ESA21
Environmental Science Activities for the 21st Century

Population: Growth

Introduction

When George Washington started the first Presidency of the United States of America, he was governing less than 4 million people who occupied an area of 2,300,000 square kilometers[1]. It was an agrarian society, with 95% of the population living on farms and only 5% in cities or towns of more than 2,500[2]. There was plenty of land, and a vast array of natural resources, just waiting to be tapped.

Today, we live in a country of over 294 million people[3]. While we are one of the major food producers in the world, it is no longer due to us being an agrarian society. Today, most people live in towns and cities, with less than 25% of the population living in rural areas. And even though we have grown to a physical size of over 9.8 million square kilometers, our population density has increased from the 2 people per square kilometer of Washington's day to almost 30 people per square kilometer today.

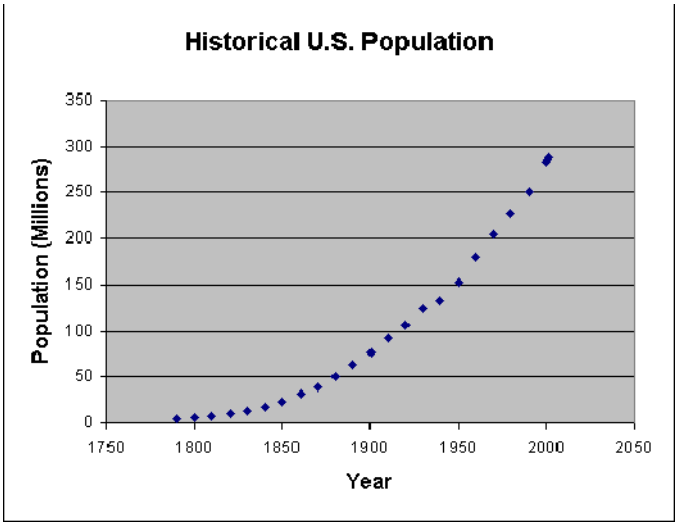

Fig. 1: Historical U.S. Population (*Data: U.S. Census*)

From where did all of these people come? The increase in territory that we experienced over that time did increase the number of people in the U.S. from the simple fact that there were already people living there. We have also expanded by immigration, with wave after wave of people entering this country to find new life and new opportunity. Neither of these, though, accounts for the largest segment. Both put together still account for less than 80 million people[4]. The largest sector of people is here due to birth.

This same thing is true of any country. Population growth over time is a function of more people being born than dying each year, or to put it scientifically, it is a function of birth rate minus the death rate. Understanding what affects the death rate is pretty simple. Wars, famine pestilence, and disease all tend to increase the death rate, while abundant food, medicine, sanitation, and peace all tend to decrease it. But understanding what affects the birth rate is not quite as simple. To understand this, you have to understand why people have babies.

Growth Factors

While the exact reason a person has a child will vary, it usually falls into one of several categories. Some have babies for societal reasons such as to carry on the family name. Anybody who has ever had their mother or father ask them when they are going to get married, settle down, and have kids knows this reason very well. The drive to carry on the family name is very strong and should never be underestimated. China's "One Baby Policy" in which couples pay fines and lose health benefits if they have more than one child has resulted in a disparity in the number of males and females. Some families have resorted to abortion or giving their child up for adoption if they find out it is a female. This has led to a situation where there are almost 10% more males under the age of 30 than there are females. Even

with the shorter lifespans of males, this ratio might never reverse to its natural trend, and could be a tremendous societal problem for China in the future.

Some people have children for religious reasons. For some faiths, it is a matter of not doing anything to prevent having children. For instance, the Roman Catholic faith believes that it is immoral to use artificial means to prevent conception. For others, there are actual dictates to have more children, as the more children there are, the more souls there will be available to go to a good place in the afterlife.

There are other factors that play into people having children. A lack of education and economic opportunity for women has been correlated to increased birth rates. Women in these situations generally do not have information about birth control and see having more children as a way of providing for their later life. Getting married at an early age also leads to having more children. The average woman has about 30 years in which she can have children. If she starts having children at an early age, then she is much more likely to have a lot of children.

John Eli Miller versus Jules Francis Pratte

One other major factor has to do with the energy use per capita and whether a country is agrarian or industrial. In societies that do not have the use of modern farm equipment and are still agrarian, there is an economic incentive to have more kids. For instance, take the example of the John Eli Miller family. Miller was a farmer born in the mid 1800's who had 5 children, 61 grandchildren, and 338 great-grandchildren when he died. Some environmental textbooks use this example to show that the population can bloom quickly. However, the point needs to be made that this is an example from an agrarian society that had not industrialized. This is not the typical example from an industrialized society with modern machinery like you find in most of America, Europe, and Japan.

As a contrary example, let us look at the Jules Francis Pratte family. Jules was born in the late 1800's in a small town near St. Louis. Like John Miller, he had a fairly large brood of children (Miller had 7 in total, Pratte had 6). However, Pratte's six children only produced 14 grandchildren, much less than the 63 of Miller. These 14 grandchildren only produced 21 great-grandchildren, which is a far cry from the 341 great-grandchildren of Miller.

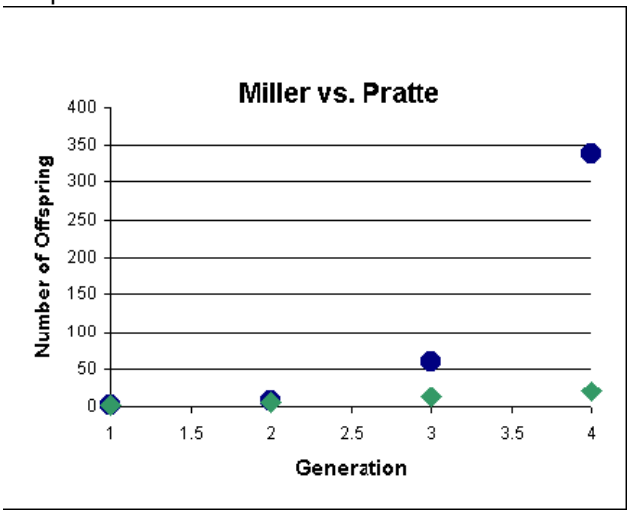

Fig. 2: Miller (circles) versus Pratte (diamonds)

The difference is that all of Pratte's family have had occupations in the industrial or professional sector of the American economy. In an agrarian society, especially without modern machinery, every child you have is another free field hand. Children usually start working on the farm at an early age, and will be responsible for producing more food than they eat. This results in a net income for the family. In an industrial society with strict child labor laws, every child you have is another mouth that you have to feed. In a very real sense, every child you have will be a serious drain on your financial resources. This societal difference accounts for a large difference that you will find in the population growth rates in the two different kinds of cultures even though most industrialized societies have a longer life span.

Additional Reading

USCENSUSBUREAU Helping You Make Informed Decisions U.S. Census Bureau	**Topic**: Population Projections for the U.S. **Summary**: Information on projected population increases in the U.S. **Link**: http://www.census.gov/population/www/projections/ppl47.html

Activity

One of the redeeming qualities of the Internet is its ability to present information in a dynamic manner with color images and animation, and to tailor the information to individual viewers through interactive elements. An example of a highly informative and interactive educational site are the population simulations from France's Institut national d'études démographiques (INED – National Institute of Demographics) at http://www.ined.fr/en/everything_about_population/play_population/. The site presents viewers with a personalized view of human population growth by tailoring the material to each individual according to age and geographic location. In this exercise you will visit this web site and complete the questions on the activity sheet as you navigate through these simulations.

References

1 http://www.census.gov/population/censusdata/table-2.pdf, October 16, 2004.
2 http://www.census.gov/population/censusdata/table-4.pdf, October 16, 2004.
3 http://www.census.gov/main/www/popclock.html, October 16, 2004.
4 http://eh.net/encyclopedia/?article=cohn.immigration.us, October 16, 2004.

ESA21: Environmental Science Activities

Activity Sheet
Population Growth

Name:

Go to http://www.ined.fr/en/everything_about_population/play_population/. We will be using two of the simulations listed in the box in the upper right corner of the page – “The family game” and “The population and me”. Launch each activity by clicking on the link to visit the activity page and then selecting “Launch the Movie”.

The family game

(1.) View the introductory material on a woman’s reproductive window. Hit the lever to randomly determine the onset of sterility with menopause. Pull the lever several times and observe how this affects potential fertility. Explain your observations below.

(2.) Proceed in the activity and enter the age at which you think women should first be married. Then increase and decrease the age and observe how this affects potential fertility. Explain your observations below.

(3.) Proceed in the activity and enter the length of time which you think infants should be breastfed. Then increase and decrease the time period and observe how this affects potential fertility. Explain your observations below.

(4.) Enter your ideal family size and then select your preferred method of contraception. The simulation estimates the chances of unintended births by using the average failure rate of different contraceptive methods. Click the lever 10 times and record the number of unintended births each time. Advance to the final page and examine each method of contraception, clicking the lever 10 times for each and recording the number of unintended births. Record your results in the table below. Which methods had the least unintended births? Which had the most?

Method	Avg. unintended births
Sterilization	
Oral Contraceptive	
IUD	
Condom	
Periodic Abstinence	
Withdrawal	
Amulet	

The population and me

(5.) Enter your age and see how the world's population has changed since the year of your birth. Enter the appropriate information in the table below. Change the current age to the age of a parent and a grandparent and complete the table for each.

	Current Age	Parent	Grandparent
Your Age			
Population When You Were Born			
The Current Population			
Population since birth multiplied by			

Are you surprised by the changes in the world's population since your birth? What about the changes since the year of birth of your parents or grandparents?

(6.) Click on a region on the map on the right and see how its population characteristics have changed over your lifetime. Complete the table below for your current age. Which region's population changed the most of your life? Which one changed the least?

Region	Multiplication factor
North America	
Latin America and the Caribbean	
Europe	
Asia	
Africa	
Oceania	

(7.) Advance to the next page by clicking the "My birth cohort" tab. Reset the region to "world". This page shows you how others born in your birth year are faring around the world. See the percentage of others born the year you were that are alive in the world and each region by clicking on the map. Enter the results in the table below.

Region	% of your cohort alive today
World	
North America	
Latin America and the Caribbean	
Europe	
Asia	
Africa	
Oceania	

Are you shocked by the percentage of individuals in some regions of your age that are already dead? Explain why or why not.

(8.) Advance to the next page by clicking the “My place in the population” tab. Use the pull-down menu to set the geographical region to “world”. This page shows where you fall in the age distribution of the world and its regions. In other words, it shows what percentage of the population is older than you and what percentage is younger than you. Begin by seeing what percentage of the current population is younger than you for the world and each region – enter the results below.

Region	% population younger than you
World	
North America	
Latin America and the Caribbean	
Europe	
Asia	
Africa	
Oceania	

(9.) Reset the geographical region to “world” and use the slider bar to see how the percentage of the world’s population that is younger than you will change over your lifetime. Pick three years of significance in your coming life (such as turning 40 years old or retiring at age 65) and see how you fit into the world’s population in these years. Enter the results in the table below. Are you surprised by what you see? Why or why not?

Year	% population younger than you
Current	
Year: _____	
Year: _____	
Year: _____	