Lesson Design Protocol Prepared by Crystal Heckaman

Grade Intended: 9th or 10th grade


Rationale for teaching this lesson:

This lesson was chosen because it is part of the school’s science curriculum and it is essential to the foundation of a student’s understanding as to how objects or information are grouped together based on their similarities.

It is important for students to learn the different systems of classification that early and modern biologists have created for grouping organisms in order to better understand the background behind one particular complex scientific process.

This fits in the overall school curriculum through ties to the sciences as well as history and math. The examination of plant and animal characteristics including habitat and physical differences in order to form similar understandable groups is science. The focus on two distinctly important historical classification systems, namely Aristotle and Linnaeus, provides the setting of how scientists developed theories that are/were commonly accepted. Mathematics is also an essential part of creating an understanding of spatial relationships such as the concept of organism classification and parts of leaves.

Academic Standards

“Standards are statements that define *what students should know and be able to do* upon completion of specific levels of instruction. Standards serve as a gauge for excellence and are differentiated from minimum competencies or outcomes because they describe the challenging goals we aspire to for expanding and improving education in the schools of the United States. Standards improve students’ academic achievement by providing a framework for curriculum development, instruction, and assessment. The purpose of developing academic standards at the state level is to better serve schools and the local community in the process of performing these curriculum activities.” (Indiana Department of Education)

Standard 1: Principles of Biology: Evolution

B.1.35 Explain that the degree of kinship between organisms or species can be estimated from the similarity of their DNA sequences, which often closely matches their classification based on anatomical similarities. Know that amino acid similarities also provide clues to this kinship.
Through Linnaeus’s method of grouping organisms based on physical and structural similarities and other scientists’ observations of similarities reflecting evolutionary relationships, students will develop the ability to “explain the degree of kinship between organisms or species…based on anatomical similarities.”

**Performance Objectives:**

Given a piece of posterboard with 10 leaves and explicit instructions, students will write a dichotomous key that can be used to identify the leaves as distinctly different from each other, while also explaining anatomical similarities that occur between species that are more closely related.

Given an example of a mnemonic device, students will write their own mnemonic creation that forms a connection between the taxonomic groups with 100% participation.

Given an explanation of classification systems and the history behind their development, students will answer the section assessment questions in their biology notebooks to demonstrate their understanding of the content.

**Advanced Preparation**

Write agenda on the board for students to follow along in daily activities

Learn how to group organisms according to their physical similarities

Understand that (for the most part) 2 organisms that appear similar to each other are more closely related than 2 organisms that look less like each other

Create overhead containing tree diagram of organisms’ relationships with one another

Collect leaves from 10 different local trees. Glue 1 dried leaf from each tree to a large poster board creating collage of different leaves for each group.

Provide each student with a piece of paper that has an example of the beginning of a dichotomous key on the top.

**Procedure:**

**Introduction/Motivation:**

As we continue through the unit on evolution, change through time, we will take the time today to discuss how curious scientists grouped organisms into similar groups. We will also spend time learning the framework behind our current classification system.

In this example, how would you group the following organisms: African elephant, raccoon, Northern Cardinal, blue whale, polar bear, Canada lynx, panda bear, and bald eagle? Did you group organisms into the exact same categories as the person sitting next to you? *(Gardner’s Logical-Mathematical and Bloom’s Analysis)*

Let’s look at how one scientist would have grouped these organisms. Using overhead, work your way down through the tree diagram, uncovering bubbles as you discuss how they are different from the others. This classification system was created by Carolus Linnaeus and continues to be used today as new organisms and fossilized ones are discovered.

**Step-By-Step Plan:**
Provide background information to students: Before we further explore our modern classification any further, let us take a look at the history behind the development of the first widely accepted classification system.

Ask students if they know who created the first classification system. (wait for students to respond and if several guesses are made without correct answer, move on to provide them with correct answer) Aristotle- a philosopher. Though he knew little about science he was able to classify organisms into similar groups, such as plants or animals, and subdivided those groups into smaller groups according to physical structure and size, or physical differences and habitat that the organism could be found in. As new species were discovered, scientists often found it difficult to place the organism into one of the preexisting categories and a new system was needed to replace Aristotle’s.

Ask students who replaced Aristotle’s classification system. When student(s) reply “Carolus Linnaeus”, ask them if they can recall what he based his system on. Wait for several educated guesses to occur before providing answer- “physical and structural similarities of organisms that revealed relationships of organisms.”

Discuss with class the two-word naming system, binomial nomenclature, which Linnaeus developed to identify species and its importance to the scientific community. Ex. A bluebird to us in the US is likely not the same bluebird to people in other parts of the world, but a Sialia sialis will always be an Eastern bluebird and a Cyanocitta cristata remains a common Blue Jay.

Ask students if there are any other animals that they can think of that people in other countries may confuse when using common names.

Ask students how binomial nomenclature is used to effectively to name an organism. (Bloom’s Comprehension)

Students will divide into groups of 4 (making sure that gifted and talented students and students with disabilities are divided up equally among groups) and create a dichotomous key using leaves collected from various trees in the surrounding area. (Gardner’s Interpersonal, Logical-Mathematical; Bloom’s Application, Synthesis) They can compare colors, shapes, structures, veining, numbers of lobes, leaf edges, or anything else. With their dichotomous key, however, someone outside of the group must be able to read the students descriptions and determine which leaf is being described. Remind students to set up their group’s key in standard form. (1A. If “a”, go to 2; 1B. if not “a”, go to 3)

A representative from each group will present their key to the classroom. Students will be asked to follow along and ask questions if any of the steps in the key are questionable to them. (Bloom’s Analysis, Evaluation)

Taxonomy is a highly scientific way to arrange knowledge of groups of organisms into smaller more specific subgroups. Explain to students that there are 7 levels that Linnaeus developed. They are (in order from largest to smallest): Kingdom, Phylum, Class, Family Order, Genus, Species.
An easy way to remember these levels is through a mnemonic device: “King Philip Came Over For Great Spaghetti.”

Ask students to come up with their own way of remembering the levels, write it down on a scrap piece of paper and hand it in when finished. (Bloom’s Synthesis) It is easier for us to remember mnemonics when they are related in some way to our own lives. Read through several of the students ideas and provide feedback as to the ease and usefulness of their creations. (Gardner’s Interpersonal, Linguistic)

With students, flip to page 465 of book to check out some examples of classification of mammals and to observe where the species diverge from being in the same group. Without understanding the scientific names behind the classification system, ask students to develop their own ideas as to why blue whales, ferrets, and domestic cats are all mammals- yet at the order blue whale is a cetacean while ferrets and cats are carnivore. What is their difference at this point? One step further separates ferrets from cats. Can students depict and part of the Latin word that may help them understand something about that animal? (Bloom’s Knowledge, Comprehension, Application)

Closure:

Ask students if they have any questions pertaining to the information that was provided today and clarify information that is unclear.

Ask students what they have learned today. Make sure to point out key vocabulary words- taxonomy, binomial nomenclature, kingdom, phylum, class, order, family, genus, and species- as well as the two men that developed classification systems- Aristotle and Linnaeus- that were essential to our understanding of relationships between organisms.

Students must work on Section Assessment #1-5 on their own and #6 with a partner for extra credit. If students (most likely gifted and talented) get done with extra time left, ask them to help struggling students through the homework problems.

Accommodations/Adaptations

Students exhibiting gifted and talented behaviors are likely to need more interesting and challenging materials and projects to complete. According to Snowman and Biehler’s Psychology Applied to Teaching, gifted and talented students could be given supplemental reading and writing assignments that incorporate a specific concept from the day’s lesson that the student finds interesting. These particular students could also help struggling students by becoming a peer tutor and assisting them with daily classroom assignments, lab work, or projects. These adaptations allow students to either further develop their understanding of a topic through individual investigation or confirm their understanding of the topic by assisting students who struggle more with the topic.
Students with learning disabilities vary a great deal from one another and therefore their adaptations will differ from one another. Most students in the typical classroom, especially students with learning disabilities, are more apt to learn when a combination of auditory and visual instructions, including hands on activities, is utilized. Often times students have short attention spans, especially when it comes to classes that they are required to take but do not enjoy. In these cases, teachers should recognize this issue and make adjustments to create relatively brief assignments instead of long, drawn out ones. This is a logical adjustment for any classroom teacher who has to handle students that are there because they have to be.
All are Animals and all have vertebrae

Mammals: have young that suckle milk
- Large sea animal: Blue Whale
- Long feeding appendage: African Elephant
- Carnivores: predator, one who consumes others
- Carnivores
  - “True Bears” body structure and manner of walking
  - “Small bears”
    - Common Raccoon
    - Cats
      - Canada Lynx

Birds: egg-laying, feathered animals with wings
- Raptor: bird of prey
  - Bald Eagle
  - Perching and Song birds
    - Northern Cardinal

- Distinct black and white color pattern
  - Giant Panda
- Distinct yellow-white fur color
  - Polar Bear