ECOLOGY -- POPULATIONS

I. Population Characteristics

A. Population Density: the number of organisms in a specific area

(ex: 11 deer per square mile)

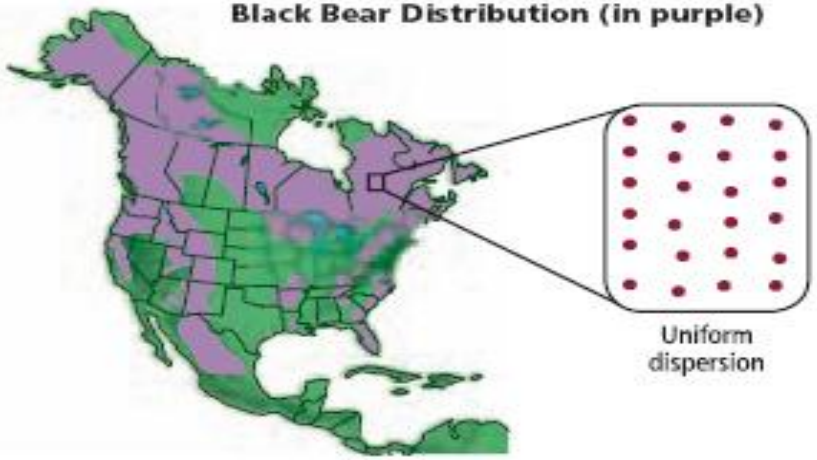
B. Range: the area where a particular organism lives and reproduces

C. Dispersion: how individuals in a population are spread out within their range

Black Bear

Density: one bear per several hundred square kilometers

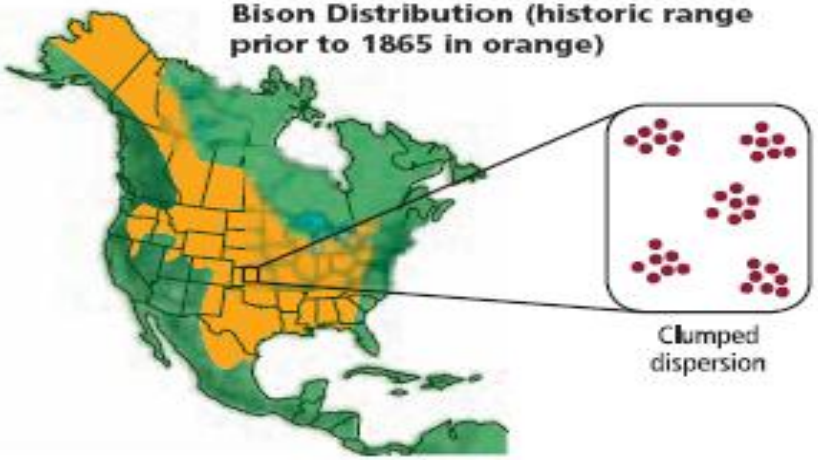
Dispersion: American black bear males usually are dispersed uniformly within territories as large as several hundred square kilometers. Females have smaller territories that overlap those of males.



American Bison

Density: four bison/km^2 in Northern Yellowstone in 2000

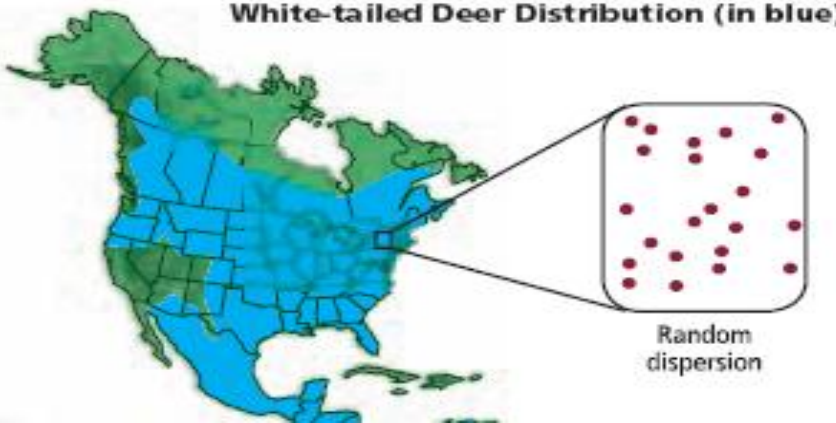
Dispersion: American bison are found in clumped groups called herds.



White-tailed Deer

Density: 10 deer/km^2 in some areas of the northeastern United States

Dispersion: White-tailed deer are dispersed randomly throughout appropriate habitats.



II. *Limiting Factors: situations that prevent a population from increasing*

A) Density-Independent Factors

--do not depend on the number of individuals in the population.

--Usually abiotic factors such as pollution, weather events and natural disasters

B) Density-Dependent Factors

-become limiting only when population reaches a certain size

-strongest when population is large and dense

-usually biotic factors such as food, predators, disease, and competition

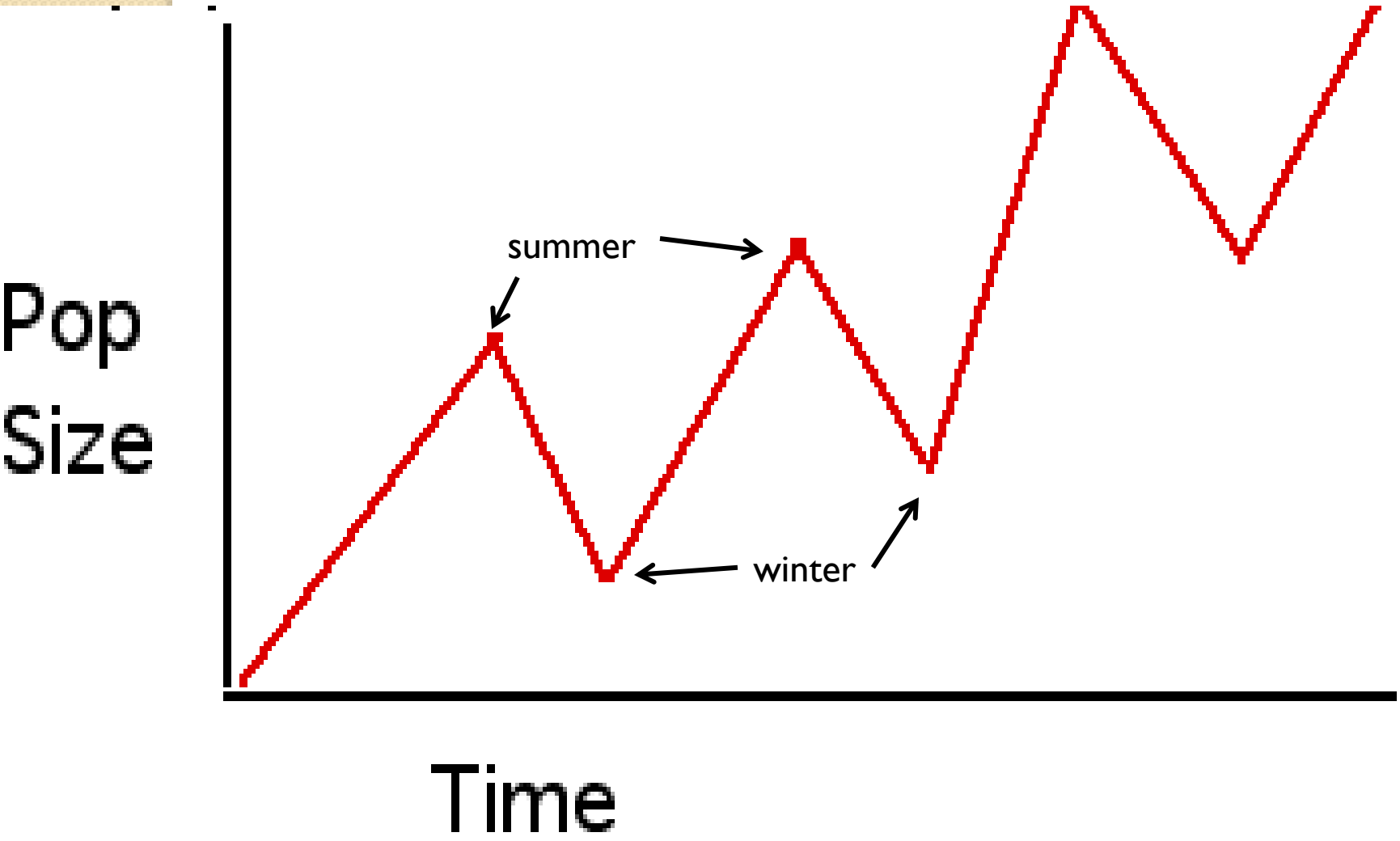
C. Sawtooth Curve: Shows periodic fluctuations (rise and fall) of populations.

--Can show density-dependant factors at work (predator-prey)

--Can show density-independent factors at work (seasonal changes)

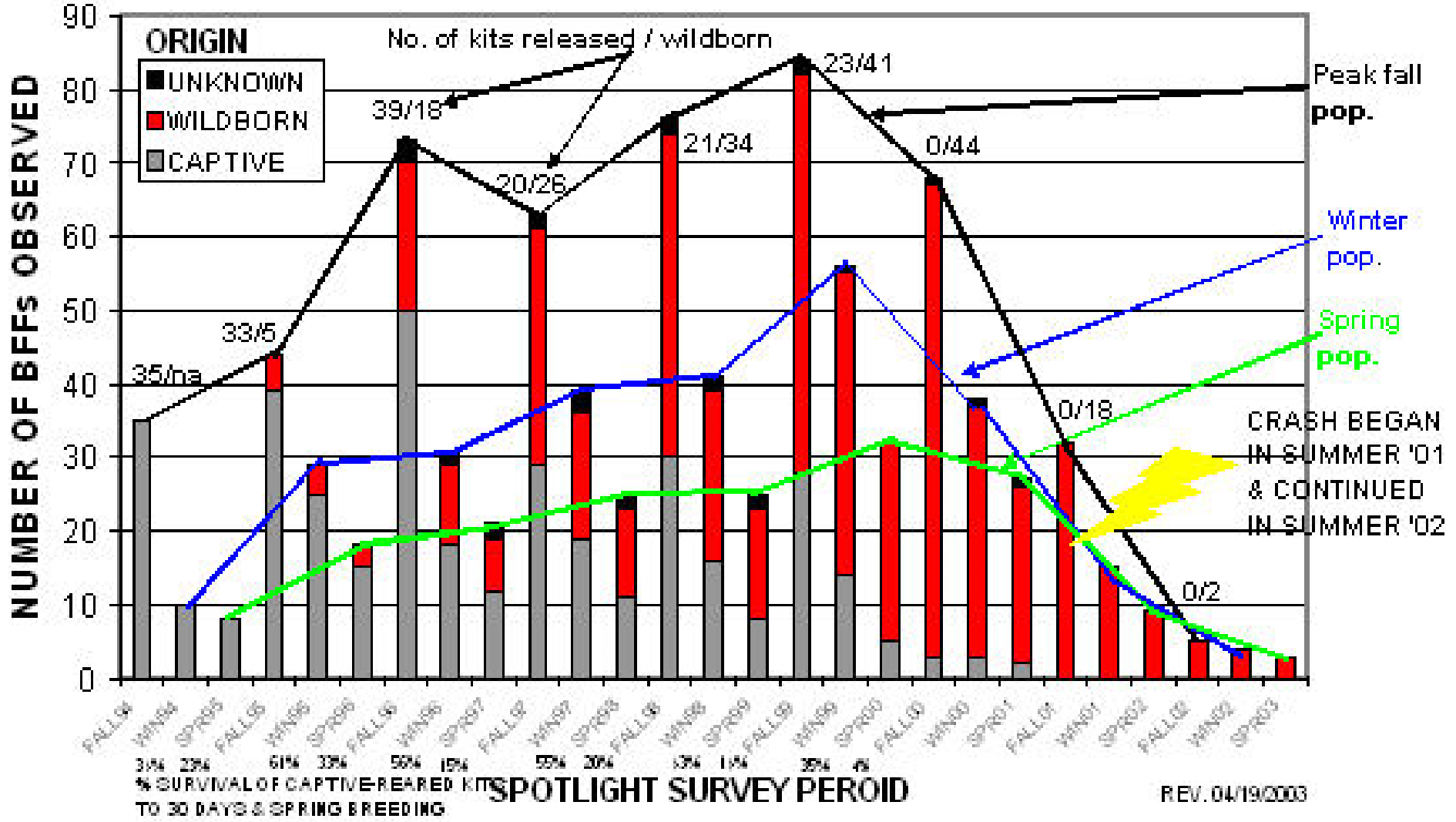
Sawtooth Graph

-showing seasonal population fluctuations



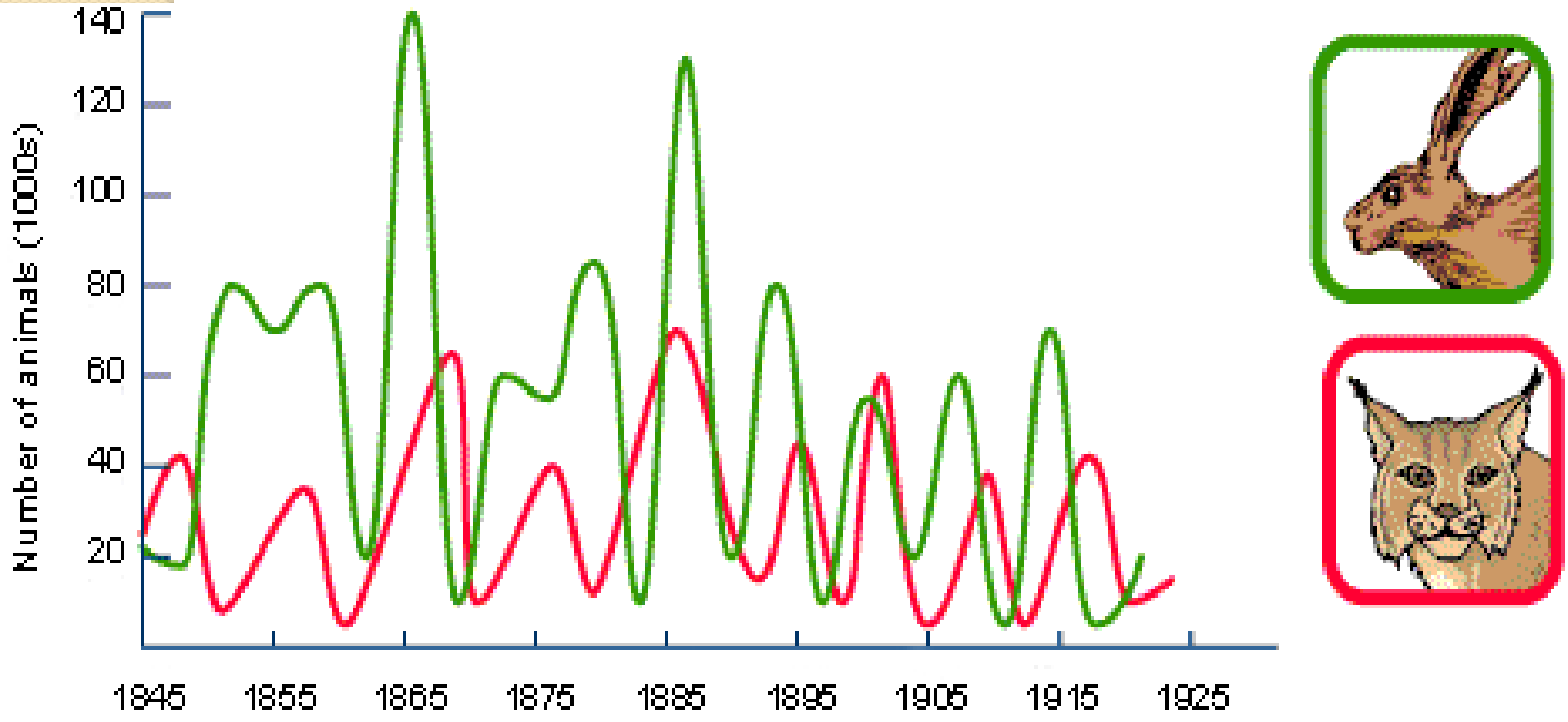
UL BEND NWR BLACK-FOOTED FERRET POPULATION, PHILLIPS COUNTY, MONTANA

Totals: Kits released = 171 / Wildborn = 188



Sawtooth curve

--showing predator-prey interaction



II. Population Changes

A. Calculating Change in Population:

(Births + I) - (Deaths + E)

Immigrants (I) *- Individuals moving into a population*

Emigrants (E) *- Individuals moving out of a population (exiting)*

II. Population Changes

B. *Growth Rates=*

Change in Pop./Total Pop X 100

Example-

C. *Birth Rate=*

Number of births/Total Pop X 100

-Example-

D. *Death Rate=*

Number of Deaths/Total Pop X 100

Example-

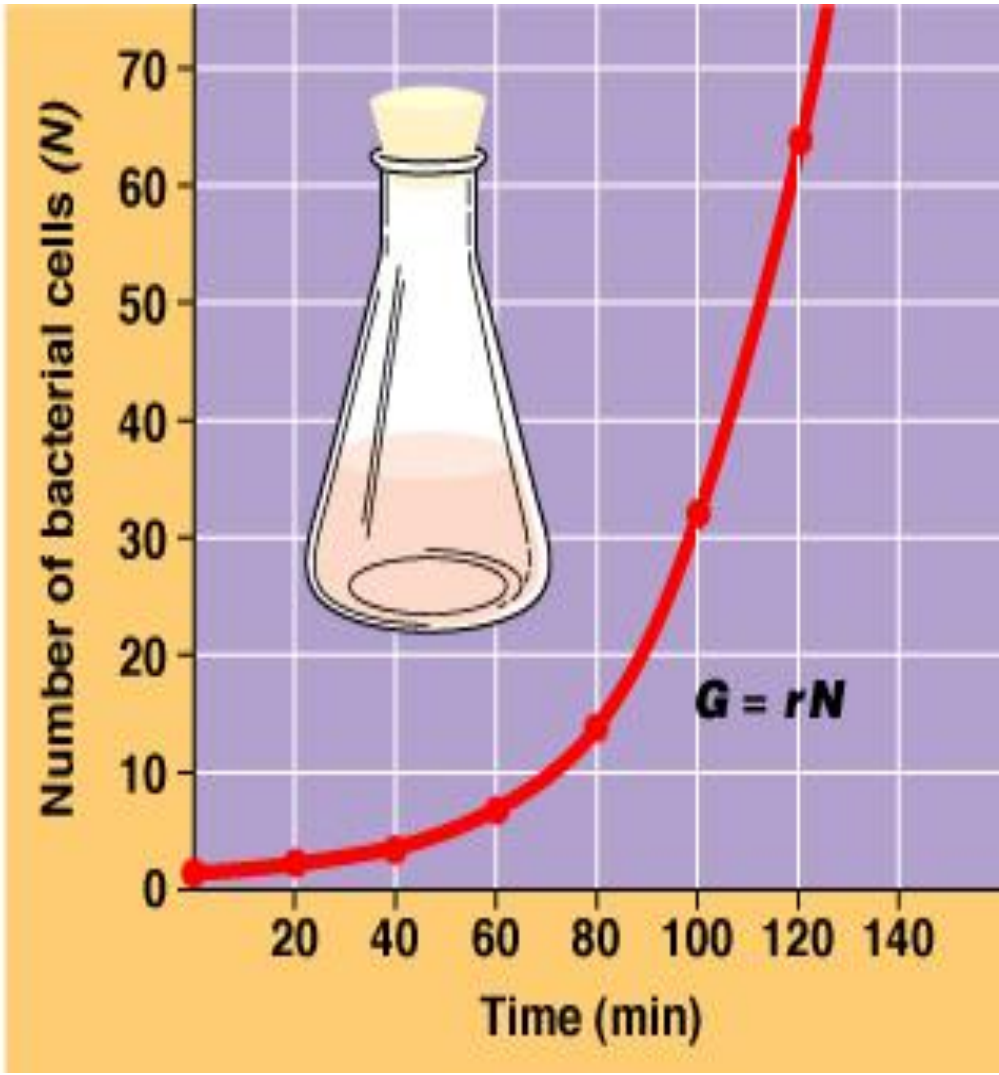
B. *Biotic Potential*

The growth rate of a population if every individual survived and reproduced.

- *Under such ideal conditions, a population would have* ***exponential growth***

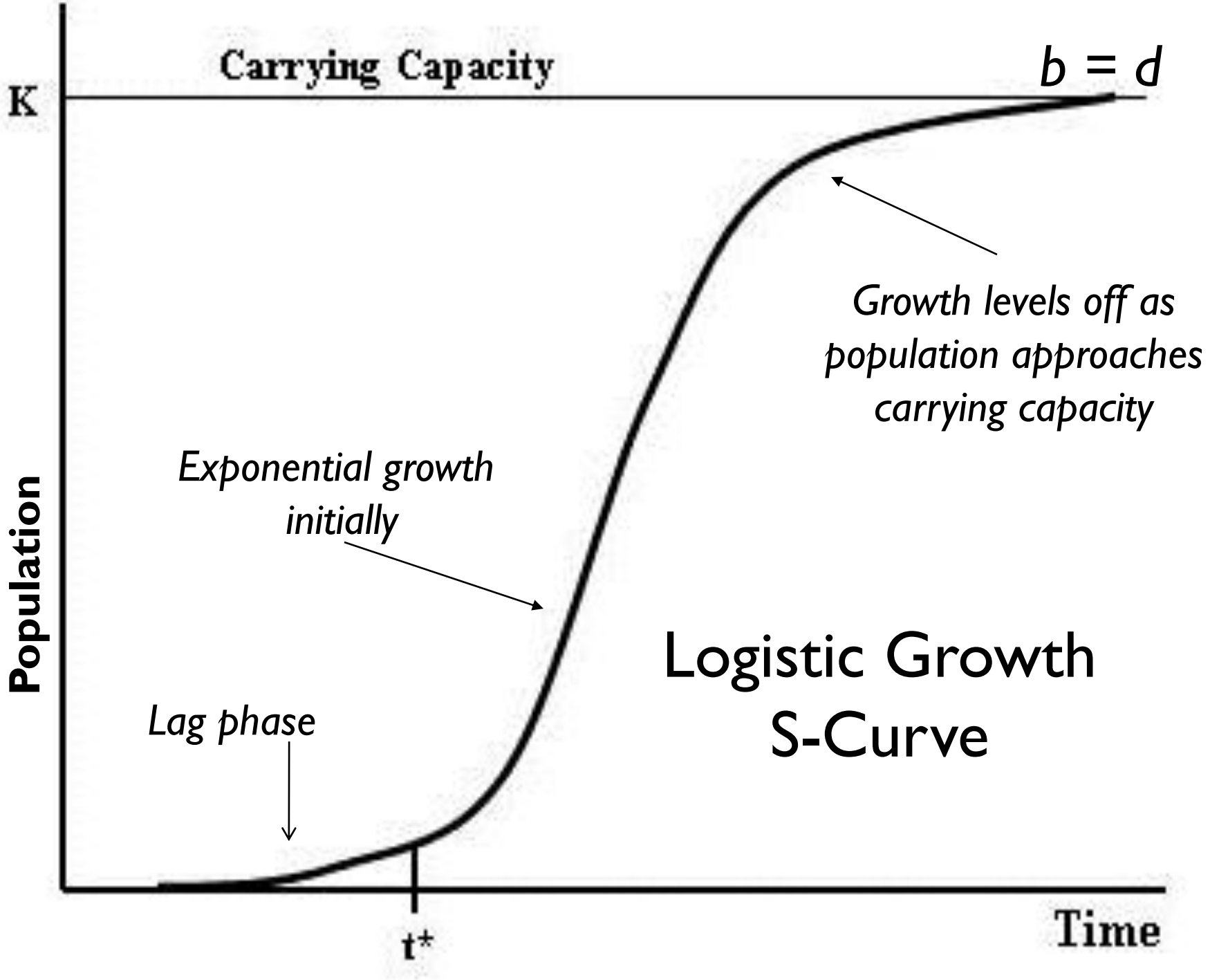
Exponential growth = J-curve

Time	Number of Cells	
0 minutes	1	$= 2^0$
20	2	$= 2^1$
40	4	$= 2^2$
60	8	$= 2^3$
80	16	$= 2^4$
100	32	$= 2^5$
120 (= 2 hours)	64	$= 2^6$
3 hours	512	$= 2^9$
4 hours	4096	$= 2^{12}$
8 hours	16,777,216	$= 2^{24}$
12 hours	68,719,476,736	$= 2^{36}$



C. *Carrying capacity*: *the maximum number of individuals in a species that an environment can support*

1. *Determined by the amount of resources available (food, water, nutrients, etc)*
2. *Results in logistic growth*


Carrying Capacity
b = d
K
Growth levels off as population approaches carrying capacity
Exponential growth initially
Logistic Growth S-Curve
Lag phase
Population
t*
Time

D. Reproductive patterns

1. r-strategist: produce many offspring in a short period of time, usually to take advantage of a temporarily available resource (mice, flies)

2. k-strategist: produce a few offspring that have a better chance of surviving with intense parental care (humans, elephants)

Minnesota Black bear Population

DNR Data:

3000 Baits with Tetracycline

165 Baits eaten by other Animals – How did they know?

935 Baits eaten by Bears– How did they know?

1750 Bears Shot by Hunters

*120 of these were marked – Teeth were stained

$N = M \times T / P$

935 X 1750
Divided by 120 =

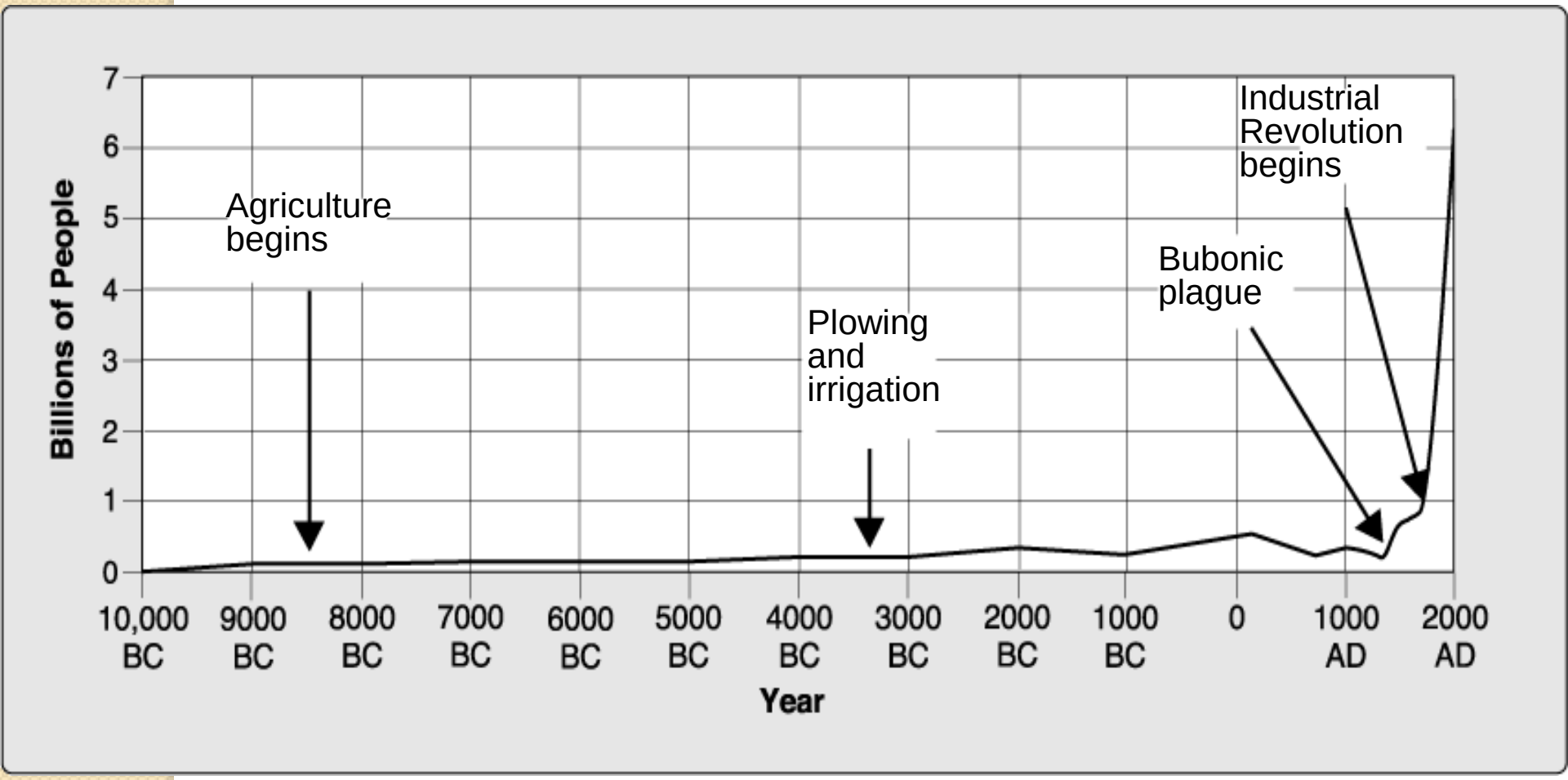
13,635

Number adjusted to 12,400 due to: Canadian migration and Bears eating Cattle Feed

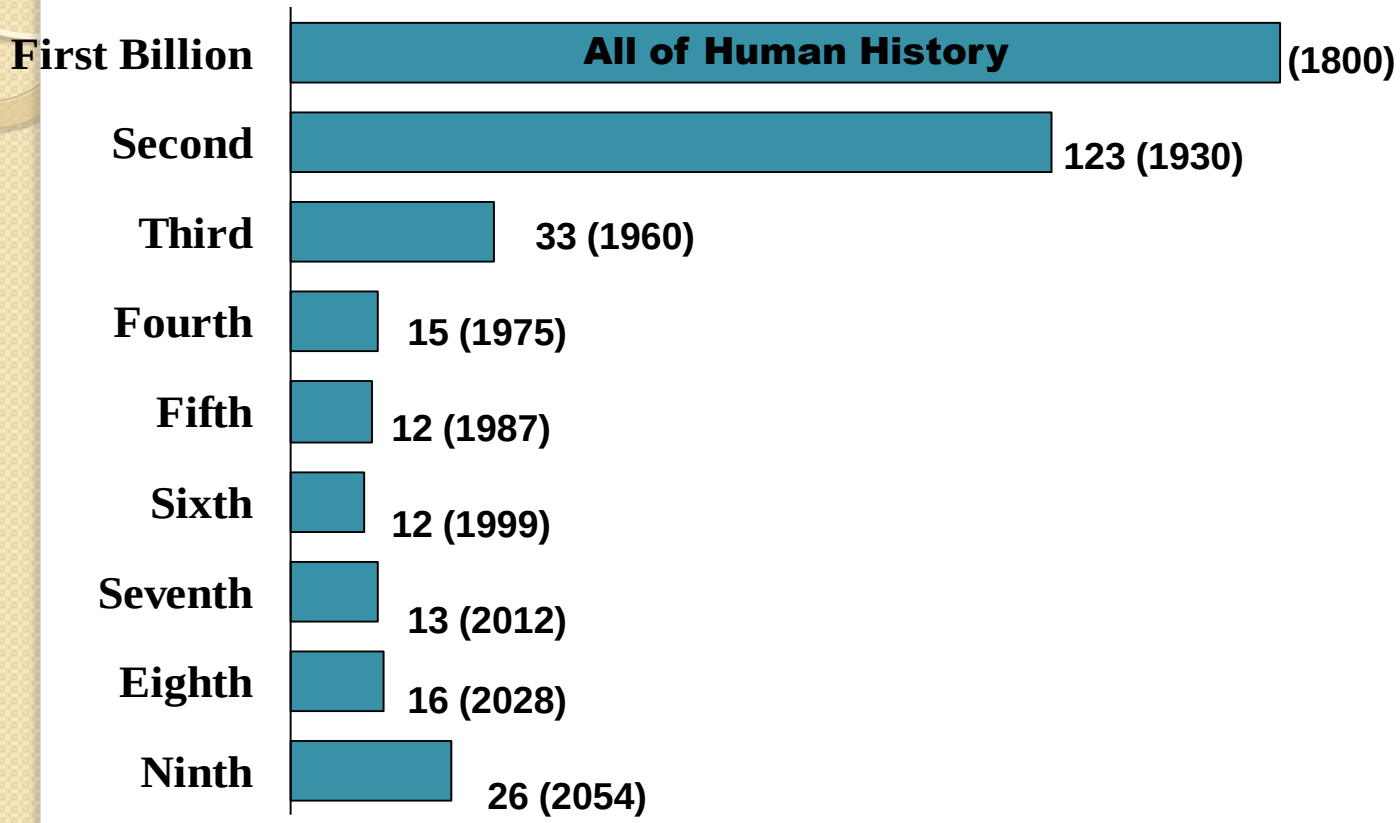
III. Human population growth:

Year	**Estimated population (in millions)**
0 A.D.	130
1650	500
1850	1,000 (1 billion)
1930	2,000
1970	4,000 (4 billion)
1998	6000
Sept 2012	**6,987,000,000**
U.S.	**314,000,000**

A. The graph of human population is a J curve. It shows exponential growth



Number of years to add each billion (year)



Sources: First and second billion: Population Reference Bureau. Third through ninth billion: United Nations, World Population in 2300 (medium scenario), 2003.

Draw a graph of a population of organisms that is impacted annually by limiting factors and is moving toward being endangered.

Draw a graph of a population of organisms that is established and continues to be relatively stable.

How can you tell a predator population graph from a prey population graph?

B. What has allowed human populations to grow exponentially?

1.)medicine
2.)plenty of food(agriculture)
3.) sanitation

** medical advances allow people to live longer and decreases infant mortality(Child death)*

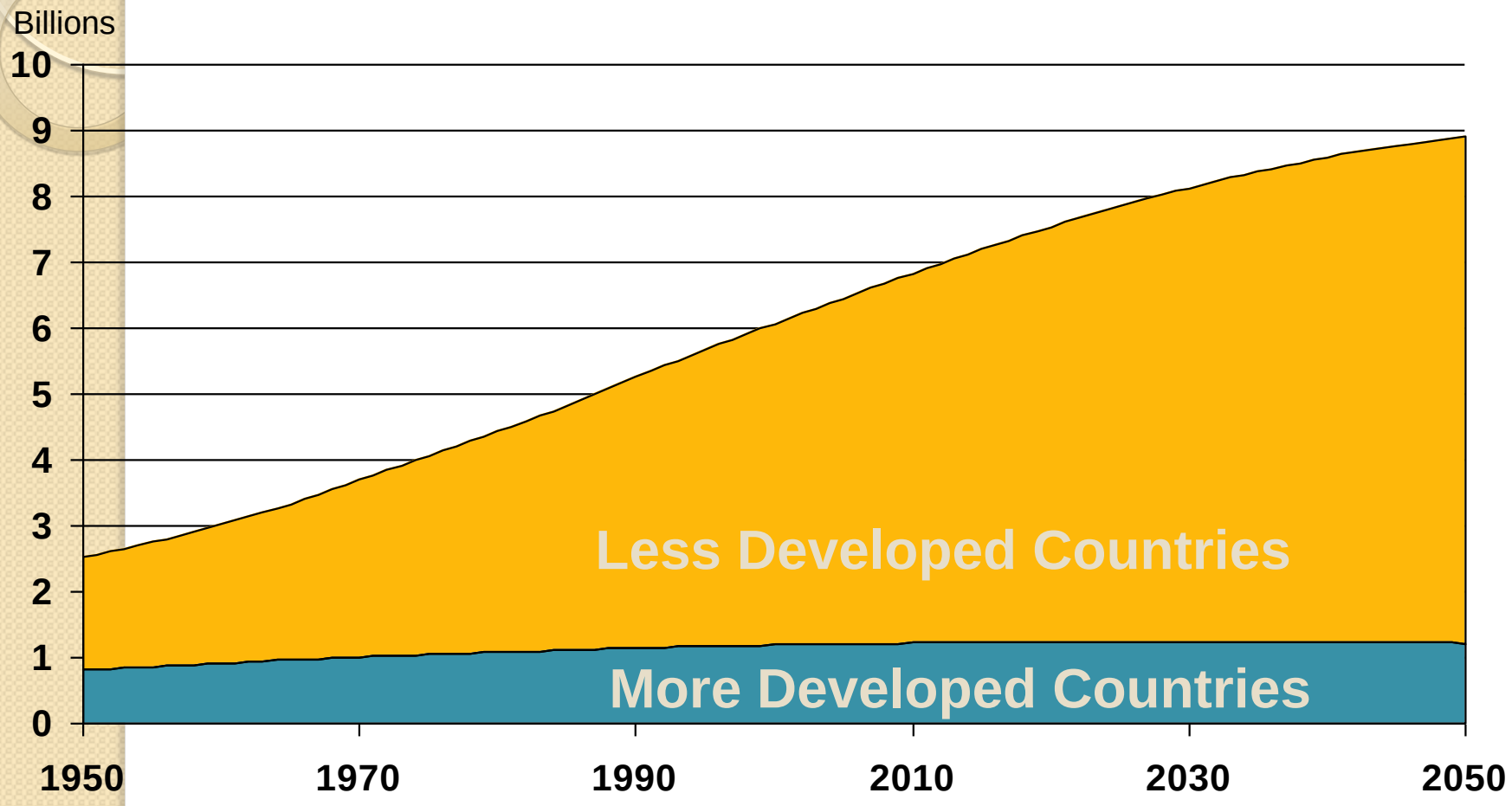
C. What is Earths' carrying capacity?

1. *Unknown*
2. *J curve will continue until some resource becomes limiting*
3. *Some countries have exceeded their carrying capacities: China, Ethiopia, Somalia, India*

D. Demographic Transition

1. *Shift from high birth & death rates in a population to low birth & death rates*
2. *Eventually results in slow, or no, population growth*
3. *US, Europe, Japan have shifted*
4. *Most people live in countries that have not yet gone through this change*

Growth in More, Less Developed Countries

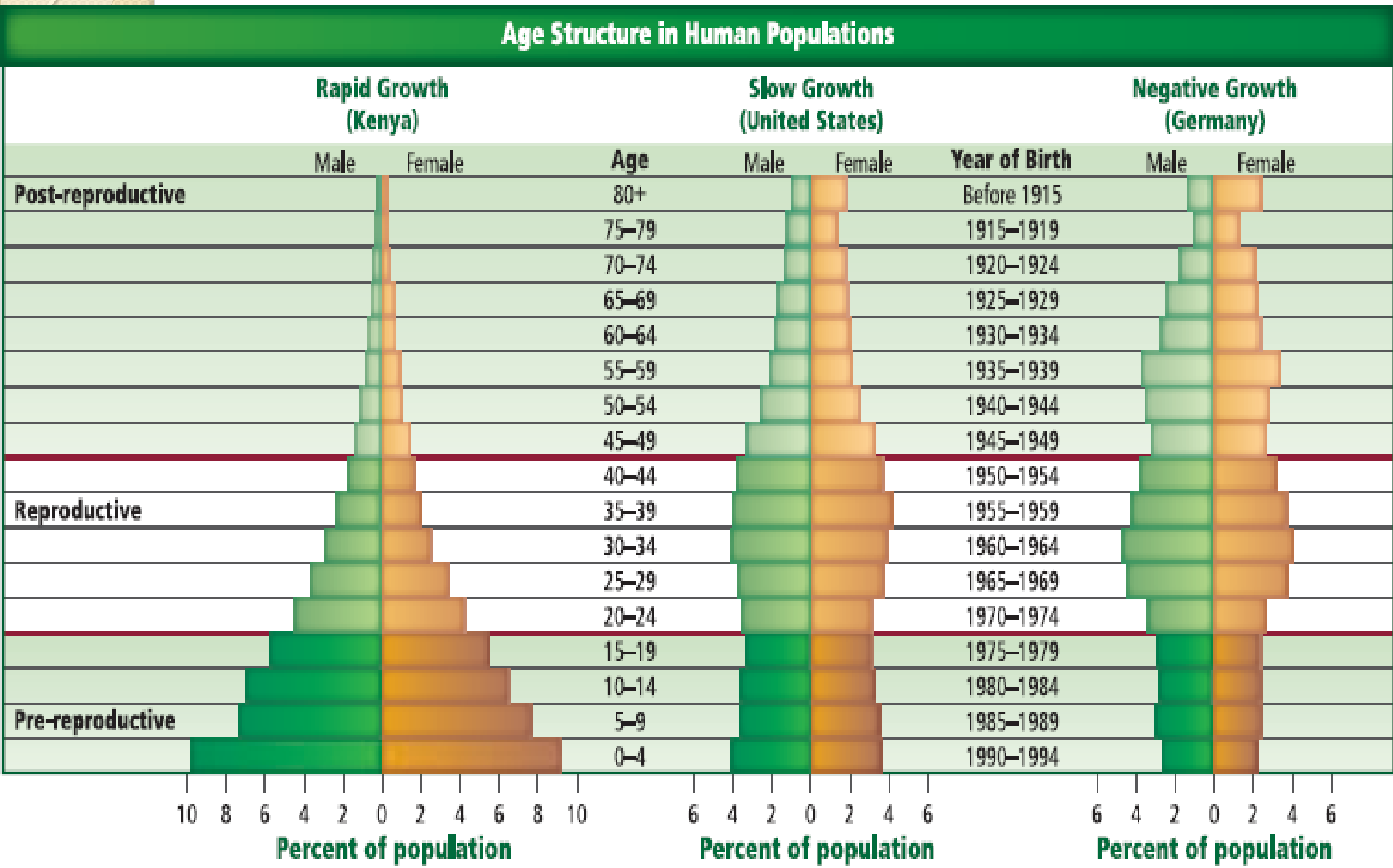


Source: United Nations, World Population Prospects: The 2002 Revision (medium scenario), 2003.

World Population Clock

Natural Increase per	World	More Developed Countries	Less Developed Countries	China
Year	**80,224,198**	**912,053**	**79,312,145**	**7,813,361**
Day	**219,792**	**2,499**	**217,294**	**21,407**
Minute	**153**	**2**	**151**	**15**

Source: Population Reference Bureau, 2004 World Population Data Sheet.


Age Structure in Human Populations
Rapid Growth (Kenya)
Slow Growth (United States)
Negative Growth (Germany)
Male
Female
Age
Year of Birth
Post-reproductive
Reproductive
Pre-reproductive
80+
75–79
70–74
65–69
60–64
55–59
50–54
45–49
40–44
35–39
30–34
25–29
20–24
15–19
10–14
5–9
0–4
Before 1915
1915–1919
1920–1924
1925–1929
1930–1934
1935–1939
1940–1944
1945–1949
1950–1954
1955–1959
1960–1964
1965–1969
1970–1974
1975–1979
1980–1984
1985–1989
1990–1994
10 8 6 4 2 0 2 4 6 8 10
6 4 2 0 2 4 6
6 4 2 0 2 4 6
Percent of population
Percent of population
Percent of population

E. Human Population Control

1. *What factors cause populations to change?*
   - *a) Births*
   - *b) Immigration*
   - *c) Deaths*
   - *d) Emigration*

2. *How can overpopulation be controlled?*

Control	*births?*	*deaths?*
	immigration?	*emigration?*

3. *Zero population growth (ZPG)*
    a) *A.k.a. replacement rate*
    b) *B + I = D + E*
    c) *2 children per family*
    d) *China allowing only 1 child!*