

# What is Population Dynamics?

## Worksheet

Population dynamics is the study of changes in population size driven by birth rates, death rates, immigration, and emigration. Growth can be exponential (unlimited) or logistic (limited by carrying capacity).

## Questions

1. A population with a doubling time of 20 years is an example of
  - A) exponential growth
  - B) logistic growth
  - C) carrying capacity
  - D) extinction
2. The S-shaped curve in population growth represents
  - A) exponential only
  - B) logistic growth (lag, log, stationary phases)
  - C) linear growth
  - D) random fluctuation
3. If carrying capacity is 10,000 and current population is 8,000, population growth will
  - A) continue exponentially
  - B) slow down
  - C) stop immediately
  - D) go negative
4. A tornado destroys habitat and kills many individuals (density-independent). This is an example of
  - A) density-dependent limiting factor
  - B) density-independent limiting factor
  - C) carrying capacity
  - D) emigration only
5. A bacterial colony starts with 500 cells and doubles every hour. How many cells after 6 hours?
6. A wolf population in a park starts at 20, has birth rate 0.3 and death rate 0.1 per year. What is the population after 10 years (assuming exponential growth)?
7. A lake can support 5,000 fish (carrying capacity  $K$ ). If 500 fish start in the lake and growth is logistic, what happens over time?
8. Define: What is population dynamics?
9. Define: What is exponential growth?
10. Define: What is carrying capacity ( $K$ )?

## Answer Key

1. A) exponential growth - A fixed doubling time indicates exponential growth (constant per-capita rate in an unlimited environment).
2. B) logistic growth (lag, log, stationary phases) - Logistic growth shows lag (slow start), exponential phase (rapid), and stationary phase (approaching K).
3. B) slow down - As population approaches K, resources become limited, and growth slows (logistic model).
4. B) density-independent limiting factor - Density-independent factors affect populations regardless of how crowded they are (weather, disasters).
5.  $N_0 = 500$  cells Doubling time = 1 hour ( $r = 1$  per generation)  $t = 6$  hours = 6 generations  $N(t) = N_0 2^t = 500 2^6 = 500 64 = 32,000$  cells
6. (finite rate)  $= 1 + (\text{births} - \text{deaths}) = 1 + (0.3 - 0.1) = 1.2$   $N(t) = N_0 \lambda^t = 20 1.2^{10} = 20 6.19 = 124$  wolves (In reality, logistic factors slow growth before this.)
7. Initial population  $N_0 = 500$ ,  $K = 5,000$  Early phase: population grows slowly at first (few individuals) Lag phase: rapid exponential growth (limited by resources) Stationary phase: growth slows near K (resource competition, predation) Final: population stabilizes around 5,000
8. The study of how populations change in size over time due to births, deaths, immigration, and emigration.
9. Population growth with a constant per-capita rate in an unlimited environment (no resource constraint).
10. The maximum population size an environment can sustain indefinitely given available resources.

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