Human Population Growth

**\*-include in lab write-up**

**\*Purpose:** What can be learned and predicted from the pattern of human population growth?

**\*State standard**: **6c**

**6.** Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept:

**6c.** Students know how fluctuations in population size in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.

**Background:** The world’s population recently reached more than 6 billion. To get an idea of how big a number that actually is, think of it as money. If you had six billion dollars, how long would it take you to send it at the rate of $1,000 a day? It would take 6,000,000 days or 16,500 years! At its present rate of growth (1.7% a year), the population of the world is expected to double in 40 years! Where will 12 billion people live? How will we produce twice as much food as we do now? Where will twice as much electricity come from? Many people are now realizing that the capacity of the planet to support human life is not unlimited. The population pressures are made even worse by the fact that the people and resources of the planet are distributed unevenly. Asia, for example, has approximately 58% of the population, but only 20% of the landmass. North America has approximately 6% of the world’s population, but uses over 40% of the energy. These, and other inequities, add further stress to an increasingly crowed planet.

 In the 1700’s, the British economist Thomas Malthus was one of the first people to warn about the dangers of overpopulation. He illustrated that populations increase in a **geometric** **progression**, were 5 becomes 10, 10 becomes 20, and 20 becomes 40. This type of growth, he and others contended, would soon overcome the food supply, resulting in famines, wars and other disasters. In the 1960’s, Dr. Paul Ehrlich again took up the campaign to curb world population growth. Although not everyone is in agreement with the predictions of some population control advocates, the need to slow the rate of population growth is becoming more and more accepted. In China, for instance, the government rewards (or even requires) one-child families. **Zero population growth** (ZPG) is a movement that strives to adjust the worldwide birthrate to equal the death rate, through education, so that no population growth continues. Most countries, however, are quite far from this goal at the present time.

**\*Background Questions: *Don’t write the question out.***

1. What is the present growth rate for global human population?

2. What are some population pressures the world is experiencing?

3. Why are planetary resources so unevenly distributed?

**Materials:** colored pencils graph paper calculator

**\*Section I: Exponential Growth**

Exponential growth can increase quite rapidly. This is the type of growth normally exhibited by natural populations. In nature, however, the growth is never unlimited. At some point, a natural population will run out of some of the material necessary for its survival. These limiting factors are usually food, living space or raw materials needed to support life. The data in Table 1 was collected during an actual investigation of the growth of bacteria in a test tube.

**Procedure:** Make a line graph using the data from Table 1. Do not copy the table.

**Table 1:** Growth of a Bacterial Population

|  |  |
| --- | --- |
| **Time (hour)** | **Number of Organisms** |
| **0** | 1,500 |
| **1** | 2,000 |
| **2** | 4,000 |
| **3** | 7,000 |
| **4** | 14,000 |
| **5** | 30,000 |
| **6** | 59,000 |
| **7** | 71,000 |
| **8** | 76,000 |
| **9** | 77,000 |
| **10** | 74,000 |
| **11** | 67,000 |
| **12** | 58,000 |
| **13** | 45,000 |
| **14** | 35,000 |

**\*Graph 1:** Bacterial Populations

Put time on the X-axis (count by .5 hours) and population on the Y-axis (count by 2,000).

## \*Conclusions for Section I: *Don’t write out the question.*

1. During which hours was the bacteria population growing at a faster rate than it was dying off?

2. During which hours were the bacteria maintaining a relatively stable population? (The birth rate approximately equaled the death rate)

3. During which time was the population in a death phase? (More individuals were dying than were being born)

\***Section II: Exponential Growth**

The human population can also be studied using population data and growth curves. Since humans reproduce quite differently than bacteria, our data will not accumulate as quickly as that in section B. You will see, however, similarities in the growth patterns of both populations.

**Procedure:** Make a line graph using the data from Table 2. Do not copy the table.

**Table 2:** Growth in World Populations {1600-2026 (predicted)}

|  |  |
| --- | --- |
| **Year** | **Estimated Population (in billions)** |
| **1600** | .5 |
| **1700** | .6 |
| **1800** | .8 |
| **1830** | 1.0 |
| **1900** | 1.6 |
| **1930** | 2.0 |
| **1960** | 3.0 |
| **1975** | 4.0 |
| **1978** | 4.2 |
| **1981** | 4.5 |
| **1986** | 4.9 |
| **1992** | 5.5 |
| **2000** | 6.2 |
| **2020** | 8.6\* |
| **2026** | 10.0\* |
| **2040** | 12.4\* |

\* Projections

**\*Graph:** Plot years (in 20-year intervals) on the X-axis, and world population (in .5 billion of people) on the Y-axis.

## \*Conclusions for Section II: *Do not write out the question.*

1. In what ways is this graph similar to that of the bacterial population?

2. In what ways is it different from that of the bacterial population?

3. How long did it take the world’s population to double from .5 billion to 1 billion? From 1 to 2 billion? From 2 to 4 billon?

4. What is the current predicted doubling time for our population?

# \*Section III: World Population Data

The human population problem is not one of mere numbers. The way in which the population is distributed around the world is also of great concern. Some regions are growing much faster than others are. Some regions have more land or resources than others do do. These and other unbalances lead to the establishment of “have” and “have not” societies, often causing social unrest and political conflicts. Table 3 shows some population, and related data, for six regions of the world.

**Procedure:** Use Table 3 to answer the following questions. Do not copy the table.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Region | **1984 Population (millions)** | **2000 Population (millions)**  | **Growth Rate (%)** | **Doubling Time (years)** | **Arable Acres\* Per Person** |
| **North America** | **262** | **297** | **0.7** | **99** | **2.20** |
| **Former****Soviet Union** | **274** | **316** | **1.1** | **68** | **2.10** |
| **Latin America** | **357** | **562** | **2.6** | **30** | **1.10** |
| **Europe** | **491** | **510** | **0.3** | **208** | **0.71** |
| **Africa** | **531** | **855** | **2.9** | **24** | **0.85** |
| **Asia** | **2,782** | **3,680** | **1.8** | **38** | **0.40** |

**Table 3:** Population Data For Various Regions Of The World

Arable Acres = amount of land available to grow food

## \*Conclusions for Section III: *Do not write out the question.*

Identify the regions with the largest and smallest 1984 populations. Now look at the amount of arable land (land that can be used to grow food) per person in each of the regions.

1. How do the largest and smallest 1984 populations compare in terms of arable land?

2. What does this tell you about the ability to feed the populations of each of these regions?

3. What are the three fastest growing regions in the world?

4. In how many years will each (of the three fasted regions) double their populations?

Two important types of data are missing from the table above. These are energy consumption (how much of the worlds energy is used by a region) and gross national product (GNP). GNP is the amount of money, per person, produced in each region.

7. Which region do you think leads in each of these categories? Why?

8. Which regions are probably at the lowest end of the scale in each of these categories? Why?

# \*Section IV: World Population Data

One of the best ways to slow population growth is to limit the size of families. Some countries are currently making major efforts to promote birth control and limit the number of children born. These efforts, however, are meeting with limited success in most areas. Table 4 shows the relationship between population growth and the average number of children per family.

**Procedure:**

1. Use Table 4 to answer the questions. Make a line graph using the data from Table 5. Do not copy the tables.

**Table 4:** Relationship Between Population Growth and Average Family Size Patterns

|  |  |  |
| --- | --- | --- |
| ONE-CHILD FAMILY | **TWO-CHILD FAMILY** | **THREE-CHILD FAMILY** |
| **1 person = 1 generation****1 person = 2 generations****1 person = 3 generations****1 person = 4 generations*****4 people total*** | **1 person = 1 generation****2 person = 2 generations****4 person = 3 generations****8 person = 4 generations*****15 people total*** | **1 person = 1 generation****3 person = 2 generations****9 person = 3 generations****27 person = 4 generations*****40 people total*** |

**Table 5:** United States Population and Projections

|  |  |
| --- | --- |
| Year | Population in Millions |
| **1870** | **50** |
| **1890** | **75** |
| **1920** | **100** |
| **1950** | **175** |
| **1968** | **200** |
|  | **Estimated Projections** |
|  | Two Child Families Three Child Families |
| **1995** |  **280 300** |
| **2013\*** |  **295 400** |
| **2030\*** |  **310 500** |
| **2050\*** |  **330 700** |
| **2070\*** |  **360 1000** |

## \*Projections

**\*Graph:** United States Population and Projections

Make a line graph from the data in Table 5. Years on the X-axis (count by 10’s) & population on the Y-axis (count by 25 million). Plot the curves for two-child families on the same axis as the curve for three-child families. Label each curve. Years 1870 through 1968 is the same line for both graphs. The line then splits apart, moving in two different directions. (see the example)

## \*Conclusions for Section IV:

1. After **4 generations**, how many times greater is the population from a three-child family than from a one-child family?

2. How much more food and water, in percentages, will a three-child family require after 4 generations as compared with a one-child family?

3. Calculate the number of people that will be produced after 4 generations of a four-child family tradition.

*Human Population Growth Lab Overall Conclusion*

What was the objective of this lab? Use at least 4 complete sentences in your response and use 5 key words. Highlight them!