IB Environmental Systems and Societies

Unit 5 Pollution Management

We do not inherit the earth from our ancestors, we borrow it from our children

– Native American Proverb

	Assessment Objective	Teacher Notes
5.1.1	Define the term pollution	
5.1.2	Distinguish between the terms point source pollution and non- point	Point source pollution is generally more easily managed because its impact is more localized, making it easier to control emission, attribute responsibility and take legal action.
5.1.3	State the major sources of pollutants.	Sources of pollutants are combustion of fossil fuels, domestic and industrial waste, manufacturing and agricultural systems.
5.2.1	Describe two direct methods of monitoring pollution.	Students should describe one method for air and one for soil or water.
5.2.2	Define the term biochemical oxygen demand (BOD) and explain how this indirect method is used to assess pollution levels in water.	
5.2.3	Describe and explain an indirect method of measuring pollution levels using a biotic index.	This will involve levels of tolerance, diversity and abundance of organisms. The concept of indicator species should be understood. A polluted and an unpolluted site (for example, upstream and downstream of a point source) should be compared.
5.3.1	Outline approaches to pollution management with respect to figure 5.	Pollutants are produced through human activities and create long-term effects when released into ecosystems. Strategies for reducing these impacts can be directed at three different levels in the process: altering the human activity, regulating and reducing quantities of pollutant released at the point of emission, and cleaning up the pollutant and restoring ecosystems after pollution has occurred. Using figure 5, students should be able to show the value and limitations of each of the three different levels of intervention. In addition, students should appreciate the advantages of employing the earlier strategies over the later ones and the importance of collaboration in the effective

	Assessment statement	Teacher's notes
5.3.2	Discuss the human factors that affect the approaches to pollution management.	Cultural values, political systems and economic systems will influence the choice of pollution management strategies and their effective implementation. Real examples should be considered.
5.3.3	Evaluate the costs and benefits to society of the World Health Organization's ban on the use of the pesticide DDT.	
5.4.1	Outline the processes of eutrophication.	Include increase in nitrates and phosphates leading to rapid growth of algae, accumulation of dead organic matter, high rate of decomposition and lack of oxygen. The role of positive feedback should be noted in these processes.
5.4.2	Evaluate the impacts of eutrophication.	Include death of aerobic organisms, increased turbidity, loss of macrophytes, reduction in length of food chains and loss of species diversity.
5.4.3	Describe and evaluate pollution management strategies with respect to eutrophication.	Students should apply the model in 5.3.1 in the evaluation of the strategies. For example: • Altering the human activity producing pollution can be exemplified by alternative methods of enhancing crop growth, alternative detergents, and so on. • regulating and reducing pollutants at the point of emission can be illustrated by sewage treatment processes that remove nitrates and phosphates from the waste. • Clean-up and restoration can be exemplified by pumping mud from eutrophic lakes and reintroducing plant and fish species.
5.5.1	Outline the types of solid domestic waste.	Students should consider their own and their community's generation of waste. Consider the different types of material, for example, paper, glass, metal, plastics, organic waste (kitchen or garden), packaging, as well as their total volume.
5.5.2	Describe and evaluate pollution management strategies for solid domestic (municipal) waste.	Consider recycling, incineration, composting and landfill.
5.6.1	Outline the overall structure and composition of the atmosphere.	
5.6.2	Describe the role of ozone in the absorption of ultraviolet radiation.	Ultraviolet radiation is absorbed during the formation and destruction of ozone from oxygen. Memorization of chemical equations is not required.

	Assessment statement	Teacher's notes
5.6.3	Explain the interaction between ozone and halogenated organic gases.	Halogenated organic gases are very stable under normal conditions but can liberate halogen atoms when exposed to ultraviolet radiation in the stratosphere. These atoms react with monatomic oxygen and slow the rate of ozone re-formation. Pollutants enhance the destruction of ozone, thereby disturbing the equilibrium of the ozone production system (see 1.1.5).
5.6.4	State the effects of ultraviolet radiation on living tissues and biological productivity.	The effects include mutation and subsequent effects on health and damage to photosynthetic organisms, especially phytoplankton and their consumers such as zooplankton.
5.6.5	Describe three methods of reducing the manufacture and release of ozone-depleting substances.	For example, recycling refrigerants, alternatives to gas-blown plastics, alternative propellants and alternatives to methyl bromide (bromomethane).
5.6.6	Describe and evaluate the role of national and international organizations in reducing the emissions of ozone-depleting substances.	Examine the role of the United Nations Environment Programme (UNEP) in forging international agreements (for example, the Montreal Protocol and subsequent updates) on the use of ozone-depleting substances, and study the relative effectiveness of these agreements and the difficulties in implementing and enforcing them. In addition, students should be familiar with what steps national governments are taking to comply with these agreements.
5.7.1	State the source and outline the effect of tropospheric ozone.	When fossil fuels are burned, two of the pollutants emitted are hydrocarbons (from unburned fuel) and nitrogen monoxide (nitric oxide, NO). Nitrogen monoxide reacts with oxygen to form nitrogen dioxide (NO_2), a brown gas that contributes to urban haze. Nitrogen dioxide can also absorb sunlight and break up to release oxygen atoms that combine with oxygen in the air to form ozone. Ozone is a toxic gas and an oxidizing agent. It damages crops and forests, irritates eyes, can cause breathing difficulties in humans and may increase susceptibility to infection. It is highly reactive and can attack fabrics and rubber materials.
5.7.2	Outline the formation of photochemical smog.	

	Assessment statement	Teacher's notes
5.7.3	Describe and evaluate pollution management strategies for urban air pollution.	Measures to reduce fossil fuel combustion should be considered, for example, reducing demand for electricity and private cars and switching to renewable energy. Refer to clean-up measures, for example, catalytic converters.
5.8.1	Outline the chemistry leading to the formation of acidified precipitations.	Refer to the conversion of sulfur dioxide and oxides of nitrogen (NO_X) into the sulfates and nitrates of dry deposition and the sulfuric and nitric acids of wet deposition. Knowledge of chemical equations is not required.
5.8.2	Describe three possible effects of acid deposition on soil, water and living organisms.	Include: •one direct effect, for example, acid on aquatic organisms and coniferous forests •one toxic effect, for example, aluminium ions on fish •one nutrient effect, for example, leaching of calcium.
5.8.3	Explain why the effect of acid deposition is regional rather than global.	Refer to areas downwind of major industrial regions that are adversely affected by acid rain and link them to sources of sulfur dioxide and nitrogen dioxide emissions. Consider the effect of geology (rocks and soils) on water acidity through buffering.
5.8.4	Describe and evaluate pollution management strategies for acid deposition.	Measures to reduce fossil fuel combustion should be considered, for example, reducing demand for electricity and private cars and switching to renewable energy. Refer to clean-up measures at "end of pipe" locations (points of emission). Consider the role of international agreements in effecting change. The cost-effectiveness of spreading ground limestone in Swedish lakes in the early 1980s provides a good case study.

5.1.1 Define the term pollution.

'…the contamination of the Earth and the atmosphere to such an extent that normal environmental processes are adversely affected.'[1]

This means that not only anthropogenic causes can be blamed for pollution. Natural phenomenon such as volcanic eruptions increase the amount of contaminants in the environment.

5.1.2 Distinguish between the terms point source pollution and non- point source pollution, and outline the challenges they present for management.

Point source pollution originates from a define place that can be located easily on a map. Whereas non-point source pollution cannot be identified from one single source as easily. Therefore a nuclear explosion or leak could easily be identified to a nuclear power plant, air pollution comes from many sources and the pollution is dispersed over a larger area.

In order to manage point source pollution, governments and local authorities can impose strict regulations on the emissions of factories and industries. This is a contrast to non-point source pollutants, where communities have to change habits to reduce the overall emissions produced. For example car-sharing, encouraging the use of public transport.

5.1.3 State the major sources of pollutants.

Essentially, in modern life the '…combustion of fossil fuel, domestic and industrial waste, manufacturing and agricultural systems'[2] contribute to pollution both locally and globally. In living our daily lives and the growth of our development these factors all release contaminants into our environment. Construction of new houses and roads releases dust particles and minerals into the atmosphere, whilst agriculture contaminates water systems through increased use of fertilisers and chemicals.

[1] Andrew Davis and Garrett Nagle, 'Environmental Systems and Societies', (Pearson Education Limited, New Jersey, 2010), p 217.
[2] Andrew Davis and Garrett Nagle, 'Environmental Systems and Societies', (Pearson Education Limited, New Jersey, 2010), p 218.

5.2.1 Describe two direct methods of monitoring pollution.

To measure pollutants in the environment is difficult as naturally different levels of the 'pollutants' already exist in the environment. Some soils and water have higher pH than others due to rock type and vegetation present. However, combining the characteristics of soil and water can allow analysis to be complete to see if the area is contaminated. Normally the following attributes are used to study soil:

- texture
- water retention characteristics
- phosphorous and potassium content
- density
- infiltration rates
- amount of organic matter
- microbial biomass

Methods to monitor water pollution include using different chemicals as indicators. Chemical indicators of water quality include ammonia, dissolved oxygen, nitrate, pH, phosphate and salt (as chloride). Other methods are conducting a Biochemical Oxygen Demand (BOD) test, Chemical Oxygen Demand (COD) test and the turbidity of water.

Recording data of atmospheric chemistry is carried out by many organizations locally and globally therefore monitoring air pollution is much easier. Monitoring sulphur dioxide, nitrogen dioxides, ozone and Volatile Organic Compounds (VOCs) are very simple ways to show changes in air quality.

5.2.2 Define the term biochemical oxygen demand (BOD) and explain how this indirect method is used to assess pollution levels in water.

Biochemical Oxygen Demand is a method to determine how polluted a river or body of water is. The more organisms present in a river the more oxygen is consumed in respiration. Certain chemicals within water encourage a certain species to thrive and their population to growth. Such species are called indicator species. Consequently, if there is a high BOD level, biodiversity is low and pollution is high. This means the species which thrives in the contaminant has no or little competition and the population increases. Therefore more respiration. In contrast, where a high diversity of species is present the BOD tends to be lower. This is because no species is dominant and therefore populations are in equilibrium with their environment.

'BOD is measured in the following way.
1. Take a sample of water of measured volume.
2. Measure the oxygen level.
3. Place the sample in a dark place at 20^{o}C for five days (lack of light prevents photosynthesis which would release oxygen and give an artificially low BOD).
4. After five days, re-measure oxygen levels.
5. BOD is the difference between the two measurements.'[3]

5.2.3 Describe and explain an indirect method of measuring pollution levels using a biotic index.

The absence of an indicator species is a fundamental part of biotic indices and the Trent Biotic index in particular. This then shows the introduction of a factor that makes it difficult for the indicator species to survive, such as reduced oxygen levels or lower light levels (through eutrophication).

[3] Andrew Davis and Garrett Nagle, 'Environmental Systems and Societies', (Pearson Education Limited, New Jersey, 2010), p 220.

5.3.1 Outline approaches to pollution management with respect to figure 5.

The impact of pollution can be managed at different points either at source (with human activity), during the release (through regulation) or after the pollution has occurred. These each have varying degrees of success and limitations to the effectiveness. Some suggested ways to manage pollution are highlighted in Figure 5.

5.3.2 Discuss the human factors that affect the approaches to pollution management.

Each society faces different challenges when it comes to the management of pollution. Some societies have economic barriers to instigating change to the recycling and processing of waste. Cultural values and political systems often play a significant role in the initial activity, particularly mining and energy production. This way they have more control of the emissions and should be able to regulate emissions much easier. Use the case studies on pages 282 – 283 of 'Environmental Systems and Societies Course Companion' by Jill Rutherford for details.

5.3.3 Evaluate the costs and benefits to society of the World Health Organisation's ban on the use of pesticide DDT.

DDT was introduced by the World Health Organisation in 1955 in order to control lice and anopheles mosquito to reduce the spread of Typhus and Malaria. Malaria accounts for around 1 million deaths per year and 250 million people are diagnosed per year. Whereas typhus leads to influenza like symptoms and muscular pain although it is not fatal.

Between 1950-1980 DDT was extensively used in farming as a pesticide. Although it killed many insects which were beneficial to farming as a whole. As a result of the realisation that DDT was damaging the environment and farming systems between 1970-1980 the progressive banning of DDT in MEDCs started. DDT was internationally banned as a pesticide in many countries through the Stockholm Convention (1972) and restricted to control disease.

The toxic build up of DDT in the environment (bioaccumulation) and the gradual increase of DDT in the food chain as we rise through the trophic levels caused massive concern. Rachel Carson's 'Silent Spring' initially highlighted the concern that DDT was damaging the environment and in particular bird species. Research believed that DDT was the cause of an increased rate of asthma, diabetes, liver-, breast- and/or pancreatic cancer. Also an increased risk of early pregnancy loss or premature births and increased rate of male infertility (2007 South Africa)[4] to those who were in contact with DDT. However, in countries where DDT has been used more the reduction of Malaria death rates have been reduced, e.g. Ecuador 1993-1995 61% reduction in Malaria due to increased use of DDT. This obviously signifies the importance of the DDT ban for agricultural use but not for disease control despite the risks to health.

[4] Andrew Davis and Garrett Nagle, 'Environmental Systems and Societies', (Pearson Education Limited, New Jersey, 2010), p 230.

5.4.1 Outline the process of eutrophication.

'Eutrophication refers to the nutrient enrichment of streams, pond and groundwater. It is caused when increased levels of nitrogen or phosphorous are carried into water bodies. It can cause algal blooms, oxygen starvation and eventually the decline of biodiversity in aquatic ecosystems.'[5]

There are two types of eutrophication; natural and anthropogenic. Natural eutrophication results from the build in decaying organic material which is subsequently released into the water causing it to be nutrient rich. Anthropogenic eutrophication is the increase of nutrients through human activity such as mining or industrial effluence.

The process of eutrophication is highlighted by Rutherford as follows:

'The process of eutrophication

- Fertilizers wash into river or lake.
- High levels of phosphate in particular allow algae to grow faster (as phosphate is often limiting).
- Algal blooms form (mats of algae) that block out sunlight to plants beneath them, which die.
- More algae mean more food for the zooplankton and small animals that feed on them. They are food to fish which multiply as there is more food so there are then fewer zooplankton to eat algae.
- Algae die and are decomposed by aerobic bacteria.
- But there is not enough oxygen in the water so, soon, everything dies as food chains collapse.
- Oxygen levels fall lower. Dead organic material forms sediments on the lake or river bed and turbidity increases.
- Eventually, all life is gone and the sediment settles to leave a clear blue lake.'[6]

5.4.2 Evaluate the impact of eutrophication.

Eutrophication has some profound effects not only on ecosystems but on agricultural and subsequently economic systems too. The increase in the amount of algae, especially in excessive quantities, is obviously detrimental to aquatic ecosystems. This leads to loss in biodiversity. This may have an effect where the body of water is used for fishing industries. The release of phosphates and nitrogen into the water is out with their control. The creation of algae releases hydrogen sulphide (a foul smelling gas) which looks very unsightly.

The process of eutrophication causes the death of aquatic vegetation and aerobic organisms, this in turn, increases the water turbidity. In the initial stages of the process an increase in the amount of organisms decreases the amount of oxygen in the water. Therefore one can identify a high biochemical oxygen demand level and low biodiversity. This leads to anaerobic (oxygen-deficient) water.

5.4.3 Describe and evaluate pollution management strategies with respect to eutrophication.

Using figure 5 we can adapt our activities to use fertilisers and pesticides which have a reduced impact on the environment. Governmental agencies could ban or at least limit the use of chemicals containing phosphates and

[5] Andrew Davis and Garrett Nagle, 'Environmental Systems and Societies', (Pearson Education Limited, New Jersey, 2010), p 230.
[6] Jill Rutherford, 'Environmental Systems and Societies Course Companion', (Oxford University Press, Oxford, 2009), p. 287.

nitrates. Planting 'buffer zones between fields and watercourses to absorb excess nutrients'[7] would reduce the speed of the eutrophication process. Industrial and sewage waste could be diverted to areas where the problem is not as prevalent or treated prior to disposal. In order to combat the lack of oxygen in water, air can be pumped into the water to counteract the eutrophication process.

Finally, to remedy the situation organisations can 'dredge sediments with high nutrient levels' and 'remove excess weeds physically or by herbicides and algicides'[8]

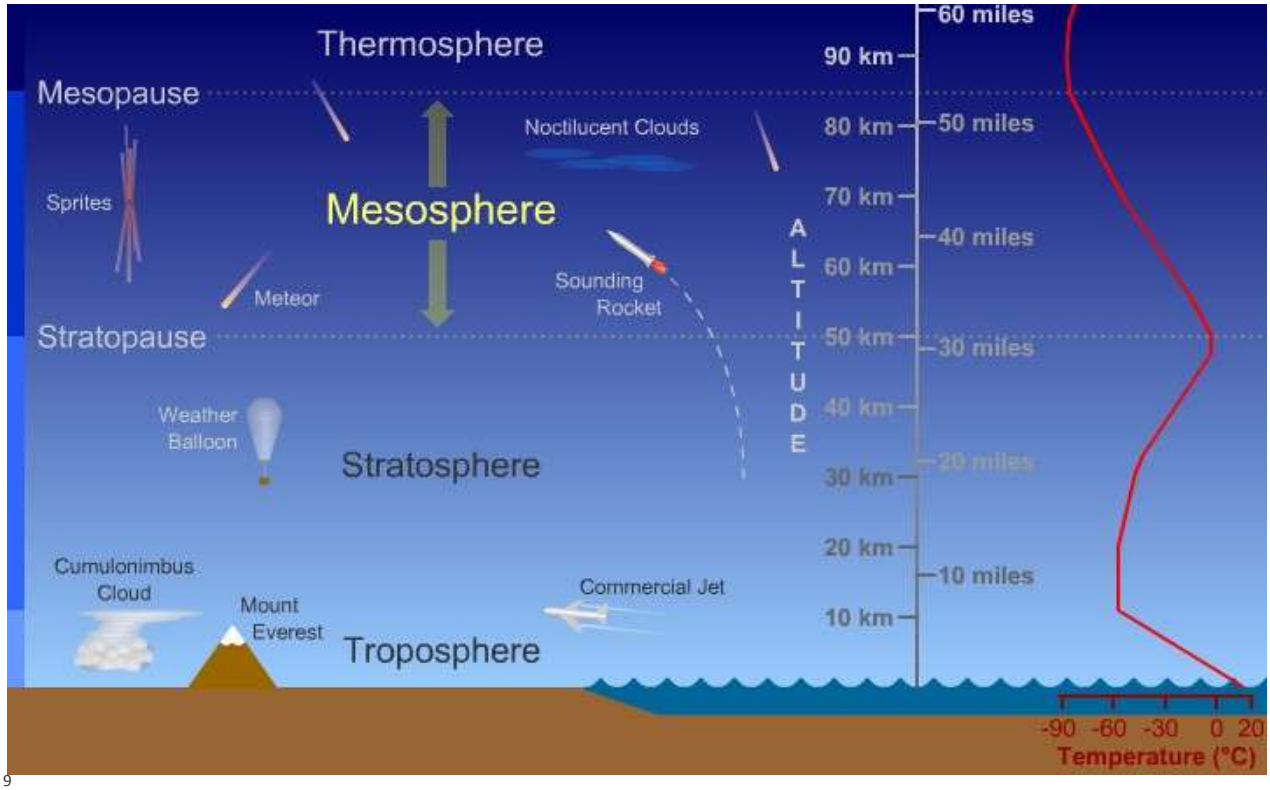
5.5.1 Outline the types of solid domestic waste.

Solid domestic waste is the waste produce in the home. Therefore everything we use, and dispose of is regarded as solid domestic waste.

5.5.2 Describe and evaluate pollution management strategies for solid domestic (municipal) waste.

The main method for Solid Domestic waste disposal are; landfill, incineration, recycling and composting. Each has advantages and disadvantages. These should be clearly written in your own notes.

5.6.1 Outline the overall structure and composition of the atmosphere.



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[7] Jill Rutherford, 'Environmental Systems and Societies Course Companion', (Oxford University Press, Oxford, 2009), p. 287.
[8] Jill Rutherford, 'Environmental Systems and Societies Course Companion', (Oxford University Press, Oxford, 2009), p. 287.
[9] 'Mesosphere', Windows to the Universe, National Earth Scientists Association, 2010. Web. 01.05.2012, <http://www.windows2universe.org/earth/Atmosphere/images/mesosphere_diagram_big.jpg>

'The normal components of dry air include nitrogen (78.1 per cent), oxygen (20.9 per cent), argon (0.93 per cent) and carbon dioxide (0.038 per cent). In addition there are other important gases such as helium, ozone, hydrogen and methane.' [10]

5.6.2 Describe the role of ozone in the absorption of ultraviolet radiation.

Ozone has a very insignificant percentage of the Earth's atmospheric composition however, it's role is of paramount importance to life on Earth. The function of ozone is to protect Earth from harmful UV rays by absorbing the sun's rays. Additionally, ozone traps terrestrial radiation within our atmosphere. Therefore ozone is considered to be a greenhouse gas.

5.6.3 Explain the interaction between ozone and halogenated organic gases.

Halogen – any group of five non-metallic elements with similar bonding. E.g Fluorine (F), Chlorine (Cl), Bromine (Br), Iodine (I) and Astatine (At). Halogens react with metals to produce salt.

The destructive role of Chlorofluorocarbons (CFCs) was discovered in 1974 – these destroyed stratospheric ozone.

Ozone depleting substances (ODS) include CFCs, HCFCs, Halogens and Methyl Bromide. These do not naturally occur. They are persistant in the atmosphere for around 10 years and rise up into the stratosphere from the trophosphere. They then react with UV and break down releasing halogen atoms. Therefore acting as catalysts for ozone depleting reactions.

5.6.4. State the effects of ultraviolet radiation on living tissues and biological productivity.

- UV-B is associated with eye damage, cataracts, sunburn and skin cancers.
- UV-B can also lead to a weakening of the human immune system leading to a decreased immune response to infectious agents.
- Some plants are UV sensitive, such plants produce a lower yield the following an increase in the exposure rate.
- Exposure in shallow water is higher than deeper water. So phytoplankton are exposed to UV-B due to their habitat. This causes problems in their development in early stages of life. Fish tend to inhabit deeper water so exposure is much lower.

5.6.5 Describe three methods of reducing the manufacture and release of ozone-depleting substances.

- In the USA – 1990 Clean Air Act aimed to recover and recycle ODS whilst servicing and disposing of Refridgerators and Air Conditioning equipment.
- German Scientists manufactured HCFCs as an alternative to CFCs. The greenfreeze brand which manufactured equipment which uses HCFCs was commissioned by Greenpeace.
- 1996 - Complete phasing out of Halogen and CFC use globally.
- 2005 – Phasing out of Methyl Bromide (MeBr) and replacing the pest control with less harmful alternatives.
- Governments try to impose strict quotas on Agricultural sectors to reduce the use of fertilisers and pesticides.

[10] Andrew Davis and Garrett Nagle, 'Environmental Systems and Societies', (Pearson Education Limited, New Jersey, 2010), p 242.

5.6.6 Describe and evaluate the role of national and international organisations in reducing the emissions of ozone-depleting substances.

The United Nations Environment Programme (UNEP) decided to implement a plan to protect the ozone layer during the Vienna Convention in 1985.[11] Whilst the finer details of the plan were put into practice after the Montreal Protocol in 1987. This was an international agreement on the reduction of the emissions of ozone-depleting substances.[12] The majority of countries which signed up to the agreement met their targets. However, China and India still produce larger quantities due to their rapid development. This international collaboration has been exceptionally successful. Although there are predictions that CFCs would not peak in the atmosphere until 2005. So the successes have still to be monitored frequently.

5.7.1 State the source and outline the effect of tropospheric ozone.

When fossil fuels are burned, two of the pollutants emitted are hydrocarbons (from unburned fuel) and nitrogen monoxide (nitric oxide, NO). Nitrogen monoxide reacts with oxygen to form nitrogen dioxide (NO_2), a brown gas that contributes to urban haze. Nitrogen dioxide can also absorb sunlight and break up to release oxygen atoms that combine with oxygen in the air to form ozone.

Ozone is a toxic gas and an oxidizing agent. It damages crops and forests, irritates eyes, can cause breathing difficulties in humans and may increase susceptibility to infection. It is highly reactive and can attack fabrics and rubber materials.

5.7.2 Outline the formation of photochemical smog.

'There is a special kind of smog called photochemical smog. It forms when photons of sunlight hit molecules of different kinds of pollutants in the atmosphere. The photons make chemical reactions happen. The pollution molecules turn into other kinds of harmful chemicals. That mixture of harmful chemicals is called photochemical smog.

The chemicals in photochemical smog include nitrogen oxides, Volatile Organic Compounds (VOCs), ozone, and PAN (peroxyacytyl nitrate). Nitrogen oxides mostly come from the engines of cars and trucks. VOCs are given off by paint, gasoline, and pesticides. Ozone is a form of oxygen that is harmful. PAN is a type of pollution that is made by chemical reactions between other kinds of pollution.'[13]

5.7.3 Describe and evaluate pollution management strategies for urban air pollution.

Once again if we use figure 5 to describe the management for urban air pollution we can identify many ways to reduce air pollution. Primarily, by changing our own habits walking, cycling or taking public transport more often should reduce the amount of emissions from vehicles. Alternatively, car sharing would reduce the amount of cars on the road. If the standards for car inspections increased then the amount of inefficient cars would be reduced. Other options include using cleaner sources of energy (which have different problems), installing catalytic convertors to cars which do not have them.

Secondly, governmental intervention can support the above initiatives or implement new regulations. For example

[11] Andrew Davis and Garrett Nagle, 'Environmental Systems and Societies', (Pearson Education Limited, New Jersey, 2010), p 247.
[12] Jill Rutherford, 'Environmental Systems and Societies Course Companion', (Oxford University Press, Oxford, 2009), p. 291.
[13] 'Photochemical Smog' , Windows to the Universe, National Earth Scientists Association, 2010. Web. 01.05.2012, < http://www.windows2universe.org/earth/Atmosphere/smog.html >

in Mexico City 'the government implemented a one-day-stop programme called Hoy no curcula (today my car doesn't move).'[14]

5.8.1 Outline the chemistry leading to the formation of acidified precipitations.

Dry deposition of Sulphur Dioxide and Nitrogen Oxides tend to occur near to the source. However, if the SO_2 and NO_x particles stay in the atmosphere for too long the chance of oxidisation occurring are greater. When this happens the Sulphuric acid (H_2SO_4) and Nitric acid (HNO_3) are formed and can be carried further resulting in wet deposition.

5.8.2 Describe three possible effects of acid deposition on soil, water and living organisms.

The acidic deposits from the oxidisation of SO_2 and NO_x result in significant impacts within some areas across the globe. Primarily deposits can cause soil acidification and results in leaching of Calcium (Ca), Magnesium (Mg) and Potassium (K) consequently reducing soil fertility and reducing pH. Seondly, damage to aquatic ecosystems through increased NO_x leads to increased risk of eutrophication. Finally, the damage to vegetation results in the acidity of the soil, mobilisation of heavy metals and ground-level ozone.

5.8.3 Explain why the effect of acid deposition is regional rather than global.

The variation in factors which cause acid rain to form make it difficult to show the distribution of acid rain. Naturally areas with minimal rain do not suffer as badly as areas which have high annual rainfalls. Areas which do suffer from acid rain have the following 'features in common:

- They are industrialised belts.
- They are downwind of dense concentrations of fossil-fuel power stations, smelters and large cities.
- Some of them are in different climate zones from the source areas – coniferous forests in cooler areas are more affected than temperate deciduous forests because the carbon dioxide in more soluble at lower temperatures, so colder areas have more acidic precipitation.
- They are upland areas with high rainfall.
- They contain lots of forest, streams and lakes.
- They have thin soils.' [15]

5.8.4 Describe and evaluate pollution management strategies for acid deposition.

Essentially reducing the consumption of fossil fuels and produce with a sulphur base will inevitably reduce the amount of oxidisation of SO_2 and NO_x. Therefore the practices applied to reducing air pollution tend also to reduce acid rain.

[14] Andrew Davis and Garrett Nagle, 'Environmental Systems and Societies', (Pearson Education Limited, New Jersey, 2010), p 252.
[15] Andrew Davis and Garrett Nagle, 'Environmental Systems and Societies', (Pearson Education Limited, New Jersey, 2010), p 255.

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'Photochemical Smog', Windows to the Universe, National Earth Scientists Association, 2010. Web. 01.05.2012, < http://www.windows2universe.org/earth/Atmosphere/smog.html >