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ABSTRACT

This collection of classroom activities, designed to complement any lesson plan, aim to help young Americans learn how population and consumption of resources are interrelated and realize that their personal decisions will affect everyone's quality of life. The activities focus on population education and can fit into the curriculum via science, social studies, mathematics, health, or environmental education. The document contains 10 activities that are a sample of the more than 100 activities available in 5 Zero Population Growth (ZPG) teaching kits and activity books. (MM)

People, Resources and the Environment: Population Education for a Sustainable Future.

Teachers' PET Project
Population Education Training

PEOPLE, RESOURCES AND THE ENVIRONMENT:

Population Education for a Sustainable Future

It is vitally important that young Americans learn how population and consumption of resources are interrelated and realize that their personal decisions will affect everyone's quality of life. Population education is needed to prepare the next generation for responsible global citizenship in the 21st century, and fits naturally into the curriculum, via science, social studies, math, health, and environmental education.

To make this easy for teachers, we have assembled this collection of value-neutral classroom activities designed to complement any lesson plan. In it, population concepts and trends are presented in a manner that will help your students understand this information and apply it to their own experience. All of them will be actively involved in each exercise. The different activities can take from as little as five minutes to as much as half an hour, and each focuses on a separate population-related issue, such as doubling time, carrying capacity, resource distribution, interdependence in nature, and so forth. We hope you will find them valuable additions to your lesson plan.

These are just a few samples of the more than 100 activities available in ZPG's five teaching kits and activity books. For descriptions and price information, please consult the ZPG Catalog of Teaching Materials.

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1400 16th Street, NW, Suite 320, Washington, DC 20036 (202) 332-2200 1-800-POP-1956
Fax: (202) 332-2302 Email: PopEd@zpg.org www.zpg.org/education Printed on recycled paper

Contents:

POPULATION RIDDLES

MILLIONS AND BILLIONS

THE SIGNIFICANCE OF LARGE NUMBERS can be hard to understand. The world's population is over 6.1 billion, and the population of the United States is about 283 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.

Do you accept your uncle's offer?

Why or why not?

How long would it take to count a billion dollars at this rate?

How long would it take to count a million dollars at the same rate?

How old are you if you are a million seconds old?

How old are you if you are a billion seconds old?

BACTERIA BOTTLES

DOUBLING TIME is the time it takes a population to double at a constant rate of growth. Bacteria, for instance, multiply by division. One bacterium becomes two. Then two divide into four; the four divide into eight, and so on. For a certain strain of bacteria, *the time for this division process is one minute.*

If you put one of these bacterium in a bottle at 11:00 p.m., the entire bottle will be full by midnight. When would the bottle be half full?

How do you know?

Suppose you could be a bacterium in this bottle. At what time would you first realize that you were running out of space?

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Suppose that at 11:58 some bacteria realize that they are running out of space in the bottle. So they launch a search for new bottles. They look far and wide, and finally, offshore in the Arctic Ocean, they find three new empty bottles. Great sighs of relief come from all the bacteria. This is three times the number of bottles they've known. Surely, they think, their space problems are over. Is that so?

Since their space resources have quadrupled, how long can their growth continue?

CALENDAR RIDDLE

EXPONENTIAL GROWTH is a constant rate of growth applied to an increasing base. Doubling a small number over and over soon means doubling ever-larger numbers.

A father complained that his son's allowance of $5 per week was too much. The son replied, "Okay, Dad. How about this? You give me a penny for the first day of the month, 2 cents for the second, 4 cents for the next, 8 cents for the next, and so on for every day of the month." The father readily consented.

Who was the more clever?

What would the son's allowance be on day 31?

Bacteria Bottles was taken from *101 Ways to Teach About Exponential Growth and Its Consequences*, available free from the Tri-County Teacher Education Center, Sebring, FL 33870.

ACTIVITY 1

The More the Merrier?

Concepts:

As the population of a region grows, the population density increases. Populations of high density require more cooperation and coordination of activities.

Objectives:

Students will be able to:

▷ List situations where population density is an advantage or disadvantage.
▷ Find a list of the world's largest cities in an almanac and three facts about one city from other reference sources.

Subjects:

Social Studies, Math, Science

Skills:

Observing, brainstorming, critical thinking, using reference materials

Method:

Students briefly demonstrate the effects of crowding in a "jumping jack" activity and discuss the pros and cons of population density.

Introduction:

Human population growth has a variety of consequences, both direct and indirect. This introductory activity looks at one of those consequences easiest to see in daily life — crowding. With population growth, the average population density will increase, even if the population is denser in some places than others. Visualizing increased population density in a variety of environments can help us plan for the future. For example, in a place already densely populated, an increase can result in more crowding, traffic, waiting in lines, waiting lists, tighter clusters of houses, compact apartments, less space and a general sense of stress. In a mostly unpopulated place, a slight increase in population density can interrupt a previously uninterrupted horizon, reduce or fragment open space, and require new electrical wires and other services.

In the discussion following the brief demonstration, students can weigh the pros and cons of higher population densities. They will explore the services that are enhanced by a higher population density as well as the challenges posed by increased crowding.

Materials:

Masking tape

Procedure:

1. Have students imagine that the number of students in your classroom has doubled. Have them list the effects of this. Make sure that both positive and negative impacts are discussed.

   Answers could include more friends, more ideas, more sharing, less space, crowding, more noise, competition for chairs and books, less attention from the teacher.

2. Have students vote by secret ballot on whether they would like to have more, fewer or the same number of students in the class as they have now. Tally and announce the results to the class.

3. Mark off an area in the classroom with masking tape, chalk or furniture (about a 10 ft. x 10 ft. area). Select two students to stand in the area and do jumping jacks.

4. Keep doubling the number of students doing jumping jacks in the area until it becomes impossible to add more. If you find they have coordinated their arm movements, secretly ask one of the students to get out of synch.

5. Solicit observations from the original pair on how their environment and behavior changed.

Discussion Questions:

1. Did the students jump in synch? Why did this happen? How did this happen? Does anything like this happen in the real world?

   Coordination of movement is necessary in crowded situations in the real world, too. People get in lines at crowded events, they obey traffic signals and laws, etc.

2. What happened when one person was out of synch? What would happen if that occurred in the real world?

   Have them imagine a person who always disobeyed traffic signals, wouldn't wait his/her turn, or wouldn't share.

3. List situations, events and activities for which it is better to have a lot of people around, and those for which solitude is better.

   Possible activities for large groups include parties, fiestas, family reunions, sports events, competitions, dances, walking on dark streets. It is often less desirable to have big crowds for classes, bicycling, shopping, driving, walking, thinking, drawing, studying, reading, sleeping, waiting for the bus and private conversations.

4. If you had a paper delivery route, would you want it to be in an area with high population density or low population density?

   In highly populated areas it would be easier to deliver more papers in a shorter amount of time, and therefore make more money. If the households were scattered farther apart you might enjoy more fresh air and open scenery on your walk but you would not be able to deliver as many papers before you had to leave for school.

5. What other services are easier to provide for an area of high population density?

   Possible answers might include mail delivery; electricity; telephone, cable, water and sewer connections; door to door sales. Additionally, services centered in one building, like community hospitals, schools, libraries, etc., can be more convenient to people who live close.

6. What qualities are desirable about areas of lower population density?

   Possible answers include more peaceful, open space, more space to plant gardens, fresher air, more nature, less noise, more space to cut loose or to get away.

7. If you had a cold, would more people be likely to catch it where population density was high or low?

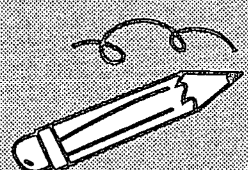
   Colds, like other contagious diseases, can pass more easily in areas of high population density. In the densely populated city of Tokyo, Japan, people wear face masks when they have a cold so as not to spread it.

8. If population continues to grow locally, what is the impact on population density?

If population grows the density will become higher and/or some people may migrate to other areas.

9. Human migration can change the population density of an area relative to neighboring areas, as people move into or out of it. What might make a particular place more crowded and what might make a particular place less crowded, in the long term and in the short term?

Job possibilities, nice retirement areas, healthy climate for allergy sufferers, entertainment and cultural variety, better quality of life and affordable housing are some reasons that areas become more crowded. Places where a major industry goes bust, where civil war breaks out, where job possibilities decline or where taxes are too high, tend to lose people.



Follow-up Activities:

1. This activity shows that population densities impact crowding, amount of open space, delivery of services and contagious disease. As follow-up it is important to discuss the secondary consequences of population density and the idea that populations require more resources than just land area to support them. When population density outstrips the ability of existing local resources to meet the needs of the population, people may want to leave in search of better places. This, in turn, changes the population density of both the place they leave and the new place in which they settle.

2. Have students look in an almanac or atlas for a list of the world's largest cities (such as Tokyo, Sao Paulo, Mexico City or New York). Instruct them to select one of the cities and to find three facts about how population density shapes the lifestyle in that place. They could find this information in an encyclopedia or travel guide. (Example: In Tokyo, the average highway speed is 10 miles per hour due to heavy traffic.)

ACTIVITY 9

Cougar Hunt

Introduction:

It's been said that every person on the planet, around six billion of us, could fit into the state of Texas. But being able to fit a certain number of people into a space doesn't mean they'd be able to live there for any length of time. We need more than just a certain amount of space to survive; we need things like food and water. There isn't enough farmland or drinking water in Texas or in all of North America, for that matter, to support six billion people. Texas, the United States and the planet all have limits to how much they can give to support people. Every habitat does. This simulation helps students understand the concept of carrying capacity by having them act out the survival attempts of cougars living in an area with limited food resources.

Materials:

200 small paper cups to represent animals (prey). They are marked on the bottom as follows:

100 cups marked S (squirrel = 1 kg)
50 cups marked R (rabbit = 2 kg)
30 cups marked P (porcupine = 7.5 kg)
19 cups marked B (beaver = 20 kg)
1 cup marked D (deer = 75 kg)

Blindfold (could use a scarf or bandana)

Procedure:

1. Select a certain surface on which to spread the paper cups. This could be a counter or large table or the floor in one corner of a room or outdoors in the school yard. Set the cups out upside down so the students can see the letters marked. Using the list above, write the names of the five types of prey and the number of kilograms of food provided by each on the chalkboard.

2. Indicate the area where you have set out the cups. "This is the habitat of a population of cougars, or mountain lions. Each of you represents one cougar. Right now you will each try to find enough food in this habitat to survive for about a month, which is about 50 kg."

3. Select one student from the class and explain, "This cougar has been injured by tackling a big buck and now has a broken leg so that he/she will have to hunt on one leg." Tell the student to hop.

4. Select another student. "This cougar is blind due to an injury caused by a porcupine." (Give the student a scarf or bandana to use as a blindfold.)

Concepts:

Every piece of land has a limited carrying capacity for the number of animals and/or humans it can support.

Objectives:

Students will be able to:

- ▶ Act out their roles as cougars trying to amass food for survival.
- ▶ Calculate the amount of "prey" they gathered in kilograms.
- ▶ Define carrying capacity and explain how it relates to animals.
- ▶ Determine the similarities and differences between animal and human population growth patterns.

Subjects:

Science, Math, Social Studies

Skills:

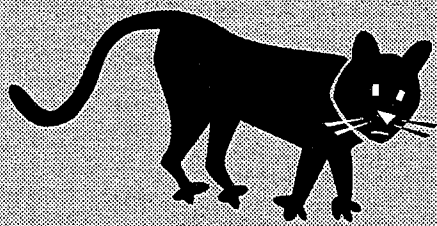
Observing, understanding cause and effect, adding, role playing, using metric system

Method:

Students will gain a better understanding of what is meant by carrying capacity when they act as predatory animals in a finite area and attempt to accumulate enough food to stay alive.

5. Select a third student. "This cougar is a female with two cubs and each cub needs 25 kg of food to live, so if they are all going to survive, she needs to find 100 kg of food."

6. Indicate the list on the board and read it aloud to be sure the students understand what they're looking for. Ask each student to set up a cougar den by selecting a small area where he/she will bring his/her prey. This could be a student's desk or areas along the wall.



7. Give students the following instructions: "Each cougar must walk into the habitat to hunt. (Cougars don't run down prey, they stalk it.) When a cougar finds a prey animal, he or she picks it up and carries it to his or her den. Each cougar can only carry one prey animal at a time. Remember that in the wild, cougars don't fight over prey, as a resulting injury may kill them." The students continue to repeat the process until the game is over, picking up just one prey species per trip.

8. When all the paper cups have been gathered, the game is over, and each student returns to his/her desk to calculate the quantity of food he/she gathered.

9. Ask students to announce to the class the amount of food they gathered. On the chalkboard, record these numbers vertically in descending order. Then, draw a horizontal line at "50" to represent the amount needed to survive. Any cougars who gathered 50 kg or more would survive, while the others would not. Note: You may need to adjust the amount of prey needed to survive based on the number of students in your class. With the amount of prey available using 200 paper cups, about 10-18 cougars would survive. This would be an appropriate portion for a class of 25-30 students.

Discussion Questions:

1. How many kilograms did each cougar gather? How many cougars can survive in the habitat? If more cougars played the game, would the habitat support them? Why?

   Having more predators than prey would mean fewer prey animals would survive to reproduce. Because more would be taken out than was being put back, the food supply wouldn't be sufficient to support the cougars.

2. How many kilograms did the blind cougar gather? The injured cougar? The mother cougar? What are the chances of her cubs surviving in this habitat? Can a blind or injured cougar survive in the wild? Who is the mother going to feed first?

   She will probably feed herself first to keep healthy so that she can tend to her cubs. If she doesn't survive, they have no chance at all. Even if this litter doesn't survive, perhaps the habitat will support healthy cubs in the future.

3. Who got the deer? The deer was worth 75 kg of meat, which is half again as much food as any cougar needed for survival. Would a real cougar have continued to hunt after getting that much food? Why or why not?

No. Animals in the wild only hunt and eat when they're hungry — they only take as much food as they need.

4. What would happen to the cougar population if all the rabbits died of a disease?

This would cut the cougars' food supply significantly. They would have to eat more of the other animals than usual to make up for the lack of rabbits, which would reduce the populations of the other prey animals.

5. Conversely, what would happen to the cougars' prey animals if the cougars' numbers dwindled as a result of humans hunting them intensively?

Just as the cougars compete with each other for the prey animals, the prey animals compete with each other for their food — the plants within the habitat. If the cougars are not around to keep the herbivores' numbers in check, the area will not be able to provide enough vegetation to support the extra animals.

6. What would happen to the cougar population if the water became polluted?

The cougars and all the other animals drinking that water would become sick and some of them might die. If different proportions of predator and prey animals died, it could upset the balance of the food chain.

Why would the concentration of the pollutant be greatest in the cougars?

All creatures store the pollutants they've consumed over their lifetimes in their bodies — they never go away. Because the cougars are at the top of the food chain, they are not only getting their share of the pollutant from the drinking water, but they are taking in all of the pollutants stored in the tissues of each animal they eat.

7. Though this game is about the carrying capacity of cougars in a region, do the same rules apply to humans? How are they similar?

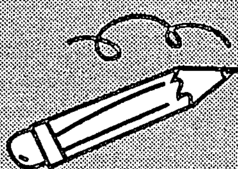
Yes. One similarity is that humans are at the top of the food chain. Another is that, just as the cougars competed for prey in their hunting area, humans compete for a limited number of resources within our habitat (society).

How are they dissimilar?

An example of a dissimilarity is that humans generally don't stop "hunting" when we have enough; we continue competing for more than we need.

What do humans compete over?

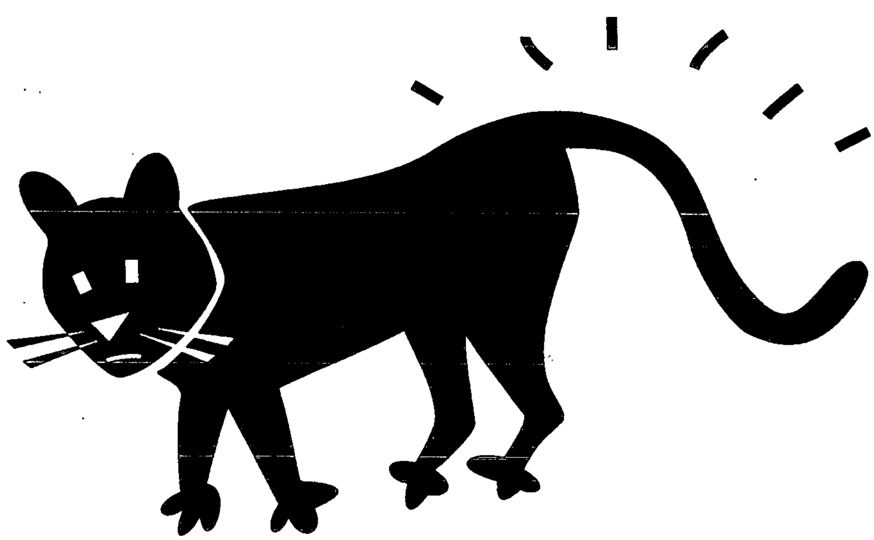
As individuals, we compete mostly for money and the things it can buy. We also compete over means of becoming more fit to compete for money, through things like education and jobs. As nations, we compete for resources like land, water, gasoline, oil, timber, minerals, etc.



Follow-up Activity:

Once students have grasped the concept that the size of an animal population depends on the amount of available resources, extend the idea of carrying capacity to humans through one or both of the following two activities: *"World Real Estate"* and *"Growing Pains in Texas Hill Country."*

Cougar Hunt was adapted with permission from Joan Wagner, Burnt Hills Middle School, Burnt Hills, NY. It is based on "Oh Deer!", an activity developed by Project WILD, ©1983.



Teachers' PET Project
Population Education Training

THE STORK AND THE GRIM REAPER

CONCEPT: Population growth occurs when a species' birth rate exceeds its death rate. Worldwide, the human birth rate is currently three times the death rate. Every environment has a limit to the number of members of a certain species it can support. Humanity's rapid population growth has the potential to exceed the carrying capacity of this planet. This is a visual demonstration illustrating (1) the relationships between birth rate and death rate, and (2) population growth within a finite space.

INTRODUCTION: Usually we think of carrying capacity in terms of how many frogs can live in a pond or how many cattle can be raised in a particular pasture. But carrying capacity applies to human beings, too. People consider more than just the basics of food, water and shelter when we measure an area's carrying capacity. We include the idea of *quality* of life. Because we expect so much more from our surroundings than animals do, we have to be more thoughtful about how many of us can live in one place. How many people can share a city, state or planet and still have that area provide each person with clean surroundings, a quiet place to think, a safe neighborhood, good schools, hospitals and so on? Humans don't want only to survive; we want to be happy and healthy, too.

MATERIALS:
- Clear container of 1 qt. capacity
- An old towel
- "Stork" and "Grim Reaper" name tags
- Masking tape
- Bucket of water
- Food coloring
- 1/3 cup measure and 1 cup measure
- Globe or map of the world

PROCEDURE:

Fill the bucket with water and add food coloring so it will be more visible in the clear container. Place the clear container with the towel under it in front of the class.

Ask for two volunteers from the class to assist. Designate one the "Stork" and the other the "Grim Reaper." Each student should tape the appropriate label to him or herself.

Hold up the clear container.

> *"This will represent the world, and the colored water in the bucket will represent people. Stork, you'll be adding people to the world by pouring dippers of water into the container. Grim Reaper, you'll be taking people from the world by scooping water out of the clear container and pouring it back into the bucket. At this time, the world's birth rate is three times the death rate. Based on that fact, who should receive the large dipper?"* (Stork) *"Who should use the small dipper?"* (Grim Reaper)

Signal the Stork and Grim Reaper to start. Make sure that for every dipper-full the Stork adds, the Grim Reaper subtracts one. They should continue in turn while the class observes. When it becomes clear that the water level is steadily rising tell the Stork and Reaper to stop.

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DISCUSSION QUESTIONS:

1. Why did the water level rise steadily? *Because more was being added than taken out.*

2. What would this mean if the clear container really was the world? *It would mean that the Earth's carrying capacity has been exceeded and that not all of these people could survive.*

3. What size would the Grim Reaper's dipper have to be for the water level to stay the same? *The same size as the Stork's dipper.*

4. Throughout history, the Stork and Grim Reaper's real-life dippers were usually about the same size. But over the last 200 years, the Stork's dipper has grown much larger than the Grim Reaper's. Can you think of some reasons why the death rate has gone down in recent years? ***Advances in medicine:*** *Doctors gradually became better at healing people because of new discoveries in the sciences and from increased contact with other countries, which allowed them to learn from each other.* ***Better sanitation:*** *People invented safer ways of disposing of garbage and human waste so their surroundings were cleaner and didn't breed so much disease.* ***Better nutrition:*** *Advances in farming made it possible to grow better food in greater quantities. Also, improvements in medicine made people more aware of the importance of eating a variety of foods.*

   All of these things worked to allow more people to survive infancy and childhood and extended the average lifespan. People used to only live to be about 50 or maybe 60, whereas now many people survive much longer.

5. What is the carrying capacity of our classroom? Consider the following questions:
   How large is the room?
   How much space does each person take?
   How much space is taken by resources: tables, chairs, desks, etc.?
   How much open space is needed to have the class run smoothly?
   Could you comfortably fit twice as many people in the classroom as you have now?

6. What is the carrying capacity of your home? (Consider the number of people who could regularly eat and sleep there.)

FOLLOW-UP ACTIVITY

Show the different growth rates of the countries below.

United States:	Stork = 1 cup	Grim Reaper = 1/2 cup
Mexico:	Stork = 1 cup	Grim Reaper = 3 tablespoons
Oman:	Stork = 1 cup	Grim Reaper = 2 tablespoons
Italy:	Stork = 1 cup	Grim Reaper = 1 cup
Japan:	Stork = 1 cup	Grim Reaper = 2/3 cup
Nigeria:	Stork = 1 cup	Grim Reaper = 1/3 cup

Point out where each country is on the globe or map before beginning. Be sure both sets of people work at the same speed, with the different growth rates shown by variations in sizes of dippers. The more slowly growing countries, of course, will have a more slowly rising water level. (Start out with Italy's clear container about half-full, so students won't be confused and think that it's completely unpopulated. The rest of the buckets can start out empty.)

Teachers' PET Project
Population Education Training

FOOD FOR THOUGHT

CONCEPT: This simulation demonstrates the inequitable distribution of population and resources among the different regions of the world, and goes on to study the social effects of these inequities.

OBJECTIVE: After completing this activity, students will be able to state at least two factors that might be used to determine the relative well-being of a country or region, and identify at least two potential impacts of inequitable resource distribution.

SKILLS USED: Interpretation and analysis of demographic data, role playing, applying academic knowledge to real-world events.

SUBJECTS: Social studies, science, math

MATERIALS:
Yarn or string
Masking tape
Ambassador's cards (provided in activity script)
Labels for energy consumption and wealth
Transparent tape
28 oz. Hershey's Chocolate Kisses™
107 matches (or toothpicks)
10 sandwich-sized ziplock bags
Overhead Transparency (optional)

PROCEDURE:

Preparation, the night before

1. Measure out the yarn or string for each region according to the chart below. You can use a different color yarn for each region, or, if you only have one color, make a tag to label each piece with the name of the region whose perimeter it will represent.

2. Count out the number of Hershey Kisses™ required for each region and bag them. Make labels for them according to the chart, and tape the appropriate label to each bag. Do the same for the matches.

3. Read through all the discussion questions and make notes to yourself about links to local, national and international current events; seeing such ties between the activity and the real world will dramatically enhance the meaning the students glean from the exercise. As much as possible, you'll want to encourage them to make observations, critically evaluate the demographics, and hypothesize on possible causal relationships between the statistics.

   Your students will likely start discussion of these issues themselves, but if they don't, the discussion questions will help to stimulate and/or direct class discussion. Because of the large amount of information in each section, it's best to discuss each group of statistics immediately after reading them – while they're fresh in the students' minds – rather than saving all discussion for the end.

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Region Information Chart					
	North America	Latin America	Europe	Africa	Asia
Yarn With 60 Participants- feet *(meters)* With 24 Participants- feet *(meters)*	35 (10.7) 25 (7.6)	36 (11.0) 25 (7.6)	38 (11.6) 27 (8.2)	43 (13.1) 30 (9.1)	44 (13.4) 31 (9.4)
2000 Population in millions[1] With 60 Participants (1 = 100 million) With 24 Participants (1 = 250 million)	306 3 1	518 5 2	728 7 3	800 8 3	3,684 37 15
Region's Percent of World Land Area[2]	15%	16%	18%	24%	25%
Percent of Region's Land That is Arable[3]	12%	8%	14%	6.8%	18%
Per Cap. Energy Consumption[4] (measured in barrels of oil) 1 Match = 1 Barrel	60 matches	10 matches	26 matches	4 matches	7 matches
Per Capita GNP[5] 1 Hershey's Kiss™ = $300	$28,230 94 kisses	$3,880 13 kisses	$13,420 44 kisses	$670 2 kisses	$2,130 7 kisses

Set up, just before class period begins

1. Arrange the yarn on the floor to represent the regions and tape it in place.

   Note: The activity is designed for use with a group of either 24-30 or 55-60 participants. If your group will be in the 24-30 range, use the smaller yarn lengths.

2. Hide the bags of Hershey's kisses™ and matches in a larger bag. Place the bag within easy reach of where you'll be standing as you lead the activity.

Introducing the activity

1. While students are still seated, read or paraphrase the following introduction:

   All societies need and use natural resources such as land and energy, but the ways in which various societies use these things can differ greatly. For example, a small population may use an enormous amount of farmland or gasoline compared to the amounts used by other, much larger populations. This creates "have" and "have not" societies with potential for human discomfort and social conflict. The simulation we're about to do is going to demonstrate how this happens.

2. Appoint 5 students to be the "ambassadors" for the world regions. Give them their information cards and direct them to their regions.

3. Populate the regions with the rest of the students, according to the chart. Given the length of the demonstration, you may wish to have students sit, rather than stand, in their regions.

   Note: If you have too few students, use chairs to substitute for the missing citizens. If you have too many students, appoint the extra students to a "United Nations Advisory Committee." Instruct the Committee to pay close attention, as you will be asking for their opinions as a neutral party later in the activity. They should be thinking in terms of whether the inequities in each region's share of

population/food/income are problems, and if so, what policies could lead to solutions.

4. Identify each region by name for the class.

   Note: the regions in this simulation are those defined by the United Nations and, therefore, Mexico is included in Latin America rather than in North America. The sixth world region, Oceania, is not included because its population is so small relative to the others that it cannot be accurately represented.

5. Explain that the dimensions of their regions are to scale, and the number of students within each region is proportional to its actual population; the idea is to give an accurate sense of the population density in each area.

Facilitating the activity

For each section, follow this basic procedure:

1. Cover definitions of section's terms, referring students to the overhead transparency or chalkboard.

2. Cover world statistics.

3. Offer any supplemental information provided.

4. For the first three sections (Population Demographics, Quality of Life, and Land Use Patterns) you will call on the ambassadors to read their regions' respective statistics. A sequence that works well is North America, Latin America, Europe, Africa, Asia.

   In the last section (Energy Consumption & Wealth), you will be distributing the bags of matches and Hershey's Kisses™. It makes a more dramatic impression to start with the region whose amount is the smallest and continue in ascending order to the region whose share is largest. Referring to the labels on the bags, you will read aloud each region's quantity of each resource. Hold each bag up high so the whole class can see it before you pass it to the appropriate ambassador.

5. Cover discussion questions.

POPULATION DEMOGRAPHICS

I. Definitions: Terms A-E

A. POPULATION: The number of people living in a region.[6]
B. BIRTH RATE: The number of births per 1000 people per year.[7]
C. DEATH RATE: The number of deaths per 1000 people per year.[8]
D. RATE OF NATURAL INCREASE: Growth caused by having more births than deaths in a year (does not include immigration or emigration).[9]
E. DOUBLING TIME: The number of years it will take a population to double in size if it maintains its current growth rate.[10]

II. World Population Demographics

a. The 2000 world population is 6.1 billion.
b. The birth rate is 22 per 1000.
c. The death rate is 9 per 1000.
d. The world's annual growth rate is 1.4%.
e. At this rate the world's population will double to 12.2 billion in 51 years.

III. Supplemental Information

Regarding Population Growth Rates:

- A population grows whenever its birth rate is higher than its death rate.
- The growth rate is determined by the size of the difference between the birth and death rates. The closer these rates are, the lower the growth rate.
- Where birth and death rates are equal, the population's growth rate is zero.
- The world's current birth rate is almost two and a half times its death rate.

IV. Ambassadors Read Statistics A-E from Their Cards

V. Discussion Questions

1. What will it mean to have our population double? What else will we need to have twice as much of to provide for all those people?

We'll need twice as much of everything people need to live:

- food
- land to grow the food on
- clean water
- shelter
- schools
- hospitals
- roads
- cars
- energy to power our cars and heat our homes and cook our food...

2. Asia's doubling time is 48 years. If we returned in 48 years and did this exercise again, would we be able to fit twice as many people into Asia's space?

QUALITY OF LIFE

I. Definitions: Terms F-I

F. SECONDARY SCHOOL ENROLLMENT RATIO: The ratio of the percentage of each gender's population in the applicable age group (12-17 years of age) enrolled.[11]

G. TOTAL FERTILITY RATE: The average number of children a woman will have in her lifetime.[12]

H. INFANT MORTALITY RATE: The yearly number of children who die before reaching the age of one year per 1,000 live births.[13]

I. LIFE EXPECTANCY: The average number of years a person born today could expect to live under current mortality rates.[14]

II. Worldwide Quality of Life

f. Of the world's 12-17 year-olds, 65% of boys, and 59% of girls are enrolled in school.

g. The world's women bear an average of 2.9 children.

h. The world infant mortality rate is 57 per 1000.

i. The average human life expectancy at birth is 66 years.

III. Ambassadors Read Statistics F-I from Their Cards

IV. Discussion Questions

1. Can you see any connection between Africa's unusually high infant mortality rate of 88 per 1000 (almost 1 in 10), and its high total fertility rate of 5.3 children per woman?

When people know each of their children has about a 10% chance of not surviving to adulthood, they will have more children to increase the likelihood that some will survive. This is especially crucial for people living in societies where there is no social security or retirement plans, where the elderly are entirely dependent on their children for care and financial support.

2. Infant mortality rates are consistently lower in regions in which girls have access to higher education. Is this coincidental, or is there a correlation here? What abilities and/or knowledge do educated people have that might be useful to them as parents?

Literacy (including reading and basic math): Parents with these abilities can:

- read directions, such as appear on over-the-counter medicines and infant formula.
- educate themselves about any subject, including child development and care
- get better jobs and earn more money

Health/Biology: Exposure to these subjects makes people more aware of how to take good care of themselves and their children. They understand the importance of:

- good nutrition
- medical care, especially perinatal care

3. What do indicators like a high infant mortality rate and short life expectancy say about the quality of life in a region? What are some possible causes?

Possibilities include:

- Food that's insufficient in quantity or nutritional value
- Lack of clean water
- Low quality medical care or none at all
- Exposure to high levels of pollution

LAND USE PATTERNS

I. Definitions: Terms J & K:

J. URBAN POPULATION: Percentage of the total population living in areas termed urban by that region (typically towns of 2,000 or more or in national or provincial capitals).[15]
K. ARABLE LAND: Farmland; land capable of growing crops.[16]

II. Worldwide Land Use Patterns:

j. 45% of the world's population (about 2.7 billion people) now live in urban areas.
i. There are 0.5 acres of arable land per person on Earth.

III. Supplemental Information:

Regarding Urbanization:

- By 2025, the number of the world's people living in urban areas is expected to double to more than 5 billion.
- Ninety percent of this growth will occur in the developing world.

- Almost 75% of the population in the developed world already lives in urban areas.
- In the developed world–especially North America–most of the current population shift involves people moving away from concentrated urban centers to sprawling suburban and metropolitan regions, or to small and intermediate-size cities.[17]

Regarding Arable Land:

- The lowest authoritative estimate of the minimum amount of arable land required to feed one person–without intensive use of synthetic fertilizers–is 0.17 acres.[18] (This doesn't include crops for textiles or cash crops needed for income.)

IV. Ambassadors Read Statistics J & K from Their Cards

V. Discussion Questions

1. How will population growth affect the amount of arable land available per person?

When people share a limited resource such as arable land, each person's share of that resource becomes smaller in direct proportion to the number of additional people using it.

2. What would it mean for a country to have its amount of arable land per capita fall below the minimum required to grow enough food to sustain its population?

Such a country would be dependent on imported foods, making it vqlnerable to price hikes and shortages.

3. What do you think usually causes people to move to cities?

The shift of jobs from agriculture to industry and services–leading to a concentration of economic opportunities in urban areas.

4. What are some possible positive and negative effects of having such large proportions of countries' populations shifting to urban areas?

Positive Effects: More green space is left open for:

- other species to inhabit.
- trees and other plants to continue producing the oxygen we all need
- potential farmland.

Well-planned cities can offer people:

- more job opportunities.
- better public services and living conditions.

Negative Effects: When a city's population grows very rapidly, two major effects are likely:

Higher rates of unemployment and poverty

- occur when more people come looking for work than there are opportunities available.
- can happen in spite of economic growth.

Greater environmental problems

- infrastructure facilities and services can't expand quickly enough to keep up with increased demand.
- streets become congested, levels of pollution rise, sanitation systems are overwhelmed, and residents' health and general quality of life declines sharply.

ENERGY CONSUMPTION & WEALTH

I. Definitions: Terms L & M

L. ENERGY CONSUMPTION: The total amount of energy used by each region per year divided by the number of people living in that region–includes industrial use.[19]

M. GROSS NATIONAL PRODUCT: A commonly used measure of a nation's wealth, determined from the annual profits generated within in a region by all goods and services exchanged that year.[20]

II. Symbolism of Props

Regarding the Matches:

- While energy is provided in many ways, including wood, coal, natural gas and nuclear power, in this activity, all these sources have been combined and are expressed in terms of barrels of oil.
- These matches represent the average amount of energy consumed by each citizen of each region in the course of a year.
- Each match = 1 barrel of oil. One barrel of oil contains 42 gallons.

Regarding the Hershey's Kisses™:

- The Kisses™ represent the amount each person would get per year if his/her region's annual GNP were divided equally amongst all its citizens, expressed here in U.S. currency.
- Each Kiss™ = $300.

III. Distribute Bags to Ambassadors.

Note:

- start with the region with the smallest amount and work up to the region with largest amount.
- hold each bag up high so the whole class can see it.
- from the labels, read aloud each region's quantity.

IV. Instruct Ambassadors to Distribute the Candy Amongst Their Citizens

Note:

- expect and allow students to migrate and ask for aid.
- assist them in making connections between their reactions to the simulation and real world phenomena.

V. Discussion Questions

1. What would it be like in this room if we lit all these matches?

2. Who would have to breathe all that smoke? Would only the citizens of North America be breathing the pollution generated by their 60 matches?

3. What do the people in our Asian and African regions think about the fact that the North Americans have a bag bulging with wealth, when they have so little?

4. How could/do people from regions with less wealth and opportunity get access to those things?

5. What does the North American Ambassador think about the uneven distribution of wealth? What does he/she want to do about it?

6. How will the wealthier regions decide to which countries they will offer foreign aid? What, if any, conditions will you impose on nations receiving your help? Will you trust the countries receiving money from you to put it to good use, or will you attempt to control what is done with it?

7. How will the less densely populated regions decide from which countries they will accept immigrants? What, if any, conditions will you impose on people seeking permission to immigrate? Will you accept only very well-educated people, or will you base your decision on need–giving preference to those with the least opportunity in their home countries? Or those suffering political persecution? Or refugees from war-torn nations? Or would it be based solely on numbers, first-come, first-served?

8. In the process of eating the Hershey's Kisses™, which region generated the most empty wrappers? Do you think this is an accurate representation of how much garbage each region creates as a function of its wealth and consumption?

9. [Good for the United Nations Advisory Committee, if you have one.] *What does the group think should be done about the inequitable distribution of wealth and consumption of resources? Do donor nations have the right or obligation to link aid to certain policies that might enable recipient countries to become self-sufficient in the future? What might those be? Should rich countries be required to reduce their consumption levels? How could this be encouraged or enforced? What should be done about environmental problems (acid rain, ozone depletion) caused by one region, but affecting others?*

SOURCES:

1, 5-10, 12-15, 20 — "*2000 World Population Data Sheet.*" Population Reference Bureau, Washington, DC.

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4 — The World Bank, *World Development Indicators 2000.* www.worldbank.org/data/wdi2000

11 — "*1998 Women of Our World.*" Population Reference Bureau, Washington, DC, 1998.

17 — Roberts, Leslie, Ed. *World Resources 1996-97.* The World Resources Institute, The United Nations Environment Programme, The United Nations Development Programme, and The World Bank. Oxford University Press, New York, 1996.

18 — Engelman, Robert, and Pamela LeRoy. *Conserving Land: Population and Sustainable Food Production.* Population Action International, Washington, DC, 1995. p. 9.

19 — The World Bank, *World Development Report 1995.* Oxford University Press, New York, 1995.

For the latest data for this activity, please see www.zpg.org/education and download a free copy.

AMBASSADOR CARDS

I am the NORTH AMERICAN AMBASSADOR. Here are some statistics that shape my region of the world:

A. North America's population is estimated at: 306 million
B. Our birth rate is: 14 per 1000
C. Our death rate is: 9 per 1,000
D. Our annual growth rate due to natural increase is: 0.6%
E. At this rate our population will double in: 124 years
F. Of our 12-17 year-olds, 97% of the boys, and 97% of the girls are enrolled in school.
G. North American women bear an average of: 2.0 children
H. Our infant mortality rate is: 7 per 1000
I. Our life expectancy at birth is: 77 years
J. The percentage of our people living in urban areas is: 75%
K. Acres of arable land available per person: 1.8 acres

I am the **LATIN AMERICAN AMBASSADOR**. Here are some statistics that shape my region of the world.

A. Latin America's population is estimated at: 518 million
B. Our birth rate is: 24 per 1000
C. Our death rate is: 6 per 1000
D. Our annual growth rate due to natural increase is: 1.8%
E. At this rate our population will double in: 39 years
F. Of our 12-17 year-olds, 51% of the boys, and 58% of the girls are enrolled in school.
G. Latin American women bear an average of: 2.8 children
H. Our infant mortality rate is: 35 per 1000
I. Our life expectancy at birth is: 70 years
J. The percentage of our people living in urban areas is: 74%
K. Acres of arable land available per person: 0.8 acres

I am the **EUROPEAN AMBASSADOR**. Here are some statistics that shape my region of the world.

A. Europe's population is estimated at: 728 million
B. Our birth rate is: 10 per 1000
C. Our death rate is: 11 per 1000
D. Our annual growth rate due to natural increase is: -0.1%
E. At this rate our population will not double.
F. Of our 12-17 year-olds, 99% of the boys, and 100% of the girls are enrolled in school.
G. European women bear an average of: 1.4 children
H. Our infant mortality rate is: 9 per 1000
I. Our life expectancy at birth is: 74 years
J. The percentage of our people living in urban areas is: 73%
K. Acres of arable land available per person: 1.0 acres

I am the **AFRICAN AMBASSADOR**. Here are some statistics that shape my region of the world.

A. Africa's population is estimated at: 800 million
B. Our birth rate is: 38 per 1000
C. Our death rate is: 14 per 1000
D. Our annual growth rate due to natural increase is: 2.4%
E. At this rate our population will double in: 29 years
F. Of our 12-17 year-olds, 35% of the boys, and 29% of the girls are enrolled in school.
G. African women bear an average of: 5.3 children
H. Our infant mortality is: 88 per 1000
I. Our life expectancy at birth is: 52 years
J. The percentage of our people living in urban areas is: 33%
K. Acres of arable land available per person: 0.7 acres

I am the **ASIAN AMBASSADOR**. Here are some statistics that shape my region of the world.

A. Asia's population is estimated at: 3 billion, 684 million
B. Our birth rate is: 22 per 1000
C. Our death rate is: 8 per 1000
D. Our annual growth rate due to natural increase is: 1.4%
E. At this rate our population will double in: 48 years
F. Of our 12-17 year-olds, 64% of the boys, and 52% of the girls are enrolled in school.
G. Asian women bear an average of: 2.8 children
H. Our infant mortality rate is: 56 per 1000
I. Our life expectancy at birth is: 66 years
J. The percentage of our people living in urban areas is: 35%
K. Acres of arable land available per person: 0.4 acres

Teachers' PET Project
Population Education Training

EARTH: THE APPLE OF OUR EYE

CONCEPT: A visual demonstration of the limited sources of food available from land and water.

MATERIALS: An apple, a knife, and a paper towel

PROCEDURE: Slice the apple according to the instructions, following with the italicized text (quick-reference box at top). Use the Q & A to encourage critical thinking in discussion of these facts.

PART I: FARMLAND

Whole Apple = Planet Earth	**1/8** = Habitable Land
3/4 = Water	**3/32** = Habitable, but not arable Land, due to unsuitable soil or development
1/4 = Land	**1/32** = Arable Land
1/8 = Uninhabitable & Non-arable Land: poles, deserts, swamps, high/rocky mountains	**1/32 Peel** = Topsoil

1. HOLD THE APPLE OUT SO THE CLASS CAN SEE IT.
   "This apple represents our planet."

2. CUT THE APPLE INTO QUARTERS. HOLD OUT 3/4 IN ONE HAND AND 1/4 IN THE OTHER.
   "What do these 3/4 represent? (Water.) So, only 1/4 of the Earth's surface is land."

3. SET THE **3/4** (WATER) ASIDE. SLICE THE REMAINING **1/4** (LAND) IN HALF, LENGTHWISE. TAKE **1/8** IN EACH HAND, AND HOLD OUT ONE OF THEM.
   "1/8 of the Earth's surface, or half of all land, is inhospitable to people and to crops: these are the polar regions, deserts, swamps, and high or rocky mountains."

4. SET THAT **1/8** ASIDE AND HOLD OUT THE OTHER.
   "This 1/8 of the Earth's surface, the other half of all land, represents the total area on which people can live, but can't necessarily grow food."

5. SLICE THIS **1/8** LENGTHWISE INTO FOUR PIECES. HOLD OUT **3/32** IN ONE HAND AND **1/32** IN THE OTHER.
   "Each of these pieces represents 1/32 of Earth's surface. These three represent land that never was arable because it's too rocky, wet, cold, steep or has soil too poor to produce food. They also contain land that was once arable but is no longer because it's been turned into cities, suburbs, highways, shopping centers, schools, churches, parks, factories, parking lots, and other forms of development that can no longer be farmed."

6. SET **3/32** ASIDE AND HOLD OUT **1/32**.
   "So, only 1/32 of the Earth's surface has the potential to grow the food needed to feed all of the people on Earth."

7. CAREFULLY PEEL THE **1/32** SLICE OF EARTH, AND HOLD THIS PEEL UP SO THEY CAN SEE IT
   "This tiny bit of peel represents the topsoil, the dark, nutrient-rich soil that holds moisture and feeds us by feeding our crops. Eighty percent of U.S. croplands currently lose an inch of topsoil every 33 years, twenty times faster than the natural rate." [1]

A project of Zero Population Growth, Inc.
1400 16th Street, NW, Suite 320, Washington, DC 20036 (202) 332-2200 1-800-POP-1956
Fax: (202) 332-2302 Email: PopEd@zpg.org www.zpg.org/education Printed on recycled paper

DISCUSSION QUESTIONS

Preface: Erosion by wind and water is the most serious cause of soil loss and degradation. Although erosion is a natural process, it is accelerated greatly by farming and construction. Deforestation, unsustainable farming practices, and animal grazing also increase the erosion rate. Under natural conditions, erosion occurs at the rate of 0.04 mm a year. U.S. croplands lose 0.8 mm per year and China's and India's lose an average of 3.3 mm annually.[2] More than 25 million acres (an area the size of the states of Ohio, Indiana, Illinois, Michigan, Wisconsin, and Minnesota put together) of productive arable land are severely degraded and abandoned worldwide every year. The lowest authoritative estimate of the minimum amount of arable land required to feed one person for one year without the intensive use of synthetic fertilizers is 0.17 acres. In order to feed the nearly 80 million humans added to the population annually, 12 million acres of new land must be put into production.[3] Each year, development, urbanization, and highway construction claim 25-86 million acres worldwide. One-half of these lands come from cropland.[4]

1. ***HOW DO THE FACTORS MENTIONED ABOVE CONTRIBUTE TO EROSION OF ARABLE LAND?***
   Deforestation: When trees are cut down, the soil loses the shelter of branches and leaves that protect it from the force of rain and wind that otherwise blow and wash it away. The root systems that hold the soil in place from underneath are also destroyed. **Over-farming:** Each kind of crop takes certain elements from the soil. Over-farming occurs when the same crop is grown in the same place for too many years in a row, and the soil can't renew itself. Eventually all of that particular element is gone, and that soil is unable to grow anything. One way to avoid this is <u>crop rotation</u>. Farmers divide their land into sections, and every year, they change the kind of crop grown in each section. One section might be left unplanted, giving the soil microbes time to break down dead plant and/or animal matter into soil nutrients. **Over-grazing:** When cattle eat grass, they pull it out of the ground by the roots, taking some soil with it. Each bite leaves a patch of ground uncovered, exposed to the wind and the rain. These animals' sharp hooves also tear up the surface a little with each step.

2. ***HOW MANY PEOPLE CAN THE EARTH FEED WITH ITS EXISTING CROPLANDS?***
   Although much of the hunger problem stems from uneven food distribution, rising affluence also plays a role in the number of humans that the world's food supply can sustain. Per capita consumption of grain in a low-income nation, such as India, whose people's diets consist of primarily a single starchy staple, like rice, is 440 lb/year. However, a typical American consumes almost 2000 pounds of grains each year, the bulk of which is indirectly consumed from eating animal products such as beef, pork, poultry, eggs, milk, and other dairy products. The current world grain harvest is 1.85 billion tons. Even if this harvest were expanded to 2 billion tons in the future, it could support 10 billion people who eat like a typical Indian, or 2.2 billion people with the average diet of a person living in the United States.[5]

3. ***WHAT CONCLUSIONS CAN WE DRAW ABOUT THE RELATIONSHIP BETWEEN A GROWING POPULATION AND A SHRINKING AMOUNT OF LAND CAPABLE OF GROWING FOOD FOR THOSE PEOPLE?***
   With a limited amount of land and a growing number of people to feed from that land, each person's part becomes smaller and smaller. Protecting our land resources is therefore of great importance.

4. ***HOW CAN WE PRESERVE FARMLAND?***
   By not building on arable land: Land covered up by buildings, highways, and other forms of development can't be used for growing crops. In the U.S., nearly 16 million acres of forest, cropland, and open space were converted to urban and other uses from 1992-1997. That's 3.2 million acres a year.[6] At that rate, an area the size of New York state is covered every decade. **By eating lower on the food chain:** While 800 million people suffer from malnutrition or starvation, meat production requires a disproportionate amount of grain input.[7] Producing a pound of beef in a feedlot requires seven pounds of grain, a pound of pork requires four, and a pound of poultry requires two pounds of grain.[8] The land that is used to produce grain for consumption by animals is inaccessible for growing grain for human consumption. **By reducing pollution:** Pollution impairs the ability of the land and the seas to provide food that's both sufficient in quantity and free of contaminants. **By stabilizing human population growth.** Quite simply, the more people there are to feed, the less food there is to go around. Food supply is an excellent example of the relationship between any resource and the *size* <u>and</u> *consumption*

patterns of the population that depends on it.

PART II: WATER

3/4 = Water **1/8** = Food-Producing Areas 4/32 = Coastal Areas	**4/32 Peel** = Photic Zone: top 100 meters, habitat of most marine life **Sliver of Peel** = Freshwater: only .3% of all Earth's water

1. RETURN TO THE **3/4** OF THE ORIGINAL APPLE THAT REPRESENTS OCEAN.
   "Some of our food comes from the sea. Yet, despite the vastness and seeming uniformity, many regions of the world's oceans are unproductive due to a lack of life-supporting nutrients. Nearly one billion people, mostly in Asia, rely on fish as their primary source of protein."[9]

2. SET ASIDE **2/4**. CUT THE REMAINING **1/4** IN HALF. SET **1/8** ASIDE AND HOLD OUT THE OTHER **1/8**.
   "This 1/8 represents the productive zones of the ocean along the equator and the western margins of continents. Currents cause upwelling which brings nutrients to the surface. These nutrients support large numbers of marine plants and animals."

3. PEEL THE SKIN FROM THIS **1/8**.
   "This peel represents the <u>photic zone</u>, the top 100 meters (330 feet) of the ocean which light can penetrate, supporting photosynthesis. Since the marine food chain depends on photosynthesizing plants, especially phytoplankton and algae, almost all ocean life is concentrated in this narrow photic zone. 100 meters down, the amount of light is only 1% of what it is at the surface."[10]

4. CUT A VERY SMALL WEDGE FROM THE APPLE SKIN. HOLD IT OUT.
   "Fresh water is another precious and finite resource that is essential to all life on this planet, including human life. It is supplied by rainfall, groundwater, rivers, lakes and streams. Although 3/4 of the Earth is covered by water, only 3/10 of 1% is available fresh water in river, lakes and shallow groundwater. It is what we drink, cook with, bathe in, and water crops with when rain doesn't provide enough moisture.

DISCUSSION QUESTIONS:

Preface: Worldwide, 70% of water pumped from underground sources or diverted from rivers is used for irrigation, 20% is used by industry, and residential use accounts for 10%.[11] Although municipal use of water is a small percentage, it has grown very rapidly in the last 100 years. Since 1900, municipal use of water has increased 19 times and industrial use has grown 26 times, but agricultural use has increased by only five times.[12] In the United States, over 40% of the groundwater (which serves as drinking water for over half the population) is contaminated by industrial, agricultural, and even household pollution, waste disposal into the ground, and chemical wastes from mining and petroleum production. After contamination, it is extremely difficult and costly to purify the groundwater. For example, one quart of used motor oil, poured into the sewer, can contaminate up to two million gallons of drinking water.

1. WHAT JEOPARDIZES THE OCEANS' HEALTH AND CAPACITY TO PRODUCE FOOD FOR US?
Water Pollution: More than half of the world's population lives within 60 miles of a coastline; this places a serious burden on marine ecology: countless acres of coastal habitat are lost because of the daily discharge of billions of gallons of <u>sewage</u> into the ocean; shellfish beds are contaminated by <u>toxic substances</u> released by industry into rivers and streams; marine life is devastated by <u>oil spills</u>; the dumping of <u>drill muds</u> into the ocean wipes out entire populations of sea creatures.[13] **Over-fishing:** When we take too many fish from the oceans, there are too few left to reproduce and restore their population for the next year. Between 1950 and 1995, the world's human population more than <u>doubled</u> and, in turn, the *monitored* annual world fish catch

almost quadrupled. FAO estimates that 11 of the world's 15 major fishing grounds and 70% of major fish species are fully or partially overexploited.[14]

2. *HOW CAN WE PRESERVE THE OCEANS' HEALTH AND FOOD-PRODUCING CAPABILITY?*

By voluntarily restricting our seafood consumption, so the fish stocks will have a chance to regenerate. **By reducing pollution in all its forms:** You can work against the dumping of drill muds, toxic substances, hazardous waste and other garbage into the to the ocean by writing to owners of corporations that engage in such activities, expressing your alarm and your intentions not to buy their products until they stop polluting the oceans. Also, write to your elected officials, encouraging them to sponsor legislation to restrict or prohibit these practices, and expressing your appreciation when they do. **By stabilizing population growth:** Again, more people will consume more resources and produce more garbage and other forms of pollution.

3. *WHAT OTHER SOURCES OF CLEAN FRESHWATER ARE AVAILABLE TO US?*

Desalination is an extremely expensive process in which *tremendous* amounts of energy are used to convert saltwater to steam, which is then condensed back into liquid, leaving behind all salts. It's more realistic to focus on ways to protect and preserve the freshwater sources that we currently have than to count on desalination to significantly increase the supply in the future.

4. *HOW CAN WE PROTECT OUR FRESHWATER?*

By reducing water consumption: Encourage the cultivation and use of more water-efficient crops and more grain-efficient sources of protein, such as poultry. It takes 23 times more water to produce one ton of beef than one ton of grain.[15] Don't let water run when it's not being used; fix leaky faucets immediately; take showers (which use less water than baths), and install water-efficient shower heads; water your lawn only at night, when the sun will not cause immediate evaporation. Boston reduced its total water consumption by 24 percent by simply repairing leaky pipes, installing water-saving fixtures, and educating the public about water saving measures.[16] **By reducing contamination:** Choose environmentally benign products for home use wherever possible: non-toxic cleaning supplies, undyed toilet paper and paper towels, liquid laundry soaps without phosphates, and non-chlorine bleach. Take used motor oil to a recycling center rather than dumping it down the drain or throwing it in the trash. Use rechargeable batteries, or take used ones to a disposal site. Buy foods grown without the use of toxic pesticides. **By stabilizing population growth:** An increasing population consumes ever more water and creates ever more pollution. In contrast, a stable population can better assess current and future water needs and can plan accordingly.

This activity is based on one that originally appeared in KUITATK, a Native American Science Education Association Issue Publication. The water section based on "Apple Ocean," from: Project O.C.E.A.N. Habitat Curriculum Guide (Draft) by the Oceanic Society/San Francisco Bay Chapter, Building E, Fort Mason, San Francisco, CA 94123.

Sources: [1,2]Louisiana State University Agronomy www.agronomy.lsu.edu/courses/agro2051/chap17.htm (viewed on 10/25/2000). [3,4] David Pimental, et. al "Will Limits of the Earth's Resources Control Human Numbers?" *Environment, Development, and Sustainability*, 1999, p. 22-23. [5]Lester Brown, et. al, *Beyond Malthus* (New York: W.W. Norton & Company, 1999), p. 36. [6]1997 National Resources Inventory website www.nhq.nrcs.usda.gov/NRI/1997/ (viewed 10/25/2000) [7]Hunger Facts, www.thehungersite.org (viewed 10/25/2000). [8]L. Brown, et.al. *Beyond Malthus*, p.103. [9]Lester Brown, et.al *State of the World 2000* (New York: W.W. Norton & Company, 2000), p.188. [10]"Apple Ocean." Project O.C.E.A.N., 1988. [11]L. Brown, et. al *Beyond Malthus*, p. 38. [12]Lester Brown, et. al, *State of the World 1999* (W.W. Norton & Company, 1999), p. 137. [13]"Assaulting the Seas." Zero Population Growth, 1991. [14]L. Brown, et. al. *State of the World 2000*, p. 188. [15]"ZPG Earth Day 2000 Pop Quiz." Zero Population Growth, 2000. [16]L. Brown, et. al. *State of the World 1999*, p. 138.

ACTIVITY 11

Everything Is Connected

Concepts:
In nature, everything is connected to everything else. Human population growth, for example, is a factor that can have far-reaching effects on the environment and society.

Objectives:
Students will be able to:
- ▶ Identify possible environmental, social, political and economic effects of a growing world population.
- ▶ Create a concept map within a cooperative learning group or as a class to illustrate these cause and effect relationships.

Subjects:
Science, Social Studies

Skills:
Drawing connections, explaining cause and effect relationships, working in a cooperative group, concept mapping

Method:
Students identify ways that many factors in human society and the natural environment are interdependent by creating a concept map or "future wheel" as a class or in cooperative learning groups.

Introduction:

"Everything is connected to everything else" is often called the First Law of Ecology. This activity encourages students to consider the connections between aspects of our natural environment and human society.

Materials:

Chalkboard and chalk
or
Large pieces of butcher paper/flip chart paper
Markers
Tape

Procedures:

1. Write the words "More People" in the middle of the chalkboard. Tell students that you want them to think of what might be the environmental, economic or social impacts of there being more people. You may want to provide an example, such as… "more people"… might mean "more cars on the road" or "more houses." Next to "More People," draw an arrow and add one of these concepts. Be sure to tell students that there are no right or wrong answers, but you may ask them to explain their proposed connections. Also, let them know that the cause and effect relationship can be positive, negative or neutral.

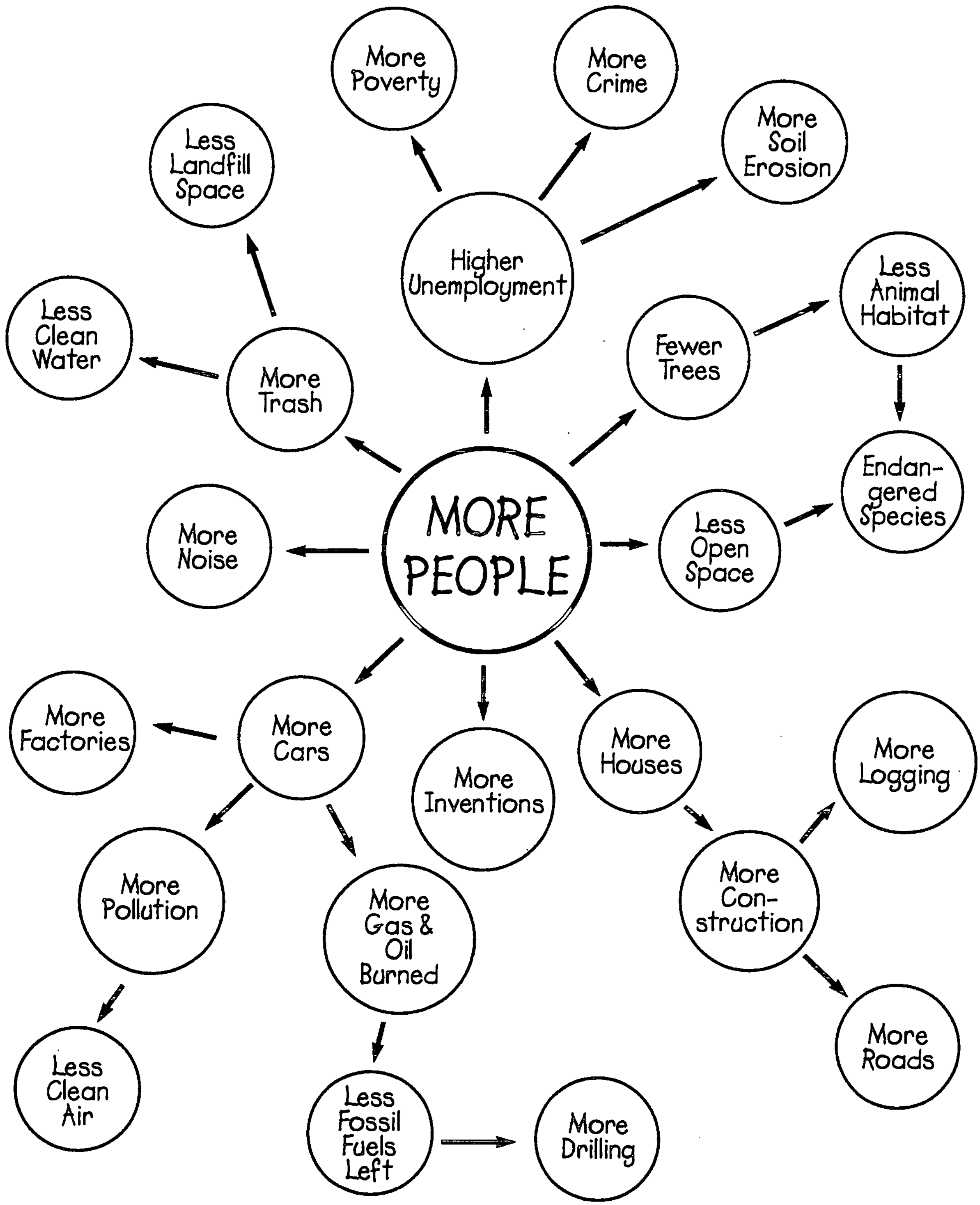
2. Invite students to come up to the board, a few at a time, to add to this word web. They may add on to the central concept, "More People," or add on to what someone else may have contributed. For each concept that a student adds, he/she should draw arrows to any of the other concepts that form a cause and effect relationship. The object is for the class to create a large and interconnected web.

3. After all of the students have had a chance to contribute to the web and have taken their seats, walk them through the web, starting from the middle. You may wish to ask individual students to explain their additions to the web and to see if other members of the class agree or disagree.

Alternative Procedures:

Instead of having students create one large future wheel on the chalkboard, divide students into groups of three or four and distribute butcher paper and markers to each group. As cooperative groups, they will construct their future wheels, filling the paper as completely as possible. Then have each group tape up their future wheel and allow time for students to view each group's work. You may want to have a representative from each group explain some of the cause and effect relationships on their wheel.

Future Wheel Sample



SOMETHING FOR EVERYONE

CONCEPT: Carrying capacity refers to the number of a given species that an area's resources will support without impairing that area's ability to *continue* supporting that population. Sustaining our natural resource base requires observation and the cooperative use of resources held in common. In this simulation, students desiring to draw renewable resources from a common pool devise, by trial-and-error, short-term consumption strategies that will preserve a long-term supply of the resource.

MATERIALS: Tokens (such as poker chips, or peanuts in the shell) - 10 per student
Candies or other reward
Stopwatch or watch with a second hand
CD or tape player
CD or tape of lively music (at least 8 minutes' worth)

PROCEDURE:

Count out ten chips for each student playing the game. Put one-fourth of them in a separate pile.

Seat the students in a circle.

In the center of the circle, place the pile comprising one-fourth of all the chips. (For example, if you have 4 students, you use 40 chips total and begin with 10 in the center. If you have 10 students, you use 100 chips and begin with 25, and so on.)

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

1. The chips belong to all of you, to the group.
2. Music will be played, and while it is playing, each of you may take chips out of the pool of chips in the center.
3. You may not put chips back into the pool once you have taken them out.
4. Each of you may trade in 10 chips for a piece of candy (or decal).
5. 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.
6. 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.
7. You may not talk to anyone during the game.

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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.

The players will most likely completely empty the pool almost instantly the first time the game is played. 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.

Continue to play the game for several rounds without giving the students time to communicate with one another in between.

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 that only has enough room and food in it 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 tine 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 outpaces the time required by air and water to clean themselves.)*

2. 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?

3. 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?

5. 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 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.

Take A Stand

ACTIVITY 29

Introduction:

Sometimes it is easier to think through an issue if you are asked to "take a stand" on it. For this activity, students are asked to take a position and articulate their views on several contemporary issues that are related to population and resource consumption trends.

Materials:

Signs reading: "Strongly Agree," "Agree," "?," "Disagree," "Strongly Disagree"
Masking tape

Procedure:

1. Tape the signs up on the wall around the classroom.

2. Explain to the students that you will be reading several statements to them, and that they should stand in front of the sign that most closely represents their reaction to the statement you've read. They will then be asked to explain their particular stand on each issue. They are free to move to a different sign if/when their opinions change after hearing their classmates' views.

3. When facilitating the activity, try to give equal time to representatives of different sides of the issue and solicit remarks from as many students as possible. Do not let your own opinions show, but you may pose questions to help students articulate their thoughts.

Note: Use your discretion in choosing statements that you feel students have enough information on to form an opinion and that fit best with your curriculum guidelines.

Statements:

1. As one of the richest countries in the world, the United States should welcome all those from other nations who wish to live here.

2. In an effort to feed a growing population, people in developed countries should drastically reduce the amount of meat they consume.

3. Arable land in the United States should not be used for housing, shopping centers or other urban uses.

4. In a real crunch, jobs are more important than environmental quality in the United States.

5. To reduce teen pregnancy in the United States, school health services should offer contraceptives to all students who want them.

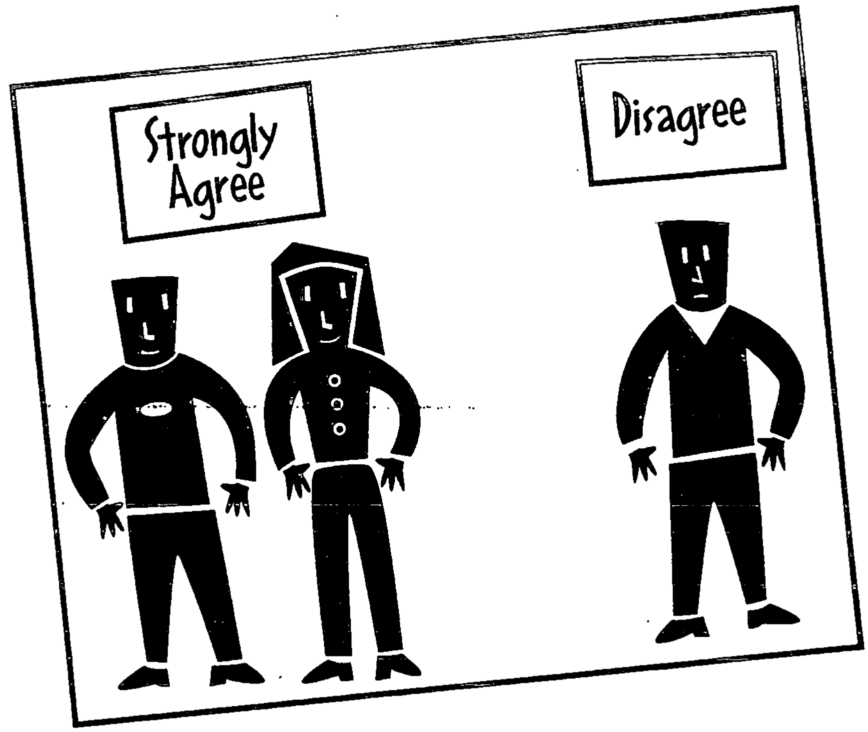
Concepts:
Dialogue and debate on ethical issues related to population and the environment are helpful in clarifying personal opinions.

Objectives:
Students will be able to:
▶ Articulate their thoughts on statements that deal with ethical issues about population and the environment.

Subjects:
Social Studies, Science, Language Arts, Family Life Education

Skills:
Values clarification, communication, discussion

Method:
Students articulate their thoughts about the ethical issues related to population and the environment, and consider the opinions of their classmates.



6. Any new construction or other project that may threaten the quality of America's drinking water should be prohibited.

7. Science and technology will certainly ensure that food production and energy supplies keep up with the demands of a growing population.

8. Americans should be required by law to separate their trash and recycle newspaper, glass and cans.

9. Endangered species' habitats should not be developed for any reason.

10. To lower our use of energy and levels of air pollution, we should spend more money on improving our public transportation systems than our highways.

Adapted with permission from *The Environment to Come: A Global Summary*, Population Reference Bureau, Washington, DC, 1983.

Teachers' PET Project
Population Education Training

THE BASICS OF POPULATION EDUCATION

Dear Teacher: The following facts and principles form the backbone of ZPG's population education materials. Each of our activities is designed to communicate one or more of the following concepts, all of which are integral to a working understanding of the relationships between people, resources and the environment. You may wish to use this collection as a whole to prepare an introduction to a unit on population, or you may wish to use one segment at a time as preface or conclusion to individual activities.

THE HISTORY OF HUMAN POPULATION GROWTH

Years Elapsed	Year		Human Population
3,000,000	10,000 B.C.	*(Agricultural Revolution)*	5-10 Million
10,000	1 A.D.		170 Million
1,800	1800	*(Industrial Revolution)*	1 Billion
130	1930		2 Billion
30	1960		3 Billion
15	1975		4 Billion
12	1987		5 Billion
12	1999		6 Billion

ENABLING GROWTH

AGRICULTURE: About 12,000 years ago, several cultures shifted from hunting and gathering to farming. Humans became the first and only species ever to control our own food supply, and steady population growth was the result. In the absence of other limiting factors, *any* population will expand to the limit of its food supply; this happens so reliably that it is considered a law of ecology.

TECHNOLOGY: The development of agriculture led by turns to settlement, division of labor, mathematics, literacy, and science. By about 1800, major advances collectively referred to as the "Industrial Revolution" were occurring. Breakthroughs in medicine, nutrition and sanitation brought down child mortality rates and led to longer life spans. The mechanization of agriculture and improvements in food preservation led to even greater increases in food production and availability. Human numbers began doubling at an unprecedented pace.

RATES OF GROWTH

PAST: 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.

PRESENT: World population reached 6 billion people in 1999. 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.[1] The United States, with over 280 million people, is growing by more than 2.4 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.[2] At 5% per year, the U.S. also has the highest teen pregnancy rate of any modern industrialized country.

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FUTURE: With a current annual growth rate of 1.4%, world population is projected to double in just 49 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.

Zero population growth is the demographic term for the state of equilibrium reached when birth and death rates are the same. Momentum is also a factor in population growth. Some countries, like the U.S., are growing even though the average woman has just two children. In such cases, a population can still take 60-70 years to stabilize, and will do so only when the percentage of elderly people is equal to the percentage at child-bearing age.

DENSITY VS. CONSUMPTION

SPACE VS. CARRYING CAPACITY: "The entire world's population could fit into the state of Texas." This statement is frequently cited by people who don't understand the difference between *land not currently **occupied by humans***, and *the **amount** and **type** of land required to **support** human life*. People are only able to live in densely populated areas if enough space elsewhere is left much less densely populated. For instance, arable land must be available to grow the food for people living in cities and suburbs, and trees and other plants must be left to produce the oxygen we all need.

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. The land within Texas could not provide enough food, water, or energy to meet the needs of 6 billion people; nor could it accommodate all the waste generated by so many. Because that area could not come close to *sustaining* all the world's people, the fact that we could all physically *fit* into that space is virtually meaningless.

WHAT IS OVERPOPULATION? Most people equate overpopulation with crowding, but, in fact, density is largely irrelevant to questions of overpopulation. What *is* relevant is carrying capacity. An area is overpopulated when its long-term carrying capacity is being degraded by its current human occupants.

DEGREE OF IMPACT: 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.[3] 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 nearly 25% of the world's annual energy consumption, including 25% of fossil fuels.[4,5] On average, one American consumes as much energy as 2.5 Japanese, 6.6 Mexicans, 16.5 Chinese, 33 Indians, 82.5 Vietnamese, or 121 Bangladeshis.[6]
>
> **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.[7]
>
> **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.[8,9] 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.[10,11]

GLOBAL WARMING: In 1996, the United States was responsible 23% of the world's carbon dioxide emissions, more than any other country.[12] Our per capita emissions are greater than every country except the United Arab Emirates.[13] Carbon dioxide is the primary greenhouse gas, responsible for 60 % of global warming caused by greenhouse gases.[14]

WATER POLLUTION: In the United States, 40% of all surface waters are unfit for bathing or fishing.[15] Agricultural chemicals, eroded sediment, and animal wastes have fouled over 173,000 miles of waterways.[16] In addition, groundwater reserves are being depleted in many regions, and overall are being used at a rate 25% greater than their replenishment rate.[17]

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.[18] 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.[19]

Population growth and rapid consumption of resources are equal parts in the problem of environmental degradation, so addressing only one of these problems will not be enough. For example, the United States could reduce our consumption of resources and generation of pollution by half today, but *if we did so without slowing our growth rate*, the difference would be made up in 116 years, when our population is expected to double what it is now.

THE ENVIRONMENT

THE IMPORTANCE OF BIODIVERSITY: The greater the variety of species within it, the more robust an ecosystem will be. It is the biodiversity, the variety of life on Earth, all inter-connected to each other, that makes our survival possible. Biodiversity provides crucial "ecosystem services"--clean water, breathable atmosphere, and natural climate control, upon which all species depend. The extermination of plant populations changes climates locally and has severe regional effects through disturbance of the water cycle. Food, medicine and shelter are all derived from the abundant organic resources of the Earth. In fact, more than 50% of the prescription drugs dispensed worldwide are derived from wild plant species.[21]

But as human numbers grow, we demand more space and resources from the Earth, and taking more for ourselves means leaving less for other species. Loss of wildlife habitat results in the extinction of countless numbers of plant and animal species every year. Currently, 20-75 plant and animal species are lost every day as a result of deforestation. It is estimated that by 2015 some 6-14% of all species will have gone extinct.[22]

EVERYTHING IS CONNECTED: Failing to anticipate *all* the results of our actions may have negative effects no one wants. For example:

> Scientists in the Netherlands recently found that some bird eggs were not hatching because the eggshells were breaking in the nests. They traced this problem back to the burning of fossil fuels. Birds get calcium for their eggshells from the shells of the snails they eat. Snails absorb calcium for their shells from the soil, but in this area, the soils had become acidic from acid rain. The rain was acidic because of air pollutants caused by the burning of fossil fuels (such as gasoline and coal). The acidic moisture in the soil dissolved its calcium, thus depriving the snails of their calcium, which in turn deprived the birds of calcium, weakening their eggshells.[23]

No one burns fossil fuels with the intent of causing acid rain *or* making it so difficult for birds to reproduce. Nevertheless, we are equally as responsible for the unintended consequences of our actions as for the intended ones.

RECOMMENDED RESOURCES

50 Simple Things Kids Can Do to Save the Earth, John Javna, EarthWorks Group, 1990, Kansas City, MO: Andrews and McMeal, 156 pp. $6.95 (p) This book is full of experiments, facts, things kids can do to keep the planet healthy and make a difference. For grades K-8. (A revised edition may be in progress during 1999.)

Our Endangered Planet: Population Growth, Suzanne Winckler and Mary M. Rodgers, 1991, Minneapolis, MN: Lerner Publications, 64 pp. $22.60 (h) With plenty of color photographs, a glossary, and a list of organizations to contact, this book is an excellent way to introduce population material to children. The comprehensive text covers the contributing causes of overpopulation, and focuses on education, working together, and cultural sensitivity as possible solutions to this complex issue. For grades 5-8.

Overpopulation, Rebecca Stefoff, 1992, Broomal, PA: Chelsea House, 111 pp. $19.95 (h) Part of the **Earth at Risk** series, **Overpopulation** gives an accurate and comprehensive understanding of the social and environmental impacts and causes of population growth. The author's inclusion of adequate preliminary information and simple vocabulary enables even middle school students to grasp the concepts. For grades 5-12.

Ishmael, Daniel Quinn, 1995 (reissue), New York: Bantam, 263 pp. $13.95 (p) This novel won the Turner Tomorrow Fellowship in 1991 for a work of fiction offering positive solutions to global problems. It is the story of a man in search of a teacher. The teacher he finds provides his student with an entirely new vision of both humanity's history, and its potential role in the universe. For grades 6-12.

Beyond the Numbers: A Reader on Population, Consumption, and the Environment, Laurie Ann Mazur editor, 1994, Washington, DC: Island Press, 450 pp. $22.00 (p) Divided into eight topic sections, this reader covers a number and variety of issues tied to population. Thoughtful essays address both the causes and effects of population growth including the social, political, and economic factors involved. For grades 9 and up.

The State of the World Population, serial, Nafis Sadik, New York: United Nations Population Fund. Each year UNFPA publishes a report dedicated to specific population issues. $9.95 (p) The 1998 edition highlights the unprecedented growth of young and old generations, while previous editions have focused on resources and the environment, urbanization, women, and population and development. For grades 9 and up.

The Population Explosion, Paul and Anne Ehrlich, 1991, New York: Touchstone, 320 pp. $9.95 (p) A follow up to the **Population Bomb**, it examines human population growth as it relates to a host of environmental and social problems. This work illustrates many of the issues through detailed facts and examples, and the final chapters are dedicated to solutions. For grades 9 and up.

Museum of Man: www.popexpo.net/english.html
National Center for Health Statistics: www.cdc.gov/nchswww
Population Action International: www.populationaction.org
Population Reference Bureau: www.prb.org
U.S. Census Bureau: www.census.gov
United Nations Population Fund: www.unfpa.org
World Bank, Development Education Program: www.worldbank.org/depweb
Zero Population Growth
- Main Page: www.zpg.org
- Population Education: www.populationeducation.org

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