Phylogeny Activity

Project Description:
The lesson will introduce students to phylogenies, including how to build and interpret them and their application. The lesson will include a hands-on activity in which student will build a phylogeny using candy “organisms.”

Project Objectives:
Students will be able to:

1. Understand historical and contemporary explanations of adaptation and biodiversity
2. Identify traits and use those traits to build a phylogeny
3. Correctly interpret phylogenies, including relatedness, homology and convergence
4. Apply evolutionary thinking to specific biological examples

North Dakota State Science Standards:

9-10.1.6. Identify principles governing evolution and equilibrium within systems (e.g., cause and effect, positive and negative feedback)

8.4.1. Identify the evidence of biological evolution. (e.g., adaptation, radiation, extinction) as found in the fossil record

9-10.4.1. Relate the concept of natural selection to its evolutionary consequences

9-10.4.2. Identify evidence for evolution (e.g., fossil records, vestigial structures, similarities between organisms, and DNA)

9-10.5.2. Relate the changes in the Earth’s atmosphere to the evolution of photosynthetic life forms

Schedule:

11:00-11:30 Cultural connection

11:30-11:45 Evolution- what is it? And why is it important?

11:45-12:00- Introduction to phylogenetic tress

1. Introduction: Why are phylogenetic trees important? What do we use them for?

2. Define terms: Evolution, phylogeny, node, common ancestor, parsimony, others….
3. Small activity: build a phylogeny with three organisms. (Same as the ungulate example, but pick a ND native organism- Need a handout for this!)

4. Regroup: How do we use trees to determine relatedness?

12:00-12:30 Lunch

12:00-1:30 – Candy Phylogeny Activity- Establish student groups, introduce the activity and directions. (See student handout for Candy Phylogeny Activity at the end of the lesson plan).

Outline of Candy Phylogeny Activity
1. Student groups will define their candy traits
2. Student groups will fill out the character matrix
3. Student groups will draw 2-3 phylogenies
4. Student groups will determine the “best” of their phylogenies using parsimony
5. “Best” phylogenies will be shared with the class, instructor will provide feedback on strengths and conforming to conventions of phylogenetic representation

1:30-2:00 – Homology and convergence in phylogenies- Define homology and convergence, provide examples in nature, relate it back to candy phylogeny- where there any convergent traits on the candy phylogenies?

2:00-2:30- Applications of phylogenies. Where does flu come from? Where do the foods we eat come from?

2:30-3:00- Wrap up
CONSTRUCTING AND EVALUATING CANDY PHYLOGENIES

Instructions

Work with your group to construct and evaluate phylogenetic trees of a collection of candies. To build the tree, use the steps outlined below.

Step 1: Spend some time looking at the candy to assess possible characters (get creative, wrapper color, ingredients etc). Choose 10 characters. Define your characters such that only two character states are possible in your collection of candy. Next determine the polarity, relative to the outgroup. If the trait is present in the outgroup, assume it is ancestral. Now code the characters in the matrix below (1= has the character, 0= does not have the character).

Step 2: Now draw 3 hypothetical trees. At this point do not worry about whether it is the best tree or how the traits will map onto the tree.

Step 3: Now map each of the character traits from your matrix onto the trees. It will probably be easiest to code each of your traits with a number or letter. Put a slash and indicate whether it is a gain or loss of the trait. Which tree is most parsimonious?

Step 4: Now use the idea of parsimony to see if you can create a better tree. Using your chosen tree, now indicate which traits are synapomorphies and homoplasies.

Matrix

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