PiXL KnowIT!

GCSE Chemistry

AQA Topic – Chemistry of The Atmosphere

Overview
Chemistry of The Atmosphere

The composition and evolution of the Earth's atmosphere

- The proportions of different gases in the atmosphere
- The Earth's early atmosphere
- How oxygen increased
- How carbon dioxide decreased

Carbon dioxide and methane as greenhouse gases

- Greenhouse gases
- Human activities which contribute to an increase in greenhouse gases in the atmosphere
- Global climate change
- The carbon footprint and it's reduction

Common atmospheric pollutants and their sources

- Atmospheric pollutants from fuels
- Properties and effects of atmospheric pollutants

PiXL
partners in excellence

LearnIT!
KnowIT!

The composition and evolution of the Earth's Atmosphere

Part 1

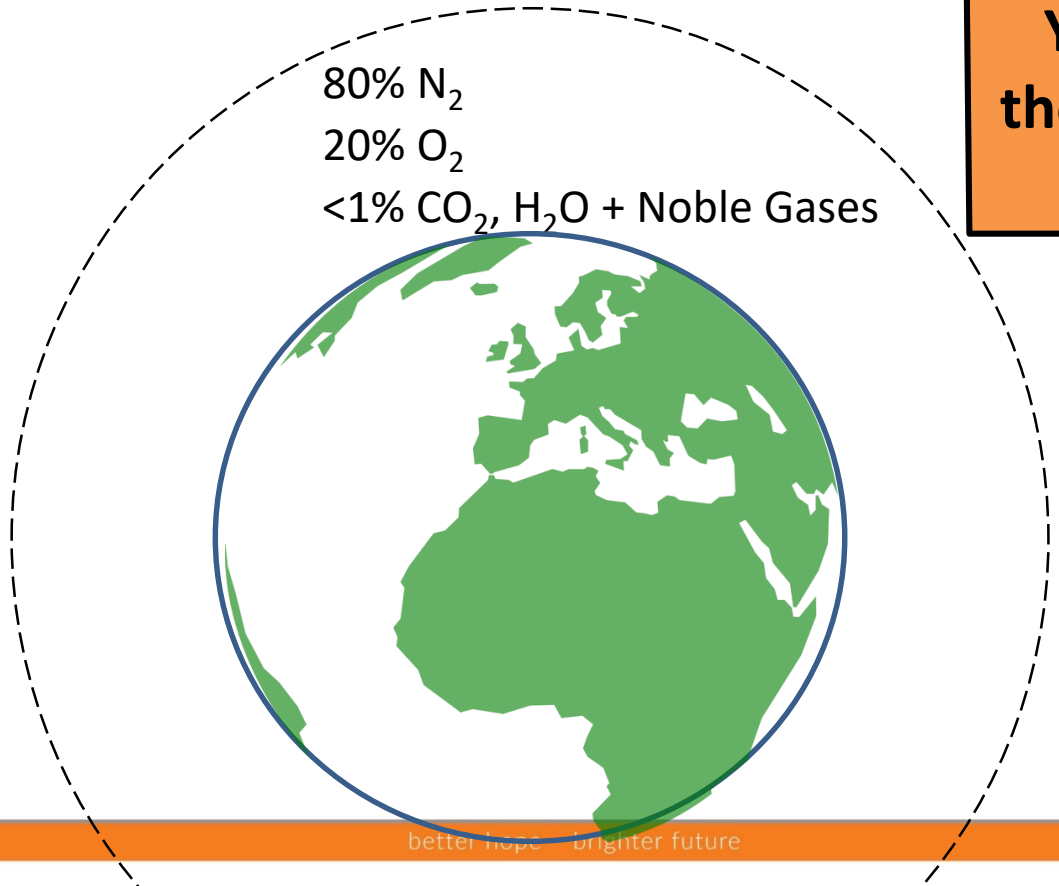
- The proportion of different gases in the atmosphere
- The Earth's early atmosphere

The proportions of different gases in the atmosphere

For **200 million years**, the proportions of different gases in the atmosphere have been much the same as they are today:

- about four-fifths (approximately **80%**) **nitrogen**
- about one-fifth (approximately **20%**) **oxygen**
- small proportions of various other gases, including carbon dioxide, water vapour and noble gases.

You must learn these percentages for the exam



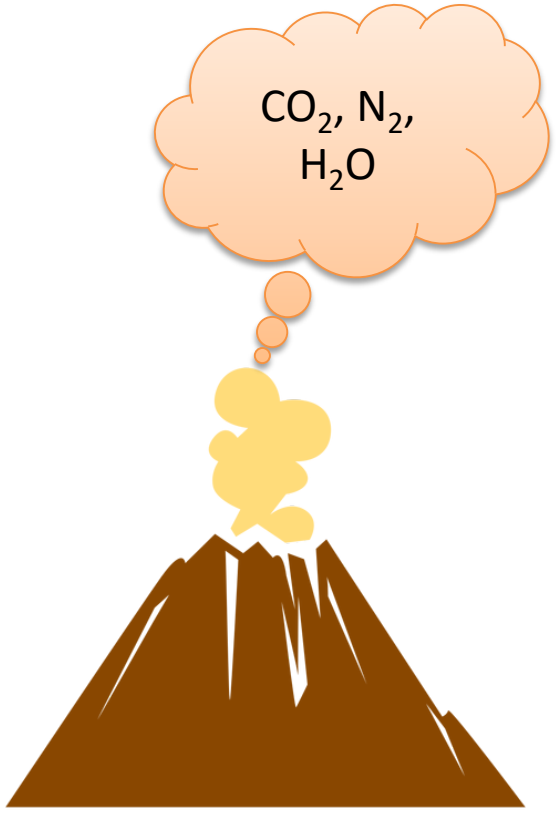
The Earth's early atmosphere

Theories about what was in the Earth's early atmosphere and how the atmosphere was formed have changed and developed over time. Evidence for the early atmosphere is limited because of the time scale of 4.6 billion years.

There are a number of different theories as to how the atmosphere evolved.

One theory suggests:

- During the first billion years there was **intense volcanic activity** that **released gases** that formed the early atmosphere consisting of mainly **carbon dioxide** with **little or no oxygen gas**.
- **Water vapour condensed** to form the oceans.
- **Volcanoes** also produced **nitrogen** which gradually built up in the atmosphere and there may have been small proportions of **methane** and **ammonia**.
- When the oceans formed, **carbon dioxide dissolved in the water** and **carbonates** were **precipitated** producing sediments, reducing the amount of carbon dioxide in the atmosphere.



PiXL
partners in excellence

QuestionIT!

The composition and evolution of the Earth's Atmosphere (Part 1)

- The proportion of different gases in the atmosphere
- The Earth's early atmosphere

The composition and evolution of the Earth's atmosphere Part 1– QuestionIT

1. Name 4 gases in the Earth's atmosphere.

2. Give the proportions of gases in the Earth's atmosphere.

3. Why is evidence for the Earth's early atmosphere limited?

4. What gases are believed to have been released from volcanoes during the first billion years of the Earth's existence?

5. How did the oceans form?

6. Why did the amount of carbon dioxide in the earlier atmosphere decrease?

7. What gas in the current day atmosphere was not present in the atmosphere 4.6 billion years ago?

PiXL
partners in excellence

AnswerIT!

The composition and evolution of the Earth's Atmosphere (Part 1)

- The proportion of different gases in the atmosphere
- The Earth's early atmosphere

1. Name 4 gases in the Earth's atmosphere.
   Nitrogen, oxygen, other gases such as carbon dioxide, water vapour and noble gases.
2. Give the proportions of gases in the Earth's atmosphere.
   Nitrogen 80%; Oxygen 20%; small proportions of other gases.
3. Why is evidence for the Earth's early atmosphere limited?
   The timescale of 4.6 billion years.
4. What gases are believed to have been released from volcanoes during the first billion years of the Earth's existence?
   Nitrogen, carbon dioxide, water vapour; small amounts of ammonia and methane.

5. How did the oceans form?
   Water vapour in the atmosphere condensed.
6. Why did the amount of carbon dioxide in the earlier atmosphere decrease?
   When oceans formed carbon dioxide dissolved in the water; carbonates precipitated producing sediments, reducing carbon dioxide in the atmosphere.
7. What gas in the current day atmosphere was not present in the atmosphere 4.6 billion years ago?
   Oxygen.

PiXL
partners in excellence

LearnIT!
KnowIT!

The composition and evolution of the Earth's Atmosphere
Part 2

- **How oxygen increased**
- **How carbon dioxide decreased**

How oxygen increased and carbon dioxide decreased

Organisms evolved that changed the atmosphere in a significant way.

Algae and plants produced the **oxygen** that is now in the atmosphere by **photosynthesis**, which can be represented by the equation:

$$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$$

$$\text{Carbon dioxide} + \text{water} \xrightarrow{\text{light}} \text{glucose} + \text{oxygen}$$

Algae first produced oxygen about 2.7 billion years ago and soon after this oxygen appeared in the atmosphere. Over the next billion years plants evolved and the percentage of oxygen gradually increased to a level that enabled animals to evolve.

Algae and plants **decreased** the percentage of **carbon dioxide** in the atmosphere by **photosynthesis**. Carbon dioxide was also decreased by the formation of **sedimentary rocks** and **fossil fuels** that contain carbon.

Oxygen increases due to photosynthesis.
Carbon dioxide decreases due to photosynthesis, formation of sedimentary rocks and fossil fuels.

PiXL
partners in excellence

QuestionIT!

The composition and evolution of the Earth's Atmosphere
Part 2

- How oxygen increased
- How carbon dioxide decreased

How oxygen increased and carbon dioxide decreased - **QuestionIT**

1. What organisms increased the amount of oxygen in the Earth's atmosphere?

2. Write the balanced symbol equation for photosynthesis.

3. When did oxygen first start appearing in the atmosphere and which organism was responsible?

4. Other than photosynthesis what other factors decreased the level of carbon dioxide in the atmosphere?

5. Describe the main changes to the atmosphere over time and the likely causes of these changes.

PiXL
partners in excellence

AnswerIT!

The composition and evolution of the Earth's Atmosphere
Part 2

- **How oxygen increased**
- **How carbon dioxide decreased**

How oxygen increased and carbon dioxide decreased - **QuestionIT**

1. What organisms increased the amount of oxygen in the Earth's atmosphere?
   Algae and plants.
2. Write the balanced symbol equation for photosynthesis.
   $6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$
3. When did oxygen first start appearing in the atmosphere and which organism was responsible?
   2.7 billion years ago; algae.
4. Other than photosynthesis what other factors decreased the level of carbon dioxide in the atmosphere?
   Formation of sedimentary rocks and fossil fuels (natural gas, oil, coal).

5. Describe the main changes to the atmosphere over time and the likely causes of these changes.
   - Intense volcanic activity – water vapour, carbon dioxide, nitrogen, ammonia, methane released.
   - Water vapour condensed to form oceans.
   - Atmosphere mostly carbon dioxide; nitrogen slowly building up over time.
   - Carbon dioxide dissolved in oceans; carbonates precipitated producing sediments. Carbon dioxide levels in atmosphere drop.
   - Photosynthesis – algae produce oxygen.
   - Plants evolved, levels of carbon dioxide reduced, levels of oxygen increased; animals evolved.
   - Carbon dioxide levels dropped during the formation of sedimentary rock (from sediments) and fossil fuels (from organisms).

PiXL
partners in excellence

LearnIT!
KnowIT!

Carbon dioxide and methane as greenhouse Gases Part 1

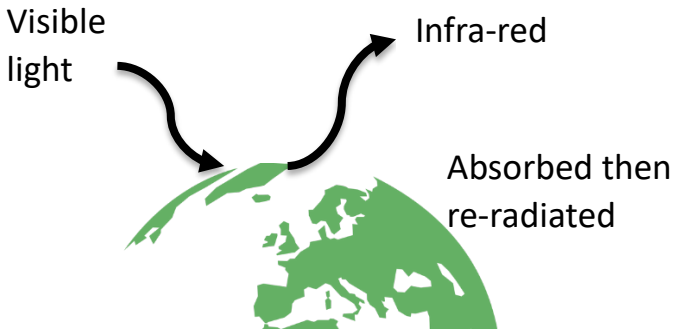
- **Greenhouse gases**
- **Human activities which contribute to an increase in greenhouse gases in the atmosphere**

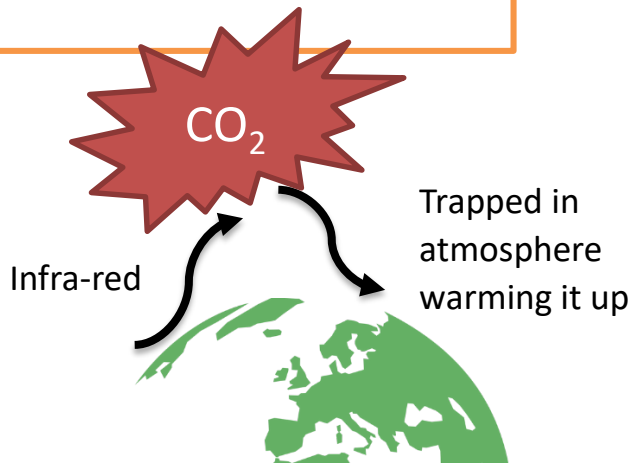
Carbon dioxide and methane as greenhouse gases

Greenhouse gases in the atmosphere maintain temperatures on Earth high enough to support life. Examples of **greenhouse gases** are:

- **Carbon dioxide**
- **Water vapour**
- **Methane**

You must know these three gases





Visible light with a **short wavelength** is **absorbed** by the Earth, it is then re-radiated as **longer wavelength infra red.**

The **longer wavelength infra red** cannot penetrate through the greenhouse gas layer in the atmosphere which contains carbon dioxide and methane.

Carbon dioxide and methane as greenhouse gases

Some human activities increase the amounts of greenhouse gases in the atmosphere namely **carbon dioxide** and **methane**.

Two human activities that **increase** the amount of the greenhouse gas **carbon dioxide** are **burning fossil fuels** and **deforestation**.

Two human activities that **increase** the amount of the greenhouse gas **methane** are **farming of livestock** e.g. cows and pigs and **landfills**.

Based on **peer-reviewed evidence**, many scientists believe that human activities will cause the **temperature** of the Earth's atmosphere to **increase** at the surface and that this will result in **global climate change**.

However it is difficult to **model** such **complex systems** as global climate change. This leads to **simplified models**, **speculation** and **opinions** presented in the media that may be based on only parts of the evidence and which may be **biased.**

PiXL
partners in excellence

QuestionIT!

Carbon dioxide and methane as greenhouse Gases Part 1

- Greenhouse gases
- Human activities which contribute to an increase in greenhouse gases in the atmosphere

Carbon dioxide and methane as greenhouse gases – QuestionIT

1. Name 3 greenhouse gases.

2. What is the link between greenhouse gases and the temperature of the Earth?

3. Name human activities which increase the amount of carbon dioxide in the atmosphere.

4. Name human activities that increase the amount of methane in the atmosphere.

Carbon dioxide and methane as greenhouse gases – QuestionIT

5. What do many scientists believe about human activities and the temperature of the Earth's atmosphere?

6. Why are there issues surrounding modelling human impact on climate change?

AnswerIT!

Carbon dioxide and methane as greenhouse Gases Part 1

- Greenhouse gases
- Human activities which contribute an increase in greenhouse gases in the atmosphere

Carbon dioxide and methane as greenhouse gases – QuestionIT

1. Name 3 greenhouse gases.
   Water vapour, carbon dioxide, methane.
2. What is the link between greenhouse gases and the temperature of the Earth?
   Greenhouse gases maintain temperatures on the Earth high enough to support life.
3. Name human activities which increase the amount of carbon dioxide in the atmosphere.
   Burning/ combustion of fossil fuels, deforestation.
4. Name human activities that increase the amount of methane in the atmosphere.
   Farming of livestock; landfill sites.

5. What do many scientists believe about human activities and the temperature of the Earth's atmosphere?
   Human activities will cause the temperature of the Earth's atmosphere to increase at the surface resulting in climate change.
6. Why are there issues surrounding modelling human impact on climate change?
   - It is difficult to model these changes
   - Simplified models are generated
   - Leading to speculation and opinions presented in the media that may be based on only part of the evidence and be biased.

PiXL
partners in excellence

LearnIT!
KnowIT!

Carbon dioxide and methane as greenhouse Gases Part 2

- Global climate change
- The carbon footprint and its reduction

Global climate change the carbon footprint and its reduction

An increase in average global temperature is a major cause of climate change. There are a number of potential effects of climate change:

Rising sea levels causing flooding

Droughts

Desertification

Ice caps melting

The **carbon footprint** is the total amount of carbon dioxide and other greenhouse gases emitted over the full life cycle of the product, service or event. The carbon footprint can be reduced by reducing emissions of carbon dioxide and methane.

QuestionIT!

Carbon dioxide and methane as greenhouse Gases Part 2

- Global climate change
- The carbon footprint and its reduction

1. What is a major cause of climate change?

2. Give three possible effects of climate change.

3. What is the carbon footprint?

4. How can the carbon footprint be reduced?

PiXL
partners in excellence

AnswerIT!

Carbon dioxide and methan
as greenhouse
Gases Part 2

- Global climate change
- The carbon footprint

  and its reduction

1. What is a major cause of climate change?
   An increase in average global temperature

2. Give three possible effects of climate change.
   Droughts/desertification/flooding/ice caps melting

3. What is the carbon footprint?
   The total amount of carbon dioxide and other greenhouse gases emitted over the full life cycle of a product, service or event.

4. How can the carbon footprint be reduced?
   By reducing emissions of carbon dioxide and ethane.

PiXL
partners in excellence

LearnIT!
KnowIT!

Common atmospheric pollutants and their sources

- Atmospheric pollutants from fuels
- Properties and effects of atmospheric pollutants

Common atmospheric pollutants and their sources

The **combustion of fuels** is a major source of atmospheric pollutants.
Most fuels, including **coal**, contain **carbon** and/or **hydrogen** and may also contain some **sulfur**.

- **Incomplete combustion** of these fuels causes **carbon monoxide** and **soot** (carbon particles) to be produced.
- **Complete combustion** of these fuels produces **Carbon dioxide.**
- As there are small amounts of **sulfur** and **nitrogen** in the fuels, these also **oxidise** to **sulfur dioxide** and **oxides of nitrogen** which are also pollutants.

Common atmospheric pollutants and their sources

The gases released in to the atmosphere when a fuel is burnt may include **carbon dioxide**, **water vapour**, **carbon monoxide**, **sulfur dioxide** and **oxides of nitrogen**. Solid particles and unburned hydrocarbons may also be released that forms **particulates** in the atmosphere.

- **Carbon monoxide** is a **toxic gas**. It is **colourless** and **odourless** and so is not easily detected.
- **Sulfur dioxide** and **oxides of nitrogen** cause **respiratory problems** in humans and cause **acid rain**.
- **Particulates** cause **global dimming** and **health problems** in humans.

QuestionIT!

Common atmospheric pollutants and their sources

- Atmospheric pollutants from fuels
- Properties and effects of atmospheric pollutants

1. What are the two main elements in most fuels?

2. What other potentially polluting element may be present in fossil fuels?

3. What gases may be released into the atmosphere when a fuel is burned?

4. Which two of these gases can lead to acid rain?

5. What else may be released, during combustion of fuels, to form particulates in the atmosphere?

6. Write the balanced symbol equation for the complete combustion of pentane C_5H_{12} .

7. Which two substances would be formed if this was an incomplete combustion reaction?

8. Describe the gas carbon monoxide.

9. Why is carbon monoxide difficult to detect?

10. What are two effects of sulfur dioxide in the atmosphere?

11. What are two effects of particulates in the atmosphere?

AnswerIT!

Common atmospheric pollutants and their sources

- Atmospheric pollutants from fuels
- Properties and effects of atmospheric pollutants

1. What are the two main elements in most fuels?
   Hydrogen and carbon.
2. What other potentially polluting element may be present in fossil fuels?
   Sulfur.
3. What gases may be released into the atmosphere when a fuel is burned?
   Carbon dioxide, water vapour, carbon monoxide, sulfur dioxide and oxides of nitrogen.
4. Which two of these gases can lead to acid rain?
   Sulfur dioxide, oxides of nitrogen.
5. What else may be released, during combustion of fuels, to form particulates in the atmosphere?
   Solid particulates, unburned hydrocarbons.

6. Write the balanced symbol equation for the complete combustion of pentane C_5H_{12} .

7. Which two substances would be formed if this was an incomplete combustion reaction?
   Water and carbon monoxide and/ or soot
8. Describe the gas carbon monoxide.
   Toxic gas; colourless and odourless.
9. Why is carbon monoxide difficult to detect?
   Colourless and odourless.
10. What are two effects of sulfur dioxide in the atmosphere?
    Respiratory problems in humans; acid rain.
11. What are two effects of particulates in the atmosphere?
    Global dimming; health problems for humans.