World Population

Student Objectives
The student:
- will explain what is meant by population growth being referred to as a "J curve"
- will explain how population, energy consumption, and limited natural resources are connected

Key Words:
carrying capacity
fossil fuel
J curve
momentum
population
renewable energy

Materials:
- *World Population* video produced by Population Connection (link in Internet Sites)
- Science Journal

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 and 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 7.3 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. The United States, with over 320 million people, is growing by more than 2.3 million people each year. At this rate, we are one of the fastest growing industrialized nations in the world, and we have the third largest population of all nations, preceded only by China and India.

With a current annual growth rate of 1.1%, 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 population's effect on the planet vastly greater than that of developing countries. Consider the following examples:

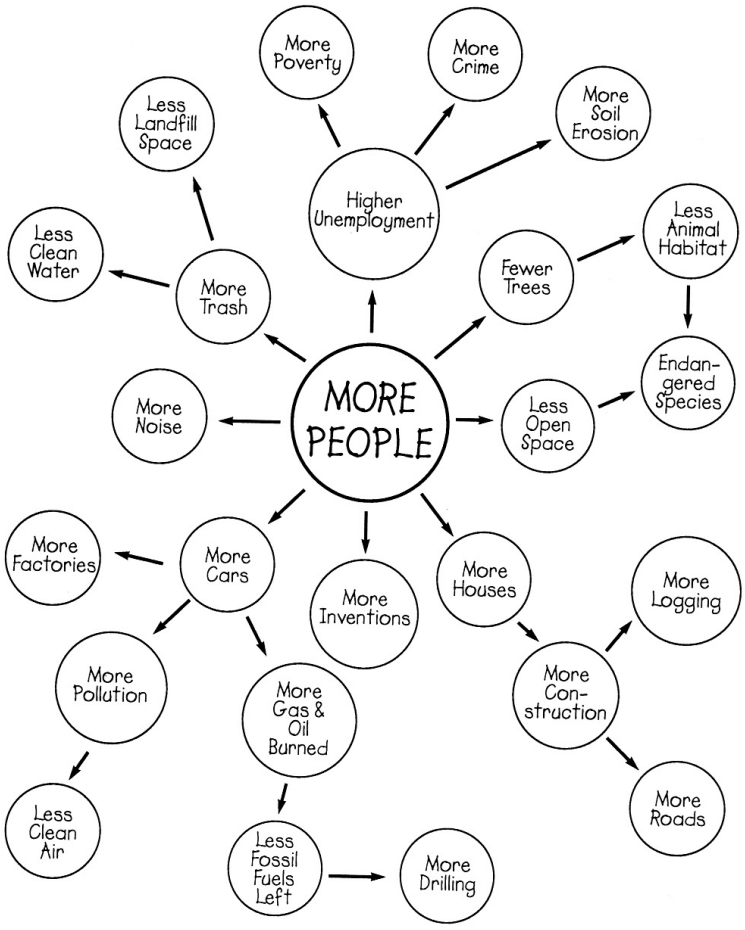
- **Energy** – Americans constitute less than 5% of the world's population, but are responsible for 26% of the world's annual energy consumption, including 25% of fossil fuels. On average one American consumes as much energy as 2.1 Germans, 6.9 Iraquis, 12.1 Columbians, 28.3 Indians, 127 Haitians, or 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 2011, the United States was responsible for16% of the world's carbon dioxide emissions, second only to China. 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. Note: It is extremely important that after showing the video you lead a discussion that also emphasizes the positives: career opportunities, the positive effects of having more people in your school/neighborhood/town, and the positive changes that the students can make in the future to improve the world as a whole. Young students can easily feel helpless by overwhelming negative images, so care must be taken to balance the message and empower them.
2. Show the 6-minute video. **https://vimeo.com/130468614**
3. Allow 5 - 10 minutes for the students to complete their Science Journal.
4. Take a few minutes to discuss the video. Remind your students that the **facts** are the historical population data presented and that there are 7 billion people on the world at the present time. 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.
5. You may wish to show the video a second time and stop it in places to discuss what is happening.

6. Have the class develop a concept map:
   - Write *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.).

7. After all of the students have had a chance to contribute, lead a discussion. Ask the students "What does this video have to do with our study of solar energy?" Students should understand that every living thing on the planet needs energy to live, and that more people means we have to share the available energy with everyone. Remind your students that in some areas of the world people have less technology and use less energy than people in our country do. Follow with a line of questions--

- in some areas of the world families don't have refrigerators, but they are starting to be available....should they be able to have one?
- in some places they don't have televisions, but would like to have one....should they be able to have one?
- Continue this line of questioning with other items the students take for grated like computers, cell phones, video games, etc.
- End the list of questions with cars.

Note: don't be surprised if some students answer 'no' to some of these questions. If that happens, ask them why. They may even have a good answer (i.e. my parents say that too much television is bad for me). Students should ultimately see that they don't have the right to tell other people what they can and cannot do....even if walking may be healthier for them than riding in a car.

8. Explain to the students that the United States is 5% of the world's population, but we use 25% of the world's resources. Draw two pie charts on the board to show the difference between these two percentages. Ask the students if everyone in the world wants to have and use the technology that we have and enjoy (refrigerators, cars, computers, etc), where is the energy going to come from? *(We would need approximately 5 Earths!)*
9. Steer the discussion into ways we can have enough energy for everyone. Things to include in the discussion are:
    - conservation of resources (if we don't need to use as much then there is more to share with others)
    - recycling (recycling uses less resources than making new)
    - reusing (we live in a very throw-away society!)
    - renewable energy sources (these can be expanded even as our nonrenewable resources are shrinking).
    - thinking of things in a new way–new housing solutions, transportation solutions, food production, etc.
    - new inventions

    During this discussion let the students brainstorm...almost no answer is wrong! If a student suggests harnessing electricity from lightning (or something similar)...respond with something like "What a great new invention.....and it's your generation that will be the ones to invent it!"
    - When a student says something like 'pump more oil' or 'dig up more coal', tell them that at present, we are digging/pumping just about as fast as we can. And, even if we could extract more of these resources faster, they are finite–non-renewable–and not a good solution for the future. We don't know when, but if we keep using these resources as quickly as we are now, someday they will become very scarce and very, very expensive.
10. On the board write 'Renewable Resources' and 'Non-Renewable Resources'. Have the students volunteer to come up and list a resource under one or the other column. Prompt them as needed until the major resources are listed. (You may want to let them use two colors–one for resources we currently use, and one for the futuristic ideas they brain-stormed.)
    - Renewable Resources - solar, wind, hydropower (dams and tidal), geothermal, biomass (wood, corn, etc), waste material (methane from garbage dumps), food,

water, oxygen
- Non-Renewable Resources - oil (includes gas and diesel), coal, nuclear fuel, natural gas, minerals

Key Words & Definitions

- **carrying capacity –** the number of a given species that an area can support without impairing its ability to continue supporting that population
- **fossil fuel** – a nonrenewable energy source created from the remains of plants that lived millions of years ago
- **J curve** – the shape that population growth appears on a graph, starting out low and shooting straight up near the end
- **momentu –** 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.
- **population** – the whole number of people or inhabitants occupying a country, region, or area
- **renewable energy** – abundant fuel sources that are replenished

Related Research

1. Population Circle - An action activity where students simulate the population of the world from AD 1500 to 2000, helping students to realize that most of our growth occurred in the past 200 years. This activity can be found on the Population Connection website at: **http://www.populationeducation.org/content/population-circle**

Related Reading

- ***A Quick Trip to 7 Billion*** (poster) by Population Connection (2011)
  On one side of the wall chart is a timeline of historical events, inventions and social movements that have affected birth and death rates over the past 200 years. The other side of the wall chart shows the challenges we face as a growing global family–from meeting our basic human needs to the delicate balance of natural ecosystems.
- **Coping With Population Growth (The Environment Challenge)** by Nicole Barber (Raintree, 2012)
  This book examines the pressures on the environment and resources due to population growth and people's needs for food, water, shelter, sanitation, education and health care.
- **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

https://vimeo.com/130468614

World Population video produces by Population Connection.

http://www.census.gov/popclock/

US Census Bureau, population clock

http://www.populationconnection.org

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

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

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

http://worldpopulationhistory.org/

Population Connection's interactive time line. Explores population, food/agriculture, health, environment and science and technology.

https://www.ted.com/talks/kevin_kelly_tells_technology_s_epic_story#t-248436

Ted Talk with Kevin Kelly on the history and impact of technology throughout human history.

http://www.youngvoicesonclimatechange.com/

Young Voices for the Planet, website created by author Lynne Cherry to showcase student actions to combat climate change. Includes videos of students (many from Florida) talking about positve actions they undertook in response to climate change.

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Florida NGSS Standards & Related Subject Common Core

			.1	.2	.3	.4	.5	.6	.7	.8	.9	.10	.11	.12
Grade 7														
Earth Structures	**# 6**	**SC.7.E.6**						**X**						
Interdependence	**# 17**	**SC.4.L.17**			**X**									
Social Studies Standards	**Sixth Grade:** SS.6.G.3.2													
Language Arts Standards	**Sixth Grade:** LAFS.6.SL.1.1 **Seventh Grade:** LAFS.7.SL.1.1 **Eighth Grade:** LAFS.8.SL.1.1													

Sixth Grade Benchmarks

Language Arts–Standards for Speaking & Listening

- LAFS.6.SL.1.1 - Engage effectively in a range of collaborative discussions with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.

Social Studies–Geography

- SS.6.G.3.2 **-** Analyze the impact of human populations on the ancient world's ecosystems.

Seventh Grade Benchmarks

Science–Big Idea 6: Earth Structures

- SC.7.E.6.6 - Identify the impact that humans have had on Earth, such as deforestation, urbanization, desertification, erosion, air and water quality, changing the flow of water.

Science–Big Idea 17: Interdependence

- SC.7.L.17.3 - Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation, and nesting sites.

Language Arts–Standards for Speaking & Listening

- LAFS.7.SL.1.1 - Engage effectively in a range of collaborative discussions with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.

Eighth Grade Benchmarks

Language Arts–Standards for Speaking & Listening

- LAFS.8.SL.1.1 - Engage effectively in a range of collaborative discussions with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their

own clearly.

National Next Generation Science Standards - Sixth to Eight Grade Standards
Science–Earth and Human Activity

- MS-ESS3-4 - Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Note: Related Common Core Language Arts Standards are listed in the Florida section above.

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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.