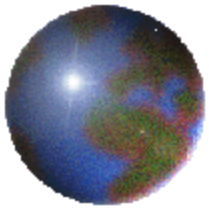
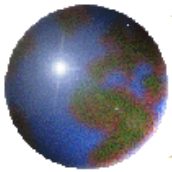


What is population ecology?

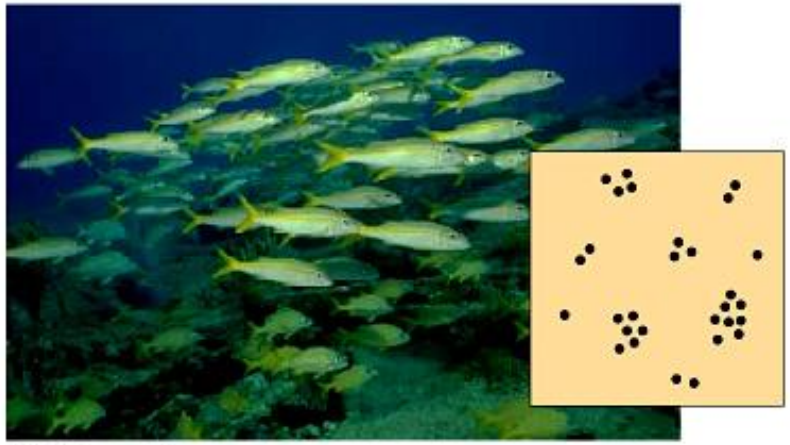


What is a population?

- A **population** is a group of individuals of a single species that simultaneously occupy the same general area.
- Density = numbers of individuals per unit area
- Dispersion = pattern of spacing amongst individuals

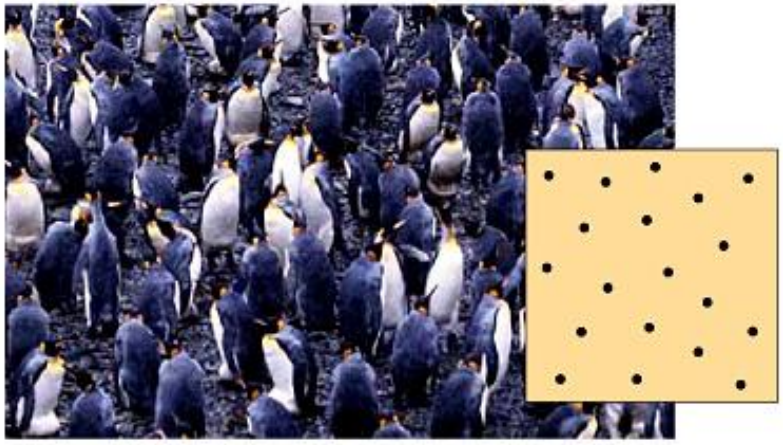
Types of Dispersion

- Clumped (patches)
- Uniform (defined space between organisms)
- Random (undefined space between organisms)



(a) Clumped

(c) Random

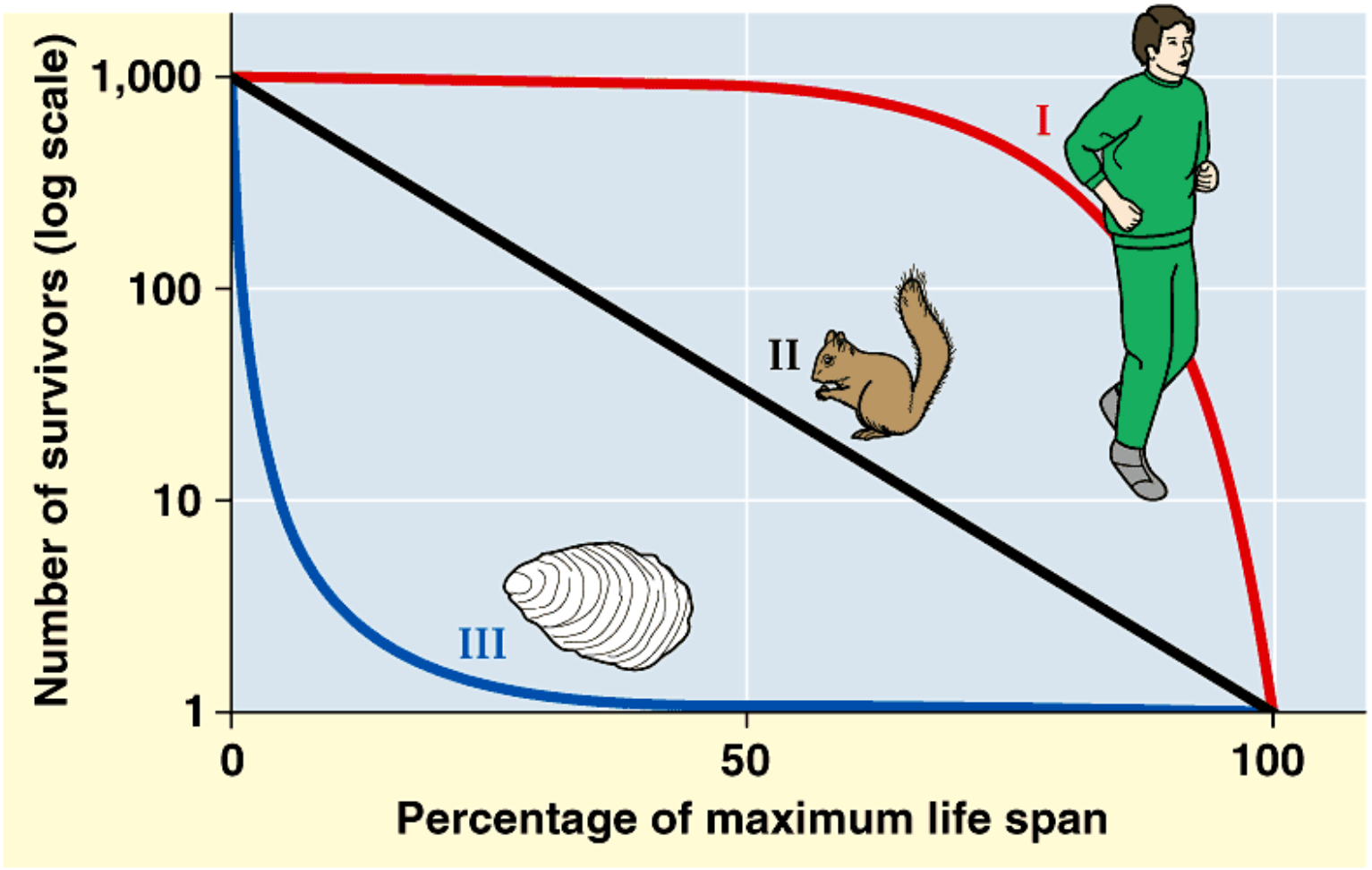


(b) Uniform

Survivorship Curves

- Type I – low death rate early in life (humans)
- Type II – uniform death rate throughout life (squirrels)
- Type III – high death rate early in life (insects, fish)

Survivorship Curves (fig. 52.3)



Population Growth Curves

- We define a change in population size based on the following verbal equation.

Change in population per unit time = births – deaths

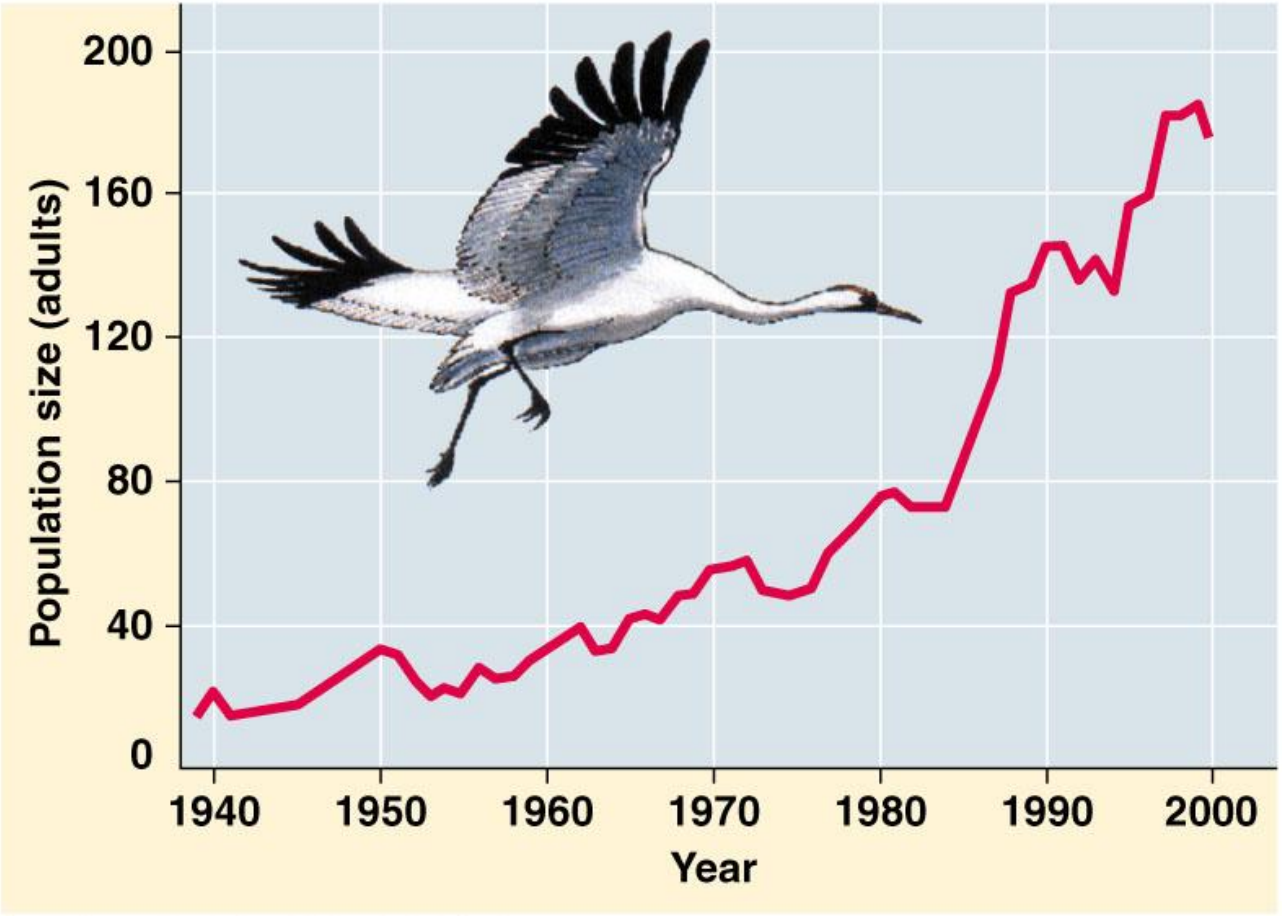
- $\Delta N/\Delta t = B-D$
- $\Delta N/\Delta t = rN$
- *r = population growth rate*

- If $B = D$ then there is **zero population growth (ZPG)**.

Exponential Growth

- Under ideal conditions, a population grows rapidly.
  - **Exponential population growth** is said to be happening
  - Under these conditions, we may assume the maximum growth rate for the population (r_{max}) to give us the following exponential growth
  - $\Delta N/\Delta t = r_{max}N$

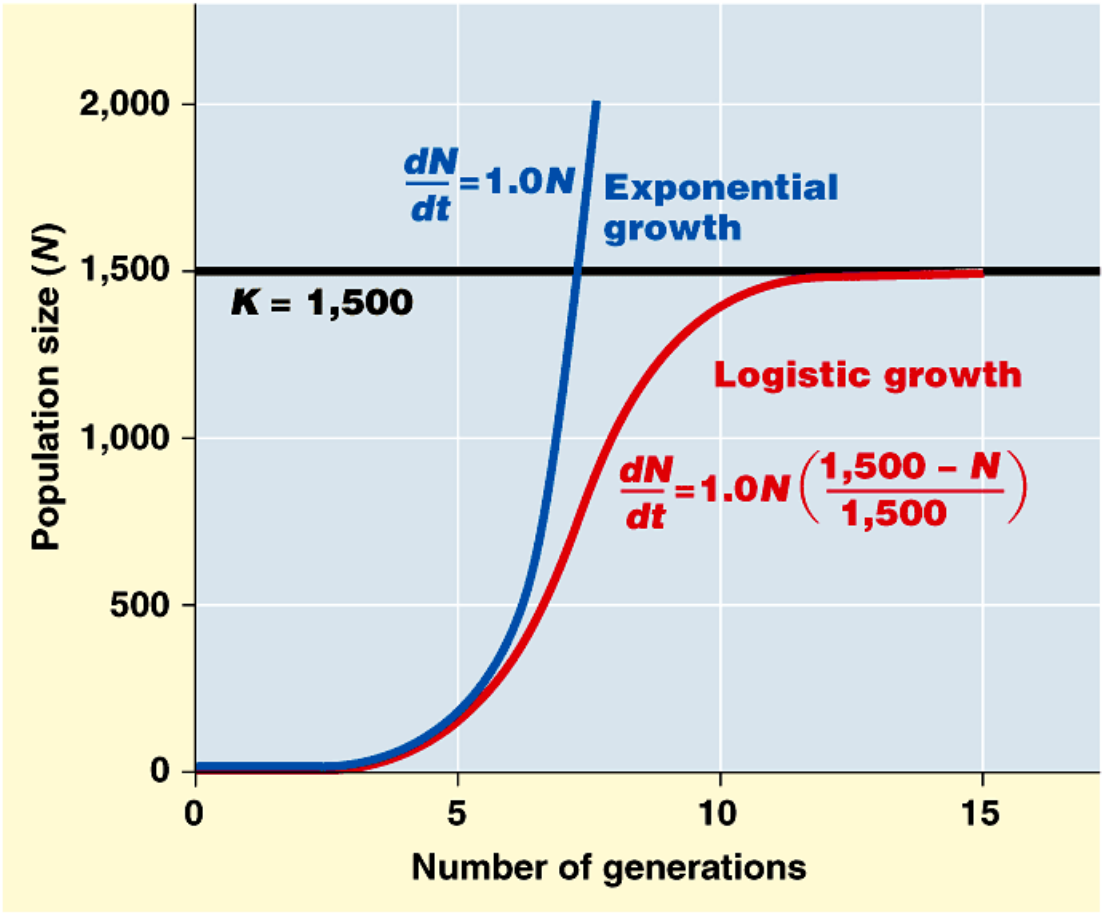
Exponential Growth (J-curve)



Logistic Growth

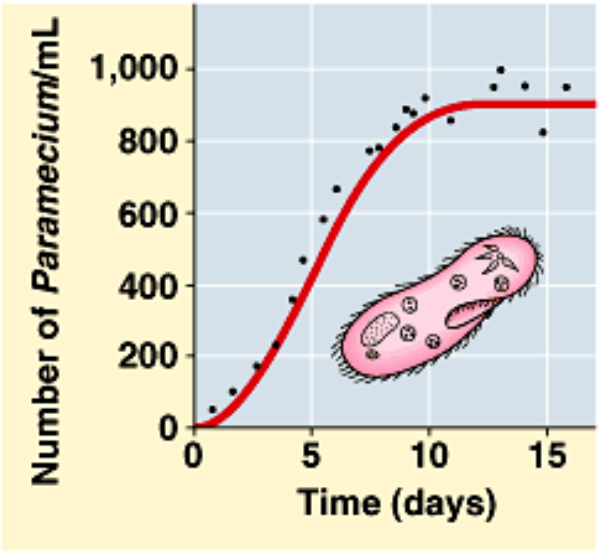
- Typically, unlimited resources are rare.
  - Population growth is therefore regulated by **carrying capacity** (K), which is the maximum stable population size a particular environment can support.
- $\Delta N/\Delta t = r_{max}N((K-N)/K)$

Logistic Growth (S-curve)

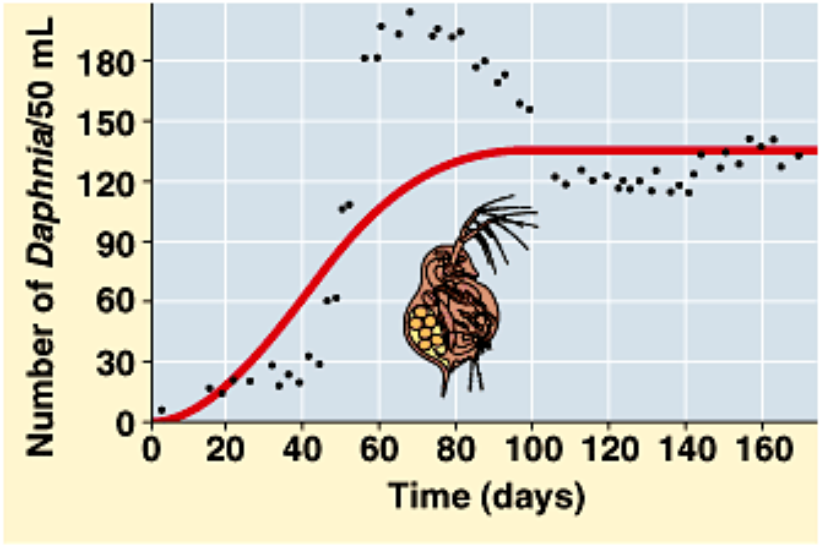


Logistic Curve

The growth of laboratory populations of some animals fits the S-shaped curves fairly well.



(a) A *Paramecium* population in the lab



(b) A *Daphnia* population in the lab

Exponential vs Logistic Growth

- Exponential Growth (r- selection)
  - In ***r*-selection**, organisms exhibit high rates of reproduction and occur in variable environments in which population densities fluctuate well below *K*. (mosquitoes)
  - These organisms reproduce in large numbers with little parental care. Many die young. (type III)
- Logistic Growth (K-selection)
  - In ***K*-selection**, organisms live and reproduce around *K*, and are sensitive to population density.(elephants)
  - These organisms reproduce in small numbers with much parental care. Many offspring survive. (type I)

Population Limiting Factors.

- Limiting factors prevent a population from reaching its biotic potential.
- Biotic potential (maximum growth rate of a population under ideal conditions – plenty of food, no predators or disease)
- Limiting factors may be:
  - density-dependent
  - density-independent

Density-dependent factors

- Factors that affect larger populations more than smaller populations. They include:
  - Pathogens (parasites, virus, bacteria, fungi)
  - Competition for resources (food, water, space)

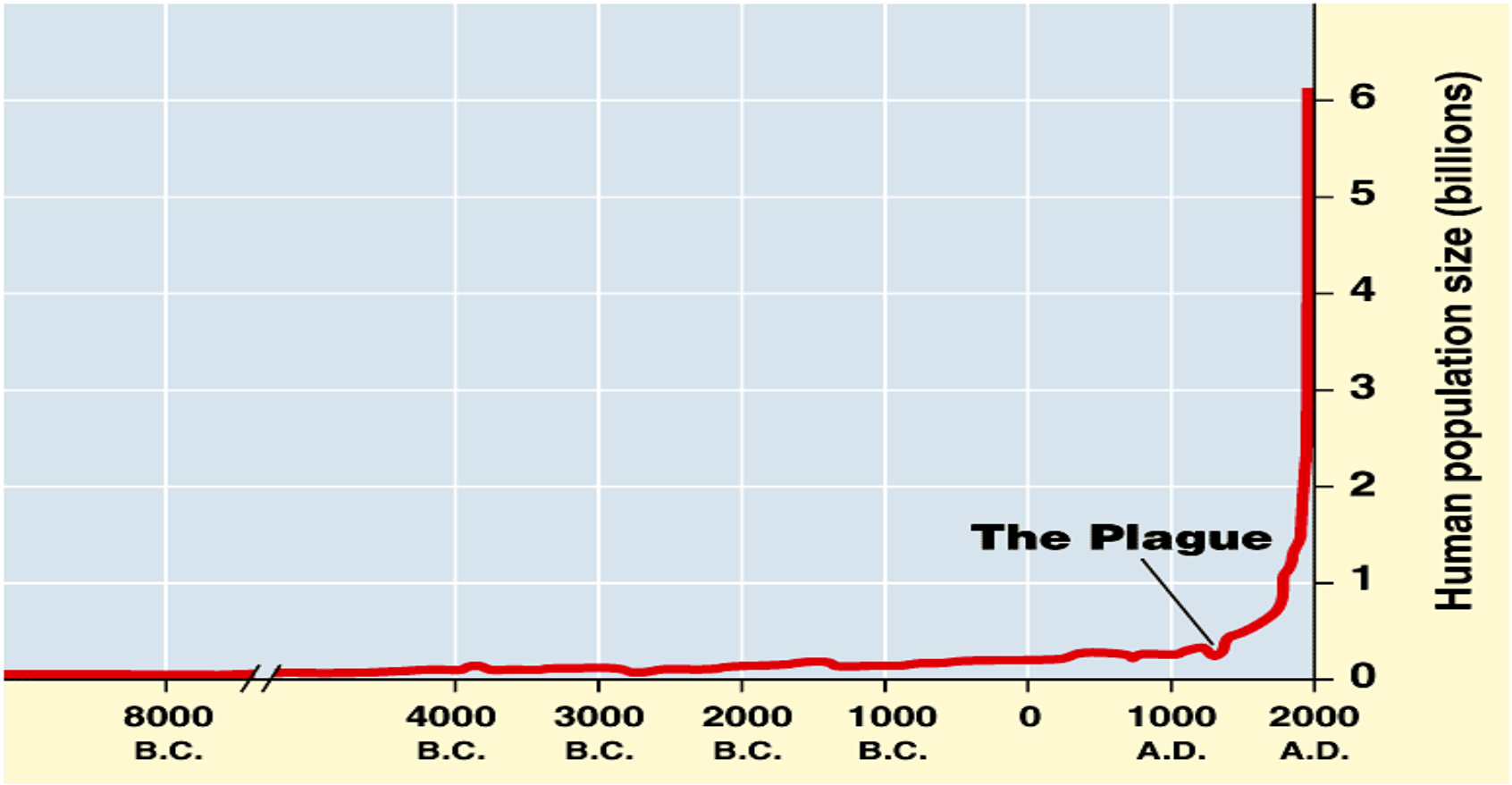
Density-independent factors

- Occur whether a population is small or large. They include:
  - Natural disasters (hurricanes, earthquakes)
  - Extremes in climate (frost, drought)

Human Population Growth

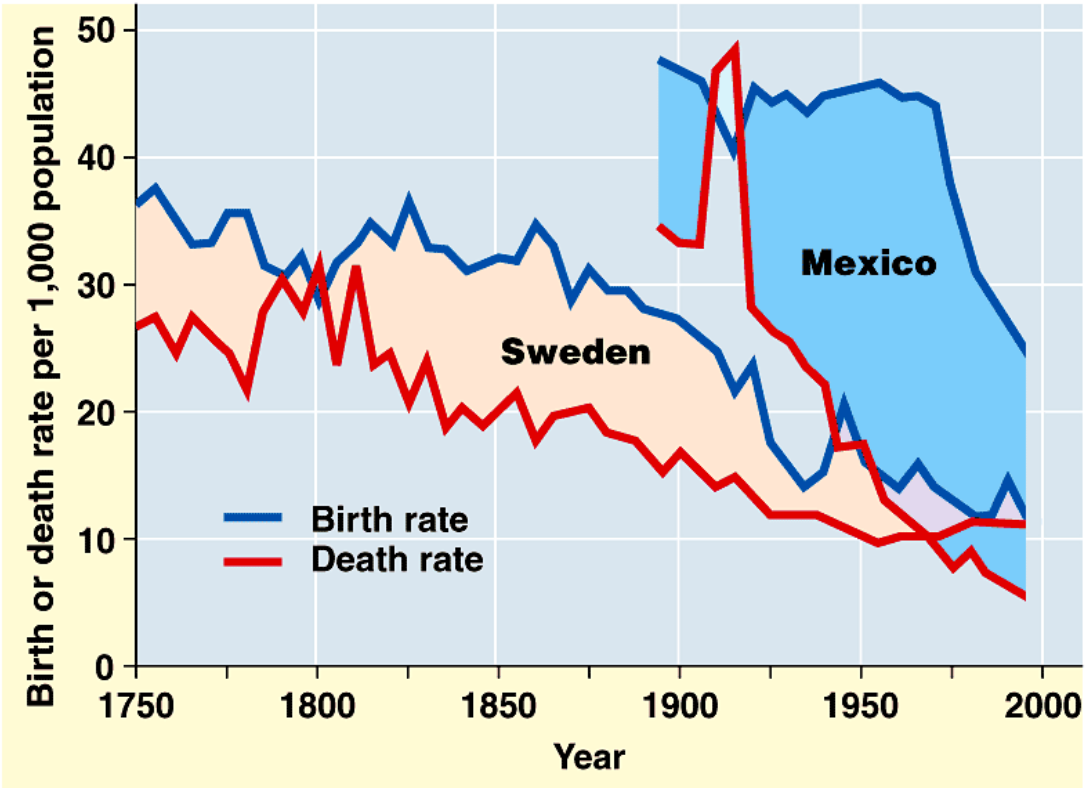
- Is currently exponential because:
  - Increases in food supply through domestication and genetic engineering
  - Reduction in disease – antibiotics, vaccinations, better hygiene
  - Reduction of human waste – water purification, sewage systems
  - Expansion of habitat – migration to previously unoccupied habitats.

Human Population Growth



Demographic Transition

- Demographic transition = the movement from high birth and death rates to low birth and death rates.



Age Structure Diagrams

- Age Structure is the relative number of individuals in a given age group (cohort)