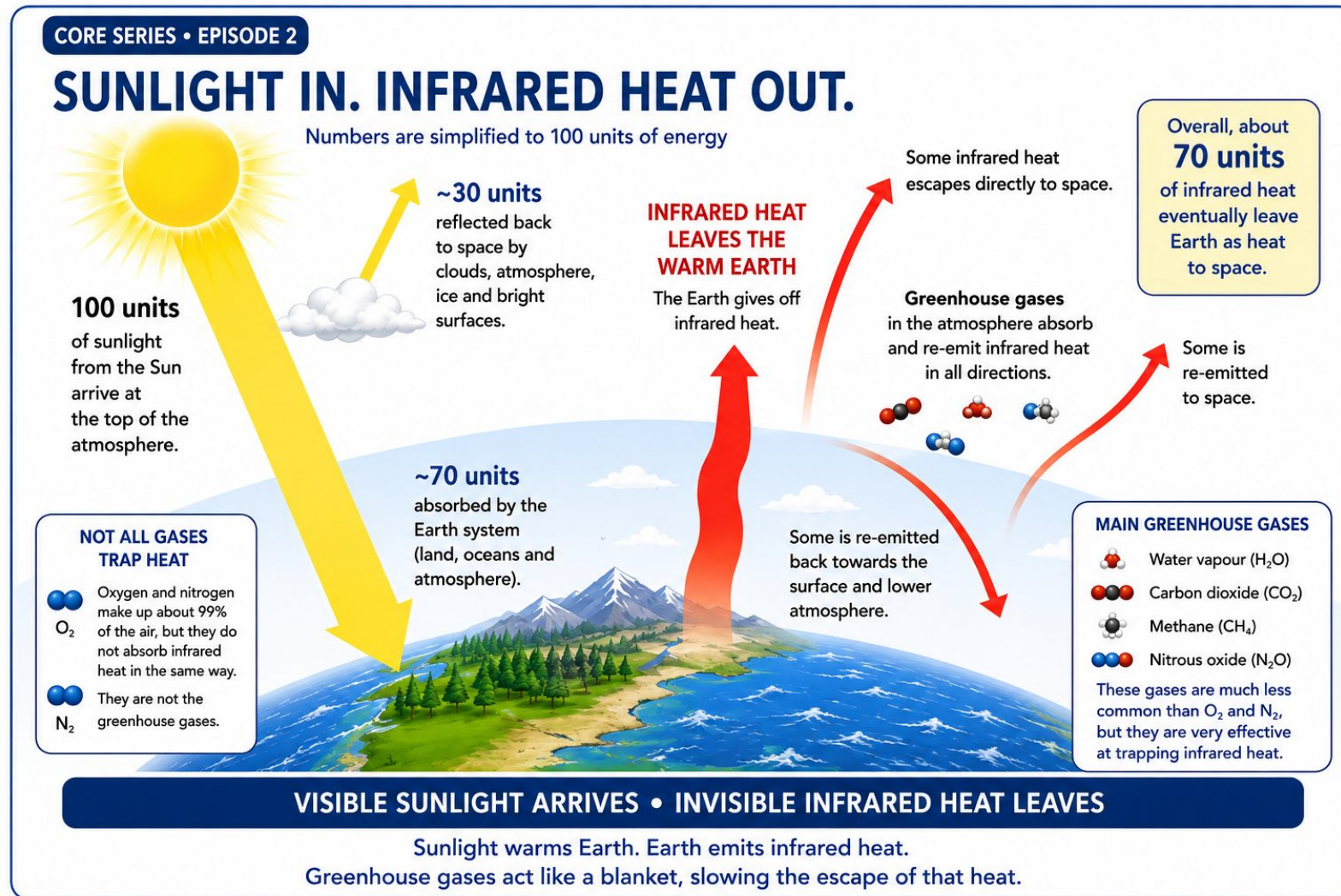
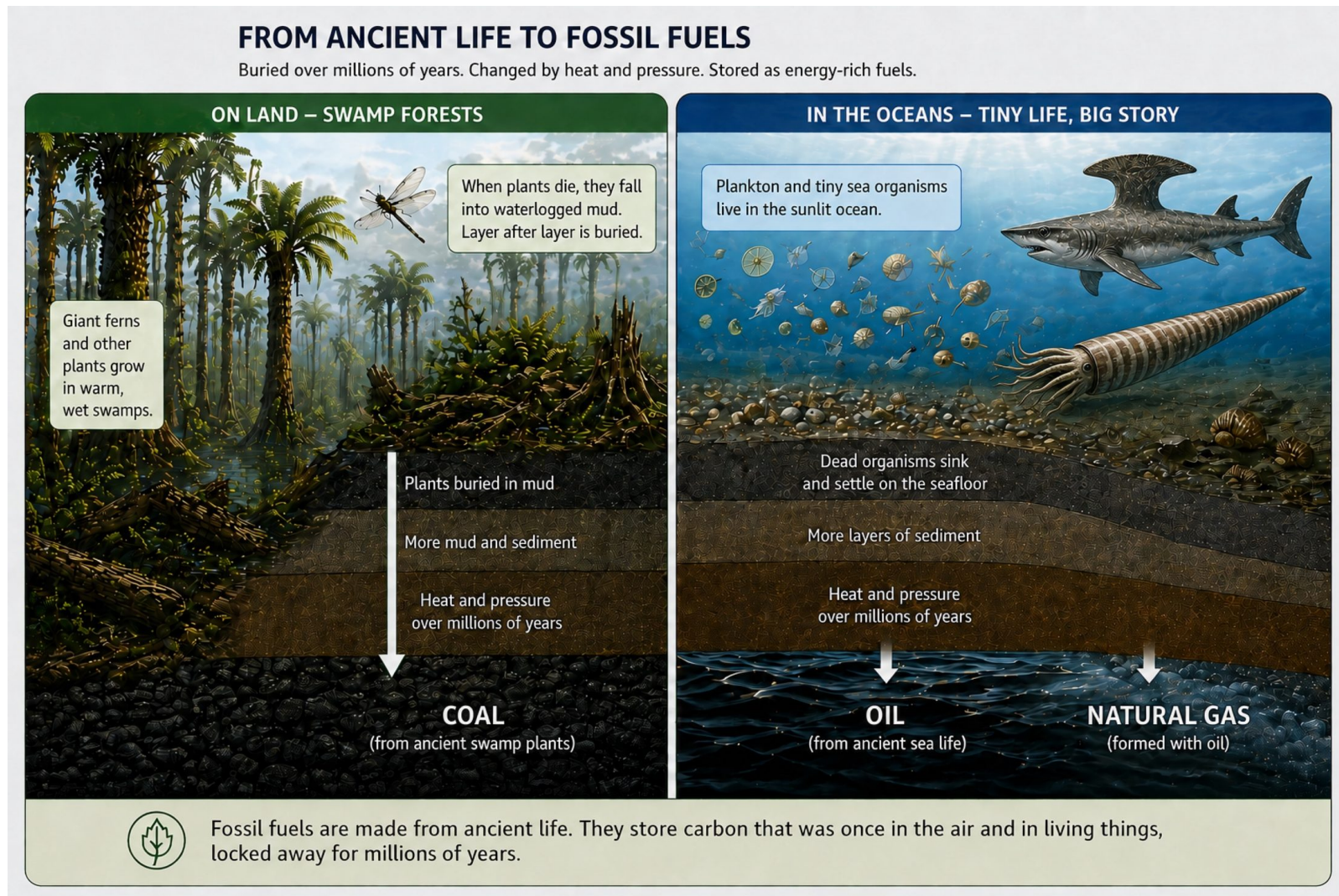


2.1 - The greenhouse effect



This picture shows a simplified balanced energy budget. Today, a small imbalance means Earth gains heat.

3.2 - From ancient life to fossil fuels



Burning fossil fuels releases carbon that was stored underground for millions of years.

Earth's energy balance

Sunlight arrives. Some is reflected. The rest is absorbed by land, oceans and the atmosphere.

ENERGY IN BALANCE

Sunlight absorbed by Earth



LAND + OCEANS + ATMOSPHERE

Infrared energy escaping to space



Energy stored: no overall change

Absorbed sunlight = infrared energy escaping to space.

EARTH GAINS ENERGY

Sunlight absorbed by Earth



LAND + OCEANS + ATMOSPHERE

Infrared energy escaping to space



Energy stored: increasing

Absorbed sunlight > infrared energy escaping to space.

Extra greenhouse gases initially reduce heat escaping to space at the same temperature. The resulting energy surplus warms the climate system.

Net zero CO2 is a different balance: human-caused CO2 emissions and removals. Sustaining it is expected to roughly stabilise CO2-caused surface warming; oceans and ice can keep changing.

Original schematic based on NASA and NOAA explanations. Arrow lengths are illustrative, not measurements. Sources and teaching notes accompany this pack.

Quiz: Stopping warming

Name: _____ Date: _____

Circle one answer for each question.

1. Earth absorbs more energy than it sends to space. What happens over time?

- A. It warms.
- B. It cools.
- C. Its temperature must stay the same.

2. What is the difference between emissions and concentration?

- A. They are two names for the same thing.
- B. Emissions are CO₂ added; concentration describes how much is in the air.
- C. Concentration means the CO₂ inside a fuel tank.

3. People halve their emissions, but additions still exceed removals. What happens to atmospheric CO₂?

- A. It immediately disappears.
- B. It automatically stays constant.
- C. It continues to rise, more slowly.

4. What does global net zero CO₂ mean?

- A. There is no CO₂ left in the atmosphere.
- B. Remaining human-caused emissions are balanced by human-caused removals.
- C. Natural sinks are guaranteed to remove any amount we emit.

5. At sustained global net zero CO₂, CO₂-caused surface warming is expected to...

- A. ...roughly level off.
- B. ...instantly return to the climate of the 1800s.
- C. ...keep increasing at the same rate for ever.

6. Why do earlier cuts in CO₂ emissions matter?

- A. They stop all changes in the oceans immediately.
- B. They remove the need to reduce methane.
- C. They reduce total CO₂ added and the warming it causes.

Talk it through: Explain why net zero is not a rewind button.

Teacher answers & guidance

1. **A.** An energy surplus increases the energy stored in the climate system.
2. **B.** Emissions are a flow. Atmospheric concentration describes the amount in the air, relative to the amount of air.
3. **C.** Reducing additions helps, but the amount still rises while total additions exceed total removals.
4. **B.** Net zero concerns human-caused emissions and removals, with the removed carbon stored. It does not mean zero atmospheric CO₂.
5. **A.** CO₂-caused warming approximately stabilises. Strong cuts in other greenhouse gases are also needed to limit total warming.
6. **C.** Less cumulative CO₂ means less CO₂-caused warming. Oceans, ice and sea level can keep changing after surface warming levels off.

Using the illustrations. Start with the greenhouse effect, link fossil fuels to additional CO₂, then compare energy balance with energy gain. The balance diagram is a global, long-term simplification; it does not describe a single day's weather.

Two different balances. Energy balance compares absorbed sunlight and outgoing infrared radiation. Net zero CO₂ compares human-caused CO₂ emissions and human-caused removals. Natural sinks can continue absorbing CO₂. Net zero does not imply immediate equilibrium throughout the oceans and ice.

Challenge answer. Net zero stops humans adding CO₂ overall. It does not remove all past CO₂ or rapidly reverse warming. Glaciers, deep oceans and sea level respond slowly.

Sources & artwork

NASA: Climate and Earth's Energy Budget

NOAA: The Earth-Atmosphere Energy Balance

IPCC AR6 WGI: Summary for Policymakers, section D.1

Illustrations 2.1 and 3.2 are reused from the Core Series resources. The energy-balance diagram is an original Climate Classroom diagram based on NASA and NOAA explanations; no agency artwork or logos are reproduced. Original and adapted artwork prepared with OpenAI tools under Graham Davies's direction. Episode content follows the Series 2 script PDFs.