed shell. The squid and cuttlefish have a small internal shell, and the octopus completely lacks a shell.

There are five other classes of mollusks not as well known. They include Caudofoveata, Aplacophora, Monoplacophora, Polyplacophora, and Scaphopoda. **Caudofoveata** are shell-less wormlike mollusks that live in burrows on the deep-sea floor. The **Aplacophorans** also lack a shell and live in the depths of the ocean, physically attach to and or eat relatives of the jellyfish and coral. **Monoplacopharans** have a caplike shell and are less than 3 cm long, they are found in the ocean depths. **Polyplacophorans** or chitons are flat long mollusks with a shell made of eight plates. Chitons live on rocky shorelines and graze on plants. **Scaphopods** also known as tusk shells, and have a long tube-shaped shell tapered at one end and open on both ends. These mollusks burrow into the sand.

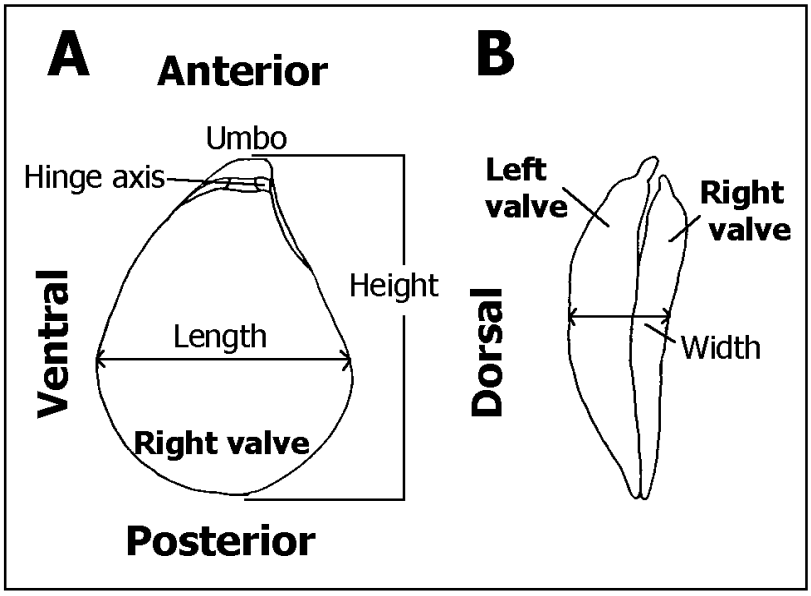


Mollusk shells are made from calcium that is extracted from the waters in which they live or from the food the mollusks eat. There are two common forms of calcium carbonate, aragonite and calcite. They differ in crystal shape, but their chemical formula is the same. The denser of the two forms, calcite, is found in the hard, outer shell of the oyster. Whether calcium carbonate becomes aragonite or calcite depends on the "seed" crystals growth pattern.

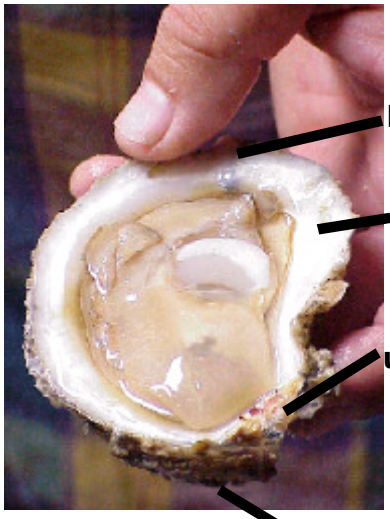
Many mollusk shells are lined with aragonite. Abalones and some oysters, including Louisiana oysters, are examples. The substance they produce is called "mother of pearl" or **nacre**. Nacre is what gives oysters and abalones the shine on the insides of their shells.

ANATOMY OF THE OYSTER SHELL

- All species of oysters share the same common anatomical parts. That is, there is a right shell and a left shell. The **right shell** is the top shell. The **left shell** is the one attached to the substrate and is called the bottom shell or cup. The left shell is usually more curved or cup-shaped than the right shell.
- Oysters belong to the group Bivalvia and have two shells hinged together. The end with the hinge is referred to as the **anterior end**. The opposite end is referred to as the **posterior end**.
- The **mantle** produces layers of tissue to form the shell. Calcium carbonate composes the chalky middle layer. The innermost layer is the **nacre**.
- The **umbo** is the portion of the shell that formed when the oyster was a veliger larva. It is on the anterior end of the shell near the hinge. One can see concentric growth lines around the umbo. These are not uniformly secreted since they can be influenced by environmental changes, such as temperature, food, stress, and disease. These factors affect the oyster's ability to produce more shell tissue.
- The **hinge** is the area where the two valve join together. It consists of three parts. On the hinge there are small projections, **hinge teeth**, that align the valve and enable it to close correctly. Oysters have very small hinge teeth. Most bivalves have more prominent teeth that can be used to help identify the species. The hinge has two ligaments. The **external ligament** is flexible and provides the axis of move ment for the two halves of the shell. The internal ligament is called the **resilium**. When the adductor muscle of the oyster is relaxed, the external ligament and resilium work together to open the shell. To close its shell, the oyster contracts its adductor muscle.



LEFT SHELL



Creating A Dichotomous Key: Pointers

When constructing a dichotomous key, one should keep certain things in mind.

- Use easily identifiable characteristics such as two valves verses one valve, instead of using variable characteristics such as color.
- Use quantitative measurements, such as 6" long or a size range of 3-6" long, rather than qualitative terms such as "large" or "tall".
- Use characteristics that are generally available in nature or to the user, rather than seasonal characteristics or those that can only be observed easily by scientists with special equipment.
- Each choice should have a positive response greater than a negative one. For instance, it "has" a characteristic rather than it "does not have" one.
- Whenever possible, begin both choices with the same word.
- Wherever applicable, begin different pairs of choices with different words.
- Always precede descriptive terms with the name of the part that you are describing.

While you are constructing the key, you must be as specific as possible so that the user does not become confused. If the two choices are not precise, a user can easily choose the wrong one, and may get the wrong classification or have to start over.

You must be alert to the wording of every choice. Doing so may save you from having to rewrite the entry in order to arrive at the correct answer. Be cautious and strive to get the most correct classifying characteristics possible.

Another helpful idea is to get several people to use the key to see if their answers match with yours. If all arrive at the same answer, it is safer to assume that the key was written correctly. If there is a discrepancy among the users, analyze the key together and compare your choices to see where the differences occurred. After you have discussed the reasons for the different choices, modify the key to adjust for any problems.

When using a key, the following may be helpful.

- Always read and consider both choices, even if the first one seems to be appropriate. Jumping to conclusions may lead to the wrong classification of the item.
- Always understand the meaning of the words used in each choice. Define the term. If you are not sure of the meaning, look it up in a dictionary. Never guess, as this could also lead to the wrong classification of the item.
- When there are measurements given in the choices, use the appropriate measuring tools or adjust them to match your own set of tools. For example, if a key measurement is given in centimeters but your ruler is divided into inches, convert the centimeter measurement into inches. Do not approximate and do not guess. Measure.
- If you are classifying a living or once-living thing, do not base your conclusion on a single observation. Living things almost always exhibit variability, so it is better to study many specimens in order to be sure that your results are representative of the majority.
- If you are left with two possible answers, read the description of both and decide which one seems to fit your specimen more precisely.
- When you have "keyed out" all of the shells, do not accept your answers to be correct. Check the description of each organism in order to see that it appropriately matches the organism. If it does not, then an error was made somewhere in key development.

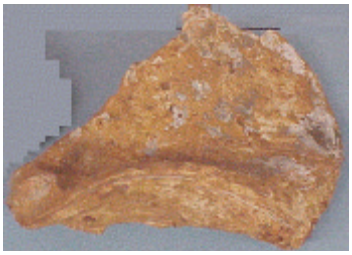
Fossil Oyster Pictures for Creating a Dichotomous Key

Cubitostrea perplicata


Pycnodonte (Gigantostrea) trigonalis


Lopha johnsoni


Cubitostrea sellaeformis




Hyotissa vicksburgensis


Fossil Oyster Pictures for Creating a Dichotomous Key

Ostrea (Turkostrea) duvali


Agerostrea falcata


Exogyra costata


Flemingostrea subspatulata


Pycnodonte mutabilis


Fossil Oyster Pictures for Creating a Dichotomous Key

Ostrea (Turkostrea) multilirata

Crassostrea gigantissima

Pycnodonta (Phygraea) pulaskensis

American Oyster
Crassostrea virginica