Title: Demography, Doubling Time and Growth Rates in Human Populations

Author(s) and Attribution: This activity was developed by Jennifer White from Colby-Sawyer College, and is based on an original activity created by Professor Laura Alexander from Colby-Sawyer College.

Summary: During this activity students learn about the study of demography, explore the factors that influence population dynamics, compare qualitative research from two different countries, and determine how the characteristics of a population play into many global environmental issues. They also calculate growth rates and doubling times for two populations and discover the best way to provide graphic representations of data.

Students are provided with data for countries that represent a broad range of demographic characteristics either in a spreadsheet or via websites online. Their data sheet includes the birth rate, growth rate, net migration, female literacy rate, infant mortality, population, total fertility rate (TFR) and life expectancy of several countries and the world as a whole.

Upon completion of this activity students generate a report which is a hybrid between the standard lab report format and a narrative/essay style. Students may choose to work alone, in pairs, or in groups on this assignment. Students are encouraged to conduct additional research on the countries they choose, providing proper citations where appropriate.

Context for Use: This activity is appropriate for lower level college courses with 10-25 students. The subject matter can be related to Environmental Studies, Business, Sociology, and Natural Science. This activity might work best when students have access to the internet, but students can also do the calculations by hand using information from the spreadsheet and then conduct the research on the countries outside of class. The full activity takes students 2-3 hours to complete, but the time could be shortened by opting to have students work on only a portion of the calculations or research.

Learning goals (Measurable Outcomes) of your activity:

- Calculate growth rate percentage
- Calculate doubling time
- Choose appropriate graphic style for a particular data set
- Convert decimal to percent
- Gather and compare qualitative demographic research for two countries
- Interpret data combined with sociological factors
- Define Total Fertility Rate (TFR)
- Describe the relationship between population, affluence (consumption), technology and environmental impact
- Explain the stages of demographic transitions

Quantitative Concepts/Skills: Please use the given list of QL skills/concepts.

- Calculate growth rate percentage
- Calculate doubling time
- Choose appropriate graphic style for a particular data set
- Convert decimal to percent

Sustainability Concepts/Skills:

- Gather and compare qualitative demographic research for two countries
- Interpret data combined with sociological factors
- Define Total Fertility Rate (TFR)
- Describe the relationship between population, affluence (consumption), technology and environmental impact
- Explain the stages of demographic transitions

Background: This activity was developed for use during the Human Population section of an Environmental Issues course at Colby-Sawyer College. In preparation for the activity students read Chapter 6 "Human Population" from their text *Essential Environment: The Science Behind the Stories* (3rd Edition), by Withgott & Brennan. Below is a description of some of the skills and concepts that students should be familiar with in order to complete all of the sections of the activity. The Resources section includes links to additional detail and background information.

<u>Calculate growth rate percentage (sample):</u>

Birth rate: 14.18 births/1,000
Death rate: 8.27 deaths/1000
Net migration: 4.31/1000

Growth rate = (birth rate – death rate) + net migration

(14.18 births/1000 – 8.27 deaths/1000) + 4.31/1000 = 10.22/1,000

Growth rate as percent = .01022 x 100 = 1.022%

<u>Calculate Doubling Time (sample):</u>

Growth rate = 1.022%

Doubling time (in years) = 70/ (growth rate)

70/1.022 = 68.49 years

Exponential Growth

Exponential growth is the increase of a population (or anything) by a fixed percent.

Total Fertility Rate

Total Fertility Rate (TFR) is the average number of children born per female during her lifetime for a particular region/country or population.

I=PAT Equation

Environmental Impact = Population x Affluence (Consumption) x Technology

This equation helps us understand the relative relationships between the three factors on the right and the environmental impact they help to create. For instance, a small population can have a large environmental impact if its members are wealthy enough to consume a lot of resources and choose technology that creates pollution (coal-fired power plants, low mileage vehicles, etc.) On the other hand, a large population with limited financial resources and/or that uses more efficient technologies based on renewable energy could have a small environmental impact. See the Resources section below for links to more detailed explanations.

Demographic Transitions

As a population gains increasing access to better sanitation, medical care, education, birth control, job opportunities, empowerment for women, reliable food sources, and more sophisticated technologies, it will undergo predictable fluctuations in birth rates, death rates and growth rates over time. The Demographic Transitions or Stages help to explain those changes. Other cultural, economic and social factors can also influence these rates, including government policies, war, natural disasters, etc. More detailed information about these Demographic Transitions can be found in the Resources section below.

Materials Needed:

- Spreadsheet containing the birth rate, growth rate, net migration, female literacy rate, infant mortality, population, total fertility rate (TFR) and life expectancy for several countries and the world OR online access to a web document such as the CIA's World Factbook, which contains that data: https://www.cia.gov/library/publications/the-world-factbook/.
- Online access is also helpful so that students can conduct the qualitative research about their countries in class, but this work could also be done as an outside assignment.

Resources:

- Info on I=PAT: http://en.wikipedia.org/wiki/I_PAT
- Info on Demographic Transitions: http://en.wikipedia.org/wiki/Demographic_transition
- CIA's World Factbook: A source of data for the spreadsheet (birth rates, death rates, population, literacy, etc.) as well as historical and sociological data on countries around the world: https://www.cia.gov/library/publications/the-world-factbook/. Relevant information

can be found in the "People & Society" section for each country; see this example from Uganda: https://www.cia.gov/library/publications/the-world-factbook/geos/ug.html

- Overview of population facts and factors from the Population Reference Bureau's "2010 World Population Datasheet": http://www.prb.org/pdf10/10wpds_eng.pdf
- Additional explanation of Demographic Transitions from Petra Tschakert, Assistant Professor of Geography, Karl Zimmerer, Professor and Department Head of Geography, and Brian King, Assistant Professor of Geography, from Penn State: https://www.e-education.psu.edu/geog030/node/205
- World Population Clock and information about population growth over time: http://www.worldometers.info/world-population/

Assessment plan: A pre-post-test assessment has been created to evaluate students' knowledge prior to the activity. (See related documentation.) The same test may be given after the activity, or the report that students write up as part of the activity can also be used in addition to, or instead of, the post-test.

Main Activity and related files: Please see "Demography-Doubling Time-and Growth Rates-Main Activity", "Demography-Doubling Time-and Growth Rates-Sample Spreadsheet", and the "Demography-Doubling Time-and Growth Rates-Pre-Post-Test" files.