

CHAPTER 5: POPULATIONS

Dr. Bertolotti

Essential Question



What factors contribute to changes in populations?



**How do ecologists study
populations?**

Characteristics of Populations

- **4** important characteristics of populations are:
 - **1. Geographic range-** the area inhabited by a population
 - **2. Population Density and distribution:**
 - **Population density** refers to the number of individuals per unit area
 - **3. Growth rate**
 - Determines whether the size of the population increases, decreases, or stays the same
 - **4. Age structure**
 - **Age structure** is the number of males and females of each age a population contains

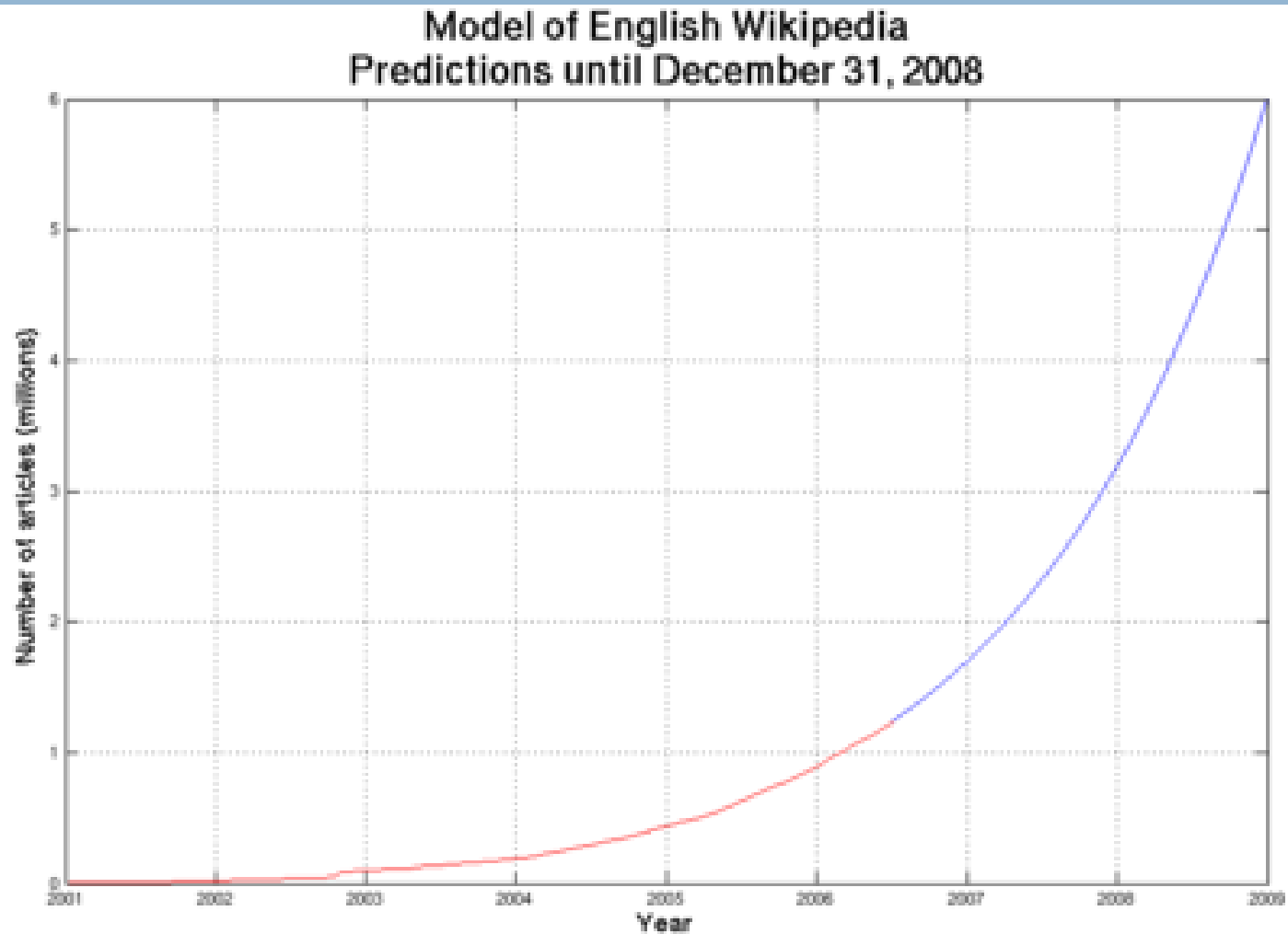
Population growth

- **3** factors can affect population size:
 - 1. The number of births
 - 2. The number of deaths
 - 3. The number of individuals that enter or leave the population
 - **Immigration:** the movement of individuals into an area, can cause population growth
 - **Emigration:** the movement of individuals out of an area, can cause populations to decrease

Exponential Growth

- **Exponential growth:** occurs when the individuals in a population reproduce at a constant rate
 - Typically represented by a J-shaped curve
 - Under ideal conditions with unlimited resources, a population will grow exponentially

Exponential curve

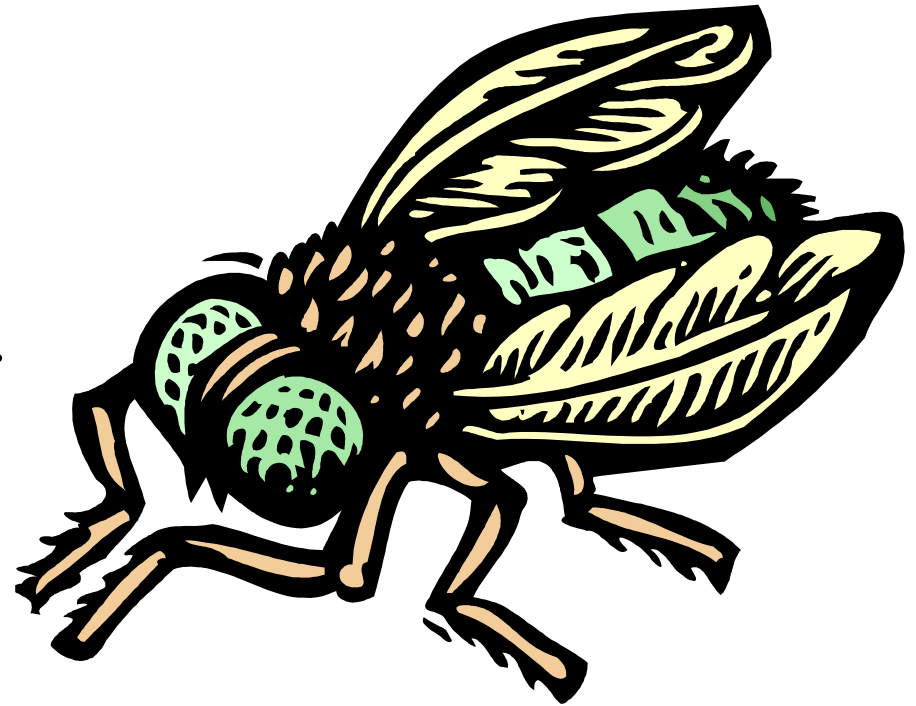


Biotic Potential

- Under favorable conditions, a species may reach its biotic potential.
- **Biotic potential**- highest reproduction rate possible for a species under “ideal” conditions.

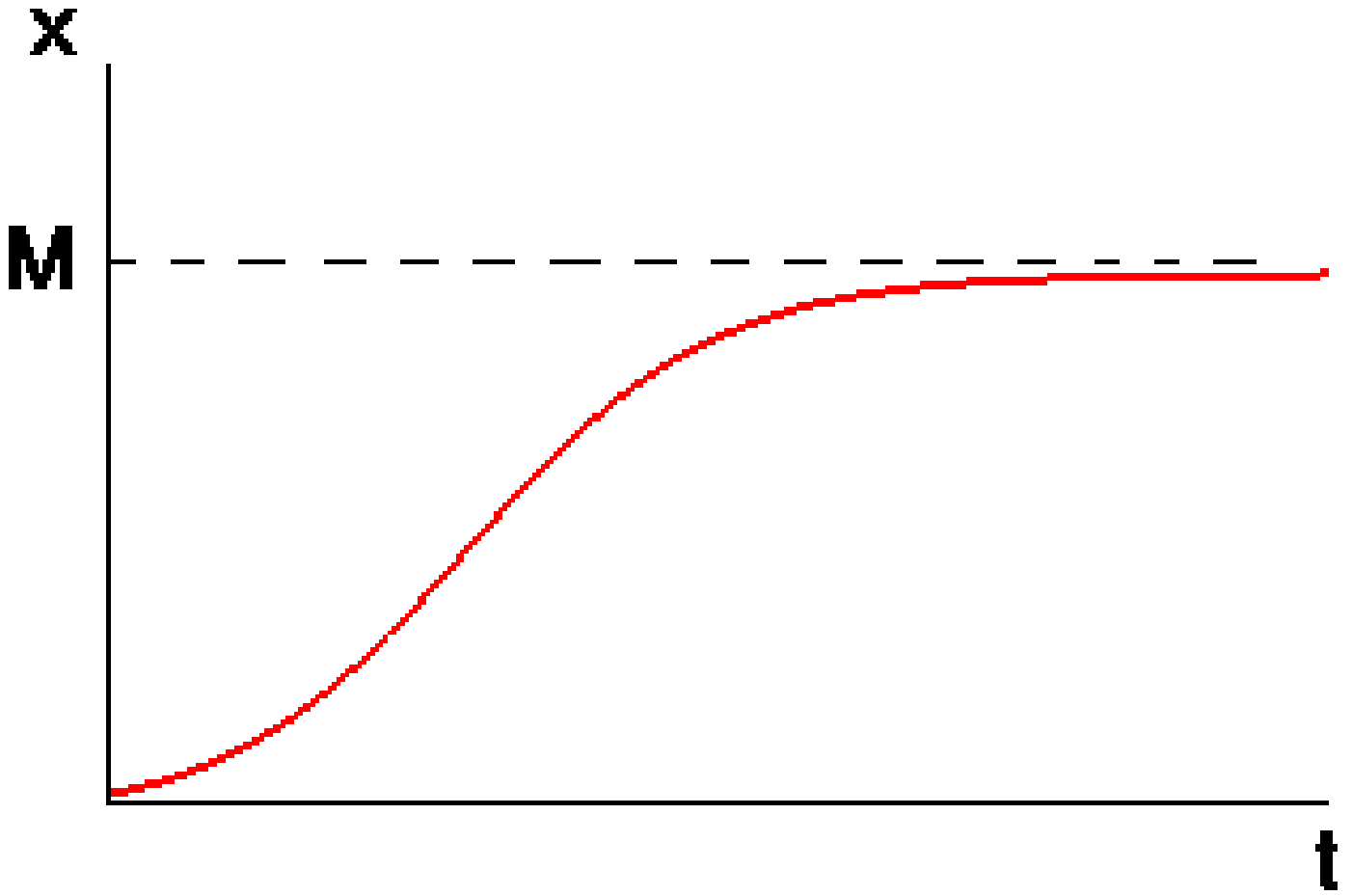
Ex) Houseflies

- lay over 100 eggs at once
- can reproduce at 1 month old
- after 7 generations,
one fly = 15 billion flies!!!



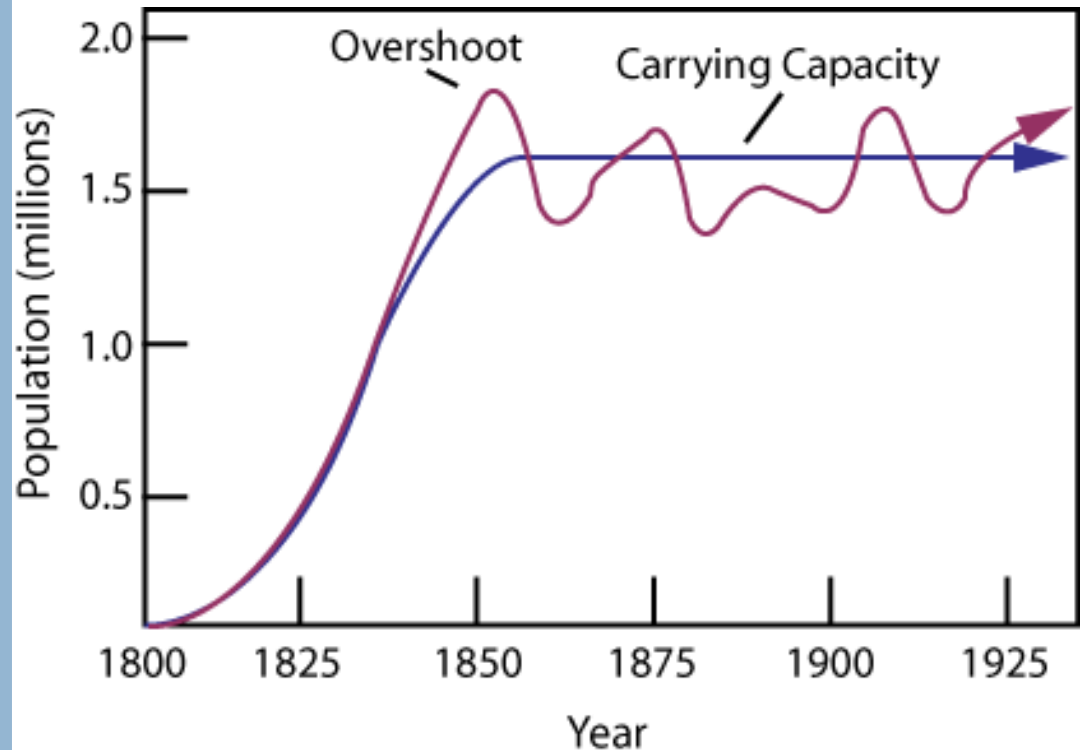
Logistic Growth

- **Logistic growth:** occurs when a population's growth slows or stops following a period of exponential growth
 - Typically happens when a resource becomes less available thus the growth of a population slows or stops
 - Is represented by a S-shaped curve
 - Consists of 3 phases
 - 1. Phase 1: Exponential Growth
 - 2. Phase 2: Growth Slows Down
 - 3. Phase 3: Growth Stops
- **Carrying capacity:** largest number of individuals of a population that a given environment can support
 - Growth typically levels off here due to factors that stabilize it

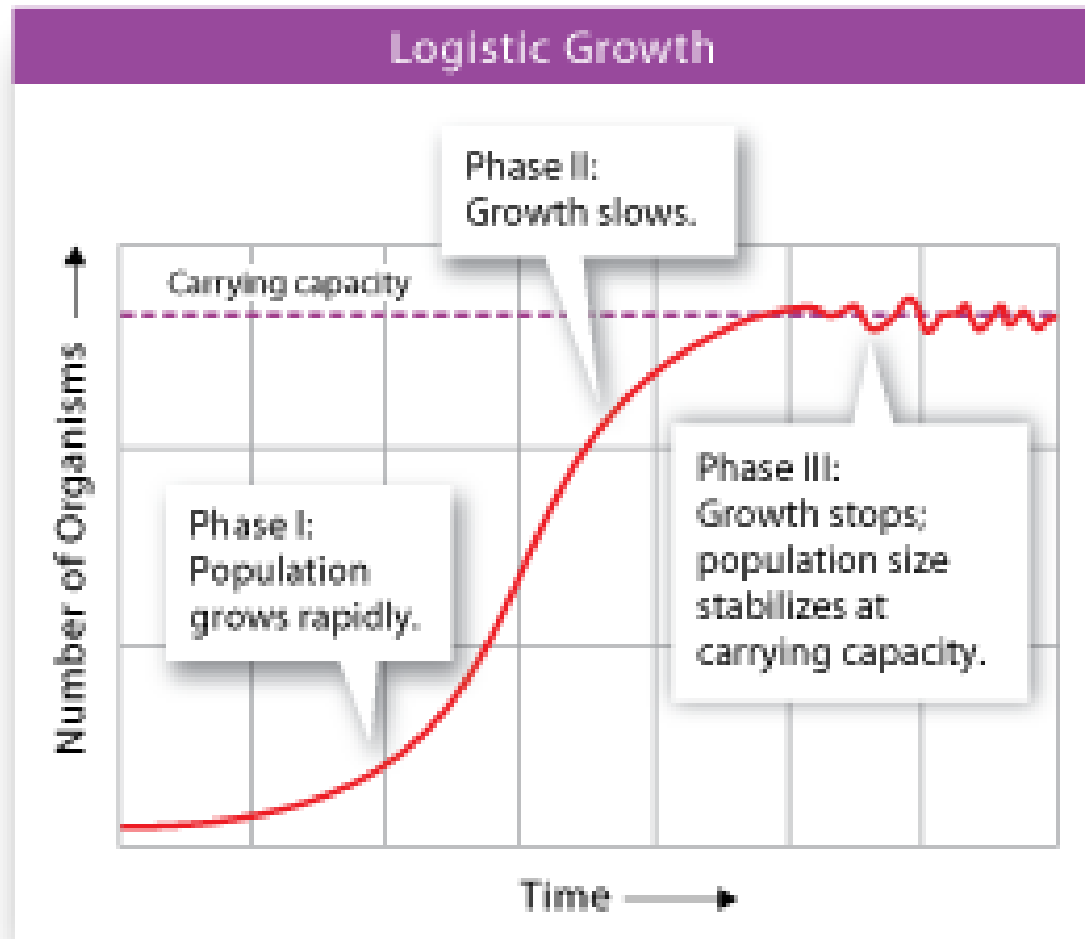


Carrying Capacity

- Population grows slowly, increases, levels off.
- Carrying capacity- total # of individuals that can be supported by the environment in a particular area
- Earth has 6.6 billion people...how many more can it support?



Logistic Growth Curve



Why should we care about populations?

- 1. Increase the growth of populations
 - Endangered species
 - Species we harvest, example: fish
- 2. Decrease the growth of populations
 - Invasive species
 - Pests (like mosquitos)
 - Biological agents of disease and their vectors
- 3. Maintain a population within limits
 - Humans
- 4. Predict changes in population size

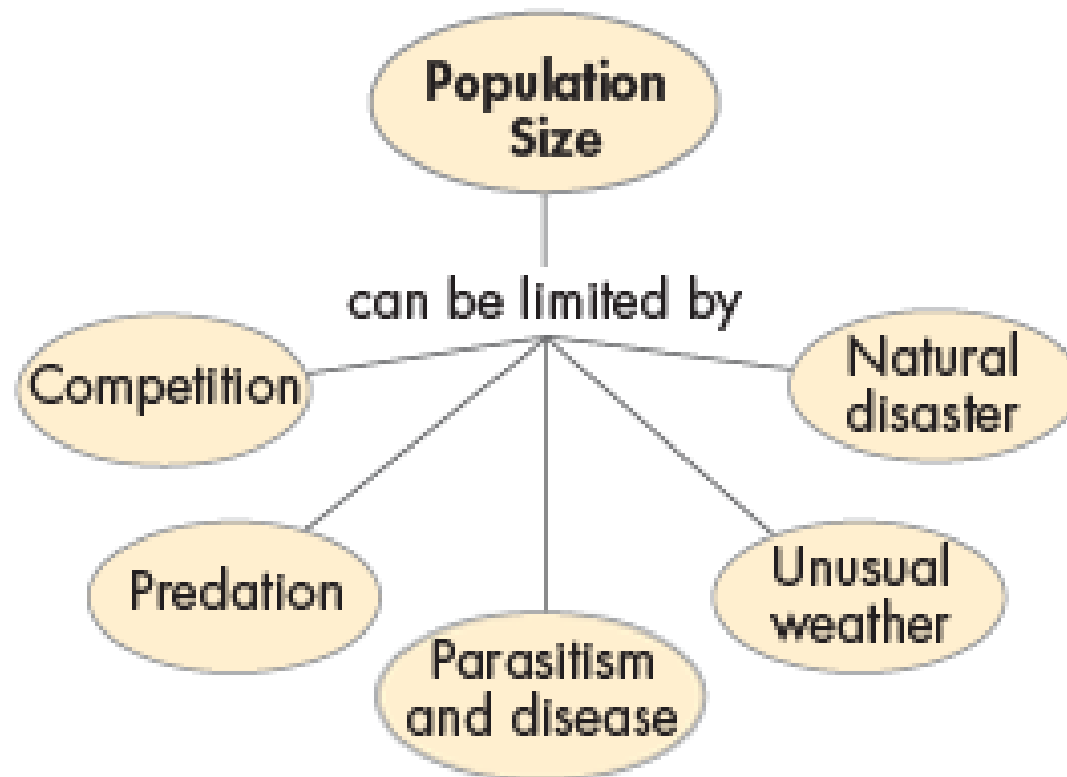


QUESTION AND ANSWER

**How do ecologists study
populations?**



**How do limiting factors affect
populations?**



Limits to Growth

- **Limiting factor:** Factor that causes population growth to decrease.
 - Examples: food, natural disasters, unusual weather, predation, parasitism and disease, competition, etc.
 - Acting separately or together, limiting factors determine the carrying capacity of an environment for a species.
 - There are 2 main types of limiting factors:
 - a) density-dependent and
 - b) density independent factors

Density-dependent factors

- A limiting factor that depends on population size is called density-dependent limiting factors
 - ▣ Density dependent limiting factors only become limiting when the population density reaches a certain level.
 - ▣ They include competition, predation, herbivory, parasitism, stress from overcrowding, and disease
 - Competition
 - When populations become crowded, individuals compete for food, space, water, sunlight, and other essentials. Resources are also used-up faster with increasing number of individuals.
 - Predation
 - Fluctuations in the populations of prey affect predator populations which in turn affects the prey. Thus, populations of both predator and prey will cycle up and down over time.

Density-dependent factors

- Parasitism and disease

- Parasites and disease-causing organisms feed at the expense of the host which results in them being weakened which causes disease or death.

- Stress from overcrowding

- Too much fighting over resources due to overcrowding can cause high levels of stress. This can weaken the body's ability to resist disease. In some species, females will neglect, kill, or even eat their own offspring.
- Thus, stress from overcrowding can lower birthrates, raise death rates, or both. It can also increase emigration rates.

Density independent factors

- **Density independent factors:** are limiting factors that affect all populations in similar ways, regardless of population size.
 - Examples include unusual weather, natural disasters, seasonal cycles, and certain human activities such as damming rivers and cutting down forests
 - The population of many species typically decline significantly in response to these factors



QUESTION AND ANSWER

**How do limiting factors affect
populations?**



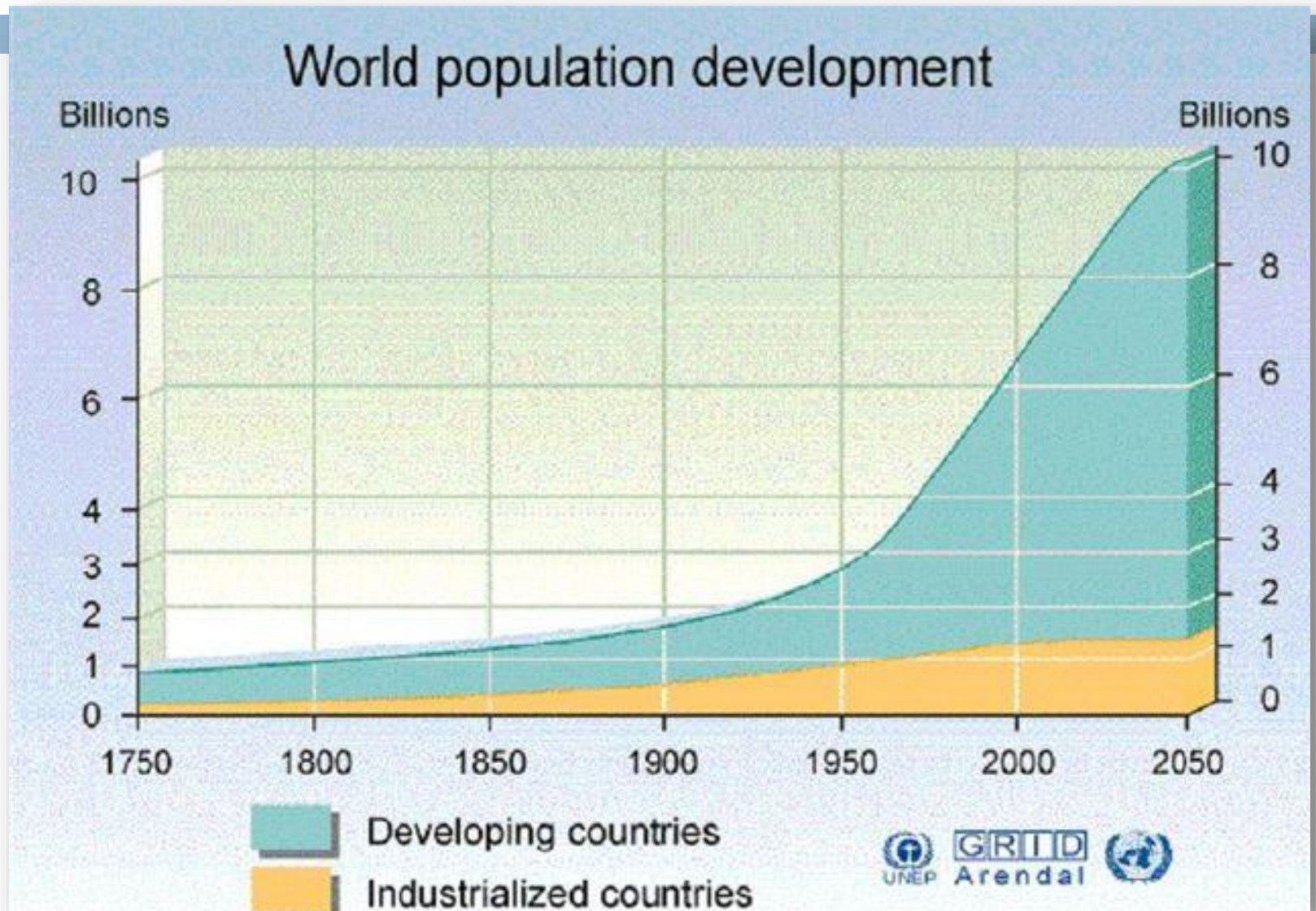
Why do population growth rates differ among countries?

Human Population Growth



- The human population, like populations of other organisms, tends to increase. The rate of that increase has changed dramatically over time.

Human population growth

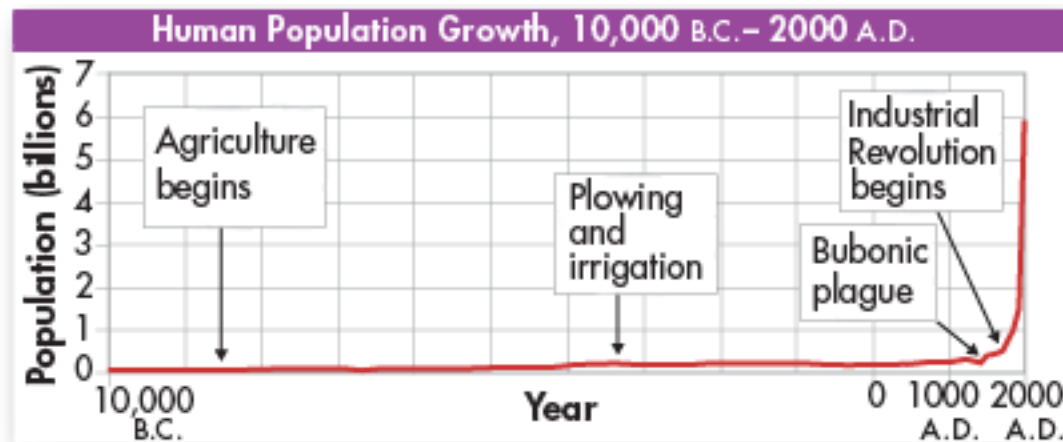


Historical Overview

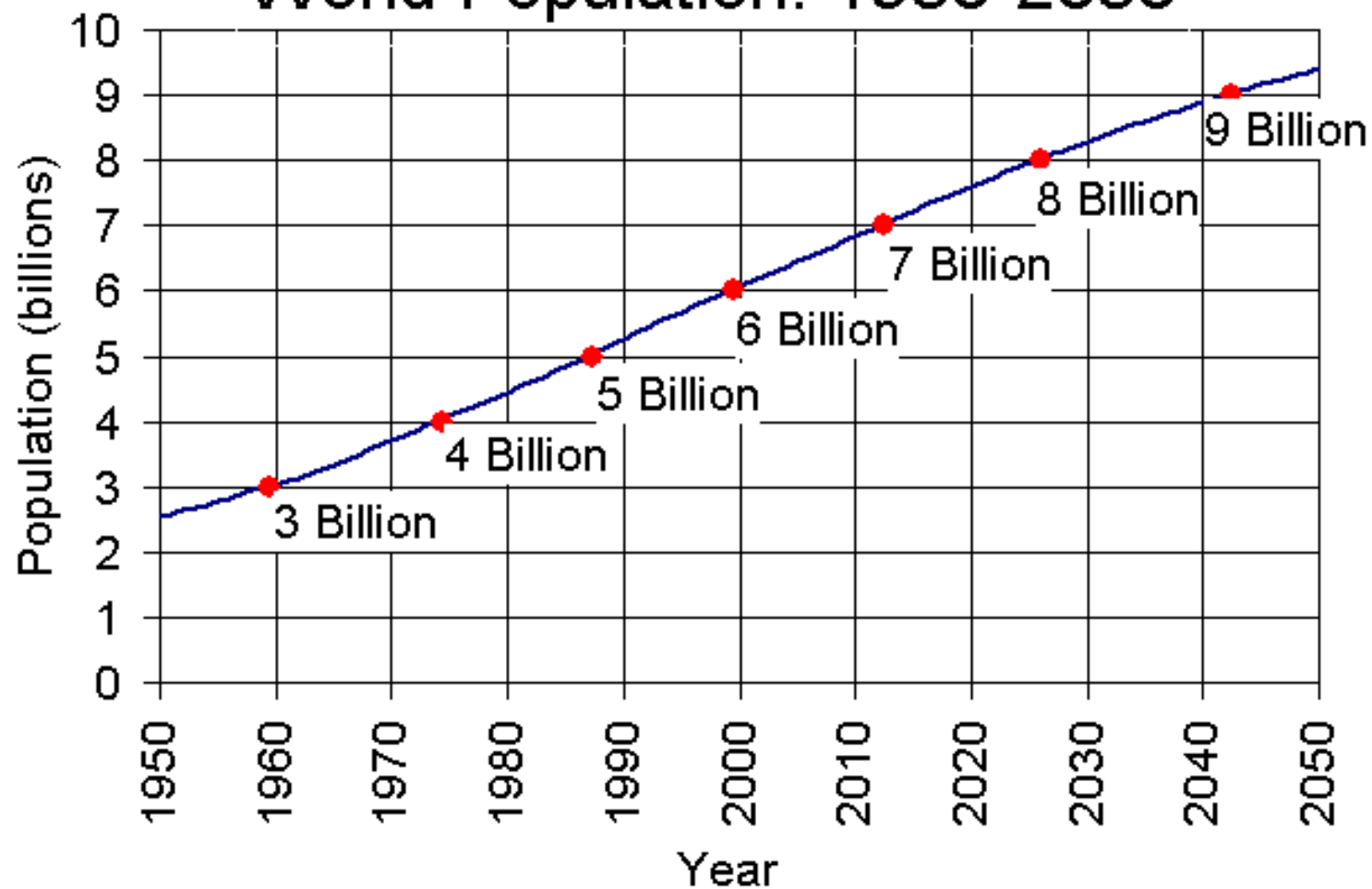
- For most of human existence, the population grew slowly because life was harsh. Food was hard to find. Predators and diseases were common and life-threatening.
- These limiting factors kept human death rates very high. Until fairly recently, only half the children in the world survived to adulthood.
- Because death rates were so high, families had many children, just to make sure that some would survive.
- The combination of lower death rates and high birthrates led to exponential growth.

Historical Overview (part 2)

- As civilization advanced, life became easier, and the human population began to grow more rapidly. That trend continued through the Industrial Revolution in the 1800s.
- Several factors, including improved nutrition, sanitation, medicine, and healthcare, dramatically reduced death rates. Yet, birthrates in most parts of the world remained high.

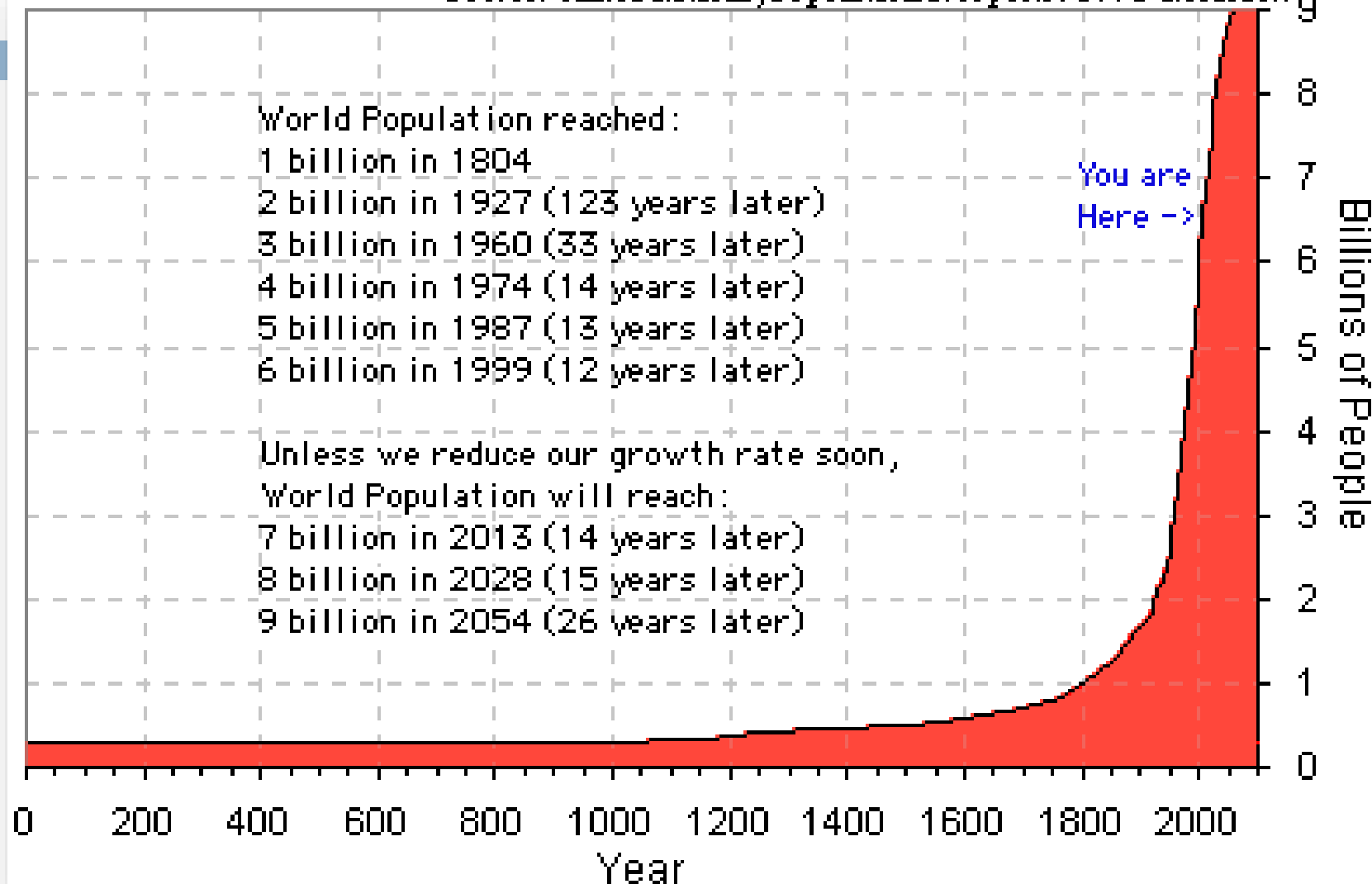


World Population: 1950-2050



Source: U.S. Census Bureau, International Data Base, July 2007 version.

Source: United Nations, Population Prospects: 2004 Revision



World human population estimates



- ▣ 6,917, 955, 195 (May 2011)
- ▣ 6,706, 993, 152 (July 2008)
- ▣ 6, 602, 224, 175 (July 2007)
- ▣ 6, 078, 684, 329 (2000)
- ▣ 5, 275, 407, 789 (1990)
- ▣ 3, 708, 067, 105 (1970)

- ▣ World population increases **everyday** by 203,800 individuals

Problems with Overpopulation

- Humans, more than anything else, are affecting the stability of Earth.
- 1.) Decrease in food supply
 - over fishing
 - agricultural land/residential
- 2.) Energy shortage-
 - renewable/nonrenewable resources
- 3.) Destruction natural resources
 - topsoil, groundwater, species
- 4.) Pollution
 - water
 - air (acid rain, ozone depletion due to CFC's in aerosol cans, global warming due to burning and deforestation → CO₂)
 - production of tons of solid waste

Ozone Shield:

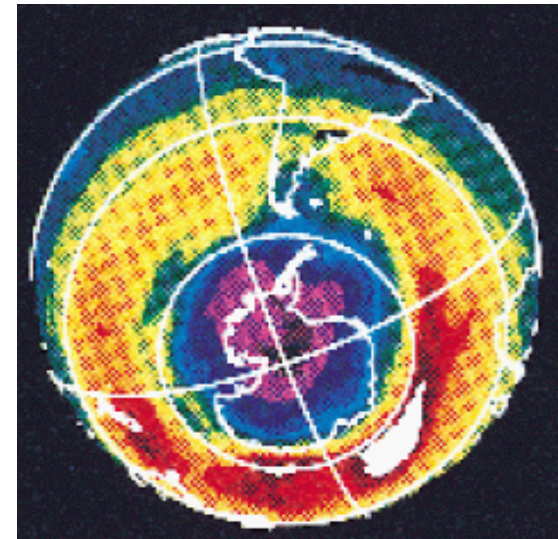
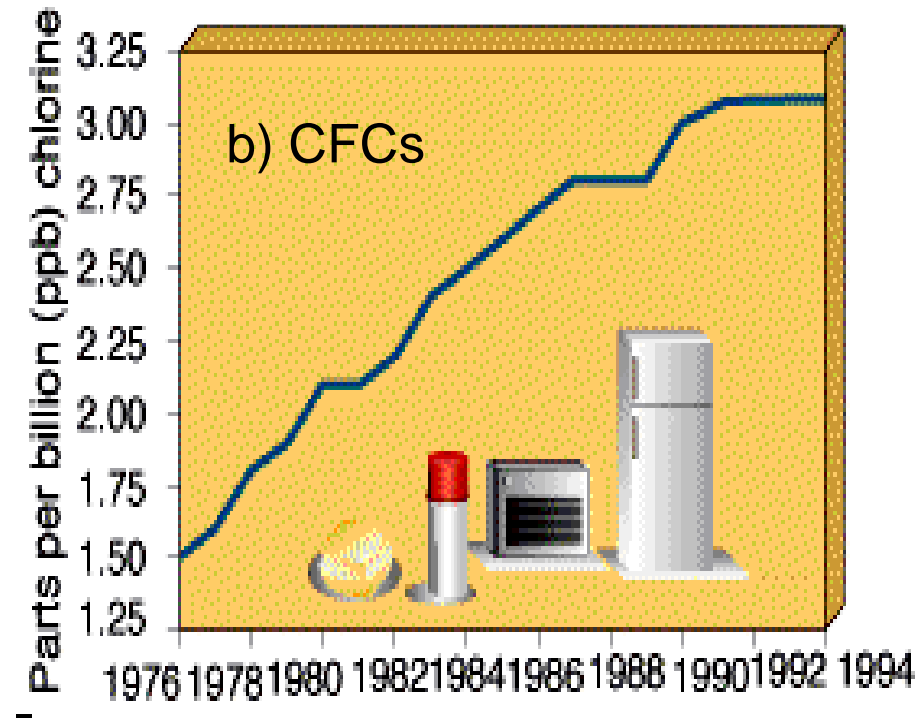
- Ozone (O_3) in the atmosphere absorbs harmful UV light.
- Since the late '70s, scientists have discovered that the ozone layer over Antarctica has decreased by as much as 60 %

Human inputs?

- Chlorofluorocarbons (CFCs)

Problems?

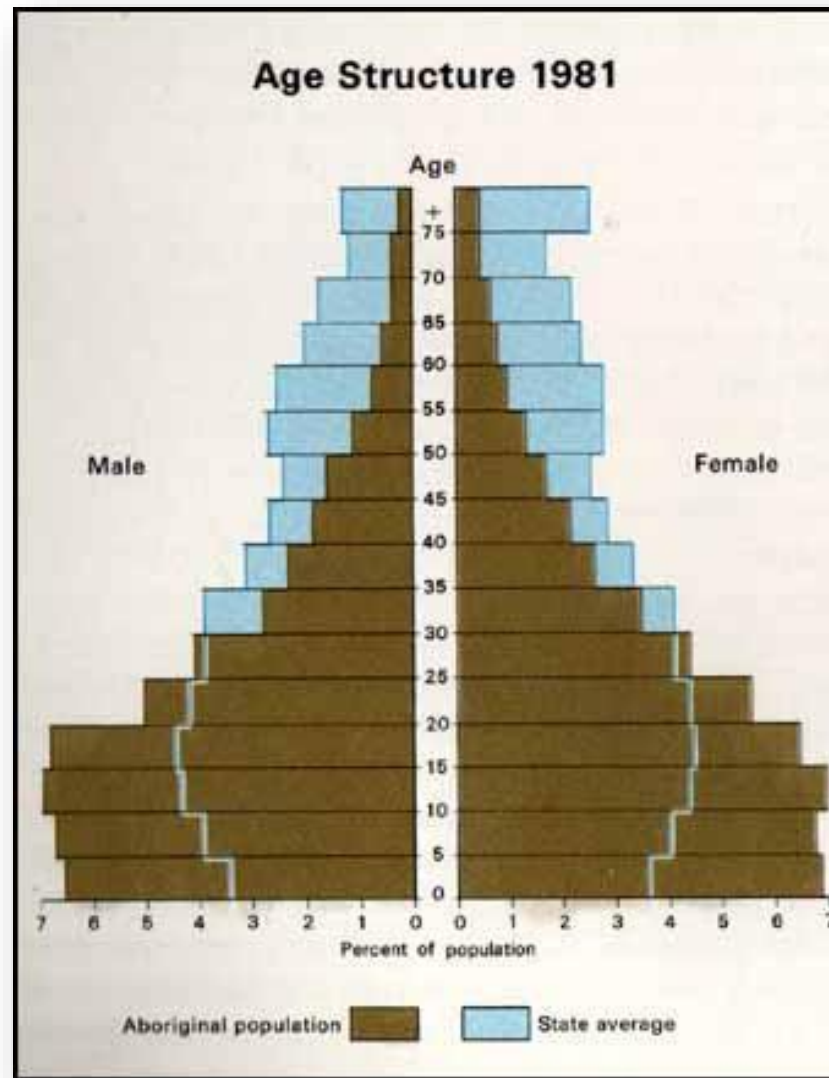
- UV light is a mutagen, which can cause skin cancer
- Cataracts



Patterns of Population Growth

- **Demography:** scientific study of human populations
 - ▣ Attempts to explain how populations change over time
 - ▣ Birthrates, death rates, and the age structure of a population help predict why some countries have high growth rates while other countries grow more slowly
- **Demographic transition:** a change in the population from high birth and death rates to low birth and death rates.
Example, USA
 - ▣ This transition can be attributed to advances in nutrition and medicine (which prolong life) and increases in the standard of living and education (which results in fewer children being born)
- **Age structure diagrams:** a graph of the numbers of males and females within different age groups of a population
 - ▣ Is used to predict future growth

Age Structure Diagram





QUESTION AND ANSWER

**Why do population growth
rates differ among countries?**

Essential Question

What factors contribute to changes in populations?