POPULATIONS (HS)

Population growth

Focus question	How quickly has population increased over human history? What might help slow the rate of increase?
Learning target	Students track the growth of the human population through time.
Vocabulary	Arable, fossil fuels, infrastructure, desertification, salinization, water-logging, developed country, less-developed country (developing)

MS-LS2.A: Interdependent Relationships in Ecosystems

Performance expectation MS-LS2-1	**Classroom connection:** Students will determine the growth of the human population through time.

Science and engineering practices

Analyzing and Interpreting Data	**Classroom connection:** Students analyze and interpret data by organizing population data (e.g., using tables, graphs, and charts) to allow for analysis and interpretation.

Disciplinary core ideas

LS2.A: Interdependent Relationships in Ecosystems	**Classroom connection:** Students analyze the organized data to determine the relationships between the size of a population, the growth and survival of individual organisms, and resource availability. **Classroom connection:** Students determine whether the relationships provide evidence of a causal link between these factors.

Cross-cutting concepts

Cause and Effect	**Classroom connection:** Students analyze and interpret the organized data to make predictions based on evidence of causal relationships between resource availability, organisms, and organism populations. Students make relevant predictions, including: *Resource availability may have effects on a population's rate of reproduction.*

Phenomena

Show the video located here: **worldpopulationhistory.org/map/2050/mercator/1/0/25/**

After showing the video, ask students to brainstorm questions individually for 30 seconds to one minute, then share their questions within small groups (3–4 students) for two or three minutes. Have groups share their questions one-by-one to the large group until all questions are shared. Create a Driving Question Board to keep note of the questions, as they will guide the rest of this unit. (for more information on driving question boards, see The Science Teacher (November 2008), Vol 75, No 8.

Possible questions:

- How many people are added in a minute?
- How many people are added in our state?
- How many people are added in the United States?
- Where are all of these people?
- What is the rank of countries by population?
- Why are some countries growing faster than others?
- What are the effects of this growth?
- What effects do the growth of human populations have on ecosystems?
- Do we have enough food?
- Can we grow enough food?
- When did we grow so large as a human population?

If no one brings up food or food production, add your own questions: Do we have enough food to feed everyone? Where are the people and where is the food? How can we feed 9.8 billion people in 2050, and what happens along the way?

To begin investigating these questions, organize the ones that relate to the sheer number of people and the rate at which the population has grown.

See these resources for additional information:

- **ourworldindata.org/world-population-growth**
- **worldpopulationhistory.org/map/2050/mercator/1/0/25/**
- **theworldcounts.com/counters/shocking_environmental_facts_and_statistics/world_population_clock_live**

Use *Lesson 1: Population Growth* to address some of those questions.

Background

According to most estimates, there will be 9.5 billion people on the planet in 2050. Many experts suggest that growers will have to produce more food in the next 50 years than has been grown in the past 10,000 years, which means doubling current production on the same amount of land. Yield increases have begun to slow (see USDA graph). Therefore, this demand will require the development of new technologies, new techniques, and new environmental practices.

What are the limits to food production possibilities? The amount of arable land may decrease if climates continue to change. Water is limited around the world and the places that are most productive are not necessarily in the areas where food is most needed. Fossil fuels, even with the addition of ethanol, run tractors while fertilizers and pesticides are also energy intensive to create. Therefore, food production is closely tied to fuel costs and availability.

Another concern is the infrastructure necessary to get food to markets before it spoils. In many less economically-developed countries, there is no system (roads, rivers, canals, etc.) to get the food to market, and storing it is not a viable option due to destruction by fungus and pests. Soil is also vulnerable to erosion, desertification (once fertile land becomes arid), salinization (build-up of salts in the soil from over-irrigation) and water-logging (saturation of soil by groundwater).

One of the largest problems in the developed world is food waste. Some of the crop is lost in the field to pests (about 30%), some is left during the harvest (10–20%), and in the U.S., it is estimated that consumers throw away as much of 50% of their food. Population pressures are driving today's food production demand. While the need to feed a growing population will continue, factors such as decreasing infant mortality rates, reducing the need for children to work, providing women with educational opportunities, and access to family planning will improve the standard of living in countries worldwide and increase the demand for food. With 9 billion eaters, the agriculture industry, made up of large-scale farmers, local food producers, entrepreneurs, agriculture scientists and engineers will all become allies in meeting future food demands.
nass.usda.gov/Charts_and_Maps/graphics/cornyld.pdf
nass.usda.gov/Charts_and_Maps/graphics/soyyld.pdf

Materials

Students will need an electronic device to access the internet.

Procedure

Students will work individually to complete the following steps.

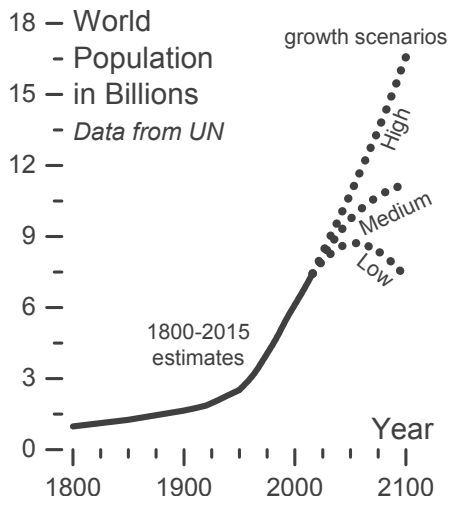
1. Have students research the information by visiting **worldpopulationhistory.org/map/2050/mercator/1/0/25/**. Ask:
   - How many years has it taken for the world population to double?
   - How many years has it taken for the world population to increase by 1 billion?
2. Students create their own table or use the example table to collect data on the years it has taken to reach each billion and to double.

Year	Population in billions	Number of years between	Years to double
1804	1 billion	many	
1928	2 billion	124	124
1960	3 billion	32	
1974	4 billion	14	56
1987	5 billion	13	
1999	6 billion	12	
2011	7 billion	12	
Estimated 2023	8 billion	Estimated 12	Estimated 49

Differentiation

Other ways to connect with students with various needs:

- **Local community:** students may investigate the population changes in their town, city, state, or home country. (census.gov to access local data)
- **Students with special needs (language/reading/auditory/visual):** Teacher may supply a graph for students to interpret or require only the mathematical calculation without the graph.
- **Extra support:** students may model exponential growth by using objects (seeds, blocks, etc) to show rapid increase as numbers increase, or complete pedigrees of their own families from grandparents to their own generations. (ties to local community also)
- **Extensions:** Students can compare birth rates from previous decades to see the change over time and how the growth rate has slowed, but how the numbers are still adding up exponentially.



Possible graph
commons.wikimedia.org/wiki/File:World_population_v3.svg

Student handout

Reflection

1. What might account for the decreasing time between billions?

Possible answers: There are currently more people to have children than before. People have a higher life expectancy and lower infant mortality.

2. How have humans utilized land resources to increase food production to allow for these increases?

Possible answers: Humans have improved farming methods, discovered and implemented the use of technology, and cleared more land from forests.

3. What are the effects of technology when used in food production?

Possible answers: Technology can lead to increased yield, more efficiency by reducing time (using tractors and harvesters), less labor needed.

4. What factors must be considered to project future growth?

Possible answers: Demographers must consider cultural factors, limits imposed by governments, number of women of childbearing age, age at marriage, education of women, child mortality rates (the higher the mortality rate, the higher the rate of population increase), women in the workforce.

5. How do you explain that resource availability does not seem to limit human population growth?

Possible answers: We are at 7.6+ billion and still growing exponentially; we have enough food to feed people; we have enough land for people to live on; people are not dying in large numbers from starvation.

Assessments

Analyze and interpret data to provide evidence for the increase in number of the human population.

Rubric for assessment

Skill	Beginning	Satisfactory	Exemplar
Student used graphical displays (graphs and/or tables) of human population data sets to identify relationships over time or space.	Student recorded data but not in a table, chart, or graph.	Student created a data table that organizes the data.	Student created a graph from organized data to show relationships.

Rubric for self-assessment

Skill	Yes	No
I created a table to organize data.		
I created a graph to show relationships between data.		