Seven Billion and Counting

A Reading A–Z Level Z2 Leveled Book
Word Count: 2,801

Connections

Writing

Imagine you are the President of the United States. Write a speech persuading citizens to actively commit to protect Earth's limited resources. Deliver your speech to your class.

Social Studies

Write a research report comparing how developing countries and rich countries have an impact on overpopulation. Include their populations, use of resources, and laws protecting the environment.

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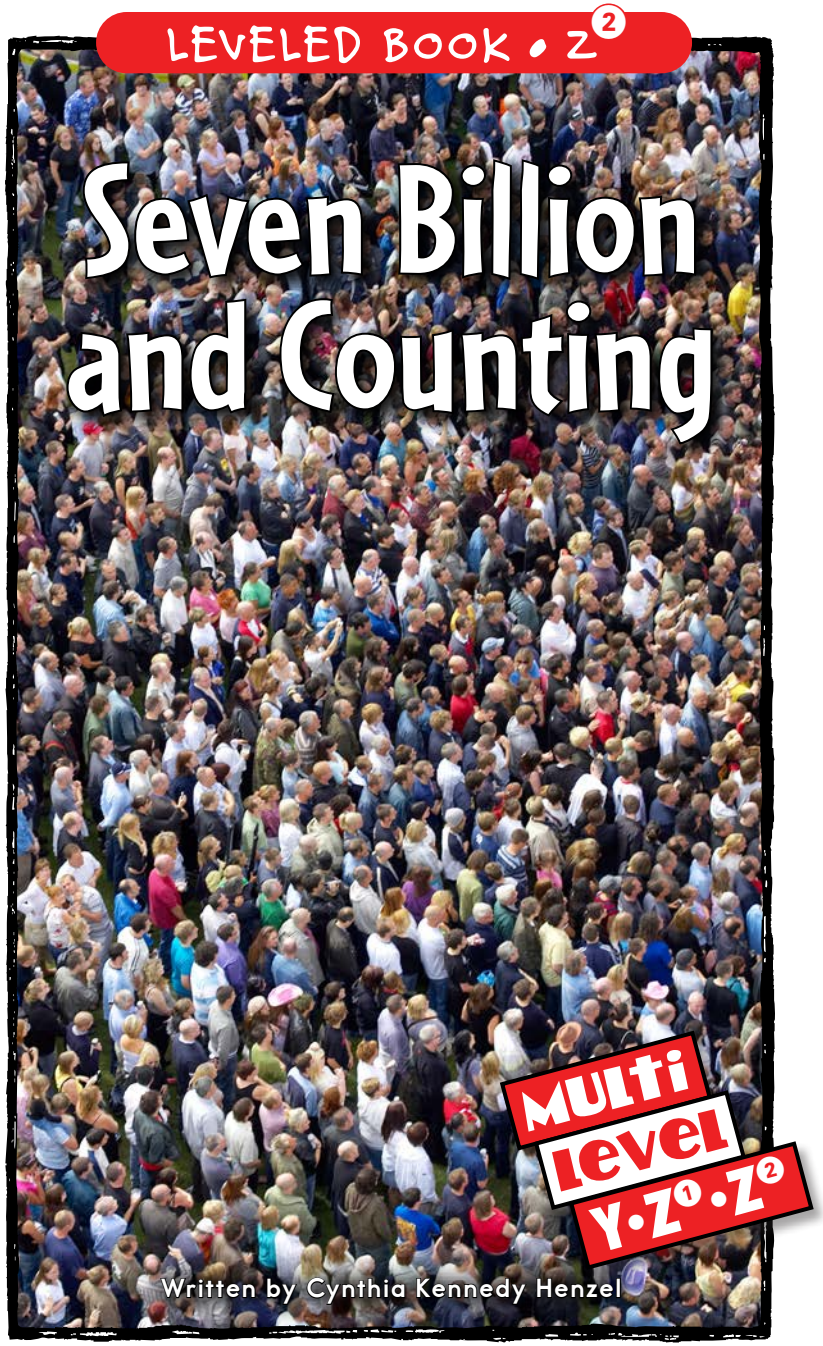

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Seven Billion and Counting

Written by Cynthia Kennedy Henzel

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Focus Question

What factors are contributing to overpopulation, and how does this affect Earth?

Words to Know

arithmetically
birthrate
carrying capacity
consumed
developing countries
ecological footprint
emitting
estuaries
geometrically
hydrologic
infrastructures
millennia
overpopulation
oversight
standard of living

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Correlation

LEVEL Z2	
Fountas & Pinnell	Y–Z
Reading Recovery	N/A
DRA	70+

India will soon have more people than any other country on Earth. Because most of its people are poor, however, India uses far fewer resources than the United States.

Table of Contents

These giant statues on Easter Island were far too heavy to carry. So how were they moved?

A Giant Mystery

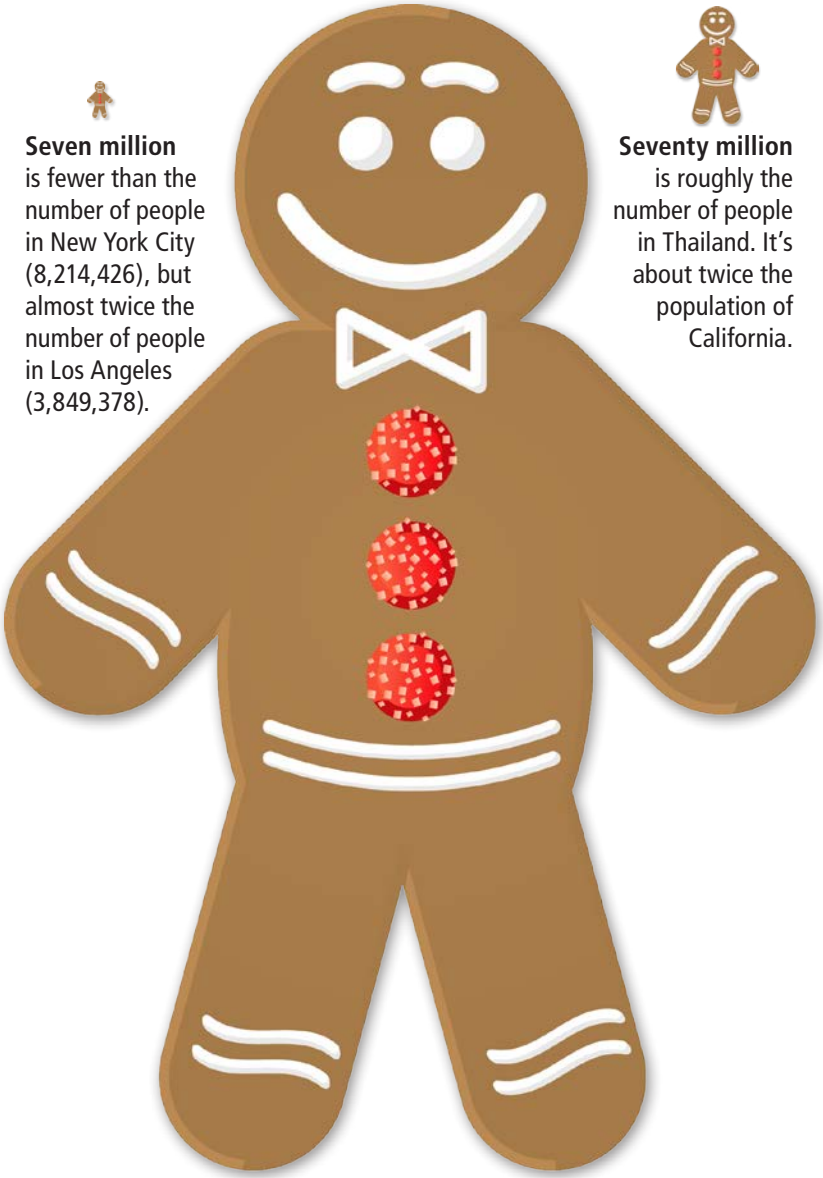
When Dutch explorers first arrived on Easter Island in the South Pacific Ocean in 1722, they were amazed to discover hundreds of colossal stone statues ringing almost the entire coast of the island, all facing inland rather than out to sea. One statue was more than 32 feet (9.7 m) long and weighed 164,000 pounds (74,389 kg)! Yet the people living on the island were poor and only had ancient tools. There were no large trees to make rollers to move the giant carvings, called *moai* (MO-eye). How was it possible that these people had carved and hauled the huge stones across the island?

Centuries later, experts discovered that Easter Island had once been heavily forested. When a group of people called the *Rapanui* (ra-pa-NOO-e) settled the island almost eight hundred years ago, they cleared trees for homes and fields. With plenty of fish, wildlife, and crops, the population grew until about 1680; then the carving stopped and the population dropped. What happened?

One popular theory is that the Rapanui used up many of their resources as their population grew too large. Resources are raw materials in our environment that help us live: food, clean water, energy. At one time, the island was able to provide a small population with food, water, and wood for building. Eventually, though, the population grew too large for everyone to get what they needed. The forests were all cut down. Many of the Rapanui died because they'd used up their resources.

Many people today think the seven billion humans on Earth are using up the planet's resources in much the same way that the Rapanui used up theirs. Will Earth's people suffer the same fate as the people of Easter Island?

What Does 7,000,000,000 Look Like?



Seven million is fewer than the number of people in New York City (8,214,426), but almost twice the number of people in Los Angeles (3,849,378).

Seventy million is roughly the number of people in Thailand. It's about twice the population of California.

Here, the giant gingerbread man represents the seven billion people on Earth. To give a sense of just how big that number is, gingerbread men representing seventy million and seven million—still huge numbers—are placed beside seven billion. By comparison, seven billion is colossal.

How Many Are Too Many?

If you look around you, Earth may not seem crowded. There are empty houses, fields, and forests. Even New York City, with an average of 27,012 people per square mile, has open spaces for parks. In fact, all the people on Earth would fit within the Los Angeles city limits if they were packed shoulder to shoulder, but it wouldn't be too comfortable!

Overpopulation is not a problem of space. Rather, it is a problem of resource availability. Overpopulation means that people have exceeded their environment's **carrying capacity**—the largest number that can live in a place without using up the resources they need in order to survive. Scientists estimate Earth's carrying capacity at between two and forty billion people. The estimate varies so much because the carrying capacity depends on how many resources each person uses.

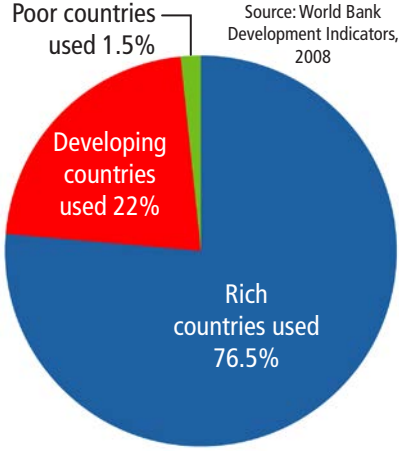
If everyone on Earth lived the way most Americans live, Earth could support only about two billion people. That's because wealthy countries like the United States and those in Western Europe use more than three-quarters of the world's resources. Those living in poverty, although they outnumber the people in wealthier countries, use only 1.5 percent of the world's resources. Because they have so little, they

have learned to function without the luxuries of wealthier nations.

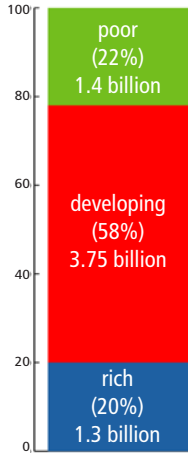
More than half the world's people live in **developing countries** where more and more resources are being used. China and India are developing countries, each with a population greater than one billion, using increasing amounts of resources as they develop. Because these developing countries want the same relative ease of life that the wealthier countries have, they are investing in and expanding their **infrastructures** and industries to obtain their goal.

If the people on Earth **consumed** only what they needed to stay alive, the planet could support about forty billion people. Other species would be pushed to extinction, however, and life for the remaining species on the planet would be hard.

World Resource Use in 2005



World Population in 2005



Many people in poor countries live on less than $1.25 a day. In rich countries, most people live on at least $10 a day. Ten dollars a day doesn't mean you're rich—far from it. It does mean you're richer than 80 percent of the other people on the planet.

A Recent Problem?

Jared Diamond, a well-known scientist, wrote about the decline of the Rapanui in his best-selling 2004 book, *Collapse: How Societies Choose to Fail or Succeed*. Along with some experts before him, Diamond thinks that at one time, ten thousand or more Rapanui probably lived on Easter Island. By the time the Europeans arrived in the eighteenth century, the island could barely support two thousand people. The forests were gone, and the best farming soil had washed away. The Rapanui had exceeded the carrying capacity of their island.

Experts suspect this kind of collapse has happened to many civilizations over the **millennia**. In the Middle East, where farming began about ten thousand years ago, populations soared with larger food supplies from irrigating crops. However, irrigation can erode soil or leave behind enough salt and other minerals to kill crops unless the soil is regularly flushed with heavy downpours of rain or a river flooding to wash out the minerals. This land, once known as the Fertile Crescent because it could grow so much food, wore out. When the Tigris and Euphrates Rivers flooded each spring, the waters brought new, life-giving topsoil. However, the floods were not uniform each year; some years, so much water would come down from the mountains that whole villages and fields were washed away. Over time, the theory goes, the floods became less and less regular, allowing more salt to build up; the carrying capacity of the land decreased, and the ancient civilizations disappeared.

Clearing trees can cause erosion. Too much salt in the soil can kill plants. Here, clearing trees for farming actually released salt from the soil and ruined it.

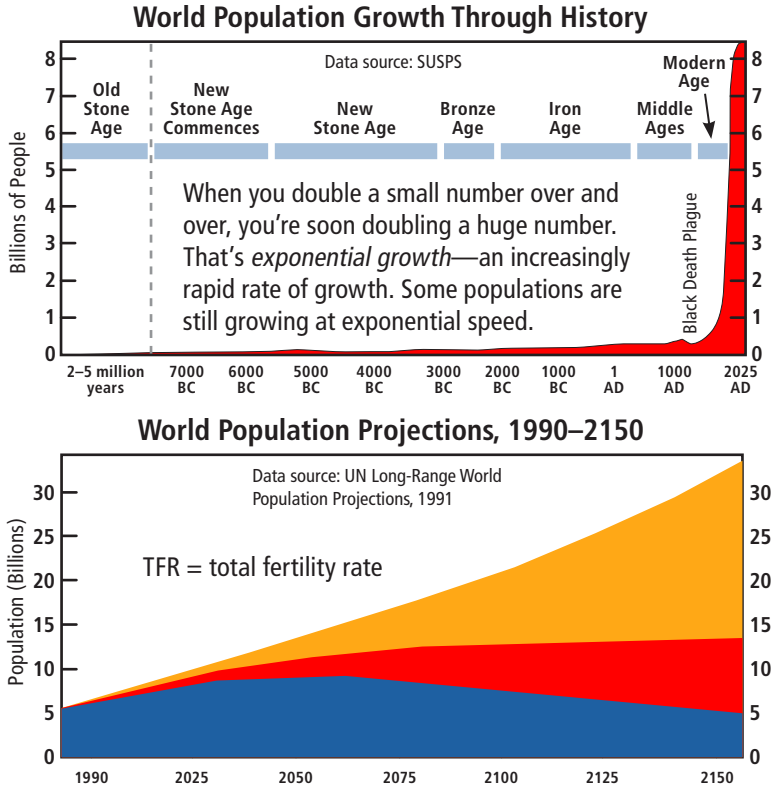
As populations exceed their carrying capacity, the result can be starvation, the spread of disease, the destruction of the environment, and wars as people fight for diminishing resources. If they can, some people leave to find new resources. The Rapanui could not leave because their nearest neighbors were several thousand miles across the ocean, and they had no wood left to build boats to reach other islands or the South American mainland. As the European population boomed in the 1800s, those people were able to move to other continents, including the Americas and Australia.

Do You Know?

A few inches of rich farming soil take hundreds of years to develop. Yet that soil can be blown or washed away in a few years. As salts left from irrigation build in the soil, it can also become useless.

The Growth Spurt

In 1800, one billion people lived on Earth. It took humans 120,000 years to reach that number. By 1927, just 127 years later, the number had doubled. Thirty-three years after that, in 1960, it had tripled: three billion people. The year 2011 saw the seven billionth person on the planet—and the population is still growing at the rate of more than 200,000 people each day.



Three estimates of future world population based on three different fertility rates. The TFR is the average number of children that each woman will have during her lifetime, worldwide.

The population explosion began with the new technology of the Industrial Revolution (1760–1850). In agriculture, new tools, farming practices, and fertilizers made it easier for farmers to work the land and produce larger quantities and more nutritious types of food. In manufacturing, steam power replaced water power and livestock power, allowing machines to work faster and longer with less human **oversight**. Railroads reduced the cost to transport goods and materials, which changed the way people lived. Better food supplies and distribution meant that more children survived childhood diseases and people were healthier. Because fewer people were needed to work on farms, more people moved from farms to cities in order to work in factories.

A seven-month-old girl inhales vaporized penicillin. Discovered in 1928, penicillin was the first antibiotic. It saves countless lives.

At the same time, scientists discovered the causes of many diseases and encouraged better hygiene. In 1796, Edward Jenner discovered the smallpox vaccine, the first of many vaccines that saved thousands of lives. Cleaner, healthier children were better able to survive to adulthood, which meant that more adults were around to have even more children. The human population boomed.

Technology to the Rescue!

Thomas Malthus sounded the alarm about overpopulation in 1798 in his *Essay on the Principle of Population.* He argued that the human population was growing **geometrically**, while the ability of food production was growing **arithmetically**. In other words, he thought that the human population was growing faster than its ability to grow food to feed that population. If families did not have fewer children, he argued, the result would be starvation on a global scale. In Malthus' time, the world population was about eight hundred million.

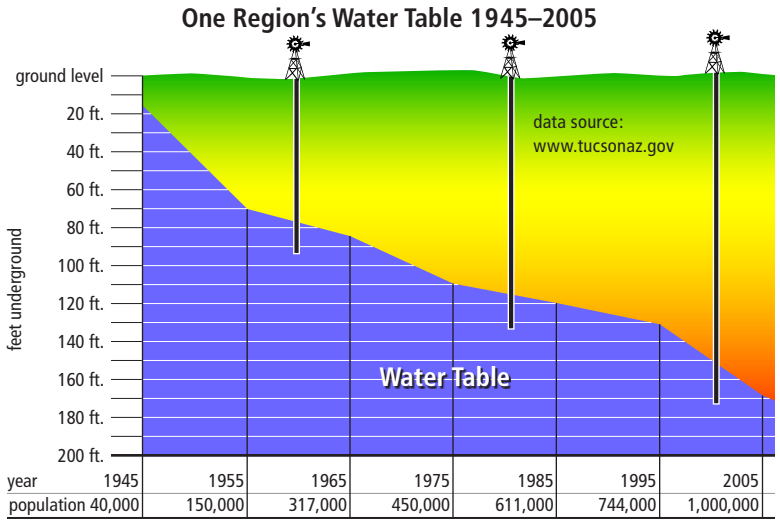
Malthus didn't know that over the next two hundred years, advances in technology would allow farmers to grow more food. But in the 1940s, the Green Revolution began. Scientists, including Norman Borlaug, who worked with farmers in Mexico, developed special seeds so farmers could produce more food. They developed pesticides and herbicides to control insects and plant diseases. Places once unfit for farming could now grow food with chemical fertilizers and irrigation.

This new farming technology spread across the globe, allowing even poor countries, such as Mexico, India, and countries in the Middle East, to grow more food. Mexico was able to grow more food than it needed to feed its own people and

became an exporter of foods. The new techniques brought a threefold increase in food production. Some people believed that this kind of human ingenuity would allow the population to grow forever.

Yet new technology brought new problems. More water was needed for irrigation. Herbicides and pesticides used for growing crops polluted food and water supplies and poisoned the environment. Rachel Carson's 1962 landmark publication *Silent Spring* brought attention to these problems. Her scientific perspective taught chemists about the impact of human activity on the environment. Some people realized that we were destroying the planet we depend on for life. But there were no New Worlds left to discover on Earth.

Of course, some resources are *renewable*. New trees can be planted. The Sun and wind offer huge supplies of energy—Earth receives enough solar energy in 1.5 hours to supply the energy needs of the whole planet for a year—if we can figure out how to harness it. Water is constantly renewed through the **hydrologic** cycle of evaporation, condensation, and precipitation. Yet most of Earth's water is salt water—only 2.5 percent is fresh. Of that small amount, two-thirds is frozen in glaciers. The amount of available fresh water is less than 1 percent of the water on Earth.



As the population of Southern Arizona grew from 40,000 to 1 million, the water table plunged 170 feet. How much deeper did people have to drill to get water in 2005 than in 1985?

Fresh water is not evenly distributed over the planet, either. Twenty percent of people, mostly in Africa and parts of Asia, do not have a safe source of drinking water. Meanwhile, much fresh water is wasted.

Seventy percent of available fresh water is used for irrigation. In the United States, underground water in the West is pumped onto fields faster than it can be replaced. The mighty Colorado River is an extreme example; in an average year, none of its water reaches its mouth at the Sea of Cortez because so much water is taken for irrigation and cities. As water becomes scarce, much of the cropland that feeds the world will become desert.

Some of Earth's resources, like coal, copper, and other metals, are finite or nonrenewable. These resources take millions of years to form, so they cannot be replaced once they are used up. Oil, a fossil fuel, is an important finite resource used in farming and manufacturing as well as to lubricate and fuel vehicles. The United States, with 5 percent of the world's people, uses 25 percent of the world's oil. As developing countries need more oil, the price of food and energy will increase.

An ecosystem is another nonrenewable resource. Ecosystems do the work that keeps our planet healthy. Swamps and **estuaries** clean water and reduce flooding using the plants that grow in them as filters; grasslands or savannas form rich soils as grasses grow and decay; and forests balance the atmosphere by taking up carbon dioxide and **emitting** oxygen. Yet heavy use of wood and farmland is destroying many important ecosystems. Half of Earth's tropical rainforests, the most diverse ecosystems, are gone. Thousands of plant and animal species become extinct each year. We cannot bring them back.

China's rapid industrialization brought great pressure on the baiji, the country's freshwater river dolphin. Water pollution and lethal fishing nets killed many; noise pollution and boat propellers killed many more. On Earth for more than twenty million years, the baiji is now extinct.

A woman pushes her bike on a road in Indonesia after heavy rains flooded the area. Floods and rising seas there have been linked to global warming. Indonesia could lose about two thousand islands by 2030 due to climate change.

The largest known species of palm tree that lived on Easter Island is now extinct. Perhaps the Rapanui cut down the trees in order to help move the moai. Whatever happened to the trees, when the Rapanui lost them, they lost their source of fuel and materials for construction. They also lost the forest ecosystem that protected the topsoil from erosion and kept it healthy, provided habitat for mammals and birds, stored water, and recycled waste. Their tiny island was transformed forever.

Our planet is transforming, too. Burning fossil fuels such as oil and coal releases carbon dioxide into the atmosphere, trapping more heat at Earth's surface. Our planet is getting warmer, which is changing ecosystems around the world. Already we have seen shrinking polar ice caps, deserts increasing in size, and more dramatic weather. These trends cannot easily be reversed.

The Good News

By 2010, the global population growth rate had slowed from a high of 2.2 percent to 1.1 percent per year. In many rich countries, population growth has actually stopped or reversed, creating a negative population growth. Their **birthrate** is now below the replacement rate of 2.1 children per woman. The replacement rate is the average number of children born per woman that over time will create a stable population.

More people are becoming aware that Earth has limited resources. Renewable sources of energy, such as wind and solar power, are being developed. Many countries have passed laws to protect and clean the air and water as well as many ecosystems.

Since 1985, water use per person has decreased in the United States, mostly thanks to more efficient use of water by farming and industry. Forests have increased, although the ecosystems of old-growth forests are often lost, even when new trees are planted, because the complexity of the ecosystems in old-growth forests can take time to become established.

An Uncertain Future

Despite the good news, the world's population continues to grow, mostly in poor and underdeveloped countries. The United Nations predicts a global population of about 9.6 billion by 2050. By most estimates, this number is almost twice the amount of people who can live on Earth sustainably. But no matter which estimate you believe, everyone now agrees that the human population cannot keep growing forever without destroying the planet.

China's One-Child Policy

China's population, at over 1.3 billion, is the largest in the world. In 1979, the country began a one-child policy to control population growth. The policy made it against the law for many couples to have more than one child. Although the policy is estimated to have lowered China's population by 400 million, the policy is controversial. Many Chinese couples prefer to have a son, so infant girls are sometimes killed or given away. Today, there are many more young boys than girls. This will make it difficult for young men to find wives. In addition, the children born in the last few decades will find it difficult to support the huge number of aging Chinese people.

Education Is the Key

Education and equality for women matter most in reducing birthrates. In Saudi Arabia, a wealthy country with little equality for women, the birthrate remains high.

There are ways to encourage lower birthrates. The first is to make sure that children and mothers can receive the health care they need. Clean water, healthy food, and quality health care allow many more children to reach adulthood. Families generally consist of fewer children if parents believe the children they have will survive.

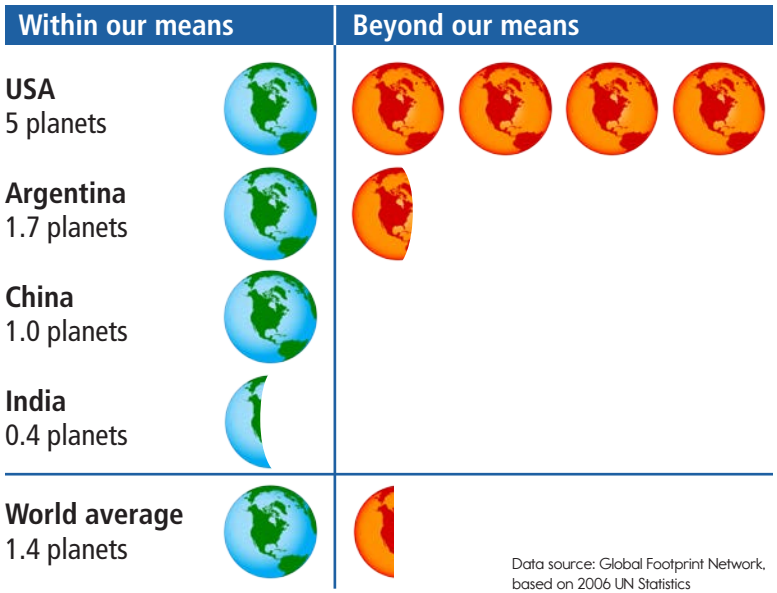
Second, governments can encourage smaller families by providing support for elderly and sick people. In some parts of the world, parents have many children to make sure someone will care for the parents when they are old or sick.

The third and most effective tool to reduce birthrate is to educate women. When women are educated, given the same opportunities as men, and given control over deciding the size of their family, they often choose to have fewer children.

Enough for Everyone

The United States has an **ecological "footprint"**—that is, the amount of land required to supply the resources it uses—much greater than the amount of land it occupies. It has exceeded its carrying capacity. Therefore, its citizens must import resources from other countries to maintain their **standard of living**. With seven billion people on Earth, we'd need three or four more planets for everyone to live like most people in the United States. Rich countries can share Earth's resources more fairly, though, in order to lower the global birthrate.

How many planets we'd need if everyone lived like a resident of the following:



Data source: Global Footprint Network, based on 2006 UN Statistics

Everyone in the world can have enough to eat if people in rich countries eat smarter and waste less. According to the Institute of Mechanical Engineers, which released a food study in January 2013, almost 50 percent of food produced is wasted. Grain is the world's most important source of food. Yet as meat production has boomed for rich and developing countries, a third of the grain grown worldwide is used to feed livestock. It takes between 11 pounds (4.99 kg) and 16 pounds (7.25 kg) of grain and about 5,214 gallons (19,737 L) of water to create 1 pound (0.45 kg) of meat. Eating less meat means more grain and more water available for people in poor countries and protection of valuable grasslands.

Irrigation makes possible this wheat farm in a desert in Saudi Arabia.

Average Americans use 3 times the food and 250 times the fresh water needed to survive. They could reduce their ecological footprint by eating smarter, recycling, and conserving energy. Americans are the world's biggest consumers; they consume 20 percent of the world's energy. They could instead be the world's most efficient consumers if they make intelligent choices about how to live.

An Island in Space

The Rapanui left records on carved tablets, but no one has been able to translate the ancient language yet. We might never know for sure what happened, but some experts believe that as Easter Island became overpopulated, the tribes fought for resources, the moai were toppled, and thousands died. Eventually, Europeans brought diseases that killed more. By 1877, only 111 people remained.

Today, Easter Island's population is growing again. Some of the moai have been restored. But most of the native plants and animals have become extinct, and the ancient culture of the Rapanui is lost. Hopefully, the tale of this little island can teach us to protect our limited resources on Earth, our own little island in space.

Glossary

arithmetically *(adv.)* with a constant rate of change (p. 13)

birthrate *(n.)* the number of babies born in a population within a specific period of time (p. 18)

carrying capacity *(n.)* the greatest population that an environment can support indefinitely (p. 7)

consumed *(v.)* ate, bought, or used (p. 8)

developing countries *(n.)* countries moving toward higher standards of living and more advanced economies, largely through the development of industry (p. 8)

ecological footprint *(n.)* a measure of the impact that people or other living things have on the environment, especially the natural resources used to sustain them (p. 21)

emitting *(v.)* sending out from (p. 16)

estuaries *(n.)* parts of rivers where fresh water mixes with the ocean's salt water (p. 16)

geometrically *(adv.)* with a constant ratio of change (p. 13)

hydrologic *(adj.)* of or relating to the science dealing with the distribution and circulation of water on Earth (p. 14)

infrastructures *(n.)* frameworks of public structures and systems that regions depend on to function, such as roads and utilities (p. 8)

millennia *(n.)* thousands of years (p. 9)

overpopulation *(n.)* the condition of having too many people or other living things in an area (p. 7)

oversight *(n.)* supervision (p. 12)

standard of living *(n.)* the level of material comforts and wealth available to a person, community, or country (p. 21)