

METHOD

Students watch the video “World Population” and participate in guided exploration of an online timeline to explore how improvements in medicine, food and agriculture, and public health and sanitation during the Industrial Revolution contributed to population growth.

INTRODUCTION

Human population has grown exponentially over the past 200 years due to advancements in medicine, food and agriculture, and public health and sanitation. Understanding how these technological and social innovations improved quality of life by reducing mortality is critical to a complete understanding of demographic history.

MATERIALS

- Student Reading Cards (provided)
- Timeline Exploration Guide (provided)

PART 1

Introducing World Population History

Procedure

1. Have students respond in writing to the following true/false statements and explain their thinking. Ask a few students to share their responses.
 - a. Human population growth has remained constant throughout human history.
 - b. A rising birth rate is the main contributing factor to population growth.
2. As a class, watch “World Population,” a 6-minute video showing the history of human population growth from 1 C.E. to the present and the projected growth to 2050. The video streams from the website www.WorldPopulationHistory.org.
3. Ask students to share observations from the film. Refer back to the first true/false statement – *Human population growth has remained constant over time*. Ask if any students would change their answers from true to false and have them elaborate.

CONCEPT

Global population has grown exponentially since the Industrial Revolution as advances in medicine, food and agriculture, and public health and sanitation have led to a global decline in the death rate.

OBJECTIVES

Students will be able to:

- Describe the trajectory of human population growth from 1 C.E. to the present.
- Explain how the changes in the global death rate impact population growth.
- Identify advances in medicine, food and agriculture, and public health and sanitation that contributed to population growth during the Industrial Revolution.

SUBJECTS

World History, AP Human Geography, Geography, Environmental Science (General and AP)

SKILLS

Classifying historic events, identifying trends, understanding cause and effects

4. Recap the film and discussion, emphasizing that human population has increased exponentially over the past 200 years. Prior to the Industrial Revolution, growth was slow and relatively steady because the birth and death rates were roughly the same. Explain that the death rate declined during the Industrial Revolution and altered this balance, causing human population to grow. Ask students to hypothesize what caused a decline in the death rate during the Industrial Revolution.

PART 2

Understanding Why We've Grown

Procedure:

1. Before class, review the Timeline Exploration Guide and familiarize yourself with the timeline on www.WorldPopulationHistory.org.
2. Distribute the Student Reading Cards to 12 students. They will read the cards aloud when prompted.
3. Display the map and timeline on the main page of www.WorldPopulationHistory.org and explain to students that you'll be exploring specific advances in medicine, food and agriculture, and public health and sanitation that catalyzed the population explosion in Western Europe and the United States. You might want to point out that you'll be looking at milestones organized by theme, rather than purely chronologically.
4. Follow the Timeline Exploration Guide, stopping at the listed milestones and discussing their significance in greater detail.

ASSESSMENT

Monitor students' involvement in the various class discussions covering the "World Population" video and the guided timeline exploration. Have each complete an exit ticket listing three things they learned about past global population growth and one question they still have.

Cut along the dashed lines.

Reading Card #1: For much of history, human population has grown at a slow to moderate pace. This slow rate of growth is attributed to a relatively even ratio of births to deaths. A lot of people were being born, but a high percentage of them died, primarily from what we now consider preventable causes. Changes in the birth rate or death rate of a population can have a great impact on population size. From 1 C.E. to 1700, death rates were high and we find that population did not grow as fast as it would in more recent years.

Reading Card #2: The Industrial Revolution began in England in the late 1700s and had a significant impact on the death rate of the newly industrializing countries of Europe and North America. Advancements in medicine, food and agriculture, and public health and sanitation all played a large role in reducing mortality and improving quality of life, which in turn, increased population growth rates. Europe's population was estimated at 125 million in 1700. Two hundred years later, its population had nearly quadrupled in size, reaching an estimated 420 million by 1900. Innovation and discovery during the Industrial Revolution, coupled with extraordinary increases in overall rate of natural increase, had profound impacts on the economy, environment, and society.

Reading Card #3: During the 1800s and 1900s, advances in medicine dramatically improved quality of life in Western Europe and the United States. Discoveries in biology and chemistry led to the development of new medicines, adoption of innovative medical techniques, and aseptic practices. Many of these advances would not have been possible without the invention of the microscope in 1676.

Reading Card #4: Further important medical discoveries followed the microscope. In 1796, Edward Jenner discovered a cure for smallpox. The idea that many diseases are caused by micro-organisms was later scientifically proven by French chemist Louis Pasteur and called germ theory.

Reading Card #5: Germ theory was fundamental in the development of antibiotics and other antimicrobial medicines. Penicillin, later discovered in the early 1900s, provided quick and complete treatment of previously incurable bacterial illnesses. Years later, strategic vaccination campaigns were able to eliminate common diseases like measles, mumps, diphtheria, and tetanus in Europe and the United States.

Reading Card #6: During the Industrial Revolution, improvements in how we grow and transport food had a great influence on population. Greater quantities and access to food lessened the dangers and impacts of famine and improved overall nutrition on a grand scale. The British Agricultural Revolution (1700-1850) resulted in unprecedented increases in labor and land productivity between 1600s and 1800s. Advances in farm machinery made it easier for farmers to ready and harvest greater expanses of agricultural land with ease.

Reading Card #7: New agricultural methods, such as the four-crop rotation method, greatly increased crop and livestock yields by improving soil fertility and reducing fallow. By the 1800s, many British agricultural practices had been adopted by most of continental Europe and natural fertilizer, along with other agricultural implements, was being produced commercially at a large scale. Later, the development and widespread use of chemical fertilizers often replaced natural fertilizer and led to even heartier and more bountiful crop yields.

Reading Card #8: The Industrial Revolution also made food more accessible. The development of the steam engine dramatically changed the way agricultural goods were transported across Europe, providing quick and reliable access to cities across the continent. In the early 19th century, British engineer Richard Trevithick constructed the first steam locomotive. By 1950, Britain had more than 6,000 miles of railway track, which allowed it to transport goods and people faster than ever before.

Reading Card #9: What better farming methods did for crop yields, better sanitation and sewage regulation did for public health. During the Industrial Revolution, populations in Britain's urban centers increased rapidly as people migrated into cities to fill new jobs in factories. London doubled in size between 1801 and 1841. As the population grew, demand for basic necessities outstripped supply. Overcrowded neighborhoods, often served by inadequate public water supplies with poor waste disposal systems, led to recurring outbreaks of cholera, dysentery, tuberculosis (TB), typhoid fever, and other water-borne diseases.

Reading Card #10: As cities grew, social reformers and physicians began to identify connections between the intolerable conditions of urban slums, poor sanitation, and the need for greater investment in public health. Edwin Chadwick led the British movement toward sanitation reform. Later, in 1854, physician John Snow discovered that cholera was transmitted through contaminated water. In the United States, chlorination and other treatments for public water supply became common practice by the early 1900s, further decreasing the incidence of water contamination and disease.

Reading Card #11: Increasing population and urbanization also meant a higher concentration of human waste. Early sewage systems discharged raw and untreated sewage directly into waterways. Later, as tolerance from cities downriver waned, municipalities developed more advanced methods of wastewater treatment. Modern sewer systems were developed in an attempt to dispel contaminated wastewater and fecal matter away from populated areas.

Reading Card #12: Through the beginning of the 20th century, advances in medicine, food and agriculture, and public health and sanitation affected populations primarily in more developed countries. But as these advances spread out from their epicenters in Europe and North America and into developing nations, death rates fell dramatically in these regions as well. Following World War II, human population grew explosively, reaching annual growth rates as high as 4 percent for some developing nations. World population hit 1 billion in 1804. It took 123 years for the population to double 2 billion in 1927. From there, it only took 47 years for the population to double to 4 billion. The global population reached 8 billion in 2022, this time having doubled in 48 years.

Below is a detailed description of how to facilitate class discussion using the website www.WorldPopulationHistory.org. The purpose of the discussion is to explore the impacts that advances in medicine, food and agriculture, and public health and sanitation had on population size.

The “Student Reading” sections contain the text from all 12 student reading cards. Cards are divided into five thematic categories: Pre-Industrial Population Growth, Medical Advances, Food and Agriculture Advances, Public Health and Sanitation Advances, and Global Impact.

Use the following structure for each reading:

1. Student reads appropriate card.
2. Teacher clicks on noted milestone* and allows time for students to read. You may want to expand on the significance of each or discuss links between multiple milestones.
3. Go over topics in the Discussion section. In many cases, this requires students to use prior knowledge to draw connections and make inferences about how and why the milestone impacted population growth. This discussion can be teacher-led or done in small student groups.

*The Milestones below list the year in which the event occurs and its title. To find a milestone on the online timeline, simply type the year into the search box located in the upper right corner of the website, zoom in using the magnifying glass directly left of the timeline, and select the appropriate milestone.

Theme: Pre-Industrial Population Growth

CARD #1

Student Reading

For much of history, human population has grown at a slow to moderate pace. This slow rate of growth is attributed to a relatively even ratio of births to deaths. A lot of people were being born, but a high percentage of them died, primarily from what we now consider preventable causes. Changes in the birth rate or death rate of a population can have a great impact on population size. When we examine population growth from 1 CE to 1700 (when death rates were high), we find that population did not grow as fast as it did in the 19th, 20th, and 21st centuries when death rates began to decline.

Milestones

1–1700: Do not click on any milestones. Instead, direct your students’ attention to the population dots on the map and toggle between 1 C.E. and 1700.

Discussion

Observe changes in the number of dots on the map. In 1 C.E., there are 170 dots on the map. In 1700, there are 585 dots. How many dots must be added in a 322 year time frame, representing 1700 to 2022, to reach the current population of 8 billion, or 8,000 million. (7,415 dots, representing 7,415,000,000 people)

CARD #2

Student Reading

The Industrial Revolution began in England in the late 1700s and had a significant impact on the death rate of the newly industrializing countries of Europe and North America. Advancements in medicine, food and agriculture, and public health and sanitation all played a large role in reducing mortality and improving quality of life, which in turn, increased population growth rates. Europe's population was estimated at 125 million in 1700. Two hundred years later, its population had nearly quadrupled in size, reaching an estimated 420 million by 1900. Innovation and discovery during the Industrial Revolution, coupled with extraordinary increases in overall rate of natural increase, had profound impacts on the economy, environment, and society.

Milestones

1760: Effects of the Industrial Revolution

Discussion

Review the significance of the Industrial Revolution.

Why was there rural to urban migration during the Industrial Revolution? What challenges most likely accompanied this shift in population distribution?

Theme: Medical Advances

CARD #3

Student Reading

During the 1800s and 1900s, advances in medicine dramatically improved quality of life in Western Europe and the United States. Discoveries in biology and chemistry led to the development of new medicines, adoption of innovative medical techniques, and aseptic practices. Many of these advances would not have been possible without the invention of the microscope in 1676.

Milestones

1676: Leeuwenhoek Observes Microbes

Discussion

Prior to the microscope, how did people observe medical issues and health problems? How did the microscope change how people went about studying disease?

CARD #4

Student Reading

Further important medical discoveries followed the microscope. In 1796, Edward Jenner discovered a cure for smallpox. The idea that many diseases are caused by micro-organisms was later scientifically proven by French chemist Louis Pasteur and called germ theory.

Milestones

1796: Smallpox Vaccine
1858: Pasteurization

Discussion

How do vaccines work? What is pasteurization? How has pasteurization changed the food industry? How have vaccines and pasteurization impacted human health?

CARD #5

Student Reading

Germ theory was fundamental in the development of antibiotics and other antimicrobial medicines. Penicillin, later discovered in the early 1900s, provided quick and complete treatment of previously incurable bacterial illnesses. Years later, strategic vaccination campaigns were able to eliminate common diseases like measles, mumps, diphtheria, and tetanus in Europe and the United States.

Milestones

1940: Antibiotics

Discussion

What is germ theory? How have antibiotics changed the way we treat illnesses?

Theme: Food and Agricultural Advances

CARD #6

Student Reading

During the Industrial Revolution, improvements in how we grow and transport food had a great influence on population. Greater quantities and access to food lessened the dangers and impacts of famine and improved overall nutrition on a grand scale. The British Agricultural Revolution (1700-1850) resulted in unprecedented increases in labor and land productivity between 1600s and 1800s. Advances in farm machinery made it easier for farmers to ready and harvest greater expanses of agricultural land with ease.

Milestones

- 1701: Seed Drill
- 1786: Thresher
- 1834: New Farm Equipment

Discussion

How did new farming machinery increase land productivity? In what ways did these new machines make farming more efficient? How did higher crop yields and efficient farming impact population growth?

CARD #7

Student Reading

New agricultural methods, such as the four-crop rotation method, greatly increased crop and livestock yields by improving soil fertility and reducing fallow. By the 1800s, many British agricultural practices had been adopted by most of continental Europe and natural fertilizer, along with other agricultural implements, was being produced commercially at a large scale. Later, the development and widespread use of chemical fertilizers often replaced natural fertilizer and led to even heartier and more bountiful crop yields.

Milestones

- 1843: First Fertilizer Factory
- 1913: Beginning of Chemical Fertilizer

Discussion

What is the difference between natural and chemical fertilizer? What are pros and cons of large-scale fertilizer production?

CARD #8

Student Reading

The Industrial Revolution also made food more accessible. The development of the steam engine dramatically changed the way agricultural goods were transported across Europe, providing quick and reliable access to cities across the continent. In the early 19th century, British engineer Richard Trevithick constructed the first steam locomotive. By 1950, Britain had more than 6,000 miles of railway track, which allowed it to transport goods and people faster than ever before.

Milestones

1825: Steam-Powered Railway
1869: Transcontinental Railroad Completed

Discussion

How was food transported prior to railroads? What limitations in transportation did railroads address? How did railroads change people's demand for certain foods? How else did railroads change society beyond transporting food?

Theme: Public Health and Sanitation

CARD #9

Student Reading

What better farming methods did for crop yields, better sanitation and sewage regulation did for public health. During the Industrial Revolution, populations in Britain's urban centers increased rapidly as people migrated into cities to fill new jobs in factories. London doubled in size between 1801 and 1841. As the population grew, demand for basic necessities outstripped supply. Overcrowded neighborhoods, often served by inadequate public water supplies with poor waste disposal systems, led to recurring outbreaks of cholera, dysentery, tuberculosis (TB), typhoid fever, and other water-borne diseases.

Milestones

1800: A City of One Million

Discussion

Why did people move to London from rural villages? How does rural to urban migration impact the social, economic, and environmental characteristics of cities?

CARD #10

Student Reading

As cities grew, social reformers and physicians began to identify connections between the intolerable conditions of urban slums, poor sanitation, and the need for greater investment in public health. Edwin Chadwick led the British movement toward sanitation reform. Later, in 1854, physician John Snow discovered that cholera was transmitted through contaminated water. In the United States, chlorination and other treatments for public water supply became common practice by the early 1900s, further decreasing the incidence of water contamination and disease.

Milestones

1843: Start of Public Health Movement
1854: Water-Borne Diseases and Sanitation

Discussion

How are living conditions linked to human health? What is epidemiology? How does public knowledge change how communities react to and deal with health threats?

CARD #11

Student Reading

Increasing population and urbanization also meant a higher concentration of human waste. Early sewage systems discharged raw and untreated sewage directly into waterways. Later, as tolerance from cities downriver waned, municipalities developed more advanced methods of wastewater treatment. Modern sewer systems were developed in an attempt to dispel contaminated wastewater and fecal matter away from populated areas.

Milestones

1775: Flush Toilet

Discussion

What differentiates a flush toilet from previously used pit latrines? How are waste disposal, contaminated water, and the spread of disease all linked?

Theme: Global Impact

CARD #12

Student Reading

Through the beginning of the 20th century, advances in medicine, food and agriculture, and public health and sanitation affected populations primarily in more developed countries. But as these advances spread out from their epicenters in Europe and North America and into developing nations, death rates fell dramatically in these regions as well. Following World War II, human population grew explosively, reaching annual growth rates as high as 4 percent for some developing nations. World population hit 1 billion in 1804. It took 123 years for the population to double 2 billion in 1927. From there, it only took 47 years for the population to double to 4 billion. The global population reached 8 billion in 2022, this time having doubled in 48 years.

Milestones

1804, 1927, 1974, 2022: For these years, do not click on any milestones. Direct your students' attention to the map of population dots.

Discussion

Review the changes in the number of dots on the map for the years listed above. How would you characterize population growth during the past 200 years? What are the implications of a population doubling in size?

Consider space, health, natural resources, quality of life, and environmental quality.