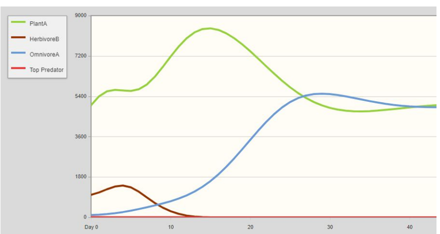
Investigation: The Habitable Planet - A Simulation of Interactions

AP Biology

In this activity, you will attempt to construct a food web and establish an ecological community. Can you construct it in such a way that it is self-sustaining? What happens when the ecosystem is out of balance? This simulation has two parts:

- The Producers
- Food Web

Simulator:
https://www.learner.org/courses/envsci/interactives/ecology/ecology.html



Part 1: The Producers

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. Given the two fictitious species of plants in the simulator, predict what will happen in this young system and record your prediction in the Data Table. Then run the simulator to 100 time steps and record the population numbers for both plants.

DATA TABLE:

Lesson 1: Step 1	**Plant A**	**Plant B**
Prediction: starting population		
Prediction: ending population		
Starting population		
Ending population		

Once you have run this simulation, answer the following questions:

1. What assumptions does this model make about co-dominance as well as the general terrain of the ecosystem?
2. Do you find one producer to be dominant? Explain why one producer might be dominant over another.
3. Read the information at the "For Your Consideration" link. Explain how this simulation illustrates an example of the competitive exclusion principle. How is succession illustrated here?

Now you'll introduce an herbivore into the environment. 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. Click on herbivore A (the rabbit) and choose "eats plant A." Predict and record what will happen to the population numbers in the ecosystem. Then, run the simulator and record your results in the data chart provided.

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

When you have finished running the simulation, answer the following:

1. Does adding the herbivore establish a more equal field? Is one producer still dominant over the other? Why might one producer be dominant over another?
2. If the simulation included decomposers, how would your current results change?
3. How do producer population numbers with the presence of an herbivore compare to the primary colonizer model?

Part 2: Food Web

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. Keeping the ideas of succession and the competitive exclusion principle in mind, think of the many factors that may go into sustaining an ecosystem. Is there any way we can all get along and live side by side?

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, i.e., Herbivore A eats Plant A, Omnivore A eats Herbivore A, and the Top Predator eats Omnivore A. Let Plant B survive on its own and see what happens. Predict whether each species will survive, and whether it will increase or decrease in number, as well as whether Plant B will survive to the end. Record your prediction in the Data Table and then run the simulation twice and record your data. Use X for "die out," ↑ for "increase in numbers," and ↓ for "decrease in numbers."

DATA TABLE:

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

When you have finished this simulation, answer the following questions:

1. Was your prediction correct? How did you arrive at your prediction? What differences were there between your prediction and the simulation?
2. What would happen to this imaginary ecosystem if the producers were to die out?
3. Did any of the species increase in number? What could account for this increase? Which species decreased in number and what might account for this decrease?
4. Which populations would benefit the most from the presence of decomposers?

Now try a more "real-life" scenario and experiment with what might happen in an ecosystem that is more like a web. This time click the "all on" button. The model shows who eats whom and the paths by which energy is transferred. Predict which populations will die out, increase in numbers, or decrease in numbers and record your predictions. Run the simulation twice and record the results in your Data Table. Then try to modify who eats whom in order to ensure the survival of all species and record what was changed in your chart.

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

1. Was your prediction correct? How did you arrive at your prediction? What differences were there between your prediction and the simulation?
2. Were you able to modify the parameters so that each species survived? Explain how you decided what changes to make.
3. Which way does energy flow and how does eating an organism result in energy transfer?
4. How do humans affect the greater food web? In this model, how could humans who do not live in the ecosystem still manage to alter the flow of energy within the web?

Deliverable:
Complete all Data Tables and Questions on a **Google Doc** and Submit via **Google Classroom**.