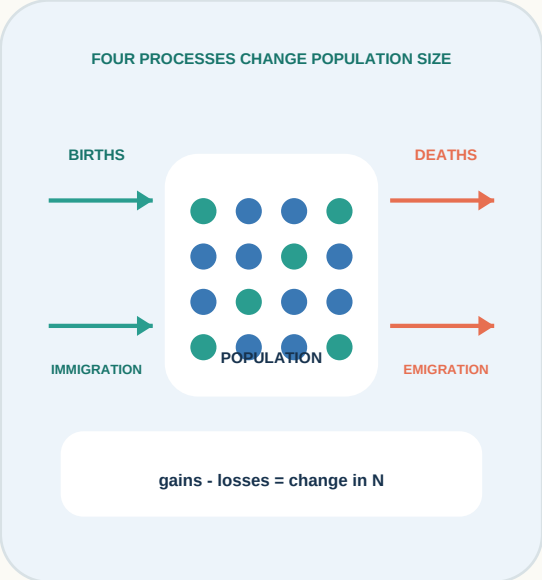
AP BIOLOGY | UNIT 8

TOPIC 8.3 Population Ecology

Population ecology tracks how births, deaths, immigration, emigration, and per capita growth change the number of individuals over time.



THE POPULATION-GROWTH CHAIN

STARTING N
current population

→

GAINS
births + immigration

→

LOSSES
deaths + emigration

→

NEW N
population after change

BY THE END, YOU SHOULD BE ABLE TO...

1. Calculate population change from demographic processes.
2. Interpret dN/dt = r_max x N under ideal conditions.
3. Build and read a properly labeled population graph.

CENTRAL IDEA

Population size changes through gains and losses. Growth rate depends not only on per capita rates, but also on how many individuals are present.

1

Population size is a demographic balance

Count every process over the same time interval. Births and immigration add individuals; deaths and emigration remove them.

THE FOUR TERMS

B

BIRTHS

birth rate counts new individuals born per unit time

+ N

I

IMMIGRATION

individuals enter from another location

+ N

D

DEATHS

death rate counts individuals lost per unit time

- N

E

EMIGRATION

individuals leave for another location

- N

POPULATION ACCOUNTING

change in N = (births + immigration) - (deaths + emigration)

WHAT THE SIGN TELLS YOU

POSITIVE CHANGE

gains are greater than losses; N increases

ZERO CHANGE

gains equal losses; N is unchanged for that interval

NEGATIVE CHANGE

losses are greater than gains; N decreases

WORKED POPULATION CHECK

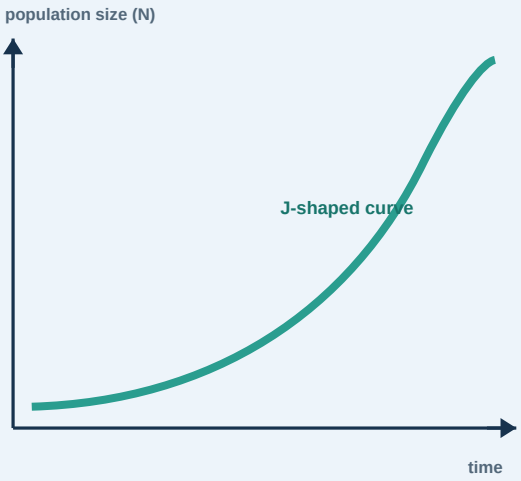
START	**N = 200**
DURING ONE YEAR	**B = 40, I = 10, D = 25, E = 5**
CALCULATE	**change in N = (40 + 10) - (25 + 5) = +20**

new population size = 200 + 20 = 220 individuals

2 Exponential growth multiplies the population

Under ideal conditions, each individual contributes to growth at the maximum per capita rate, so absolute growth accelerates as N becomes larger.

THE MODEL



$$dN/dt = r_{max} \times N$$

dN	change in population size
dt	change in time
r_max	maximum per capita growth rate
N	current population size

WHEN THE MODEL APPLIES

ABUNDANT RESOURCES

food, space, and other needs are not strongly limiting

LOW LIMITING PRESSURE

disease, predation, and competition remain low

SHORT-TERM MODEL

conditions stay favorable during the interval studied

WHY GROWTH ACCELERATES

If r_max = 0.20 per time unit: N = 100 gives dN/dt = 20, but N = 500 gives dN/dt = 100. The same per capita rate produces a larger total increase when N is larger.

POPULATION-GRAPH CHECKLIST

AXES	independent variable on x; population size or rate on y
LABELS	variable names, units, and a sensible numerical scale
DATA	accurate points plus a trend line only when appropriate
CLAIM	describe the pattern and state the conditions of the model