D.4.2 · Sustainability and change · supported focus

International Baccalaureate · IB Diploma · Biology · HL

Scope and prerequisites

Supported HL/SL core focus. First assessment 2025; current subject brief acquired; full Biology guide not acquired. Remaining guide, assessment and practical requirements retain their recorded holds.

Prerequisites: populations and ecosystems from D.4.1 and energy flow from earlier ecology. Each lesson develops its own method before independent transfer.

These are original or explicitly fictional teaching examples, not actual measurements or completed assessed learner investigations.

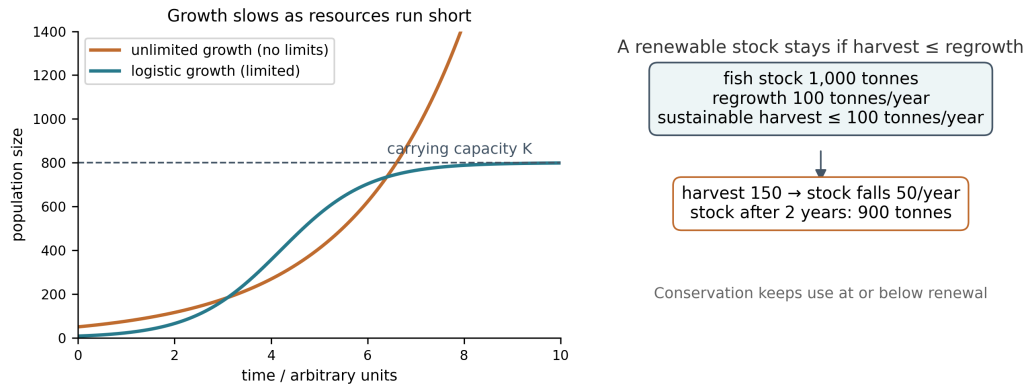
Sustainability and change

■ What would explain this observation?

- A fishery that harvests the same tonnage every year can thrive for decades, while a neighbouring one collapses in five. Both fish the same sea – what separates them?
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- Populations cannot grow without limit. The **logistic model** shows growth slowing as resources run short, levelling at the environment's **carrying capacity** – the largest population the habitat can support. Food, space, disease and predation supply the limits.
- A **renewable resource** is sustainable only when harvest stays at or below regrowth. Change is constant in ecosystems: climate shifts, species arrive, and human activity alters habitats, so management must track stocks and adjust.
- logistic model: Growth that levels at the carrying capacity as resources become limiting; carrying capacity: The largest population an environment can support; renewable resource: A resource that regenerates, such as a fish stock or a forest.



■ Choose evidence that can test it

- Compare the stock before and after each harvest season: a sustainable fishery holds the stock near its level, while decline year on year means harvest exceeds regrowth. Distinguish a falling stock from a falling CATCH, which can hide the decline until late.
- Track the same population over several years rather than once; a single count cannot show a trend.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: a fish stock is 1,000 tonnes and regrows 100 tonnes per year. A harvest of 150 tonnes per year gives net change = regrowth − harvest = 100 − 150 = −50 tonnes per year. After two years the stock is 1,000 − 2 × 50 = 900 tonnes – a sustainable harvest at this regrowth is at most 100 tonnes per year.

Example:

After better management the regrowth is 120 tonnes per year and the harvest quota is set at 80 tonnes per year. Find the yearly change in the stock and the stock after three years from 900 tonnes, using the same sequence: known quantities → model → relation → substitution → unit and interpretation. (Answer: net change = 120 − 80 = +40 tonnes per year; after three years, 900 + 3 × 40 = 1,020 tonnes – the stock recovers.)

■ Check the conclusion and its limits

- The balance model assumes a constant regrowth rate; in reality regrowth depends on the stock size itself, collapsing fastest when the stock is already small. One year's figures cannot establish a trend – management needs the whole time series and honest catch reporting.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

A renewable resource cannot be used up. This claim is false: renewable means it CAN regenerate, not that it always outpaces use – a stock harvested faster than its regrowth shrinks every year and can collapse entirely, as overfished cod stocks did.

Key:

Sustainability and change: populations level at the carrying capacity, and renewable resources stay only if harvest $\leq$ regrowth. Track stocks over time and set harvests from measured regrowth, because ecosystems never stand still.