

Overview

Air pollutants arise from a wide variety of sources, although they are mainly a result of the combustion process. It is easy to assume that most of these air pollutants arise as a result of human activity, but large amounts are also produced by natural processes such as forest fires, volcanoes and bacteria. The largest sources of pollutants produced by human activities include motor vehicles and industry. Motor vehicles emit a wide variety of pollutants, principally carbon monoxide (CO), oxides of nitrogen (NO_x), volatile organic compounds (VOCs) and particulates (PM₁₀). In addition, photochemical reactions resulting from the action of sunlight on nitrogen dioxide (NO₂) and VOCs from vehicles lead to the formation of ozone, a secondary long-range pollutant, which impacts in rural areas often far from the original emission site. Acid rain is another long-range pollutant influenced by vehicle NO_x emissions. The effects of air pollution can range from slight feelings of discomfort to major breathing difficulties and even death. For example, high concentrations of SO₂ and smoke were responsible for increased mortality rates during the smogs of the 1950s. Children up to the age of 14, and particularly children under 5 years old, are susceptible as pollutants are quickly absorbed into the body. Also the elderly and those with respiratory ailments are more at risk.

The activities

The activities look at air pollution and how it is monitored. Pupils can collect data for their own area and analyse it in terms of the levels of air pollution and the effect on human health. There are five activities in this unit. The activities 'Air pollution' and 'Air pollution and health' should be completed first, if they are going to be used and the remaining ones in any order. Air pollution "Activity sheet A or B" could also be used for independent work / homework. Access to computers is required for the activities on forecasting air pollution and analysing air pollution maps.

- **Air pollution**
Many sources of pollutants are natural. Students compare the levels of pollution from natural sources with those produced by human activities.
- **Air pollution and health**
Students find out how air quality is recorded (AQI) and the effects of air pollution on health.
- **Forecasting air pollution**
This activity is about forecasting air pollution. Students find out about the air quality in their area.
- **Analysing air pollution graphs**
Students interpret a graph showing how carbon monoxide levels vary over a week.
- **Analysing air pollution maps**
Maps of the United Kingdom showing the levels of different pollutants provide material for students to analyse.

Curriculum links (for students aged 14–16)

How Science Works (from POS KS4 for England)

- 1a how scientific data can be collected and analysed
- 2b collect data from primary or secondary sources, including using ICT sources and tools
- 3b use both qualitative and quantitative approaches
- 3c present information, develop an argument and draw a conclusion, using scientific, technical and mathematical language, conventions and symbols and ICT tools

GCSE or equivalent 14-16 specifications

This activity does not directly support the teaching of pesticides in relation to the environment but could still be used as a standalone activity to give a wider perspective during the teaching of environmental topics and how science works. References to use of pesticides, food and farming methods and effect on health were found in the following specifications.

England (GCSE)

AQA Science A

- Biology Unit 1b: Evolution and Environment: 11.8 How do humans affect the environment?
- Chemistry Unit 1a: Products from Rocks: 12.3 How do we get fuels from crude oil?
- Chemistry Unit 1b: Oils, Earth and Atmosphere: 12.6 What are the changes in the Earth and its atmosphere?

AQA Science B

- Unit Biology 1: 11.8 How do humans affect the environment?
- Unit Chemistry 1: 11.3 How do we get fuels from crude oil?
- 12.6 What are the changes in the Earth and its atmosphere?
- 13.4 How should we generate the electricity we need?

AQA Biology

- Unit 1: 11.8 How do humans affect the environment?

AQA Chemistry

- Unit 1: 11.3 How do we get fuels from crude oil?
- 11.6 What are the changes in the Earth and its atmosphere?

AQA Physics

- Unit 1 Physics: 11.4 How should we generate the electricity we need?

AQA Applied Science (Double Award)

- Science for the Needs of Society Unit 2
- 11.3 Countryside and environmental management, Energy resources
- 11.5 Transport and communication, Fuel for transport

Edexcel 360 Science

- Biology B1 a: Topic 1 Environment
- Chemistry C1 b: Topic 7 There's One Earth

Edexcel 360 Additional Science

Biology B2: Topic 3 Energy Flow; Topic 4 Interdependence

Edexcel Science

Biology B1 a: Topic 1 Environment

Chemistry C1 b: Topic 7 There's One Earth

Edexcel Additional Science

Biology B2: Topic 3 Energy Flow; Topic 4 Interdependence

OCR Science A (21C science)

Module C1: Air Quality

OCR Chemistry A (21C science)

Unit C1: Air Quality

OCR Chemistry B (Gateway Science)

Module C1: Carbon Chemistry Item C1g Using carbon fuels

Module C2: Rocks and metals Item C2f Clean air

OCR Physics B (Gateway Science)

Module P2: Living for the Future,

Item P2c Fuels for power

OCR Applied Science (Double Award)

Section 2.3: Obtaining useful chemicals 2.3.2 Useful chemicals - using raw materials

Section 2.5: Energy resources 2.5.1 Energy resources - fuels

Section 2.6: Planet Earth 2.6.1 Planet Earth – the atmosphere

Scotland (SCE standard grade)

Science

Topic 3: Energy and its Uses: 3. Non-renewable sources of energy

Topic 4: A Study of Environments: 5. Pollution

Biology

Topic 1: The Biosphere: Sub-Topic c: Control and management

Chemistry

Topic 5: Fuels

Wales (WJEC GCSE)

Science

Chemistry C1: 6. Production and use of fuels

Physics P1: Energy, radiation and the universe 1: Generation of electricity

Additional Science

Biology B2:7. The impact of human activity on the environment

NI (CCEA GCSE)

Science (Single Award)

Module 2: Human Activity and Health, Man's activity on Earth

Module 4: Materials and their management, Oils, polymers and materials

Biology

Section 3.2 Environment: 3.2.12 Pollution

Chemistry

Section 3.7 Chemical change: Combustion

Applied Science (Double Award)

Unit 2: Science for the needs of society, The importance of energy: Energy resources

Learning objectives

By working through this unit, students should know:

- about the substances that cause air pollution
- about the sources of some pollutants in air
- the effect of some pollutants on the human body
- how air quality is monitored and recorded
- about forecasting air quality.

Teaching and learning approaches

- Interpreting and evaluating data ✓ (LSS1, LSS4)
- Discussing ideas in a small group ✓ (LSS2)
- Gathering information from a variety of sources ✓ (LSS1)
- Handling ideas and information: using computers ✓ (ICT)
- Interacting with a variety of audio-visual media ✓

For further information about Learning Skills for Science (LSS) click here.

Downloads

Air pollution

- PowerPoint presentation
 - slide 1 – starter stimulus
 - slide 2 – gases in the atmosphere
 - slide 3 – pollutants in the air
 - slide 4 – table showing amounts of naturally produced pollutants
 - slide 5 – table showing amounts of pollutants produced by human activities
 - slide 6 – graph of pollutants
- Fact file blanks (make several copies and cut in half)
- Information sheet – Air pollution – where does it come from?
- Activity sheet A – Air pollution – where does it come from?
- Activity sheet B – Air pollution – where does it come from? (simplified version)

Air pollution and health

- PowerPoint presentation
 - slide 7 – AQI
 - slide 8 – AQI bands and values
- Information sheet – Air quality and health
- Activity sheet A – Air pollution and health
- Activity sheet B – Air pollution and health (simplified version)
- Fact file blanks (if not used in the first activity) (optional)

Forecasting air pollution

- PowerPoint presentation
 - slide 9 – air quality stimulus
 - slide 10 – forecasting air quality instructions
 - slide 11 – blank table 1 from ‘Activity sheet – Forecasting air pollution’
 - slide 12 – instructions for completing table 2 on ‘Activity sheet – Forecasting air pollution’
 - slide 13 – blank table 2 from ‘Activity sheet – Forecasting air pollution’
 - slide 14 – blank table to compare pollutants from different areas
- Activity sheet – Forecasting air pollution

Analysing air pollution graphs

- PowerPoint presentation
 - slide 15 – carbon monoxide graph
- Excel spreadsheet with carbon monoxide data (optional)
- Activity sheet A – Interpreting graphs
- Activity sheet B – Interpreting graphs (simplified version)

Analysing air pollution maps

- PowerPoint presentation
 - slide 16 – instructions for getting the graphs
 - slide 17 – questions for the graphs

Acknowledgements

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Information from the Air Quality Archive website is used in the activities. The Air Quality Archive is prepared and hosted by AEA Energy & Environment, on behalf of the UK Department for Environment, Food & Rural Affairs and the Devolved Administrations.