Modeling Population Growth

Introduction: A population is a group of organisms that belong to the same species and live in the same area at the same time. There are no definite boundaries to a population. The boundaries of a population may result from a geographical feature, such as a lakeshore, or a researcher can arbitrarily define them. Population growth is determined by three factors: the number of births, the number of deaths, and the number of individuals entering or leaving the population. In this activity, you will use your knowledge of mathematical equations to plot the growth of a population over time.

Purpose:
1. To calculate the growth of a population over time and plot the data on a graph.
2. To observe the effect of the carrying capacity on population size.
3. To distinguish between exponential growth and logistic growth.

Getting Started: You have been asked to determine the size and the growth rate of a population of rabbits over a 20-year period. You must use the following information to determine the size of the population each year. You will graph your data and answer the follow-up questions.

The Rabbit Population Statistics
- The initial population size in year 0 is 75 rabbits.
- The birth rate each year per 100 rabbits in the population is 50.
- The death rate each year per 100 rabbits in the population is 30.
- There is no migration.

Follow these steps to model and calculate the growth rate in a population of rabbits:

1. According to the information in the above box, will the rabbit population increase or decrease each year? How do you know? _____

   _____

2. Calculate the percent increase in the population each year. Show your work in the space below.

   % change in population size = (Birth Rate – Death Rate) / 100 rabbits

3. Given the percent increase calculated in step 2 and the number of rabbits present in year 0, by how many rabbits will the population increase in the first year? Show your work.

4. At the end of year 1, what is the total size of the rabbit population? Show your work.

5. Write a word equation for determining the population size in each year based on the calculations used in steps 3 and 4.

6. Fill in the data table on page 3 with the information you know about year 1. You must show your work and the answer in the **Population Size** column.

7. Ready to calculate the population size each year? Wait! There is another piece of vital information! The rabbits have limited resources available to them. The rabbits live in an area that can only support 600 rabbits. When the population reaches 600 rabbits, the birth rate and the death rate will be reversed. The birth rate per 100 rabbits will be 30. The death rate per 100 rabbits will be 50.

    a) What happens to a population when the death rate is higher than the birth rate? _____

    _____

    b) What will be the percent decrease given this new information?

    c) Write a word equation that will calculate the population size when the death rate is higher than the birth rate.

8. You have now written two equations:
    a) When will you use the equation from step 5? _____

    b) When will you use the equation from step 7c? _____

9. Using these two equations, fill in the data table on page 3 for all years shown. You must show your work and your answers to receive credit. Round your answers to a whole number of rabbits!

Data Table: Population Change Over a 20-Year Period

| YEAR	Population Size: Show calculation and answer
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

** Round to a whole number of rabbits.

Graphing Your Data:

Make a line graph showing your data on population growth over the 20-year period.
- Determine what variable to place on the x-axis and the y-axis.
- Label each axis.
- Scale each axis appropriately.
- Title your graph.
- Plot points as accurately as possible.

Title: _____
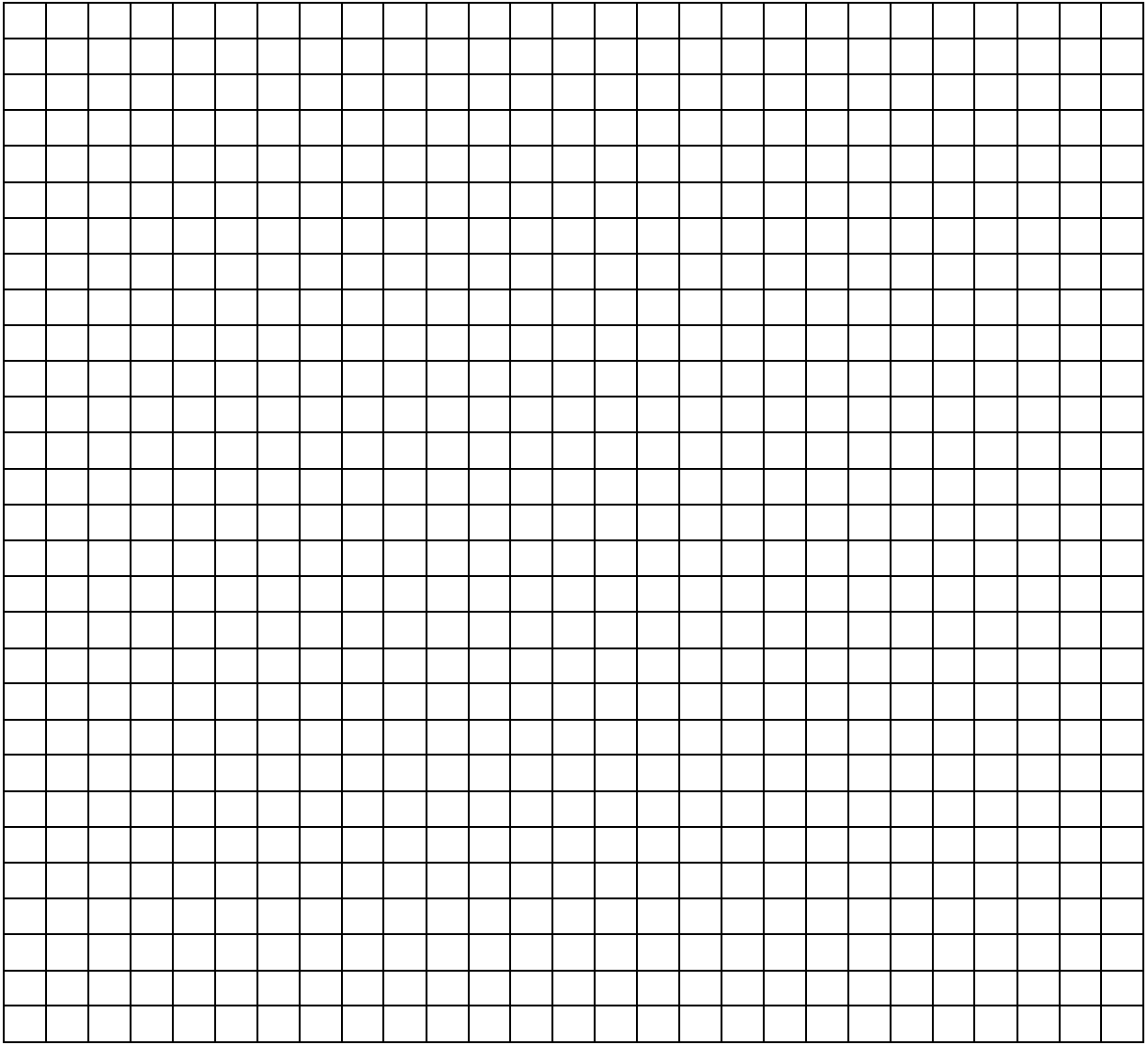
10. Define the term "carrying capacity". Draw a line on your graph above representing the carrying capacity of the rabbits. Label the line. _____

_____

11. What three factors determine the growth rate of a population? _____

_____

12. Name and describe the type of growth that is occurring during the first 12 years. _____

_____

_____

13. Name and describe the type of growth that occurs after the 12 year mark. _____

_____

_____

14. What will happen to the birth rate and the death rate of a population when:

    a) resources are abundant? _____

    b) resources are limited? _____

15. List three factors that might determine the carrying capacity of a population.

    ➢   _____

    ➢   _____

    ➢   _____

16. Describe what happens in a population in the years after the carrying capacity is reached.

_____

_____

_____

17. Explain what changes you would see in your graph if, in year 6, twenty new rabbits immigrated into

    this population. _____

18. Assume that a pair of mice produces 6 offspring, and that half the offspring are male and half are
    female. Further, assume that no offspring die. If each pair of mice breeds only once, how many
    offspring would be produced each year for 5 years?

    Year 1: _____

    Year 2: _____

    Year 3: _____

    Year 4: _____

    Year 5: _____