

Population Dynamics

APES Year End Review

Global Population

- **2007: 6,625,000,000 (1.2% growth rate)**
- **2008: 6,705,000,000 (1.2% growth rate)**
- **2009: 6,810,000,000 (1.2% growth rate)**
- **2010: 6,818,300,000 (estimated)**

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, ethics

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

Population Estimation Methods

Mark-Recapture Model	Model type	Description
Lincoln-Peterson Method	Closed population	Fisheries origin, one marking period
Schnabel Method	Closed population	Fisheries origin, multiple marking periods
Jolly-Seber Model	Open population	Multiple marking periods
Polluck's Robust Design	Combination of closed and open models	During short periods of sampling closed assumptions, over the longitudinal study treated as open system

Total Fertility Rate (TFR)

- The Total Fertility Rate or TFR is an estimate of the average number of children who will be born alive to a woman during her lifetime if she passes through all her childbearing years (ages 15-44) conforming to age-specific fertility rates of a given year.
 - In simpler terms, it is an estimate of the average number of children a woman will have during her childbearing years.

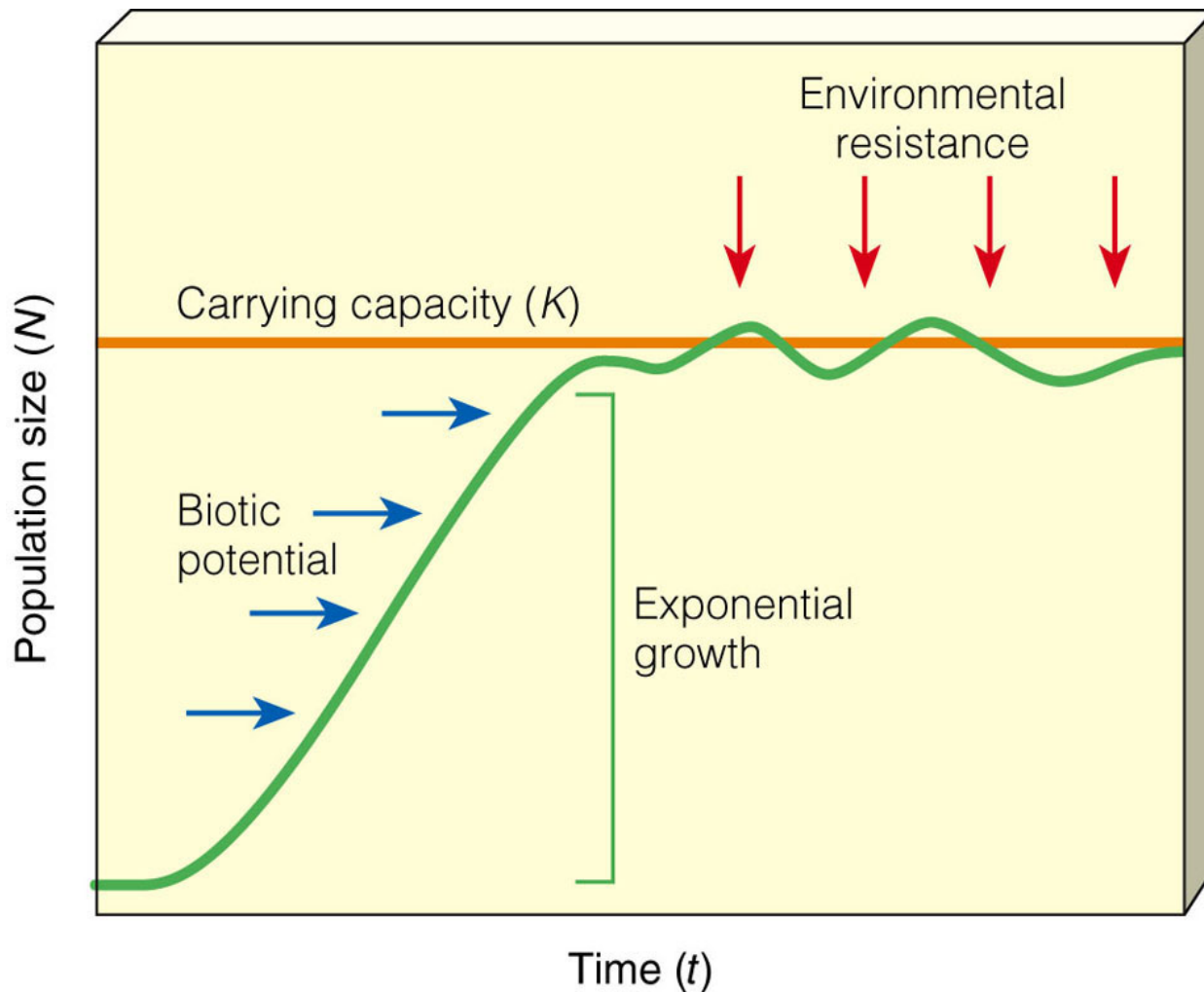
Replacement Level Fertility (RLF)

- **The Replacement Level Fertility or RLF is the number of children a couple must have to replace them.**
 - **The average for a country or the world usually is slightly higher than 2 children per couple (2.1 in the United States and 2.5 in some developing countries) because some children die before reaching their reproductive years.**

Population Growth

- Populations show two types of growth
 - **Exponential**
 - J-shaped curve
 - Unlimited Growth
 - Growth is independent of population density
 - **Logistic**
 - S-shaped curve
 - Growth affected by environmental stress
 - Growth is not independent of population density

Exponential and Logistic Population Growth: J-Curves and S-Curves



- Populations grow rapidly with ample resources, but as resources become limited, its growth rate slows and levels off.

Rule of 70

- To determine the doubling time of a population, divide 70 by the percentage of growth.
 - Uses the exponential growth calculation
 - If the growth rate is 2%, then,
 - $70 \div 2 = 35$ years

Carrying Capacity (K)

- Exponential curve is not realistic due to carrying capacity of area
- Carrying capacity is maximum number of individuals a habitat can support over a given period of time due to environmental resistance (sustainability)

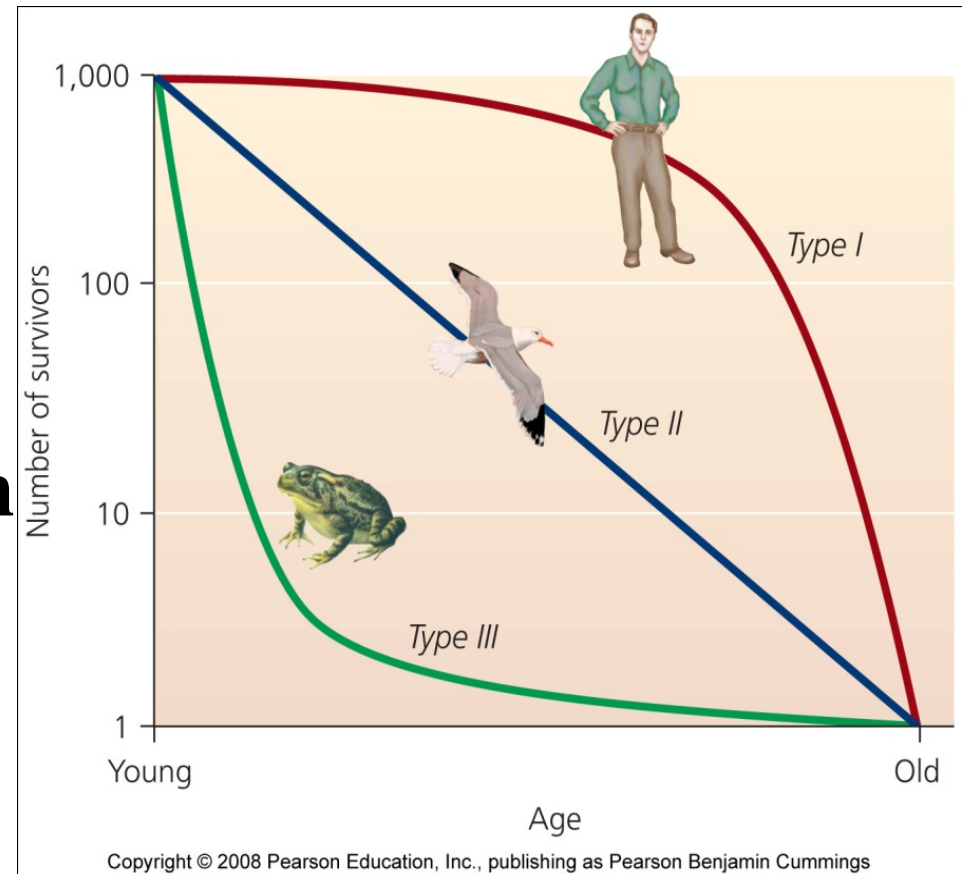
K-selected vs. r-selected species

TABLE 5.4 Traits of r-selected and K-selected species

r-selected species	K-selected species
Small size	Large size
Fast development	Slow development
Short-lived	Long-lived
Reproduction early in life	Reproduction later in life
Many small offspring	Few large offspring
Fast population growth rate	Slow population growth rate
No parental care	Parental care
Weak competitive ability	Strong competitive ability
Variable population size, often well below carrying capacity	Constant population size, close to carrying capacity
Variable and unpredictable mortality	More constant and mortality predictable

Survivorship curves

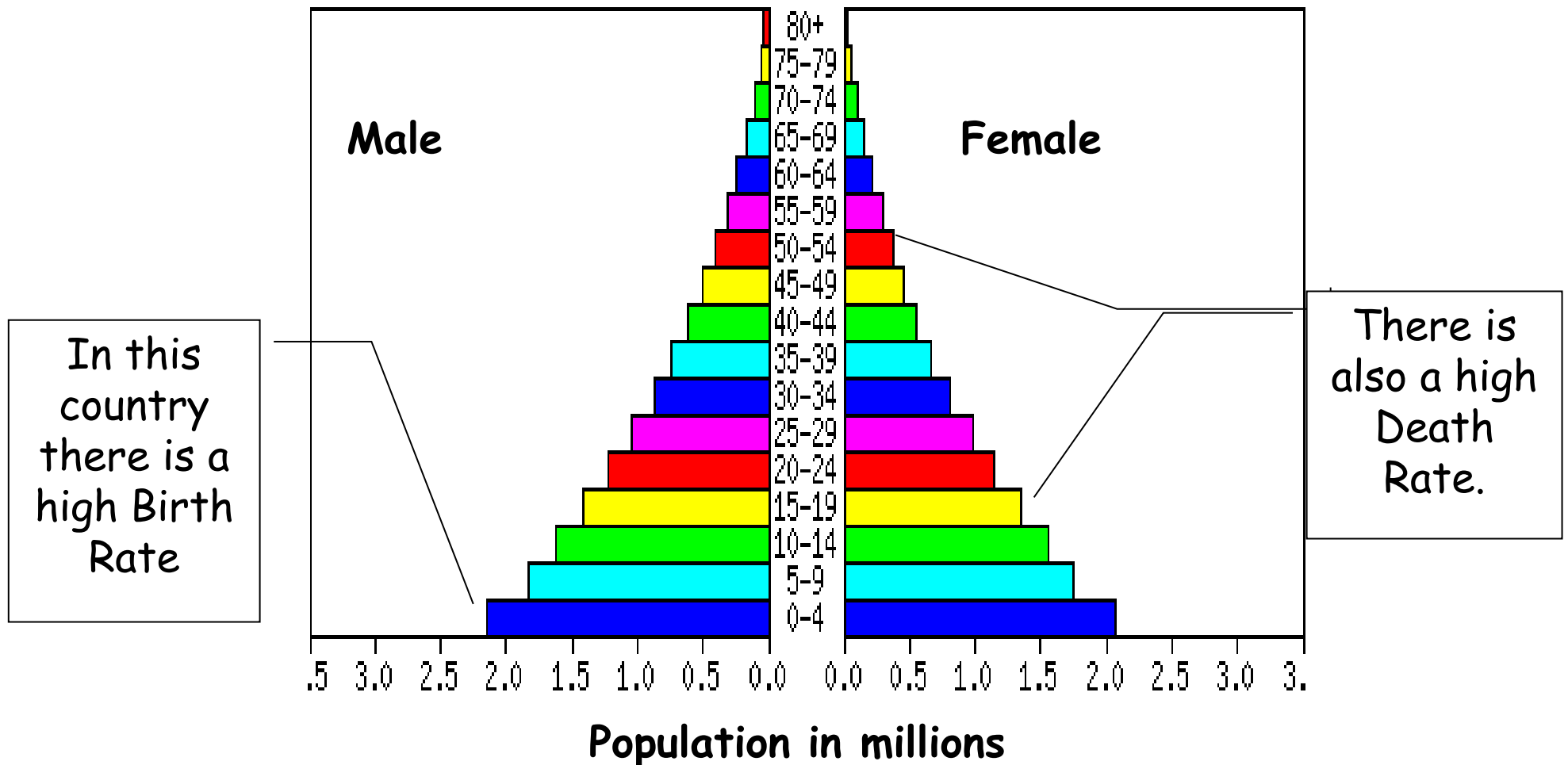
- **Type I:** late loss, K-strategists that produce few young and care for them until they reach reproductive age thus reducing juvenile mortality
- **Type II:** constant loss, typically intermediate reproductive strategies with fairly constant mortality throughout all age classes
- **Type III:** r-strategists with many offspring, high infant mortality and high survivorship once a certain size and age



Age Structure

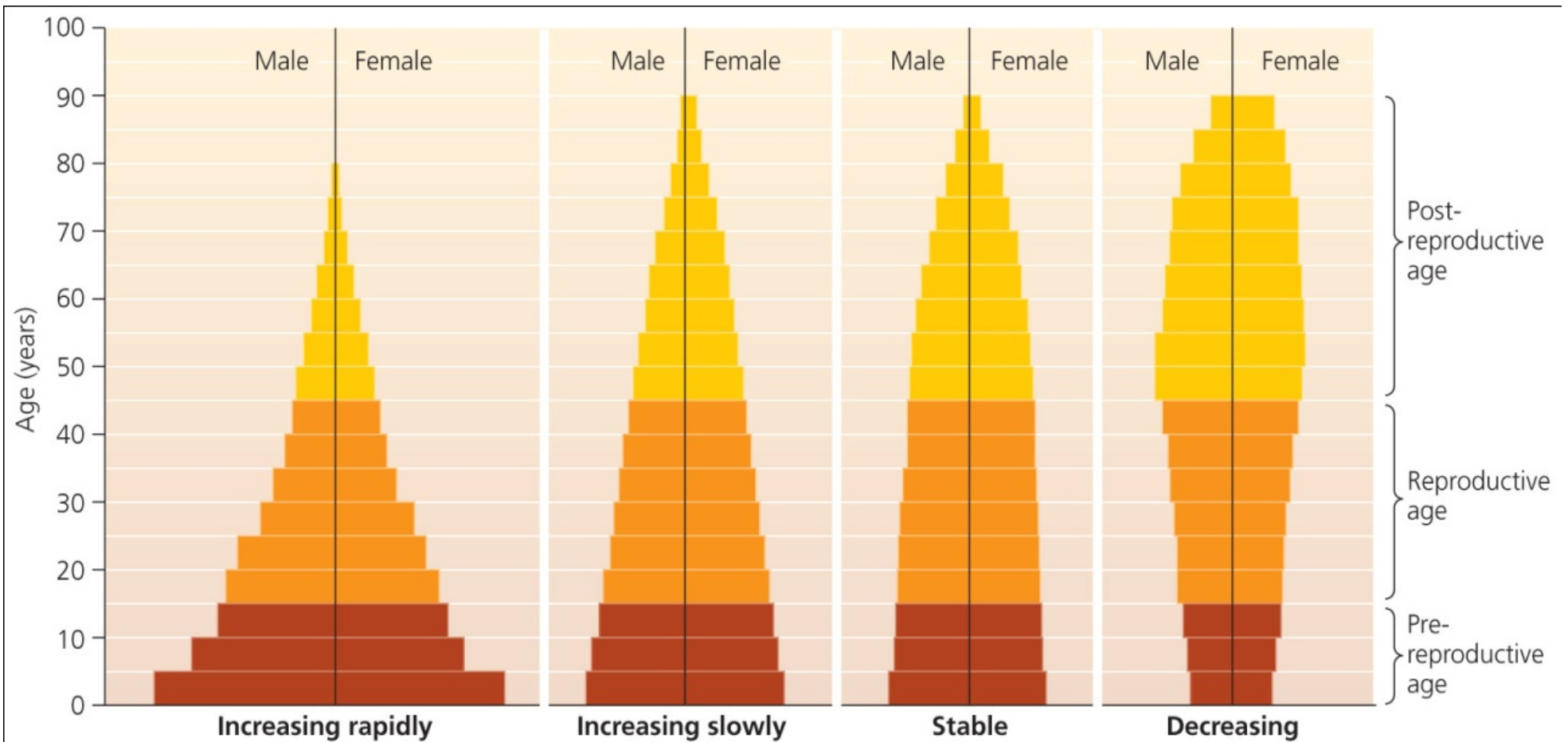
- The age structure of a population is usually shown graphically
- The population is usually divided up into prereproductives, reproductives and postreproductives
- The age structure of a population dictates whether it will grow, shrink, or stay the same size

Population pyramids are used to show information about the age and gender of people in a specific country.



This population pyramid is typical of countries in poorer parts of the world (LEDCs.)

Population characteristics



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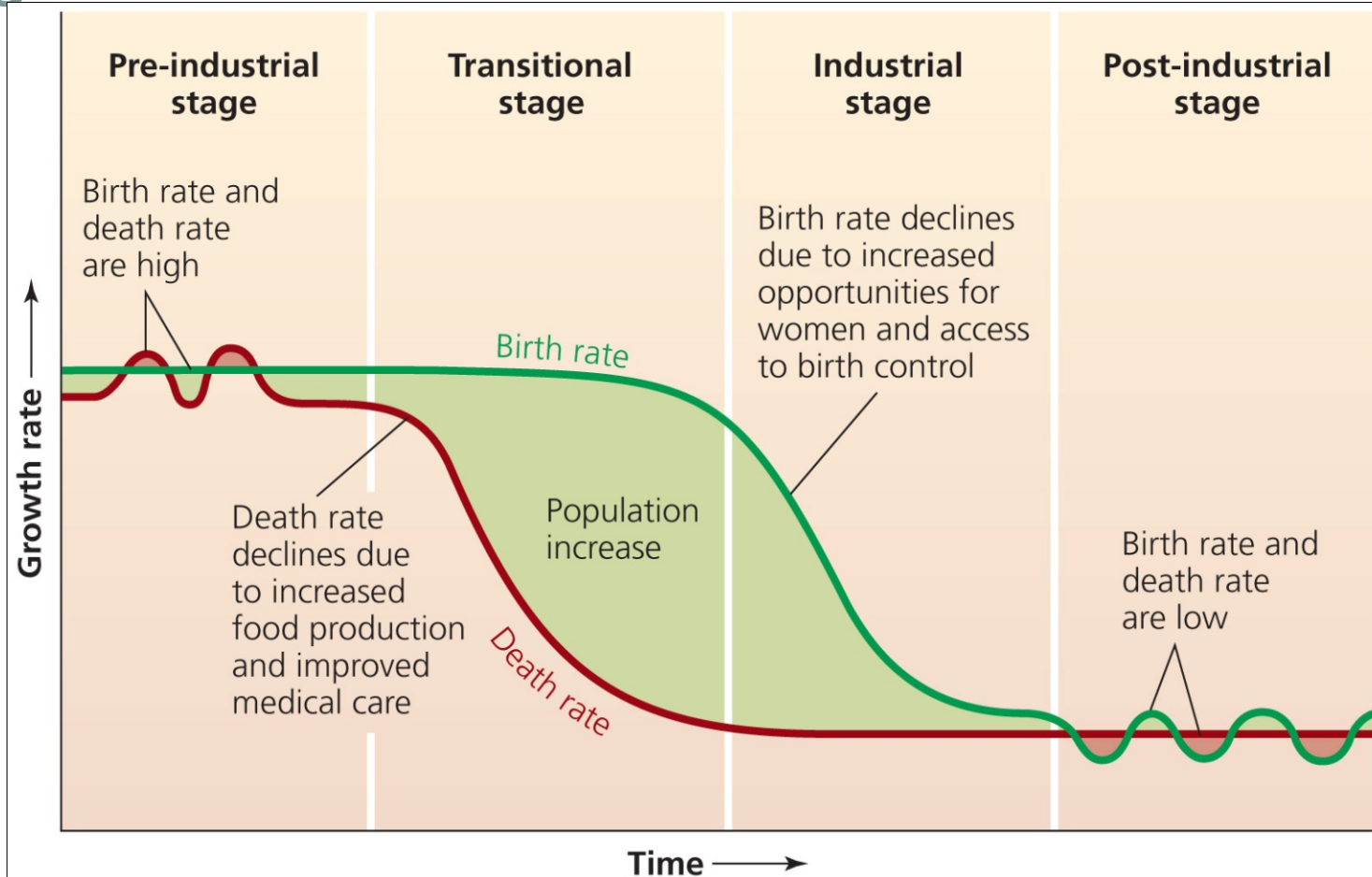
Age Structure: Young Populations Can Grow Fast

- How fast a population grows or declines depends on its age structure.
 - ***Prereproductive age***: not mature enough to reproduce.
 - ***Reproductive age***: those capable of reproduction.
 - ***Postreproductive age***: those too old to reproduce.

The demographic transition

- **Demographic transition** = a model of economic and cultural change to explain the declining death and birth rates in industrializing nations
- Stable preindustrial state of high birth and death rates change to a stable post-industrial state of low birth and death rates
- As mortality decreases, there is less need for large families
 - Parents invest in quality of life

The demographic transition's four stages



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Population growth is seen as a temporary phenomenon

The International Conference on Population and Development

- In 1994 Cairo, Egypt, 179 nations called on all governments to offer universal access to reproductive health care within 20 years
 - Offer better education and health care and alleviate poverty, disease, and sexism
- Despite the success of family planning, recent Republican administrations in the U.S. have declined to fund family-planning efforts
 - George W. Bush cancelled funding as one of his first acts on becoming U.S. president in 2001

Conclusion

- The human population is larger than at any time in the past and getting older
- Populations are still rising, even with decreasing growth rates
- Most developed nations have passed through the demographic transition
- Expanding rights for women slows population growth
- Will the population stop rising through the demographic transition, restrictive governmental intervention, or disease and social conflict caused by overcrowding and competition?
- Sustainability requires a stabilized population in time to avoid destroying natural systems