EARTH AND SPACE

Energy resources and climate

Teacher review edition. Ask your teacher if anything is unclear.

How do energy choices affect the climate?

What you will learn

- Compare renewable and non-renewable resources.
- Explain the greenhouse effect in clear steps.
- Distinguish weather from climate and mitigation from adaptation.

Energy resources

Renewable resource
An energy resource that nature replaces quickly enough for continued human use.

Non-renewable resource
An energy resource used much faster than nature replaces it.

Energy resources supply energy for heating, transport and electricity. They can be renewable or non-renewable.

Type	Meaning	Examples
Renewable	Naturally replaced quickly enough for continued human use.	Sunlight, wind and flowing water
Non-renewable	Used much faster than it is naturally replaced. Supplies are limited.	Coal, oil, natural gas and uranium

Choosing an energy resource

Every energy resource has benefits and drawbacks.

- Wind turbines burn no fuel while generating electricity, but output changes with wind speed.
- Fossil-fuel power stations can supply electricity when needed, but burning fuel releases carbon dioxide.
- Compare cost, reliability, emissions, land use and habitat effects.
- Include making and maintaining equipment. Renewable resources still require materials and equipment.

Weather and climate

Climate
The usual patterns of weather in a place over many years.

Weather
Conditions such as temperature, rain and wind at a particular place and time.

- Weather includes today's rain, wind and temperature at a particular place.
- Climate describes the usual patterns of weather over many years.
- A cold week in Ireland is a weather event.
- Climate evidence includes long records from many places and changes in ice and ocean temperatures.

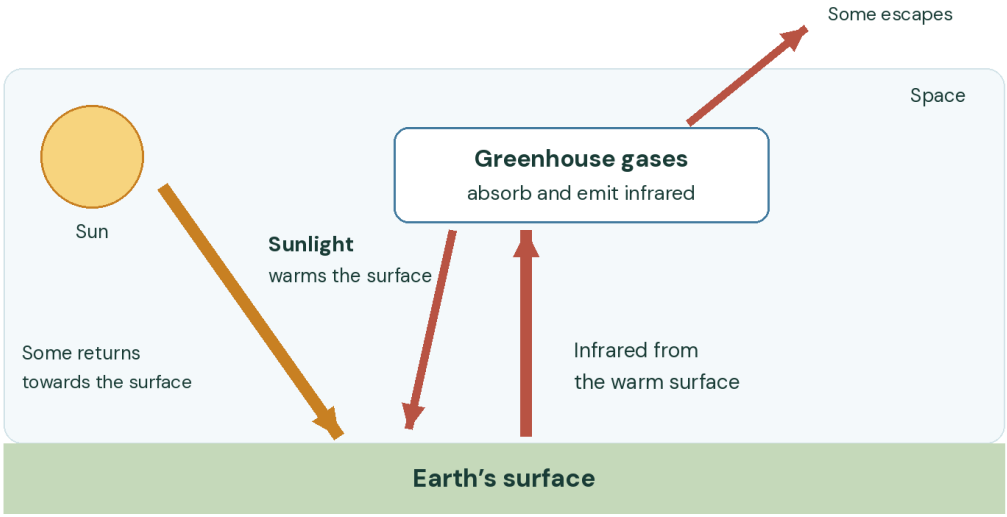
The natural greenhouse effect

Greenhouse effect
The warming caused when gases absorb infrared radiation and emit some of it back towards Earth's surface.

The natural greenhouse effect keeps Earth warmer than it would be without greenhouse gases.

- Sunlight warms Earth's surface.
- The warm surface gives out infrared radiation, carrying energy away.
- Greenhouse gases absorb some infrared radiation and emit it in all directions.
- Some radiation returns towards the surface; some escapes to space.
- Greenhouse gases include carbon dioxide, methane and water vapour.

The greenhouse effect: follow the radiation



Gases emit infrared in all directions. The arrows show selected pathways.

Simplified model: greenhouse gases are mixed through the atmosphere, not a solid layer.

Sunlight warms the surface. Greenhouse gases absorb infrared from the warm surface and emit infrared in all directions. Some returns towards the surface and some escapes to space.

Why extra greenhouse gases cause warming

More greenhouse gases strengthen the greenhouse effect.

- Burning fossil fuels adds carbon dioxide. Some farming activities and other processes add methane.
- Extra greenhouse gases reduce the energy escaping to space at first. Earth gains energy and warms.
- As Earth warms, it gives out more infrared radiation. Energy still escapes to space.
- The warming affects rainfall, ice, sea level and living things.

Responding to climate change

> **Mitigation**
> Action to reduce the causes of climate change, such as cutting greenhouse-gas emissions.

Mitigation tackles the causes of climate change. Adaptation helps us cope with its effects.

Response	Examples
Mitigation	Insulate buildings, use less fossil fuel and generate electricity from low-emission resources.
Adaptation	Improve flood defences, prepare for heatwaves and change farming methods to suit changed conditions.

Read climate claims carefully

Check the timescale and evidence behind a climate claim.

- A single day, a few years and several decades answer different questions.
- Look for long records and more than one source of evidence.
- A climate projection describes what may happen under stated conditions.
- Future warming partly depends on greenhouse-gas emissions, so different emissions choices lead to different projections.

Worked examples

A headline says, “This week was colder than last week, so the climate is cooling.” Is this conclusion supported?

Work through it

1. The measurements compare two weeks, so they describe short-term weather.
2. Climate describes patterns over many years. Compare long records, not only these two weeks.
3. A cold week can happen during a long-term warming trend. The headline does not provide enough evidence for its conclusion.

Common mistakes

Common mistake: A cold week proves global warming has stopped.

Remember: A cold week is local weather. Global warming is a long-term change studied using records from many places.

Common mistake: Greenhouse gases form a lid that stops all energy escaping.

Remember: They absorb and emit infrared radiation. Some returns towards Earth, but energy still escapes to space.

Answering questions

- Explain the greenhouse effect in order: sunlight warms the surface → the surface emits infrared → greenhouse gases absorb and emit infrared → some returns towards the surface.
- When comparing energy resources, discuss the same features for both, such as reliability, emissions and habitat effects. Give a reason for your conclusion.

Try an investigation

Compare two energy resources using information selected with your teacher. Make a table of their benefits, drawbacks and environmental effects. Add one example of climate mitigation and one example of adaptation.

Plan, record and review

- Question and prediction: What are you testing, and what do you think will happen? Give a reason.
- Change, measure, keep the same: What will you deliberately change? What will you measure, and in what units? What stays the same to make it a fair test? For an observation, say what you will record consistently instead.
- Record and look for a pattern: Use a table with headings and units. Look for a pattern or a result that does not fit.
- Conclude from evidence: Answer your question using a result or observation. Say if the evidence is unclear.
- Improve the investigation: What would you repeat or change, and how would that make the evidence better?

Do practical work with your teacher and follow the laboratory safety instructions.