Meet needs without using up the future

Sustainability means meeting present needs while preserving resources and the capacity to meet the needs of future generations. It concerns how humans live within, and depend on, natural systems.

1. PROTECT THE SYSTEM THAT PROVIDES THE RESOURCE

Natural systems
Soils, waters, living organisms

→

Benefits today
Food, materials, clean water

→

Future availability
Depends on healthy systems

Extension: natural capital includes natural resources and the systems that provide ecosystem services. A forest supplies timber, but also stores carbon, supports habitat and influences water movement. Maintaining only the timber harvest does not necessarily maintain all the forest's benefits.

2. RENEWABLE DOES NOT MEAN UNLIMITED

RENEWABLE RESOURCES

Fish populations and forests can regenerate. Their continued supply depends on the rate of use and the conditions needed for renewal. Removing organisms faster than replacement can deplete the stock.

NONRENEWABLE RESOURCES

Mineral deposits and fossil fuels form too slowly to replace human extraction on useful timescales. Reduce unnecessary use and recover reusable materials; using less slows depletion but does not make the stock renewable.

3. EXTENSION: CONSIDER THE WHOLE LIFE CYCLE

A product uses resources during extraction, manufacture, transport, use and disposal. Repair, reuse and recycling can reduce demand for new materials; pollution prevention reduces damage before cleanup is needed. Assess environmental effects alongside affordability, health and access to essential services. A cheaper product is not automatically sustainable, and a change that reduces one impact may increase another. Sustainability involves long-term outcomes, not just a green label.

Human needs, ecosystem services and shared dimensions: US EPA, Sustainability and the ROE.
Resource use across product life cycles: US EPA, Sustainable Materials Management Basics.

Scope: College Board AP Environmental Science CED, Topic 5.12, p. 108.

Use indicators to track change

An environmental indicator is a measurable feature that helps reveal the condition of a system or the pressure on it. Topic 5.12 identifies the following indicators as guides to sustainability.

1. SIX LINES OF EVIDENCE

Indicator	What to examine
Biological diversity	Changes in species, genetic diversity and ecosystems. Loss can signal damage to ecological systems and their functions.
Food production	Total output and output per person. Also consider whether producing food degrades soil, water or future productivity.
Global surface temperature	Long-term changes in the global average, not one hot day or one location. Warming can stress ecosystems and human systems.
Atmospheric CO_2	Track atmospheric accumulation. Lower annual emissions do not necessarily cause concentrations to fall.
Human population	Population size and change affect total demand. Consumption per person and technology also influence the resulting pressure.
Resource depletion	Track stocks and use rates. Declining forests, fish stocks or water reserves can warn that extraction is outpacing replenishment.

2. READ THE PATTERN, NOT ONE NUMBER

Use consistent units, a stated baseline and a meaningful time span. Separate totals from per-person values and short-term variability from a long-term trend. More food production may be beneficial, but if it depends on depleting an aquifer, it can undermine future supplies. Similarly, lower resource use per product may be offset by making many more products. These are illustrative trade-offs: no single indicator proves that a society is sustainable. Combine indicators and investigate the mechanism behind a change.

Required indicator set and sustainability: College Board, STB-1.A.1.
Interpreting linked environmental indicators: US EPA, Sustainability and the ROE.
Emissions and concentrations: NOAA, Climate Change - Atmospheric Carbon Dioxide.
Resource use versus economic growth: UNEP, Decoupling.

Scope: College Board AP Environmental Science CED, Topic 5.12, p. 108.

Harvest the renewal, not the stock

Sustainable yield is the amount of a renewable resource that can be removed without reducing its available supply over time. Compare harvest with net replenishment over the same period.

1. KEEP STOCK AND FLOW SEPARATE

A stock is the amount present; a flow is an amount added or removed per unit time. This simplified fish example assumes a starting biomass of 1,000 tonnes and annual net natural growth of 100 tonnes before fishing.

End stock = start stock + net growth - harvest

Harvest (t/year)	Net change (t)	End stock (t)	Result
80	+20	1,020	Increases
100	0	1,000	Unchanged
140	-40	960	Decreases

2. THE REPLACEMENT RATE CAN CHANGE

The table is an illustration, not a real catch recommendation. If net growth falls to 50 tonnes in a later year, harvesting 80 tonnes would reduce the stock by 30 tonnes. Recruitment, natural mortality, food supply and environmental conditions affect renewal. Monitoring and revised harvest limits are therefore necessary; one year of apparently balanced use does not establish a permanently sustainable yield.

3. EXTENSION: SUSTAINABLE IS NOT ALWAYS MAXIMUM

Maximum sustainable yield is the largest long-term average harvest supportable under the prevailing conditions. It is not the largest catch obtainable today. Management may set a lower target to account for uncertainty and ecosystem needs. Fish also feed predators, and fishing can affect habitat and non-target species. Maintaining the harvested population alone is therefore not a complete test of ecosystem sustainability. Include these interactions when evaluating a management strategy.

Sustainable yield: College Board, STB-1.A.2; numerical example created for this summary.
Maximum sustainable yield: NOAA Fisheries, Sustainable Seafood Glossary.
Ecosystem interactions and management: NOAA Fisheries, Ecosystem-Based Fisheries Management.

Scope: College Board AP Environmental Science CED, Topic 5.12, p. 108.