



ESA21

Environmental Science Activities for the 21st Century

Population: Basic Statistics

Introduction

For all of its futuristic stylings, the television show *Star Trek* was, like most science fiction, a commentary on the state of society at the time it was written (late 1960's). One of the more famous episodes of that series was the one entitled The Mark of Gideon, which dealt with a planet that was so overpopulated that people did not have anywhere to sit down. At the time of the show, the Earth's population was at about 3.5 billion, and was increasing at an incredible rate. The effects of such a large population on the environment were beginning to become abundantly clear, and people had begun to wonder just how many more people the Earth could hold. This *Star Trek* episode was just one of a number of television shows, movies, and books at that time (ex. *Soylent Green*) that foretold of an ominous future if we did not begin to do something.

Since that time, the only thing that seems to have changed is that the world's population has gotten larger. We now have more than 6.3 billion occupants, and [we are continuing to grow](#). Not only that, but the United States population is growing dramatically, meaning that US citizens may someday need to make a decision about how much is too much and then develop a policy, if it were possible, to control growth.

Demographic Basics

Demographers are researchers who study population and its changes. Some terms that they use are birth rate, death rate, replacement-level fertility, and total fertility rate. We will discuss them here:

Birth rate: Commonly used as the *crude birth rate*, this is the number of births per 1,000 people within a certain population.

Death rate: Commonly used as the *crude death rate*, this is the number of deaths per 1,000 people within a certain population.

The formulae for determining crude birth rate and crude death rate for a given time interval, such as a year, are as follows:

$$\frac{\text{total number of births in a population}}{\text{total population}} \times 1,000 = \text{crude birth rate}$$

$$\frac{\text{total number of deaths in a population}}{\text{total population}} \times 1,000 = \text{crude death rate}$$

Replacement-level fertility: This is the average number of births couples in a population must have in order to keep the population stable at a certain number. In more developed countries, this number is approximately 2.1. In any human population, the replacement-level fertility always exceeds 2.0 because some offspring do not make it to the age of 15, which is the age demographers define as the beginning of the reproductive years; therefore, more offspring are needed to cover for the shortfall. In less developed countries, the replacement-level fertility is higher than 2.1 because of harsher conditions and increased childhood mortality.

Total fertility rate: This is the average number of children a woman in a population has in her lifetime. Excluding immigration and emigration from the equation, if the total fertility rate exceeds the replacement-

level fertility in a population, then the population is growing. If the total fertility rate is below the replacement-level fertility, then the population is reducing. Germany, for example, is a growing in population only because of immigration because its total fertility rate is well below replacement-level fertility.

An excellent web site for finding statistics related to population is the following:

<http://www.geographyiq.com>

When you arrive at the site, click on where it says “Rankings” on the menu at the upper left. When you arrive at the next web page, scroll down until you see the “Population” topic heading. You will see categories related to population such as birth rate, death rate, and total fertility rate listed. Statistics for each country in the world are provided.

Determining in Percentage Terms How Fast a Population is Growing or Declining

Here is the formula for determining how fast a population is growing or shrinking annually:

$$\text{Annual Rate of Population Change} = \frac{\text{Births} - \text{Deaths}}{1,000} \times 100 = X\%$$

We all learned at one time or another that we can simply a formula by crossing out zeroes in the numerator and denominator, so we are left with the following version:

$$\text{Annual Rate of Population Change} = \frac{\text{Births} - \text{Deaths}}{10} = X\%$$

Example: Let us say that a certain population has 28 births and 8 deaths per 1,000 people in that population for a certain year. How fast is that population growing or shrinking for that year?

$$\text{Annual Rate of Population Change} = \frac{28 - 8}{10} = 2\%$$

The population is growing at 2% per year.

Doubling Time and the Rule of 70

Mathematicians are so smart. In economics, they found that if one divides an annual percentage rate into a certain number, then the number of years for that amount to double could be determined. Likewise for population, if the growth rate is divided into the number 70, then the number of years it would take for the population to double could be precisely determined if the growth rate stays the same from year to year; hence, a population growing at 1% per year would take 70 years to double.

Example: A population of 10 million is growing 3.5% per year. If it stays at this rate from year to year, how many years would it take for the population to reach 20 million?

$$\frac{70}{3.5} = 20 \text{ years}$$

Yes, it is that simple to figure. If the population grows consistently at 3.5% per year, then 20 years is all the time it takes for the population to double.

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Activity Sheet
Population Basic Statistics

Name:

To answer the following questions, go to <http://www.geographyiq.com> and click on "Rankings" that you see in the menu on the left. Look at the list under the title Rankings and find Population. Look to the right of the word Population and click on the link labeled "All Descending". You will then see a list of the countries of the world and their populations. Answer the following questions:

1. Which is the most populous country in the world?
2. Of the two most populous countries, in fraction terms, approximately how much of the world's population do these two most populous countries comprise if world population is 6.3 billion? Circle the correct answer.

one eighth one sixth one third one half

3. Using 6.3 billion, what percentage of the world's population belongs to the United States? Circle the correct answer

2% 5% 8% 10%

4. Click on "Rankings" in the menu at the left of the <http://www.geographyiq.com> web site. You will see under the title Rankings "Birth Rate" and "Death Rate". Go to those web pages to get the following information:

Country	Birth Rate	Death Rate
Germany		
Somalia		
United States		
Mexico		
China		

5. Using the formula for calculating *annual rate of population change* that you read in the lecture part for this activity, use the information in the table above to determine the change for the countries below. If the population has a higher death rate than birth rate, be sure to show a negative value for population change.

Country	Annual Pop. Change (X%)
Germany	
Somalia	
United States	
Mexico	
China	

6. Go back to the list under the title "Rankings" at <http://www.geographyiq.com> and click where it says "All Ascending" next to **Population growth rate** (Note: You can still get the same information from "All Descending"; the information is simply listed in reverse). Find the listed population growth rate for Germany. How does the growth rate shown for Germany there compare with Germany's annual rate of population change that you calculated above? How much do they differ?

7. Why do these numbers differ? In other words, what is taken into account when they calculated the population growth rate that you found for Germany as opposed to the growth rate that you calculated for Germany just using the birth rate and death rate numbers? Without this factor, would Germany still be growing?

Population Explosion or Not?

8. Based on what you've noticed from observing the population statistics for countries of the world, what can you say about what is happening with population in general around the world:

the population explosion is continuing world-wide
population is now showing a negative growth rate (reduction) in approximately 95% of the countries in the world

population is stable world-wide with total fertility rates equaling replacement-level fertility, neither growing nor shrinking significantly

some countries are still growing at a high rate, but other countries have total fertility rates well below replacement-level fertility

Total Fertility Rate and Replacement-Level Fertility

9. On the "Rankings" web page found at <http://www.geographyiq.com> , find Total Fertility Rate in the list under Rankings. Click on the link All Ascending that you see to the right of Total Fertility Rate.

Which country in the list comes closest to equaling the replacement-level fertility of 2.1?

10. Which country has the fewest number of children born per woman?

11. Regarding the highly populated countries of India and China, find the total fertility rates of the two countries. Based on those figures, which of the two countries has been more effective in decreasing its total fertility rate?

12. Looking at the list of the countries and their total fertility rates, which countries can you generalize to be less stable politically: those with low total fertility rates or those with high total fertility rates?