The greenhouse effect: energy and evidence

Teacher / technician

YEAR 10 / LESSON 62 / CHEMISTRY + SCIENCE (DOUBLE AWARD)

Staff preparation and answer guidance. Keep separate from student sheets. Desk-based radiation model with explicitly invented energy units. No misleading claim that a bottle experiment proves atmospheric warming.

Coverage and delivery

Shared core: 2.13. Carbon dioxide as a greenhouse gas; mechanism explained with radiation and energy balance. This is a model/evidence activity, not a gas-heating experiment.

Allow about 60 minutes. Follow the student sequence and use the answers to check reasoning.

Requisition • class of 30, working in 15 pairs

Item	Per pair / setup	Class total
Booklet / writing tools	1 per learner	30 sets
Drawing tools / ruler / optional arrows	1 set per learner or pair	30 writing sets; optional 15 arrow sets

Immediate safety

No laboratory chemicals, gases or heating. Use reusable model pieces normally and return them after the activity.

Preparation and delivery

Read alongside the student method

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1. Provide 30 booklets and drawing tools, with optional model arrows. No heaters, compressed gases or chemical generation are required.

2. Use the NASA energy-budget source for the physical mechanism. Keep the 100/98 values explicitly labelled as an original simplified exercise; they are neither watts per square metre nor observations.

3. Require arrows to show absorption/emission, outgoing energy to space and energy conservation. Avoid a solid “blanket lid” diagram that implies permanent trapping.

4. Distinguish radiative greenhouse warming from suppression of convection in a glass enclosure. Bottle material, mixing, humidity, geometry and thermometer placement can confound a simple comparison.

5. Explain water vapour primarily as a feedback in current global warming, while added long-lived gases such as CO_2 act as drivers. Avoid claiming water vapour is irrelevant.

6. Allow 10 minutes recall, 20 model building, 20 critique and 10 explanation. Use the model’s limits as part of the answer, not as an excuse to deny the established mechanism.

Close of lesson

• Keep annotated models and return shared materials.

Check before teaching

Check the cards, reference data and quantities against this requisition. Keep the staff answer guide separate until the checking stage. Supplied numerical practice datasets are labelled examples; they are not class measurements.

Answers and teaching notes

Expected explanations • do not give as experimental observations

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• Incoming solar radiation is mainly shorter wavelength; Earth emits longwave infrared after absorbing energy. Some sunlight is reflected, and radiation is also absorbed by the atmosphere.

• Greenhouse gases absorb selected infrared wavelengths and emit radiation; they do not reflect every wavelength or prevent all energy leaving. The surface/atmosphere exchange energy while Earth still emits to space.

• A: 100−100=0 net units per interval. B: 100−98=+2 initially, so energy accumulates. This indicates warming tendency, not a calculable number of degrees from the supplied data.

• CO_2, CH_4, water vapour and N_2O. Carbon monoxide is CO, a different chemical species; it is not another name for carbon dioxide.

• Unequal convection, container absorption, humidity and sensor position can change measured temperatures. A bottle observation alone does not isolate the atmospheric radiative mechanism.

• Natural greenhouse effect makes the surface warmer than otherwise; increased greenhouse gases enhance it. Ozone depletion concerns stratospheric ozone and ultraviolet protection, not the main explanation for current global warming.

References and provenance

Pearson Chemistry specification

NASA Earth energy budget

NASA causes of climate change

Prepared 22 November 2026. Original wording, tables and questions. Sources inform the concepts and technique; the lesson scope and classroom quantities are explicitly described here. No laboratory trial or final school risk approval is claimed.