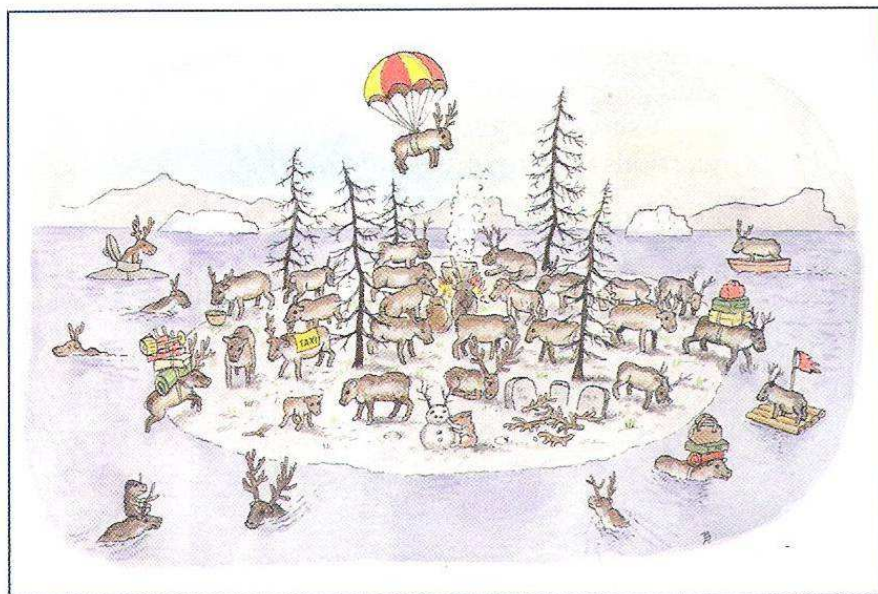


Activity 4

Factors Affecting Population Size



GOALS

In this activity you will:

- Investigate the factors that affect the size of a population.
- Interpret a graph and make calculations to examine factors affecting fluctuations in populations.
- Calculate the doubling time of the human population.
- Distinguish between an open and closed population.

What Do You Think?

The population of your community may be going up, going down, or remaining the same. The change depends on whether individuals are being added to or taken away from your community.

- What can take place in your community, or any other community of living things, that can influence the size of the population?

Write your answer to this question in your *Active Biology* log. Be prepared to discuss your ideas with your small group and other members of your class.

For You To Do

This activity provides an opportunity for you to examine the factors that affect the changes (fluctuations) that occur in a population in an ecosystem.



Part A: Reindeer Population

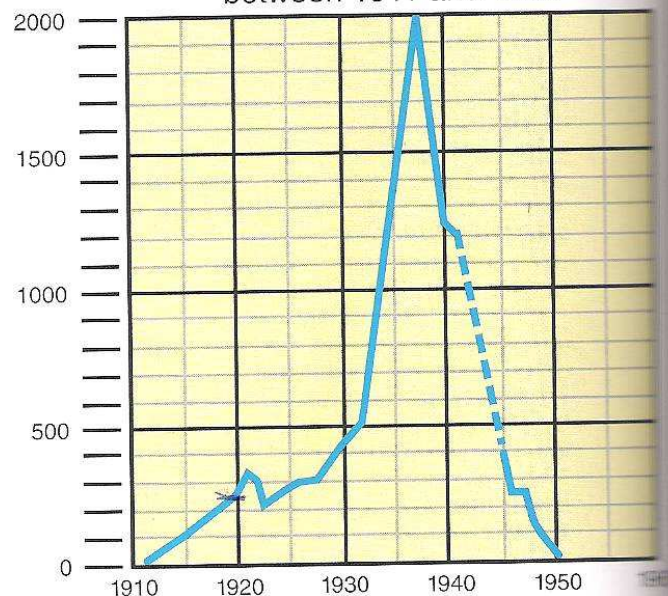
1. In 1911, 25 reindeer, 4 males and 21 females, were introduced onto St. Paul Island near Alaska. On St. Paul Island there were no predators of the reindeer, and no hunting of the reindeer was allowed. Study the graph shown below and answer the questions in your *Active Biology* log.



- c) What was the average annual increase in the number of reindeer in the years between 1930 and 1938?
- d) During which of the three periods 1911—1920, 1920—1930, or 1930—1938, was the increase in the population of reindeer greatest?
- e) What was the greatest number of reindeer found on St. Paul Island between 1910 and 1950? In what year did this occur?
- f) In 1950, only eight reindeer were still alive. What is the average annual decrease in the number of reindeer in the years between 1938 and 1950?
2. In your group, discuss the questions on the next page. Then answer them in your *Active Biology* log.

- a) In 1911 the population was 25 reindeer. What was the size of the population in 1920? What was the difference in the number of reindeer between 1911 and 1920? What was the average annual increase in the number of reindeer between 1911 and 1920?
- b) What was the difference in population size between the years 1920 and 1930? What was the average annual increase in the number of reindeer in the years between 1920 and 1930?

Changes in the Reindeer Population on St. Paul Island between 1911 and 1950



- a) St. Paul Island is more than 323 km (200 miles) from the mainland. Could leaving or arriving at the island have played a major role in determining the size of the reindeer population? Explain your answer.
- b) What might account for the tremendous increase in the population of reindeer between 1930 and 1938, as compared with the rate of growth during the first years the reindeer were on the island?
- c) St. Paul Island is about 106 km² (41 square miles). What effect might 2000 reindeer have on the island and its vegetation?
- d) Consider all the factors an organism requires to live. What might have happened on the island to cause the change in population size between 1938 and 1950?
- e) Beginning in 1911, in which time spans did the reindeer population double? How many years did it take each of those doublings to occur? What happened to the doubling time between 1911 and 1938?
- f) If some of the eight reindeer that were still alive in 1950 were males and some females, what do you predict would happen to the population in the next few years? Why?
- g) What evidence is there that the carrying capacity (number of individuals in a population that the resources of a habitat can support) for reindeer on this island was exceeded?
- h) What does this study tell you about unchecked population growth? What difference might hunters or predators have made?

Part B: Human Population

1. On a piece of graph paper, plot the growth of the human population using the following data.

Human Population Growth between A.D. 1 and 2000			
Date A.D.	Human Population (millions)	Date A.D.	Human Population (millions)
1	250	1930	2070
1000	280	1940	2300
1200	384	1950	2500
1500	427	1960	3000
1650	470	1970	3700
1750	694	1980	4450
1850	1100	1990	5300
1900	1600	2000	6080
1920	1800	2010	?



2. Use your graph to determine the doubling times for the human population between A.D. 1 and 2000.
 - a) How much time elapsed before the human population of A.D. 1 doubled the first time?
 - b) Is the amount of time needed for the human population to double increasing or decreasing?
 - c) What does that indicate about how fast the human population is growing?
3. Extend your graph to the year 2010.
 - a) What do you estimate the human population will be in that year?
4. Using the equations below, estimate the doubling time for the current population based on the rate of growth from 1990 to 2000.
 - a) In what year will the present population double?

- c) In what ways is the Earth as a whole similar to an island such as St. Paul? Does the Earth have a carrying capacity? Explain your answer.



$$\text{Annual rate of growth (in percent)} = \frac{(\text{population in 2000} - \text{population in 1990}) \times 100}{\text{population in 1990} \times \text{number of years}}$$
$$\text{Doubling time} = \frac{70}{\text{annual rate of growth}}$$

5. In your group, discuss the following questions. Then answer them in your *Active Biology* log.
 - a) What similarities do you see between the graph of the reindeer population and your graph of the human population?
 - b) What are the three or four most important factors required to sustain a population?
 - c) What might happen to the population of humans if the present growth rate continues?
 - d) What methods could be used to reduce the growth rate?
 - e) Suggest several problems in the United States that are related to the human population.
 - f) What are the most important three or four factors to think about with regard to the world population?