Human activities that increase greenhouse gases

4.9.2.2 · Chemistry of the atmosphere · revision notes

Which human activities add carbon dioxide and methane to the atmosphere, and how to judge the evidence that this is warming the Earth. Expect 'give two activities' recall questions, data on carbon dioxide levels, and questions asking you to evaluate evidence in a report and describe uncertainties.

Key facts

- Carbon dioxide: burning fossil fuels; deforestation
- Deforestation: burning releases CO_2 AND fewer trees remove CO_2 by photosynthesis
- Climate models are simplified because the climate system is very complex
- Methane: cattle and other livestock farming; rice paddy fields; waste decaying in landfill
- Peer review = other experts check the work before it is published
- Good evidence: peer reviewed, lots of data, not biased, conclusion supported by the data

Notes

Activities that increase carbon dioxide

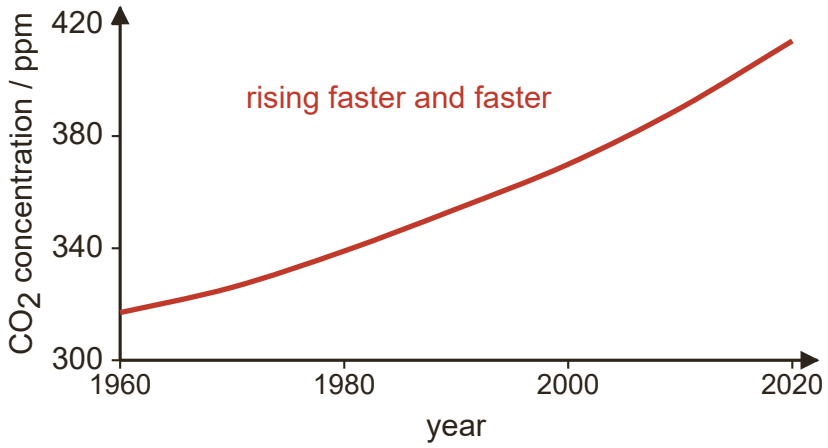
- **Burning fossil fuels** (coal, natural gas and fuels made from crude oil) for electricity, heating and transport. Combustion releases the carbon locked up in the fuels as carbon dioxide.
- **Deforestation**: when forests are cut down and burned, carbon dioxide is released, and there are fewer trees left to remove carbon dioxide by photosynthesis.

Activities that increase methane

- **Farming cattle** and other livestock: the animals release methane produced during digestion.
- **Rice paddy fields**: rice grows in flooded fields, and decay in the waterlogged soil releases methane.
- **Landfill sites**: waste decaying in landfill releases methane.
- A growing world population needs more food and energy, so these activities are increasing.

The evidence and its uncertainties

- Using **peer-reviewed** evidence, many scientists think that human activities will make the Earth's average surface temperature rise, and that this will lead to global climate change.



Measured carbon dioxide levels have risen every decade.

- **Peer review**: other experts in the same field check the methods, data and conclusions before the work is published. This helps to catch mistakes and reduce bias.
- The climate is a very complex system, so it is difficult to model. Scientists use **simplified models**, which give a range of predictions.
- Uncertainties include incomplete data about past climates, natural changes (e.g. volcanic eruptions and changes in the Sun) and not knowing how much gas people will release in future.
- Media reports may simplify, use only part of the evidence, or be **biased**. Check who produced a report, whether it was peer reviewed and how much data it is based on.
- Scientists need to **communicate results to a wide range of audiences** (the public, politicians, businesses) clearly, so that people can make informed decisions.

How to answer each type of question

Give human activities that increase a greenhouse gas

1 to 4 marks | **Grade 4**

1. Check which gas the question asks about.
2. Carbon dioxide: burning fossil fuels, deforestation.
3. Methane: livestock (cattle) farming, rice paddy fields, landfill sites.

Example. Give **one** human activity that increases the amount of carbon dioxide in the atmosphere and **one** human activity that increases the amount of methane.

Model answer.

Carbon dioxide: burning fossil fuels / deforestation (1)

Methane: cattle (livestock) farming / rice paddy fields / waste decaying in landfill sites (1)

Explain how an activity increases carbon dioxide

2 marks **Grade 5**

1. Say how the gas is released (e.g. combustion).
2. For deforestation, add the second effect: fewer trees to photosynthesise.

Example. Explain how deforestation increases the amount of carbon dioxide in the atmosphere.

Model answer. Burning the trees releases carbon dioxide (1). There are fewer trees to remove carbon dioxide from the atmosphere by photosynthesis (1).

Use data on carbon dioxide levels

2 to 4 marks **Grade 5**

1. Read the values carefully from the table or graph, with units.
2. Increase = later value − earlier value.
3. Percentage increase = increase ÷ earlier value × 100, rounded as asked.
4. Link the trend to a cause, such as more burning of fossil fuels.

Example. The table shows the mean concentration of carbon dioxide in the atmosphere, in parts per million (ppm), measured at one station.

Year	1960	1980	2000	2020
Carbon dioxide concentration (ppm)	317	339	370	414

(a) Calculate the percentage increase in carbon dioxide concentration from 1960 to 2020. Give your answer to 2 significant figures.
(b) Suggest **one** reason for the increase.

Model answer.

(a) Increase = 414 − 317 = 97 ppm (1); 97 ÷ 317 × 100 = 30.6 (1); = 31% (to 2 significant figures) (1)
(b) More fossil fuels were burned (e.g. for electricity and transport) / more deforestation (1)

Evaluate the evidence in a report

3 to 4 marks | **Grade 8**

1. Comment on the amount of data and where and how it was collected.
2. Ask whether it is measured data or opinion, and whether it was peer reviewed.
3. Check whether the conclusion goes further than the data (e.g. 'proves' a cause).
4. Finish with a judgement about the quality of the evidence.

Example. A newspaper article says: 'We asked 20 people in one town, and most said summers feel hotter than they did 30 years ago. This proves that burning fossil fuels is causing climate change.' Evaluate the quality of the evidence in this article.

Model answer.

Any four from:

the sample is small (only 20 people)	(1)
it is from only one town, so it does not represent the whole Earth	(1)
it is based on opinions of how summers feel, not measured temperatures	(1)
it has not been peer reviewed	(1)
it gives no evidence linking the change to burning fossil fuels, so it cannot prove the cause	(1)
so the evidence is poor quality and does not support the claim	(1)

Don’t lose marks

- Writing just 'pollution' or 'cars'. Say 'burning fossil fuels (e.g. petrol in cars)'.
- Giving only one effect of deforestation in a 2-mark question. Also say that fewer trees are left to photosynthesise.
- Mixing up the gases: livestock, rice paddy fields and landfill release methane; burning fuels and deforestation release carbon dioxide.
- Saying scientists have 'proved' what will happen. Say the evidence suggests it, and that predictions are uncertain.
- Bringing the ozone layer into a greenhouse gas answer.

More tips

Memory tricks

- Carbon dioxide: 'Fuels and Forests'. Methane: 'Cows, Crops (rice) and Rubbish (landfill)'.
- Deforestation is a double hit: carbon dioxide released AND less carbon dioxide removed.
- Judging a report? Ask 'Who, how much, checked?': who produced it (bias), how much data, was it peer reviewed.

Exam technique

- Read which gas the question asks about before listing activities.
- In 'evaluate the evidence' questions, comment on sample size, how and where data were collected, peer review and possible bias, then give a conclusion.
- When you describe a trend, quote values from the graph or table with units (e.g. ppm).
- A correlation is not proof of a cause: say the rise in carbon dioxide matches the rise in fossil fuel use, not that it 'proves' it.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

Give two activities that release carbon dioxide

Burning fossil fuels and deforestation both increase the carbon dioxide in the atmosphere.

Grade 4

Give two activities that release methane

Farming cattle and other livestock, growing rice in paddy fields, and waste decaying in landfill sites.

Grade 5

Explain how deforestation increases carbon dioxide

Burning the trees releases carbon dioxide, and fewer trees are left to remove it by photosynthesis.

Grade 5

Describe trends in carbon dioxide data

Quote values from a graph or table and calculate changes, e.g. the increase or percentage increase over a period.

Grade 6

Explain why peer review matters

Other experts check the methods, data and conclusions before publication, which reduces errors and bias.

Grade 7

Describe uncertainties in climate evidence

The climate is complex, so models are simplified, data about the past are incomplete and future emissions are unknown.

Grade 8

Evaluate the quality of a climate report

Judge the amount of data, how it was collected, peer review, possible bias and whether the conclusion fits the evidence.

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