

Exercise walk-through

3.5

Population Growth and Resource Availability

AP Environmental Science

Carrying capacity, and what happens past it

carrying capacity

K – the maximum population an environment can support long-term

approaching K

growth slows as resources per individual fall – the logistic curve flattens

overshoot

a population may exceed K when resources are temporarily abundant

then a die-off

the excess cannot be supported, and numbers crash – sometimes below K

what sets K

the scarcest resource: food, water, nesting sites, or space

and it moves

K is not a constant – a wet year or a new technology raises it

K is a property of the environment, not of the species. That is why a habitat's degradation lowers it even when the population has not changed.

Exam tips

- Use the **rule of 70**: doubling time $\approx 70 \div \text{growth-rate}(\%)$; a growth rate is (births — deaths) per 1000 $\div 10$.
- Read **age-structure diagrams**: a wide base predicts rapid growth, even bars a stable population.
- Contrast **r-selected** (many offspring, little care) and **K-selected** (few, much care) strategies.
- Know the **demographic transition** stages and what lowers birth rates (education, family planning, development).
- A falling **growth rate** still means growth — the population only shrinks when deaths exceed births.

Worked example – the rule of 70

A country's population grows at 2% per year. Find its doubling time, and the growth rate that would halve it.

- Rule of 70: doubling time
$$= \frac{70}{\% \text{ growth rate}}$$
- $= \frac{70}{2} = 35 \text{ years}$
- To **halve** the doubling time to 17.5 years you would need $70/17.5 = 4\%$.
- Growth is **exponential**: a small rate change moves the doubling time a long way.

Doubling time $= 70/r$
works for **anything** growing exponentially – population, GDP, energy use.
Put r in as a **percent**, not a decimal.

Exercises 2.1-2.3

2.1 Write the percent growth-rate formula (births and deaths). [1]

2.2 A population of 2000 has 60 births and 20 deaths. Find the percent growth rate. [2]

2.3 What shape is growth with unlimited resources? [1]

Exercises 2.1-2.3

2.1 Write the percent growth-rate formula (births and deaths).

[1]

2.1

- $$\% = \frac{\text{births} - \text{deaths}}{\text{population}} \times 100$$

2.2 A population of 2000 has 60 births and 20 deaths. Find the percent growth rate. [2]

2.2

- $$\frac{60 - 20}{2000} \times 100 = 2\%$$

2.3 What shape is growth with unlimited resources?

[1]

2.3

- J-shaped (exponential)

Exercise 3.1

3.1 With limited resources, population growth follows a

[1]

☐

A J-shaped (exponential) curve

B S-shaped (logistic) curve

C straight line

D decreasing curve

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3.1 B

- an S-shaped (logistic) curve

Exercise 3.2 (a)

3.2 A town of 5000 has 100 births, 40 deaths, 30 immigrants, and 10 emigrants in a year.

(a) Find the net population change.

[2]

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(a) Find the net population change. [2]

(a)

- $(100 + 30) - (40 + 10) = 80$

Exercise 3.2 (b)

3.2 A town of 5000 has 100 births, 40 deaths, 30 immigrants, and 10 emigrants in a year.

(b) Find the percent growth rate.

[2]

Exercise 3.2 (b)

3.2 A town of 5000 has 100 births, 40 deaths, 30 immigrants, and 10 emigrants in a year.

(b) Find the percent growth rate. [2]

(b)

- $\frac{80}{5000} \times 100 = 1.6\%$

Exercise 3.3

3.3 Explain why a population's growth slows as it approaches its carrying capacity. [2]

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3.3

- As the population nears carrying capacity, resources become limited and competition rises, so births fall and deaths rise, slowing growth