Population Growth – **Day 3**

South Asia

Patterson/Smith

Seven Billion and Counting

World of 7 Billion

Student Reading

The growing human population places huge amounts of pressure on the Earth. The sheer number of people, and their behaviors, contributes to many of the environmental, social, and economic issues facing the planet. Although it may not seem as if the world is getting more crowded, growing population threatens the health of our ecosystems and the quality of life for Earth's inhabitants.

In the six seconds it takes to read this sentence, 15 more people will be living on the Earth. In fact, the world's population grows at a near-record pace, with a population equal to New York City added every month, and equal to Germany added every year. In the year 2000, there were six billion of us, and the number of people is growing every second. This growth in human numbers has been called a "population explosion."

What Ignited the Explosion?

The population explosion has been very recent in the scope of human history. People lived on Earth for about three million years before the world population reached 500 million, around the year 1600. Until then, **birth rates** and **death rates** were about the same, keeping the population stable. People had many children, but a vast number of them died before age five. Without modern medicine, vaccines, and clean, healthy living conditions, many children did not survive common diseases.

The late 1700s and the 1800s was a time of great advancement in science and technology in Europe and North America. The Industrial Revolution produced many inventions that promoted longer life, such as improvements in farming, nutrition, medicine, and sanitation. By 1930, the world population had reached two billion.

As people moved to cities to live and work, families became smaller. It was no longer necessary to have many children to work on family farms in Europe and North America, and birth rates dropped in industrialized countries. By the mid-twentieth century, death rates throughout the rest of the world also began to drop as medical technologies spread across the globe. But, birth rates remained high in developing countries, since their economies still relied largely on farming. Families in these places still needed many children to work the land. Although population growth slowed in developed countries, the "population explosion" continued in the less developed world.

In 1960, the global population reached three billion. Just 15 years later, in 1975, the population soared to four billion and it topped five billion in 1987. In 1999, the Earth became home to six billion people, and the population had doubled in less than 40 years. Although population growth is now slowing, the population is expected to reach seven billion by late 2011, and demographers predict that the world will grow by two to three billion more people by the year 2050.[1]

Crowding the Earth

No one knows for sure how many people the Earth can support. Every environment has a **carrying capacity** – the point at which there are not enough natural resources (food and fuel) to

support any more members of a given species. This concept applies to people too. The carrying capacity of humans is hard to estimate because it greatly depends on how people use the Earth's resources.

The population issue relies on the concept of carrying capacity rather than numbers alone. The entire world population could fit into Texas and each person could have an area equal to the space of a typical American family home. But, this ignores the amount of land required to provide the resources (food, water, shelter, clothing, and energy) that we need to maintain our lifestyles. Though there is enough space for the people, the ecological footprint – the land and water area that would be required to support the region's population and lifestyle – would need a space much larger than Texas. There is a limited amount of gas to power our cars and trees to provide lumber for heating and cooking. The more resources that each person uses, the fewer people the earth can support.

Only a small amount, 10 percent, of all land is **arable** (able to be farmed). The rest is built up into cities and towns or is too cold, wet, rocky, or dry to grow crops. As the number of people continues to grow, the small portion of land which must provide food for these people remains the same, or becomes smaller as cities expand. Already, one billion people suffer from **malnutrition** because they do not have enough to eat.[2]

Upsetting the Ecological Balance

Many countries try to grow more food in order to feed their growing numbers of people. Each year, about 18 million acres of forests (an area equal to the size of Vermont and New Hampshire combined) are cut down to create more farmland and grazing land and to obtain wood for fuel and other uses.[3] The loss of these forests affects the entire Earth. Consider that rainforests are home to half of the world's animal and plant species, some of which may provide key ingredients for medical innovations. The loss of these species could devastate the delicate ecological balance.

Water supplies also suffer as the population continues to grow, especially in less developed regions that lack the ability to transport water across long distances. As more food is needed to support greater numbers of people, a larger amount of water is dedicated to agriculture. This greatly depletes water supplies and leaves less available for drinking and **sanitation**. Currently, almost one million people around the world lack safe drinking water and 2.6 billion people suffer from inadequate sanitation.[4]

Loss of **biodiversity** is another problem associated with overpopulation. As cities expand with population growth, previously uninhabited lands, such as forests and prairies, are developed for human use. Many of the most biologically diverse regions on Earth have lost more than 70 percent of their vegetation due to human activity. As the ranges of the native species in these regions diminish, they are much more likely to become **extinct**.[5]

Even the ground we live on is affected by overpopulation. Soil is destroyed as larger livestock herds become necessary to produce more food. Billions of animals are now over-grazing the world's grasslands, turning them to dust. Croplands are destroyed when the rich topsoil blows away after being overworked and misused. This devastation of land has left millions of environmental refugees worldwide, as people are forced to migrate from their homes in search of more fertile land, cleaner water, and a better quality of life.

Population Growth: North American style

You might associate overpopulation with the teeming masses of people in countries like India and China. Surely, a huge, wealthy country like the United States doesn't have a problem, does it? Every year, our country's population grows by almost three million people, which is about the population of Houston. The U.S. has one of the highest birth rates among industrialized countries.

Some argue that population growth in the U.S. may have more serious environmental impacts than growth in any other part of the world because of the "typical American lifestyle." Each American uses more energy, more water, and produces more garbage than a person living anywhere else in the world. While Americas are less than five percent of the world population, we consume 25 percent of the world's energy and produce 23 percent of the world's carbon dioxide emissions.[6] In one year, the average American uses almost two times as much energy as the average New Zealander, more than five times the average person in China, and 16 times as much as the average Kenyan.[7] This immense energy use also adds to the world's air and water pollution as fossil fuels such as oil and coal are burned. All of the carbon dioxide released from burning these fuels makes the U.S. one of the leading contributors to global warming.

What Can Be Done?

There are better alternatives than competing with one another for the last best space or the only remaining clean water. Certainly, we can encourage our government to help us and other nations deal with population and environmental problems. Individuals can also make lifestyle decisions that will significantly reduce the stress on our resources and environment. We can protect our environment by making thoughtful choices about where we live, how we use energy in our homes, what we eat, how we travel, and how much garbage we produce. By considering the environment in these important decisions, we can have a collective, healing impact on the biological systems that sustain us.

Choices in family size can also impact how people stress natural resources and the environment. Many American parents already limit their families to one or two children (a number that would lead to population stabilization). These choices really do make a difference. After four generations, a two-children-per-generation family will consume 160 percent fewer resources (including fish, meat, wood, and vegetable products) than a family with a three-child tradition.

Overpopulation can negatively impact the environment and the health and quality of life of people everywhere. Every decision we make affects not only those around us but also the entire planet. Even the small choices we make every day can make a difference. By thinking carefully about the impact we want to leave on the Earth, we can ensure that future generations are able to enjoy this planet and access its bountiful natural resources in the same ways that we do today.

Glossary

arable: land in which crops can be grown

biodiversity: the variety of species in nature and the genetic diversity within each species

birth rate: the number of births each year per 1,000 people

carrying capacity: the number of people who can be supported at a sustainable level in an area with given resources and technology

death rate: the number of deaths each year per 1,000 people

demographer: a scientist who studies the characteristics of human populations, such as size and growth rate

extinct: no longer existing; when a plant or animal species dies off, we say it is extinct

sanitation: the prevention of disease and promotion of good hygiene by maintaining clean conditions and safe drinking water

Directions: Answer the below questions in complete sentences on your own piece of paper. Your answers should show your understanding of the material.

1. What factors kept a high percentage of children from reaching their fifth birthdays?
2. What happened to birth rates in industrial countries?
3. What happened to birth rates in developing countries?
4. What is arable land? What percentage of the world's land is arable?
5. Is the U.S. being a responsible member of the world community? Explain your answer.

Name: _____ Date: _____

Math Path to 7 Billion

Student Worksheet 2 - Version B: Millions and Billions

The scale of large numbers can be hard to understand. The world's population is approaching seven billion, and the population of the United States is over 300 million. Is that a little or a lot? This exercise will help you appreciate the difference between millions and billions:

> Your rich uncle has just died and has left you one billion dollars. If you accept the money you must count it for eight hours a day at the rate of one dollar per second. When you are finished counting, the billion dollars will be yours and only then may you begin to spend it.

How long (in minutes, hours and days) would it take to count a million dollars at this rate? (Show your work, rounding to the nearest tenth).

Answers: _____ minutes
_____ hours
_____ days

How many years would it take to count a billion dollars at the same rate? (Show your work, rounding to the nearest tenth.)

Answers: _____ years

Do you accept your uncle's offer? Why or why not?

_____

_____

Math Path to 7 Billion

Student Worksheet Answers

PART 1:

Student Worksheet 1: Feel the Rhythm

1. 1×10^6; 2,740 people/day; 114 people/hour; 1.9 or 2 people/minute
2. 8.3×10^7; 158 people/minute

Student Worksheet 2: Millions & Billions

1. $1,000,000; $1; 8
2. 1,000,000 seconds
3. 16,666.7 minutes; 277.8 hours; 34.7 days
4. 95.1 years; No, because it would take over 95 years to count the money.

Extension Answers:

At a million seconds old, you are about 11 1/2 days old.
At a billion seconds old, you are about 31 1/2 years old.

PART 2:

Student Worksheet 3: Measuring a Million

Answers will vary depending on what kind of paper students measure.

PART 3:

Student Worksheet 4: Bacteria Bottles

1. 11:59 pm
2. Because the bottle is full at midnight and the doubling time is one minute.
3. Answers will vary. To clarify, ask students: "At 11:55 p.m. when the bottle was only 3% full and 97% empty, would it be easy to see that there was a space problem?"; No.
4. The bacteria's growth can continue at its current rate for two more minutes, or until 12:02 a.m.:

   At 11:58, the first bottle is one-quarter full. By 11:59, the bacteria will have doubled to fill the first bottle halfway. By midnight, bottle 1 will be completely full. By 12:01, the bacteria in bottle 1 will have doubled and will fill up bottle 2. By 12:02, the bacteria in bottles 1 and 2 will each have doubled, to fill bottles 3 and 4.

Population Circle

World of 7 Billion

Introduction:

Students may know that world population is currently about seven billion, but it is instructive to put that number in the context of history. By simulating population growth over the last 500 years, students discover that most of our growth occurred in the past 200 years.

Materials:

Counting Cards
Chalk or yarn

Procedure:

1. Cut out the Population Circle counting cards.
2. Using chalk or yarn, place a 10-foot diameter circle on the floor, and ask the class to gather around it. Explain to the class that the circle represents the Earth, and that you will be looking at how the population of the Earth changed from 1510 to 2010, a 500 year span.
3. Distribute the 28 counting cards. Each card represents 250 million people. If you have fewer than 28 students, you may use chairs or some other item to represent additional people.
4. Ask the two students with the number "0" on their cards to step into the circle. Explain that these students represent everybody who lived on the Earth 500 years ago, when our population was about 500 million people. Now almost seven billion people live on the Earth.
5. Tell the class, "We will be counting from 1 to 100 to find out how our population grew. As we count, we will fast forward through the past 500 years. With every number we say, we will jump ahead five years. When we reach 100, all 500 years will have passed, and we will be at the present. Listen carefully, because when we get to the number on your card, you will need to step into the circle.
6. Ask the students to forecast the number when they think the next person will enter the circle.
7. As a group, start counting at a comfortable pace. Stop when you reach 100.

Concept:

The history of human population growth is a fitting real-world example of exponential growth.

Objectives:

Students will be able to:
- Describe the trends of human population growth.
- Explain the basic attributes of exponential growth (slow start, fast finish).

Subjects:

Geography, History, Math, Science, Social Studies

Skills:

Observing patterns, critical thinking, graphing

Method:

Students experience the changing pace of population growth by simulating the Earth's population growth over the last 500 years.

Discussion Questions:

1. What did you observe about how our population changed over time?

   It took a long time to add any people to the Earth. Most of our growth happened in just the past century.

2. After we started counting, who was the first person to join the circle? What number did he/she have? From the start, how many years did it take to add 250 million people to the Earth?

   The first person to join the circle had the number 51. It took 255 years to add 250 million people (51 x 5, or 255 years).

3. Towards the end of the simulation, how long was it taking to add 250 million people to the Earth?

   It took five years or less. Between the numbers 88 and 100, we added at least one person to the Earth with each number called.

4. Based on what you saw happening by the end of the simulation, how do you think this activity would be different if we came back in five years and did it again?

   The trend suggests we would need one or two more people for the simulation if we did it five years from now.

5. What would happen if we continued to grow at this rate?

   The Earth would become increasingly crowded.

6. If current growth rates continue, the world's population would double in about 60 years. How many more numbers past 100 would we need to count before the population of the circle doubled? How many more people would enter the circle?

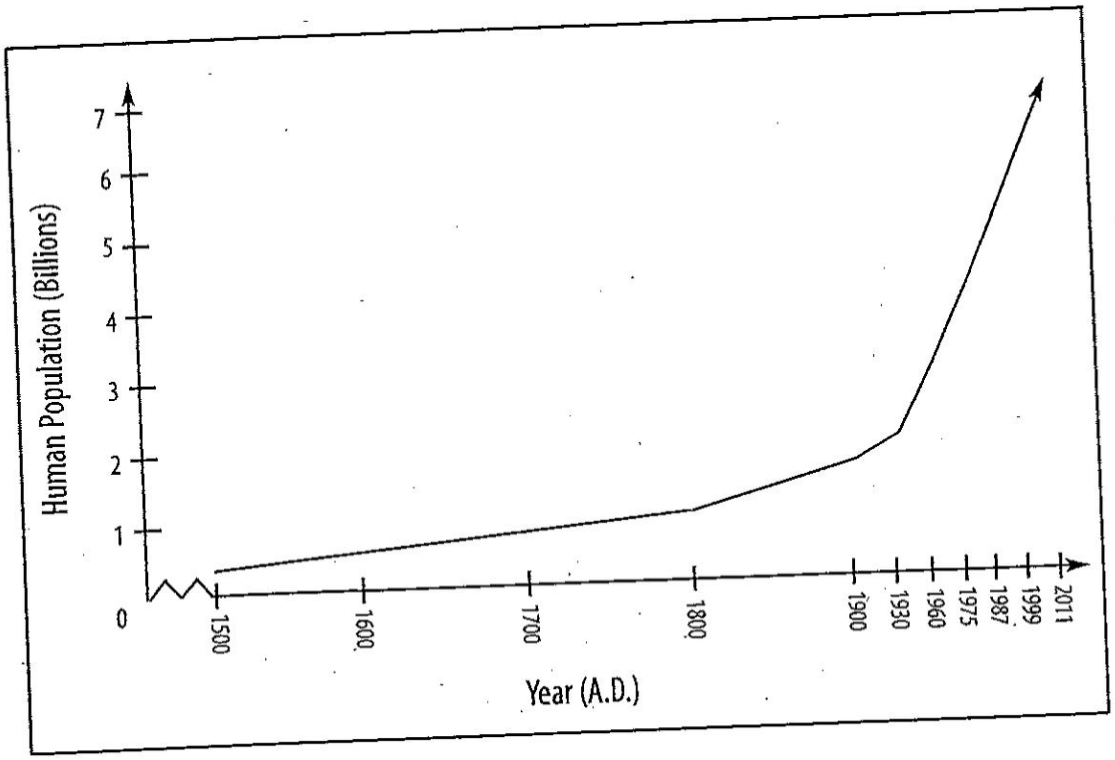
   We would need to count to 112, or 12 more numbers (60 years/5 years=12). We would need to add an additional 28 people to the circle.

Follow-up Activity:

Using the data chart below, have the students draw a line graph to illustrate the history of population growth over this 511-year period.

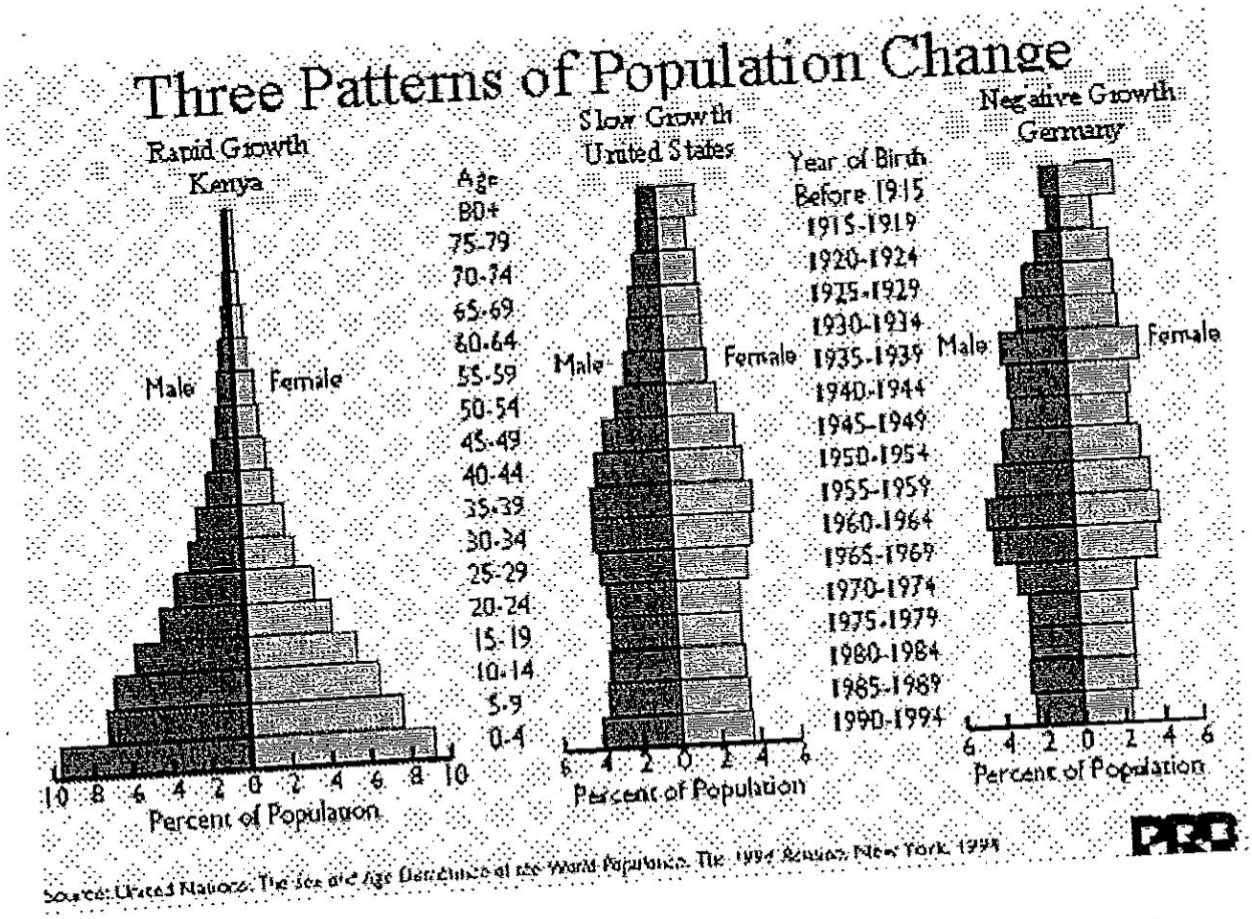
Year	Population
1500	500,000,000
1600	545,000,000
1700	610,000,000
1800	1,000,000,000
1900	1,600,000,000
1930	2,000,000,000
1960	3,000,000,000
1975	4,000,000,000
1987	5,000,000,000
1999	6,000,000,000
2011	7,000,000,000

Human Population Through the Past 511 Years



Population Circle Counting Cards

Population Circle **0** (1510)	Population Circle **0** (1510)	Population Circle **51** (1775)	Population Circle **60** (1810)	Population Circle **70** (1860)
Population Circle **75** (1885)	Population Circle **78** (1910)	Population Circle **82** (1930)	Population Circle **85** (1935)	Population Circle **88** (1950)
Population Circle **89** (1955)	Population Circle **90** (1960)	Population Circle **91** (1965)	Population Circle **91** (1965)	Population Circle **92** (1970)
Population Circle **93** (1975)	Population Circle **93** (1975)	Population Circle **94** (1980)	Population Circle **95** (1985)	Population Circle **95** (1985)
Population Circle **96** (1990)	Population Circle **97** (1995)	Population Circle **97** (1995)	Population Circle **98** (2000)	Population Circle **98** (2000)
Population Circle **99** (2005)	Population Circle **100** (2010)	Population Circle **100** (2010)		



Source: United Nations, The Sex and Age Distribution of the World Population, The 1994 Revision, New York, 1995

Population Growth – **Day 4**

South Asia

Patterson/Smith

Name:

Block:

World in the Balance – 53 min

Teacher:

Learning Objective

3. Analyze and use geographic tools to interpret the effects of population growth on resources and vice versa.

1. By the end of the century by what percentage is Japan's population expected to shrink?

2. Where is the Taj Mahal? Why was it built?

3. In what part of India are birth rates low?

4. What is the "son" preference? Why does the family want to have another one?

5. What percentage of marriages in India are "arranged?" Arranged meaning that family chooses who the person is going to marry.

6. What could happen if the woman fails to produce a son?

7. What happens when women get an education and start working?

8. What are towns and villages running out of?

9. What is the magical number of children per family?

10. Why do Japanese women need to work since 1989?

11. Why do you think the young people leave the country?

12. How did Globalization impact the old couple's plans for the future?

13. What happens when a countries workforce is shrinks?

14. An American will pollute more than _____ then children in India over their lifetime.

15. What is happening to the environment in Sub-Saharan Africa as countries try to develop?

17. If Kenya and India can get focus their populations on working instead of having children they can become like what productive countries:

18. World Population in 1800 = ____ billion

2000 = ____ billion

Name: Teacher Version

World in the Balance – 53 min

Block:

Teacher:

Learning Objective

3. Analyze and use geographic tools to interpret the effects of population growth on resources and vice versa.

1. By the end of the century by what percentage is Japan's population expected to shrink?

50%

2. Where is the Taj Mahal? Why was it built?

India, in memory for a woman who died during child birth

3. In what part of India are birth rates low?

South India

4. What is the "son" preference? Why does the family want to have another one?

The value placed on having a son, he is the one that will take care of the family when grows up

5. What percentage of marriages in India are "arranged?" Arranged meaning that family chooses who the person is going to marry.

95%

6. What could happen if the woman fails to produce a son?

She could be attacked

SKIP 13:00 – 15:00 GRAPHIC, SHOWS BURNS

7. What happens when women get an education and start working?

Their lives get better

18:41 BRIEF NATIVE NUDITY

8. What are towns and villages running out of?

Water....

9. What is the magical number of children per family?

2 children per family, so children replace their parents

10. Why do Japanese women need to work since 1989?

Families need the extra income to raise children

11. Why do you think the young people leave the country?

Better jobs, education, and more opportunity

12. How did Globalization impact the old couple's plans for the future?

They couldn't sell their wood because people could but cheap wood from the Philippines

13. What happens when a countries workforce is shrinks?

It damages the economy, people don't pay taxes

14. An American will pollute more than __30____ then children in India over their lifetime.

15. What is happening to the environment in Sub-Saharan Africa as countries try to develop?

It's damaging the ecosystems, which will be devastating for farmers in the region

40 Minute – Birth and Death Rate link

Skip 41:15 to 50 min, talk of prostitution/condoms

17. If Kenya and India can get focus their populations on working instead of having children they can become like what productive countries:

South Korea, Taiwan, Hong Kong

18. World Population in 1800 = 1 billion
2000 = 6 billion

Population Growth – **Day 5**

South Asia

Patterson/Smith

Name:_____

Block:_____ Population Growth - CFA

Date:_____

Learning Objective – Determine the factors of population growth

Score:

Green - Advanced	Blue - Proficient	Yellow – Close to Proficient	Orange – Far from Proficient	Red- Below Expectations
Students' response shows mastery of material and persuasive evidence is presented to reinforce argument.	Students' response shows general understanding of material and limited facts are cited.	Students' response shows general understanding of population growth and its impact on the world.	Students' response shows partial understanding of population growth and its impact on the world.	Students' response is well below expectations.

Directions: Chose one of the below questions and answer in paragraph form (five sentence minimum). In your response you need to provide evidence that shows your understanding of the material. If for some reason you can't write five sentences I want you to explain why.

1. **What factors (different reasons) contributed to the rapid population growth of humans over the last two hundred years?**

Or

How is having a large population both an asset (something good) and a burden (something bad) for developing countries?

One for All

World of 7 Billion

Introduction:

Renewable resources, such as trees or fish, can be maintained if managed properly. But if not given an opportunity to reproduce, these resources can be exhausted quickly, especially as the demand for the resources grow. In managing these resources, it is important for people to use them cooperatively and to not sacrifice long-term gain for short-term profits. In the following activity, students play a game where cooperative decisions must be made if all are to benefit.

Materials:

Tokens (such as poker chips), about 200 chips
Candies or other reward
CD or tape player or iPod hooked up to small speakers
CD or tape of lively music or songs from iPod (at least 8 minutes)

Procedure:

1. Count out 30 chips.
2. Seat 10 students in a circle.
3. In the center of the circle, place the pile of 30 chips.
4. Read the following rules carefully to the students. Allow time for questions and answers to make sure students understand the rules of the game thoroughly.

Rules

- You may not talk to anyone during the game or communicate with hand or facial gestures.
- The chips belong to all of you, to the group.
- Music will be played, and while it is playing, each of you may take chips out of the pool of chips in the center.
- You may not put chips back into the pool once you have taken them out.
- Each of you may trade in 10 chips for a piece of candy.
- As soon as the music stops, I will double the number of chips left in the pool at that time, and then continue the game.
- There will never, however, be more chips in the pool than there are at the start of the game. This is the maximum number of chips the pool can hold.

Concept:

Sustaining our natural resource base requires conservation and the cooperative use of resources held in common.

Objectives:

Students will be able to:
- Identify a strategy that would produce a sustainable use of resources in a simulation game.
- Draw parallels between the chips used in the game and renewable resources upon which people depend.
- Draw parallels between the actions of participants in the game and the actions of people or governments in real-world situations.

Subjects:

Civics, Economics, Family and Consumer Sciences, Geography, Science, Social Studies

Skills:

Finding cooperative strategies, following discussion

Method:

In a simulation, students desiring to draw renewable resources from a common pool determine short-term consumption strategies that will preserve a long-term supply of the resource.

5. Start the music and watch what happens. Typically, the players take all of the chips in the first round, completely emptying the pool. If this happens, point out that, as it's impossible to double zero, the game is over. Ask if they'd like to try again. Each student must return all his or her chips to the pool. Start the music and the game again. If the players leave chips in the pool at the end of the first round, double the number of chips (not to exceed 30) and continue playing. If any player accumulates 10 chips, they can trade it for a candy.
6. After the students have played two or three rounds, ask three additional students to join the circle of players and continue the game. After another two rounds, ask three more students to join the circle (you should now have 16 players in the circle).
7. As the game continues, watch to see if players begin to come up with cooperative strategies for sharing the chips even without communicating. If not, you may allow them to talk in later rounds. Once you see that they are starting to work toward the same goal, you may stop the game and start discussion. (You may want to have enough candy on hand so that all of the students get a piece.)

Notes to the leader:

DO NOT explain the significance of the chips before playing the game. The rules are the only instruction the players get.

When doubling the chips in the pool, remember there can "never be more chips in the pool than there are at the start of the game, this is the maximum number of chips the pool can hold." Think of the chips in the pool as fish in a pond. The pond only has enough room and food to support as many fish (or chips) as there were in the pool at the start of the game. That number is the pool's "carrying capacity" for chips.

After that, ask students how they feel about the way the game worked out. As a group, help the students think of ways they could cooperate to allow more of them to get their 10 chips without depleting the pool of resources. Play again using these strategies developed by the students.

Discussion Questions:

1. What do the chips represent?

   Renewable resources, such as fish or trees. (Coal, gasoline, oil, iron, aluminum are examples of nonrenewable resources, and therefore aren't applicable in this exercise.)

2. Can we draw any parallels between the way the group treated the chips and the way individuals, and society as a whole, uses or overuses renewable resources?

   DEFORESTATION: cutting trees down without planting replacements or at a rate at which newly planted trees are not given time to grow to maturity before they too are harvested; or cutting down old-growth or tropical rainforests which can never be replaced. OVERFISHING: taking so many fish that not enough are left to reproduce and replenish the stocks for the next year.

OVERFARMING: depleting the soil of nutrients without giving it time to regenerate. (Conversely, we overwhelm nature by producing too much; the rate at which we produce carbon dioxide and other forms of pollution far out paces the time required by air and water to clean themselves.)

3. Imagine that each of you playing the game represents a different country. What are some resources that nations may have in common?

   Oceans, air, fish, coral reefs, rivers, etc.

   Is it realistic for nations to share these resources cooperatively?

4. How many chips were taken out of the pool by each player in the different game variations? How many candies (or other rewards) did this generate? How did it make you feel about other members of the group?

5. Why do you think more players were added in the middle of the game? What do they represent?

   The additional players represent an increasing population while the amount of resources stays the same, demanding even greater cooperation for equitable distribution.

6. How did talking about the game make you play differently? After discussing strategies, did it seem differing attitudes were behind different ways you played the game? Why did some participants take as many chips as they could reach and others left some behind? How did this make you feel?

7. Have you experienced a similar situation at home, with friends, in your community? (It may help to provide an analogy, such as several people in the house competing for hot water in the morning.) How, in the long run, can more benefit if individuals refrain from taking too much? What sort of attitude do we need to have as individuals to achieve the goal of the greatest benefit for all?

This activity was adapted from "Something for Everyone," found in Teaching Population: Hands-on Activities, Population Connection, 2008., which was adapted by permission from an activity developed by Kurt and Ursula Frischknecht and Karen Zimbelman in Thinking Globally and Acting Locally: Environmental Education Teaching Activities by Lori D. Mann and William B. Stapp, ERIC/SMEAC, 1982.