15.3

Sunshine State STANDARDS
SC.G.1.3.2: The student knows that biological adaptations include changes in structures, behaviors, or physiology that enhance reproductive success in a particular environment.
SC.G.2.3.3: The student knows that a brief change in the limited resources of an ecosystem may alter the size of a population or the average size of individual organisms and that long-term change may result in the elimination of animal and plant populations inhabiting the Earth.
SC.G.2.3.4: The student understands that humans are a part of an ecosystem and their activities may deliberately or inadvertently alter the equilibrium in ecosystems.

BEFORE, you learned
- Over time, all populations stop growing
- All populations are affected by limiting factors
- Reproductive strategies include opportunism and competition

NOW, you will learn
- How human populations differ from other populations
- How humans adapt to the environment
- How human populations affect the environment

EXPLORE Population Change

How can you predict human population growth?

PROCEDURE
1. Copy the graph on the right. The graph shows population growth expected in the United States with an increase in both birth and death rates and with steady immigration.
2. The graph shows a medium rate of growth. Draw another line to show what low population growth might look like. Label it.
3. Explain the patterns of birth rates, death rates, and immigration that might be likely to result in low population growth.

WHAT DO YOU THINK?
- How would the projected U.S. population size change if there were no immigration?
- How might an increase in immigration affect expected birth rates?

VOCABULARY
pollution p. 550

Human populations differ from populations of other species.

Humans are not the fastest or the largest organisms on Earth. They must get food from other organisms. Humans have a limited sense of smell, and the vision of a human is inferior to that of a hawk. However, the human population now dominates our planet. Why? Humans are able to shape their environment. Humans are also able to determine their own biological reproduction. Because humans can control many factors that limit growth, Earth’s carrying capacity for humans has increased. Two key factors that have increased Earth’s carrying capacity for humans are habitat expansion and technology.
Habitat Expansion

Individuals who study the history of ancient peoples know that populations of humans have spread throughout the world. Discoveries of ancient human tools and skeletons indicate that the first human populations lived on the continent now known as Africa. Over time, human populations have spread over nearly the entire planet.

The word *habitat* refers to a place where an organism can live. Humans have expanded their habitats, and thus the population has grown. Humans can survive in many different environments by adding air conditioning or heat to regulate indoor temperature. They can design and build shelters that protect them from harsh environments.

Adapting to Climate

Humans have designed buildings that allow them to survive in different climates.

- Adobe houses stay relatively cool in the high temperatures of the desert.
- Some houses along the shore are built on stilts to protect them from rising water.
- Houses in areas with snowy, cold winters are built with steep slanting roofs.
Human populations are growing.

As you’ve read, humans have developed solutions to many limits on growth. These solutions have allowed the human population to grow rapidly. Scientists are studying the history of this growth and trying to predict whether it will continue or change.
History of Human Population Growth

Until about 300 years ago, the human population grew slowly. Disease, climate, and the availability of resources limited population size. Most offspring did not survive to adulthood. Even though birthrates were high, death rates were also high.

Notice the human population on the graph below. Many historical events have affected its growth. For example, the development of agriculture provided humans with a more stable food source. This in turn helped support human population growth. Today, populations across many parts of the world are increasing rapidly. Scientists identify three conditions that allow for rapid growth: the availability of resources, lack of predators, and survival of offspring to reproductive age. As these conditions change, so does the population.

Population Projections

To help prepare for the future, scientists make predictions called population projections. Population projections forecast how a population will change, based on its present size and age structure. Population projections provide a picture of what the future might look like. Using population projections, government agencies, resource managers, and economists can plan to meet the future needs of a population.

The blowout of the graph shows three projections for the human population size. Experts disagree about the rate at which the population will grow.
In addition to population size and age structure, scientists making population projections consider other factors. These factors include the ages of individuals having children. The average number of offspring produced by an individual also affects projections. In addition, life expectancy and health in a particular population affect population growth.

The factors affecting population growth vary from society to society. The human population in the African country Botswana provides an example of how disease and health can affect population growth.

In some African countries, death rates due to HIV/AIDS have lowered population projections for the year 2015 by almost 18 percent. Botswana’s population will decline, because more than 30 percent of adults are infected with HIV/AIDS. So many people in Botswana have already died of HIV/AIDS that the average life expectancy has dropped from 63 years of age in the late 1980s to 32 years in 2003. Consider the impact this will have on the population’s age structure. Because many people who die from HIV/AIDS are in their reproductive years, the long-term effects on population growth will be significant.

CHECK YOUR READING What factors do scientists consider when they make population projections?

How can you graph population growth data for your area?

PROCEDURE

1. Use local population data taken from each census over five decades.
2. On graph paper, mark off five decades along the x-axis. Make a y-axis to show population size.
3. Plot the census information for each decade as a line graph.

WHAT DO YOU THINK?

• How did the local population change over time?
• What do you think accounted for the change?

CHALLENGE Based on the trend you see so far, how might the population change in the future? Use another color to extend the line on your graph to project population change over the next five decades. Explain why you think the population will change as you have predicted.
Human population growth affects the environment.

You have read that extinction of species is a part of the history of life on Earth. The ways a population uses and disposes of resources have a great impact on local and global environments. As the human population continues to grow and use more resources, it contributes to the decline and extinction of other populations.

Some scientists estimate that over 99 percent of the species that have ever existed on Earth are now extinct. Most of these species vanished long before humans came on the scene. However, some experts are concerned that human activity is causing other species to become extinct at a much higher rate than they would naturally. Human populations put pressure on the environment in many ways, including

- introduction of new species
- pollution
- overfishing

Introduction of New Species

Travelers have introduced new species to areas both on purpose and by accident. Many species introduced to an area provide benefits, such as food or beauty. Some species, however, cause harm to ecosystems. One example of an introduced species is the zebra mussel. An ocean vessel accidentally released zebra mussels from Europe into the Great Lakes region of the United States. With no natural predators that consume them, the mussels have reproduced quickly, invading all of the Great Lakes, the Mississippi River, and the Hudson River. The mussels compete with native species for food and affect water quality, endangering the ecosystem.

Kudzu is another introduced species. In the 1930s, kudzu was used in the southeastern United States to keep soil from being washed away. The plants, which have beautiful purple flowers, were imported from Japan. Starch made from kudzu is also a popular ingredient in some Asian recipes. However, populations of the kudzu vines planted in the United States have grown too far and too fast. Kudzu grows as much as 0.3 meters (about a foot) per day, killing trees and other plants living in the same area.

The kudzu plant, though at one time considered beautiful, is threatening other species.
Pollution

While human activities might cause some populations to decline, they can also cause other populations to grow. Sometimes this population growth causes pollution and habitat disturbance. Pollution is the addition of harmful substances to the environment. One example of such an activity is large-scale hog farming.

Human demands for pork combined with a growing human population have caused the hog farming industry to expand. Between 1987 and 2001, the hog population in North Carolina grew from 2.6 million to 10 million. These 10 million hogs produced more than 50,000 tons of waste each day. Wastes from large populations of hogs affect water supplies, soil, and air quality.

Pollution has also affected the Salton Sea in southeastern California. The growing demand for goods and agriculture has led to chemical dumping from industries and pesticide runoff from nearby farms. The rivers that run into the lake carry high levels of harmful chemicals such as DDT. Local birds that live and feed in this area have weakened shells that cannot support baby birds. Pollution has also caused fish to become deformed.
Overfishing

Fish and crustaceans such as shrimp and lobsters have long been an important food source for many people. In the 1900s, the techniques and equipment that fishers used allowed them to catch so many fish that fish populations began to decrease. As the human population has continued to grow, so has the demand for fish. However, if fish do not survive long enough in the wild, they do not have the chance to reproduce. Many species have been so overfished that their populations may not recover.

Lobster fishing in particular has supported coastal communities in the northeastern United States for generations. But the demand for this food source has caused populations to decline. Areas that fishers trapped for years may now have only a small population of lobsters. And the lobsters fishers are catching may not be as large as those from earlier decades.

In order to help lobster populations recover, laws have been enforced to protect their life cycle and reproduction. Today, people who trap lobsters are required to release females with eggs. They are also allowed to keep only mature lobsters. Younger lobsters are returned to the waters to mature and reproduce. Efforts like these help protect the lobster population and secure the jobs of fishers by helping fish populations remain stable.

Fishers harvesting lobster measure the tails of the animals they catch. A lobster that is too small is returned to the sea to allow it to grow.

CHECK YOUR READING Describe how overfishing would affect resources.

KEY CONCEPTS
1. What factors—other than birth, death, immigration, and emigration—must scientists consider when making projections of human population?
2. Give an example of how Earth’s carrying capacity for humans has increased.
3. What are three ways that humans affect other populations?

CRITICAL THINKING
4. Infer Consider the effect of HIV/AIDS on Botswana’s human population. How might age structure affect Botswana’s population growth?
5. Analyze Do you think it is possible to predict the maximum number of humans that Earth can support? Why or why not?

CHALLENGE
6. Apply Identify a challenge faced by the human population in your state. Explain how the challenge is related to pollution, introduction of new species, habitat disturbance, or overfishing.

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