Life Sciences

It's All About What's Inside
Classification and the Tree of Life - Students Lab

6-8

Lesson plan by Deb Williams, modified by TBI

PROBLEM QUESTION:

How do scientists determine the evolutionary history of an organism in order to correctly place it on the Tree of Life?

HYPOTHESIS: ????

MATERIALS:

Set of 6 plastic eggs

VOCABULARY

Taxonomy, DNA, Phylogeny Tree, Tree of Life

Domains of Life: Archaea, Bacteria, and Eukaryote

BACKGROUND CONTENT:

Traditionally, the classification of organisms or **taxonomy,** has relied on physical characteristics to understand the relationships between living things. Carl Linnaeus in the 1700's classified organisms this way. His system used broad grouping characteristics that gradually become more descriptive until the organism reached a species name. The system that began with Linnaeus is Kingdom, Phylum, Class, Order, Family, Genus and Species. For example the wolf is classified in the Animalia Kingdom (all moving and respiring organisms), Chordata Phylum (animals with spinal cords), Mammalia Class (animals with hair and mammary glands), Carnivora Order (meat eaters), Canidae Family (dogs), Canis Genus (jackals, coyotes, and wolves), *lupus* Species (wolf). The binomial name is *Canis lupus* which translates to wolf dog.

The naming of organisms with binomial nomenclature helps describe and identify related species. At the present time there are approximately 1.4 million named species, an overwhelming diversity of species that can be comprehended using taxonomy. The following example uses a classification scheme to separate out 6 kinds of animals (Figure 1). However, classification can occur in several ways.

PROCEDURE part 1:

1. Obtain a set of 6 plastic Easter eggs from the resource table.

2. Carefully examine the eggs without opening them. Classify the eggs using at least two different features (similar to Figure 1).

3. Record the characteristics you used to classify the eggs on the blank classification scheme provided (Figure 2).

4. Trade your classification scheme with another working group; use their scheme to classify your eggs. Did you classify the eggs the same way? Are there multiple ways to classify organisms by physical features? How do we find the correct one?

5. Discuss with the class the methods used to classify eggs.

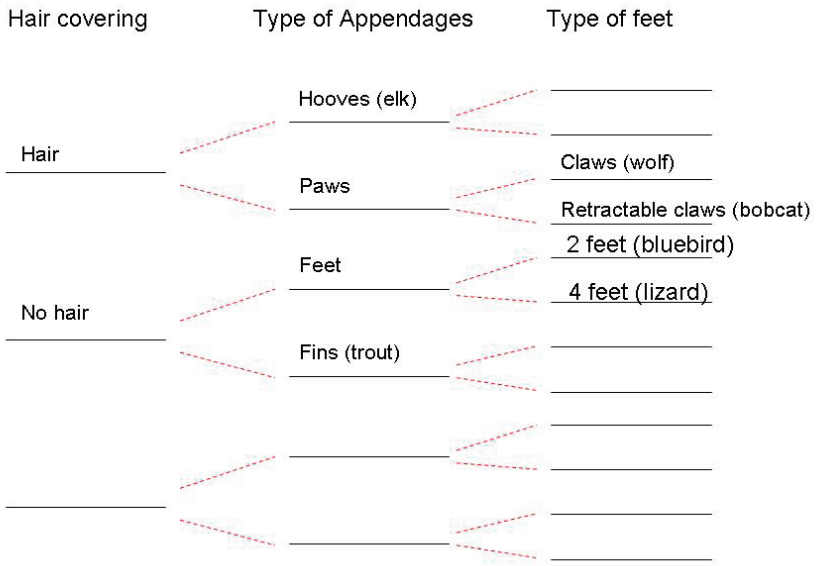

FIGURE 1. A classification scheme for Elk, Bobcat, Wolf, Lizard, Bluebird, Trout . The characteristics used for classification are hair covering, type of appendages, and type of feet.

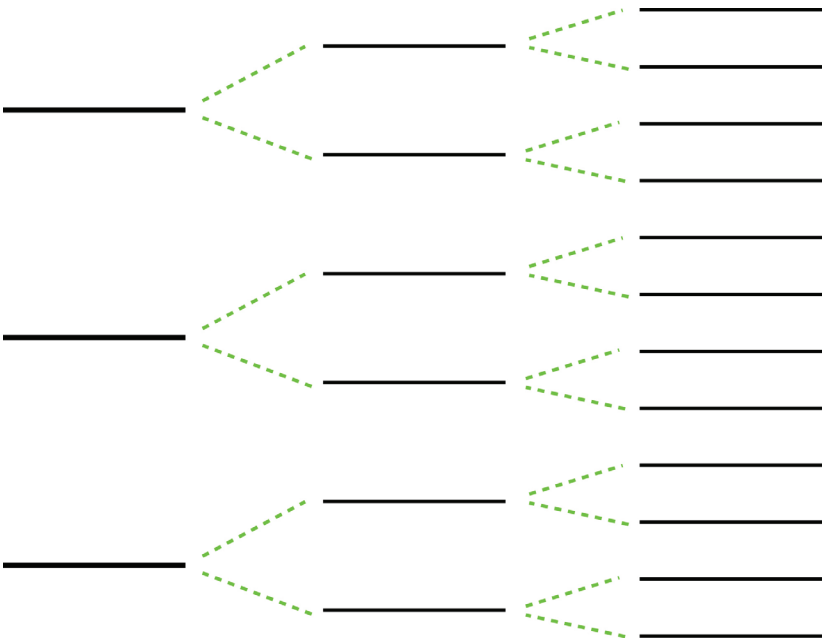

FIGURE 2. Classification of egg organisms.

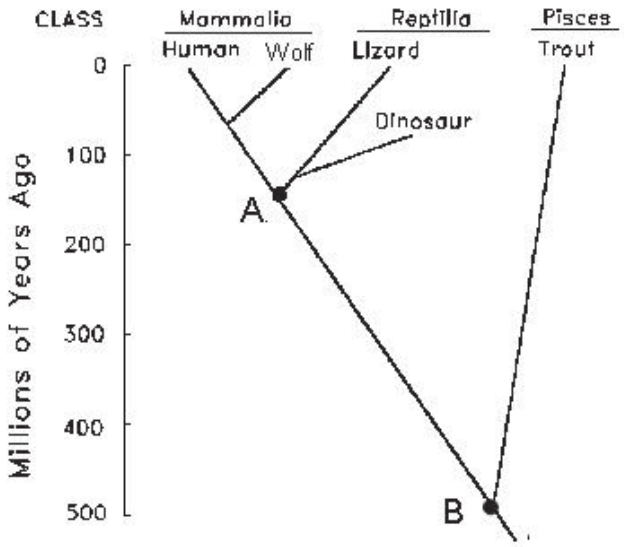

FIGURE 3. PHYLOGENY TREE

Technological tools have allowed scientists to readily and relatively inexpensively classify organisms by their genetic information. This advancement has greatly changed the way biologists view relationships between organisms and the evolution of organisms. Scientists determine evolutionary history by analyzing genetic material, or **DNA**, in the cell.

DNA is the code for life and is found in every cell of every living organism. Scientists now can see genetically that certain organisms are similar because they share common genes and therefore ancestors. Above is an example of a **phylogeny tree** which represents genetic relationships of organisms through time (Figure 3). There is a common ancestor at point 'A' at 150 million years ago for mammalian and reptilian species. At point 'A' cold blooded land species diverged from warm blooded land species. There is a common ancestor at 500 million years ago for all species with boney vertebrae at point 'B'. At this point 'B', land species separated from aquatic species.

PROCEDURE part 2:

6. Open your eggs and examine the genetic code inside. Record the code given for each of your eggs and their physical characteristic on the table provided.

7. Analyze the genetic code 3 letters at a time. Remember, these three letters represent the codon for the RNA, which is translated into an amino acid which they in turn hook together to make proteins. Determine which eggs are related genetically.

8. Describe how your eggs are related based on the genetic information. Explain any relationships in the last column of the table.

9. Create a phylogeny tree or "Tree of Life" for your eggs using the information you have learned (similar to Figure 3).

10. Compare the data you collected in the first part of the lab to the data from the second part of the lab. Is your physical classification scheme similar to the genetic classification scheme? If not, how are they different?

11. Describe a possible evolutionary event or events that occurred at the junctions of any lines on your phylogeny tree.

Genetic Code	Number of Egg	Color of Egg	Number of eyes	Horns	Tail	Number of legs	Relatedness of the Eggs

'Tree of Life' - create your drawing here

SUMMING IT UP:

The **Tree of Life** represents the relationship of all life on earth. On this tree, there are 3 domains of life, Bacteria, Archaea, and Eukaryote that are depicted by the 3 large branches of the tree. Bacteria and Archaea, as well as, the base of the Eukaryote branch are all single celled organisms. Using the Tree of life answer the following questions:

1. Where are humans on the tree of life?
2. What is the name of the Domain that humans belong?
3. Fungi and bears share a common ancestor. How can this be?
4. What is the purpose of classifying organisms?

RESOURCES:

http://nsm1.nsm.iup.edu/rgendron/labs.shtml

http://evolution.berkeley.edu/evosite/evo101/IIntro.shtml

http://www.tbi.montana.edu outreach/hotscience/materials/