

Chapter 7

The Human Population

Module 22

Human Population Numbers

After reading this module you should be able to

- explain factors that may potentially limit the carrying capacity of humans on Earth.
- describe the drivers of human population growth.
- read and interpret an age structure diagram.

Which do you believe plays a bigger role in moving toward sustainability?

Population Size or Economic Development

Global Trends Quiz (if applicable)

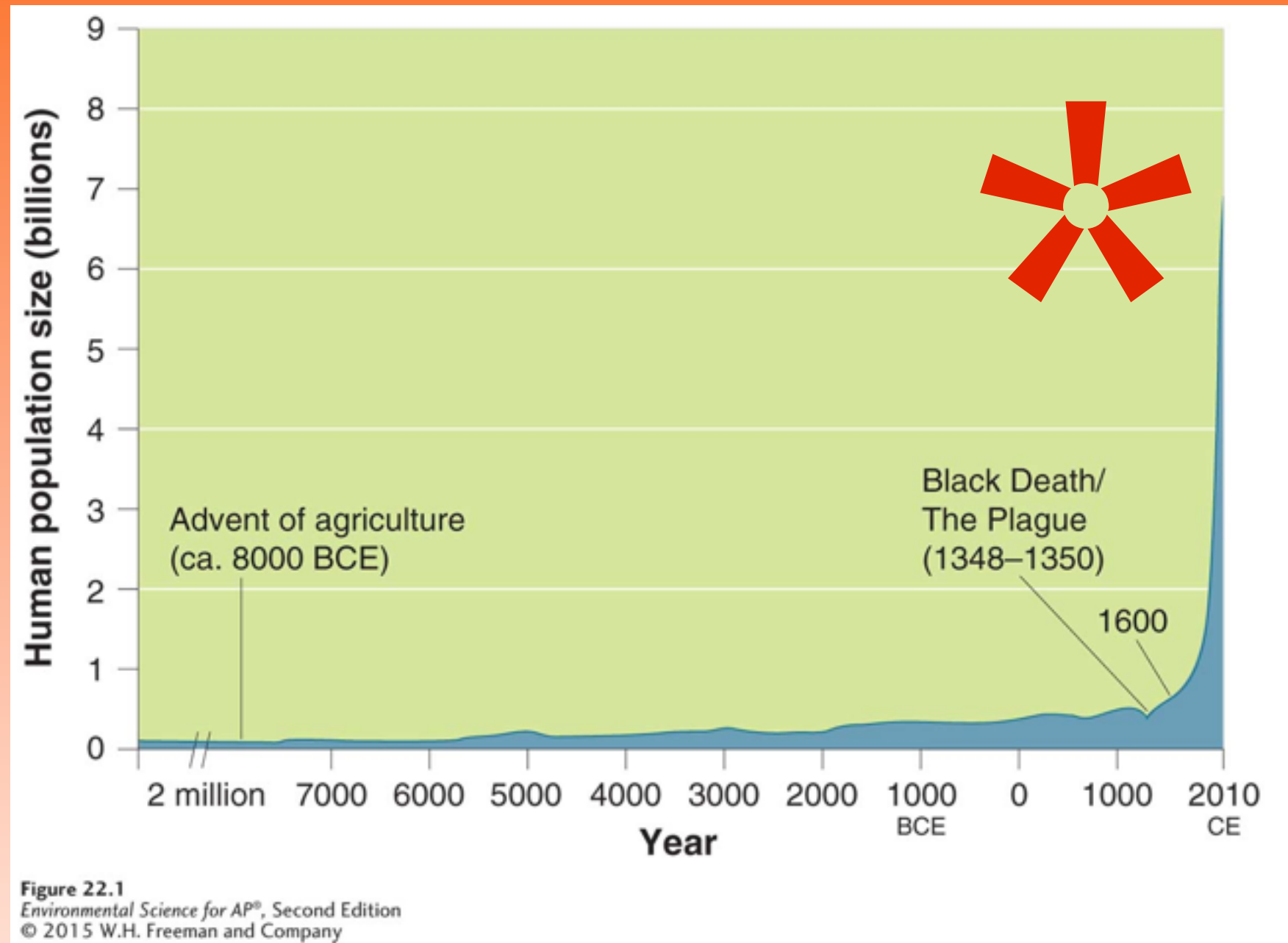
Scientists disagree on Earth's carrying capacity

- Under ideal conditions, all populations grow exponentially.
- In most cases exponential growth stops or slows when an environmental limit is reached.

What are the potential limits to human population growth?

Are these density dependent or independent?

Scientists disagree on Earth's carrying capacity



Human population growth. The global human population has grown more rapidly in the last 400 years than at any other time in history. Mainly due to increases in agricultural production and sanitation.

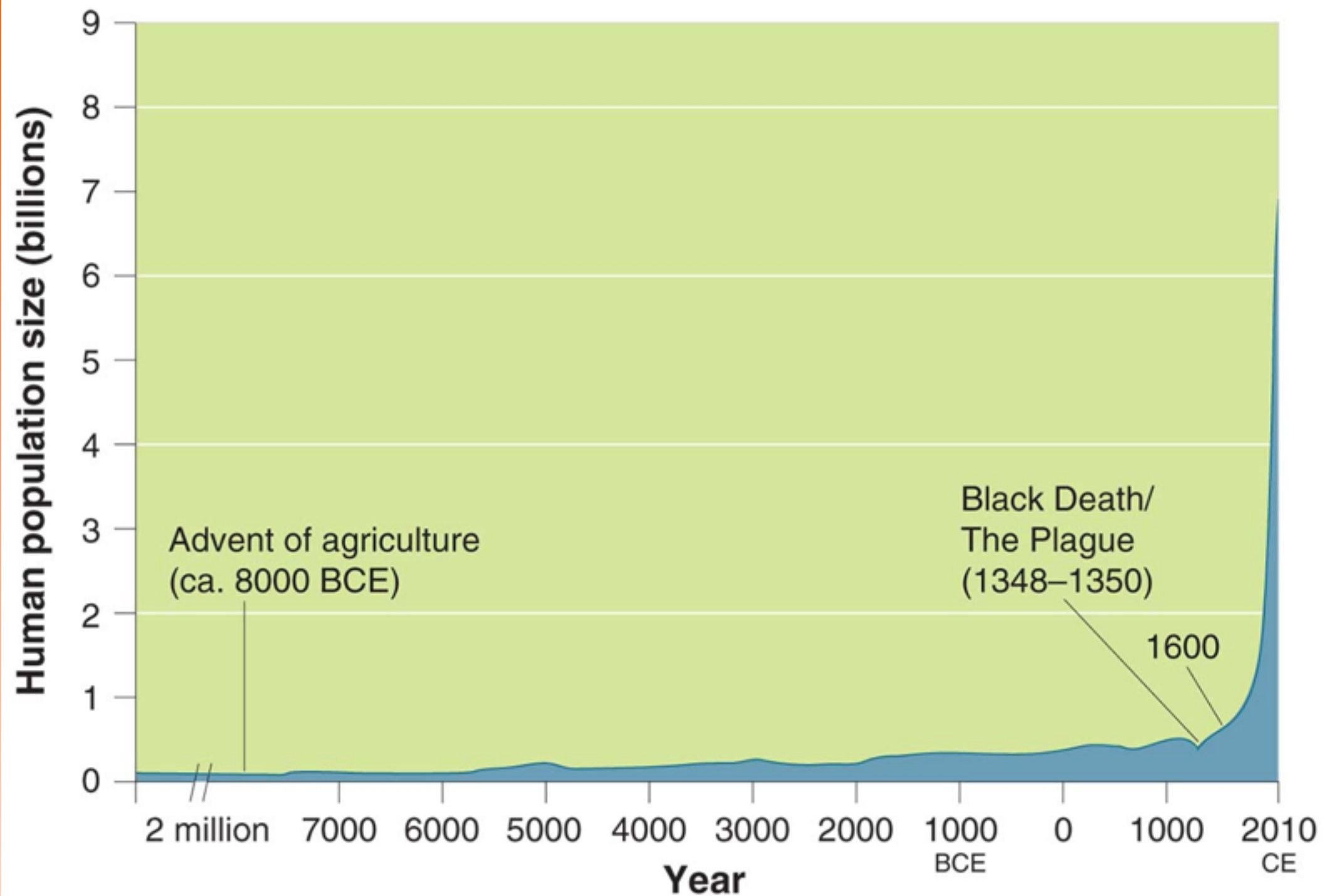


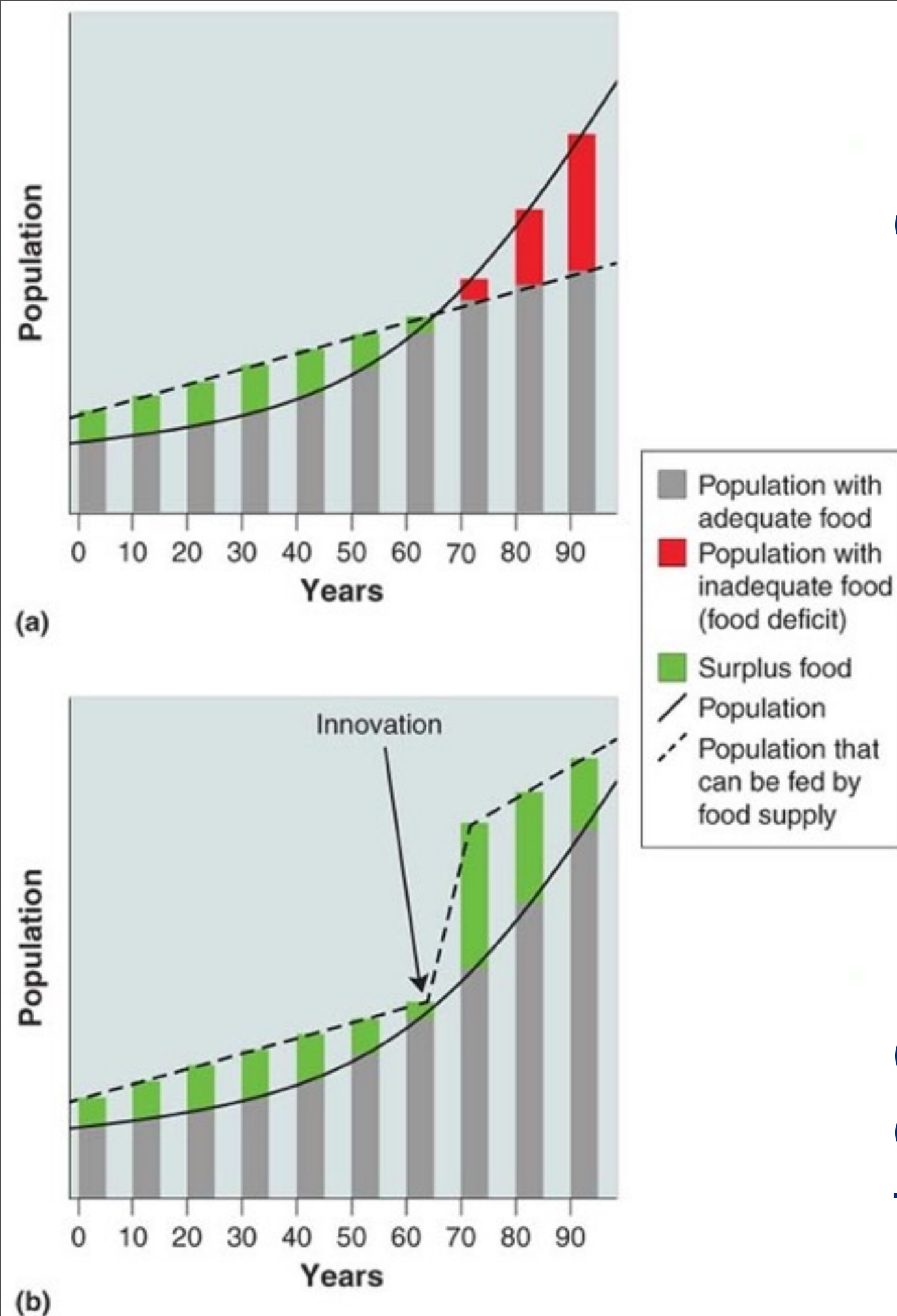
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At what approximate year did human population growth begin to experience exponential growth?

Show Historical World Population Growth Video

- show world population clock

How are the two graphs different?



How might humans differ from other organisms with respect to carrying capacities?

Many factors drive human population growth.

- In order to understand the impact of the human population on the environment, we must first understand what drives human population growth.

Factors that drive population growth include:

- Population size
- Birth and death rates
- Fertility
- Life expectancy
- Migration

Factors that Drive Human Population

- **Demography** The study of human populations and population trends.
- **Demographer** A scientist in the field of demography.

Changes in Population Size

- **Immigration** The movement of people into a country or region, from another country or region.
- **Emigration** The movement of people out of a country or region.
- **Crude birth rate (CBR)** The number of births per 1,000 individuals per year.
- **Crude death rate (CDR)** The number of deaths per 1,000 individuals per year.

Changes in Population Size



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The human population as a system.

We can think of the human population as a system, with births and immigration as inputs and deaths and emigration as outputs.

Changes in Population Size

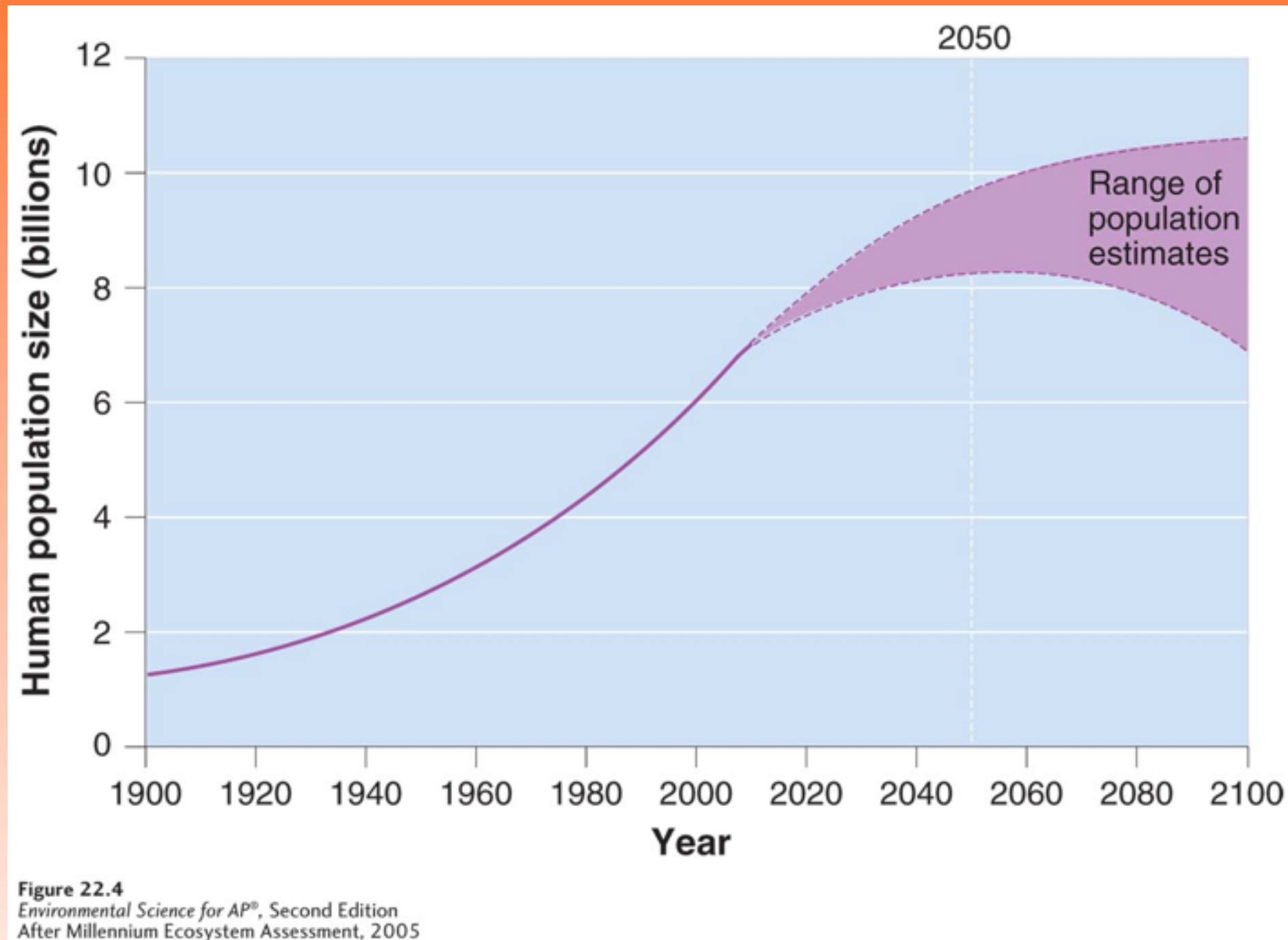
- Global population growth rate = $(\text{CBR} - \text{CDR}) \div 10$
- National population growth rate =
 $(\text{CBR} + \text{immigration}) - (\text{CDR} + \text{emigration}) \div 10$
- **Doubling time** The number of years it takes a population to double.
- Doubling time (years) = $70 \div \text{growth rate}$

$(\text{CBR} + \text{immigration}) - (\text{CDR} + \text{emigration})$ alone
can be used to estimate population growth

Fertility

- **Total fertility rate (TFR)** An estimate of the average number of children that each woman in a population will bear throughout her childbearing years.
- **Replacement-level fertility** The total fertility rate required to offset the average number of deaths in a population in order to maintain the current population size.
- Replacement level fertility tends to be higher in developing countries because mortality among young people tends to be higher.

Population Growth

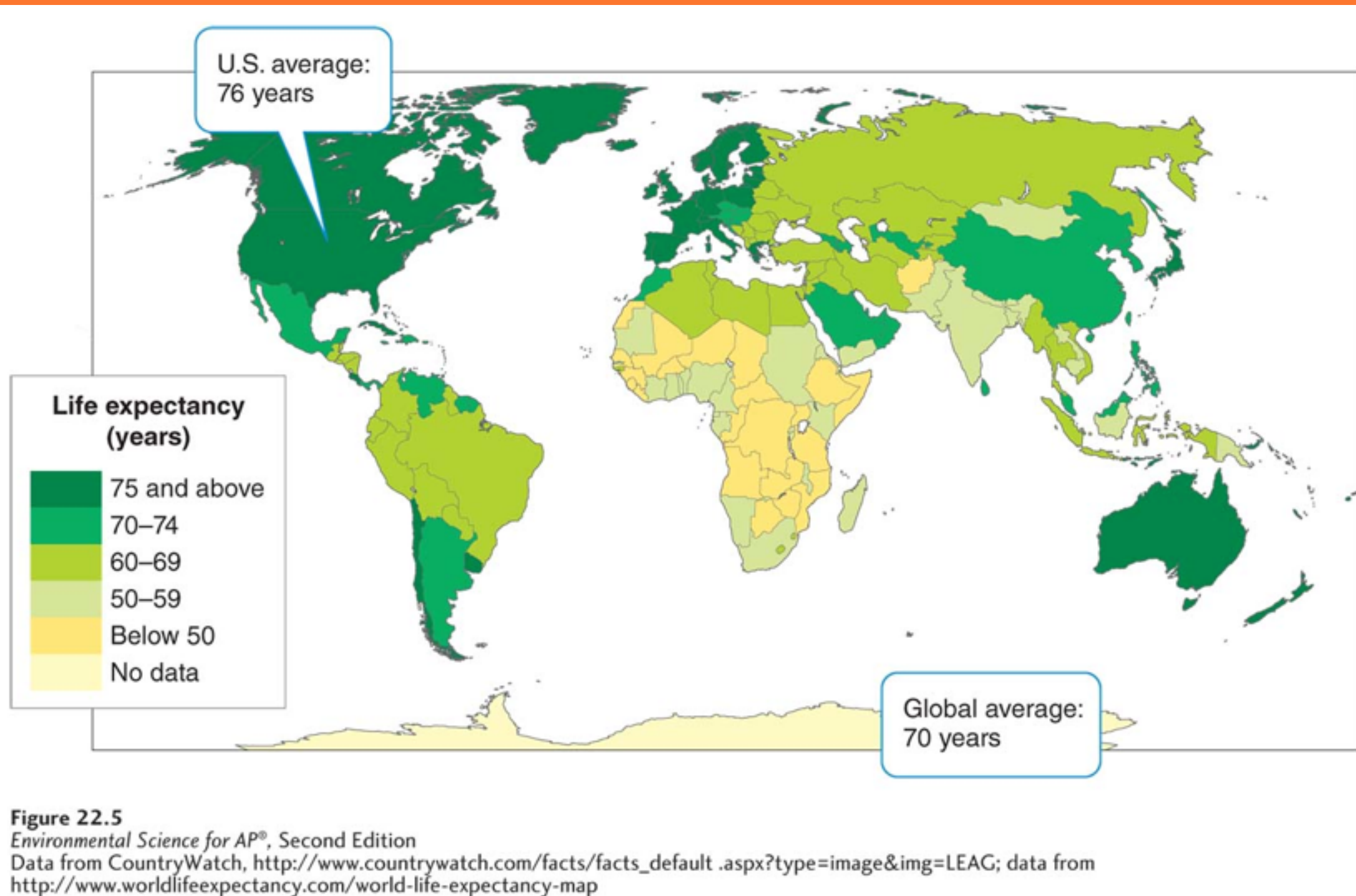


Projected world population growth. Demographers project that the global human population will be between 8.1 billion and 9.6 billion by 2050. By 2100, it is projected to be between 6.8 billion and 10.5 billion. The dashed lines represent estimated values.

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, given the current average life span and death rate in that country. Generally higher in developed countries (wealthy).
- **Infant mortality** The number of deaths of children under 1 year of age per 1,000 live births. Generally higher in developing countries (poor).
- **Child mortality** The number of deaths of children under age 5 per 1,000 live births. Generally higher in developing countries (poor).

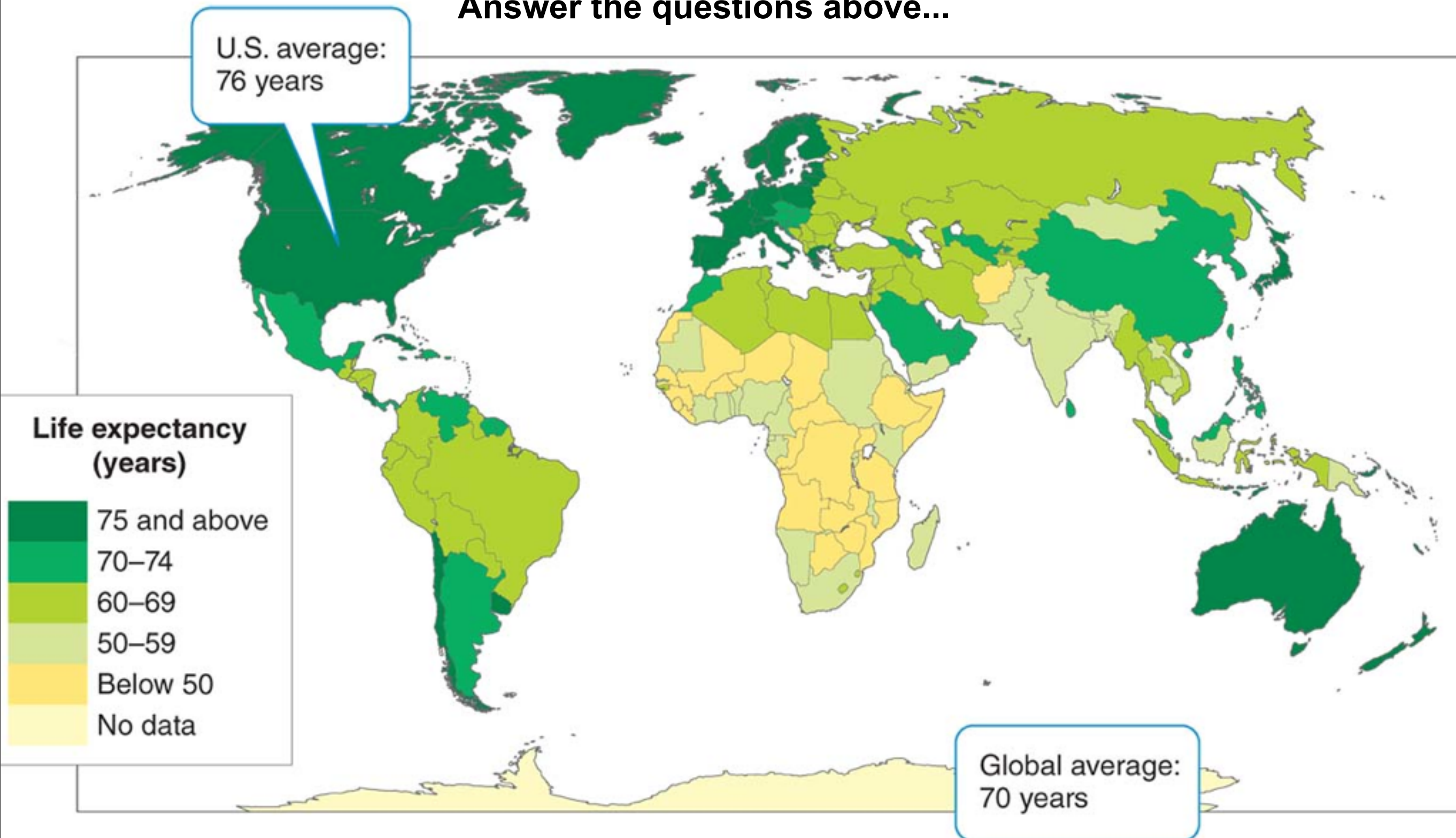
Life Expectancy



Average life expectancies around the world. Life expectancy varies significantly by continent and in some cases by country

Which countries/regions experience long life expectancies and low infant mortality?
Which countries/regions experience short life expectancies and high infant mortality?
Name the common characteristics shared among nations that enjoy long life expectancies and low infant mortality rates.

Answer the questions above...

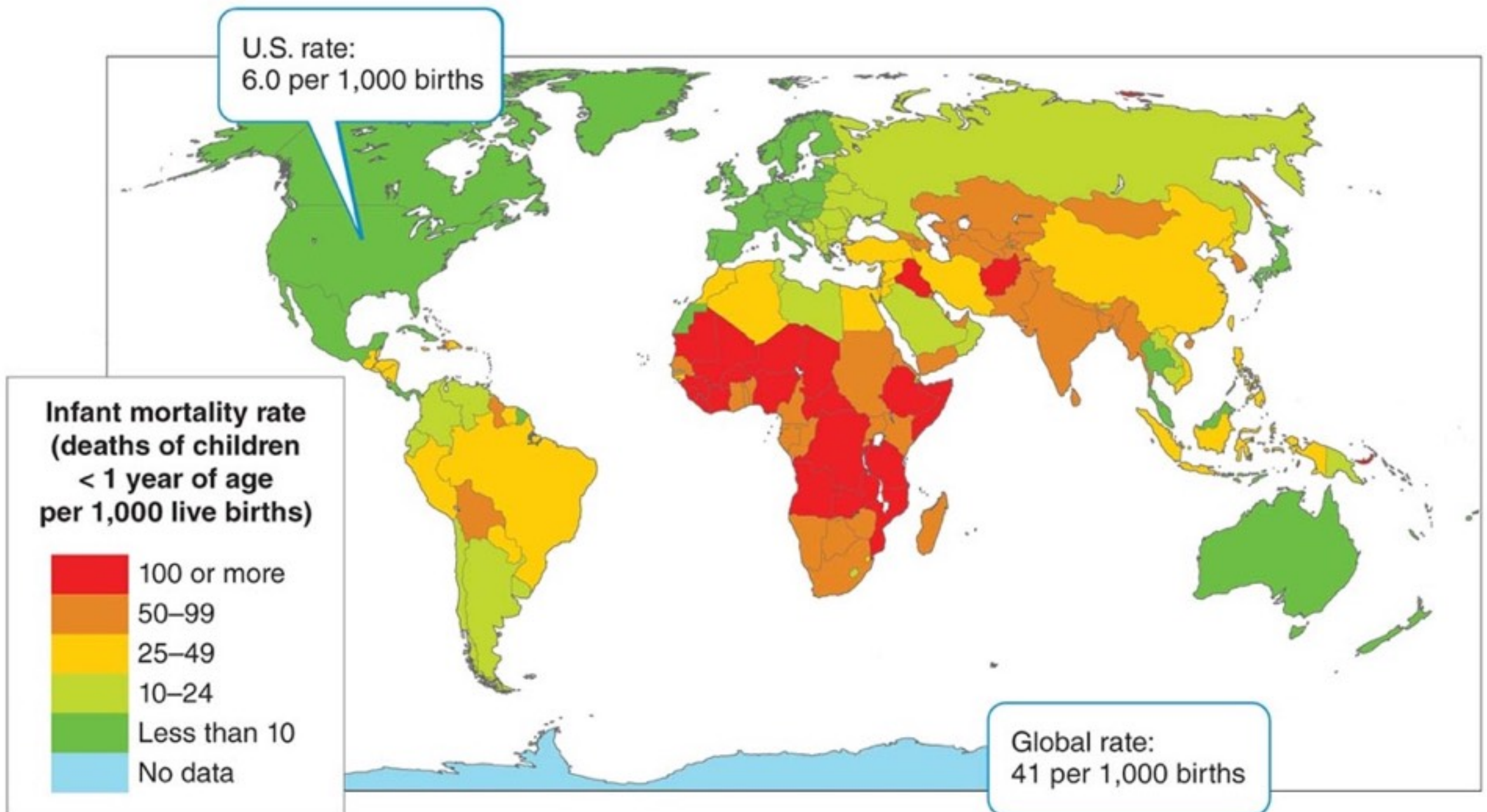


Which countries/regions experience long life expectancies and low infant mortality?

Which countries/regions experience short life expectancies and high infant mortality?

Name the common characteristics shared among nations that enjoy long life expectancies and low infant mortality rates.

Answer the questions above...



Check for Understanding

How can a country that exhibits long life expectancies can still have a high crude death rate?

What would have a disproportionately large effect on a population growth HIV/AIDS or cancer? Why?

How might a country with low CBR still experience population growth?

What would expect to happen to population size in a country that has negative net immigration and low TFR?

Migration

- Regardless of birth and death rates, a country may experience population growth, stability, or decline as a result of net migration.
- **Net migration rate** The difference between immigration and emigration in a given year per 1,000 people in a country.

Age structure diagrams describe how populations are distributed across age ranges

- **Age structure diagram** A visual representation of the number of individuals within specific age groups for a country, typically expressed for males and females.
- **Population pyramid** An age structure diagram that is widest at the bottom and smallest at the top, typical of developing countries.
- **Population momentum** Continued population growth after growth reduction measures have been implemented.

Age Structure Diagrams

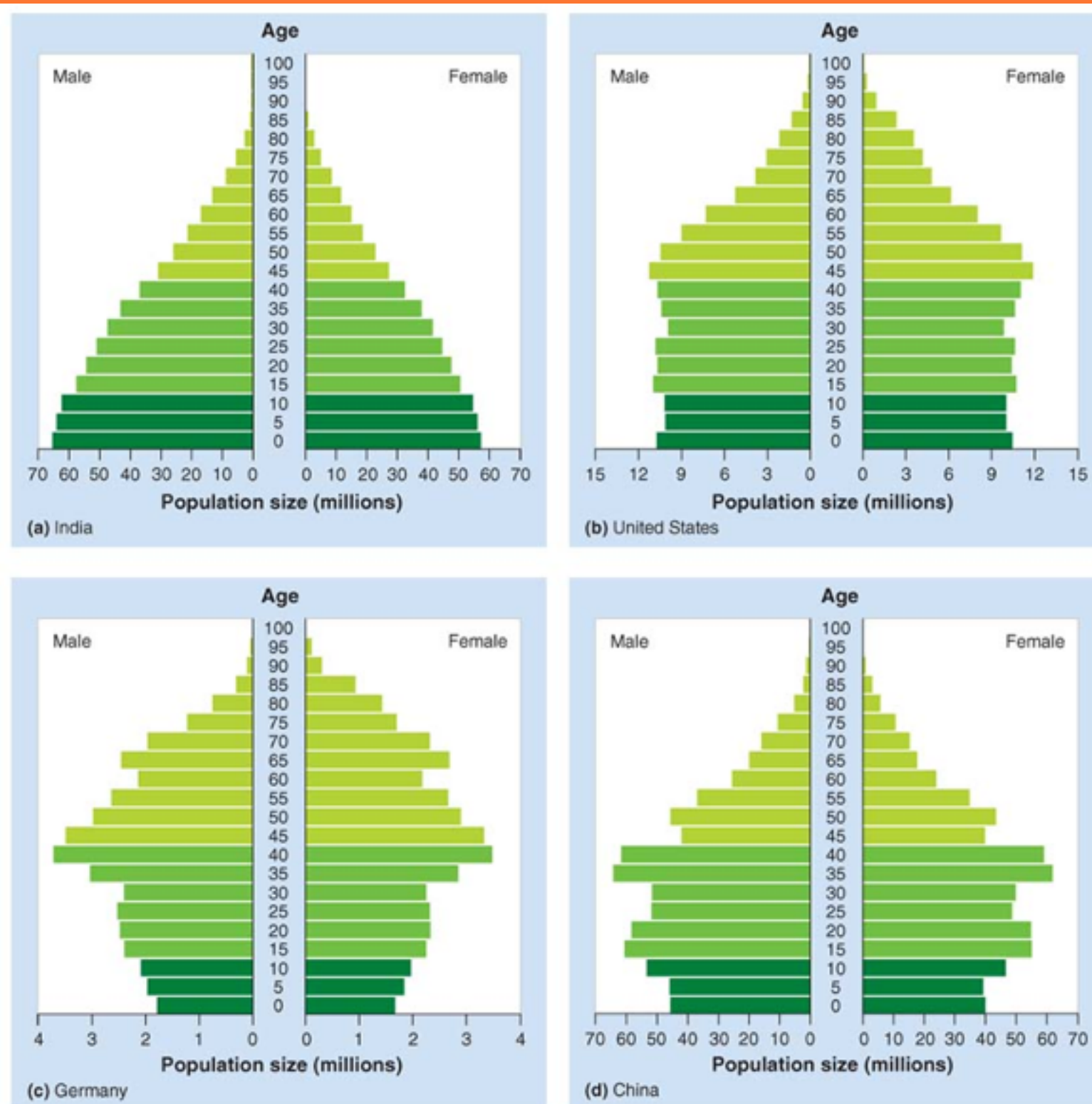
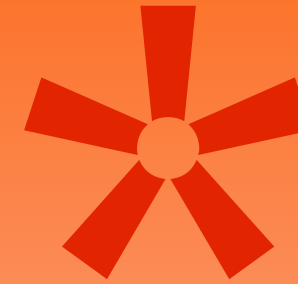


Figure 22.8
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 Data from <http://www.census.gov/ipc/www/idb/pyramids.html>

Age structure diagrams in 2010. The horizontal axis of the age structure diagram shows the population size in millions for males and females in each 5-year age group shown on the vertical axis. (a) A population pyramid illustrates a rapidly growing population. (b) A column-shaped age structure diagram indicates population stability. (c) In some developed countries, the population is declining. (d) China's population control measures will eventually lead to a population decline.

Module 23

Economic Development, Consumption, and Sustainability

After reading this module you should be able to

- describe how demographic transition follows economic development.
- explain how relationships among population size, economic development, and resource consumption influence the environment.
- describe why sustainable development is a common but elusive goal.

Demographic transition follows economic development

- **Theory of demographic transition** The theory that as a country moves from a subsistence economy to industrialization and increased affluence it undergoes a predictable shift in population growth.
- **Developed country** A country with relatively high levels of industrialization and income.
- **Developing country** A country with relatively low levels of industrialization and income.
- **Affluence** The state of having plentiful wealth including the possession of money, goods, or property.

The Theory of Demographic Transition

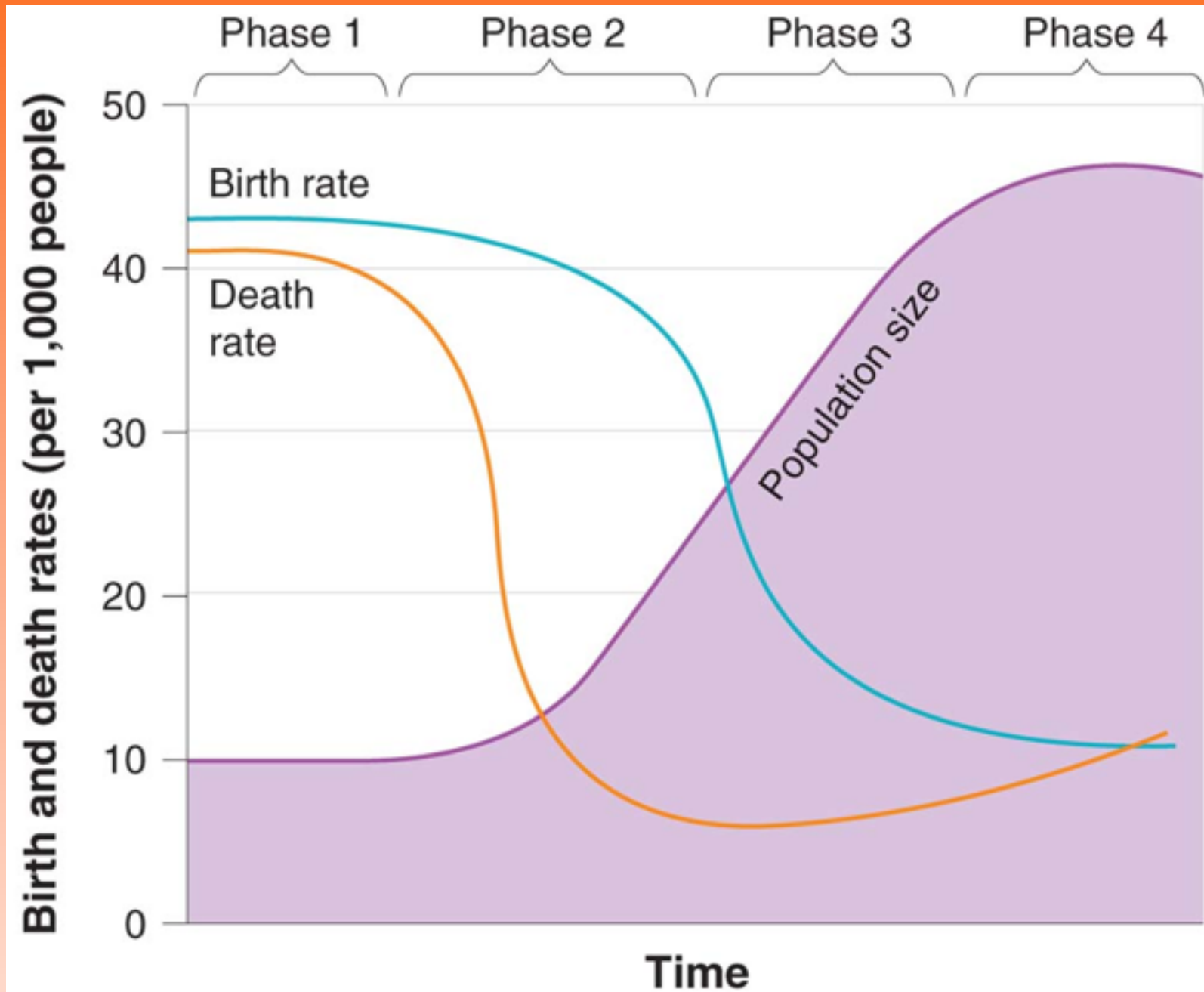


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Demographic transition. The theory of demographic transition models the way that birth, death, and growth rates for a nation change with economic development. Phase 1 is a preindustrial period characterized by high birth rates and high death rates. In phase 2, as the society begins to industrialize, death rates drop rapidly, but birth rates do not change. Population growth is greatest at this point. In phase 3, birth rates decline for a variety of reasons. In phase 4, the population stops growing and sometimes begins to decline as birth rates drop below death rates.

The Theory of Demographic Transition

- Phase 1: Slow population growth because high birth rates and high death rates which offset each other.
- Phase 2: Rapid population growth because birth rates remain high but death rates decline because of better sanitation, clean drinking water, availability of food and health care.
- Phase 3: Stable population growth as the economy and educational system improves and people have fewer children.
- Phase 4: Declining population growth because the relatively high level of affluence and economic development encourage women to delay having children.

Family Planning

- **Family planning** The practice of regulating the number or spacing of offspring through the use of birth control.

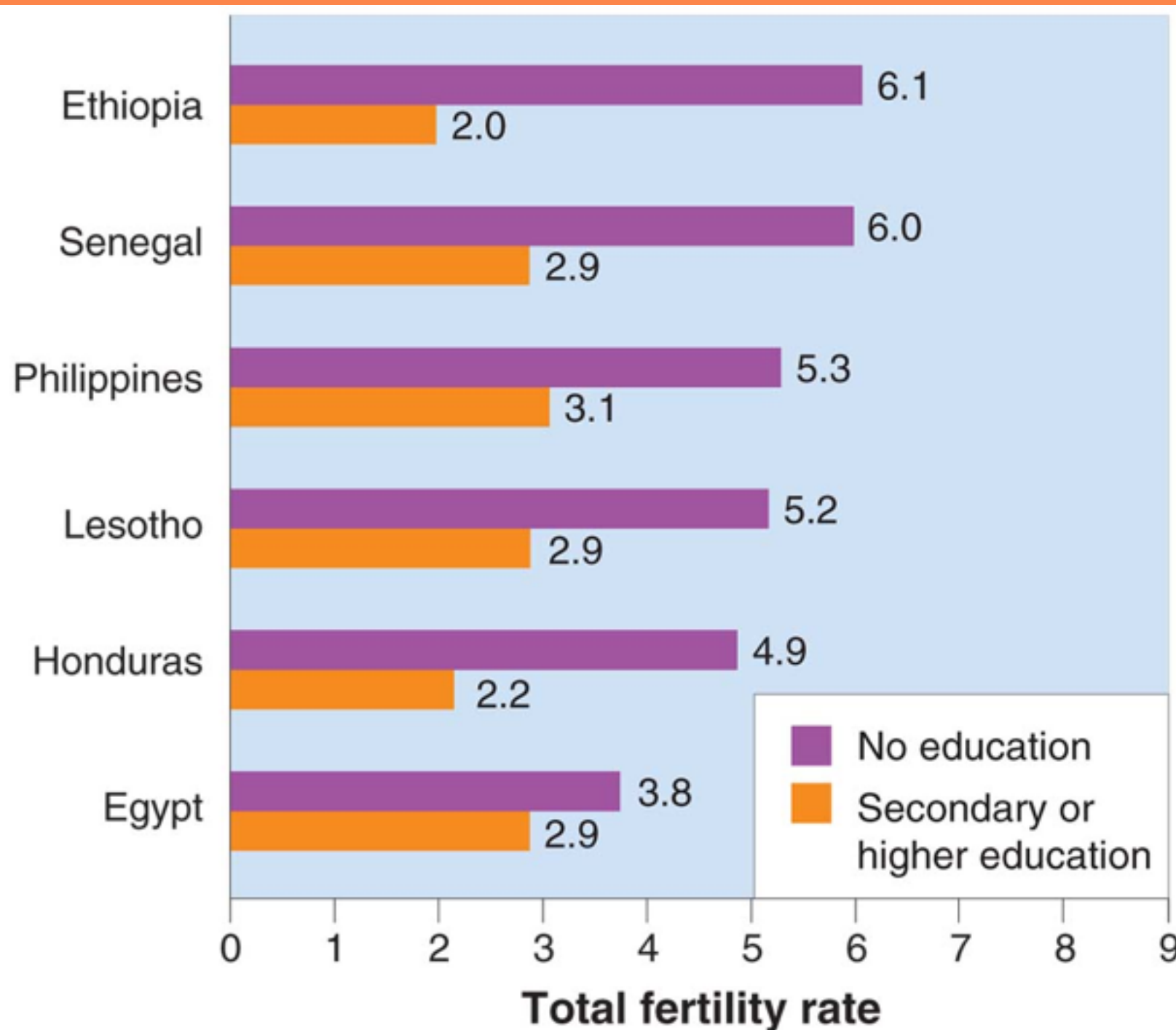


Figure 23.4
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Data from Population Reference Bureau, 2007 World Population Data Sheet, http://www.prb.org/pdf07/07WPDS_Eng.pdf

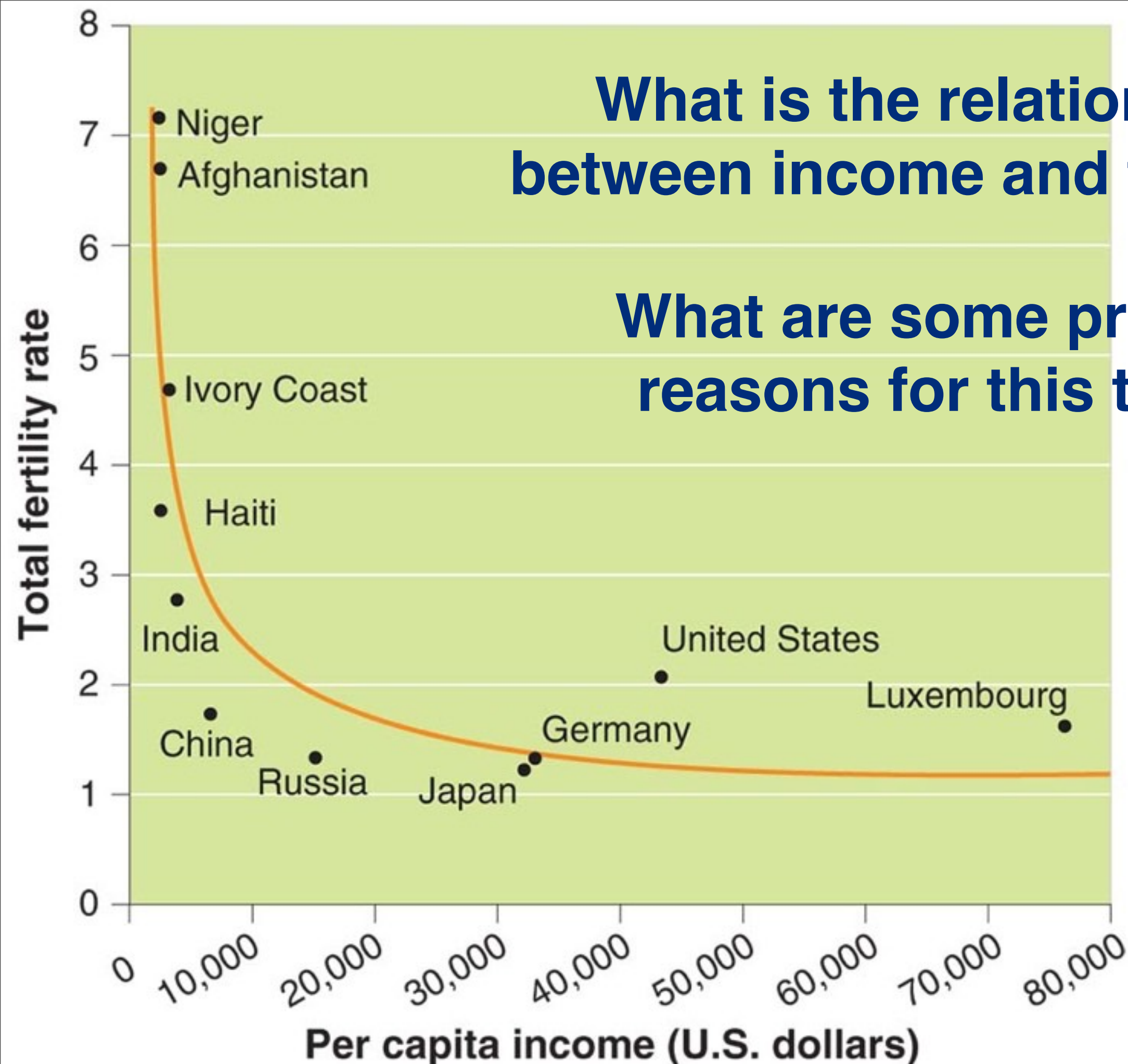
What conclusions can we draw from this?

Total fertility rates for educated and uneducated women in six countries. Fertility is strongly related to female education in many developing countries.

Fertility rates are also less in more affluent women.

**What is the relationship
between income and fertility?**

**What are some probable
reasons for this trend?**



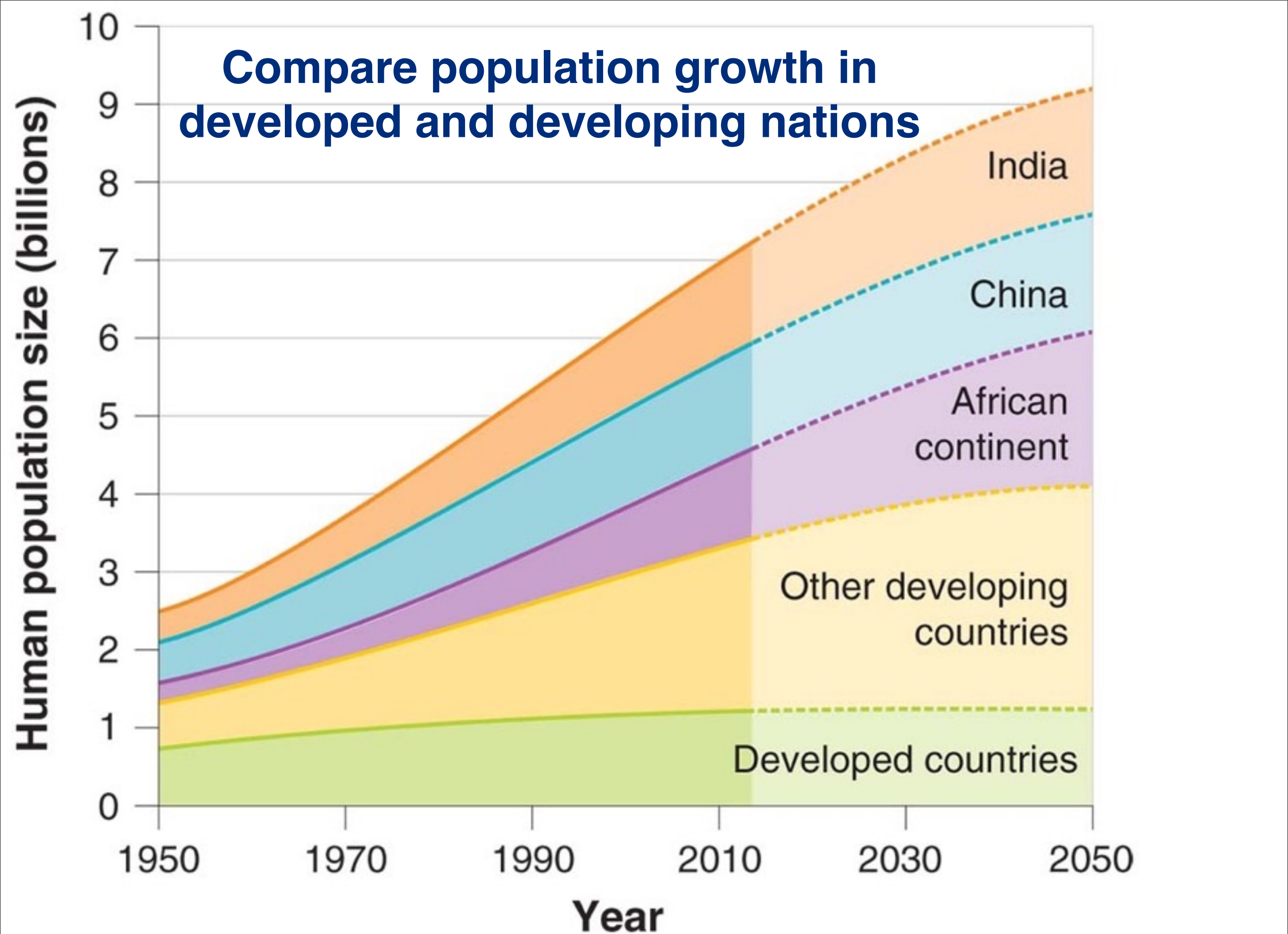
Kenya, Thailand and China have all implemented effective family planning campaigns.

List reasons for the effective reduction in total fertility rates?

What are some possible ethical concerns with governmental-led family planning campaigns?

In what ways beyond population control might family planning be beneficial?

Compare population growth in developed and developing nations



Population size, economic development, and consumption interact to influence the environment

- Both population and economic development contribute to the consumption of resources and to human impact on the environment.

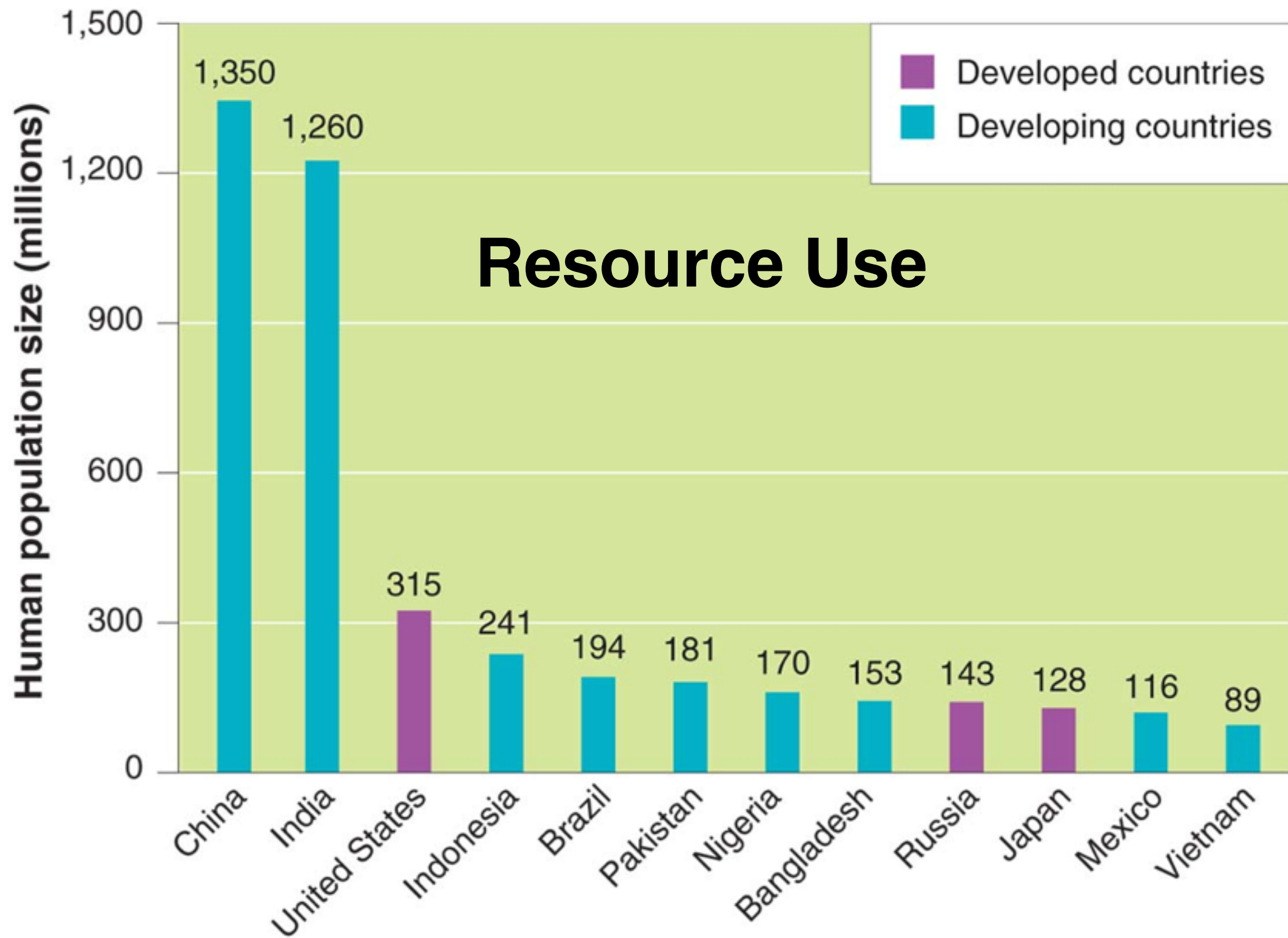


Figure 23.5
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Data from Population Reference Bureau, 2012 data

The 12 most populous countries in the world. China and India are by far the largest nations in the world. Only 3 of the 12 most populous countries are developed nations.

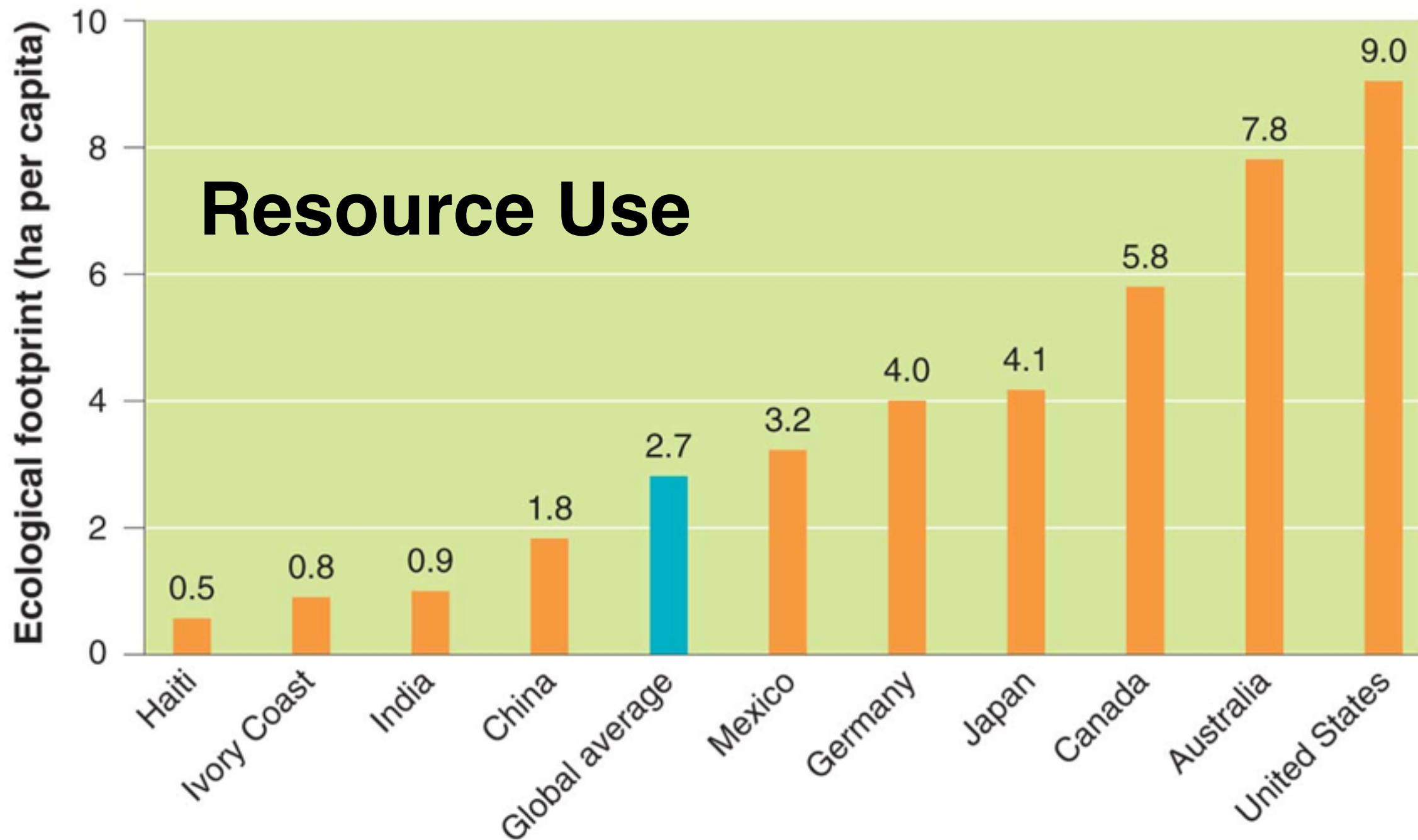


Figure 23.7
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Data from Global Footprint Network, 2009 Data Sheet

Per capita ecological footprints. Many countries exceed the global average footprint of 2.7 ha per capita.

Resource Use

- To estimate the impact of human lifestyles on Earth, environmental scientists developed the IPAT equation.
- **IPAT equation** An equation used to estimate the impact of the human lifestyle on the environment:
$$\text{Impact} = \text{population} \times \text{affluence} \times \text{technology}.$$

Resource Use

- A country's affluence often corresponds with its resource use and level of impact.
- **Gross domestic product (GDP)** A measure of the value of all products and services produced in one year in one country.

How does GDP correlate to environmental impact?

Local versus Global Impacts, and Urban Impacts

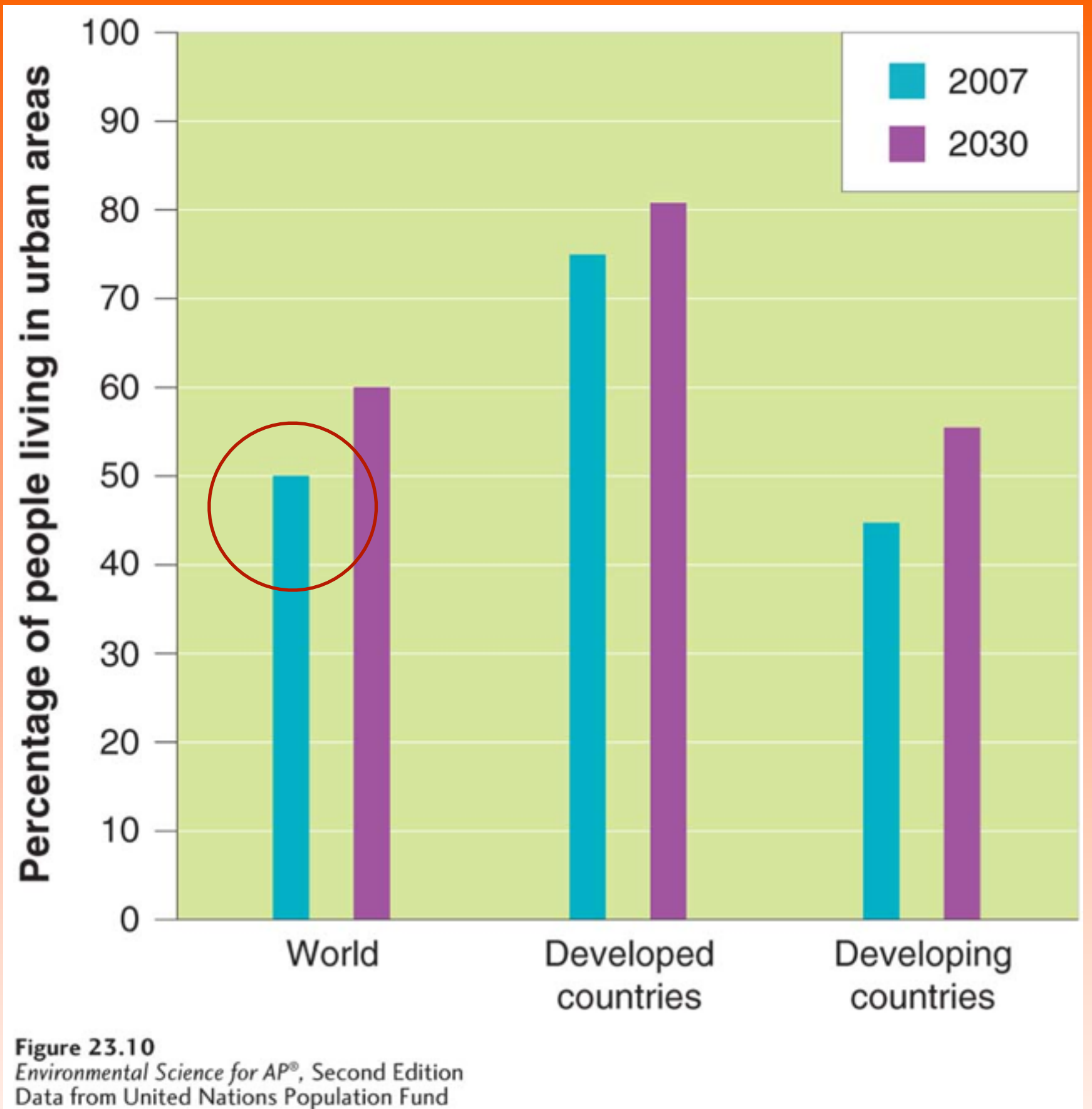
- The scale of an impact depends on the nature of the economy and the degree to which society has developed.
- Highly localized impacts are typical of rural, agriculturally-based societies.
- Global impacts are more common in affluent or urban societies.
- **Urban area** An area that contains more than 385 people per square kilometer (1,000 people per square mile).

Explain how a local impact can become a global impact.

Urban Impacts

Are cities better or worse for the environment?

Support your claim



Urban growth. More than one-half of the world's population will live in urban settings by 2030.

TABLE 23.1 The largest 20 urban areas in the world

Rank	City, Country	Population (millions)
1	Tokyo, Japan	37.2
2	Delhi, India	22.7
3	Mexico City, Mexico	20.4
4	New York-Newark, United States	20.4
5	Shanghai, China	20.2
6	São Paulo, Brazil	19.9
7	Mumbai, India	19.7
8	Beijing, China	15.6
9	Dhaka, Bangladesh	15.4
10	Kolkata, India	14.4
11	Karachi, Pakistan	13.9
12	Buenos Aires, Argentina	13.5
13	Los Angeles-Long Beach-Santa Ana, United States	13.4
14	Rio de Janeiro, Brazil	12.0
15	Manila, Philippines	11.9
16	Moscow, Russia	11.6
17	Osaka-Kobe, Japan	11.5
18	Istanbul, Turkey	11.3
19	Lagos, Nigeria	11.2
20	Cairo, Egypt	11.2

Table 23.1

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Sustainable development is a common, if elusive, goal

- According to The Millennium Ecosystem Assessment:
- Ecosystem sustainability will be threatened if the human population continues along its current path of resource consumption around the globe.
- The continued alterations to ecosystems that have improved human well-being (greater access to food, clean water, suitable housing) will also exacerbate poverty for some populations.
- If we establish sustainable practices, we may be able to improve the standard of living for a large number of people.

**What is the difference between
sustainable development and
economic development?**