Chapter 7

The Human Population

Scientists Disagree on Earth's Carrying Capacity

Roughly every 5 days, global population increases by 1.8 million infant born and 800 people die.
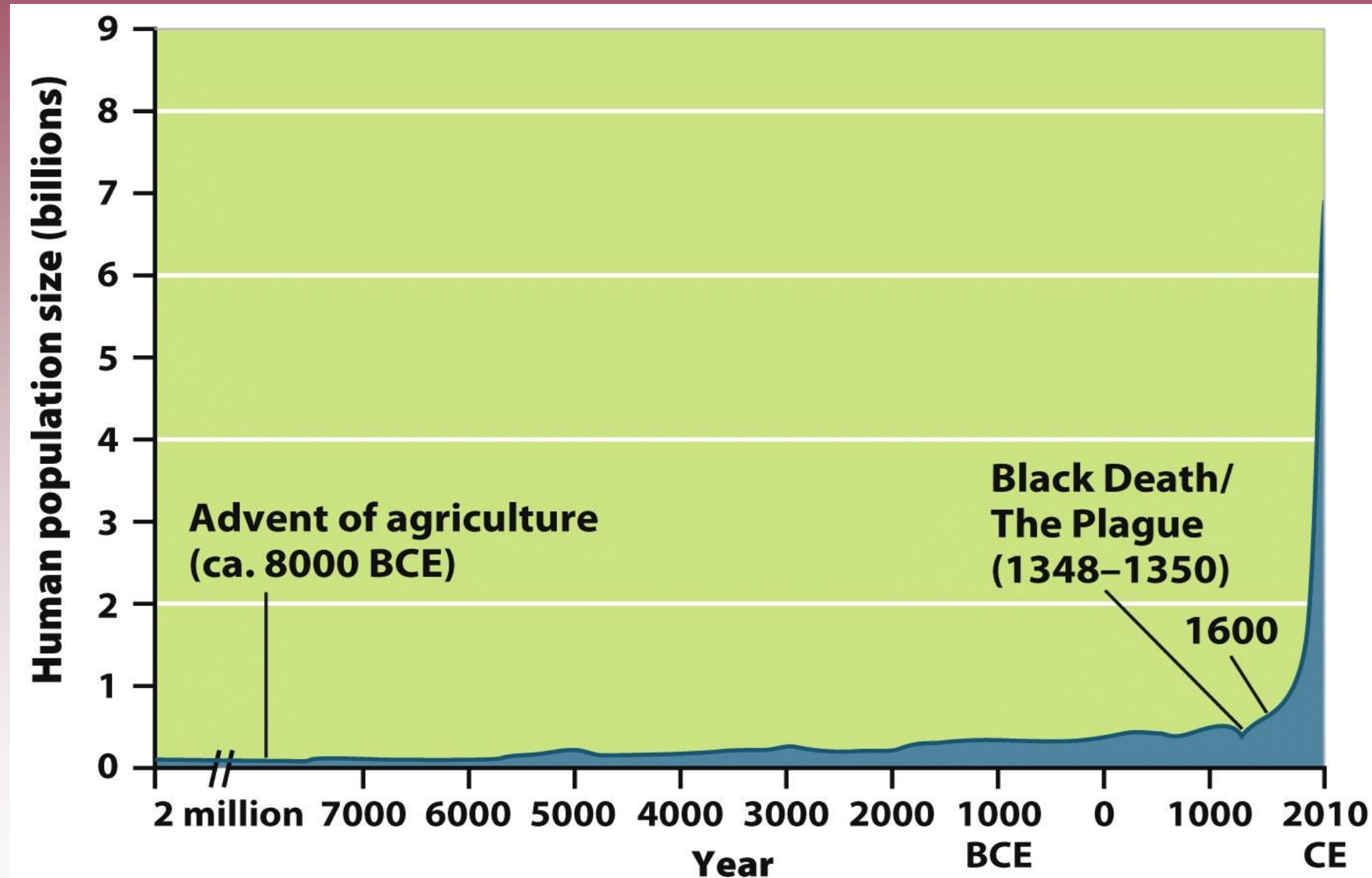

Figure 7.1
Environmental Science
© 2012 W. H. Freeman and Company

Theorists

- **T. Malthus** – theorized human population size would exceed the food supply <mark>(food is linear, growth is exponential)</mark>

  - Stop aiding the poor and let natural selection take its course (survival of the fittest)

 - "Green Revolution" – technology will save us (GMOs)

- **K. Marx** – matter of distribution of resources, give resources to all regardless of status and wealth.

Scientists Disagree on Earth's Carrying Capacity

•The following graphs show theoretical models of food supply and population size.

a. In 100-year period w/o significant improvements, human population will grow exponentially, while food supply grows linear (fixed amt. each year).

b. With agricultural technology advancements, the food supply increases, food surplus.
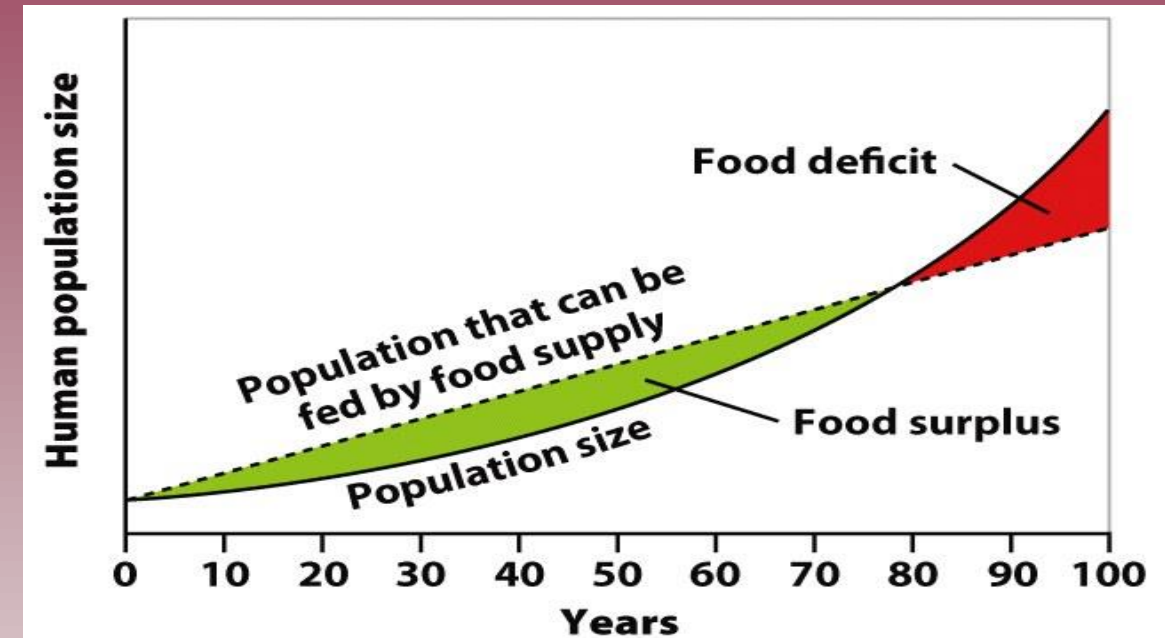
(a) No significant improvement in agricultural technology
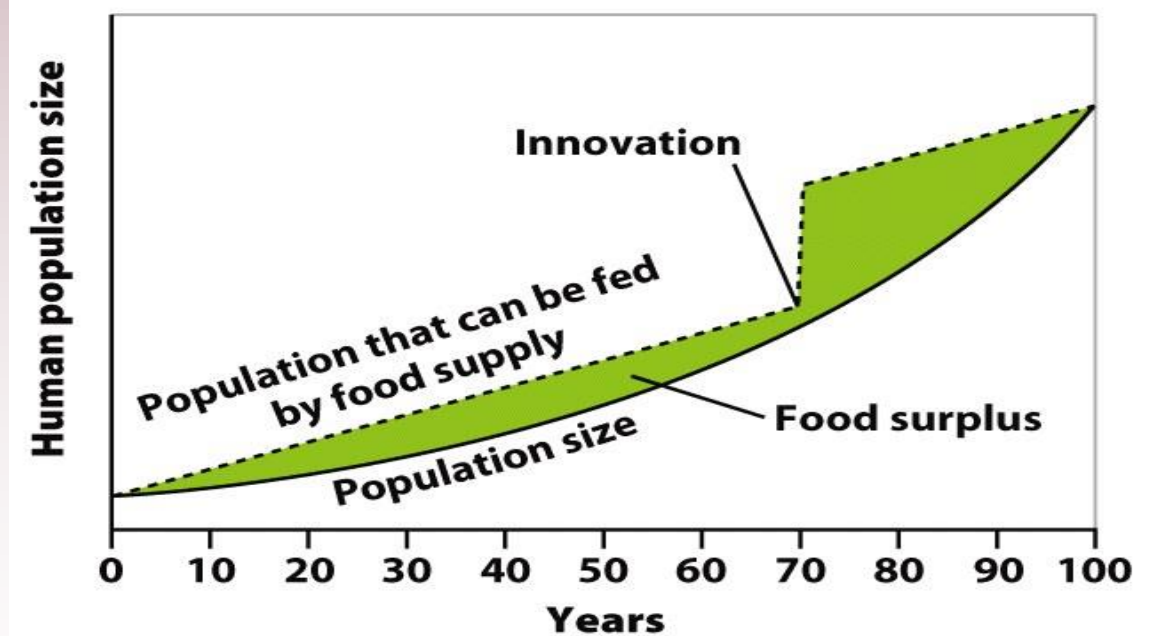
(b) Significant improvement in agricultural technology

Figure 7.2
Environmental Science
© 2012 W. H. Freeman and Company

Population Density

Population Density is number of individuals living in a given area

1. Population density = # of Individuals
                                        size of Area (ha, km^2)

Ex. Calculate the population density for 2,500 individuals living on 10,000 hectares of land?

Factors that Drive Human Population Growth

- **Demography**- the <mark>study of human populations</mark> and population trends.
  - *Changes in Population Size* – input vs. output, input is greater than output...system expands
  - *Fertility* – role of births play on population
  - *Life Expectancy* – outputs due to human life span
  - *Age Structure* – future size of the population due to age groups shifting in child bearing years
  - *Migration* –regardless of births vs. deaths, population growth, decrease, stability based on entering or leaving the country

Changes in Population Size

- **Crude birth rate (CBR)**= the number of births per 1,000 individuals per year. **(#births/1000ppl/year)**

- **Crude death rate (CDR)=** the number of deaths per 1,000 individuals per year. **(#deaths/1000ppl/year)**

- **We use 10 to represent the value as a percentage** *(because the rate is per 1000ppl, we have to divide by 10 to get it out of 100...%)*
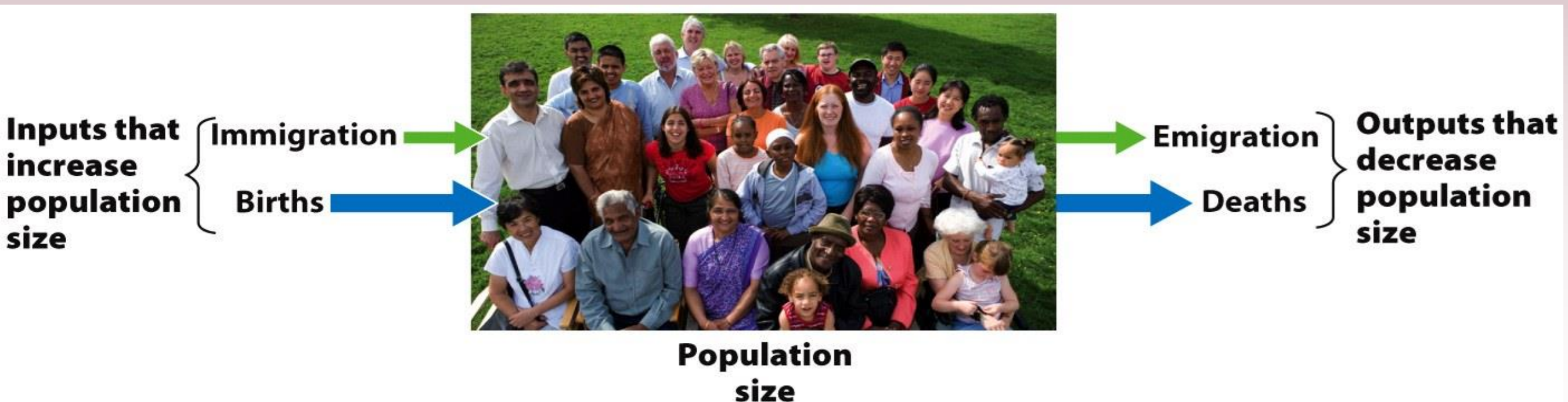
1. **Global** population growth rate $= \dfrac{(CBR - CDR)}{10}$

Ex. What was the global growth rate in 2014, when there were 20 births and 8 deaths per 1,000ppl worldwide?

Changes in Population Size

- <u>Immigration</u> **(In)**- the movement of people <mark>into</mark> a country

- <u>Emigration</u> **(Exit)**- the movement of people <mark>out</mark> of a country.

- <u>**Net migration rate-**</u> the difference between immigration and emigration in a give year per 1,000 people in the country.

<mark>Net Migration Rate (#people/year)</mark>= <u>number of immigrants</u>
#people in the population

Inputs that increase population size { Immigration   Births → }

Emigration   Deaths { Outputs that decrease population size

Population size

Changes in Population Size

- Immigration...add to CBR

- Emigration...add to CDR

2. **National** population G. rate =

$$\frac{(CBR+ immigration) - (CDR + emigration)}{10}$$

- Ex. What is the growth rate of a population with 100,000ppl that has 2,000 births, 500 death, 200 emigrants, and 100 immigrants per year?

Changes in Population Size

- **Doubling time–** is the number of years **(time) its takes a population to double**

- Growth rate is usually in a %, for doubling time….ignore that percentage (use # from % but not the actual % sign)

Rule of 70 (doubling time)

- Doubling time (in years) = $\dfrac{70}{\text{growth rate}}$

Ex. What is the doubling time of a population that grows 2% per year??

Try it…..

- What was the growth rate of a nation of 1,000,000 people that has 15,000 births, 4,000 deaths, 1,000 emigrants and 3,000 immigrants per year? When will this population double?

Fertility

- **Total Fertility Rate (TFR)-** an estimate of the average number of children that each woman in a population will bear.

- In the U.S, TFR was 2.1, each woman of childbearing age would have just over 2 children.

- **Replacement level fertility-** the total fertility rate required to offset the average number of deaths in a population and for the current population size to remain stable. (2 children will replace the 2 parents)
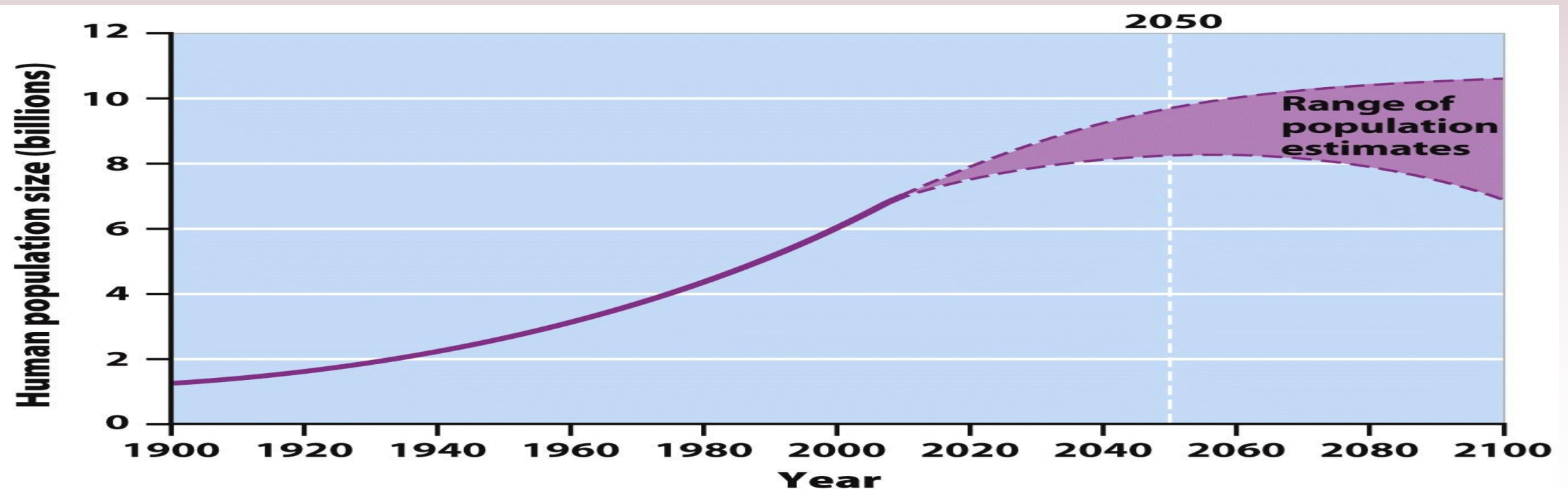

Figure 7.4
Environmental Science
© 2012 W. H. Freeman and Company

Fertility

- **Developed countries-** countries with relatively high levels of industrialization and income.

- **Developing countries-** countries with relatively low levels of industrialization and income of less that $3 per person per day.

- A country with a TFR of less than 2.1 and no net increase in immigration is most likely to experience a population decrease... Below replacement rate.

- A country with a TFR more than 2.1 and no net decrease in emigrant, is likely to experience a population growth...above replacement rate.

Life Expectancy

- **Life expectancy–** the average number of years that an infant born in a particular year in a particular country can be expected to live.
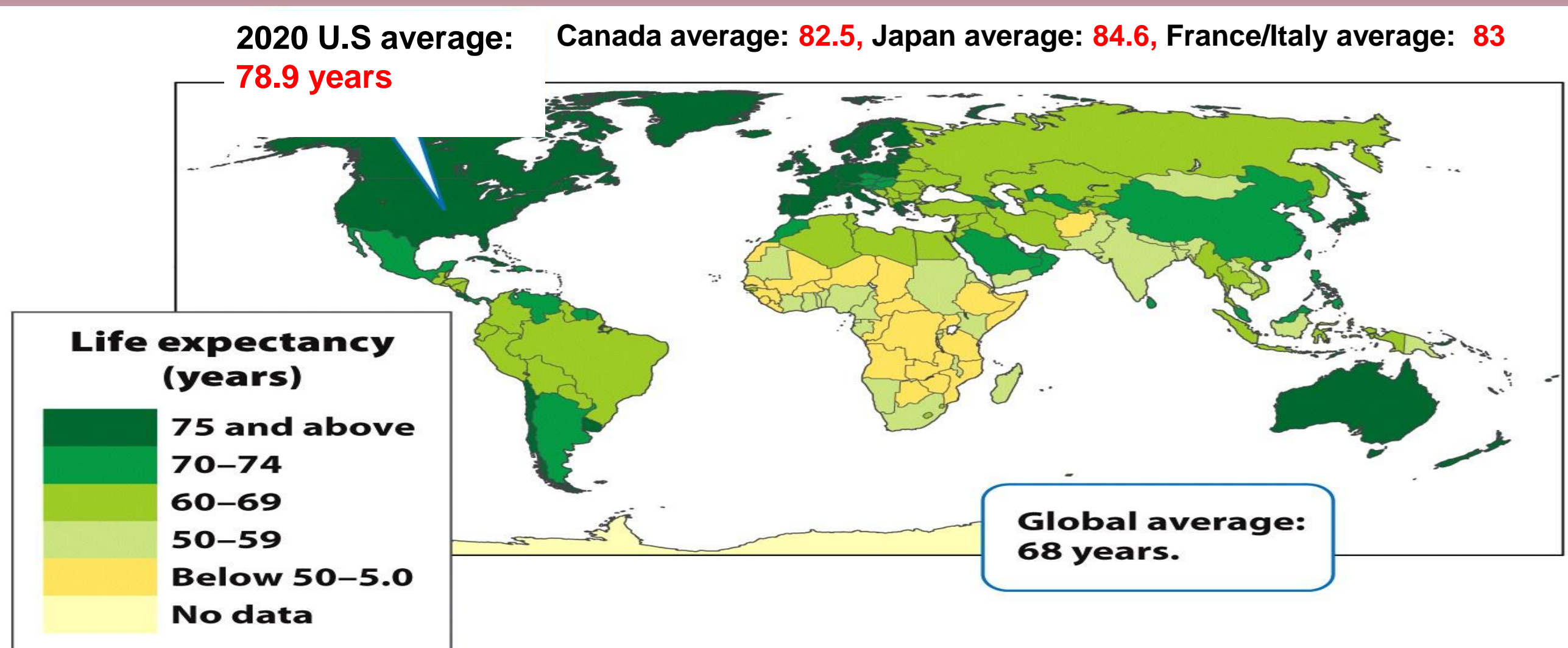
2020 U.S average: 78.9 years

Canada average: 82.5, Japan average: 84.6, France/Italy average: 83

Global average: 68 years.

Life expectancy (years)
- 75 and above
- 70–74
- 60–69
- 50–59
- Below 50–5.0
- No data

Figure 7.5
Environmental Science
© 2012 W. H. Freeman and Company

Life Expectancy

- **Infant mortality rate–** the number of deaths of children under 1 year of age per 1,000 live births.

- **Child mortality rate–** the number of deaths of children under age 5 per 1,000 live births.

U.S. infant mortality rate: 5.68 per 1,000

China's rate: 12.5, Canada 4.35, France 4.11

Infant mortality rate (deaths of children <1 year of age per 1,000 live births)

- 100 or more
- 50–99
- 25–49
- 10–24
- Less than 10
- No data

Global infant mortality rate: 29 per 1,000

Figure 7.6
Environmental Science
© 2012 W. H. Freeman and Company

Environmental Justice – due to socioeconomic status and adequate nutrition and health care.
U.S. infant mortality rate is 5.68, it is 10.8 African American, 8.2 Native American, 4.6 Caucasians, Hispanics 4.9 (all down since 2018

Age Structure

Age structure diagrams (population pyramids)– visual representations of age structure within a country for males and females.

The wide base/Pyramid shape compared to the levels above indicates large rate of population growth b/c most females have not hit child bearing years yet.
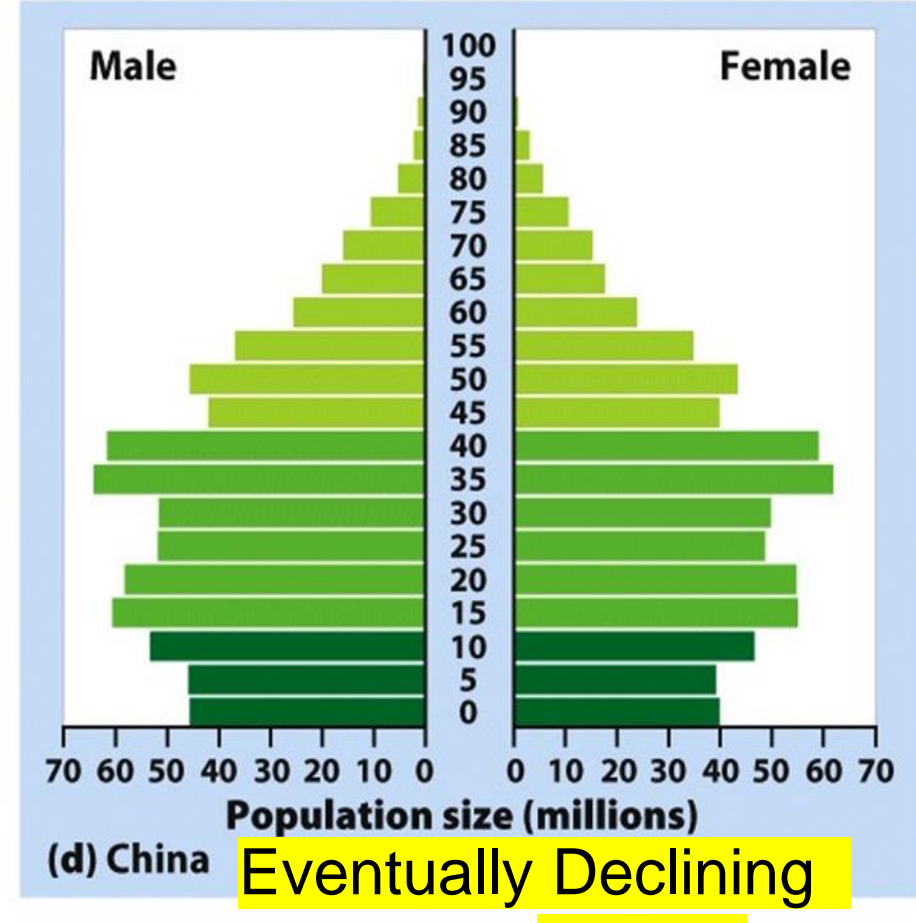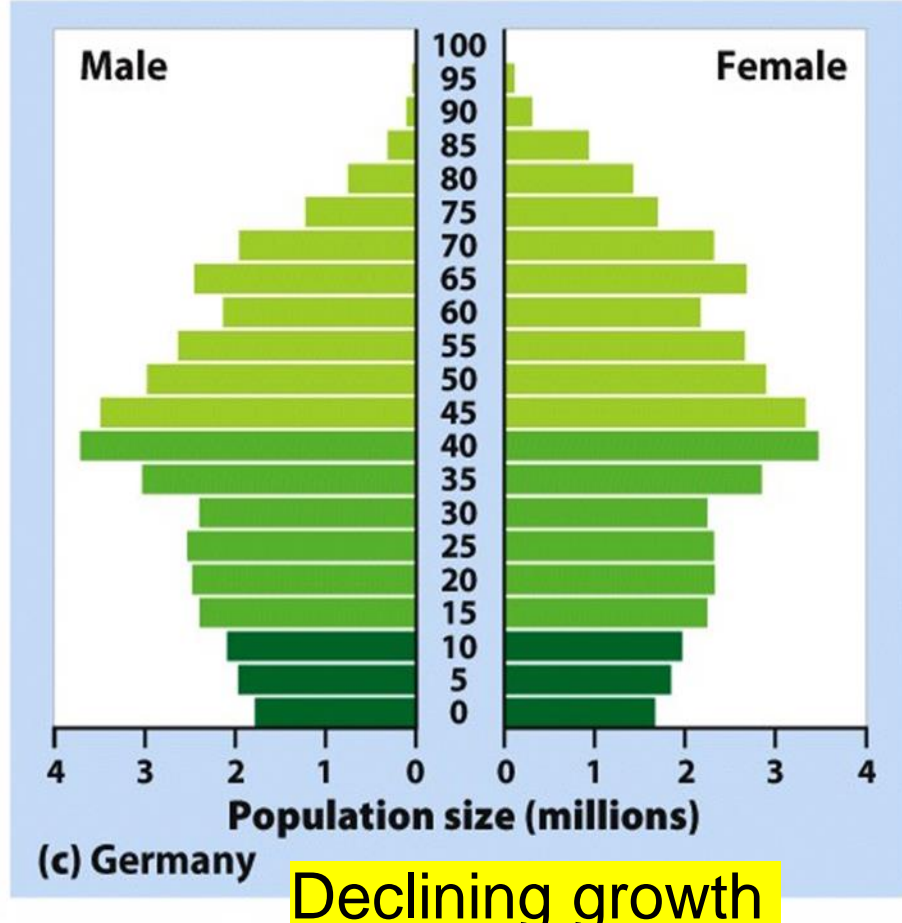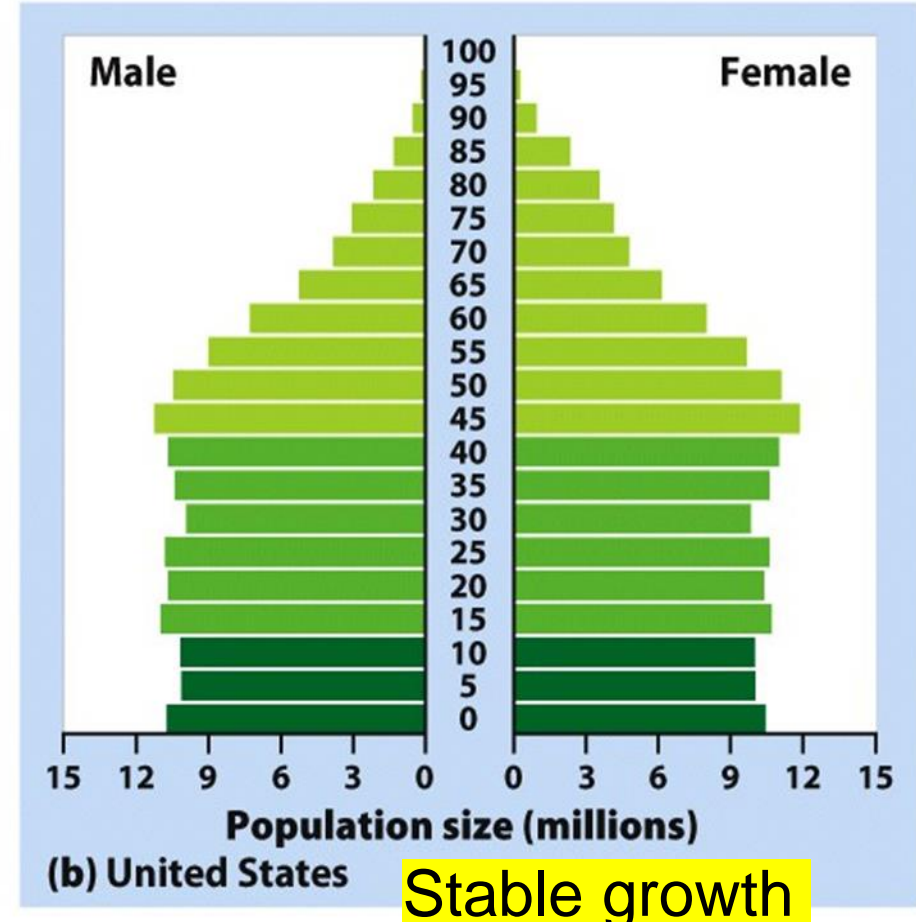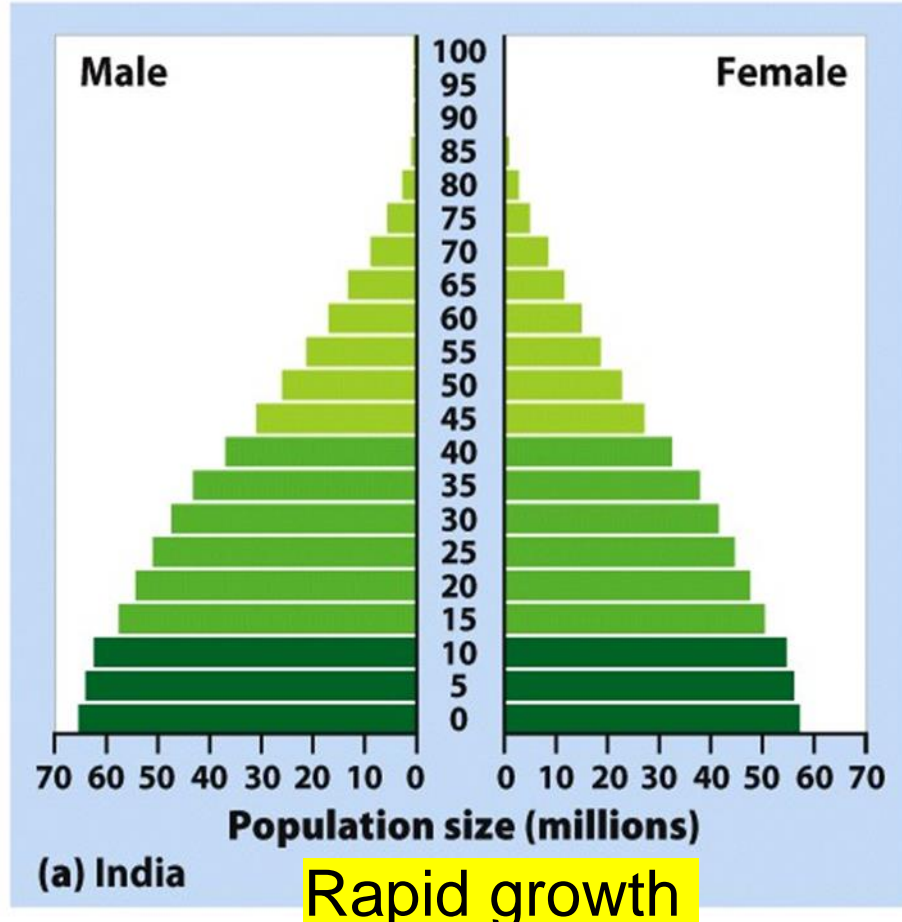

Male Female
(a) India   Rapid growth

Male Female
(b) United States   Stable growth

Male Female
(c) Germany   Declining growth

Male Female
(d) China   Eventually Declining growth

Figure 7.8
Environmental Science
© 2012 W. H. Freeman and Company

Total area of all the bars, is size of whole population

The Demographic Transition

- The **Theory of the Demographic Transition** is the theory that as a country moves from a subsistence (survival) economy to industrialization (advancements) and increased affluence (consumption), it undergoes a predictable shift in population growth.

Figure 7.9
Environmental Science
© 2012 W. H. Freeman and Company
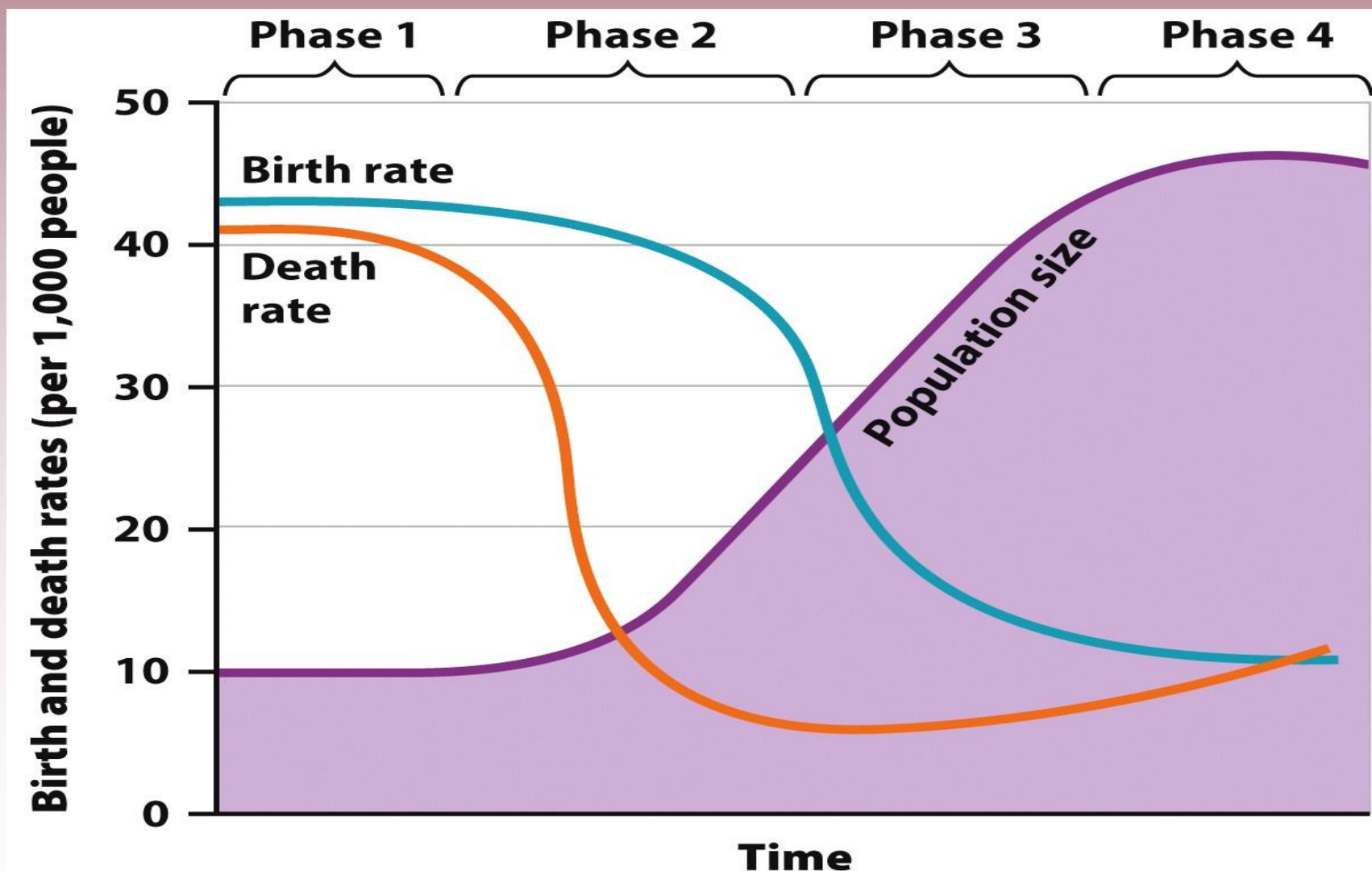
Model the way the birth, death, & growth rates for a nation change with economic development (4 phases).

The Stages of the Demographic Transition

- **Phase 1**: (*Pre-industrial period*) Slow population growth because there are high birth rates and high death rates which offset each other. (birth = death rates)

- **Phase 2**: (*begins to industrialize*) Rapid population growth because birth rates remain high but death rates decline due to better sanitation, clean drinking water, increased access to food and goods, and access to health care. (death rates drop, birth rates do not change)

- **Phase 3**: (*industrialized*) Stable population growth as the economy and educational system improves and people have fewer children. (death & birth rate level out, due to birth rates declining – less people having children)

- **Phase 4:** (*industrialized*) Declining population growth because the relatively high level of affluence and economic develop encourage women to delay having children (birth rates drop below death rates)

Family Planning

- **Family planning-** the regulation of the number or spacing of offspring through the use of birth control.

Determination of number of children a family has depends on …..

1. Education of the female (mother)
2. Age of the first born (women are delaying having children)

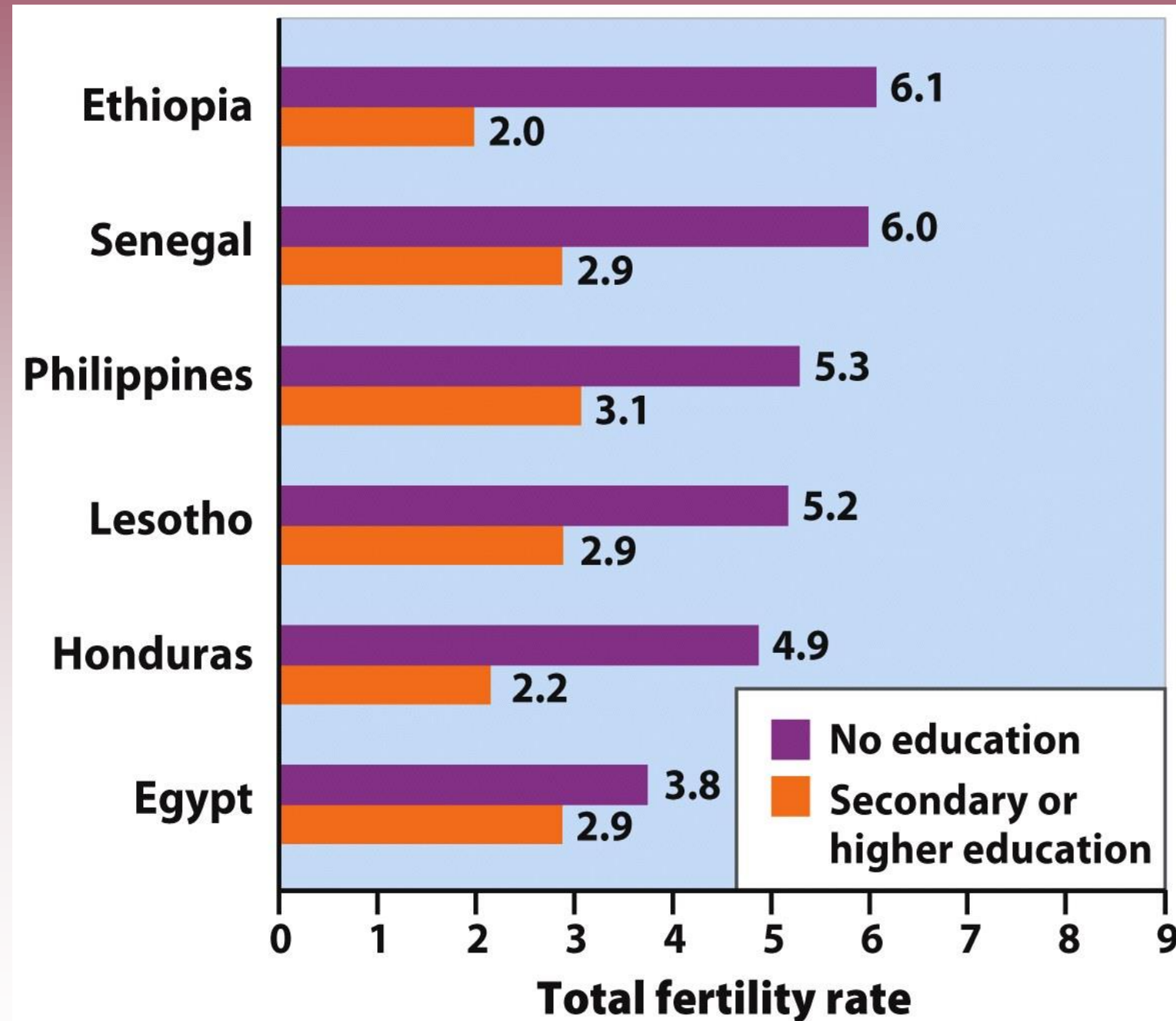3. Cultural & available resources (money, contraceptives)

Figure 7.12
Environmental Science
© 2012 W. H. Freeman and Company

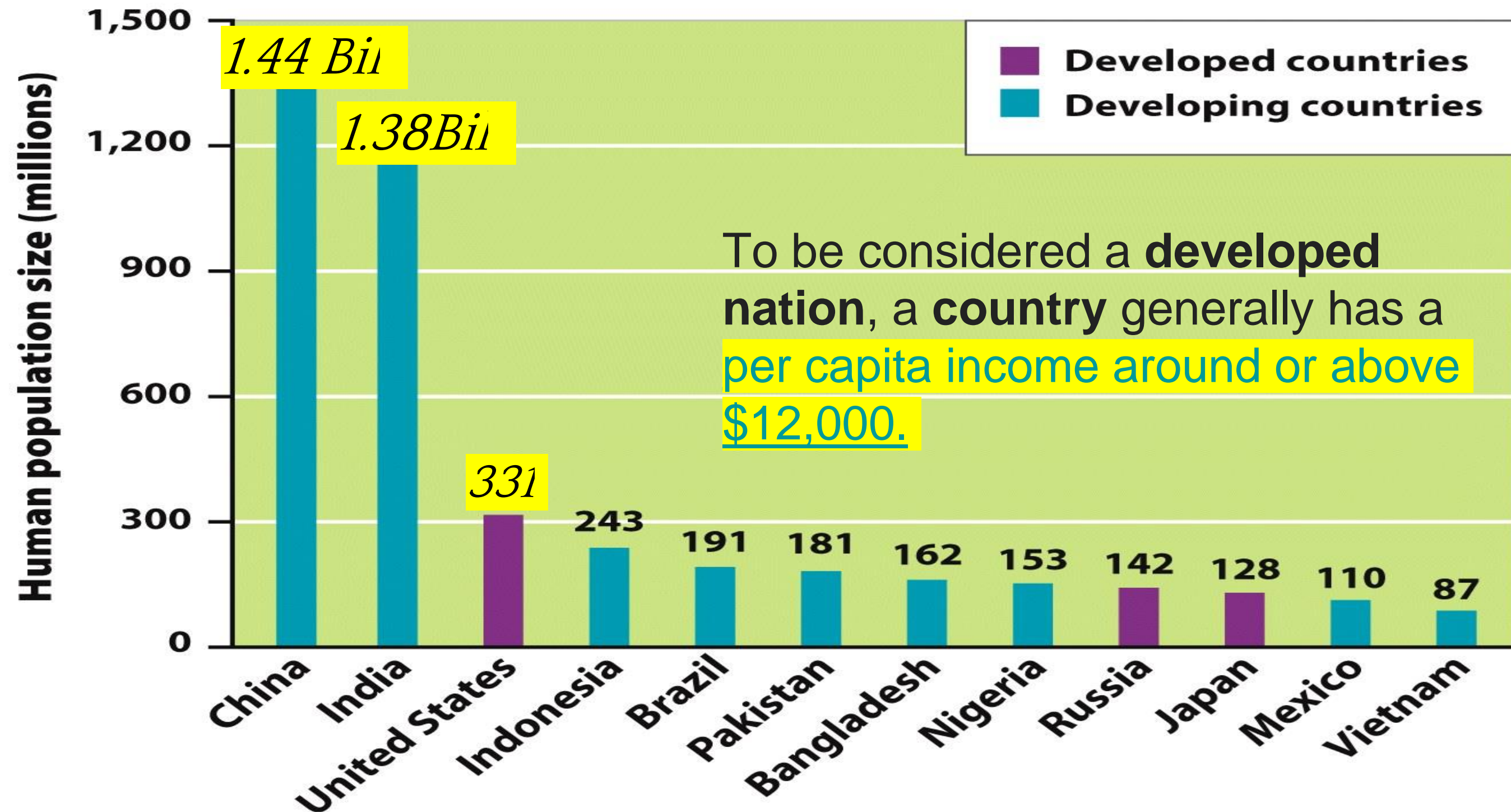# The 12 Most Populous Countries in the World (7.8 billion – 2020)

Human population size (millions)

- 1.44 Bil
- 1.38 Bil

Developed countries
Developing countries

To be considered a **developed nation**, a **country** generally has a per capita income around or above $12,000.

- 331
- 243
- 191
- 181
- 162
- 153
- 142
- 128
- 110
- 87

China India United States Indonesia Brazil Pakistan Bangladesh Nigeria Russia Japan Mexico Vietnam

Figure 7.13
Environmental Science
© 2012 W. H. Freeman and Company

Only 3 out of 12 countries are Developed Nations

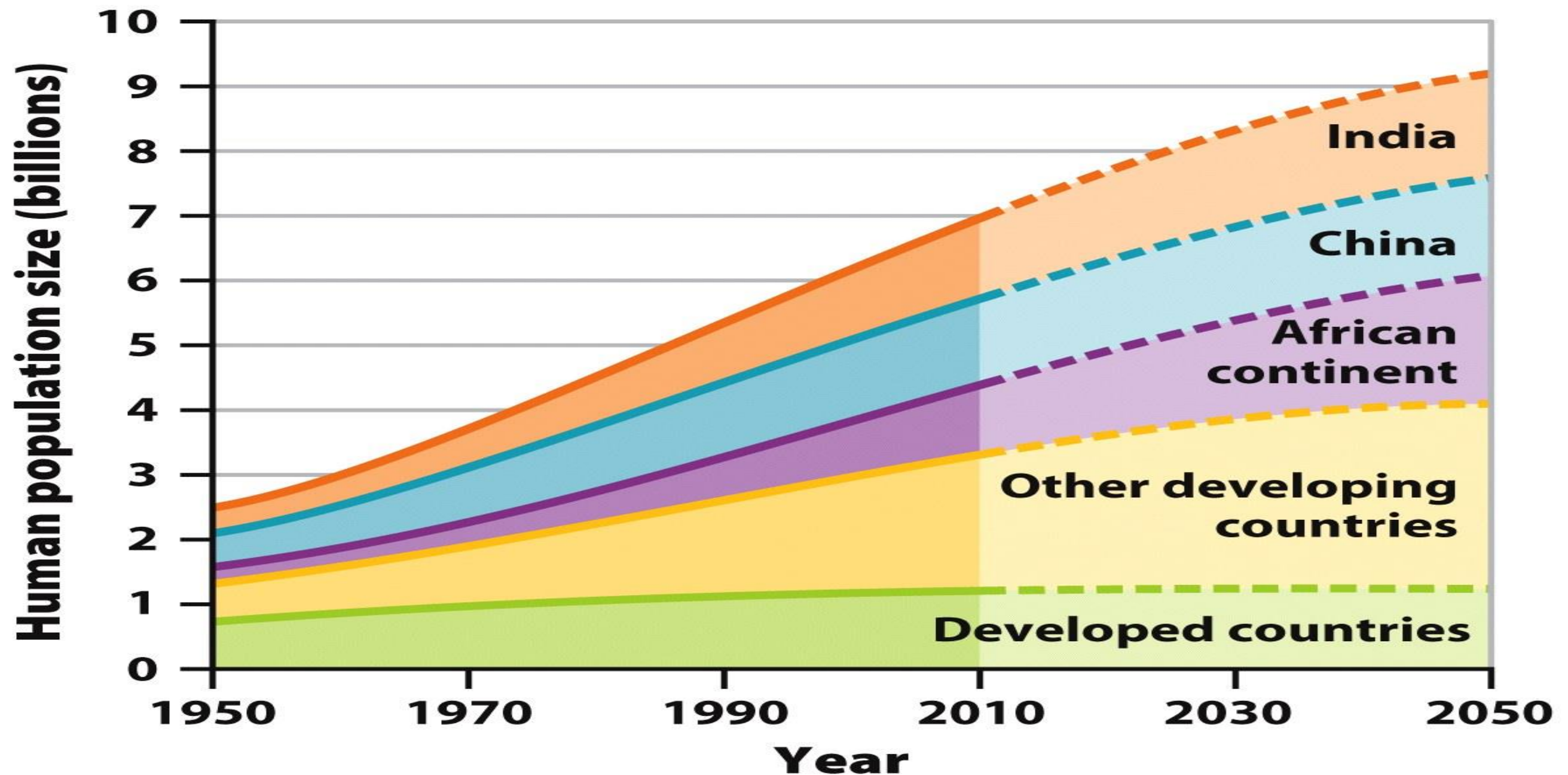# The **relationship** between economic development and population growth rate for developing nations.

Figure 7.14
Environmental Science
© 2012 W. H. Freeman and Company

Ecological Footprints

- **Affluence** –effect on our Earth by having a lot of wealth such as money, goods, or property (consumer).

A person living in the U.S (one-forth the population of China) has more than 5x the environmental impact than a person living in China and 18x someone living in Haiti.
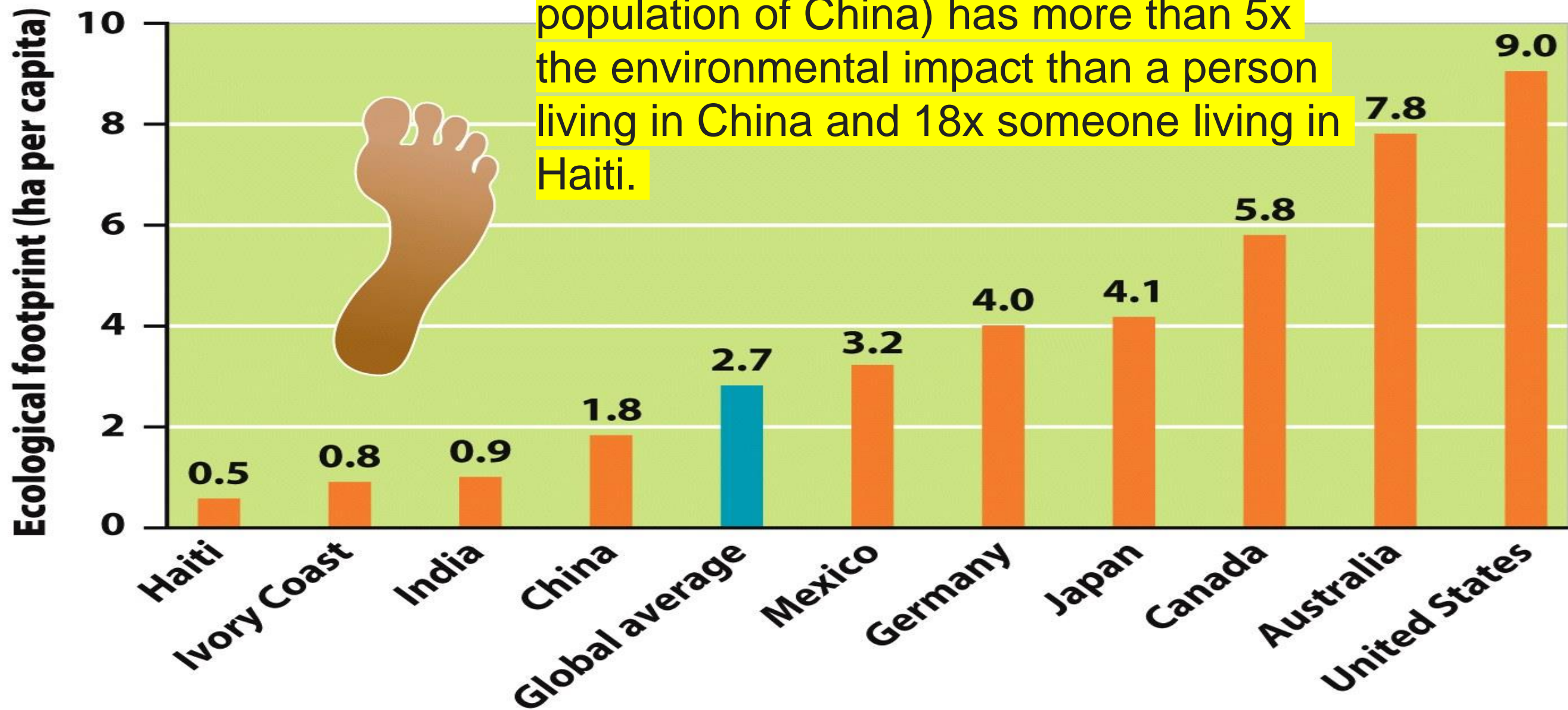
However, due to China's rapid development, it is predicted that China will exceed the U.S's footprint within 10 yrs

The IPAT Equation

- To estimate the <mark>impact of human lifestyles on Earth</mark> we can use the IPAT equation:

Impact= Population x Affluence x Technology

Impact – overall environmental effect of a human population

Population– straightforward effect on impact

Affluence – created by economic opportunity, consumers.

Technology – can either degrade the environment or create solutions to minimize our impact on the environment. (destructive vs. beneficial technology)
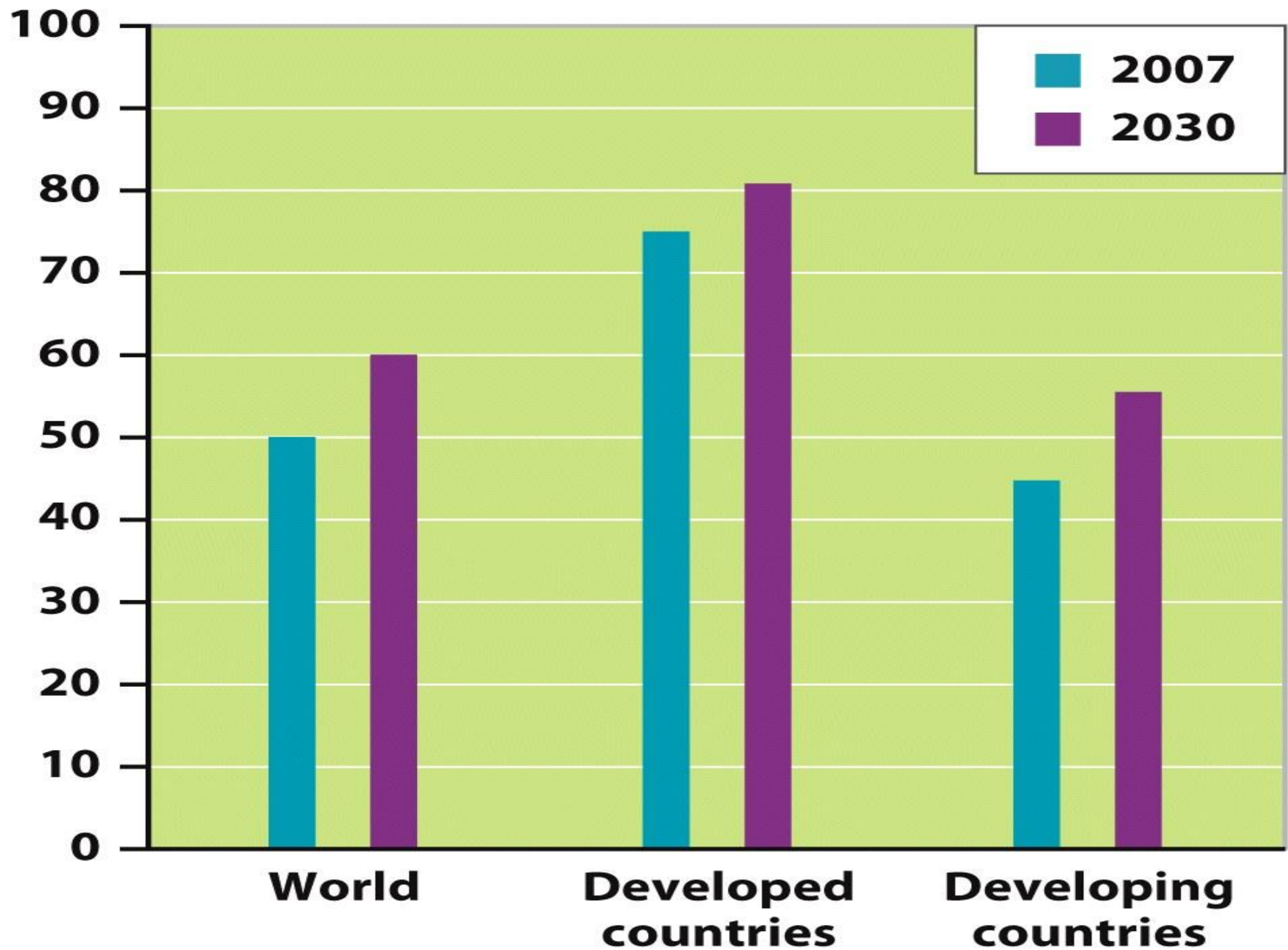
Figure 7.18
Environmental Science
© 2012 W. H. Freeman and Company

More than one half of the world population will live in urban setting (**urbanization** – cities/infrastructure/suburbs) by 2030

TABLE 7.1 The 20 largest urban areas in the world

Rank	City, country	Population (millions)
1	Tokyo, Japan	35.7
2	New York–Newark, United States	19.0
3	Mexico City, Mexico	19.0
4	Mumbai, India	19.0
5	São Paulo, Brazil	18.9
6	Delhi, India	16.0
7	Shanghai, China	15.0
8	Kolkata, India	14.8
9	Dacca, Bangladesh	13.5
10	Buenos Aires, Argentina	12.8
11	Los Angeles–Long Beach–Santa Ana, United States	12.5
12	Karachi, Pakistan	12.1
13	Cairo, Egypt	11.9
14	Rio de Janeiro, Brazil	11.8
15	Osaka–Kobe, Japan	11.3
16	Beijing, China	11.1
17	Manila, Philippines	11.1
18	Moscow, Russia	10.4
19	Istanbul, Turkey	10.0
20	Paris, France	9.90

Source: United Nations Population Division.
Note: Data are from 2007 and contain the areas defined by the United Nations as "urban agglomerations."

Table 7.1
Environmental Science

The Impact of Affluence

- <u>Gross domestic product (GDP)-</u> the value of all products and services produced in a year in that country.

GDP is made up of 4 types of economic activity:

1. consumer spending

2. investments

3. government spending

4. exports minus imports.

- A countries GDP often correlates with its pollution levels. (GDP increases as a nation begins to be able to afford to burn fossil fuels).

Population, Resources, and the Environment

The contrast between less developed and highly developed countries is overwhelming.

AFFLUENCE (opposite of poverty – wealth, privilege)

….what is it?

The Story of Stuff