**"RABBITS AND WOLVES"**

Go to the following website: www.shodor.com/interactivate/activities/rabbits/index.html

Mathematical modeling is one way to create simulations to illustrate what will happen when certain conditions occur. This modeling simulation demonstrates what happens in an ecosystem that consists of grass, rabbits, and wolves. Certain parameters (variables) can be manipulated to see what differences occur when conditions are changed. Complete the following exercise to explore the predator/prey relationship and how feeding relationships determine the size of populations.

BE PATIENT! This program takes several seconds to load!! When you look at the simulation window, you see three buttons across the top of the simulator:

Start Simulation	Step Simulation	Reset Simulation
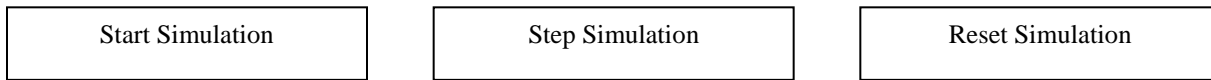
You will be using the START simulation button (this toggles to Resume Simulation and Pause Simulation) and the RESET Simulation button in this exercise.

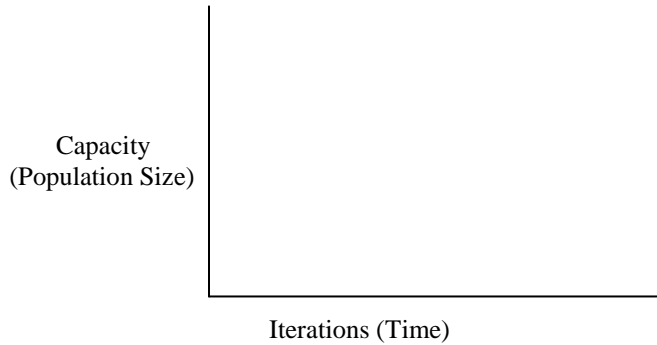At the bottom of the simulations window, you will see four buttons:

View Population Graph	View Cumulative Stats
View/Modify Parameters	View Simulation Key
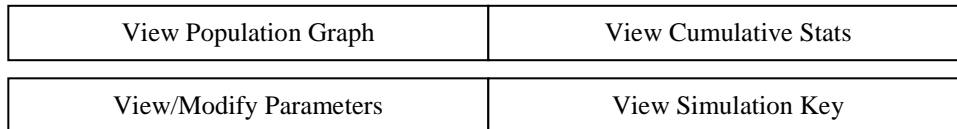
You will be using all of these buttons except for the "View Cumulative Stats" button.

EXERCISE   (Record all answers on your own paper.)

1. Click on "View Simulation Key". Based on the information in the key draw the food chain represented by this simulation.

2. If you look under the top three buttons (START, STEP, RESET) you will find some buttons that control variables. Look at the selections that have been automatically chosen. What forest size and forest border do you begin with? (A toroid border means the forest edge is curved.)

3. Click on "View Population Graph" at the bottom of the window. The graph window will come up over the simulation window. You may have to click and drag the graph window to the right so that you will be able to select the "Start Simulation" button. You should be able to see the graph and most of the simulation window simultaneously. Notice that the population graph has iterations (cycles) plotted on the x axis. This really represents the amount of time that has passed. Population capacity (%) is plotted on the y axis. This represents the size of the populations.

4. Click the button "Start Simulation" and allow the simulation to run for approximately 10 iterations. Click the "Pause Simulation" to stop the simulation. Describe the relative sizes of the wolf, rabbit, and grass populations at the beginning of the simulation.

5. Click the button "Resume Simulation" and allow the simulation to run to approximately 100 iterations.   Click the "Pause Simulation" to stop the simulation. Describe the change(s) in:
    A. Grass Population

    B. Rabbit Population

    C. Wolf Population

6. What is the maximum capacity achieved by each population?

7. How does the rise and fall of one population affect the size of a different population? Give specific evidence from your graph.

8. Using the axes below and a different colored pencil for each population, summarize the changes you observed in the populations. Be sure to include a legend.

Capacity
(Population Size)

Iterations (Time)

- Close the Population Graph
- Click the "Reset Simulation" button

9. *Assume a virus attacks the rabbit population and rabbits begin to die at about ½ their expected life span.*
- Click "View/Modify Parameters" Button at the bottom of the window
- Click "View/Change Rabbit Parameters"
- Change the maximum rabbit age to 13 to reflect this change
- Click Save My Changes
- Click Return to Simulator
- Click "View Population Graph" (your original graph is present but will be removed as soon as you click "Start")
- Click "Start Simulation" and let the simulation run for approximately 100 iterations. Click the "Pause Simulation" to stop the simulation.

10. Describe the change(s) in:
   D. Grass Population

    E. Rabbit Population

    F. Wolf Population

11. What is the maximum capacity achieved by each population?

12. How does the rise and fall of one population affect the size of a different population? Give specific evidence from your graph.

13. Using the axes below and a different colored pencil for each population, summarize the changes you observed in the populations. Be sure to include a legend.

Capacity
(Population Size)

Iterations (Time)
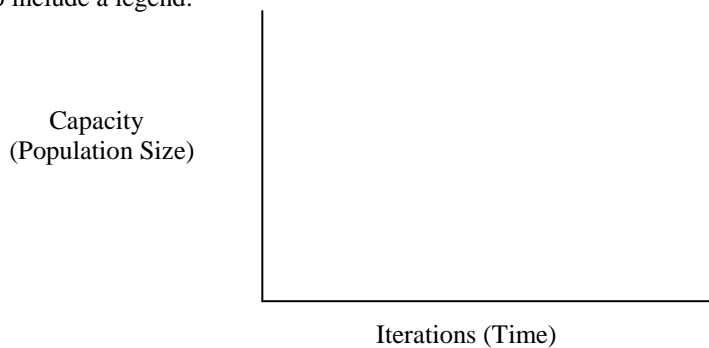
14. How does the graph in #8 compare with the graph in #13?

- Close the Population Graph
- Click the "Reset Simulation" button

15. *Because of extreme hunting, the starting wolf population is decreased to a single breeding pair.*
    - Click "View/Modify Parameters"
    - Click "View/Modify Rabbit Parameters"
    - Change the maximum rabbit age back to 25
    - Click "Save Changes"
    - Click "View/Modify Start Up Parameters"
    - Change initial number of wolves to 2
    - Click "Save Changes"
    - Click "Return to Simulation"
    - Click "View Population Graph" (again your old graph will appear until the simulation starts)
    - Click "Start Simulation" and let it run for approximately 100 iterations. Click the "Pause Simulation" to stop the simulation.

16. Describe the change(s) in:
   G. Grass Population

    H. Rabbit Population

    I. Wolf Population

17. What is the maximum capacity achieved by each population?

18. How does the rise and fall of one population affect the size of a different population? Give specific evidence from your graph.

19. Using the axes below and a different colored pencil for each population, summarize the changes you observed in the populations. Be sure to include a legend.

Capacity
(Population Size)

Iterations (Time)
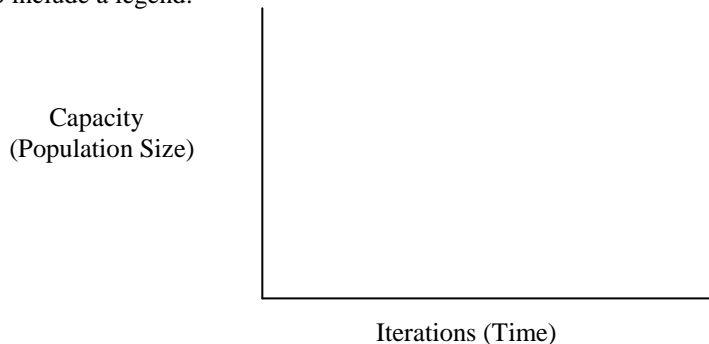
20. How does the graph in #19 compare with the graphs in #3 and #8? How does changing the beginning population change the rest of the graph? What do all three graphs have in common?

21. Draw a graph for these three populations predicting what you think would happen if the rabbits had a very successful breeding season and there was a real "bunny explosion".