# Scheme of work

## Combined Science: Trilogy

## Chemistry – Chemistry of the atmosphere

This resource provides guidance for teaching the Chemistry of the atmosphere topic from our new GCSE in Combined Science: Trilogy (Chemistry) 8464. It has been updated from the draft version to reflect the changes made in the accredited specification. Changes have been made to section 5.9.1.4 to 5.9.3.2. These changes are also reflected in the learning outcomes and opportunities to develop and apply practical and enquiry skills of most sections.

The scheme of work is designed to be a flexible medium term plan for teaching content and development of the skills that will be assessed.

It is provided in Word format to help you create your own teaching plan – you can edit and customise it according to your needs. This scheme of work is not exhaustive; it only suggests activities and resources you could find useful in your teaching.

### 5.9 Chemistry of the atmosphere

#### 5.9.1 The composition and evolution of the Earth’s atmosphere

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop Scientific Communication skills** | **Opportunities to develop and apply practical and enquiry skills** | **Self/peer assessment opportunities and resources**  *Reference to past questions that indicate success* |
| --- | --- | --- | --- | --- | --- | --- |
| 5.9.1.1 | 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. | MS 1c | 0.5 | Describe the composition of the atmosphere.  Draw accurate pie charts for the composition of the atmosphere. |  | Video clip  YouTube:  [BBC Science Bitesize - Changes to the Earth and Atmosphere](https://www.youtube.com/watch?v=6Db2WAG-VVs)  (especially up to 4.05)  [Exampro user guide PowerPoint](http://filestore.aqa.org.uk/resources/science/AQA-GCSE-SCIENCE-EXAMPRO-UG.PPTX) |
| 5.9.1.2 | 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.  One theory suggests that during the first billion years of the Earth’s existence there was intense volcanic activity that released gases that formed the early atmosphere and water vapour that condensed to form the oceans. At the start of this period the Earth’s atmosphere may have been like the atmospheres of Mars and Venus today, consisting of mainly carbon dioxide with little or no oxygen gas.  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. | *No knowledge of other theories is required.*  Given appropriate information, interpret evidence and evaluate different theories about the Earth’s early atmosphere.  WS 1.1, 1.2, 1.3, 3.5, 3.6, 4.1 | 1 | Extended writing: describe the theory of the evolution of the Earth’s early atmosphere.  Extended writing: explain why the composition of the atmosphere has changed over billions of years.  Compare the Earth’s atmosphere to that of Mars and Venus. |  | Video clips  YouTube:  [Earth and the Early Atmosphere](https://www.youtube.com/watch?v=Gyn754vw8ZQ)  YouTube: [Evolution of the Earth’s atmosphere](https://www.youtube.com/watch?v=gwGeH9O8Rx4)  Ideas about ancient volcanoes, climate etc:  [NASA website](http://www.nasa.gov/) |
| 5.9.1.3 | Algae and plants produced the oxygen that is now in the atmosphere by photosynthesis, which can be represented by the equation:  light  carbon dioxide + water 🡪 glucose + 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. | WS 1.2 | 0.5 | Extended writing: explain how algae and plants have caused the concentrations of oxygen in the atmosphere to increase. | Show that aquatic plants (eg Elodea) produce oxygen in daylight. |  |
| 5.9.1.4 | 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. | Describe the main changes in the atmosphere over time and some of the likely causes of these changes.  Describe and explain the formation of deposits of limestone, coal, crude oil and natural gas.  WS 1.2, 4.1 | 0.5 | Extended writing: explain how algae and plants have caused the concentrations of carbon dioxide in the atmosphere to decrease.  Describe how sedimentary rocks formed and locked up carbon dioxide. |  |  |

#### 5.9.2 Carbon dioxide and methane as greenhouse gases

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| --- | --- | --- | --- | --- | --- | --- |
| 5.9.2.1 | Greenhouse gases in the atmosphere maintain temperatures on Earth high enough to support life.  Water vapour, carbon dioxide and methane are greenhouse gases. | Describe the greenhouse effect in terms of the interaction of short and long wavelength radiation with matter.  WS 1.2 | 2 | Describe the effect of greenhouse gases on wavelength.  Grade 9: explain why the wavelength changes due to greenhouse gases. |  | Video clips  YouTube:  [Green house Effect and Global warming](https://www.youtube.com/watch?v=dP-tg4atr5M)  YouTube: [Discovery Channel – Global Warming, What You Need To Know](https://www.youtube.com/watch?v=xcVwLrAavyA)  (long video) |
| 5.9.2.2 | Some human activities increase the amounts of greenhouse gases in the atmosphere. These include:     * carbon dioxide * methane   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. | Recall two human activities that increase the amounts of each of the greenhouse gases carbon dioxide and methane.  Evaluate the quality of evidence in a report about global climate change given appropriate information.  Describe uncertainties in the evidence base.  Recognise the importance of peer review of results and of communicating results to a wide range of audiences.  WS 1.2, 1.3, 1.6 | 1 | Describe how greenhouse gases are produced.  Evaluate the use of models for predicting climate change. | Use the internet to obtain data for concentrations of greenhouse gases.  Evaluate the reliability of the data available on the internet.  Research the process of peer review in reporting results/data. | Video clip  YouTube:  [The Carbon Cycle](https://www.youtube.com/watch?v=dDBU0lg-HYE)  [National Geographic - Environment](http://environment.nationalgeographic.com/)  [British Antarctic Survey – Search climate change](http://search.antarctica.ac.uk/) |
| 5.9.2.3 | An increase in average global temperature is a major cause of climate change.  There are several potential effects of global climate change. | Describe briefly four potential effects of global climate change  Discuss the scale, risk and environmental implications of global climate change.  WS 1.5 | 0.5 | Identify the effects of global warming.  Explain the effects of climate change.  The [University Corporation for Atmospheric Research (UCAR)](http://scied.ucar.edu/climate-change-activities) is a good source for classroom based activities and ideas:  Describe what a carbon footprint is.  Describe how emissions can be reduced. Suggest the consequences of the reductions on the Earth, atmosphere and everyday life. | Use the internet to obtain numerical predictions for the effects of climate change. Using these predictions, suggest the possible effects on the Earth and atmosphere should the predictions become reality. | Video clips:  [BBC Bitesize Causes of climate change](http://www.bbc.co.uk/education/clips/zvw34wx) |
| 5.9.2.4 | The carbon footprint is the total amount of carbon dioxide and other greenhouse gases emitted over the full life cycle of a product, service or event.  The carbon footprint can be reduced by reducing emissions of carbon dioxide and methane. | Describe actions to reduce emissions of carbon dioxide and methane.  Give reasons why actions may be limited.  WS 1.3 | 1 | Describe what a carbon footprint is.  Describe how emissions can be reduced. Suggest the consequences of the reductions on the Earth, atmosphere and everyday life.  A person’s carbon footprint can be calculated using a variety of sites such as:  [Carbon Footprint Ltd](http://www.carbonfootprint.com)  and  [WWF Footprint Calculator](http://footprint.wwf.org.uk/) | Use data to calculate your own carbon footprint over a period/holiday. Suggest the effects on Earth and atmosphere of the calculated carbon footprint. | Video clip  YouTube:  [Carbon footprints](https://www.youtube.com/watch?v=YB9TCxhjVHo) |

#### 5.9.3 Common atmospheric pollutants and their sources

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| --- | --- | --- | --- | --- | --- | --- |
| 5.9.3.1 | 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.  The gases released into the atmosphere when a fuel is burned may include carbon dioxide, water vapour, carbon monoxide, sulfur dioxide and oxides of nitrogen. Solid particles and unburned hydrocarbons may also be released that form particulates in the atmosphere. | Describe how carbon monoxide, soot (carbon particles), sulfur dioxide and oxides of nitrogen are produced by burning fuels  Predict the products of combustion of a fuel given appropriate information about the composition of the fuel and the conditions in which it is used.  WS 1.2 | 2 | Write word equations for complete and incomplete combustion.  Use these equations to describe the reactions in terms of reactants, products made and number of each present.  Explain why the following can be produced in combustion:   * carbon dioxide * carbon monoxide * soot * water vapour * sulfur dioxide * oxides of nitrogen. |  | Video clips  YouTube:  [What is combustion?](https://www.youtube.com/watch?v=zEjEqnMBdEM)  YouTube:  [Coal Combustion and Acid Rain](https://www.youtube.com/watch?v=HE6Y0iEuXMQ) |
| 5.9.3.2 | 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 for humans. | Describe and explain the problems caused by increased amounts of these pollutants in the air.  WS 1.4 | 1 | Describe the effect of the following products:   * Carbon monoxide on the human body. * Sulfur dioxide and oxides of nitrogen on acidity of rain water. * Sulfur dioxide and oxides of nitrogen on respiratory system. * Particulates on global dimming. * Particulates on human health problems. |  |  |