**Classification Station**

Elisabeth V. Culley, M.A.
GK-12 Graduate Teaching Fellow
School of Human Evolution & Social Change
Arizona State University . Tempe . AZ
elisabeth.culley@asu.edu

Ms. Shannon Harshman
Gavilan Peak School, Deer Valley Unified School District

**Lesson**
Classification Station

**Target Grade(s)**
8th Grade

**Subjects**
classification, variation, adaptation, change through time

**Summary**
*Classification Station* was developed as part of the National Science Foundation’s GK-12 Down to Earth Science Program at Arizona State University. The lesson strives to increase science literacy in the 8th grade by using actual research problems to teach age-appropriate concepts and inquiry methods. *Classification Station* presents students with a collection of living organisms which they must organize as the basis of a classification system that identifies relationships among known species and that helps categorize newly discovered ones. Students develop and apply their pre-existing knowledge about variation, adaptation, and evolution while learning new analytical procedures. *Classification Station* is a “performance of understanding” for Strands One and Four of the Arizona Science and Technology Standard and underscores the relevance of scholastic content in contemporary scientific research.

**Target Standards & Objectives**

National Standard(s): Science as Inquiry, Life Science
Arizona State Standard(s): Science & Technology
Strand 1: Inquiry Process
Concept 1: Observations, questions, and hypotheses
   Objectives: Develop questions based on observations that lead to hypothesis formation
Concept 3: Analysis and conclusions
   Objectives: analyze data that show a variety of possible relationships to identify trends; form a logical argument about relationships between variables; explain how evidence supports the validity and reliability of conclusions; plan new investigations based on known data
Strand 4: Life Sciences
Concept 4: Diversity, adaptation, and behavior
   Objectives: determine characteristics of organisms that could change through time; describe traits that allow organisms to survive and reproduce

**Keywords:** inquiry, life science, variation, adaptation, evolution, classification, taxonomy
Classification Station: Lesson Background & Objectives

Driving Question(s)
What can classification tell us about the evolution of and relationships between living organisms?
What can the comparison of adaptive traits tell us about the evolution of and relationships between living organisms?

Learning Objectives
The lesson should increase familiarity with and understanding of the role classification systems have in organizing data and in identifying relationships among them, of the attributes necessary for an effective classification system in the life sciences, and ultimately, of the relationships among living organisms and the evolutionary principles and mechanisms that underlie them. The lesson should also reinforce and expand students’ understanding of the inquiry process, specifically hypothesis formation and the planning of new research programs.

Lesson Background & Outcomes
Classification Station requires students to be familiar with the diversity of life and with adaptive variability as integral to survival, reproduction, and evolution. Students should also understand the basic principles of classification systems in the life sciences, and specifically that variation in physical and behavioral traits is used to categorize living organisms and to identify relationships among them. Students will apply their pre-existing knowledge in various learning activities to develop and use their own classification system. Ultimately, they will identify the adaptive value and evolution of observed traits, define relationships among species and groups of species, and design future research based on their observations and conclusions.

Materials, Time, & Safety
Classification Station includes a full lesson plan, two sets of activity cards, and a student workbook for Learning Activities 1 & 2. The Contextualization and Exploration phase of the lesson should incorporate fossil replicas, skeletal remains, or photo representations of distantly and closely related species in order to generate interest in and questions about biological diversity. Teachers can have students collect resources while hiking or contact local Fish and Game and Bureau of Land Management officers or museums and universities for demonstrations. The anthropology department of most universities will maintain teaching collections that include many primates and members of the human lineage. Two- and three-dimensional representations of living organisms are also widely available on the Internet.

Classification Station will require two class periods to implement, although advanced classes may finish the group activities in one period and complete the worksheet questions at home. The amount of time dedicated to the exploration of fossil materials during the initial contextualization of the learning activities and the amount of time dedicated to follow-up discussions will significantly impact the amount of time required.

This lesson poses no particular safety concerns.
**Classification Station: Preparation & Learning Activities**

**Preparing Learning Stations**
Students will need to work at small tables in groups of 4-5 children. Each group will need two sets of cards for classifying. Students will use the first set of 12 cards to create their classification system (Learning Activity 1) and the second set of 3 cards to “test” and modify their systems (Learning Activity 2). Each student will need a copy of the Student Workbook for recording their work and answering questions.

**Contextualization & Exploration**
*Classification Station* should begin with an exploration of fossil, skeletal, and/or digital materials that will generate interest in and questions about biological diversity and that will effectively link students’ pre-existing knowledge with learning activities (see Background & Objectives). Teachers should be prepared to discuss specific adaptive traits and indicate how variation in them distinguishes organisms at different taxonomic levels. For example, teachers may point out the different dentition in herbivores and carnivores and explain that all carnivores have teeth that are specialized for capturing and shedding prey. To classify animals based on variation in dentition, then, will result in large and “gross” taxa (in this case, the Order Carnivora). Further classification must be based on variation in traits among these large groups of similar animals. Among the Canidae Family, for example, fox are distinguished by a bony crest near the back of the skull that provides additional muscle attachment and supports specialized food processing abilities not seen in coyotes or wolves. Teachers and students can actually rearrange fossils or other contextualization materials into successively smaller groups while considering the adaptive and analytical value of observed traits. Students should also be introduced to the learning activities during the contextualization and exploration process. Teachers should review the instructions for each learning activity, the types of information provided on the activity cards and any new or difficult vocabulary. While teachers should also review the standards for effective classification systems (see Terms, Traits, and Taxonomy), they should encourage students to ignore currently accepted taxa and design their own systems.

**Learning Activity 1: Developing New Systems**
During the first activity, students will use variations in the physical and behavioral characteristics of 12 species to create three distinct taxa. Emphasis is placed on the ability to identify related groups of organisms and appropriate diagnostic traits for each group. Many students will be familiar with these species; however the accepted taxonomic and common names have been omitted to minimize the impact of pre-existing knowledge.

**Learning Activity 2: Application & Modification**
The second learning activity may begin with students sharing the results of their work, and particularly the diagnostic traits for each of their taxa. Most teams will have identified the same taxa, but discrepancies may be debated. Each team will then use its own diagnostic traits to classify three “newly discovered” species. These species have controversial or surprising taxonomic status in the life sciences, and teachers should expect varying outcomes and further discussion. The class should revisit the standards for effective classification systems, address the need for modifying scientific results based on new data, and consider new research programs that have emerged from their work. Emphasis is placed on the efficacy, modification, and continuation of scientific research.

**Learning Assessments**
*Classification Station* is a “performance of understanding” lesson, applying the basic principles for classifying biological organisms, for defining evolutionary relationships, and for identifying change through time. This lesson also entails an understanding of scientific methods and the mutability of scientific knowledge. Discussions facilitated by each learning activity provide teachers further opportunities to assess and correct student knowledge, as well as guide its application in novel contexts. Finally, questions that follow each learning activity demand students express their knowledge clearly and explicitly.
Classification Station:
Terms, Traits, and Taxonomy

Terms
taxonomy/taxon
herbivorous, carnivorous, omnivorous
bipedalism, quadrupedalism
diurnal (primarily active during the day)
octurnal (primarily active during at night)
arboreal (lives primarily in trees)
prehensile (able to grasp)
digitigrades (animals that walk on their digits, or toes)

Classification System Standards
1. organizes a large amount of information so that it is easy to work with and talk about
2. identifies shared traits among group members (diagnostic traits) that support a formal taxonomy and the classification of new data
3. generates diagnostic characteristics which define groups that are mutually exclusive across a given taxonomic level (e.g., Order, Family)
4. is consistent but flexible: all individuals are not expected to show all traits considered diagnostic of its group; taxa and/or their diagnostic traits may be altered with the discovery of new information or entirely new organisms

Classification Key
1: Australopithecus bosei (Primate Group)
2: Archaeopteryx lithographica (Reptile Group)
3: Red Colobus Monkey: Piliocolobus kirkii (Primate Group)
4: Siberian Husky: Canis lupus familiaris (Canidae Group)
5: Tamarin Monkey: Saguinus mystax (Primate Group)
6: Jurassic crocodyliform (Reptile Group)
7: Miniature Domesticate: Canis lupus familiaris (Canidae Group)
8: White Throated Monitor Lizard: Varanus albigularis (Reptile Group)
9: Red Fox: Vulpes vulpes (Canidae Group)
10: Tarsier: Tarsius punulus (Primate Group)
11: Triceratops horridus (Reptile Group)
12: Dachshund: Canis lupus familiaris (Canidae Group)
13: Dryomomys szalayi (Primate Group)
14: Raccoon Dog: Canis lupus familiaris (Canidae Group)
15: Madras Treeshrew: Anathana ellioi (Primate Group)

Group Characteristics

<table>
<thead>
<tr>
<th>Primate Group</th>
<th>Reptile Group</th>
<th>Canidae Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>stereoscopic (3-D) vision</td>
<td>cold-blooded</td>
<td>olfactory adaptations</td>
</tr>
<tr>
<td>prehensile hands &amp; feet</td>
<td>air-breathing</td>
<td>peripheral vision</td>
</tr>
<tr>
<td>opposable digit</td>
<td>scales</td>
<td>fused wrists</td>
</tr>
<tr>
<td>fingernails (vs. claws)</td>
<td>egg born, independent young</td>
<td>digitigrade</td>
</tr>
<tr>
<td>warm-blooded</td>
<td></td>
<td>dewclaws</td>
</tr>
<tr>
<td>placental born, dependent young</td>
<td></td>
<td>omnivorous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>very social</td>
</tr>
<tr>
<td></td>
<td></td>
<td>placental born, dependent young</td>
</tr>
</tbody>
</table>