Ecology Habitable Planet Lab

Purpose: To examine the interrelationships between organisms in the environment.

Directions:

1. Read ALL Instructions and the introduction section BEFORE doing the lab.
2. Go to: http://www.learner.org/courses/envsci/interactives/ecology/
3. Click on “Open Simulator”
4. Download the instruction power point from Ms. Rodela’s AP Biology 2015-2016 webpage. Review this power point and refer to it as necessary to complete the lab.
5. Print our and complete this paper by hand.
6. Write a lab report (instructions are on Ms. Rodela’s web page).
7. Upload your report to Turnitin.com
8. Keep this paper with your raw data and notes to include in your binder check.

Introduction:

Ecosystems are a complex and delicate balancing game. The addition or removal of one species affects many other species with which it might compete for, or provide food. In this lab you will get a chance to "build your own" ecosystem, and explore the effects of these interrelationships.

In any given ecosystem, most organisms will carve out a niche for themselves where they can obtain all of the necessities to survive. Often, different species within the ecosystem will compete for the resources that a niche provides. However, certain species live well together—symbiotically, parasitically, or by staying out of each other's way. For example, lichen and moss, often the primary colonizers of a new ecosystem, tend to live fairly harmoniously in each other's vicinity.

In theory, an herbivore native to the ecosystem should feed primarily on the dominant species. In this system, the herbivore may consume enough of the dominant species to give the non-dominant species a chance for proliferation and survival. Similarly a predator will feed primarily on the dominant herbivore and give the non-dominant species a chance to survive.

As food webs grow more complex, the interactions between organisms increase, leading to many different possible outcomes for the ecosystem. Small changes can often lead to big changes in the climax community.

AP Biology Essential Knowledge Standards addressed:

2.D.1 All biological systems from cells and organisms to populations, communities, and ecosystems are affected by complex biotic and abiotic interactions involving exchange of matter and free energy
4.A.5 Communities are composed of populations of organisms that interact in complex ways
4.B.3 Interactions between and within populations influence patterns of species distribution and abundance
4.B.4 Distribution of local and global ecosystems change over time
4.C.4 The diversity of species within an ecosystem may influence the stability of the ecosystem

Key Vocabulary: competitive exclusion principle, succession, food web

Lesson 1: The Producers

Step 1Challenge: Try to get two plant species to co–exist.

Instructions:

1. Imagine the ecosystem is newly forming—the previous ecosystem has been destroyed by fire or flood—and the first colonizers of the successive ecosystem are, of course, producers.

2. Given the two fictitious species of plants in the simulator,
   a. Predict what will happen to the population of each species at in this young system and record your prediction in the Data Table.

Lesson 1: Step 1	Plant A	Plant B
Prediction:		
Starting population		
Ending population		

   b. Then run the simulator to 100 time steps and record the population numbers for both plants.
   c. Take a screen shot of the completed graph for your lab report

3. Answer the following:
   i. What assumptions does this model make about co-dominance as well as the general terrain of the ecosystem?

   ii. Do you find one producer to be dominant? Why might one producer be dominant over another?

Step 2 Challenge: Now you'll introduce an herbivore into the environment.

Instructions:

1. Click on herbivore A (the rabbit) and choose "eats plant A."
2. Predict and record what will happen to the population numbers in the ecosystem.

Lesson 1: Step 2	Plant A	Plant B	Herbivore A
Prediction:			
Starting population			
Ending population			

3. Rerun the simulator and record your results.
4. Take a screen shot of the complete graph for your lab report.
5. Answer the following:
   - i. Does adding the herbivore establish a more equal field?
   - ii. Is one producer still dominant over the other?
   - iii. Why might one producer be dominant over another?
   - iv. If the simulation included decomposers, how would your current results change?
   - v. How do producer population numbers with the presence of an herbivore compare to the primary colonizer model?

Lesson 1 Review Questions:

1. How does this lab illustrate the "competitive exclusion principle”?

2. How does presence of a consumer allow the other species to survive?

3. The primary colonizers of an ecosystem, the producers, are also the harbingers of primary succession. As these pioneer plants die and decay, they add organic material to the soil, which, over time, will allow for secondary succession—generally larger and more delicate producers such as trees.
    a. How will the environment be different as between Step 1 and Step 2?

    b. Assume that Plant A increases the acidity of the soil when it decays. How will this affect succession?

Lesson 2: Food Web

<u>Step 1 Challenge</u>:
Now that you have a sense for the interrelationships between the trophic levels, see how big you can make your food web and still have all of the species you add survive through the end of the simulation run.

<u>Pre Step Question</u>: Keeping the ideas of succession and the competitive exclusion principle in mind, think of factors that may go into sustaining an ecosystem.

<u>Instructions</u>:

1. First you'll run a less than "real-life" scenario. Choose only one organism from each trophic level and make sure that the food chain goes in a straight line from one trophic level to the next.
    a. Herbivore A eats Plant A
    b. Omnivore A eats Herbivore A
    c. The Top Predator eats Omnivore A
    d. Let Plant B survive on its own and see what happens.

2. Predict:
    a. Whether each species will survive
    b. Whether it will increase or decrease in number
    c. Whether Plant B will survive to the end

3. Record your prediction in the Data Table. Use X for "die out," ↑ for "increase in numbers," and ↓ for "decrease in numbers."

4. Run the simulation **twice** and record the final population numbers of each species in your data table. (Replication is a key factor in scientific experiments. You are running your simulation multiple times to see if you get the same results each time. This allows you to determine if the events you are seeing are really the way the natural world works or if you need to do further investigations.)

Lesson 2: Step 1 (X, ↑, or ↓)	Plant A	Herbivore A	Omnivore A	Top Predator
Prediction				
Simulation 1				
Simulation 2				

5. Take screen shots of the final graphs for your lab report.

6. Answer the following:
   i. Was your prediction correct?

   ii. How did you arrive at your prediction?

   iii. What differences were there between your prediction and the simulation?

   iv. What would happen to this imaginary ecosystem if the producers were to die out?

   v. Did any of the species increase in number? If so, which ones?

   vi. What could account for this increase?

   vii. Which species decreased in number and what might account for this decrease?

   viii. Which populations would benefit the most from the presence of decomposers? Explain your answer.

Step 2 Challenge:
Now try a more "real-life" scenario and experiment with what might happen in an ecosystem that is more like a web.

Instructions:

1. This time click the "all on" button. The model shows who eats whom and the paths by which energy is transferred.

2. Predict which populations will die out, increase in numbers, or decrease in numbers and record your predictions.

3. Run the simulation **twice** and record the results in your Data Table as you did in step 1.

Lesson 2: Step 2 (X, ↑, or ↓)	Plant A	Plant B	Plant C	Herbivore A	Herbivore B	Herbivore C
Prediction						
Simulation 1						
Simulation 2						
Modifications made						

Lesson 2: Step 2 (X, ↑, or ↓)	Omnivore A	Omnivore B	Top Predator
Prediction			
Simulation 1			
Simulation 2			
Modifications made			

4. Take a screen shot of all of your graphs to include in your final lab report.

5. Then try to modify who eats whom in order to ensure the survival of all species and record what was changed in your chart. (Modifications = change what each species eats)

6. Answer the following:
   i. Was your prediction correct?

   ii. How did you arrive at your prediction?

   iii. What differences were there between your prediction and the simulation?

   iv. Were you able to modify the parameters so that each species survived? Explain how you decided what changes to make.

   v. Which way does energy flow and how does eating an organism result in energy transfer?

Lesson 2 Review Questions:

Ecosystems have an extremely complex web of cause and effect. Changing one connection or altering the population of any species within an ecosystem can have dire, cascading effects on all others within that ecosystem. Given this consider the following:

1. How does a natural ecosystem offer suggestions toward a more economical and eco-friendly human model for managing ecosystems?

2. How do humans affect the greater food web?

3. In this model, how could humans who do not live in the ecosystem still manage to alter the flow of energy within the web?