NATIONAL MATH + SCIENCE INITIATIVE

Call of the Wild

Investigating Predator/Prey Relationships

MATERIALS

calculator

computer

spoon, plastic

100 beans, individual pinto

plate, paper

In the 1940's, the island of Guam experienced one of the worst ecological disasters ever recorded. The brown tree snake (*Boiga irregularis*) was accidentally introduced to the island sometime between the end of the World War II and 1952. It was originally native to Australia and the South Pacific.

The brown tree snake feeds mainly on birds, lizards, and small mammals. When it was introduced to the island of Guam, it started feeding primarily on the native bird population. To date, ten of the twelve native bird species have been completely decimated by the brown tree snake. The other two species are heavily protected to conserve their numbers.

The effects of this invasive species are still being felt today on both community relationships and the ecosystem as a whole.

PURPOSE

In this activity, you will investigate predator/prey relationships. In the first part of this lesson, you will investigate how a wolf and an elk population change over time in response to the other's presence, and how each population relates to the other. In the second part, you will get to ask your own questions regarding a similar scenario, and use a computer simulation to experimentally test your hypotheses.

FOR THE SIMULATION

This activity shows the predator/prey relationship between wolves and the elk that they feed on in a field habitat.

The following rules must be followed in this simulation:

- The field will only sustain up to 100 elk.
- After predation has occurred, the remaining elk population will double.
- Due to immigration, the habitat will always contain at least 10 elk.
- Due to immigration, the habitat will always contain at least 1 wolf.
- Each wolf must eat up to 5 elk or it will die or emigrate (leaves the habitat in search of food somewhere else).
- For every 5 elk that a wolf eats, it has enough energy to produce 1 wolf cub.

FOR THE GRAPH

When displaying your data on a two-cycle semi-log graph, make sure that you follow the following rules:

- Label the *y*-axis starting with 1, not 0, at the bottom.
- Number each line increasing by 1 individual (2, 3, 4…) until you reach 10 individuals.
- After 10 individuals, each line represents 10 more individuals than before (20, 30, 40…). Label the rest of the *y*-axis until you get to 100 individuals. Give the *y*-axis a title.
- The *x*-axis represents the 25 generations. Give this axis a title as well.

PROCEDURE

PART 1: PREDATOR/PREY CYCLES

1. How do you think that, over many generations, the wolf the elk population size relate to each other? Write your hypothesis on your student answer page.
2. Set up the habitat by placing 10 elk (beans) in a petri dish. One swipe of your spoon represents 1 wolf. Enter your initial populations of elk and wolf into Table 1.
3. With your eyes closed and one continuous swipe through the dish, pick up as many beans as you can with your spoon. Set the beans on the table beside the plate and count them.

   The number of beans represents the amount of elk that the wolf was able to consume. Record this number in Table 1.
4. Determine the number of surviving elk, surviving wolves, and if the wolves were able to reproduce or not, and record these numbers in Table 1. Remember that each wolf must consume at least 5 elk for 1 cub to be born.
5. Record the initial populations for the next generation. Remember that the surviving elk population will double. Count the number of surviving wolves and do not forget to add the number of new wolves to the starting population, as they will need to consume 5 elk as well.
6. Repeat Step 2 through Step 5 until you have 25 generations of data. When you have multiple wolves, then you will swipe that many times through the dish to generate your prey count. Do not forget to abide by the six rules as stated previously.
7. Graph the initial populations for both the elk and the wolves in Graph 1 (two lines). Graph 1 is a two-cycle semi-log graph that allows us to see both populations despite the large discrepancy in both values for wolves and elk.

PART II: WOLF/SHEEP PREDATION

Now it's your turn!

For this activity, you will use a computer simulation as a tool to perform predator/prey experiments on a population of wolves and sheep.

1. Navigate to http://ccl.northwestern.edu/netlogo/models/WolfSheepPredation. Click on the link, "Run Wolf Sheep Predation in your browser."
2. Click on the red tab in the box that says "grass?" to turn on the grass.
3. Click on "setup," then click "go" and let it run for 20 seconds.
4. After 20 seconds, click on "go" again to stop the simulation.

HYPOTHESIS

DATA AND OBSERVATIONS

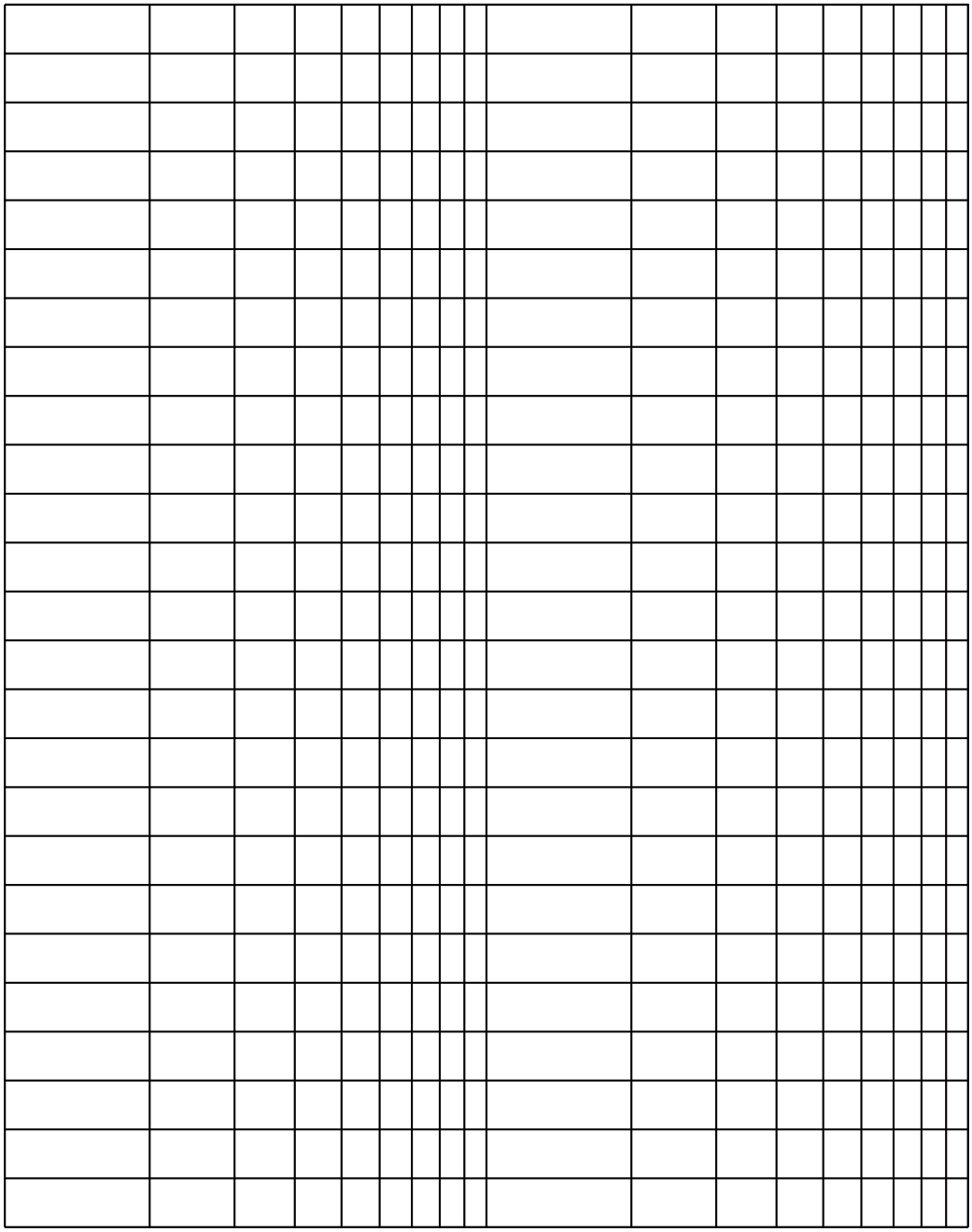
PART I: PREDATOR/PREY CYCLES

Table 1. Elk and Wolf Data

Generation	Initial Elk Population	Elk Eaten	Elk Survivors	Initial Wolf Population	Wolf Survivors	Wolves Born
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

ANALYSIS

GRAPH 1: WOLF VS. ELK POPULATION SIZES OVER 25 GENERATIONS



ANALYSIS (CONTINUED)

PART II: WOLF/SHEEP PREDATION

1. Besides the presence of grass, what other variables are you able to manipulate in this simulation?

RESEARCH QUESTIONS

Following the steps of the scientific method, use the simulation to perform the following "investigations" to answer the questions or problems. After you have completed each investigation and have gathered the data, communicate your results in a brief paragraph using the following format:

A. State the question.

B. State your hypothesis.

C. Briefly describe how you manipulated the simulation to run your "investigation." Include in your description the following factors:

- Limiting factors
- Control groups
- Experimental groups
- Independent variables
- Dependent variables

Make sure that you write precise enough descriptions of your methodology so that other students could follow your exact procedure and get the same results.

D. Make a screenshot of the generated graph to show your results. You might have to increase the size of the picture.

E. Using data from the graph, describe what changes occurred to the wolf, sheep, and grass populations in the simulation. Explain why these changes occurred.

ANALYSIS (CONTINUED)

Question #1

What would the affect be on the three different populations if the field consisted of four times as many wolves as sheep?

Now it's your turn!

Create your own questions and then use the simulation to investigate each one. Write your question in the space provided and then write your conclusion paragraph as outlined in Steps A–E previously.

Question #2

Question #3

CHALLENGE

Find three ways in which your group can manipulate the simulation so that both populations die off. When you figure this out, describe the limiting factors involved in creating this situation, and then explain why both populations were not able to survive.

CONCLUSION QUESTIONS

1. Write a statement describing the relationship between a predator population and a population of its primary prey.

2. Look at the peaks and troughs seen in both populations. Explain how they relate to each other.

3. Describe a density-independent factor that might affect the elk population size. What effect would this have on the wolf population?

4. Describe a density-dependent factor that might affect the elk population size. What effect would this have on the wolf population?

CONCLUSION QUESTIONS (CONTINUED)

5. Describe the relationship between the wolf and sheep populations over the time period indicated by the simulation. Justify your answers with evidence from the graph.

6. Describe the relationship between the grass and sheep populations over the time period indicated by the simulation. Justify your answers with evidence from the graph.

7. What indirect effect does grass have on the wolf population? Justify your answer with evidence from the graph.

8. Describe another predator/prey relationship that might follow a similar pattern as the ones seen in this lesson.

CONCLUSION QUESTIONS (CONTINUED)

9. Contrast the different effects that occur between when all of the sheep die off and when all of the wolves die off.

10. The brown tree snake still thrives on the island of Guam. Why is it still able to thrive while so much of its food has been eliminated?

11. Hypothesize what other community and ecosystem consequences have most likely occurred due to the introduction of the brown tree snake. Explain how each might affect the community and ecosystem.