

Greenhouse effect

International Baccalaureate · IB Diploma · Physics · SL

Scope and prerequisites

This handout covers selected SL topics for the course first assessed in 2025; it is not the whole syllabus.

Prerequisites: read the stated quantities and units, and use arithmetic and the model conditions below.

The examples are original and fictional: they are not real measurements or real student investigations.

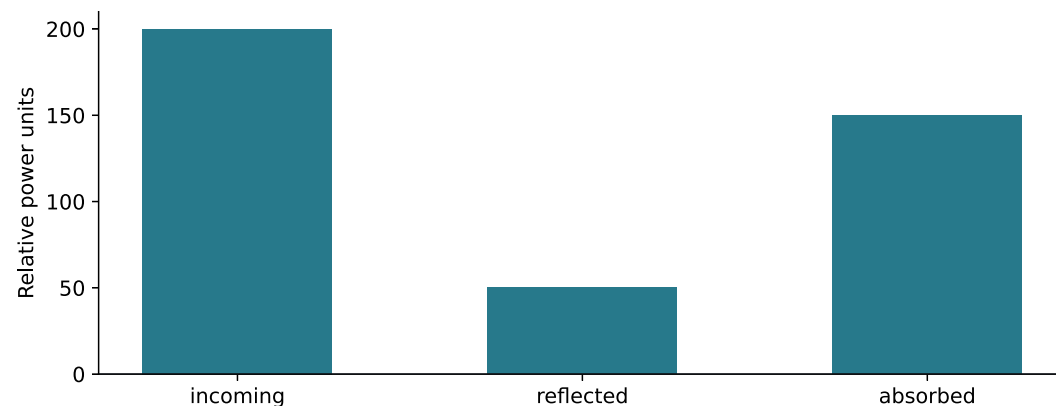
Climate evidence, energy budgets and policy

■ What would explain this observation?

- One cold day does not disprove a warming climate. Weather describes short-term conditions; climate describes distributions over longer times and regions.

■ Build the model

- The Earth energy balance includes incoming solar radiation, reflection, absorption and outgoing infrared radiation.
- Greenhouse gases absorb and emit infrared radiation.
- Feedback can alter the response to an initial forcing.
- **mitigation** : Actions addressing causes of environmental change.
- **adaptation** : Actions reducing harm from environmental impacts.



$$\text{Absorbed} = \text{incoming} - \text{reflected}: 200 - 50 = 150 \text{ units}$$

■ Choose evidence that can test it

- Distinguish mitigation, which addresses drivers, from adaptation, which reduces harm from impacts.
- A policy assessment needs evidence about effectiveness, cost, equity and uncertainty; one criterion is not the entire decision.

In the lab: Compare multi-year data using consistent baselines. State the region, timescale and uncertainty. At HL, connect a management decision to law, economics and ethics rather than treating these lenses as extra definitions only.

■ Work from known quantities

- Known: a surface receives 200 power units and reflects 50.
- Absorbed input = incoming-reflected = $200 - 50 = 150$.
- Reflected fraction = $50/200 = 0.25 = 25\%$.
- A change in reflectivity alters the absorbed budget under this model.

Your turn: Incoming energy is 240 units and reflected energy 72. Find reflected percentage.

■ Check the conclusion and its limits

- The greenhouse effect is not the same process as ozone depletion.
- A carbon footprint estimate depends on its system boundary.

Not true: One local weather observation establishes a global climate trend. Weather is a short-term local state; climate is the long-term statistical pattern. One cold day in one city cannot confirm or refute a global trend built from decades of worldwide records.

Key:

- The Earth energy balance includes incoming solar radiation, reflection, absorption and outgoing infrared radiation.
- Distinguish mitigation, which addresses drivers, from adaptation, which reduces harm from impacts.
- Watch for: the greenhouse effect is not the same process as ozone depletion.

■ Write from a reflected share of 16 percent

- Incoming energy is 250 units and reflected energy is 40 units.
- Find the reflected percentage. One local weather observation is not a climate trend.

■ **Write from an albedo of 0.60**

- A surface receives 500 units of incoming energy and reflects 300.
- Albedo = $300 \div 500 = 0.60$ – the reflected fraction, leaving 200 units (0.40) absorbed.

■ **Write from an enhanced greenhouse chain**

- Carbon dioxide concentration rises; say what happens next, link by link.
- More CO₂ re-absorbs more outgoing infrared, the surface warms until outgoing energy balances again – name the mechanism; “traps heat” names nothing.

■ **Write from a budget balance test**

- A planet absorbs 240 power units and emits 240.
- The budget balances – for now: any persistent gap between absorbed and emitted FORCES temperature change until balance returns. An imbalance is the signature of change.