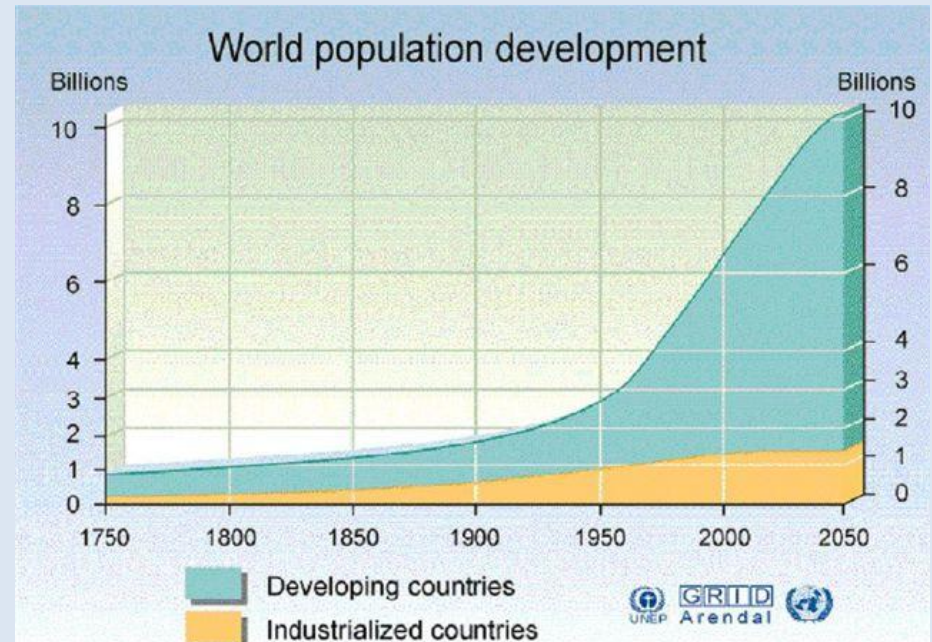


Population basics

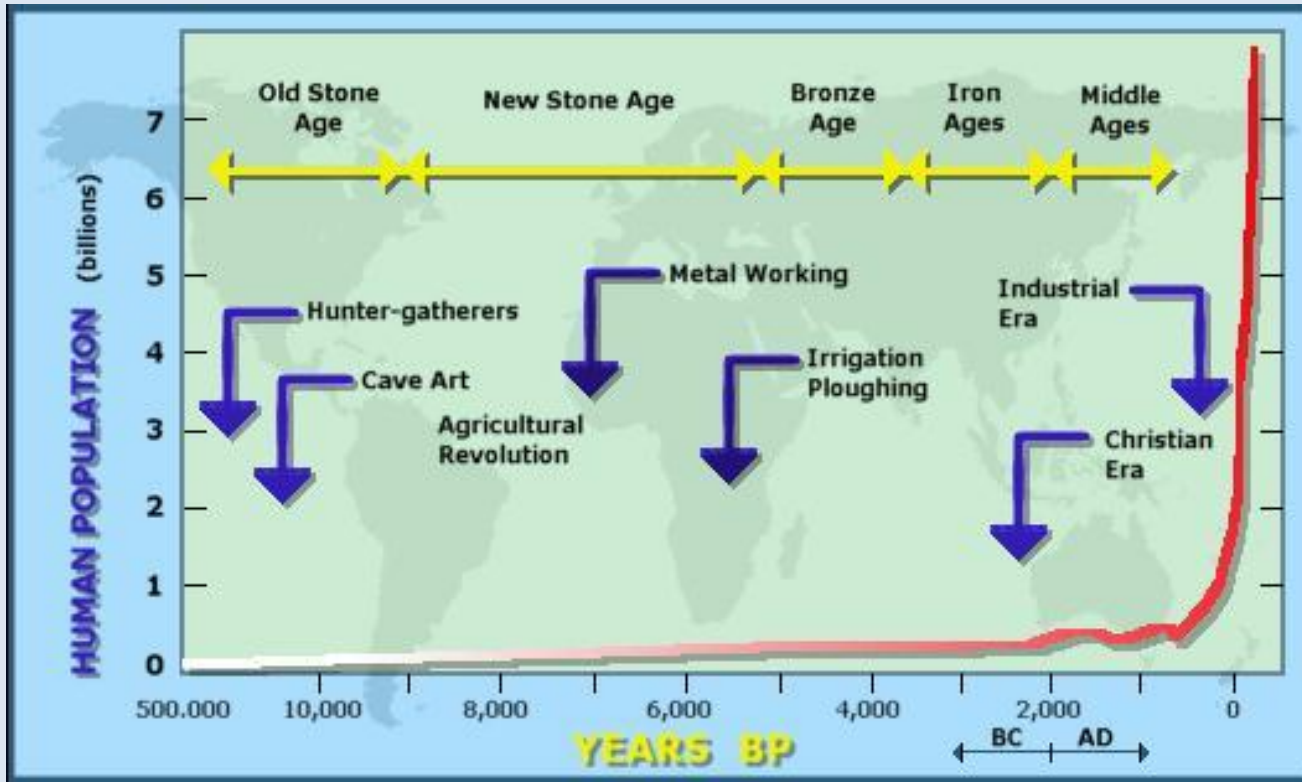
Current Human Population

- Since the early 1800s, human population has been growing exponentially.
- Current world population estimate is: 6,972,832,932 people as of 20:55 UTC (EST+5) Nov. 04, 2011 (see <http://www.census.gov/main/www/popclock.html>)



<http://www.sustainable-scale.org/areasofconcern/population/populationandscale/quickfacts.aspx>

Human Population History



1st billion
All of human history

2nd billion
130 years

3rd billion
30 years

4th billion
15 years

5th billion
12 years

6th billion
12 years

1800

1930

1960

1975

1987

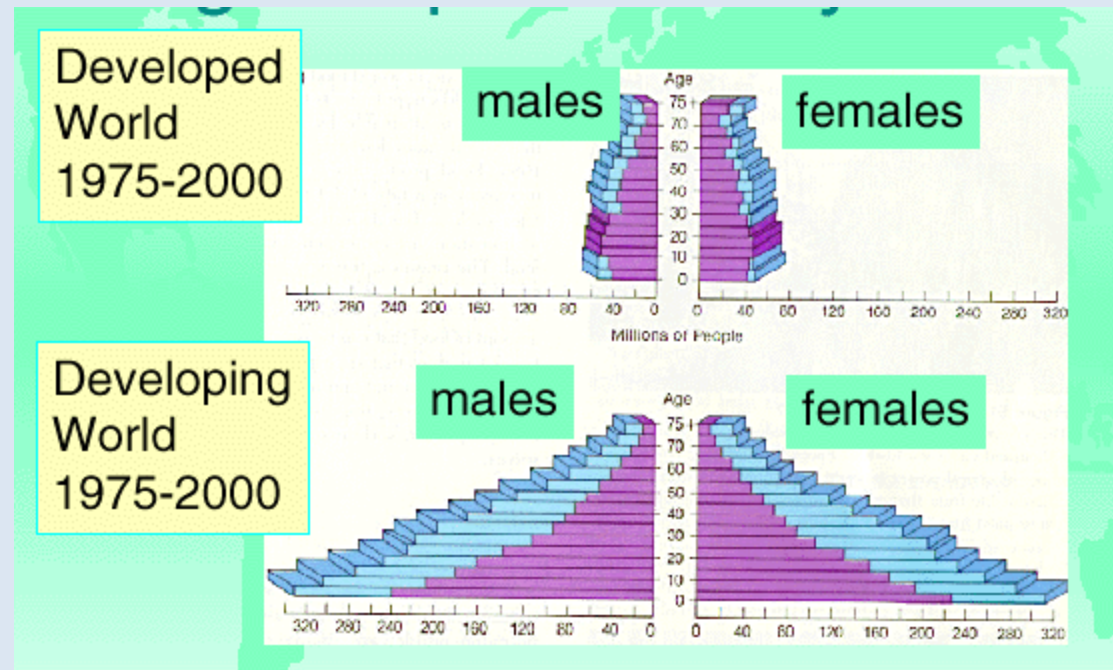
1999

Population Growth

- Population change by region
= (births + immigration) – (deaths + emigration)
- The overall rate of population growth depends on the number of births and deaths, but also on the length of generations – the age at which women have their first baby.
 - For example, if all women had three kids with a 15-year average generation time, the rate of population growth would be 2.7%. If the average spacing were 30 years, the growth would drop in half to 1.35%.

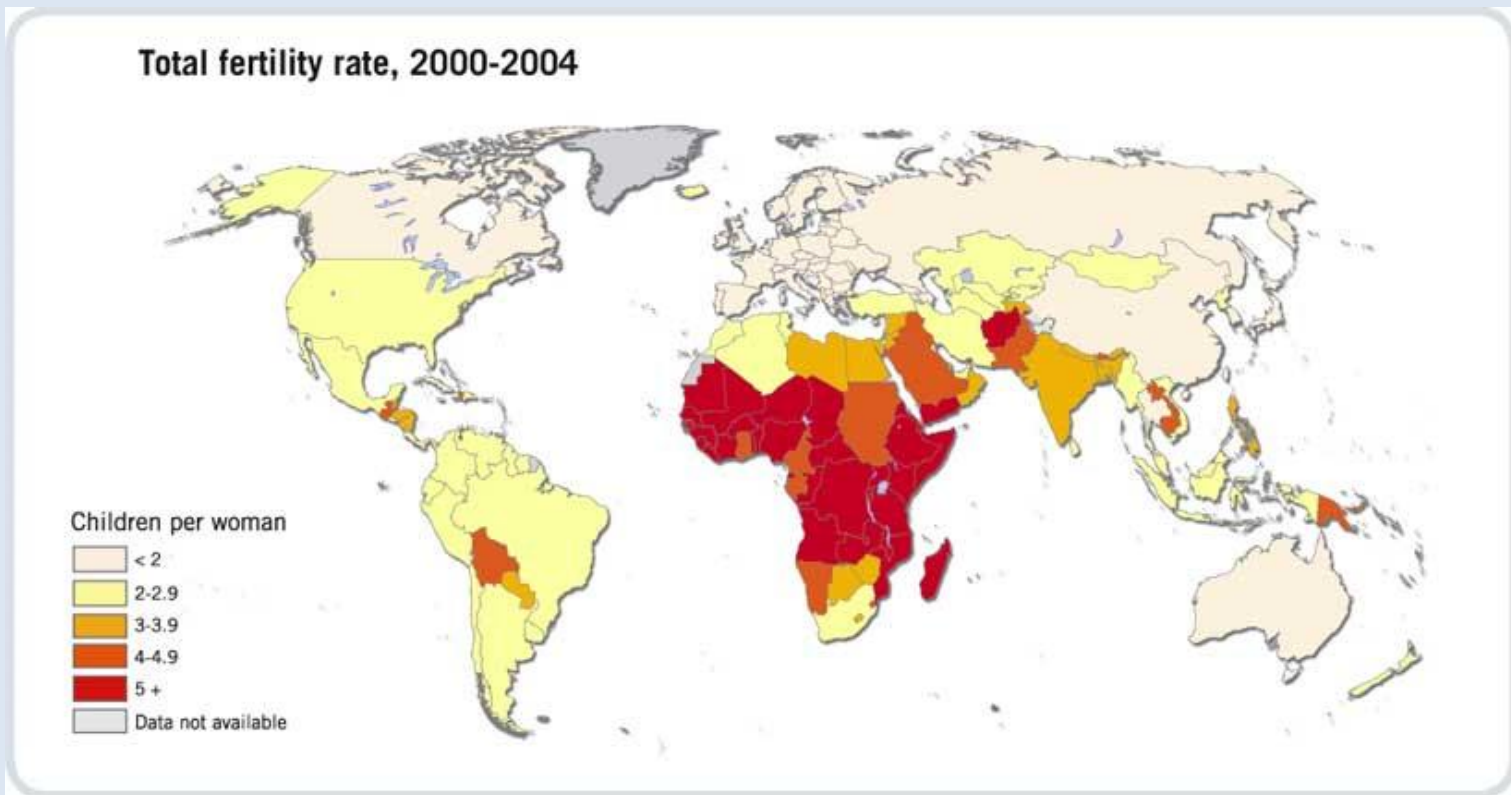
Population Growth

- Birth/Death Rates- When a substantial proportion of a country's population is young, high population growth rates in a country are to be expected, even if the average total fertility rate is modest.



Fertility Rates

- Total fertility rate (TFR) - estimate of the average number of children a woman will have during childbearing years (usually considered to be the ages of 15-49).

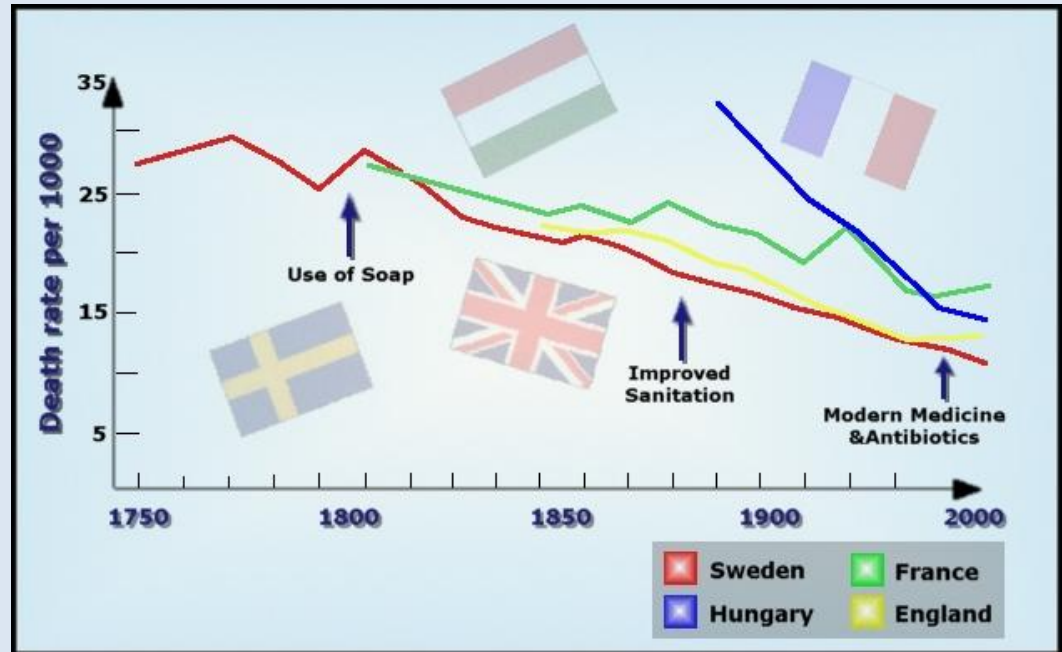


Replacement Rates

- Replacement fertility is the total fertility rate at which newborn girls would have an average of exactly one daughter over their lifetimes. That is, women have just enough female babies to replace themselves (or, equivalently, adults have just enough total babies to replace themselves).
- If there were no mortality in the female population until the end of the childbearing years then the replacement level of TFR would be very close to 2.0 (actually slightly higher because of the excess of boy over girl births in human populations).
- However, the replacement level is also affected by mortality, especially childhood mortality.
- The replacement fertility rate is roughly 2.1 births per woman for most industrialized countries, but ranges from 2.5 to 3.3 in developing countries because of higher mortality rates.

Mortality Rates

- Personal hygiene and improved methods of sanitation have played a major role and preceded the impact of modern medicine and, in particular, the development of antibiotics capable of reducing death due to infection.



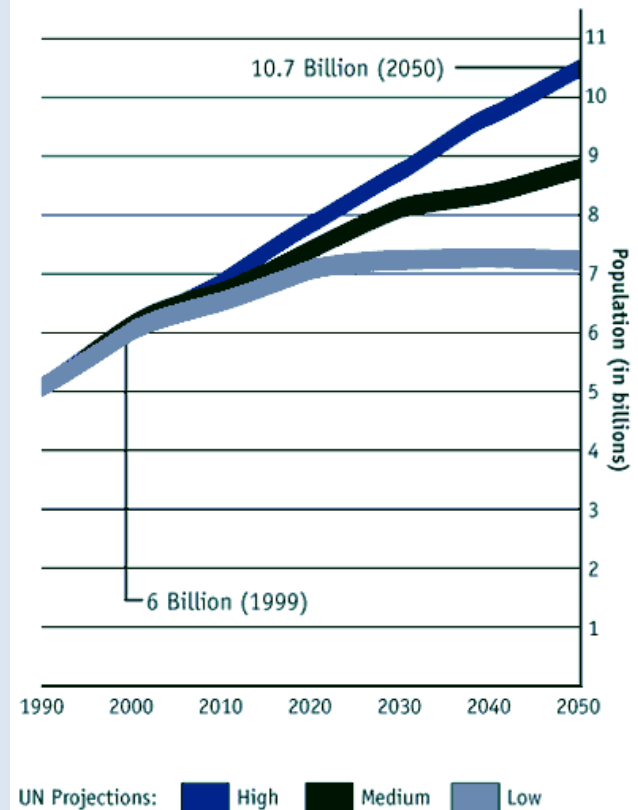
http://www.globalchange.umich.edu/globalchange2/current/lectures/human_pop/human_pop.html

Population Projections

- According to the latest United Nations projections, the most likely scenario for population in 2050 will be around 8.9 billion, and will peak out slightly above 10 billion after 2200.

World Population Growth, Actual and Projected, 1950-2050

The United Nations Population Division predicts that world population will grow from 6 billion in 1999 to between 7.3 and 10.7 billion by 2050, depending on future fertility rates, with 8.9 billion considered most likely.



Source: United Nations. 1998. *World Population Prospects: The 1998 Revision*.

Carrying capacity

- **Is there a Carrying Capacity for humans?**
- Experience with other species tells us that, ultimately, resource limitations and/or habitat degradation will force the human population curves to approach an upper limit or asymptote - the carrying capacity, often symbolized as "K" by ecologists.
- It is very natural to ask :
 - does humanity have a carrying capacity and,
 - if so, what is it - and when will we reach or overshoot this limit?

adapted from:

http://www.globalchange.umich.edu/globalchange2/current/lectures/human_pop/human_pop.html#Past

Carrying capacity

- One strand of thought discards the notion of a human carrying capacity altogether, claiming that the additional people will provide sufficient creativity and innovation to break through any possible natural barriers to human population growth.
- Most of the serious estimates of K for humans, however, lie in the range 10 -20 billion people.
- Potential solutions:
 - Make a bigger pie: Increase human productive capacities through technology and innovation
 - Put fewer forks on the table: Reduce numbers and expectations of people through such means as family planning

adapted from:

http://www.globalchange.umich.edu/globalchange2/current/lectures/human_pop/human_pop.html#Past

Carrying capacity

- Is there a Carrying Capacity for *Homo sapiens*?
- As we have seen, the human population growth curve is currently following an exponential curve or a "J-shape" (fig. 1). Common sense tells us that such growth cannot continue - otherwise within a few hundred years every square foot of the Earth's surface would be taken up by a human. Furthermore, experience with