World Population

Student Objective
The student:
- can explain what is meant by population growth being referred to as a "J" curve
- can explain what is meant by population momentum and how it affects our population projections
- will explain how population, energy consumption, limited natural resources and lifestyle habits are connected.

Key Words:
birth rate
carrying capacity
death rate
doubling time
exponential growth
J-curve
population density
population momentum
projection
sustainability
zero population growth

Materials:
- *World Population** video (link in Internet Sites section)
- Laboratory Manual

Time:
½ to 1 hour

Background Information*

A graph of human population before the agricultural revolution would likely have suggested a wave, reflecting growth in times of plenty and decline in times of want, as graphs of other species' populations continue to look to this day. The graph of recent human population growth is referred to as a **J-curve** as it follows the shape of that letter, starting out low and skyrocketing straight up.

World population is currently at 7.7 billion, and is expected to reach 8.5 billion by 2025. At the present rate of growth; nearly 80 million a year, the world adds a New York City every month, a Germany every year, and a Europe each decade. With a current annual growth rate of 1%, world population is projected to double in just 63 years. Our doubling times will be realized *if and only if* growth rates remain constant. Today, the world's birth rate is almost three times its death rate. The closer these two rates are, the slower population growth will be.

An area's **carrying capacity** is the number of a given species that area can support without impairing its ability to continue supporting that population. People are only able to live in densely populated areas if enough space elsewhere is left much less densely populated to grow food and produce oxygen.

The impact of any human group on its environment has to do with three equally important factors. The first is the number of people. The second factor encompasses the ways in which we manufacture goods, design communities, and use technology. The third is the actual amount of resources consumed by each person. Unfortunately, the rate at which industrialized nations consume resources makes their populations' effect on the planet vastly greater than that of

developing countries. Consider the following examples:

- Energy - Americans constitute less than 5% of the world's population, but are responsible for 26% of the world's annual energy consumption, including 25% of fossil fuels. On average one American consumes as much energy as 2.1 Germans, 6.9 Iraquis, 12.1 Columbians, 28.3 Indians, 127 Haitians, or 395 Ethiopians.
- Natural Resources - Industrialized countries account for only about 20% of global population, yet they consume 86% of the world's aluminum, 81% of its paper, 80% of its iron and steel, and 76% of its timber.
- Land Use - In the last 200 years the United States has lost: 71% of its topsoil, 50% of its wetlands, 90% of its northwestern old-growth forests, and 99% of its tallgrass prairie. We are currently developing rural land at the rate of 9 square miles per day, and paving over 1.3 million acres each year–an area roughly equivalent in size to the state of Delaware.
- Global Warming - In 2015, the United States was responsible for 15% of the world's carbon dioxide emissions, second only to China with its large population. Carbon dioxide is the primary greenhouse gas, responsible for 60% of global warming caused by greenhouse gases.
- Water Pollution - In the United States, 40% of all surface waters are unfit for bathing or fishing. Agricultural chemicals, eroded sediment, and animal wastes have fouled over 173,000 miles of waterways. In addition, groundwater reserves are being depleted in many regions, and overall are being used at a rate 25% greater than their replenishment rate.
- Waste - The more we consume, the more waste we produce. By the time a baby born today in the United States reaches the age of 82 years, he or she will have produced nearly 60 tons of garbage. The average resident of New York City generates 4 lbs. of solid waste each day. The average Parisian produces 2.4 lbs., while residents of Manila, Cairo, and Calcutta produce just 1.1 lbs. per day.

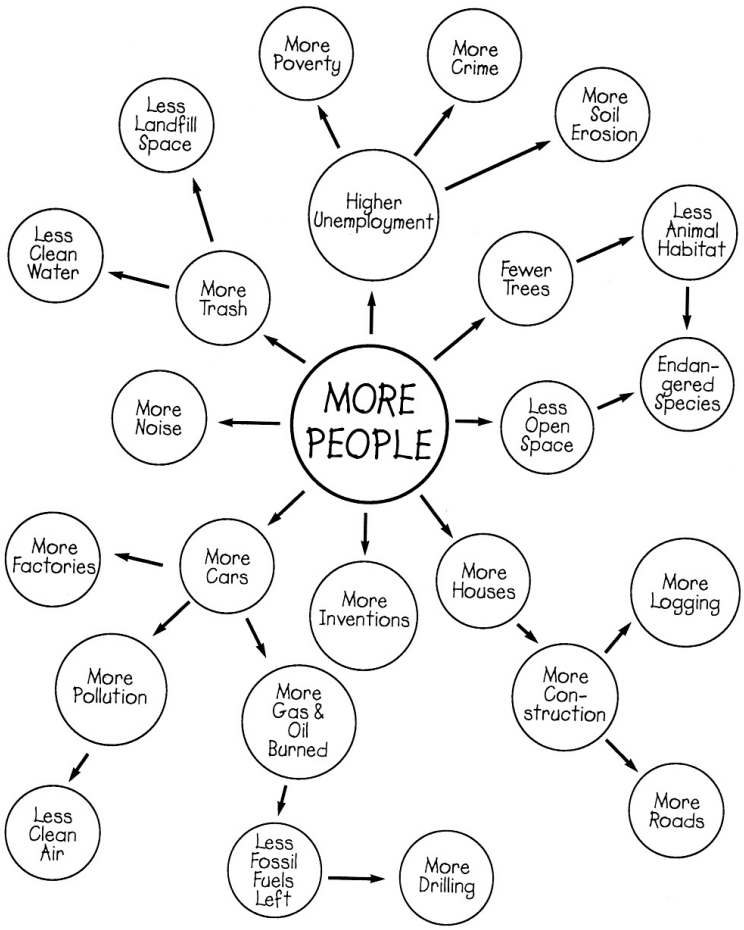
*Used with the permission of Population Connection: http://www.populationconnection.org

Procedure

1. **Engage**: Show the 6-minute video.
2. Allow 5 - 10 minutes for the students to complete the pages in their Laboratory Manual.
3. Take a few minutes to discuss the video. Remind your students that historical population data and that there are 7.7 billion people on the world (as of 2018) are **facts**. The predictions of human population in the future as well as its effects are **issues.** As with all issues, there are many different valid opinions.
4. **Explore:** Have the class develop a concept map:
   - Write the words "*More People*" in the middle of the board.
   - Tell the students that you want them to think of what might be the environmental, economic or social impacts of there being more people. (An example would be "more people might mean more cars on the road." Next to more people draw an arrow and add "more cars") See example below.
   - Tell students that there are no right or wrong answers, but they may be asked to

explain their proposed connections. Cause and effect relationships can be positive, negative or neutral.

- Invite students to come up to the board a few at a time to add to the word web. If all the concepts seem to be negative, guide the students to see at least a few positive effects (more inventions, career opportunities, friends, parks, etc.)



5. **Explain:** After all of the students have had a chance to contribute, lead a discussion. Help the students to understand that energy plays a part in almost all branches of the concept map they have drawn, and that it impacts more than just personal transportation.

Key Words and Definitions

- **birth rate –** the number of births per 1,000 in a given year
- **carrying capacity –** the number of a given species that an area can support without impairing its ability to continue supporting that population
- **death rate** – the number of deaths per 1,000 in a given year
- **doubling time** – the number of years required for the population of an area to double, given its current growth rate
- **exponential growth –** a constant rate of growth applied to a continuously increasing base

over a period of time (e.g. a savings account growing at compound interest, a snowball gathering mass, or a population growing at 3 percent yearly)

- **"J" curve** – the shape that population growth appears on a graph, starting out low and shooting straight up near the end
- **population density** – population per unit of land area (e.g. persons per square mile)
- **population momentum** – the fact that even in countries when population stabilizes with the average being two children per woman, it can take 60 - 70 years for population numbers to stabilize. Stabilization will only occur when the percentage of elderly equal the percentage in child-bearing age
- **projection** – computations of future trends given certain assumptions
- **sustainability –** the idea that a system of development meets the basic needs of all people without compromising the ability of future generations to meet their own needs
- **zero population growth** – a population in equilibrium, with a growth rate of zero, achieved when births plus immigration equals deaths plus emigration

Related Research

1. Save the class' concept map from this activity to use with the *End of Cheap Oil* activity. With another color, or a tissue overlay, add the center concept "less cheap energy". Discuss the overlaps and the differences.
2. Analyze how carbon use has changed over time with Part 1 of the *Carbon Crunch* activity on Population Connection's companion site (http://worldpopulationhistory.org/wp-content/uploads/04-Lesson-Plan.pdf). The class is divided into groups with each group investigating a different period in history and then sharing their findings and conclusions with the entire class.
3. Explore the distribution of carbon emissions around the world and explore the relationship between wealth and per capita carbon emissions in Part 2 of the *Carbon Crunch* activity on Population Connection's companion site (http://worldpopulationhistory.org/wp-content/uploads/04-Lesson-Plan.pdf

Related Reading

- ***Overdevelopment, Overpopulation, Overshoot*** by Tom Butler (Geoff Books, 2015 This large, dynamic book is filled with beautifully photographed photo-essays illuminating the depth of the damage that human numbers and behavior have caused the earth. A must-have for all environmental libraries.

Internet sites

http://populationeducation.org

Population Connection's education site. Contains *World Population* video, population clock, curriculum, lesson plans and resources.

http://www.populationconnection.org

Population Connection site contains current population events and actions, teacher resources, and internet publications.

http://worldpopulationhistory.org/map/1/mercator/1/0/25/

Population Connection's companion site to accompany the video, lets students explore and "drill down" into the various points in history and learn more about what was happening at that time in agriculture, health, society, environment and science & technology. Overlays can also be used to see land use, CO2 emissions, fertility rates, urbanization and life expectancy of different areas of the world at specific times.

https://www.census.gov/popclock/

US Census Bureau's population clock.

http://www.prb.org/

Population Reference Bureau site includes worldwide data and current population issues.

https://www.ted.com/talks/paul_gilding_the_earth_is_full

Ted Talk, *The Earth is Full*, by Paul Gilding. Ted-Ed lesson with related questions and discussion points: **http://ed.ted.com/lessons/the-earth-is-full-paul-gilding**

World Population

Florida NGSS Standards & Related Subject Common Core

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Nature of Science																					
Standard 4	**SC.912.N.4**		**X**																		
Life Science																					
Standard 17	**SC.912.L.17**	**X**				**X**			**X**												**X**
Social Studies Standards		SS.912.G.4.1, SS.912.G.4.7, SS.912.G.6.1, SS.912.W.1.1																			

Science–Standard 4: Science and Society

- SC.912.N.4.2 - Weigh the merits of alternative strategies for solving a specific societal problem by comparing a number of different costs and benefits, such as human, economic, and environmental.

Science–Standard 17: Interdependence

- SC912.L.17.1 - Discuss the characteristics of populations, such as number of individuals, age structure, density, and pattern of distribution.
- SC.912.L.17.5 - Analyze how population size is determined by births, deaths, immigration, emigration, and limiting factors (biotic and abiotic) that determine carrying capacity.
- SC.912.L.17.18 - Describe how human population size and resource use relate to environmental quality.
- SC.912.L.17.20 - Predict the impact of individuals on environmental systems and examine how human lifestyles affect sustainability.

Social Studies–Geography

- SS.912.G.4.1 - Interpret population growth and other demographic data for any given place.
- SS.912.G.4.7 - Use geographic terms and tools to explain cultural diffusion throughout places, regions, and the world.
- SS.912.G.6.1 - Use appropriate maps and other graphic representations to analyze geographic problems and changes over time

Social Studies–World History

- SS.912.W.1.1 - Use timelines to establish cause and effect relationships of historical events.

National Next Generation Science Standards
Ecosystems: Interactions, Energy, and Dynamics

- HS-LS2-1 - Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

World Population

1. In the video I was amazed to see.....

2. We should be concerned about human population growth because.....

3. With limited natural resources and a growing population, I think we should.....

4. List as many ways as you can think of to limit our use of natural resources and save our fossil fuels.