ENVIRONMENT

THE SCIENCE BEHIND THE STORIES

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Ch 8

Human Population

Part 2: Environmental Issues
and the Search for Solutions

7 Million

Typical?

PowerPoint® Slides prepared by
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Third Edition

# Case study: China's one-child policy

- In 1970, China's 790 million people faced starvation

- The government instituted a **one-child policy**

  - China's growth rate plummeted

  - In 1984, the policy exempted ethnic minorities and farmers

- Unintended consequences: killing female infants and a black-market trade in teenage girls

The human population is still growing rapidly

- It took all of human history to reach 1 billion

- In 1930, 130 years later, we reached 2 billion, and added the most recent billion in 12 years

- The global human population is 7.0 billion. (7,062,766,204)

- At today's 1.2% global growth rate, the population will double in 58 years (70/1.2 = 58) (**The Rule of 70**)
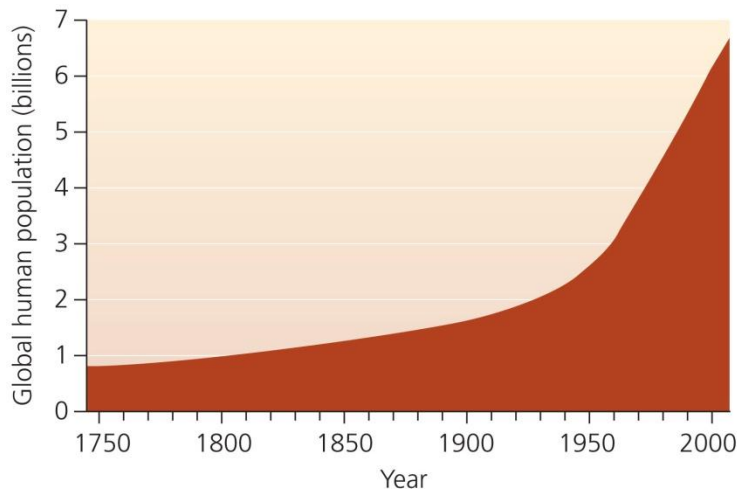
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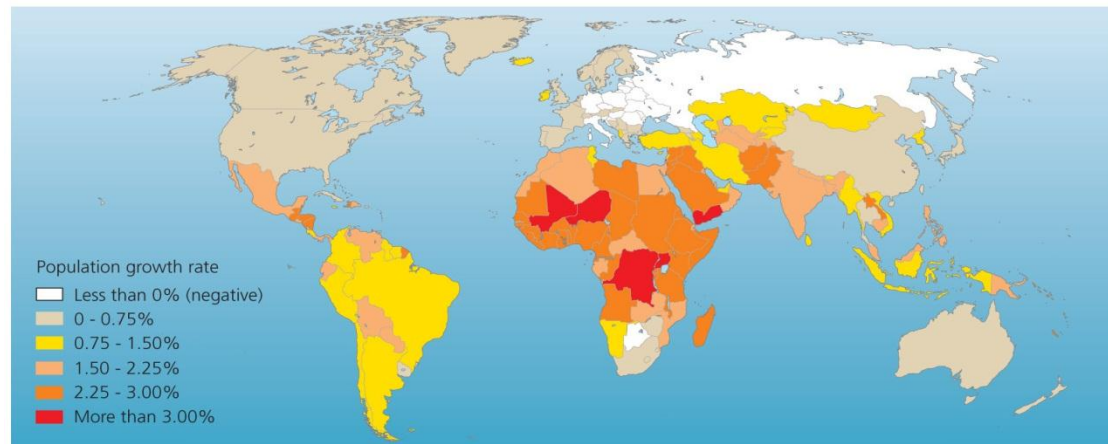
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The Rule of 70

- It states that to find the doubling time of a quantity growing at a given annual percentage rate, divide the percentage number into 70 to obtain the approximate number of years required to double.

- For example, at a 10% annual growth rate, doubling time is 70 / 10 = 7 years.

RULE OF 70

$$\text{number of years to double} = \frac{70}{\text{annual percentage growth rate}}$$

Is population growth really a problem?

- Population growth results from technology, sanitation, food

  - Death rates drop, but not birth rates

- Some people say growth is no problem

  - New resources will replace depleted ones

  - But, some resources (i.e., biodiversity) are irreplaceable

- Quality of life will suffer with unchecked growth

  - Less food, space, wealth per person

# Causes and consequences of population growth
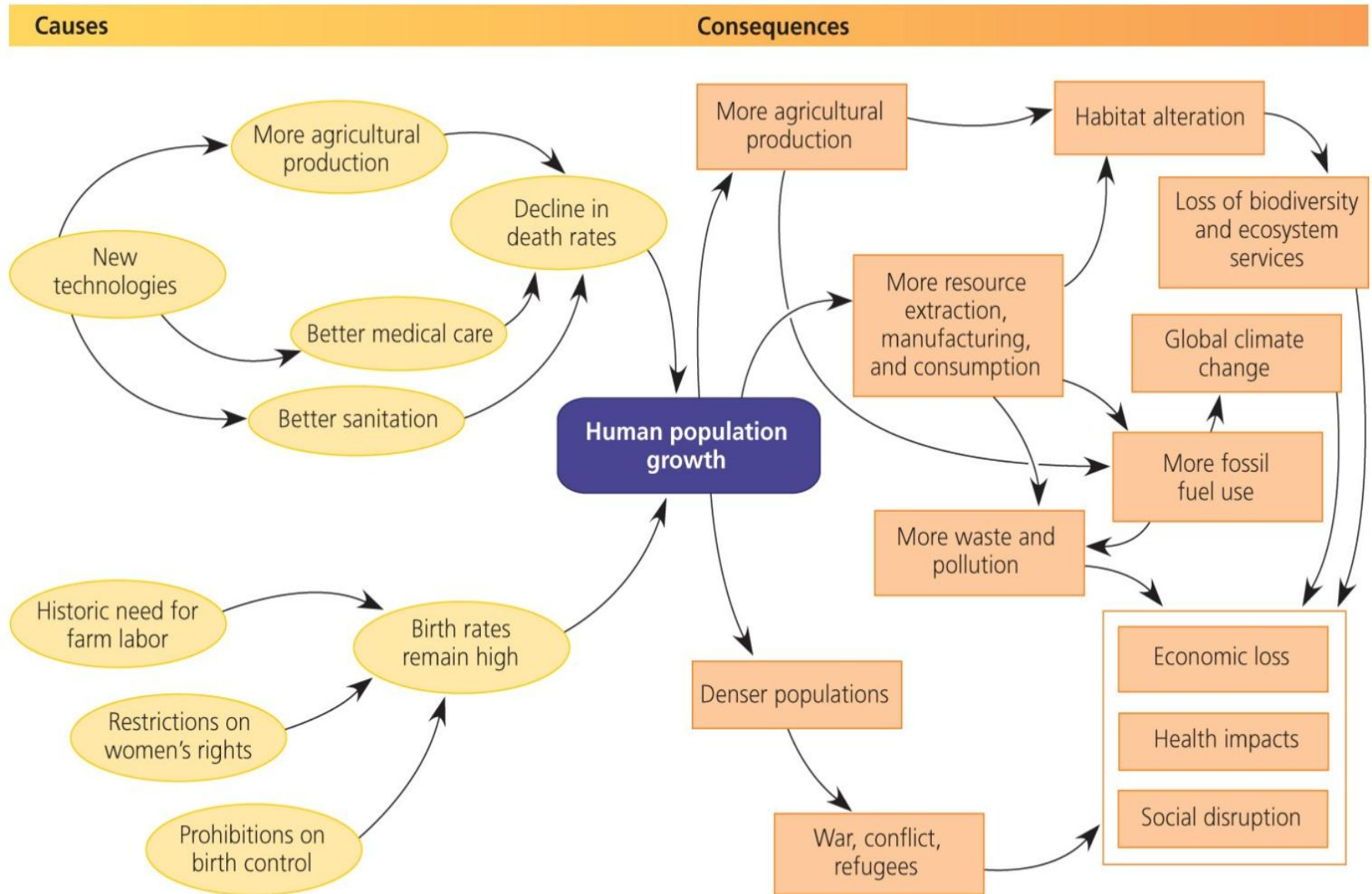
Population growth affects the environment

- The IPAT model: $I = P \times A \times T \times S$

    - Our total impact (I) on the environment results from the interaction of population (P), affluence (A) and technology (T), with an added sensitivity (S) factor

    - Population = individuals need space and resources

    - Affluence = greater per capita resource use

    - Technology = increased exploitation of resources

    - Sensitivity = how sensitive an area is to human pressure

    - Further model refinements include education, laws, and ethics

   Humanity uses 1/3 of all the Earth's net primary production

Computer simulations predict the future

- Simulations project trends in population, food, pollution, and resource availability

- If the world does not change, population and production will suddenly decrease

- In a sustainable world, population levels off, production and resources stabilize, and pollution declines

Resources
Population
Food
Industrial output
Pollution
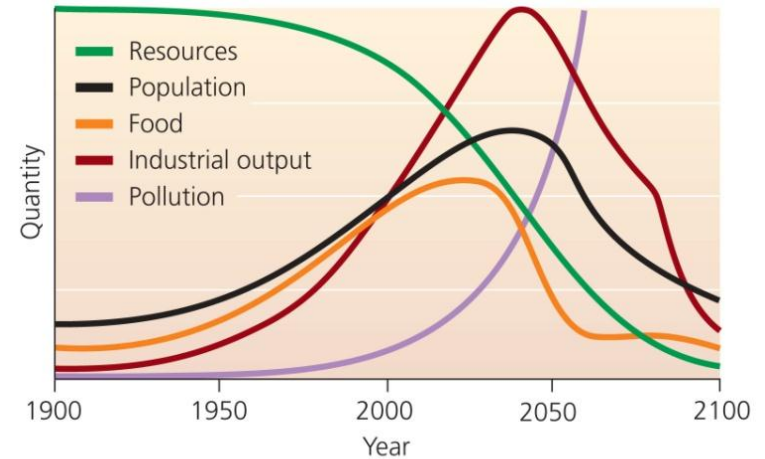
(a) Projection based on status quo policies
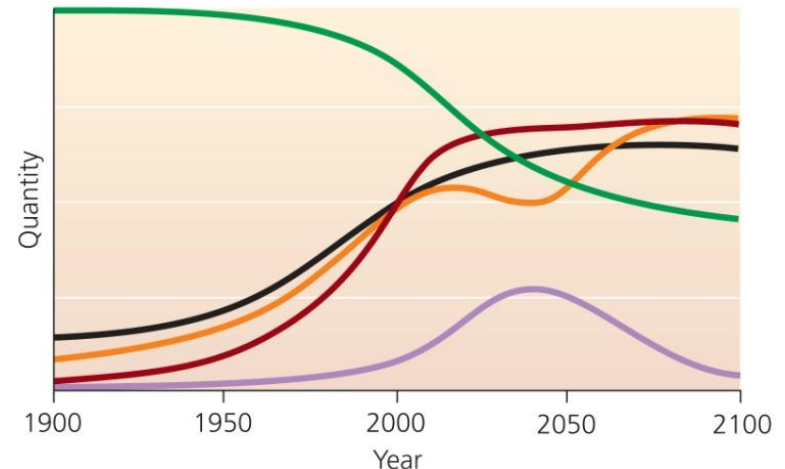
(b) Projection based on policies for sustainability

Demography

- All population principles apply to humans

  - Environmental factors limit population growth

- Humans can raise the environment's carrying capacity through technology

  - How many humans can the world sustain? 1 – 33 billion

  - Population growth can't continue forever
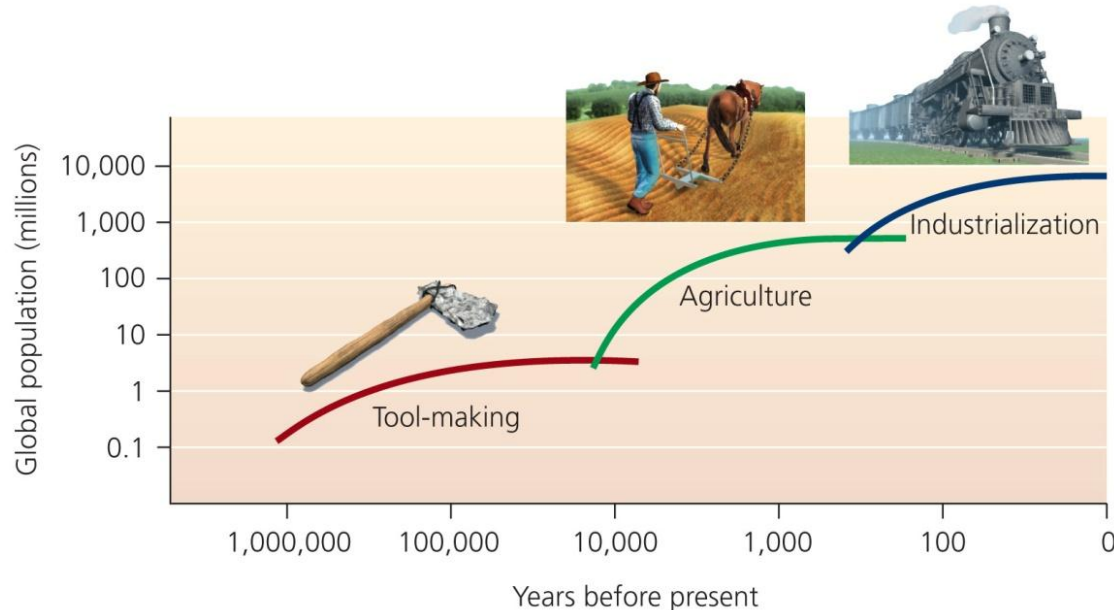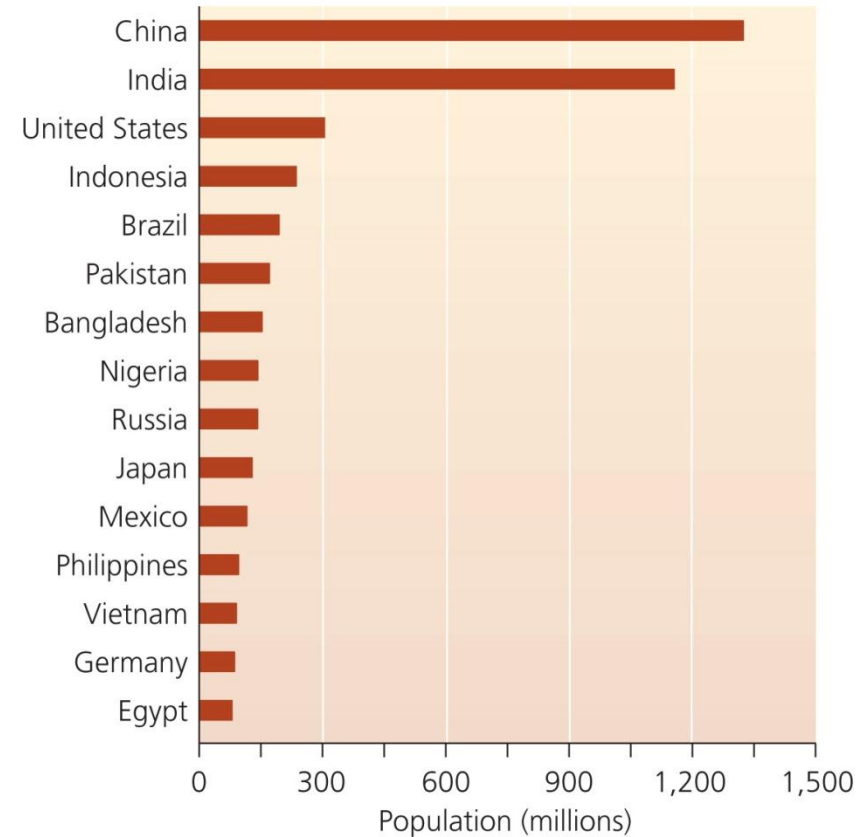

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Demography

- **Demography** = the application of population ecology to the study of humans

  - Demographers study population size,

  - Density and distribution,

  - Age structure, sex ratio,

  - And birth, death, immigration, and emigration rates

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

0   300   600   900   1,200   1,500
Population (millions)

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Population size and density

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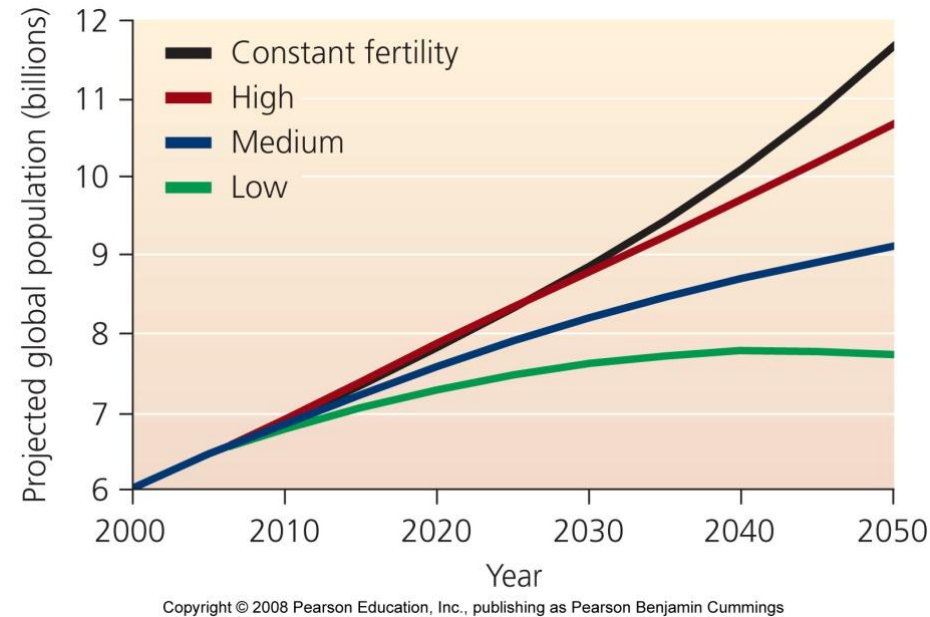
- Nobody knows the ultimate human population size

- But numbers are not the only important aspect

- Highest population density is in temperate, subtropical, and tropical biomes

  - Some areas are heavily impacted by urbanization, pollution, and fossil fuel use

Population distribution

- Increased density impacts the environment, but relieves pressure in less-populated areas

- Humans are unevenly distributed around the globe

  - Unpopulated areas tend to be environmentally sensitive (high S value in the IPAT equation)

Persons/km²

0	25 - 249
1 - 4	250 - 999
5 - 24	1,000+
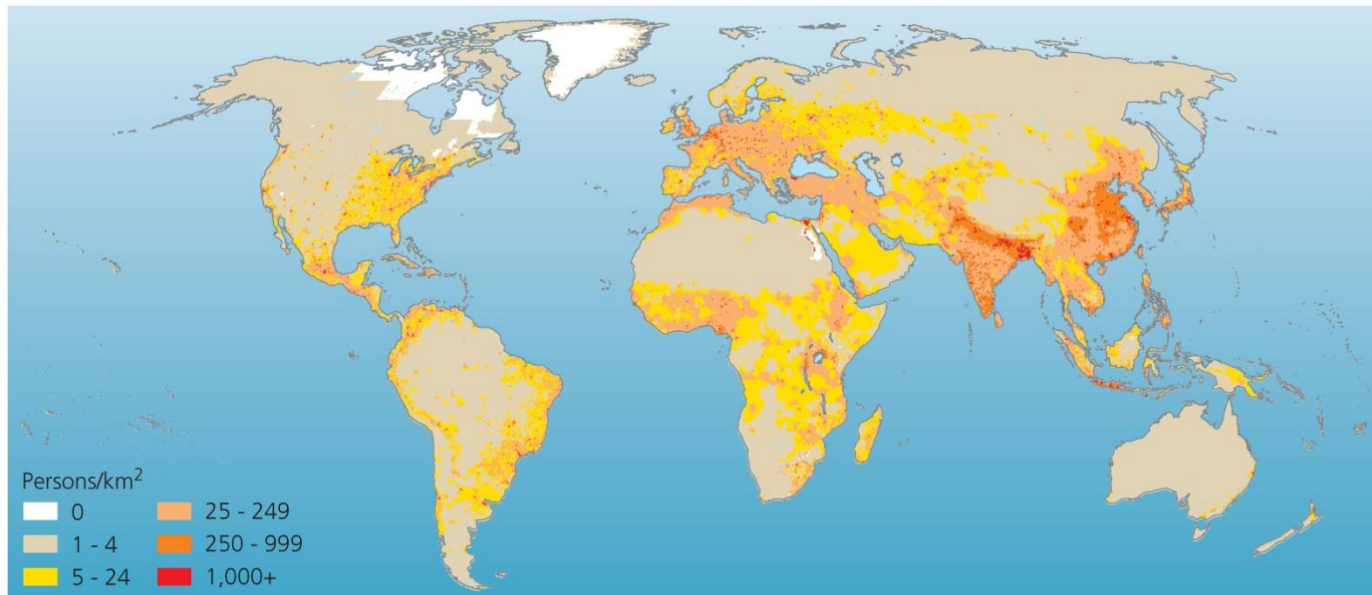
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Age structure affects future population size

- Age structure describes the relative numbers of individuals in each age class within a population.

- Having many individuals in young age groups results in high reproduction and rapid population growth
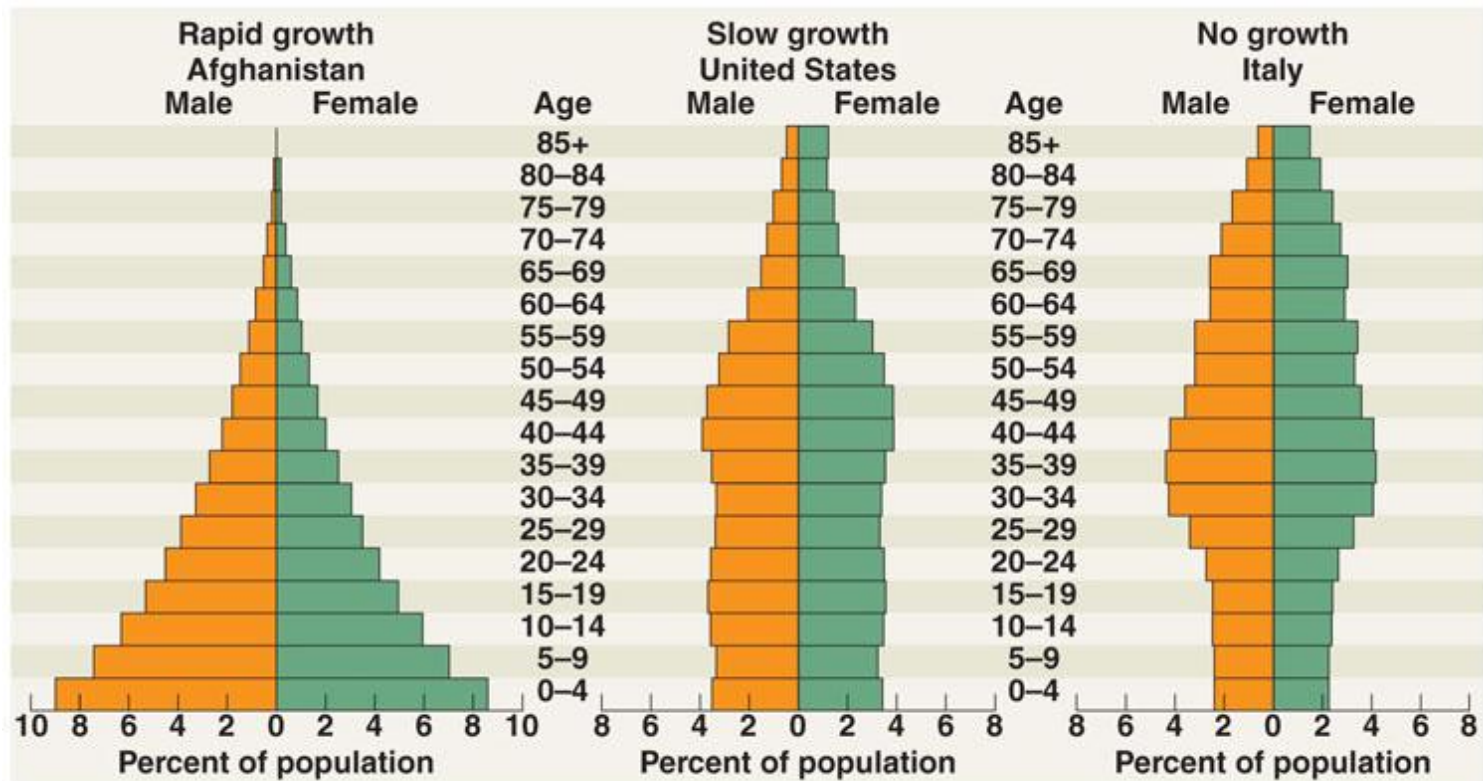
Sex ratios

- Naturally occurring sex ratios for humans slightly favors males (100 females born to 106 males)

- In China, 120 boys were reported for 100 girls

  - Cultural gender preferences, combined with the government's one-child policy, led to selective abortion of female fetuses

  - Had the undesirable social consequences of many single Chinese men

  - Teenage girls were kidnapped and sold as brides

# Population growth depends on various factors

- Whether a population grows, shrinks, or remains stable depends on:

  - Birth and immigration add individuals

  - Death and emigration remove individuals

  - Falling rates of growth do not mean a decreasing population, but only that rates of increase are slowing
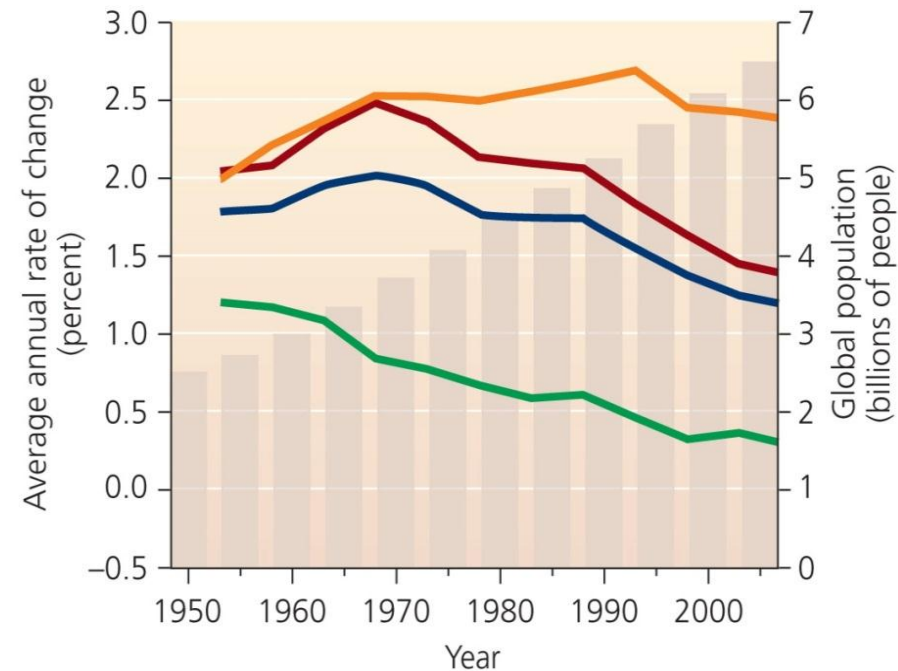
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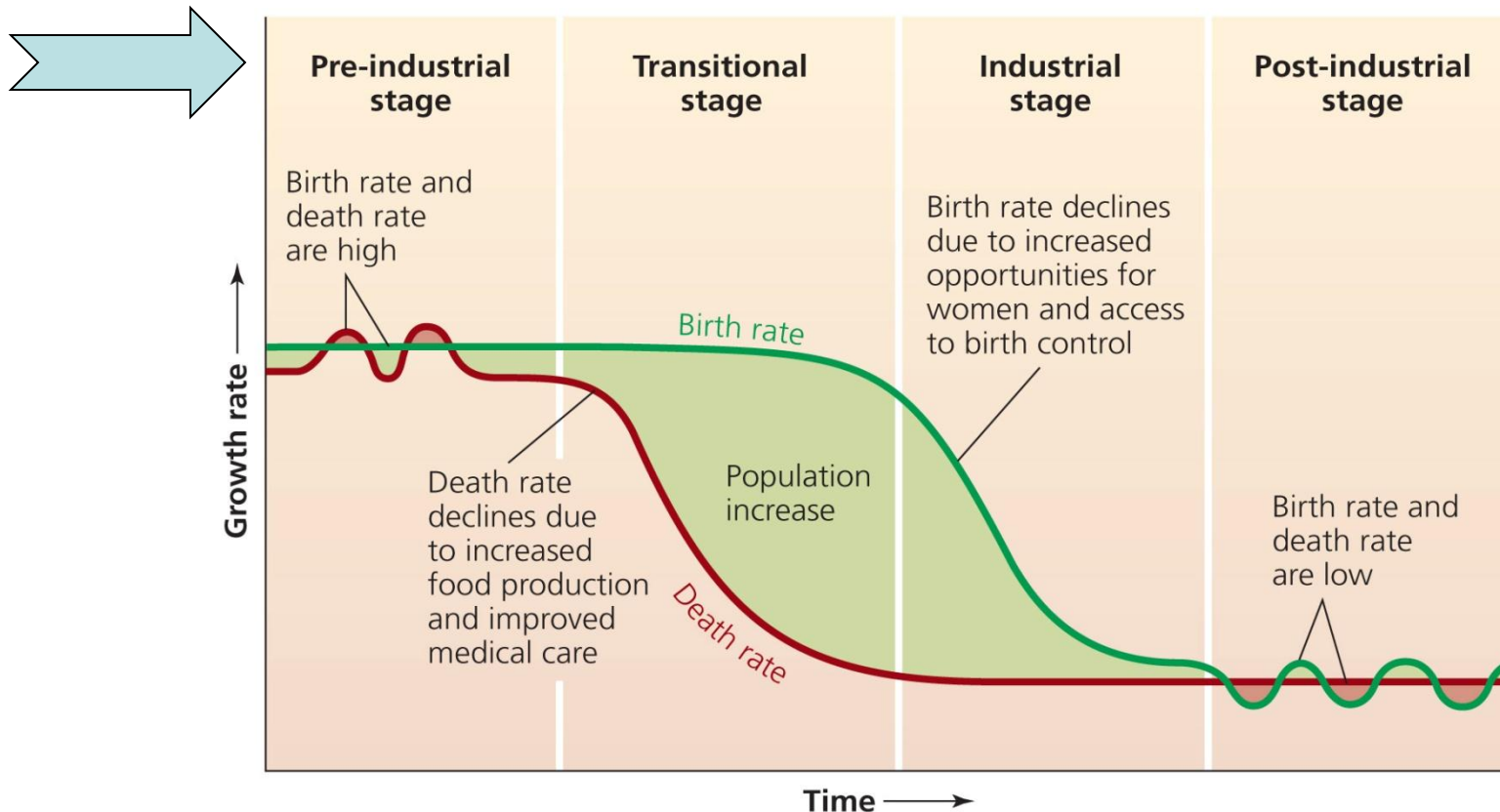
Factors affecting total fertility rate

Total Fertility Rate
Selected countries, 2009 (births per woman)

Source: CIA World Factbook 2009
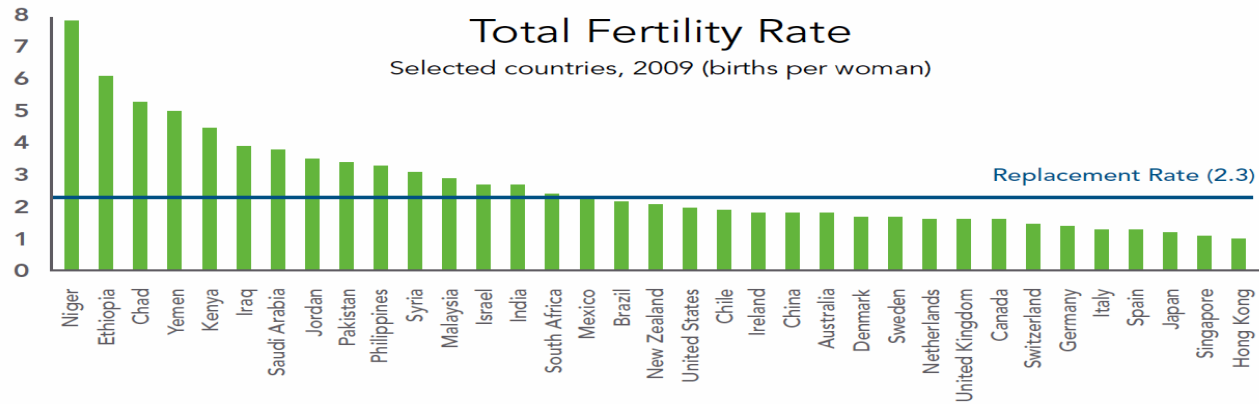
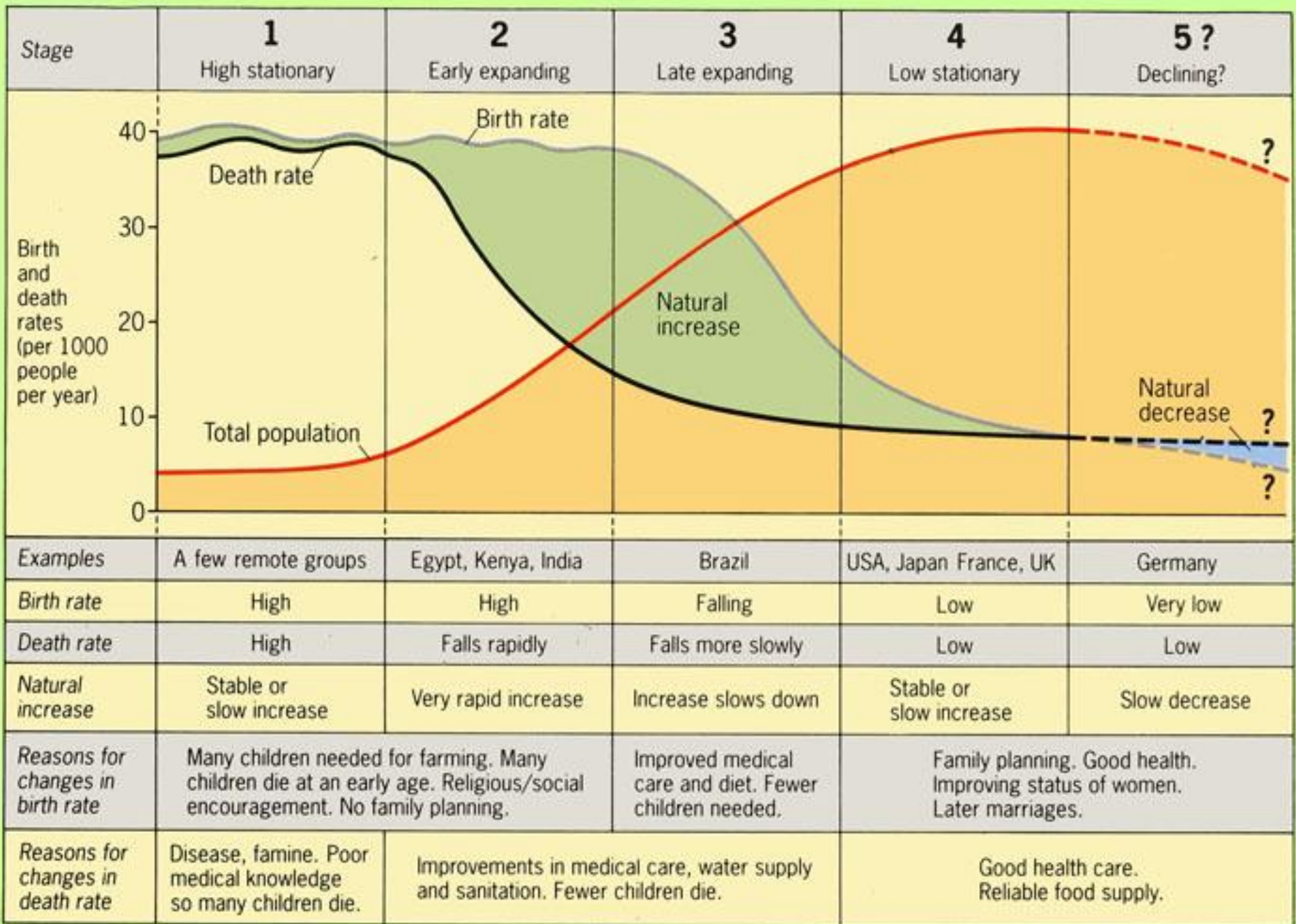- **Total fertility rate (TFR)** = the average number of children born per female

- **Replacement fertility** = TFR that keeps the size of a population stable

  - Increasing urbanization decreases TFR

  - Children go to school, and increase costs

- With social security, elderly parents need fewer children to support them

- Greater education allows women to enter the labor force, with less emphasis on child rearing

The demographic transition

- Demographic transition = a model of economic and cultural change to explain the declining death and birth rates in industrializing nations

Stage	1 High stationary	2 Early expanding	3 Late expanding	4 Low stationary	5? Declining?

Birth and death rates (per 1000 people per year)

40 — Birth rate — Death rate

Natural increase

Total population

Natural decrease ?

	1	2	3	4	5
Examples	A few remote groups	Egypt, Kenya, India	Brazil	USA, Japan France, UK	Germany
Birth rate	High	High	Falling	Low	Very low
Death rate	High	Falls rapidly	Falls more slowly	Low	Low
Natural increase	Stable or slow increase	Very rapid increase	Increase slows down	Stable or slow increase	Slow decrease
Reasons for changes in birth rate	Many children needed for farming. Many children die at an early age. Religious/social encouragement. No family planning.		Improved medical care and diet. Fewer children needed.	Family planning. Good health. Improving status of women. Later marriages.	
Reasons for changes in death rate	Disease, famine. Poor medical knowledge so many children die.	Improvements in medical care, water supply and sanitation. Fewer children die.		Good health care. Reliable food supply.	

The demographic transitions:

- <u>Pre-industrial stage-</u> birth and death rates are high

- <u>Transitional stage-</u> birth rates remain high but death rates decrease due to increased technology

- <u>Industrial stage-</u> Death rates continue to decrease while increased awareness also causes birth rates to start to decrease to close the gap.

- <u>Post-industrial Stage-</u> both birth and death rates have fallen to low and stable levels.

- <u>"Fifth stage"- Declining</u>? Birth Rates decline, death rates remain stable, leads to a decreasing population size

Is the demographic transition universal?

- It has occurred in Europe, U.S., Canada, Japan, and other nations over the past 200-300 years

- But, it may or may not apply to all developing nations

- The transition could fail in cultures that place greater value on childbirth or grant women fewer freedoms

For people to attain the material standard of living of North Americans, we would need the natural resources of four and a half more Earths

Empowering women reduces growth rates

- Fertility rates drop when women gain access to contraceptives, family planning programs and better educational opportunities

- Women lack the information and personal freedom to achieve equal power with men
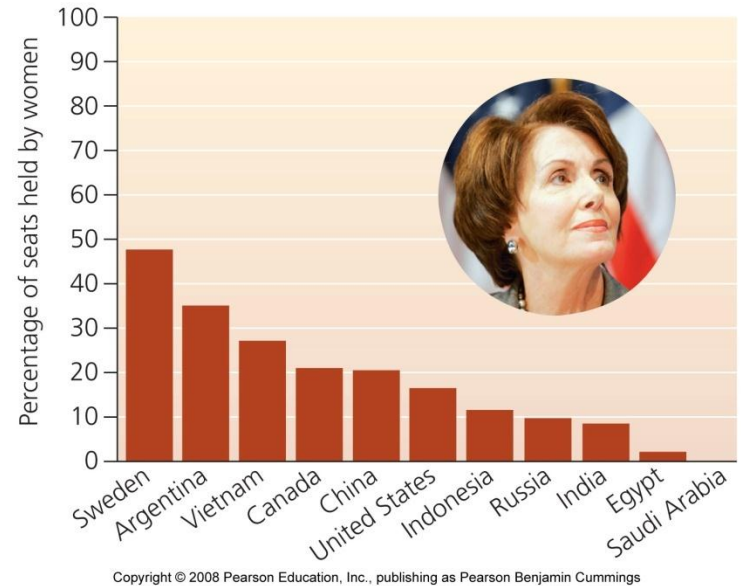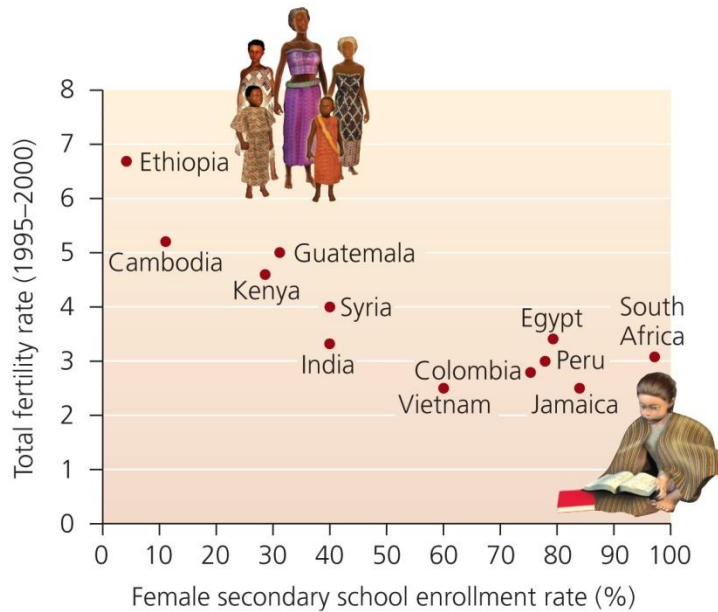
Women with little power have unintended pregnancies

Population policies and family planning work

- Many countries provide incentives, education, contraception, and reproductive health care

- Funding and policies that encourage family planning lower population growth rates in all nations

  - Thailand has an educational based approach to family planning and its growth rate fell from 2.3% to 0.7%

  - Brazil, Mexico, Iran, Cuba, and other developing countries have active programs
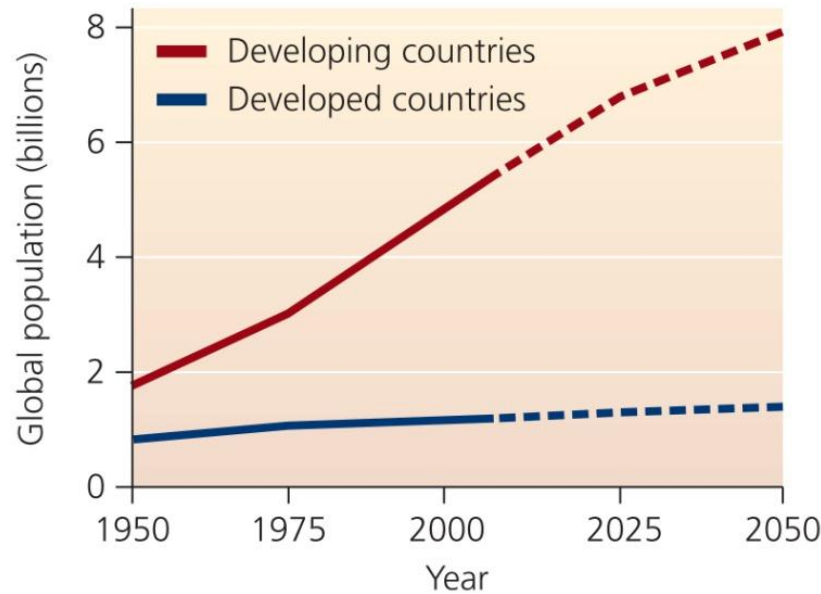
Family planning reduces unintended pregnancies
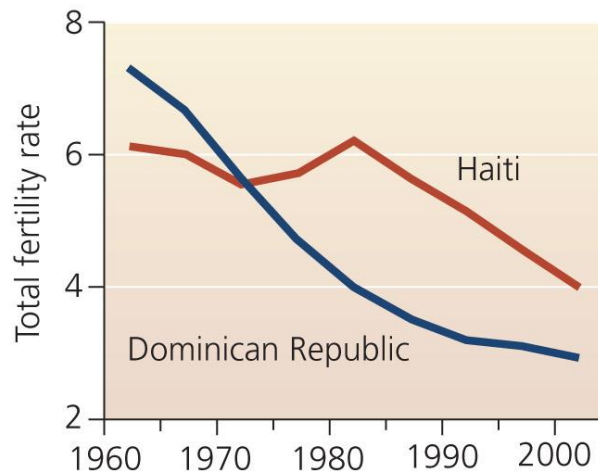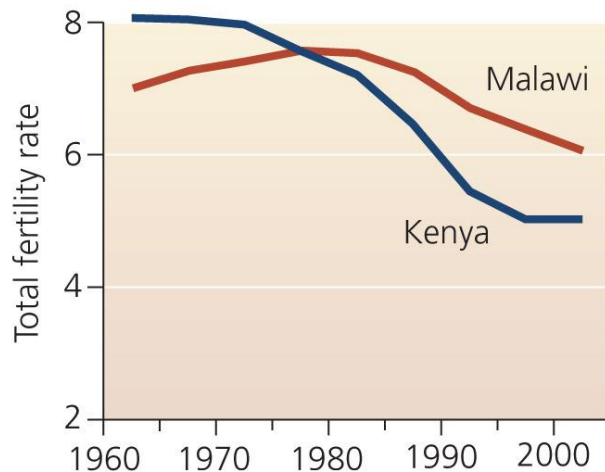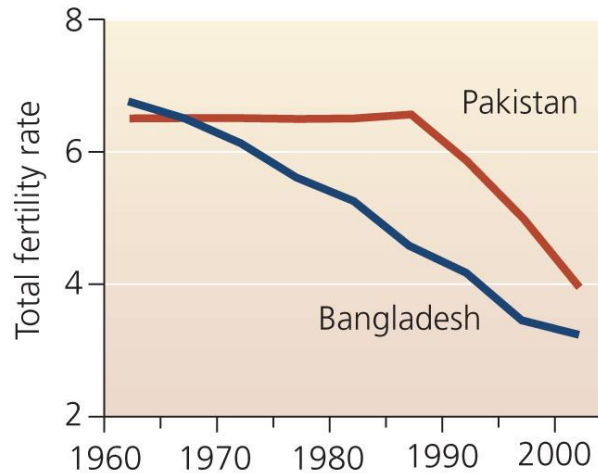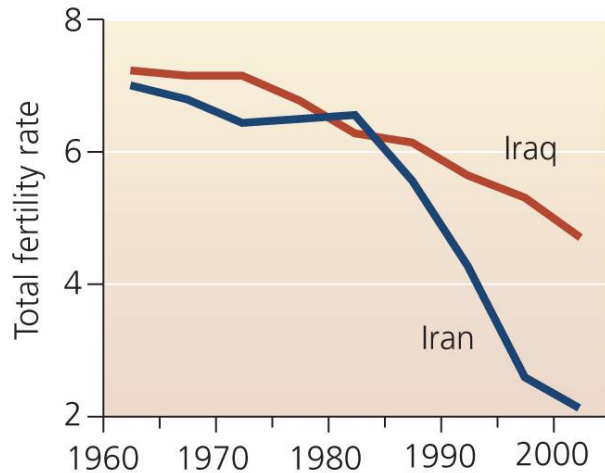
Blue = family planning accessible
Red = family planning not accessible

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Poverty and population growth are correlated

- Poorer societies have higher growth rates than wealthier societies

  - Consistent with the demographic transition theory

 - They have higher fertility and growth rates, with lower contraceptive use

99% of the next billion people added will be born in poor, less developed regions that are least able to support them

Affluence also produces severe environmental impacts

- The population problem does not exist only within poor countries

- Affluent societies have enormous resource consumption and waste production

    - People use resources from other areas, as well as from their own

    - Individuals' ecological footprints are huge

One American has as much environmental impact as 4.5 Chinese or 10 Indians or 19 Afghans

The Earth can't support our consuming lifestyle
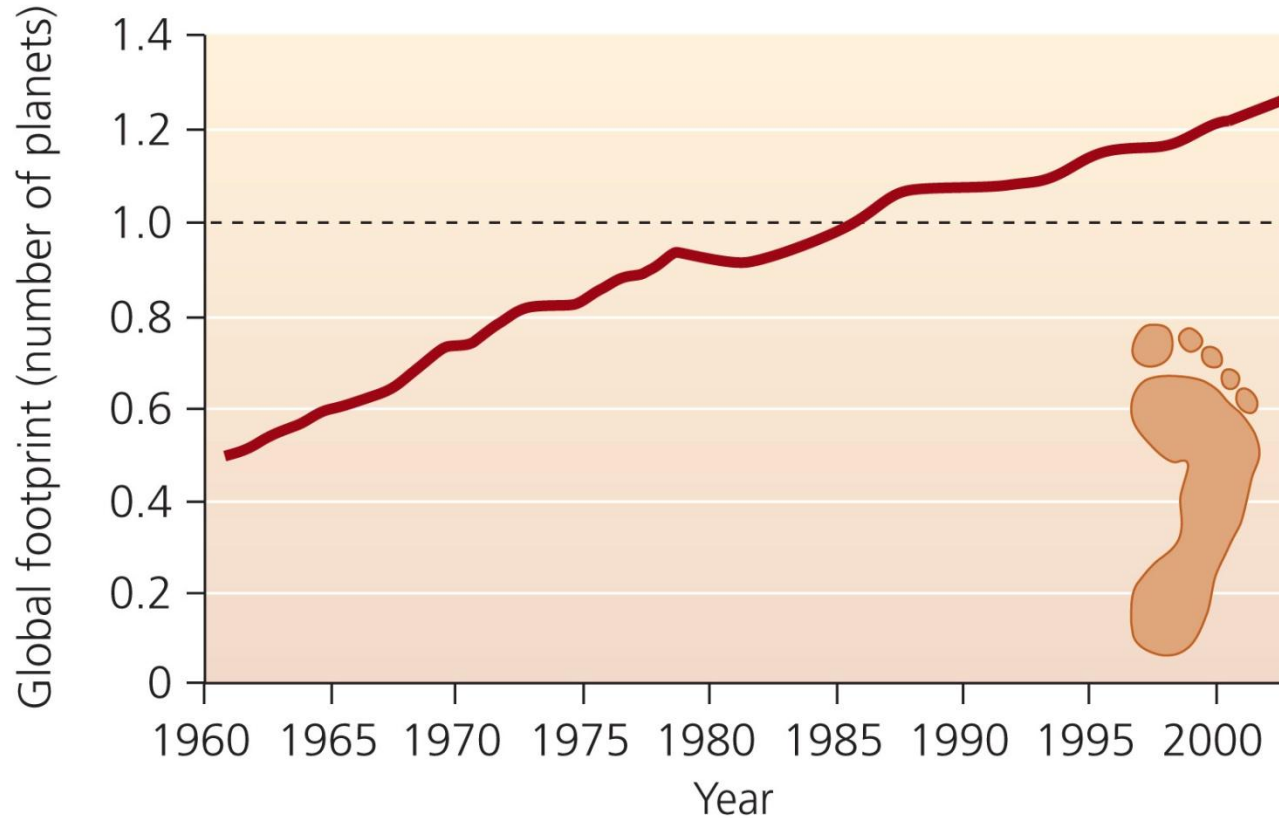
Humanity's global ecological footprint surpassed Earth's capacity to support us in 1987

The wealth gap and population growth cause conflict

- The stark contrast between affluent and poor societies causes social and environmental stress

- The richest 20% use 86% of the world's resources

    - Leaves 14% of the resources for 80% of the world's people to share

- Tensions between "haves" and "have-not's" are increasing

(a) A family living in the United States

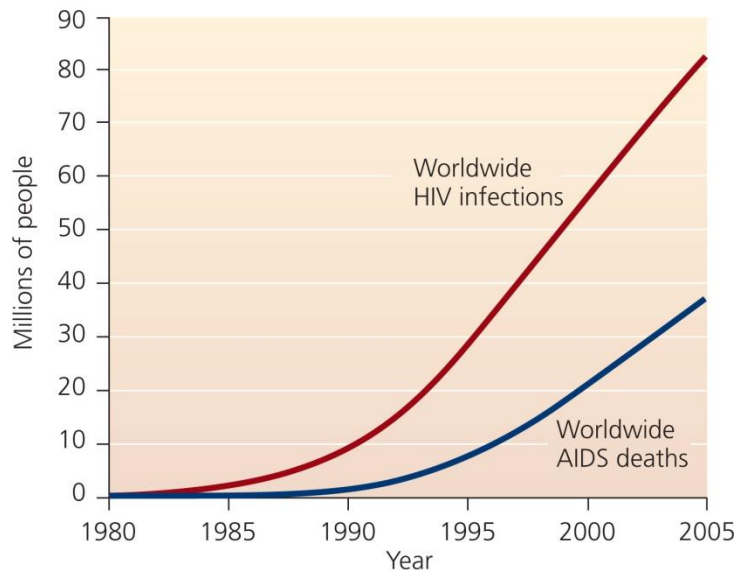Copyright © 2008 Pearson Education, Inc., publishing as Pearson Benjamin Cummings

(b) A family living in Egypt

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HIV/AIDS impacts African populations

- Of 40 million in the world infected, 27 million live in sub-Saharan Africa

- Low rates of contraceptive use spread the disease

    - 1 in 5 south Africans are infected

HIV is well established and spreading quickly around the world

Demographic fatigue

- **Demographic fatigue** = governments face overwhelming challenges related to population growth.

    - With the added of stress of HIV/AIDS; governments are stretched beyond their capabilities

    - Problems grow worse

- Nations in Africa must take aggressive steps soon

    - Or these countries will have rising death rates and increased birth rates

    - It would cause a profoundly negative outcome, both for humans and the environment

Sustainable development and population goals go hand in hand