



Unit 24: Pollution and Waste Management

Delivery guidance

Global pollution has been a major concern for several decades now. In recent years there has been a growing awareness that unless immediate action is taken, the future sustainability of the planet is at risk, threatening the lives of countless millions of people and the possible extinction of a significant number of plant and animal species. There is a concerted need for countries to take immediate action to prevent the situation from escalating to such a degree.

Learners will investigate the main issues relating to the pollution of our planet, and how this has many forms. They will develop a deeper understanding of the main causes of global pollution in relation to water, land and the atmosphere. Learners will explore the known effects of pollution on plants and animals, and investigate current and future plans to prevent and reverse the ongoing problems of pollution.

Utilise online and other resources in order to investigate policies and strategies in different countries which seek to mitigate the effects of pollution. Use any contacts who are involved in areas such as environmental science, climate analysis and research. Where possible, learners should have the opportunity to visit appropriate establishments that are, for example, involved in environmental monitoring and research, recycling and waste management.

Approaching the unit

Learners will be able to apply the accepted definition of pollution, and understand the current causes of it and the effect on the land, the sea and the atmosphere. They need to focus on factual aspects identified through many years of scientific research and experimentation.

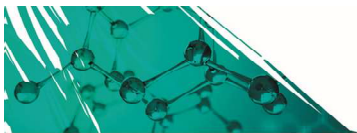
Learners will outline and describe current waste management activities performed across continents that seek to develop long-term solutions to managing the waste produced by, in particular, human activities.

Learning aim A is primarily concerned with investigating the factors that cause pollution.

Learners will need to be able to define pollution and the main forms of pollution, which should include those beyond the forms normally associated with water, land and atmospheric pollution (e.g. noise, light, buildings). The learning aim, however, does go on to focus on the three main forms. Learners should understand key water-, air- and land-pollutant sources and the effects that these have on the environment, ecosystems and humans. It is important that learners can cite the main activities responsible for carbon emissions and highlight the extent to which different countries contribute to such emissions. They must also be able to produce statistics that support the need to tackle various forms of pollution entering the environment.

Learning aim B focuses on the effects of pollution on the animal and plant kingdoms. A key concept is that traditional industrial processes, which for many years have been taken for granted, have impacted adversely on fauna and flora; this should include:

- the effect of DDT on animals and humans
- oil spills and their effects on organisms that occupy marine habitats
- the origin of acid rain from the combustion of fossil fuels and its consequences
- mining activities and metal refining, and the risk of toxic metals entering ecosystems



- the discharge of plastics into the marine environment and consequences
- light pollution and effects on wildlife.

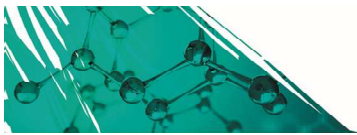
Learners should be able to describe in detail these different types of pollution and their effects on animals and humans, and assess the changes brought about by them in terms of the growth and physiology of animals, adaptation to habitat change and changes to food chains and webs. Learners must also understand how air, water and land pollution impact adversely on plant life and have resulted in a drop in the number of plant species over the past 50 years. They should appreciate the role that plants have in counteracting aspects of pollution through their ability to absorb carbon dioxide, and explain why it would be beneficial to increase the number of plants, particularly in urban environments.

Learning aim C explores current methods of waste management, the effects they have on the environment and proposals for future waste management. Learners should be able to identify sources of solid waste, including industrial, residential and commercial, as well as the categories of waste. They should be able to explain the processes involved in waste management and assess those that constitute effective waste management. They will produce statistics which show the extent to which different countries generate waste and look at a case study which looks at plastic waste in particular. A key concept is that, unlike solid waste, wastewater will be returned to the water cycle but, in order to avoid pollution of waterways, it must be subject to a treatment process, which learners should be able to describe and explain. Learners will go on to explore strategies that seek to minimise waste production and create a more sustainable future. This includes 'Reduce, Re-use, Recycle', better management at landfill sites and better methods of farming.



Assessment model

Learning aim	Key content areas	Recommended assessment approach
<p>A Investigate contributing factors of pollution</p>	<p>A1 Polluting substances and their sources</p> <p>A2 Facts and figures relating to pollution of water, land and atmosphere</p>	<p>A scientific report or news article, using appropriate terms and numerical values.</p> <p>Outline of numerical values associated with composition of pollutants and facts.</p> <p>Diagrams related to land, sea and the atmosphere, highlighting the movement of pollutants between them.</p>
<p>B Explore the effects of pollution on the Earth's flora and fauna</p>	<p>B1 Evidence of pollution effects on the animal kingdom</p> <p>B2 Evidence of pollution effects on the plant kingdom</p>	<p>Research article that provides evidence for the known effects of pollutants on animals, with examples.</p> <p>Discussion and scientific evidence related to the known effects of pollutants on plant life. This could take the form of a 'news' report on the problems of reduction in plant life on Earth.</p>
<p>C Investigate methods of waste management</p>	<p>C1 Current methods of managing waste</p> <p>C2 Future waste-management proposals and technological developments</p>	<p>A report on the most up-to-date methods of managing solid and liquid waste materials, stages in the process and the plastics problem.</p> <p>A journalistic report based on current and newly developed technology to deal with waste management for an increasing population.</p>



Assessment guidance

This unit is internally assessed via a number of independent assignments. Learners must produce individual evidence that is both original and can be authenticated. The main sources of support for this unit are likely to include:

- online research
- organised visits to organisations and companies engaged in waste management and pollution control
- watching the news and TV programmes concerned with the environment
- possible participation in field and practical activities.

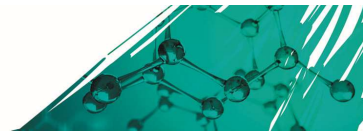
BTEC assessors could assist learners with completing their assessment by providing relevant contacts that learners can get in touch with in order to support their research.

Other relevant sources of research may include copies of government and international statistics, access to regulations surrounding pollution and waste disposal, and access to online environmental monitoring tools.

For learning aim A, learners are required to produce a scientific report or news article, using appropriate terms and numerical values. They will identify key water-, land- and air pollutants (including carbon emissions) and their sources, and explain their effects on the systems involved. This should be backed up using their research, data and numerical values associated with composition of pollutants and facts. The report should include diagrams related to land, sea and the atmosphere, highlighting the movement of pollutants between them.

The assessment criteria for learning aim B require that learners produce a research article that gives evidence for the known effects of pollutants on animals, with appropriate examples (e.g. plastic and its effects on marine life). Learners can focus on how some animal species have adapted to changes in pollution levels or on changes in food chains and food webs. There should also be discussion and scientific evidence related to the known effects of pollutants on plant life. This could take the form of a 'news' report on the problems of reduction in plant life on Earth.

Learning aim C requires that learners produce a comprehensive report on the most up-to-date methods of managing solid and liquid waste materials, showing clear understanding of the separate processes and the need for a regulated industry. It should include a case study of the plastics issue, citing the types of plastics available and their benefits and drawbacks. There should also be a journalistic report based on current and newly developed technology to deal with waste management for an increasing population.



Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 24: Pollution and Waste Management

Introduction

If learners have taken units 8 and 10, it is likely that they will have encountered some of the issues that are addressed in this unit, particularly consequences of pollution such as climate change. However, they will have an opportunity to explore different types of pollution and the impact that these will have for the environment.

Where possible, learners should draw on their own experiences, e.g. involvement in conservation activities, experiencing areas where one was advised to wear masks, and suffering medical conditions associated with contamination.

This unit would benefit from employer involvement in the form of guest speakers. A visit to a recycling/waste-management plant would give learners an idea of the range of employment opportunities in the field and of the current state of development of the industry in coping with increasing waste, landfill sites and plastics.

Learning aim A - Investigate contributing factors of pollution

- For learning aim A, the teaching is concerned with two main areas: polluting substances and their sources, and facts and figures relating to pollution. In order to gauge current knowledge and understanding, give the learners an activity, e.g. a quiz or question and answer session. Delivery methods for the learning aim should vary, including presentations (by tutor and learners), class or group discussion, group or paired activities, watching videos, reviewing articles in newspapers and scientific articles, and carrying out independent research. There could also be a visiting speaker from an organisation or government department that is involved with monitoring levels of pollution in the environment.
- For A1, learners will need to be able to define pollution as 'the introduction or presence of a substance in the environment that is harmful or poisonous' and outline the main forms of it. This could involve creating a poster or some other activity which illustrates this. It is important that they recognise forms of pollution beyond those commonly associated with water, land and atmospheric pollution. It should include pollution caused by the likes of noise, light, buildings, etc., which can be quite different to measure and indeed monitor. Ask the learners to attempt to rank the type of pollution according to its risk (e.g. 1 being serious, 2 considerable). A class or group discussion could follow, to explore the risks further.
- The focus can then move on to the three main forms of pollution: water, land and atmospheric pollution. Learners should understand the key sources and the effects that these have on the environment, ecosystems and humans. Present information on the sources and effects and ask learners to carry out some independent research. Working in groups or pairs, they could create a table with all the possible sources of pollution and all the possible effects, and identify those that can affect air, water, land or all three. They can then produce a leaflet for each of the three types of pollution, detailing the sources and effects.



- For water pollutant sources, there should be a detailed description of a range of different types of waste (industrial, agricultural, etc.) that can be discharged into water, as well as activities such as boating and transportation. The information should also identify where and how the effects of this are most likely to be felt. Similarly, for air pollution, the leaflet should detail gaseous emissions from industry and vehicle exhaust and highlight the effects on human and animal health, as well as climate. For land pollution, reference should be made to agricultural activities, deforestation and subsequent soil erosion, mining and extraction, construction and urbanisation, sewage landfill and nuclear waste. Effects should include soil erosion, changes in the water cycle following deforestation, climate patterns, effect on human health, effect on wildlife and plant life, and reduction in tourism.
- For A2, it is important that learners can cite the main activities responsible for carbon emissions, including power generation, industry and manufacturing, motor vehicles, agriculture and other land use and general waste. It would be beneficial if learners can apply their knowledge of chemistry, biochemistry and biology to explain how these activities contribute to the carbon footprint. There may also be scope for some practical activity, e.g. measuring the carbon emissions from different types of engine.
- Learners should be able to produce statistics that support the need to tackle various forms of pollution entering the environment. Firstly, ask them to research and obtain data which reveals the extent to which different countries (as per the unit content) contribute to such emissions. The learners could rank the countries against the emission statistics, and there could follow a whole class or group discussion to identify possible reasons as to why certain countries have higher emissions than others.
- Learners could then go on to research further statistics regarding pollution and the effects. These should include the tonnage of litter entering the oceans, percentage of waste in different countries entering the environment without treatment, human deaths due to unclean water, death of seabirds and marine life killed as a result of plastic waste, etc. Again learners can attempt to identify areas where these effects are higher compared to others and discuss possible reasons for this.

Learning aim B – Explore the effects of pollution on the Earth’s flora and fauna

- Learning aim B is concerned with a more detailed look at the effect of pollution on the plant and animal kingdoms. Learners will already have encountered some aspects of this in learning aim A when they were looking at the effects of water, air and land pollution. Delivery methods for this learning aim should again vary, including presentations (by tutor and learners), class or group discussion, group or paired activities, watching videos, reviewing articles in newspapers and scientific articles, and carrying out independent research. Learners would benefit greatly from a visit to a conservation project or having a visit from someone who is involved in the organisation of conservation projects.
- For B1, learners should be aware that traditional industrial and agricultural processes which for many years have been taken for granted have impacted adversely on fauna and flora. A useful starting exercise would be some type of activity which enables learners to identify different types of pollution and the effects they have on animals and humans. Use a ‘mix and match’ game where the learners have to match a pollutant or pollution source to the effect that it has on humans, animals or ecosystems; for example, DDT to reproductive and neurological conditions, plastic to effects on marine life, etc. Then ask

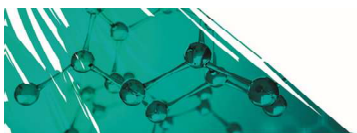


learners to produce a poster illustrating the effects of different forms of pollution on animals, humans and their ecosystems.

- Next, ask learners to carry out further research into case studies which highlight the problem of plastic building up in the oceans. This could include the case of the whale (the 'plastic whale') found on a Norwegian coast with plastic waste in the stomach. Such case studies will bring home to learners the seriousness of pollution from plastic materials. A useful activity might be to visit a beach or coastal area and investigate the number of plastic bottles and other plastic waste found within a particular area.
- Learners can move on to explore in more depth the changes in growth and physiology of animals in the presence of long-term pollutants, and how some can adapt to changes in their habitat. Again, they can independently research relevant statistics and case studies; for example, the number of reported cases of humans suffering from asthma and bronchitis due to increasing levels of sulphur dioxide in the air, and the role of the purple sea urchin in the disappearance of kelp forests due to climate change.
- For B2, the focus of teaching will move to exploring the effects of water, air and land pollution on plant life. Present information on how pollutants affect plant structure, physiology and growth, and ask learners to carry out some independent research. Working in groups or pairs, they could produce an information booklet on the effects that pollution has on plant life.
- For air pollution, the information should include how pollutants affect leaves and stems, stunting growth, and how ozone can limit photosynthesis and cause damage through increased UV rays. For water pollution, there should be reference to eutrophication and algal bloom from run-off, the effect of chemicals discharged into the water, and pH changes. With regard to land pollution, the information should particularly outline the widespread effects of acid rain: direct damage, chemical changes in the soil, reduced soil bacteria (for fixation, etc.) and pH changes.
- Learners can research the different species of plant which have dropped in numbers over the past 50 years as a result of pollution. A useful activity would be for learners, working in pairs or groups, to use their information to produce a presentation which looks at how particular species have been affected by pollution, citing aspects such as cause, areas where this has been more prevalent, and measures being taken to minimise or reverse the decline.
- Learners will be aware from their knowledge of plant biology that plants absorb carbon dioxide through the process of photosynthesis, and will appreciate the role that plants have in counteracting aspects of pollution that involve the emission of carbon dioxide. They should, therefore, understand the disadvantages associated with plant removal (e.g. destruction of rainforests) but also the benefits of increasing the number of plants, particularly in urban environments. Ask learners to research projects which seek to increase the plant population in certain areas with a view to improving the environmental conditions.

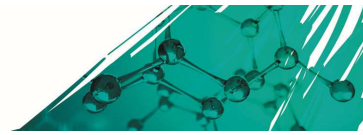
Learning aim C – Investigate methods of waste management

- Learning aim C is primarily concerned with methods of waste management and putting strategies in place to reduce waste. Learners will be aware that waste, whether industrial, commercial or household, is a major contributor to pollution. They will understand that there is a need to implement measures which aim to reduce the amount of waste. This can include reducing, reusing, recycling and making more products that are biodegradable.



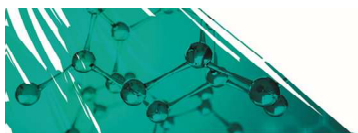
Again, delivery methods for the learning aim should vary, including presentations (by tutor and learners), class or group discussion, group or paired activities, watching videos, reviewing articles in newspapers and scientific articles, and carrying out independent research. Learners would greatly benefit from visiting a recycling plant or sewerage treatment facility or having a visit from someone who is involved in such operations.

- For C1, a good starting point to explore waste management systems would ideally be for learners to investigate those used in their own area for general, recyclable and compostable waste. Following on from this, have learners carry out independent research into the various methods of collecting waste, how it is categorised and special measures for disposing of hazardous waste. This should include hazardous substances such as chemical, microbiological and radioactive waste. They can present to the whole class and open up a discussion highlighting differences, etc.
- Learners should access regulations for waste management in their own area and identify how they are enforced and compliance monitored. Then ask learners, working in groups or pairs, to research the regulations in other countries and compare the levels of waste production. Learners could perhaps draw conclusions relating legislation and regulations to levels of waste production and attempt to identify the most effective regulatory procedures.
- From other learning aims, learners will understand that plastic is one of the most problematic waste materials and is particularly detrimental to the marine ecosystem. They will understand that this material has come to replace other materials such as glass, timber, metal, paper and cloth materials, because of its relatively low cost of production from petrochemical feedstocks and properties such as flexibility, being easy to mould, lightweight, etc. Ask learners, working in pairs or groups, to compare a particular plastic, e.g. polythene, with a material that it would likely have replaced. Learners should understand that, despite these advantages, plastics are not biodegradable, are costly to recycle and have generally given rise to a disposable 'throw away' culture.
- Learners should understand that, while solid waste has implications for the longer term, liquid waste if not managed effectively can cause short-term as well as long-term problems. They will know that water can contain soluble substances but also that particulate matter can be suspended in it, and it can contain biological material such as microorganisms. Learners could construct a detailed representation of the water cycle and identify different sources of wastewater and how this will make its way into waterways before entering the ocean and being evaporated. They can particularly identify critical points where there is a high risk of pollution and contamination, and where effective management processes are essential.
- A useful activity would be for learners to visit a water treatment plant, but if this is not possible watch a video. Ask them to take notes or give them a worksheet to answer questions on the processes involved, which will include the primary (removal of solid matter), secondary (aerobic treatment to encourage microbial growth) and tertiary (chemical treatment to sanitise) processes.
- For C2, learners by now should have fully realised that a major key to reducing pollution and ensuring future sustainability lies in implementing strategies which seek to reduce waste in general. A worthwhile activity would be for them to investigate what policies are currently in place within their own locality; this could involve gathering leaflets and other promotional material. Using this information along with that from their independent research, learners could produce a poster on each of the 3Rs (reduce, re-use, recycle). This



should indicate how they, as individuals or with their families, can: reduce, e.g. buying only what they use or turning off the heat or aircon in a room they are not occupying; re-use items, e.g. reusing rechargeable batteries or filtering water; and recycle, e.g. reusing plastic water bottles for other purposes. Learners can then extend this to research how certain industrial organisations could implement such strategies.

- Having looked at strategies involving the 3Rs, learners will appreciate that this will contribute to reducing the amount of landfill sites and constitute better management of landfill. While landfill can have some advantages for the environment (e.g. reclaiming old quarries which have scarred the landscape), problems can include leaching, smell, noise and dirt, among others. Learners will also understand that turning organic waste into compostable materials which can be used for horticulture and agriculture would further remove some of these, as well as reduce the risk of methane build-up in the ground.
- Finally, learners should understand that the agricultural sector also has a major part to play in reducing pollution and waste. Modern farming methods include those which can result in eutrophication from run-off (e.g. from use of artificial fertilisers) into waterways, and increased soil erosion. A useful activity would be for learners to research case studies where such situations have been identified. If possible, a visit to an organic farm would be advantageous, but alternatively they could produce a plan for an organic farming enterprise that takes a holistic approach to crop and livestock production.



Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

This unit links to:

- Unit 8: Contemporary Issues in Science
- Unit 10: Climate Change.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC International L3 Qualifications in Applied Science. Check the Pearson website (<http://qualifications.pearson.com/endorsed-resources>) for more information as titles achieve endorsement.

Textbooks

Ekstrom, K – *Waste Management and Sustainable Consumption* (Routledge, 2014) ISBN 9781138797260. Examines the social and cultural views of waste, shedding new light on the topic by emphasising the consumer perspective throughout.

Readman, J, Pollard, S, Smith, S, Kinniburgh, J, Salmond, J, Kibblewhite, M, Nicholas Hewitt, C – *An Introduction to Pollution Science* (RSC Publishing, 2006) ISBN 9780854048298. Covers topics including pollution in the atmosphere, the world's waters and soil and land contamination.

Waite, R – *Household Waste Recycling (Environmental Management Set)* (Routledge, 2013) ISBN 9780415848237. Gives a summary of the materials, processes and policies currently available to deal with the disposal of household waste.

Journals

Guardian Science

Nature

New Scientist

Scientific American

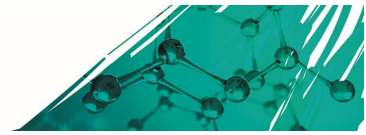
Technical journals requiring high-level reading skills and ability to use and understand technical terms. They contain articles and latest news and research into related topics.

Videos

Search YouTube for:

- 'Air Pollution 101 | National Geographic' – Air pollution
- 'Water Pollution Documentary' – Water pollution
- 'Land pollution'
- 'Waste Management and Recycling'
- 'What is Organic Farming? | Agriculture | Biology | FuseSchool' – Organic farming.

Examples of videos that can be used with the unit content. Several others will be available on video-sharing websites.



Websites

Visit the Air Pollution Information System website – a comprehensive source of information on air pollution and the effects on habitats and species.

Visit the national Environmental Protection website, which gives information on different aspects of environmental protection.

Visit the Friends of the Earth website, which considers various issues related to the environment.

Visit websites of local and national wildlife organisations and search 'Blueprint for Water' for an explanation of systems where pollutants are dealt with at source.

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling students to access them through the school/college intranet.