Leaf Classification

Purpose

To develop a classification system for a set of objects, learn about hierarchical classification systems, build skills for using the MUC System

Overview

As a group, students will develop their own classification system for sorting leaves and will learn that there are different ways to classify the same group of objects. This activity introduces the complexity of a "simple" task for which there are no absolutely correct answers.

Student Outcomes

Science Concepts

Physical Science

Objects have observable properties that can be measured using tools.
Objects have observable properties.

Scientific Inquiry Abilities

Classification helps organize and understand the natural world.
A classification system is a system of labels and rules used to sort objects.
A hierarchical system has multiple levels of increasing detail.
Identify answerable questions.
Design and conduct scientific investigations.
Use appropriate mathematics to analyze data.
Develop descriptions and predictions using evidence.
Recognize and analyze alternative explanations.
Communicate procedures, descriptions, and predictions.

Level

All

Time

One class period

Materials and Tools

A variety of different leaves
Chalk board or large paper for classification system outline

Preparation

Collect a variety of different leaves. (If time allows, take students outside to collect leaves or ask each student to bring in 3-5 different kinds of leaves and needles.)

Prerequisites

None

Background

Scientists classify many features of our environment such as clouds, soil, and vegetation. These classifications help us organize and understand the natural world. A *classification system* is an organized system for grouping objects into similar categories. There are two components to a classification system: *labels* and *rules*. Labels are the titles of the different classes in the classification system; rules are the tests or criteria you apply to decide which class an object belongs in. Well-defined labels and rules allow scientists to consistently describe and organize objects. For example, the Modified UNESCO Classification (MUC) System used in the GLOBE protocols allows GLOBE participants to consistently describe the land cover at any place on earth using the same labels and rules.

Classification systems are somewhat arbitrary, governed only by what we think makes sense. However, good classification systems do have three key characteristics.

1. The classes must be *mutually exclusive*. Any object must have one, and only one, appropriate class where it can be placed. For example, if a leaf could be placed in two categories, then the classes are not mutually exclusive and the system must be modified to have more detailed rules.

2. The classification system must be *totally exhaustive*. There must be an appropriate class for all potential objects. This is frequently achieved by having a catch-all class such as "other". For example, if a leaf does not meet the criteria for any class, then the classification system is not totally exhaustive. In this case, the system must be modified, usually by adding at least one more class.

3. A classification system should be *hierarchical*. There should be multiple levels of increasing detail. At any level of detail, all the different classes should be able to "collapse" into the next less detailed level of the classification system. Figure LAND-LE-1 is an example of a hierarchical classification system of objects. Level One classes are metal objects, wood objects, plastic objects, and objects of other materials. Level Two classes within metal objects are round objects, square objects, and other shaped objects. Level Three classes within square metal objects are smooth surfaces, rough surfaces, and mixed

Figure LAND-LE-1: Sample Hierarchical Classification System
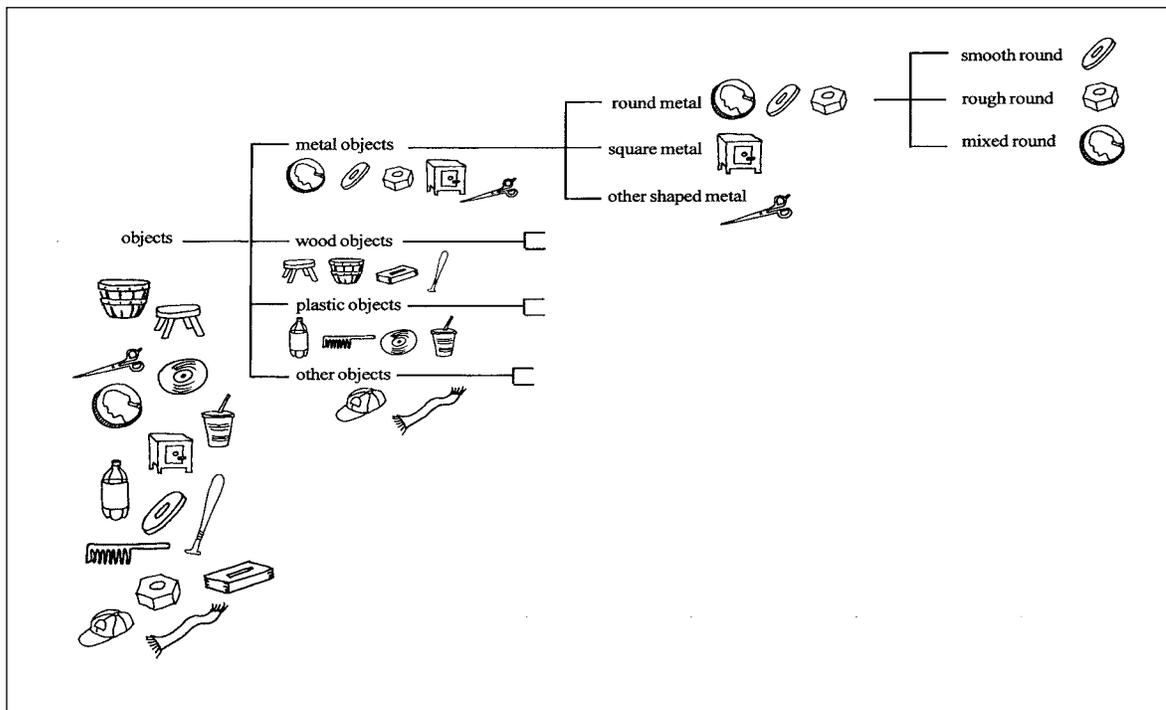
surfaces; and so on.

What To Do and How To Do It

1. Collect a variety of different leaves. If time allows, take students outside to collect leaves or ask each student to bring in 3-5 different kinds of leaves and needles. Try to get brown (old) and green (fresh) leaves. If possible, make sure there are several different varieties including plant or shrub leaves. If you live in a grassland area, you could use grasses or other herbaceous ground cover.

2. Gather the class in a circle. In the center, on the floor or on a table, spread out all of the leaves.

3. As a class, sort (classify) all of the leaves into groups of similar types. (You could also divide the class into groups and have each group perform this step. Then compare the classification systems and discuss the results.)
   Suggestion: Have the students brainstorm different characteristics that could be used for sorting the leaves. Use a chalkboard to list the suggestions. Discuss which characteristics are most important - or just have the students vote to decide the order of importance. They should realize that there is not necessarily one correct way. In this way, you will have several characteristics, in hierarchical order of importance and generality, to be used for sorting the leaves.

4. Have students sort the leaves using the chosen labels and decision rules. As the students sort the leaves, they may find that the classification system has to be modified or refined. This happens frequently in scientific projects. If there is time, students can create several different classification systems for sorting the leaves.

Discussion Questions

1. What is a classification system?
2. What labels did you use to identify different classes of leaves?
3. What rules (criteria) did you use to assign each leaf to its class?
4. How did you decide which decision criteria or rules were the most important (first) ones to use in your classification system?
5. Do all of your leaves fit into one of the classes you devised? Were there leaves that could go into more than one class? Were there some that did not fit any class?
6. How was your classification system different from other groups' or classes? How was it similar? Both systems are correct if they have what three characteristics?
7. How might you change your leaf classification system if you were sorting them for an art class? A math class?

Variations

You can use various assortments of natural or unnatural objects for this exercise (e.g. rocks, insects, buttons, shoes, and bolts). Many things work well. It is useful to use leaves, especially with younger students, to help them become familiar with local vegetation. Have your students try to sort another group of objects as an assessment activity.

Student Assessment

After completing this activity, students should be able to:

1. Describe the design of their classification system, including the basis for the labels they used to establish different classes of leaves.
2. List rules or decision criteria they used for assigning each leaf to its class.
3. Describe how they organized the hierarchical system.
4. Classify all of the leaves they collected using their system.

The ultimate measure of students' understanding of how classification systems are constructed and used will be the ease with which students are able to use the Modified UNESCO Classification (MUC) System.