Interactions Among Living Things

Unit 4

Some Important Terms…

- **Population:** All members of the same species (interbreeding organisms) within an ecosystem
- **Population Dynamics:** The study of the factors which affect population growth
- **Population Growth:** The change in size of a population with time
- **Population Size:** The number of individuals in a population
- **Population Density:** The number of individuals per unit of volume area

Population Growth

- Population size depends on the rate of removal and addition of species within a given population
- Additions and removals are the cause of **four variables**
- What are they?

Population Growth

1. **Natality**

- Birth Rate
- Number of organisms born into a population per unit of time

2. **Mortality**

- Death rate
- Number of organisms which die per unit of time

Population Growth

3. **Immigration**

- The movement of a new organism into a population

4. **Emigration**

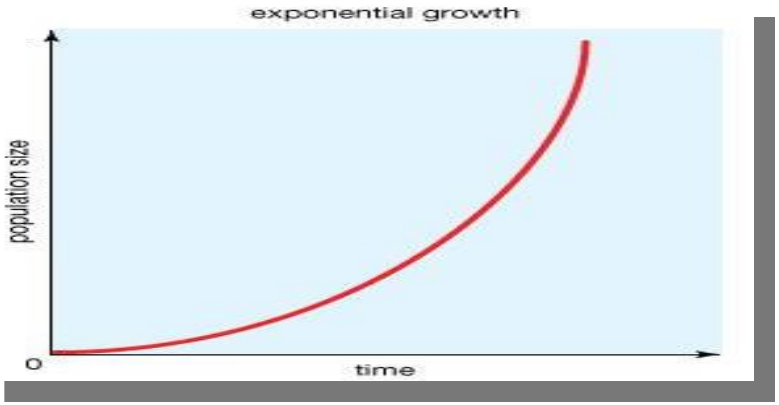
- The movement of an organism out of a population

Population Growth

- For a population to grow birth rate and immigration must be greater than the death rate and emigration

Population Growth = (Natality + Immigration) – (Mortality + Emigration)

- It is theoretically possible that populations can grow exponentially



Biotic Potential

- **Maximum rate at which a population can increase in ideal conditions**
- Species never reach their biotic potential, there are far too many limiting factors
- Example of limiting factors?

Biotic Potential

- The inability of a species to reach its biotic potential is due to **environmental resistance**
- The sum of the limiting factors in the environment that prevent a population from reaching its biotic potential

Limiting Factors on Population Growth

- Limitations that influence population growth are classified under two categories:

1. **Density-Independent Factors**
2. **Density-Dependent Factors**

Density-Independent Factors

- Abiotic, non-living, factors
- Affect a population regardless of the populations density
- Examples:

1. **Weather Cycles**
2. **Natural Disasters**
3. **Deforestation**
4. **Industrial development**

Density-Dependent Factors

- Biotic, living factors
- Usually the result of population density
- They usually affect populations that are near their carrying capacity

Density-Dependent Factors

- Examples:

1. **Disease**

- Close physical contact makes it easier for parasite and pathogens to spread

2. **Predation**

- Population growth is limited by interactions between predators and prey

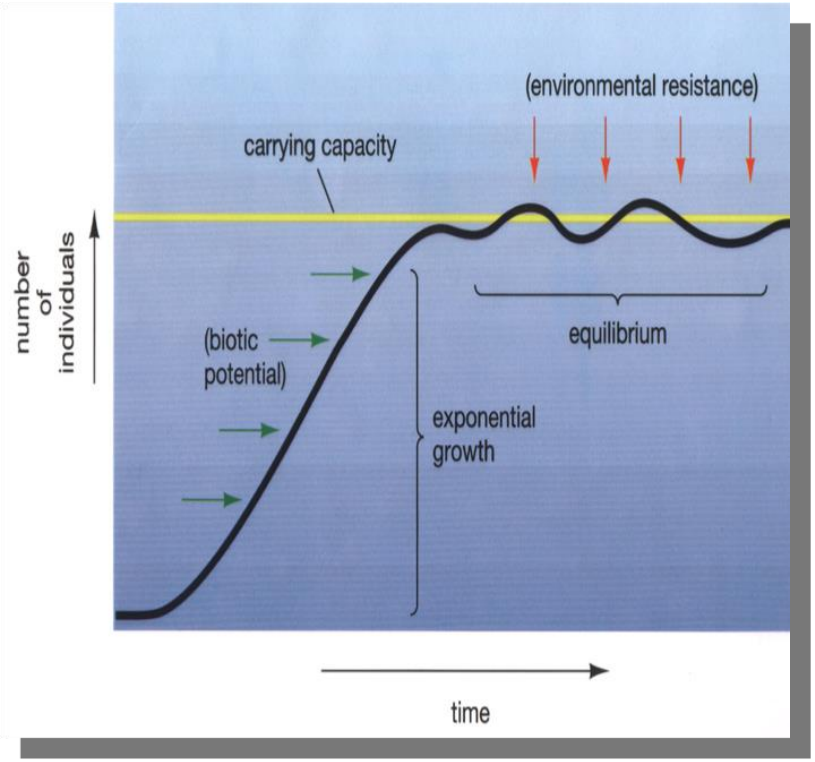
Density-Dependent Factors

3. **Competition**

- The struggle to compete for limited resources
- Two types:
  1. **Intraspecific** – within the same species
  2. **Interspecific** – between two or more different species
- The competitive exclusion principle states that when two species occupy the same niche, the better adapted will survive

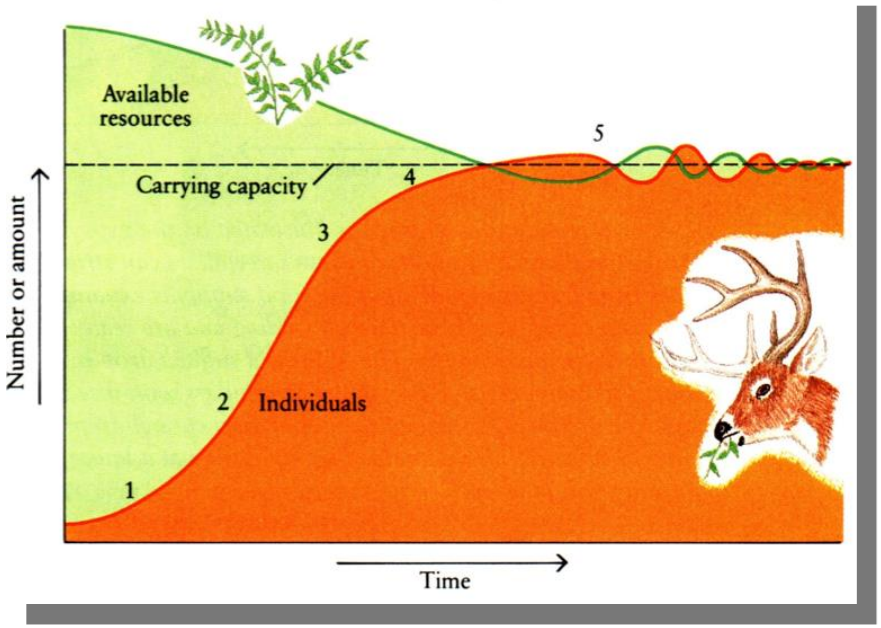
Carrying Capacity

- Some populations expand until they each a limit
- Remember that exponential growth can only occur under **favorable conditions**
- **Carrying capacity** for a population is the number of individuals of a given population that the environment can support indefinitely



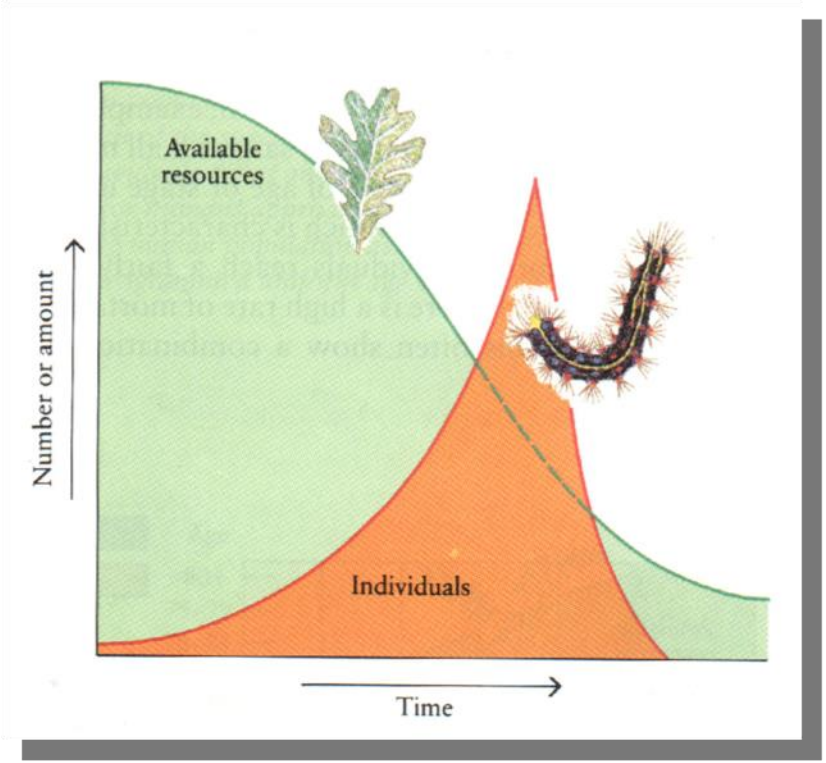
Carrying Capacity

- Once population size matches the carrying capacity of the ecosystem, **growth slows**
- Remember that carrying capacity is directly related to the limiting factors opposing it



Carrying Capacity

- Some populations can exceed their carrying capacity
- Population overshoots resources
- Ecosystem cannot withstand the the overshot population, both it and the species become damaged



Growth Curves

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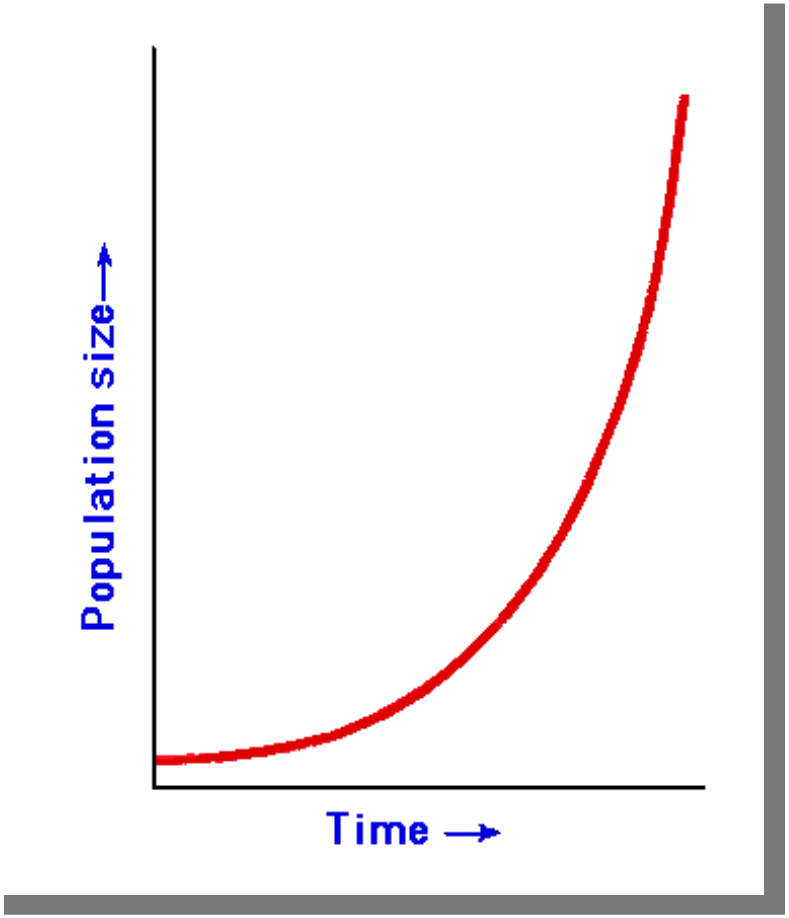
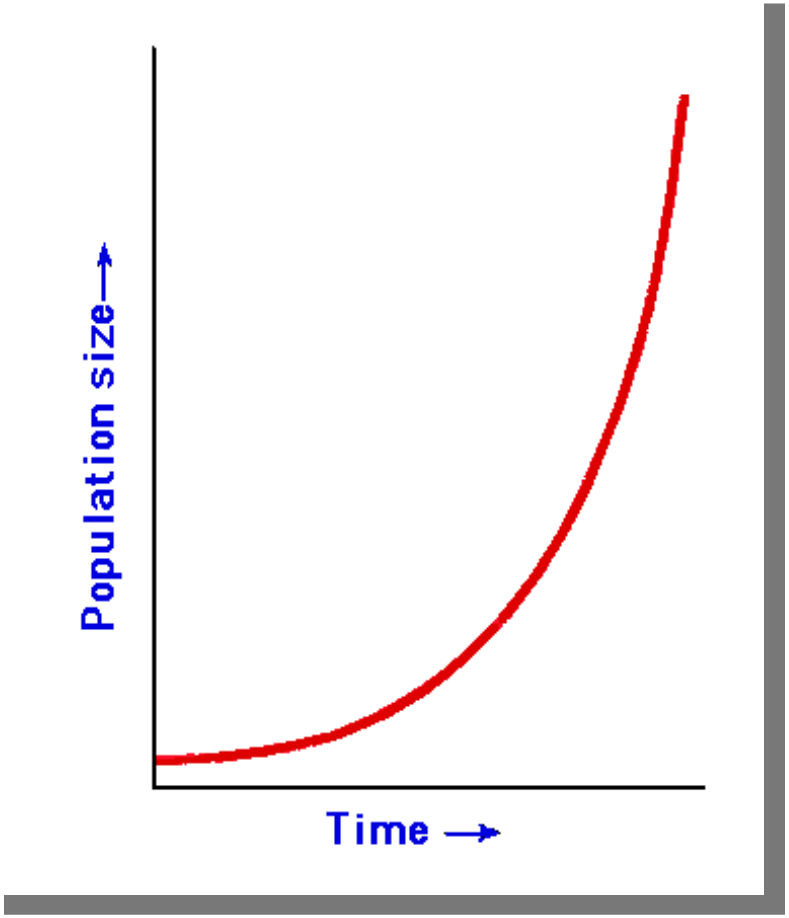
Exponential Growth Curve

- J-Shaped Curve
- Illustrates population growth in an unlimited environment
- Only in theory can populations continue to grow exponentially
- Real populations can only experience exponential growth temporarily



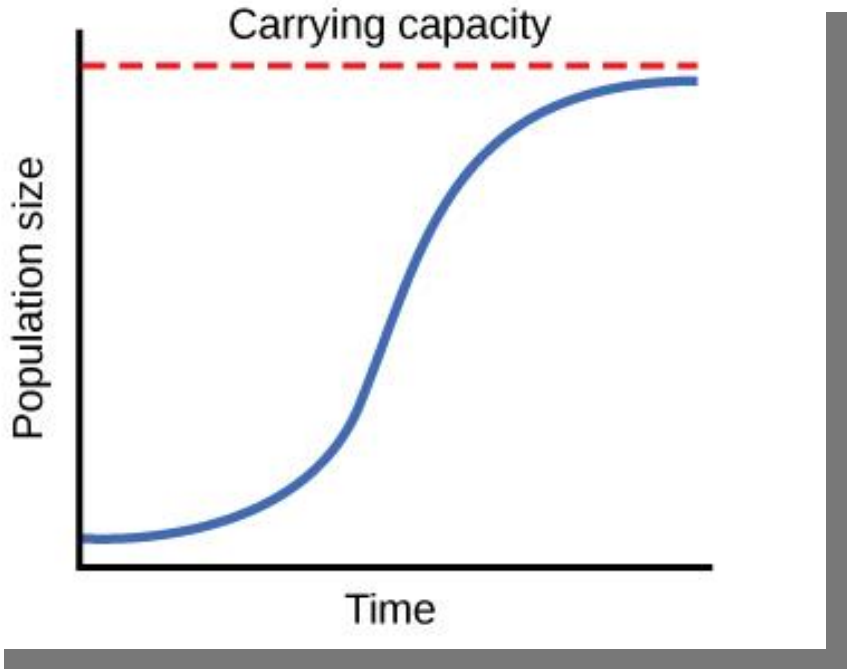
Exponential Growth Curve

- Slow growth at first – Lag Phase
- Growth continues to rise exponentially
- Under the assumption of ideal conditions
  - Continuous supply of food
  - Waste products are removed
  - Zero limiting factors



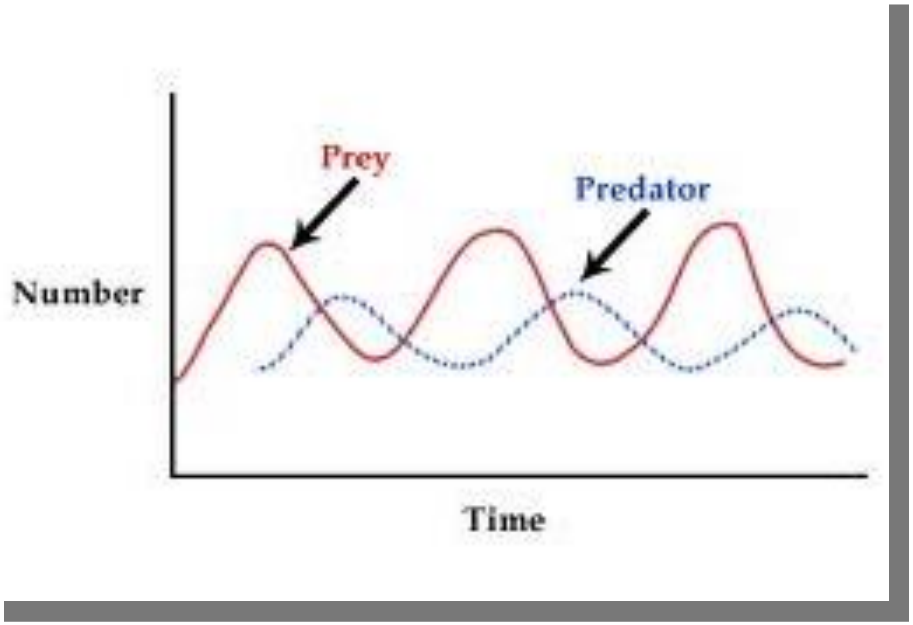
Logistic Growth Curve

- Graphs shows population change in limited environments
- Growth begins slow **(Lag Phase)**, increases quickly as environmental resistance isn't as harsh (**Exponential Phase**)
- Eventually population becomes large and meets its carrying capacity for that environment (**Equilibrium Phase**)
- Birth and death rate are equal



Predator-Prey Relationship

- In this relationship, one population gains at the expense of the other
- Illustrates a **population cycle**
- Alternating periods of high and low populations



Predator-Prey Relationship

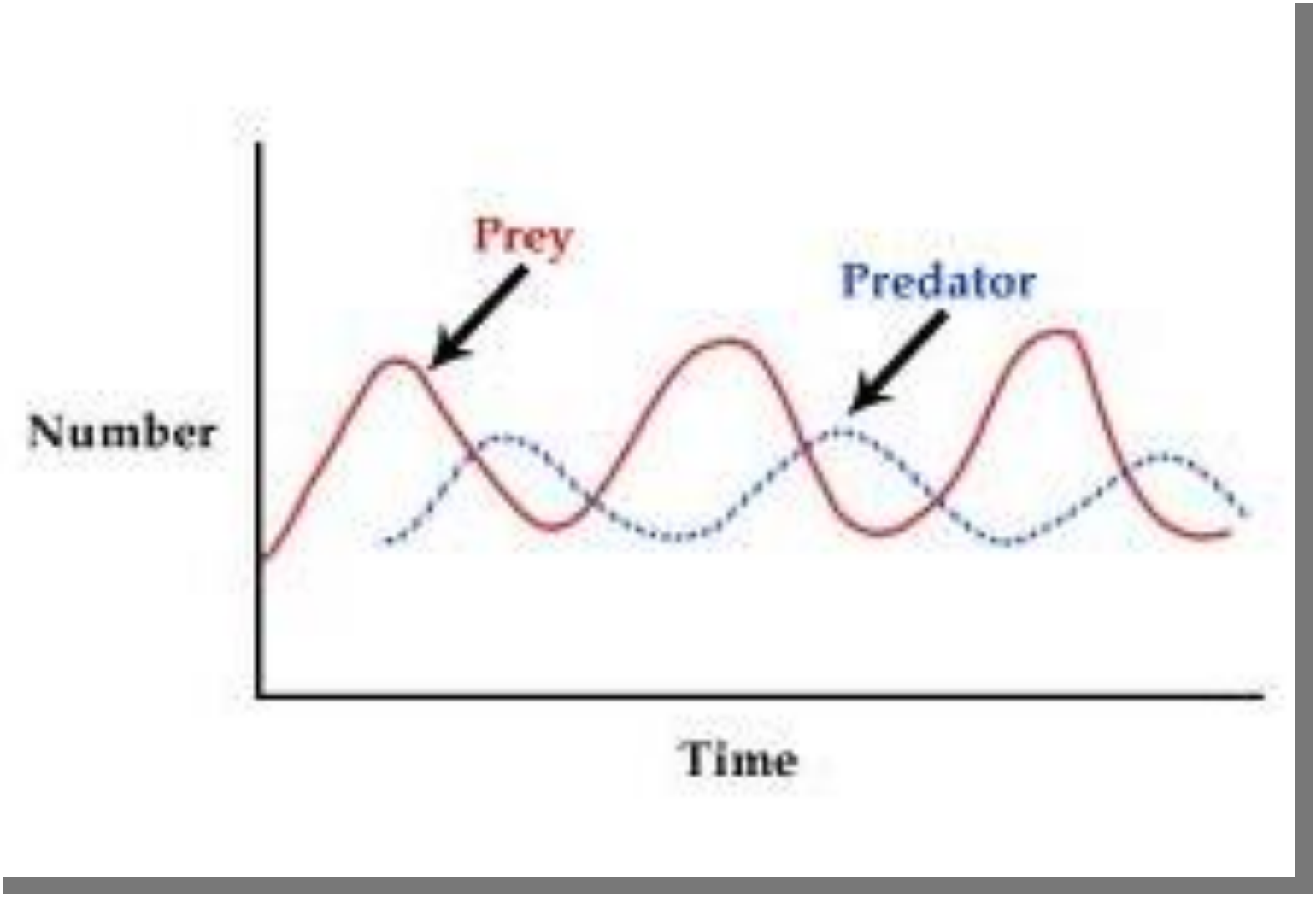
- When prey populations increase, more predation occurs because:

1. Predators encounter more prey
2. More prey can support a bigger predator population

Predator-Prey Relationship

- When predators become too numerous, they reduce the prey population, depleting food supply
- A change in the prey population leads to a change in the predator population, and vice versa

Predator-Prey Relationship



Human population growth

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Human Population Growth

- Current population is estimated at 7 billion people
- Increase in numbers is due to:
  - **Discovery/development of tools**
  - **Fire**
  - **Culture**
  - **Agriculture**
  - **Industrial/medicinal revolutions**
  - **Technology**

Tools

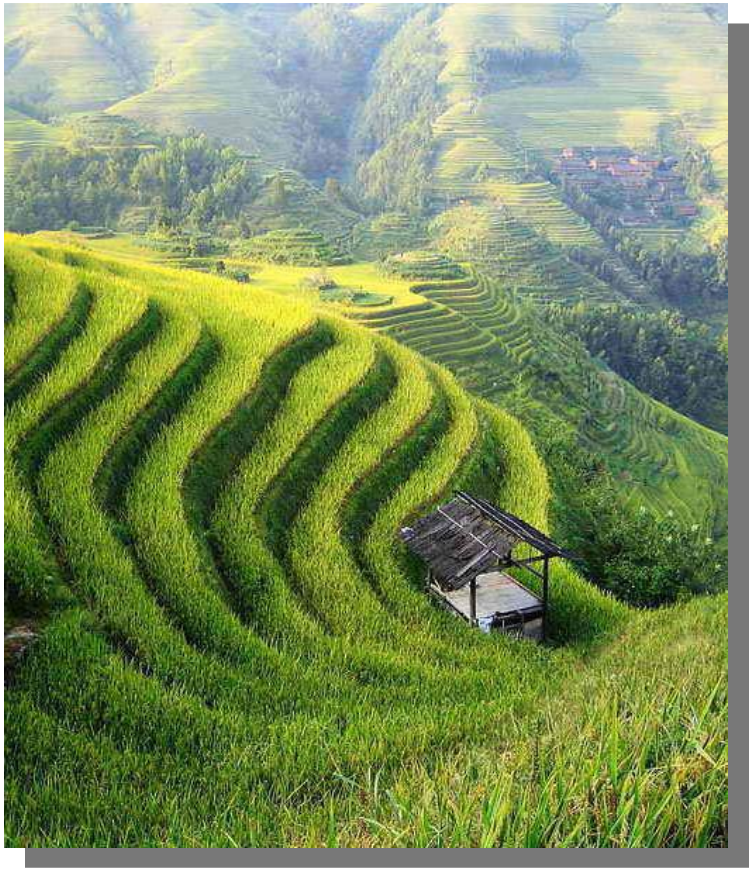
- 1st tools were stone and not well crafted
- Tools developed over time to be more efficient and more specific
- Tools allowed the progression of technology and therefore the progression of civilization

Fire

- Initially served to keep people warm, cook food, protection against predators
- Increased survival rate
- Fire became useful in working metals, allowed for the development of more complex buildings and machinery
- Essential for the industrial revolution

Agriculture

- Agriculture and animal required the domestication of animals and plants
- Raising species for our own well being
- Agricultural tools developed in such a way to increase yield and efficiency
- Changed the socio-cultural conditions of mankind by encouraging the settlement of communities

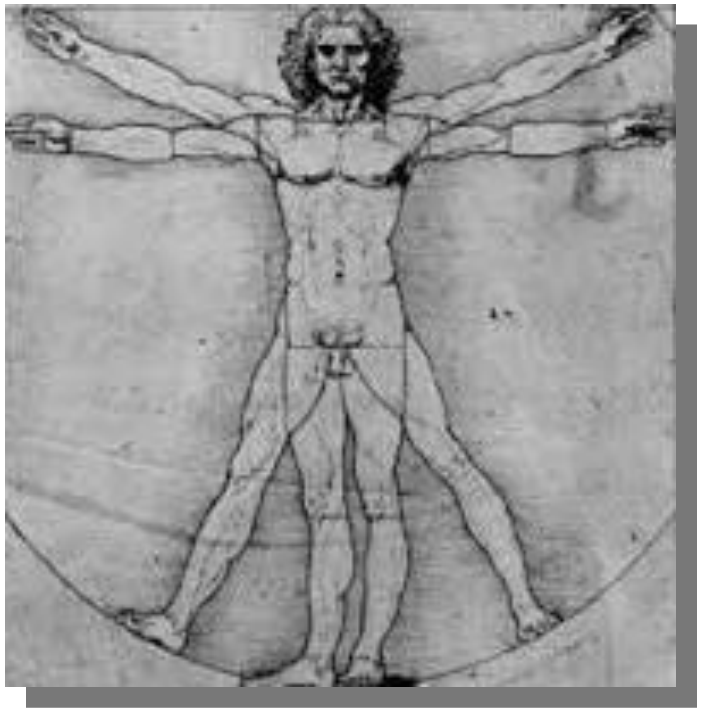


Industrial Revolution

- Industrialization increased production across the globe
- Jobs were created, lands were inhabited, colonies and settlements grew larger
- Large scale manufacturing changed the way we did business

Medicinal Revolution

- 14th century saw the development of medical schools in universities
- Able to perform dissections in a controlled space with the appropriate tools
- Learned more about the human body and its systems
- Anatomy and physiology branched into their own sciences



Medicinal Revolution

- 20th century, scientists like Pasteur, Koch, and Fleming furthered our medical knowledge
- Studied bacteria and microbiology
- Able to then develop drugs and antibiotics
- Study the link between human health and hygiene
- Vaccines were also a major advance medicinally

Medicinal Revolution

- Other major advances:
  - Ultrasound and MRI
  - Kidney dialysis
  - Organ transplantation
  - Respirators
- **All of these advances have brought unprecedented growth in human population. Now getting to a point where limited factors are shaping our existence**

Limiting Factors and Human Population Growth

- Limiting factors within the human population reflect the intraspecific competition within the human population
- Some examples:

1. **Competition for food**
2. **Disease**
3. **Sanitation**
4. **Lack of Education**

Demographic Transition

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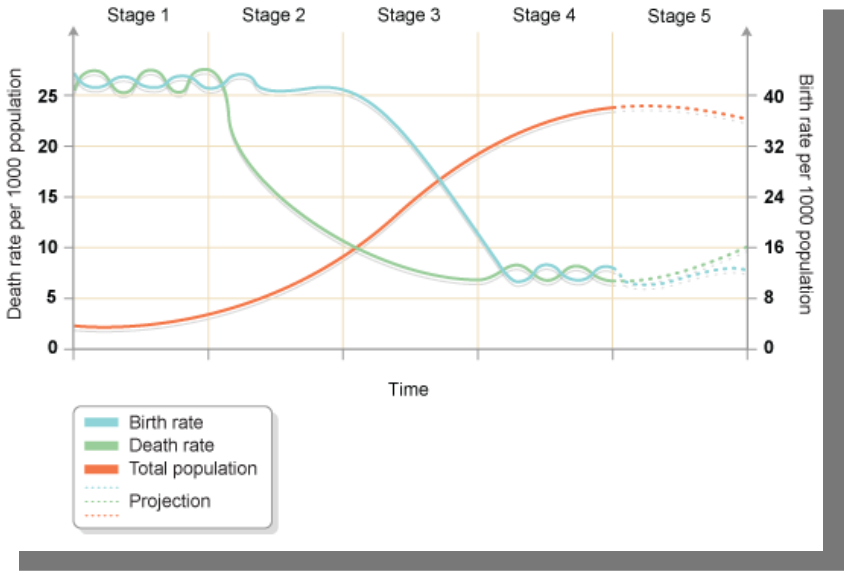
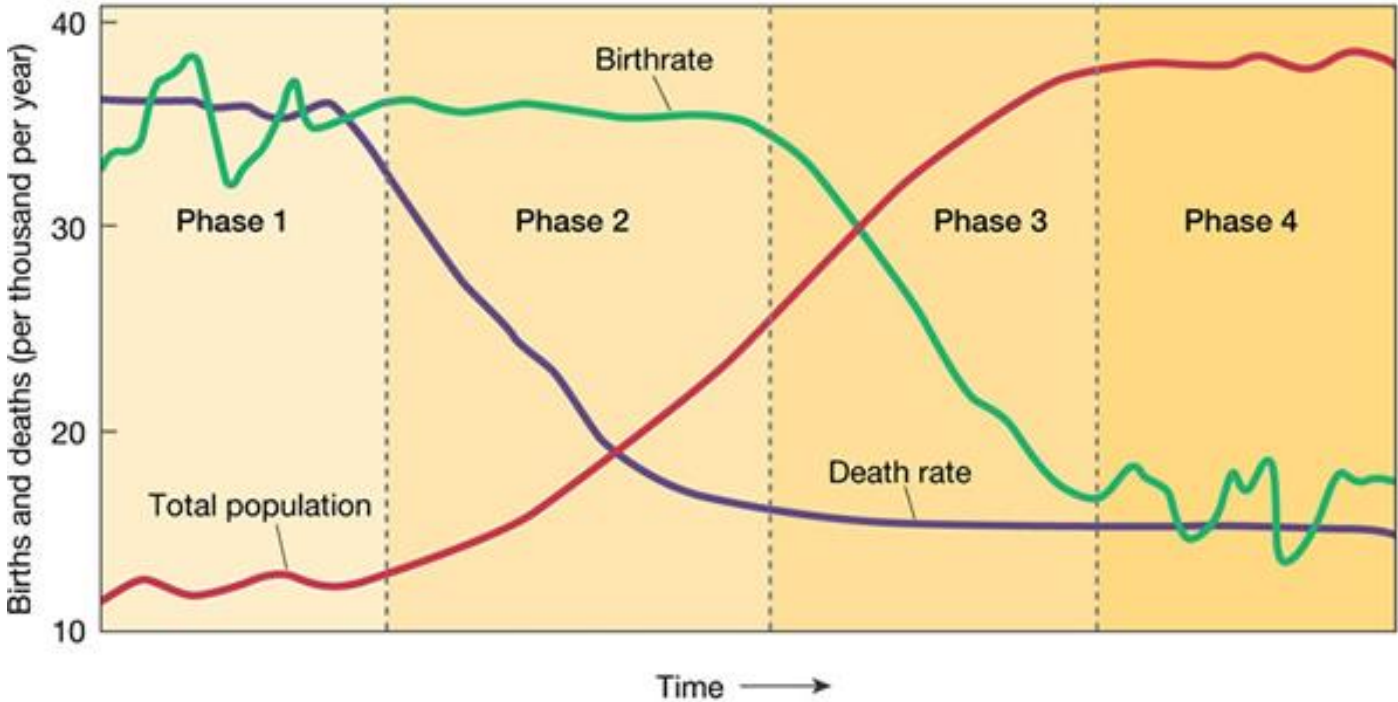
Demographic Transition

- Is a model explaining the increase and decrease that occurs in a population over time
- Suggests that populations go through series of stages known as **Demographic Transitions**
- Growth rates change in relation to social and economic progress



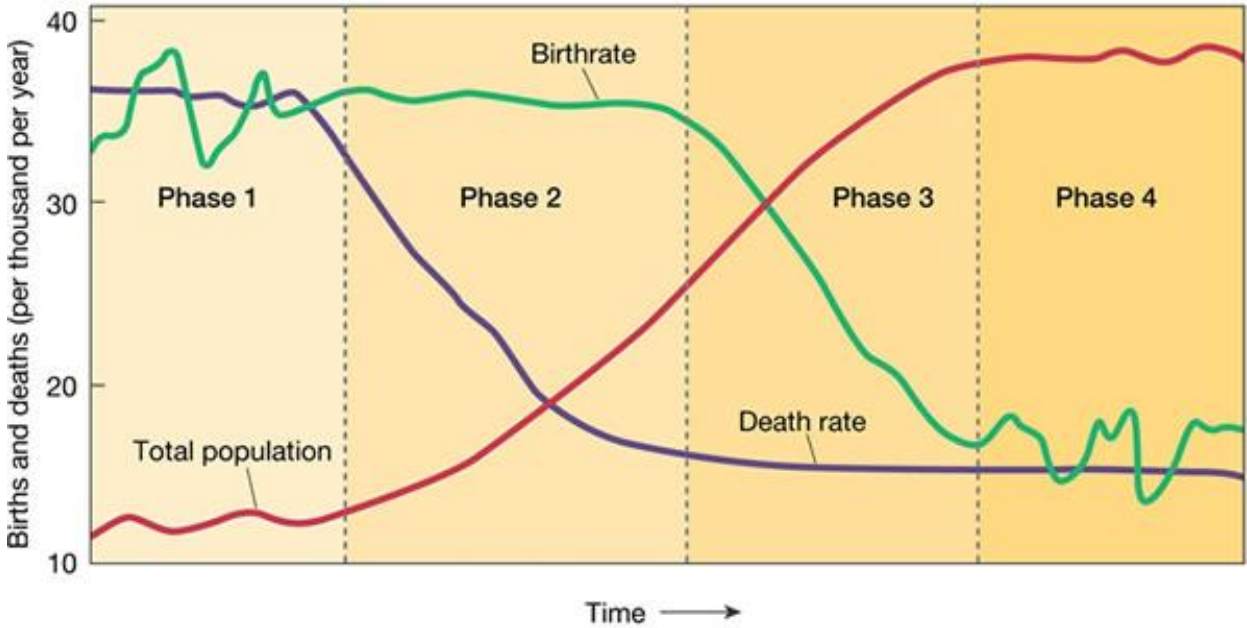
Demographic Transition

- **Phase 1**
- Birth and death rates are high
- Population growth is slow, overall growth rate is more or less stable



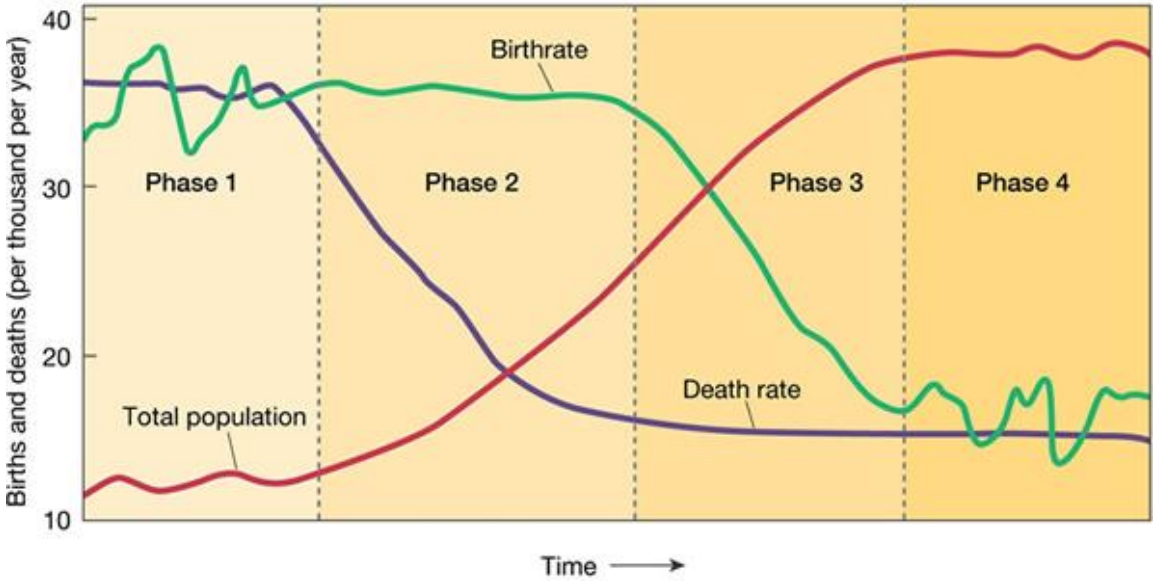
Demographic Transition

- **Phase 2**
- With improvements to living conditions (food, medicine, and sanitation) more children survive into adulthood
- Greatly reduced death rate, birth rate is still high
- Population grows rapidly



Demographic Transition

- **Phase 3**
- Higher standard of living and reduced infant mortality leads to smaller families, fewer children
- Birth and death rates stabilize at a lower level
- May have a slight increase in population size



Demographic Transition

- **Phase 4**
- Stable population growth without much change because birth and death rates are about equal
- Zero population growth