Title: "*Ecological niche modeling for Hula Hoop ecosystems"*

Author:
L. Clara Mabour
Northeast High School
lise.mabour@browardschools.com

Abstract:
Biodiversity is not limited to large scale ecosystems, scientists can measure species diversity in small areas. An organism serves roles in their ecosystems through and are indirectly connected to the abiotic and biotic materials/beings with the ecosystem. Phylogenetic trees help scientists predict the degree of relatedness between organisms and can help indicate relationships evolutionary relatedness or coevolution among organisms in similar environments. In this activity, students will use a hula hoop to mark a random area of land from which they will collect data to identify small scale biodiversity, species relatedness, and then map the locations of those organisms within the given area. Students will also produce a cladogram or phylogenetic tree to demonstrate how relatedness among the organisms.

Subject, Grade, Level:
Subjects (Biology, Marine Science, Environmental Science), grade (middle, high) (all levels)

Learning objectives:
By the end of this activity, students will be able to:

- Identify biodiversity within a small area
- Use data collected to create written maps with data points
- Understand the concept of ecological niche modeling
- Understand some elements of coevolution
- Understand concepts of comparative genetics/genomics
- Use morphological data to identify classify organisms in phylogenetic trees
- Determine relatedness of organisms through phylogenetic trees
- Use open source online phylogenetic software

Timeframe:
60 mins instructor preparation
180 mins estimated class time (two 90-minute class periods)

Day 1: Data collection and sample analysis
Day 2: map making, and gallery walk

List of materials:

- 36" Hola hoops
- Tape/glue
- Computer paper
- Construction paper
- Pencil/pens and different color permanent markers
- Translucent tracing paper/transparent sheets

- Outdoor space/ with versatile conditions (green space)
- Computer and internet access
- Cellphone/camera
- Small shovel/dissecting tray/dissecting microscope/specimen jars/petri dishes
- Gloves
- Ruler/measure tape
- Forceps
- notepad

Procedure and general instructions (for instructor). REQUIRED.

- *Review notes on biodiversity, ecological niche modeling, species richness, phylogenetic trees/cladograms, open tree of life*
- *Review lab safety protocol and microscope usage*
- *Gather the lab materials in stations (Microscope, map making equipment, computer with access to the internet,*
- *Open Tree of Life Introduction-Show students how to search taxa to develop a sample tree for the organisms*
- *assign students in groups of 3-4 and allow them to select their roles in the group (they will have to select two positions, 1 for the field research and 1 for the lab research)*
- *Lay out 1 sheet translucent paper and at least 4 or more sheets of transparent sheets for students to draw their map layers*
- *Help students display their maps and cladograms/trees around the classroom and allow them to do a gallery walk to observe the work done by other students*
- *Students will turn in a summery of their experience and answer the questions below to conclude the activity*
    - *How do abiotic factors impact the distribution of biotic beings in your sample area?*
    - *Which organisms were the most closely related and what were their positions in the space in relation to one another?*
    - *What can you conclude about the relatedness of the sample organisms and their location in the sample area?*
    - *What modifications would you make to the protocols in this activity and what next steps would you take?*

**to extend this activity for higher level courses: collect soil samples collect DNA from the samples, send for sequencing, use sequenced data to further analyze the microbial life and determine their function in the soil and the small ecosystem. This step will require BLAST, MEGAX, a text editor, Interpro at www.ebi.ac.uk/interpro*

** to extend this even further, students can select one or more organisms found in the plot and and create a map that shows the distribution in a greater region.*

Procedure and general instructions (for students)

Field research

- *In groups of 3-4 students assign roles for field exploration (the recorder 1 (writing), recorder 2 (video and photo), measurer, soil sample digger)*
- *In the outdoor space, randomly toss the hula hoop and the area with becomes your testing area (only take samples from the space, do take notes on the region, like moisture, proximity to human made structures… take pictures)*
- *You will use this data to identify different species of organisms in the selected area with the hula hoop*

Lab research

- *In groups of 3-4 students assign roles for field exploration (cartographer 1, cartographer 2, soil scientist, Phylogenetic tree researcher)*
- *Students will review the organisms and notes from the field and map the locations on the map*
- *Use different layers of transparent sheets to depict distributions of different organisms of conditions*
- *Review each organism and identify their common and scientific name*
- *Use the names to search for their position on the tree of life and use that to form a tree of the organisms in your sample*
- *Prepare your map and tree for a gallery walk, provide your notes and photos*
- *Answer the concluding questions*

Reference list

Open Tree of Life. Retrieved July 18, 2018, from https://ot14.opentreeoflife.org/opentree/argus/opentree9.1@ott93302

Any other appendices appropriate for your particular activity

Role	**Description**
(the recorder 1 (writing),	*Recorder 1 takes notes during discussions in the field about surround environment and measurements*
recorder 2 (video and photo),	*Take photos of the conditions and organisms with the hula hoop area*
Recorder 3 (measurements)	*measurer measure the temperature of the soil in 4 different points of the sample area and distance between organisms*
soil sample digger	*Collect 4 soil samples from different points within the selected area, only dig down 2-4inches*
cartographer 1,	*Draw the base of the map, rotate drawing the data layers with Cartographer 2*
cartographer 2,	*Use temp data to make the temp layer and then rotate drawing the other layers with cartographer 1*

soil analyzer	*Use the dissecting scope and naked eye to identify organisms in the soil samples, record organism and give to open tree of life researchers, helps look for common and scientific names of organism*
Open tree of life researcher	*Takes the list of organisms and searches though open tree of life portal and create a cladogram/tree for the identified organisms*