Title:
Go Extinct! Exploring Morphological Traits and Extinction Simulation Game

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Abstract:
Scientists use the Phylogenetic Tree to look at similarities and relationships between organisms, and have designed the Phylogenetic Tree by looking at different characteristics of organisms throughout time. As discussed in the film Tree Tender, all organisms are connected through this tree, though very distant at times. In ecosystems, such as the coral reefs, many of these organisms rely on each other for survival. When a species becomes extinct, we not only lose that organism, but many others that may depend on them. We are contributing to a mass extinction event, the Anthropocene Extinction. Your class will participate in a three-part activity exploring both the tree of life and mass extinction events. The first activity explores ecological concepts, such as different traits of organisms and levels of classification. The second activity explores grouping these traits on a linear line to show how scientists once ordered organisms by morphological traits, and discussing links between species and the knowledge of a common ancestor. The third activity looks at our negative contribution to the current mass extinction event, allowing students the opportunity to collaborate with each other on changes they can make to save an ecosystem. The main pedagogy used here is Differentiated Instruction through active learning and Co-operative Learning. By looking at real-world issues, students will also experience Experiential Learning, Inquiry Learning, and Open-Ended Instruction, allowing them to explore real ways they can help our planet with their peers.

Learning objectives:

- Understand how scientists once arranged organisms in the Tree of Life by morphology
- Make connections between different organisms through active learning
- Understand similarities and differences between organisms
- Discover how human impact can affect different ecosystems
- Collaborate with classmates on solving real-world problems
- Understand the balance within food webs between plants, animals, and abiotic factors

Timeframe:
Watching Tree Tender takes about 15 minutes. The three activities should take about 15-20 minutes each.

List of materials:
Paper and Colored Pencils (If drawing organisms)
Print-out Pictures of Organisms (If Skipping Optional Step)
Large Space (Preferably outside)

Procedure and general instructions (for instructor).

- Randomly assign organisms to students from the list provided
- (OPTIONAL) Give the students a few minutes to draw their organism with its name.
- If preferred, print out a picture of the organism for your students instead of drawing.
- **Activity 1**: Begin by having the students stand in the center of the room or outdoor area. Students will now order themselves on opposite sides of this area based on traits. Traits listed below start broad, and then become more specific. Some ways students can organize themselves is by:
    - Kingdom: Fungi, Plants, or Animals
    - Vertebrates vs. Invertebrates
    - Flowers vs. No Flowers
    - Asexual Reproduction vs. Sexual Reproduction
    - Warm-blooded vs. Cold-blooded
    - More categories, as you see fits your classroom and previous lessons.
    - Remind your students that this is one way scientists have classified organisms by characteristics.
- **Activity 2**: Give your students a few minutes to form a single line based on how similar their organisms' morphological traits are to one another. To help, start with the slime mold on one end and the bison on the other. Have students compare different traits to each other to find the approximate correct order.
    - Remind your students that the characteristics they practiced with in the first activity can be used to find out how closely related different organisms are (such as the same Kingdoms, Class, or Order being grouped together).
    - Change from organism-to-organism should move gradually across the line, though you may see a jump between Kingdoms, from plants to invertebrates, and within the mammals.
    - It is most important that your students are collaborating and working together, even if the students come to the wrong conclusions. A list of the approximate order is provided below. Make sure all students are participating and it is not just a few students leading the group.
    - Once in line, ask your students how many steps it takes to get from two more closely related organisms (such as the dolphin and the wolf) and two distantly related organisms (such as the wolf and the sagebrush). Remind students that while they may be more distant from each other, they're still related in some way and share a **Common Ancestor.**
    - Remind your students that when scientists originally began making the Tree of Life, they used morphological traits (just as your students have done), but can now get a better idea of evolutionary history through studying DNA called Phylogenetics.
- **Activity 3**: The ecosystems are now collapsing due to human impact.
    - Divide the students up based on the biome in which their organism occurs in (List provided).
    - Have the students discuss amongst themselves how their organisms in their biome may interact.

- Have one student volunteer to be the Tree Tender along with representing their organism. The Tree Tender will save a species when the whole class votes to protect it.
- Instructor will shuffle the cards provided, drawing a card one at a time. Cards will have a human action and how it affects one or two species in any given biome.
- When an organism in the exercise goes extinct, that student representing it must sit down.
    - Before the student sits, the classroom has the opportunity to vote on saving the species. This may be done THREE TIMES during the game.
    - If there is more than one organism affected on the card, a majority of the class must vote to save the species after the first organism (and before the second organism is read).
    - The Tree Tender must come up with a solution on how they will save the species based on how the species is being harmed in the narrative.
    - All students can assist the Tree Tender in finding this solution, as it is up to everyone on the planet to come together and find a solution to the problems we've caused.
- The game ends when you either run out of cards (in which the whole class wins) or you run out of species (in which the whole class loses).
- The game should move quickly, so the class can try multiple rounds to see what outcomes they reach. Have other students volunteer as the Tree Tender as well.
- For an added activity, you can calculate the percentage of species remaining in each round by using the following equation:

$$\frac{\text{Species Remaining at the End}}{\text{Total Number of Species}} \times 100$$

Organism and Biome Lists

In the table below, you'll find each of the four biomes represented in this activity with the organisms living in each one. Each student will represent one organism.

Desserts	**Marine**	**Prairie**	**Woods**
Sagebrush	Kelp	Prairie Grass	Pine Tree
Cactus	Coral	Wildflower	Fern
Fungi	Crab	Slime Mold	Pitcher Plant
Bee	Fish	Grasshopper	Earthworm
Tortoise	Shark	Flycatcher	Bird
Kangaroo Rat	Dolphin	Wolf	Snake
Bat		Bison	

The list below shows the approximate order for students to order themselves. It is better if students discuss how to order themselves in line, but if confusion occurs the basic order is plants (with the angiosperms, or flowering plants, occurring last), invertebrates, fish, reptiles, birds, and mammals.

Approximate Order:

Slime Mold
Fungi
Fern
Pine Tree
Kelp
Prairie Grasses
Sagebrush
Wildflower
Cactus
Pitcher Plant
Coral
Earthworm
Bee
Grasshopper
Crab
Fish
Shark
Snake
Desert Tortoise
Flycatcher
Bird
Kangaroo Rat
Bat
Dolphin
Wolf
Bison

Reference list

TreeTender. (2017). Retrieved May 9, 2018, from https://www.treetender.org