

# Chapter 5 Populations





## 5-1 How populations grow

# What affects population size?

- A population is a group of organisms belonging to a single species that lives in a given area.



## Characteristics of Populations

# Characteristics of Populations

Three important characteristics of a population are its:

- **geographic distribution**
- **population density**
- **growth rate**

# How Populations Grow

## A. Characteristics of Populations

- Populations are organisms of the same species that live in the same ecosystem and who can potentially interbreed.
- Members of populations compete with one another for resources.
- populations are the unit that evolution acts on as it selects for favorable characteristics within the gene pool that confer survival on some members at the expense of others.

## B. 2 kinds of Population Growth

### 1. Exponential Growth

rapid, unchecked growth

J shaped graph

### 2. Logistic growth

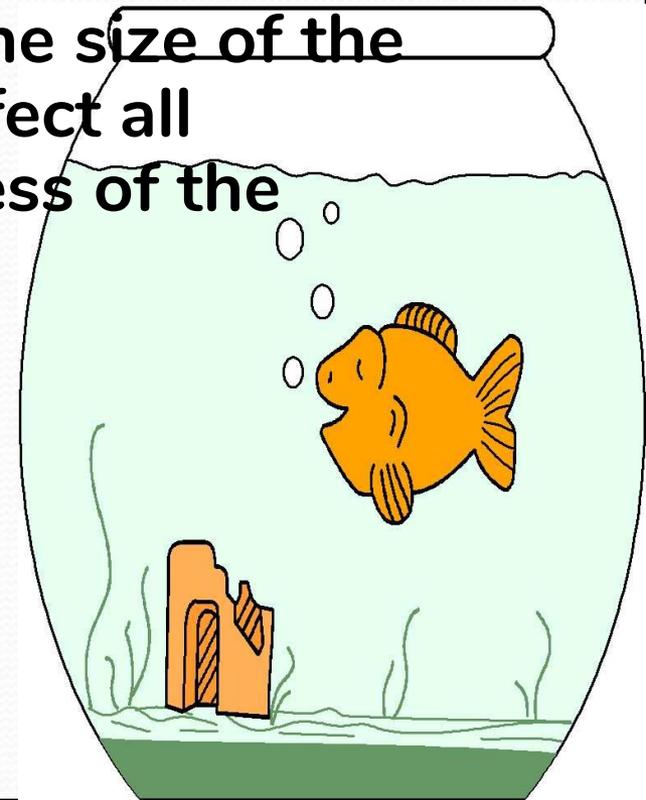
limited by some factor

S shaped graph



# Factors that affect population growth

- A situation that causes the growth of a population to decrease is called a limiting factor.
- Some limiting factors depend on the size of the population. Other limiting factors affect all populations in similar ways, regardless of the population size.
- 2 Kinds of limiting factors:
  1. Density Dependent
  2. Density Independent



# Think about it!

- 1. Imagine a small island that has a population of five rabbits. How might each of the following factors affect the rabbit population?
  - a. climate
  - b. food supply
  - c. predation
- Which of the factors depend on population size?  
(food supply and predation )
- Which factors do not depend on population size?  
(climate )



# Population Growth

- 3 factors affecting population size are-
  - number of births
  - number of deaths
  - number of individuals that enter/leave a population

Immigration-movement of individuals into a population, this can cause a population to grow

Emigration-movement of individuals out of a population, can cause a population to decrease in size

A population can grow when its birthrate is greater than its death rate.



# What are exponential growth and logistic growth?

## Exponential Growth



Under ideal conditions with unlimited resources, a population will grow exponentially.

Exponential growth occurs when the individuals in a population reproduce at a constant rate.

The population becomes larger and larger until it approaches an infinitely large size.

# Exponential Growth



**? Given abundant space, resources, & protection, a population could potentially grow exponentially.**

**? Which would you prefer:**

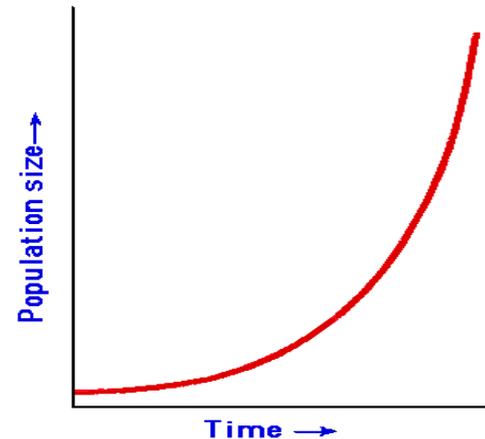
- 1. On the first day of the month, Be given \$1,000,000 to live on, or**
- 2. Get 1 cent on the first day of the month, then have that doubled for day 2, then doubled for day 3 , and so on until the end of the month?**

**It's no contest! That is exponential growth!!!**



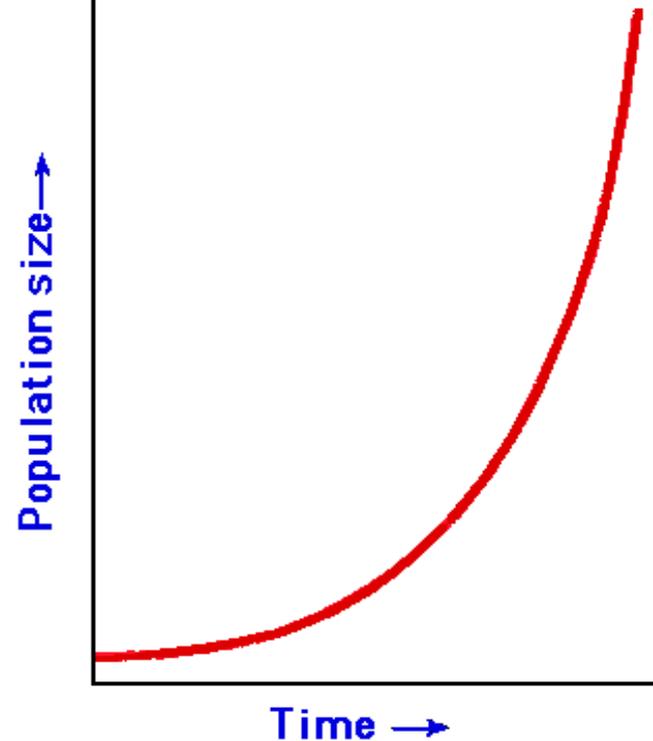
# Exponential Growth (J shaped curve)

- Exponential growth does not occur in natural populations for very long.
- What slows the growth down?
- Birthrate decreases
- Death rate increases
- Immigration decreases
- Emigration increases



# The J- shaped Curve

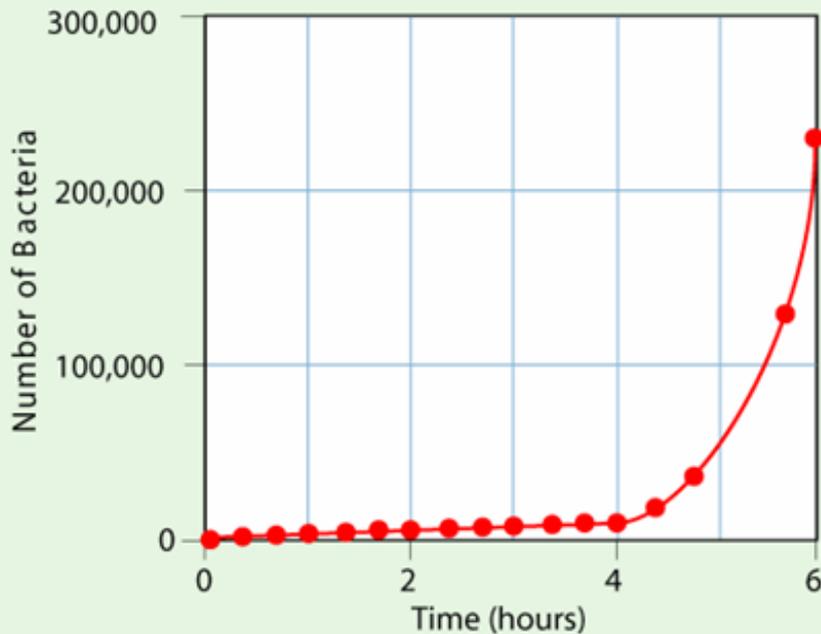
- Population growth vs. Time
- Exponential growth
- J shaped curve



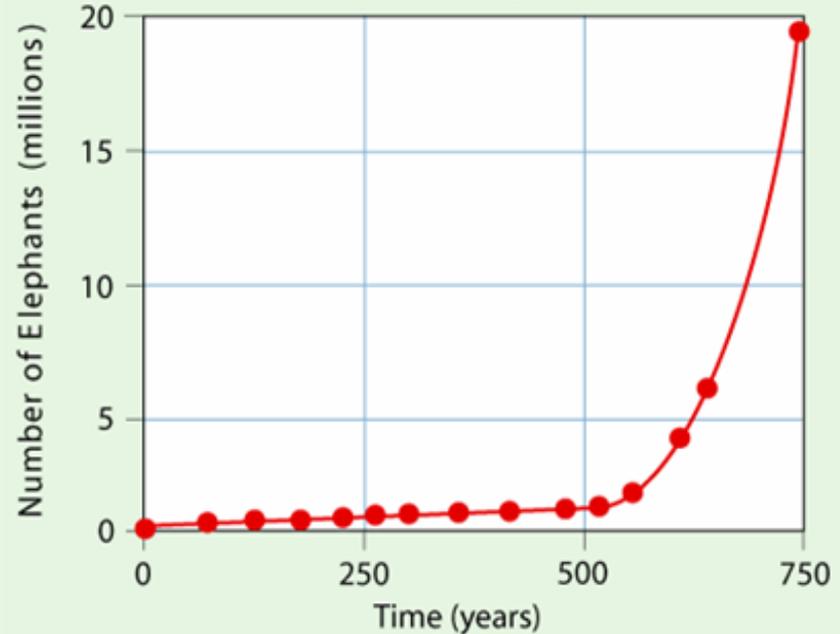
# Exponential Growth

## Exponential Growth

Growth of Bacterial Population

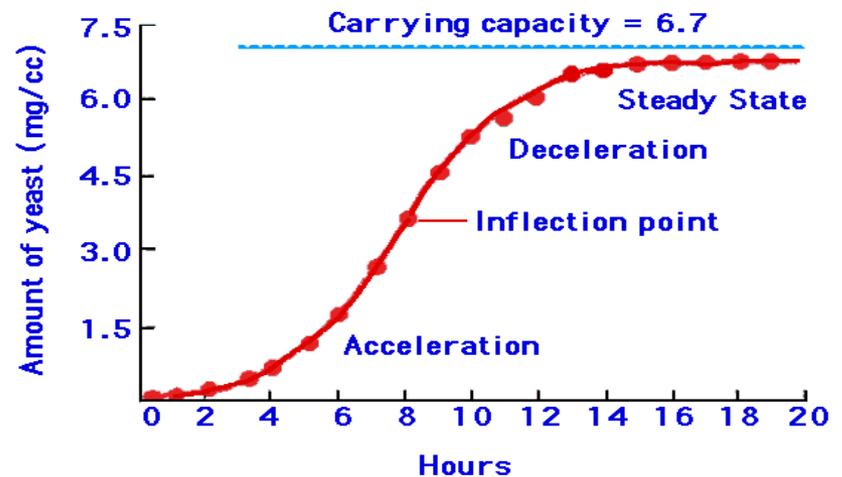


Growth of Elephant Population

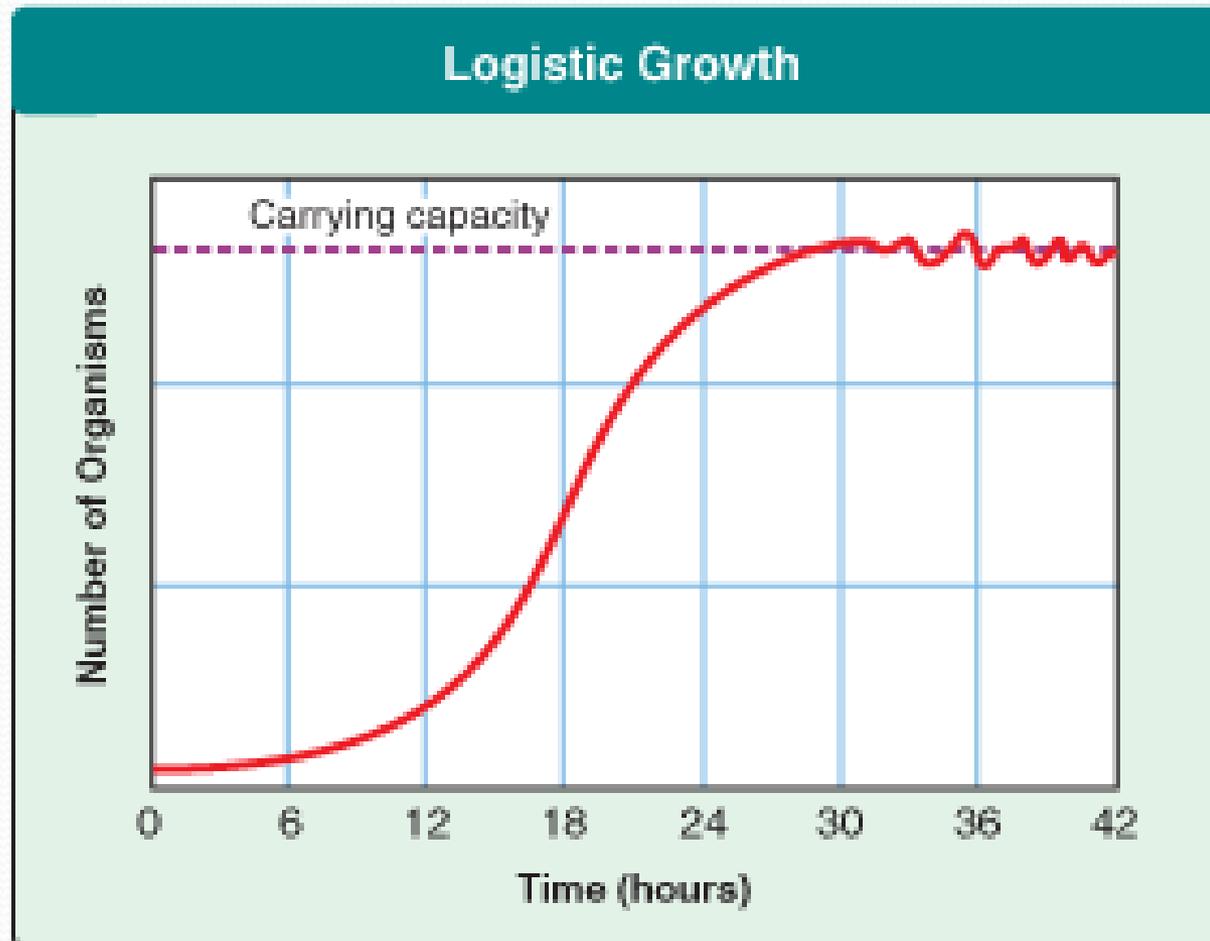


# Logistic growth

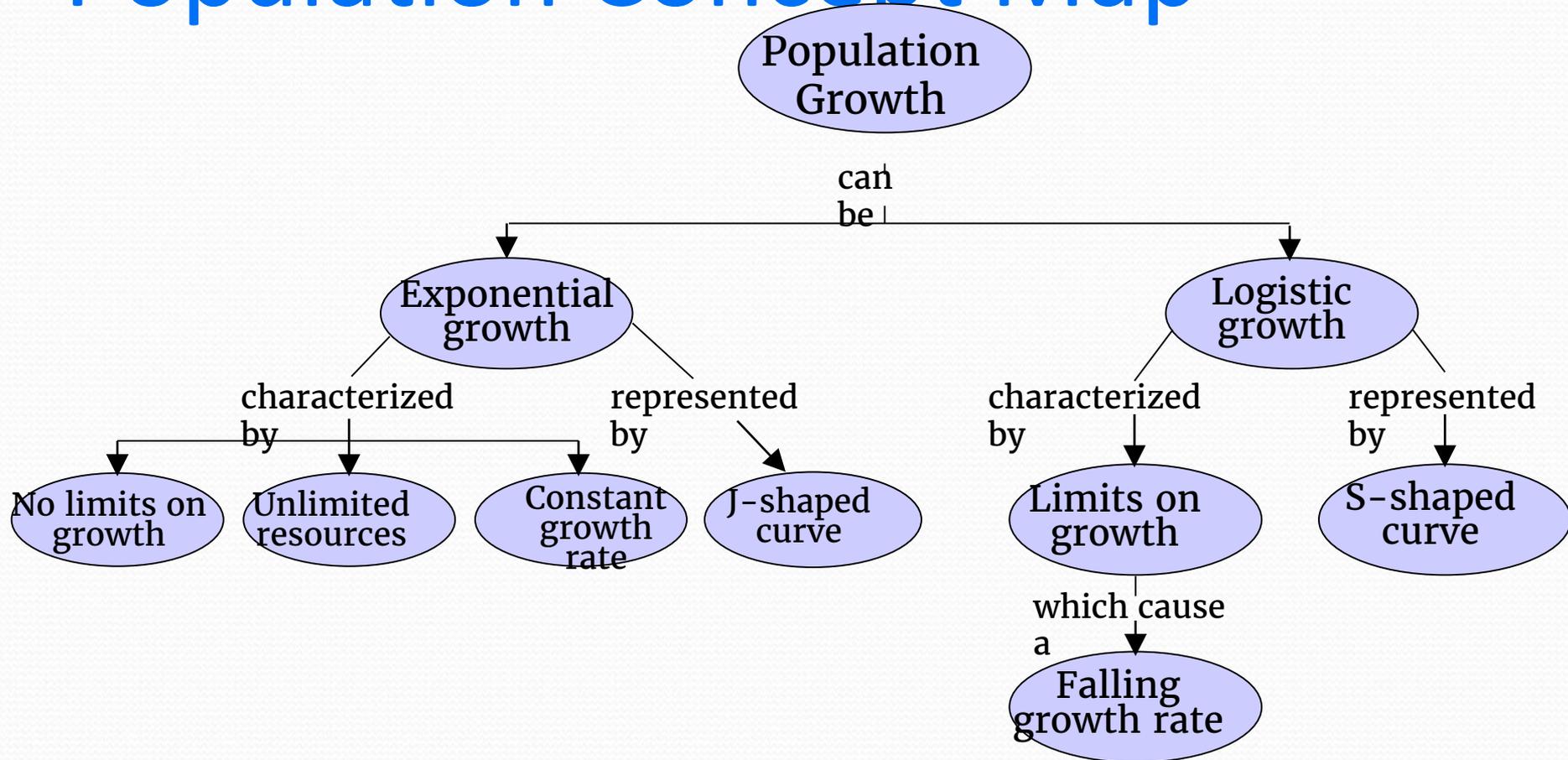
- As resources become less available, the growth of a population will slow or even stop
- As growth levels off, the “carrying capacity” is reached
- Logistic growth is shown with an S-shaped curve



# Logistic growth of Yeast



# Population Concept Map



## 5-2 Limits to Growth



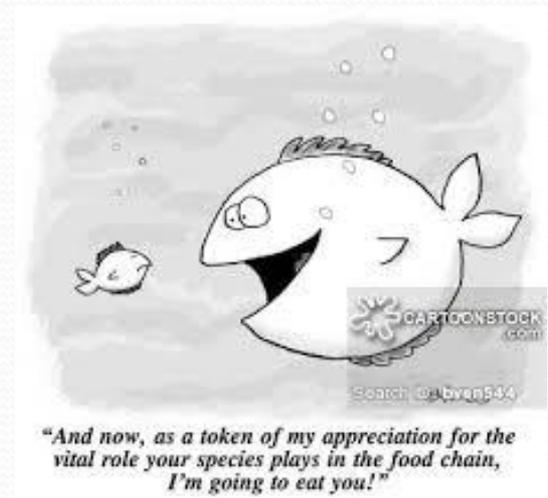
# What factors limit population growth?

## Limiting factors

- A limiting factor is a factor that causes population growth to decrease
- A limiting nutrient (more specific/narrow) would be an example of a limiting factor (less specific/broad)

# Density-Dependent Factors

- Density-Dependent Factors
  - A limiting factor that depends on population size is called a **density-dependent limiting factor**.
- Density-dependent limiting factors include:
  - competition
  - predation
  - parasitism
  - disease



# Density-Dependent Factors

- Density-dependent factors operate only when the population density reaches a certain level. These factors operate most strongly when a population is large and dense.
- They do not affect small, scattered populations as greatly.



# Competition

- When a population is crowded, organisms may compete for resources
- Resources=food, water, space, sunlight, nutrients
- Competition may be intra-species (wolf packs) or inter-species (wolves/coyotes/bears)

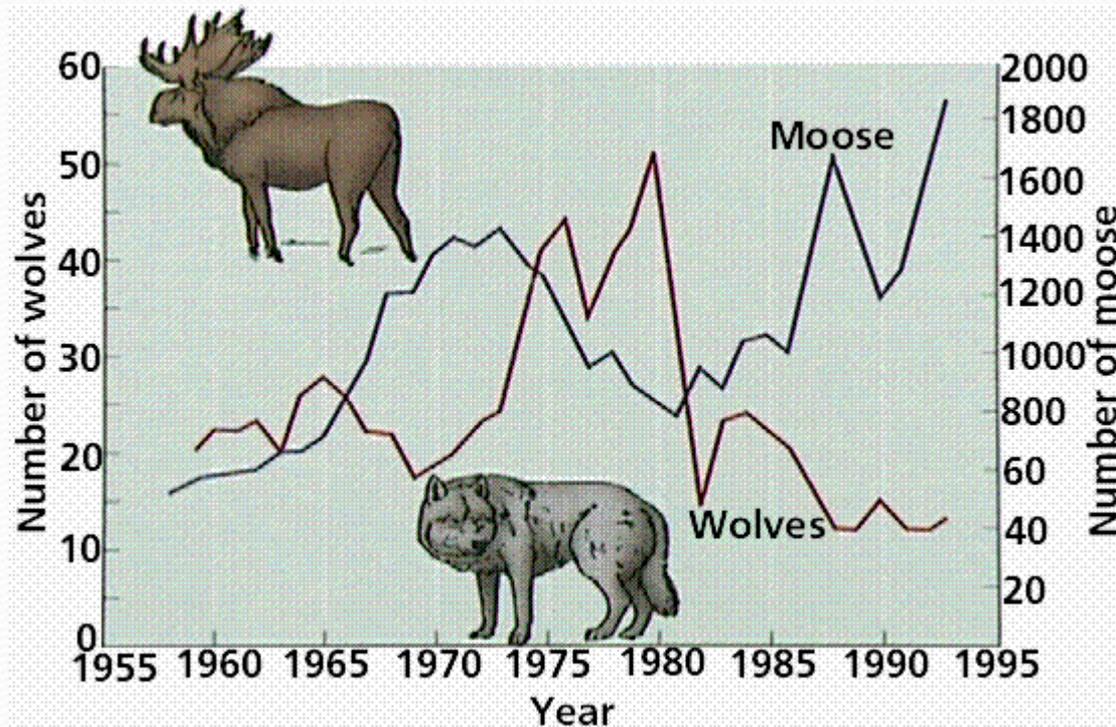


# Density-Dependent Factors

- Competition can also occur between members of different species.
- This type of competition can lead to evolutionary change.
- Over time, the species may evolve to occupy different niches.

# Predation

- Predation
  - Populations in nature are often controlled by predation.
  - The regulation of a population by predation takes place within a **predator-prey relationship**, one of the best-known mechanisms of population control.
- Predator-prey relationships fluctuate with time



# Density-Dependent Factors

## Wolf and Moose Populations on Isle Royale

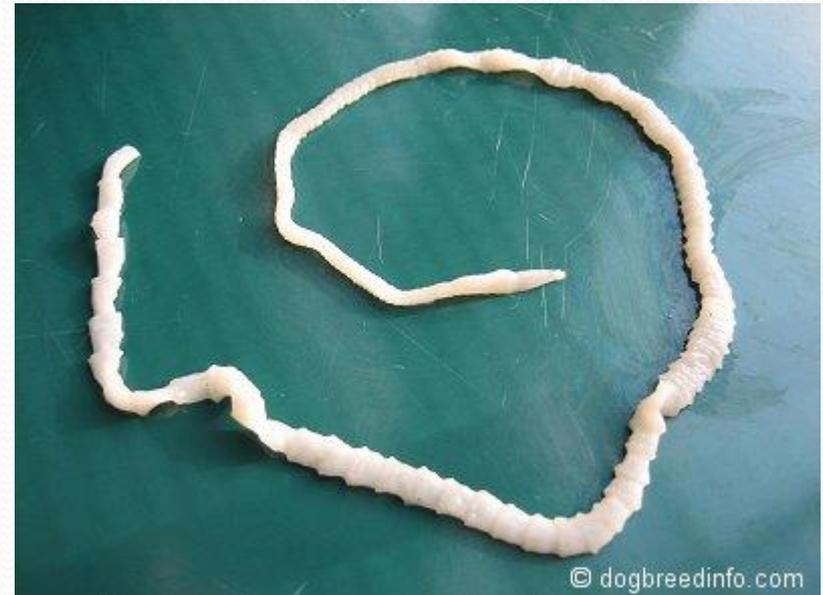


— Moose — Wolves



# Parasitism & Disease

- Parasitism and Disease
  - Parasites can limit the growth of a population.
  - A parasite lives in or on another organism (the host) and consequently harms it.
- Parasites range from microscopic (bacteria) to macroscopic (tapeworm/30 cm long)
- Parasites act somewhat like a predator in that they derive nourishment from the host



# Density-Independent Factors

- Density-Independent Factors affect all populations in similar ways, regardless of population size

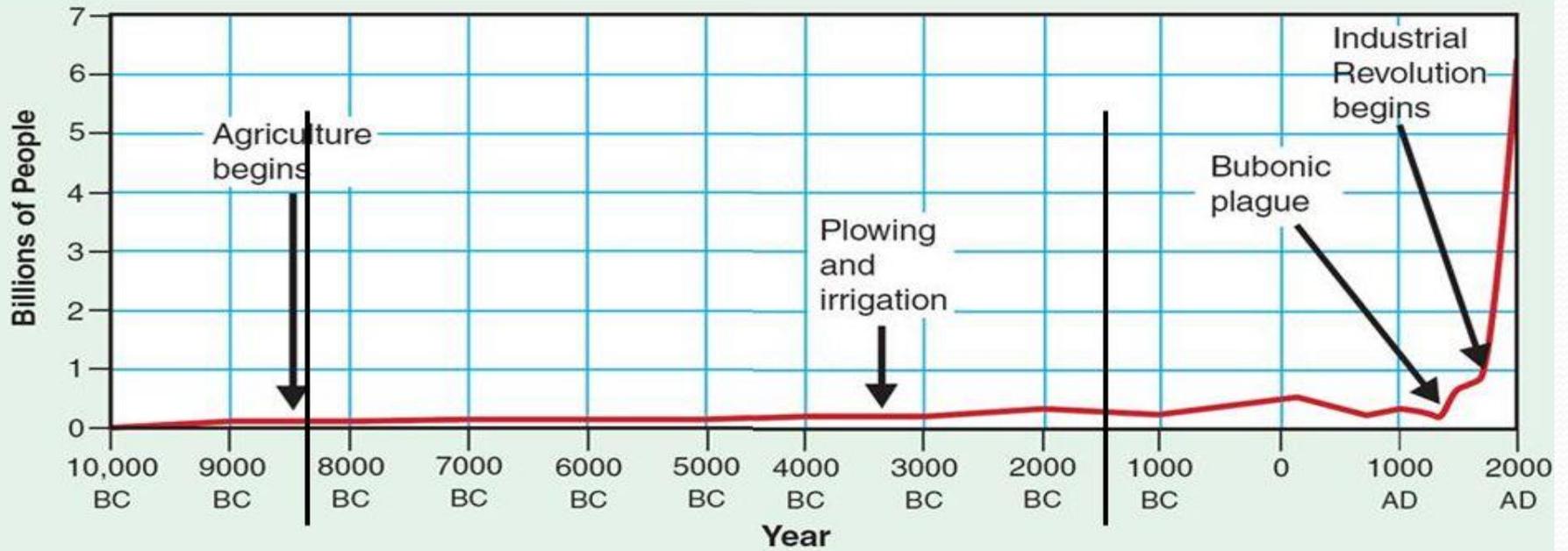
These include-

- Weather (drought, flood, heat, cold)
- Natural Disasters
- Seasonal cycles
- Human activities (clear cutting forest, dams on river, )

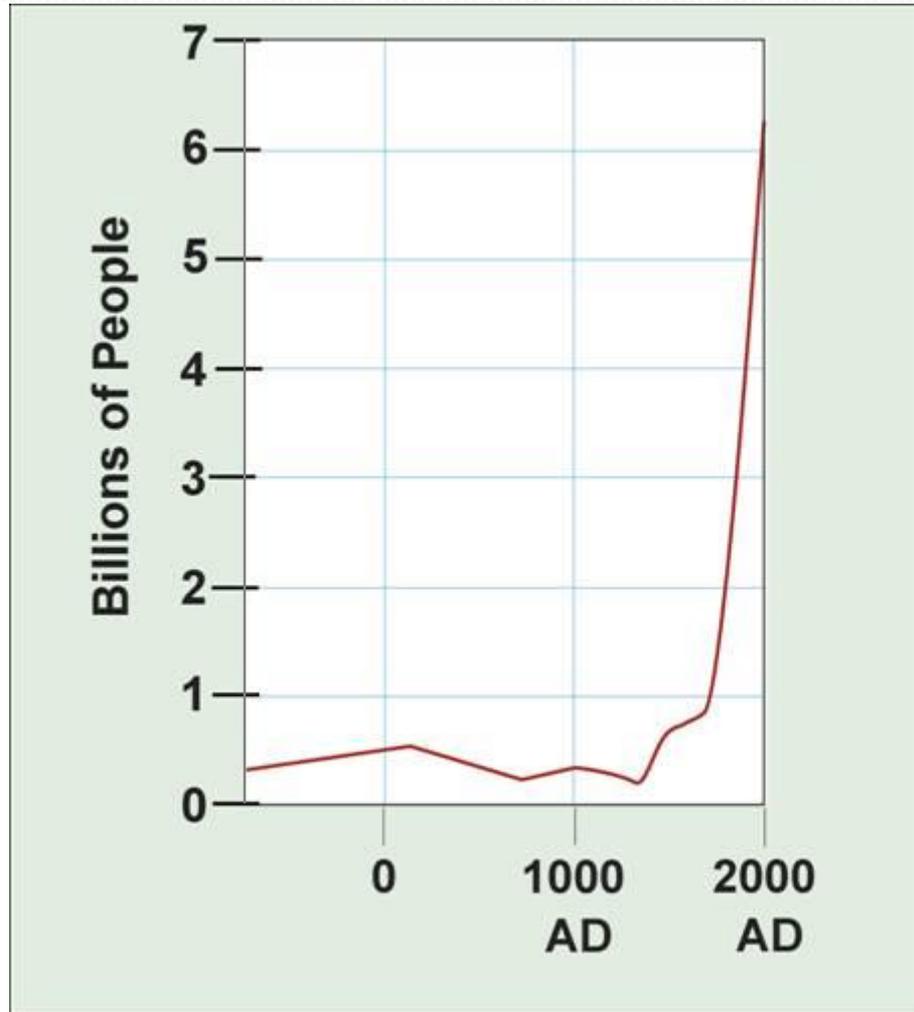


# Historical Overview

## Human Population Growth



# 5-3 Human Population Growth



# Historical Overview

- How has the size of the human population changed over time?
- Like the populations of many other living organisms, the size of the human population tends to increase with time.
- For most of human existence, the population grew slowly.
- Limiting factors kept population sizes low.

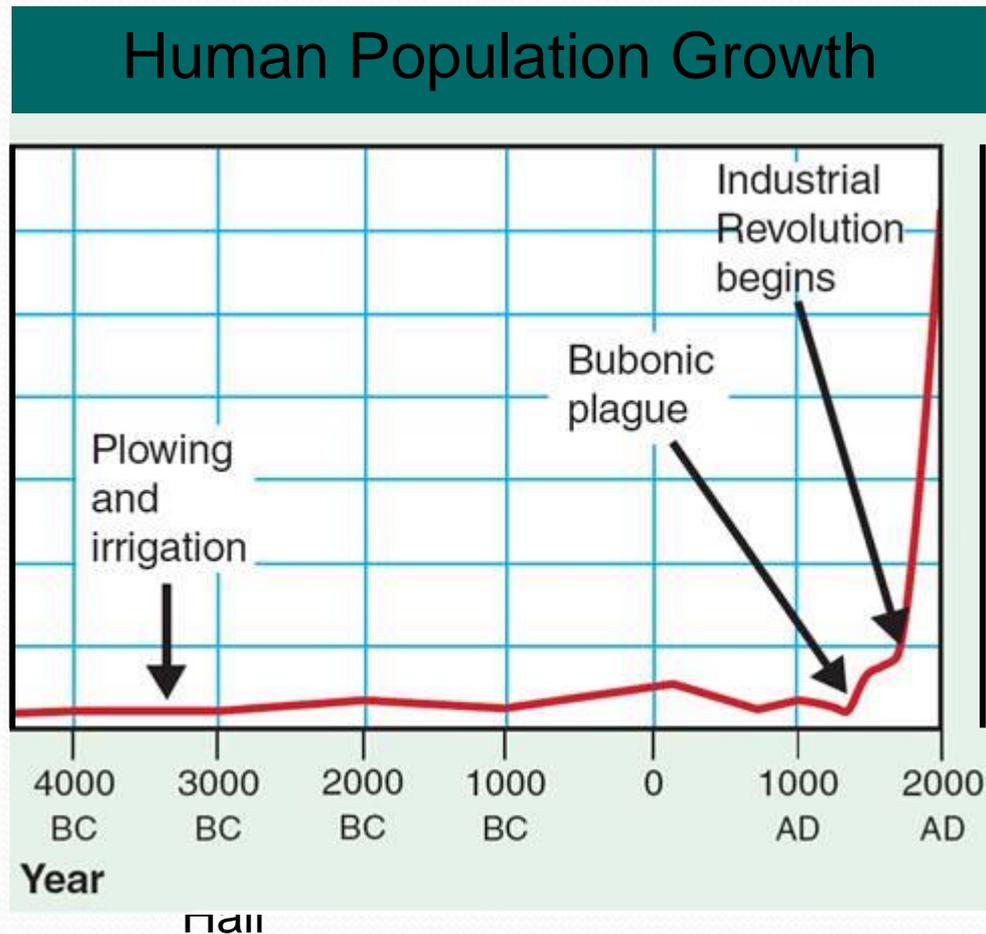
# Historical Overview

- About 500 years ago, the human population began growing more rapidly.
- Life was made easier and safer by advances in agriculture and industry.
- Death rates were dramatically reduced due to improved sanitation, medicine, and healthcare, while birthrates remained high.



# Historical Overview

- With these advances, the human population experienced exponential growth.



# Patterns of Population Growth

- Patterns of Population Growth
  - The scientific study of human populations is called **demography**.
  - Demography examines the characteristics of human populations and attempts to explain how those populations will change over time.

# Patterns of Population Growth

- Why do population growth rates differ in countries throughout the world?

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.



# Patterns of Population Growth

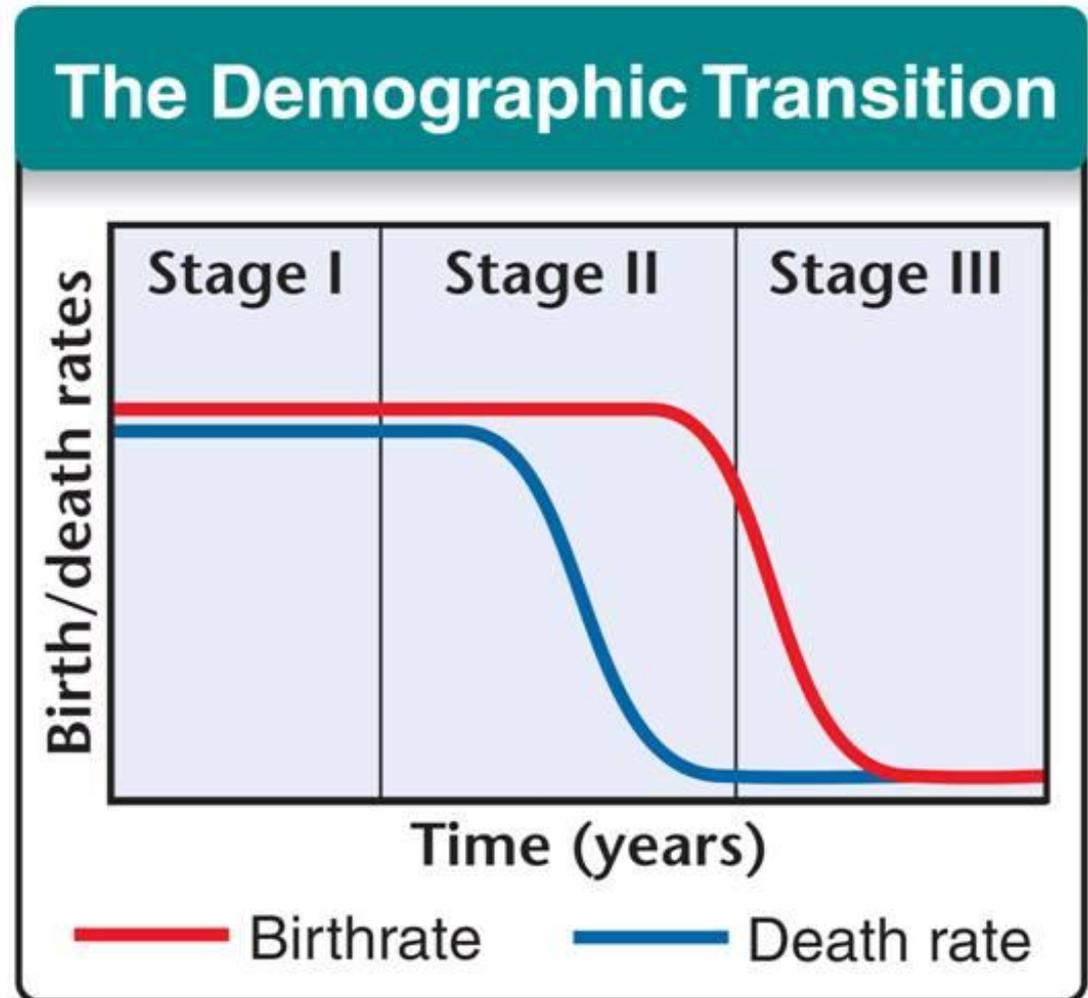
- The Demographic Transition
  - Over the past century, population growth in the United States, Japan, and much of Europe has slowed dramatically.
  - According to demographers, these countries have completed the **demographic transition**, a dramatic change in birth and death rates.

# Patterns of Population Growth

- The demographic transition has three stages.
- In stage 1, there are high death rates and high birthrates.
- In stage 2, the death rate drops, while the birthrate remains high. The population increases rapidly.
- In stage 3, the birthrate decreases, causing population growth to slow.

# Patterns of Population Growth

- The demographic transition is complete when the birthrate falls to meet the death rate, and population growth stops.



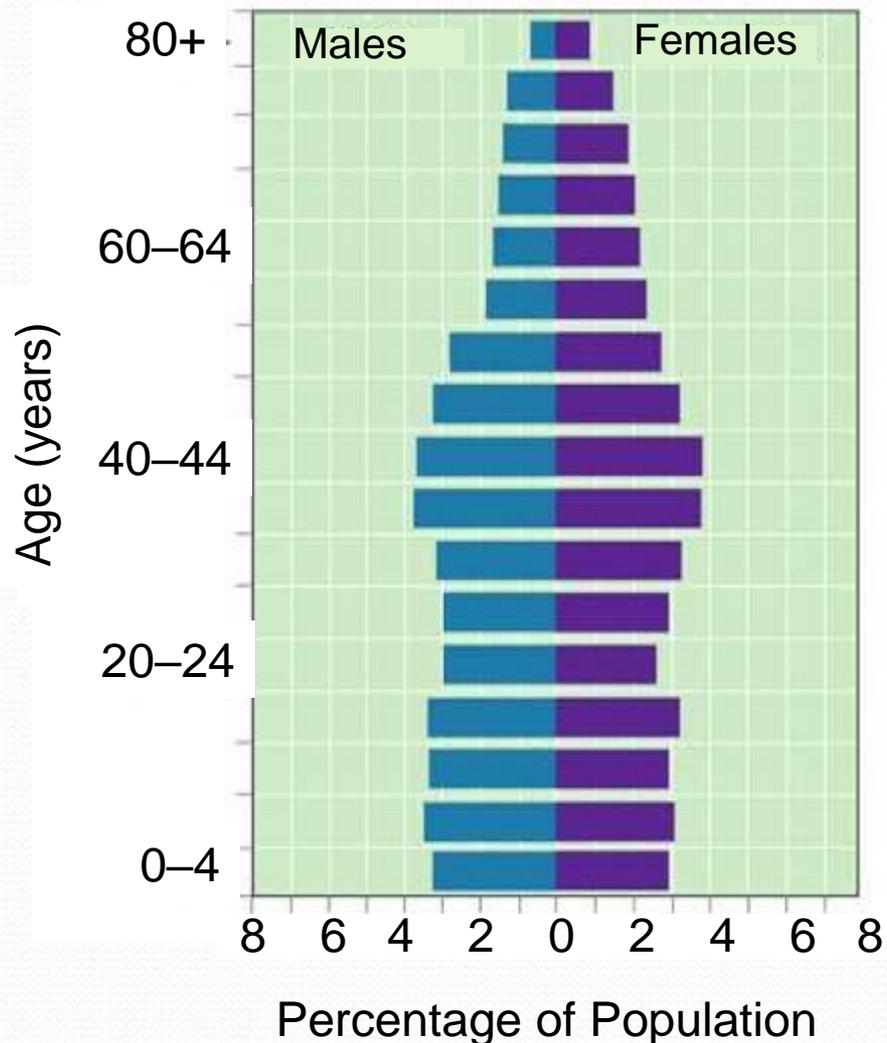
# Patterns of Population Growth

- Age Structure
  - Population growth depends, in part, on how many people of different ages make up a given population.
  - Demographers can predict future growth using models called **age-structure diagrams**.
  - Age-structure diagrams show the population of a country broken down by gender and age group.

# Patterns of Population Growth

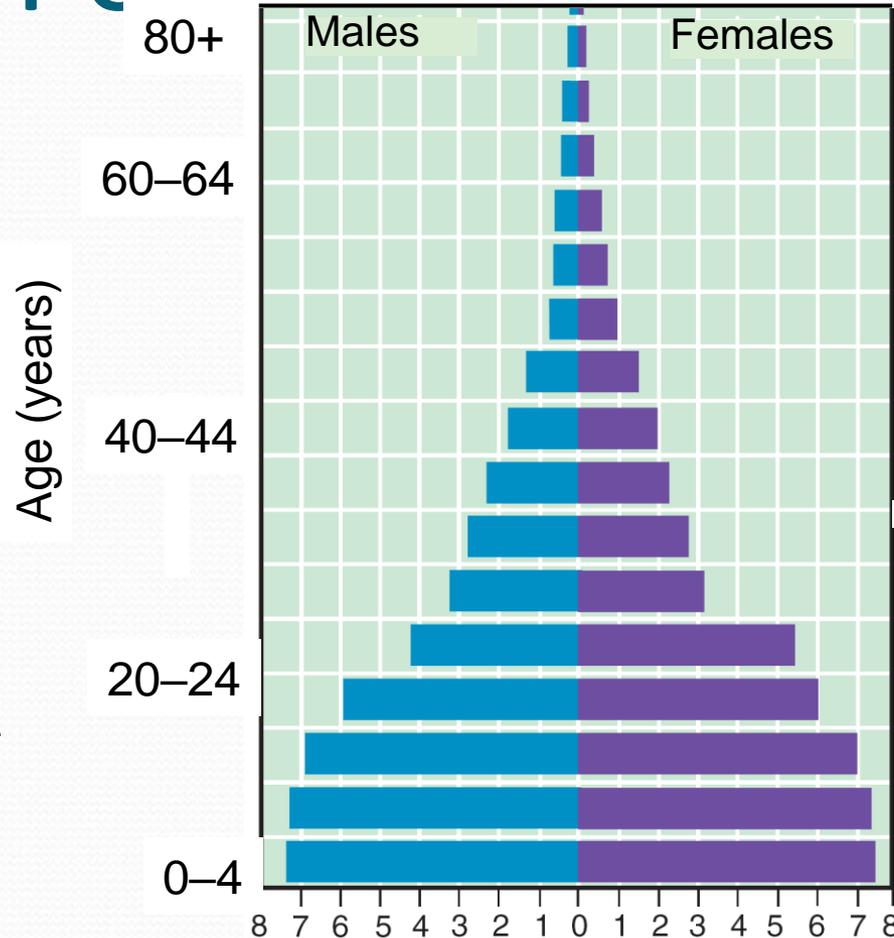
- In the United States, there are nearly equal numbers of people in each age group.
- This age structure diagram predicts a slow but steady growth rate for the near future.

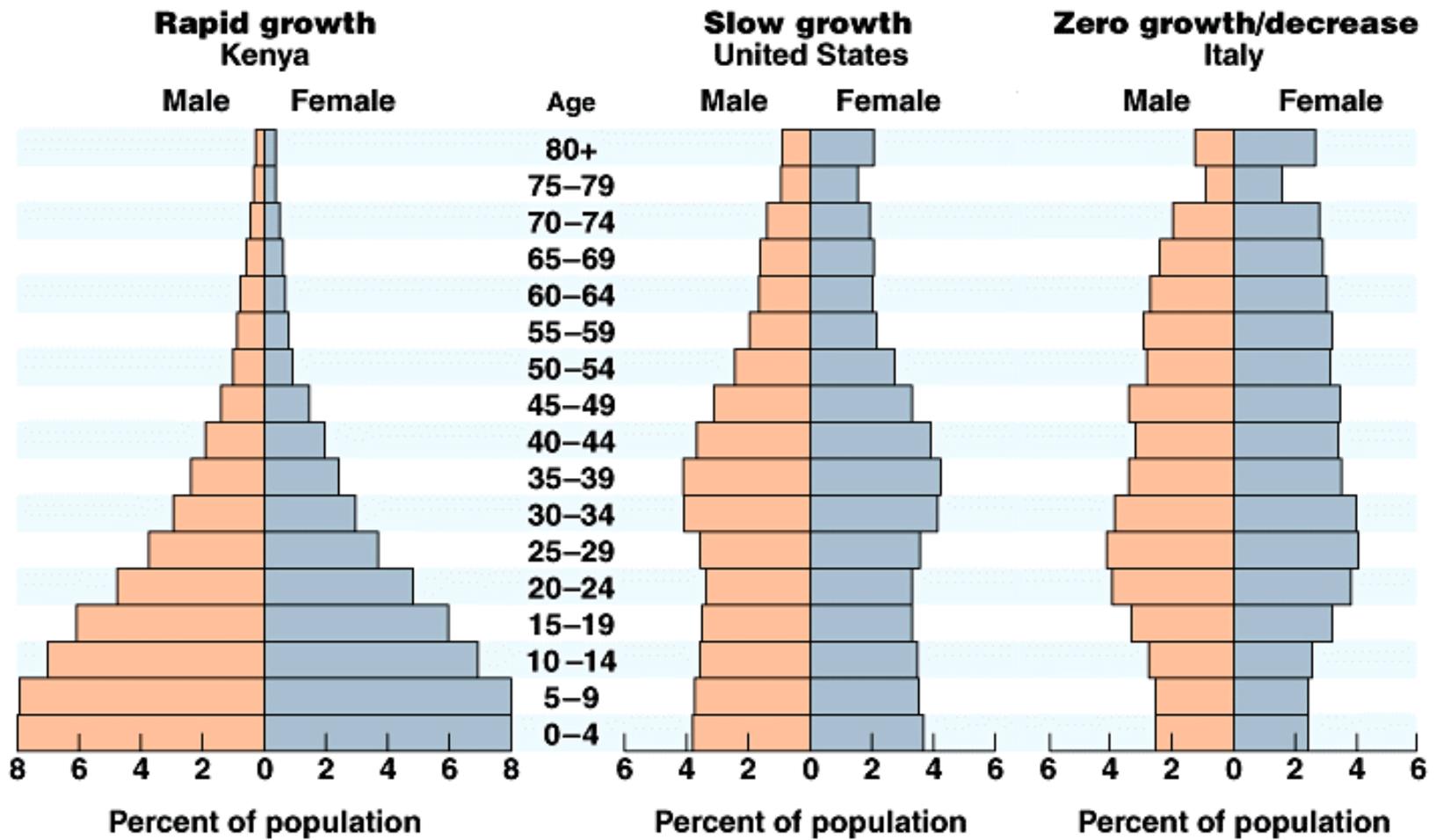
U.S. Population



- # Patterns of Population
- In Rwanda, there are many more young children than teenagers, and many more teenagers than adults.
  - This age structure diagram predicts a population that will double in about 30 years.

## Rwandan Population





# Future Population Growth

- **Future Population Growth**

- To predict human population growth, demographers must consider the age structure of each country, as well as the prevalence of life-threatening diseases.
- If growing countries move toward the demographic transition, growth rate may level off or decrease.

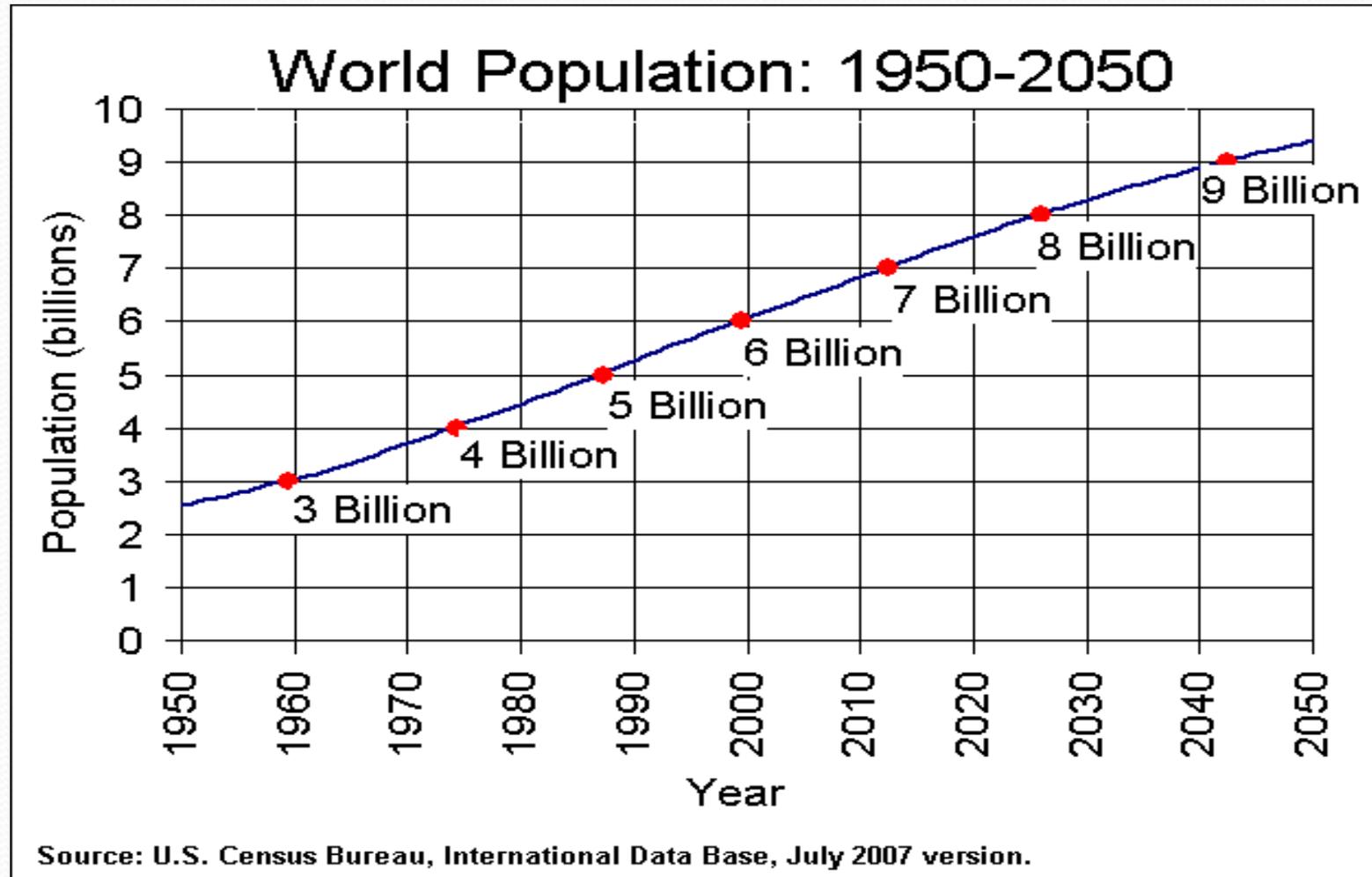
# Future Population Growth

<b>World Population: 1950–2050</b>		
<b>Year</b>	<b>Average Annual Growth Rate (%)</b>	<b>Population</b>
2000	1.23	6,078,684,329
2010	1.06	6,812,009,338
2020	0.87	7,515,218,898
2030	0.68	8,127,277,506
2040	0.54	8,646,671,023
2050	0.43	9,078,850,714

# Future Population Growth

- Ecologists suggest that if growth does not slow down, there could be serious damage to the environment and global economy.
- Economists assert that science, technology, and changes in society may control the negative impact of population growth.

# World Population Growth Projections



# Future Population Growth

**How are human contributing to the global climate change???**

**If limited resources control populations, which important resources are in danger of becoming limited to us???**



# Population Growth

Are there natural controls on human population?

What are the consequences?

What are the solutions?

