Lesson Title:	Human Ecology
Grade Level:	High School
Subject:	Ecology
Contributed By:	C. Alfano

Engagement:
- Python
  - Students will be introduced to Python
    - go over need to be explicit:
      - Give non-coding examples
      - Ex. How to get to school from point X
        - Have a map up, students will give directions to teacher, who will follow <u>exactly</u> what they said
        - Once they have a correct route, teacher will record directions
          - Teacher will change directions slightly (ex. Go east instead of west) but still follow the rest of the original directions

Source: https://www.pinterest.com/pin/464011567856159620/?nic=1a
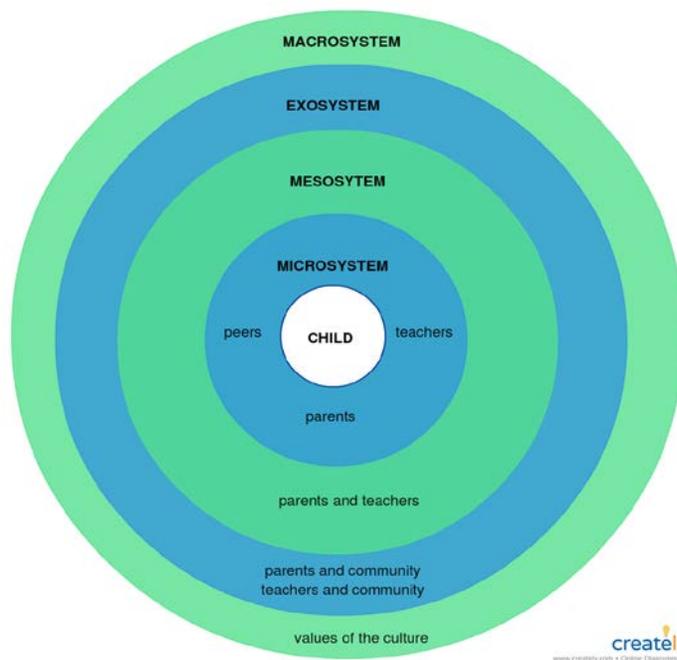
- Use these examples to explain how specific and thorough a code need to be to function correctly, and how something can not be done if it's not written correctly
  - Introduce Python, go over basic functions, as well as functions needed for lesson
    - Students will use repl.it to follow along
    - Students will also have access to a sheet with all relevant functions with a short description of what they do

- Powerpoint:
  - Introduction to Populations
    - Ask students if they have ever seen a group/herd/flock of animals (not in captivity) and describe (what animal it was, how many were there, do they know what the lifespan is...)
    - using students examples, will ask students to get into groups and try to come up with ideas of how the population is maintained
    - introduce "$N_{t+1} = N_t + B + I - D - E$" (factors leading to population change)
      - N=number of individuals (t=current year, t+1=next year)
      - B=number of births
      - I=number immigrating into population
      - D=number of deaths
      - E=number of emmigrators (moving out of population)
    - Emphasize the amount of data for a single population
    - Talk about what researchers use to do vs. what we can now do using technology such as programs

Exploration:

- Students can work in groups, but everyone has to summit their own working code; every student has their own computer.
- Students will focus on population growth by birth data
- Fecundity Table (data about births in population)
  - The students will be introduced to the table, and a blank table will be shown on the board (found at end) and each column will have a basic, mostly one-word description. The students will then figure out/discuss how each column relates to births and write it down (with some of the more complicated ones, more hints will be provided). (10 mins)

- ○ As a class, the teacher will go through what the table means (columns and equations- asking students to try to explain using their own words).
- ○ The students will then use Python to:
  - ■ Create lists for each column by prompting the user questions
    - ● Ex. The students will use the prompt "What is the number of individuals for this age group?" to collect data for the "Number surviving to age x" column
  - ■ Calculate certain equations (given in the worksheet)
    - ● Ex. The students will input the equation for the Net Reproductive Rate, which is the sum of all numbers in the "Proportion Surviving times Fecundity" column using their Python variables
  - ■ This is also something the students can work on at home, depending on the class
- ● At the end, students will submit their code on Repl.it

Explanation:

- ● The teacher will then have a pre-done code, and will go through the code line by line with the students, who will compare their code to the teacher's (the student's codes will have already been submitted)
- ● Students will also discuss how to use the data to determine if the population is growing, shirinking, or stable, using $r = \frac{\ln (R_0)}{T}$ (if r>0, the population is growing, if r<0, the population is shrinking, and if r=0, the population is stable, r is also equal to the percent of either increase or decrease).   This is done at this time because it will not be included in the Python code (students will use calculators for this).
- ● The students will then be given a population data worksheet (found at end) and using their own codes, they will fill out their own tables.

Elaboration:

- ● The teacher will ask the students:
  - ○ Why life tables are necessary/ what's the point?
  - ○ if they know any real-life situations (the teacher will give some if students don't know)
  - ○ Why did we use Python/could we use it for anything else?

Evaluation:

- They will be given a worksheet to complete individually (found at the end)
- They will be given a rubric for their presentation (Explanation of each score will be given)