Problem-Based Inquiry Series in Mathematics

Global Population and Ecological Footprints

Essential questions:

- What is unique about our current era of human civilization?
- What is an ecological footprint and when will humanity reach carrying capacity on Earth?
- What can be done to reduce per capita ecological footprints?
- What is the relationship between standard of living, population, land area, and a nation's ecological footprint?

This inquiry leads through an exploration of global human population growth, historical and projected, and the implications. The problems in this document are designed to be pursued in conjunction with a supplemental presentation and teacher coach.

Part I - Global Population Growth

Inquiry # 1: Exploring Global Population and Critical Thinking

1. Read the conversation with Zeek and Minny.

2. Reflect and Discuss

1. Were Zeek and Minny being good critical thinkers? Why or why not? <<variable—establish some tenets of critical thinking—separating emotion from reason, use of evidence, sound reasoning, backing up opinions, etc. >>

2. How can you find out for sure if there is a population problem or not? <<research and calculate>>

3. Math to the Rescue!

Zeek and Minny were arguing about whether or not the earth would get so crowded that we would "fall off the earth someday..." The real question is: How fast is population growing? How soon will it become a real problem? Math can help us see things more accurately. To explore the difference between how we see things and how they really are, make a guess about the answer to the problem below, and then solve it with the tools provided. You just might be surprised!

Population Brain Twister

How many years will it take for the world population to increase to the point where there is one person on every square foot of the Earth's surface (the point where people would be "falling off the earth")?

NECESSARY FACTS:
1) The Earth has 57,300,000 square miles of land surface. (Rounded to three significant digits. This includes the North and South Poles.)
2) 5280 feet= 1 mile
3) The current population of the Earth is approximately 8 Billion people.

In order to solve this problem we will need some more information about population and create a mathematical tool that models the growth of population.

1. World Population

Shown below is a data table from the Encyclopedia Britannica of the historical population of the world. In order to see and understand the way population has grown through the years, make a graph of the data and connect the data points.

> **<<discussion point:** the dates chosen are not even. Discuss why. This has to do with major world events. Consider how the population growth at different times is affected by our knowledge of HISTORY.>

Historical Population of the World

Year	World Population
1650	500,000,000
1750	725,000,000
1800	900,000,000
1850	1,175,000,000
1900	1,600,000,000
1914	1,810,000,000
1920	1,810,000,000
1939	2,230,000,000
1950	2,490,000,000
1982	4,531,000,000
1995	5,734,000,000
2007	6,500,000,000
2012	7,060,000,000
2024	8,000,000,000

2. Analyze the graph, and answer/discuss the following:

   a) How long does population take to double in size after 1650?
      <<About 175 years or so>>

   b) The above is called the "doubling time" of a quantity. Does the doubling time of population stay the same over history? What is happening to it?
      <<Its getting shorter>>

   c) Use the graph to make an estimate of what the doubling time is today. Another way to think of this is—how long ago was the world population one half of what it is today?
      <<About 50 years, give or take>>

3. Do the "Best Paycheck Deal" activity to develop a function for doubling growth pattern (optional)

4. Use the exponential growth function and current population doubling time to solve the Population Brain Twister.
   <solution on separate PDF link>

5. Reflection and Analysis

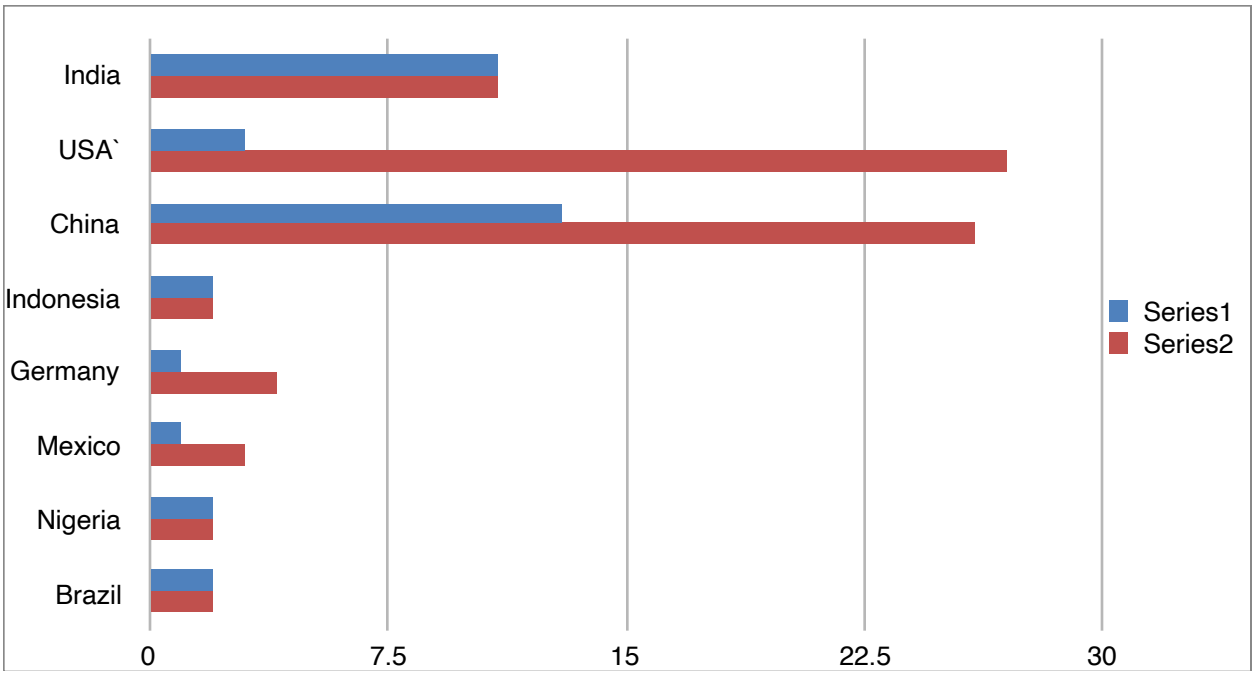
   a) Why will the effects of increasing population growth be felt long before we have 1 person on each square foot?

      <<variable: kids will come up with all kinds of ideas. We need more than 1 foot to provide our resources and absorb our waste. This leads to the concept of an ecological footprint.>>

   b) How can society adapt to exponential population growth?

      << reduce growth, and/or reduce EF>>

Year	Billions
0	0.1
500	0.2
1000	0.4
1650	0.5
1750	0.7
1800	0.9
1850	1.1
1900	1.6
1914	1.8
1920	1.8
1939	2.2
1950	2.5
1982	4.5
1995	5.7
2007	6.5
2014	7.0
2021	7.8
2035	


India
USA`
China
Indonesia
Germany
Mexico
Nigeria
Brazil
0
7.5
15
22.5
30
Series1
Series2