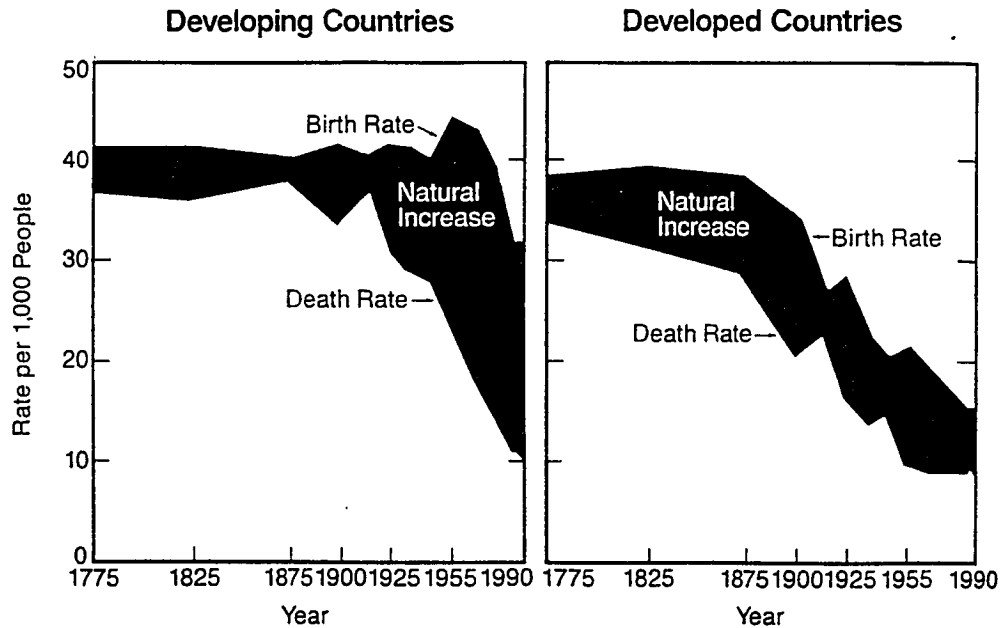# Teacher Background Information: The Explosion of Human Population

The world population grew very slowly through most of human history due to the balance between births and deaths during that time. In the 1600s things began to change as the standard of living significantly increased in Europe. Man's understanding of diseases and their causes, as well as the medical practices required to control them, improved. For various religious, social, human and political reasons, people made major efforts to eliminate disease and premature death, but only minimal effort to understand and control births. Births consistently began to outnumber deaths, and since the birth rate was greater than the death rate, the population began to increase. At first the natural increase was very small, but by 1850, the situation had changed greatly and the population soared. By the first half of this century, the annual growth rate had reached 10 per 1000 persons (1%), which meant that the world's population would double every 70 years. Unfortunately, the growth rate continued to grow until now it is approximately 17 per 1000 persons (1.7%), which means a doubling time of 41 years.
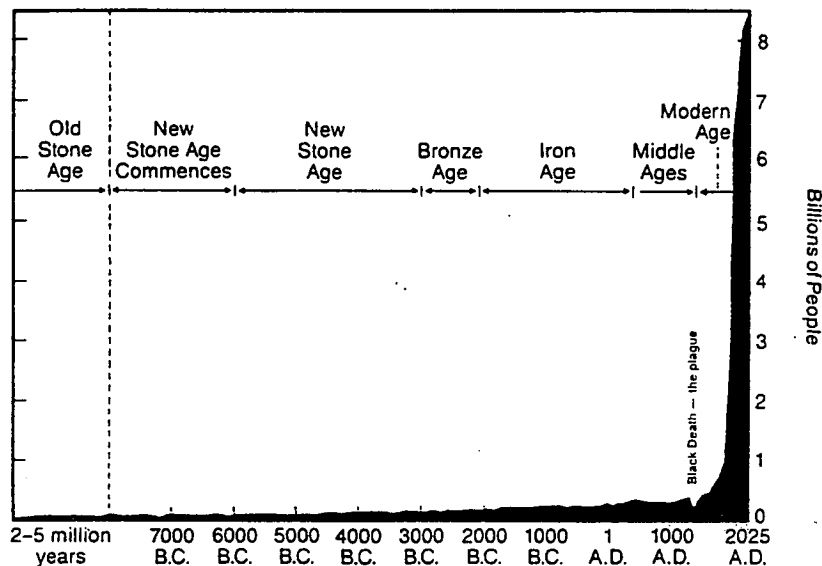
Human population growth through time, 8000 BC to 2020 AD.

Demographers study human population and in doing so find it useful to divide the Earth into "developed" countries and "developing" countries. *Developed countries* are those that have industrialized and/or have a high standard of living. These include countries in North America, Europe, the former Soviet Union, Japan and Australia. *Developing countries* are those that have low standards of living, are mostly agricultural and have little industry. In this category are India, the People's Republic of China, and the countries of East and Central Africa. In both regions, the death rate has fallen as medical practices, sanitation and education have improved with time. However, in the developed world, the birth rate has also declined, though not as fast as the death rate, resulting in moderate population growth. In the case of the developing world, the death rate has fallen much faster than the birth rate, resulting in rapidly growing populations and in growing poverty and starvation. Clearly, the addition of more and more people, means less and less land, food and energy resources for each person.

Developing Countries   **Developed Countries**

Rate per 1,000 People

50
40
30
20
10
0

1775   1825   1875 1900 1925 1955 1990   1775   1825   1875 1900 1925 1955 1990

Year   Year

Developing Countries: Birth Rate, Natural Increase, Death Rate

Developed Countries: Natural Increase, Birth Rate, Death Rate

World·birth and death rates in developing and developed countries (1775-1990)

Bacteria multiply by division; one bacterium divides and becomes 2, the two becomes 4, the 4 becomes 8, and so on. Assume that for a certain type of bacteria the time for this division is one minute. This process is an example of *exponential growth* with a doubling time of one minute. Suppose one bacterium is placed in a bottle at 11:00 AM. When the bottle is observed at noon, it is full. This is a simple example of exponential growth in a finite environment, mathematically similar to the exponentially growing human population and its increasing consumption of our finite natural resources. Keep this in mind when considering the following questions about the bacteria:

- At what time was the bottle half full of bacteria? Answer: 11:59 Am.

- If you were an average bacterium, at what time would you first realize that you were running out of space? There is no unique answer to this question, so consider: At 11:55AM when the bottle was only 3% filled and 97% empty, would you be likely to perceive the problem?

- Suppose that at 11:58 AM, some farsighted bacteria realize that they are running out of space. With a great expenditure of effort and funds, they launch a search for new bottles. The look offshore and in the Arctic, and at 11:59 AM they discover 3 new empty bottles. Great sighs of relief come from all the worried bacteria!

- The discovery quadruples the total space resource known to the bacteria. Surely this will solve the problem so that the bacteria can be self-sufficient in space.

- How long can the bacterial growth continue in the quadrupled space resource? Answer: Two more doubling times (minutes).

The following table documents the last minutes in the bottles:

The Effect of the Discovery of New Bottles	
TIME	EFFECT
11:58 AM	Bottle #1 is 25% full
11:59 AM	Bottle #1 is 50% full
12:00 Noon	Bottle #1 is full
12:01 PM	Bottle 1 and 2 are full
12:02 PM	Bottles # 1,2,3 and 4 are full

Quadrupling the resource extends the life of the resource by only two doubling times. When consumption grows exponentially, enormous increases in resources are consumed in very short times!

Like the bacteria, the human population is growing and using resources at an exponential rate. The maximum population the Earth can sustain at some reasonable average living standard for its inhabitants is called the *carrying capacity*. The human population today is over 5 billion; all indications are that it will reach 6 billion by the year 2000. Can we adequately provide for the minimal needs of 6 billion persons? Raising their standard of living to anything approaching that in developed countries may be impossible. Therefore, the population issue is one which must receive our most serious consideration in the years ahead. If we do not control our population size, natural forces may do it form us.
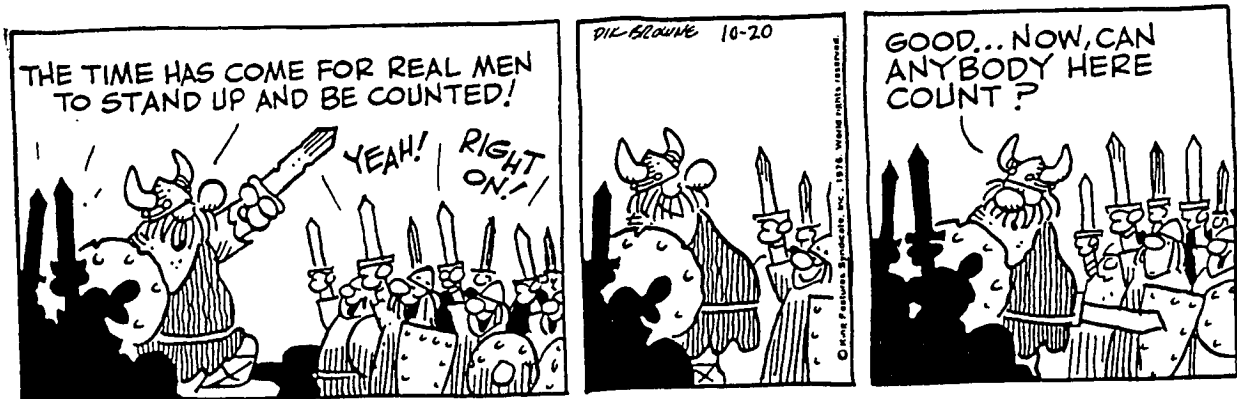
Cartoon - Hagar " Stand up and be counted! "