

Population Explosion

Florida Sunshine State Standard Benchmark: SC.G.1.4.1. - Knows of the great diversity and interdependence of living things.

Overview:

Exponential growth is defined when the increase of a quantity is raised to a power (n^x). Exponential growth is very slow in the early stages, but quickly accelerates. A frequent measure of exponential growth is "doubling time," that is, the amount of time required for the quantity to double. *The shorter the doubling time, the faster the rate of growth.*



The human population, like all populations of organisms, grows exponentially when unchecked. Although it took 130 years (from 1800 to 1930) for the world population to double, it doubled again by 1975, a mere 45 years. In 1993, the doubling time of the world population was 42 years. At that rate, the world population of 5.5 billion would be expected to reach 11 billion by 2035. Different areas of the world, however, have vastly different doubling times.

Time Frame: 1 hour

Materials: (per group of four students)

2 pennies	Approximately 40 dried beans
2 small 8-oz paper cups	Graph paper
1 large paper cup	Marking pen

Procedure:

Part I:

1. Label one small paper cup "Parents" and the other one "Offspring." Label the large paper cup "Bean Pot." Place 10 beans in the "Parent" cup and the rest in the "Bean Pot." Each bean represents an individual in the population.
2. Prepare a table with 2 columns and 12 rows. Label the left-hand column "Generation Number" and the right-hand column "Population Size."
3. Toss the 2 pennies.
 - If both pennies show heads, toss again; do not count this outcome as one of the trials.

- If both pennies show tails, one member of the parent population has died and you should remove a bean from the "Parents" cup and put it into the "Bean Pot."
 - If one head and one tail show, a member of the parent population has a child.
 - To simulate the birth, take one bean from the "Bean Pot" and place it into the cup marked "Offspring."
4. Continue tossing until there are no longer any beans in the "Parents" cup.
 5. Count the number of beans in the "Offspring" cup and record the number in the data table. This now represents generation #1.
 6. The "Offspring" now become the parents, so move all the beans from the "Offspring" cup into the "Parents" cup.
 7. Repeat steps 3 and 4 until you have completed 10 generations.
 8. Make a graph of your data, with generation number on the horizontal axis and population size on the vertical axis.

Part II:

9. Repeat the activity, beginning with step 2. Only this time assume that when a head shows to the right of the tail, the individual decides not to have a child.
 - In that case, place one bean from the "Parents" cup into the "Offspring" cup, but do not add a bean to the "Bean Pot". (T) (H)
 - If, on the other hand, the head shows to the left of the tail, proceed as you did before, taking one bean from the "Parents" cup and one from the "Bean Pot" and placing them in the "Offspring" cup. (H) (T)
 - When you have finished 10 generations, graph your data on the same graph as Part I.

Assessment:

1. From the graph, determine the doubling time for the population at the beginning, the middle, and the end of the graph. Are they all the same? Explain why.
2. Calculate doubling time and growth rate for the second set of data as you did for the first. Compare the two data sets.
3. Assume that a generation is equal to 20 years. Use the doubling time from your graph to calculate the growth rate of the population, using the formula below:

$$\text{Annual growth rate (\%)} = 70/\text{doubling time}$$

Home Learning:

- Using the Internet, research statistical information that deals with population growth and how it varies in different countries. Write a report of the factors that affect population growth in different countries.
- Construct graphs that:
 - depict a population that is at ZPG (zero population growth).
 - depict a population that is increasing rapidly.
 - depict a population that is decreasing rapidly.

Extensions:

Write a paragraph explaining the implications of this activity for the human population and the limited resources on the Earth.

