concept
The difference between a population’s birth and death rates determines rate of growth and a wide array of factors impact these rates.

objectives
Students will be able to:
• Calculate rates of population growth given birth and death rates.
• Calculate doubling time given the rate of increase.
• Explain how birth and death rates affect population growth.
• Draw connections between population growth and social/political and economic conditions.
• Summarize factors that influence fertility and mortality within one specific country and provide statistical evidence.

subjects
AP Human Geography, Geography, Algebra, Statistics, English Language Arts

skills
Calculating doubling time and half-life, researching, writing, synthesizing research

method
Students calculate the rate of natural increase and corresponding doubling time or half-life for several countries and explore factors that influence a country’s birth and death rates.
3. Write the following formulas on the board and explain that they can be used to determine a population’s annual growth rate and the number of years it will take the population to double if the growth rate remains constant.

\[
\text{birth rate} - \text{death rate} = \frac{\text{rate of natural increase} (\%)}{10}
\]

\[
\frac{70}{\% \text{ natural increase}} = \text{doubling time (in years)}
\]

**Note:** Students might wonder where the number 70 comes from. It is 100 times the natural logarithm of 2 which is used when solving the equation \(ar^n = 2a\) where “a” is the initial population and “r” is the growth factor.

4. Calculate the rate of natural increase and doubling time for the world population.

Currently, the global birth rate is 19 and the global death rate is 7.

\[
\frac{19 - 7}{10} = 1.2\%
\]

At the current growth rate of 1.2%, the world’s population will double in 58 years.

\[
\frac{70}{1.2} = 58 \text{ years}
\]

5. Distribute copies of the Student Worksheet and allow time for students to complete the calculations.

**Answers to Student Worksheet**

<table>
<thead>
<tr>
<th>Country</th>
<th>Birth Rate (2020)</th>
<th>Death Rate (2020)</th>
<th>Annual Natural Increase (%)</th>
<th>Doubling or Halving Time (in years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulgaria</td>
<td>9</td>
<td>16</td>
<td>-0.7</td>
<td>100 (halving)</td>
</tr>
<tr>
<td>China</td>
<td>10</td>
<td>7</td>
<td>0.3</td>
<td>233 (doubling)</td>
</tr>
<tr>
<td>Germany</td>
<td>10</td>
<td>12</td>
<td>-0.2</td>
<td>350 (halving)</td>
</tr>
<tr>
<td>Guatemala</td>
<td>22</td>
<td>5</td>
<td>1.7</td>
<td>41 (doubling)</td>
</tr>
<tr>
<td>India</td>
<td>20</td>
<td>6</td>
<td>1.4</td>
<td>50 (doubling)</td>
</tr>
<tr>
<td>Japan</td>
<td>7</td>
<td>11</td>
<td>-0.4</td>
<td>175 (halving)</td>
</tr>
<tr>
<td>Nigeria</td>
<td>37</td>
<td>12</td>
<td>2.5</td>
<td>28 (doubling)</td>
</tr>
<tr>
<td>South Africa</td>
<td>20</td>
<td>9</td>
<td>1.1</td>
<td>67 (doubling)</td>
</tr>
<tr>
<td>South Korea</td>
<td>6</td>
<td>6</td>
<td>0</td>
<td>n/a</td>
</tr>
<tr>
<td>United States</td>
<td>12</td>
<td>9</td>
<td>0.3</td>
<td>233 (doubling)</td>
</tr>
</tbody>
</table>
1. What are some observations you can make from this data? What patterns do you see?

Answers may include: when a country’s birth rate is higher than its death rate, the population increases; when the death rate is higher than the birth rate, the population decreases; when the birth rate and death rate are the same, the population size does not change; when the rate of growth is higher, the doubling time is shorter and vice versa.

2. Which countries from the Worksheet are growing the fastest? What similarities do you see in these countries’ statistics?

Guatemala, Nigeria, India, and South Africa are growing the fastest. The growth rate is higher and the doubling time is shorter. These countries have the largest difference between the birth rate and the death rate.

3. Which figures differ most among countries, the birth rates or the death rates? How would you explain this?

Birth rates differ more because there is more variability in family size. The birth rate is higher when the average family size is larger. For example, Nigeria (with a birth rate of 37/1,000) averages 5.3 children per family while Germany (with a birth rate of 10/1,000) averages 1.6 children per family. Death rates used to have more variability depending on a person’s access to medicine, clean water, and other necessities. Though millions of people across the world struggle to get their basic needs met, the overall rising health of people worldwide has eliminated large variations among death rates.

4. What do you think accounts for variations in death rates among countries? Why do you think the death rate in the U.S. is higher than in Guatemala?

A variety of factors can influence death rates including wars, disease, famines, and poor health care. The difference in death rates between Guatemala and the U.S. can be attributed to the U.S. having a larger proportion of elderly citizens. Death rates are relatively low in many of the countries with high birth rates because the majority of the population is young. In Nigeria, for instance, 44 percent of the population is under age 15, and only 3 percent is age 65 or older.

5. If you were a national leader in Nigeria or Guatemala, would you be concerned about the rapid population growth? Why or why not?

Answers will vary but many students will say yes, they would be concerned. Leaders of quickly growing countries are responsible for the needs of the expanding population which requires more food, water, shelter, education, transportation and energy infrastructure, healthcare, employment, and more. You would most likely find it difficult for your country to prosper in the global market if it cannot meet the needs of its own people.

6. Would national leaders have concerns if their country was losing population? Why or why not?

Answers will vary. They may fear labor shortages or a growing proportion of elderly who require more health care and home services. On the other hand, a decreasing population could alleviate crowding, unemployment, or strains on land and water resources.

7. The population of the United States actually grew at a rate of about 0.35 percent from 2019 to 2020, and Germany’s population remained the same (0 percent growth). These actual rates are both greater than the rates of natural increase calculated from birth and death rates. Why is this the case?
The rate of natural increase does not account for migration – people moving into or out of a country. Net migration accounts for roughly half of population growth in the United States. In 2020, the most common origin countries of people moving into the U.S. were Mexico, China, India, the Philippines, and El Salvador. The most common origin countries of people moving into Germany were Romania, Poland, Bulgaria, Italy, and Croatia.

Part 2: Fertility and Mortality Trends

procedure

1. Ask students to brainstorm what factors might impact the fertility and mortality in a country. Record their answers on the board.

2. Assign each student one country from the Worksheet, or allow them to select a different country. Students should conduct research to determine two factors, and an associated statistic for each, that influence fertility in the country and two factors, with statistics, that influence mortality in the country. For example, Guatemala has one of the higher birth rates. Two influential factors are that only 49 percent of females are using a form of modern contraception and the average woman gives birth to her first child when she’s 21 years old.

3. Have students write two paragraphs that summarize and synthesize their findings. The first paragraph should focus on the two fertility factors; the second paragraph should focus on the mortality factors. Each paragraph should include the two factors and their supporting statistics, if the factor has a direct or indirect relationship to fertility/mortality, and an explanation of the link between the factor and the country’s fertility/mortality.

assessment

Monitor students’ participation in the Part 1 discussion and evaluate their two paragraphs from Part 2.

follow-up activity

Focusing on the same country from Part 2, students research if and how the government has made a policy to address population growth. They should note if these strategies are working and what they would recommend to better that country’s situation, using evidence to support their claims.

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Use the formulas below to calculate the annual rates of natural increase and the doubling or halving times for the populations of the countries listed on the chart.

\[
\frac{\text{birth rate} - \text{death rate}}{10} = \text{rate of natural increase (\%)} \quad \text{and} \quad \frac{70}{\% \text{ natural increase}} = \text{doubling time (in years)}
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