



# DP IB Environmental Systems & Societies (ESS): SL



## Humans & Pollution

### Contents

- \* The Nature of Pollution
- \* Different Types of Pollution
- \* Effects of DDT on Animals
- \* Pollution Management



Your notes

## The Nature of Pollution

# The Nature of Pollution

- Pollution refers to the introduction of **harmful** substances or agents into the environment
  - These substances cannot be rendered harmless by the environment at a rate that is greater than the rate of their release
  - Pollution is harmful to organisms and can adversely affect normal environmental processes
  - It is a major source of contamination of the Earth and atmosphere, making ecosystems and habitats toxic and unpleasant
- Pollution can be:
  - **Natural** (e.g. ash from volcanic eruptions) or **human** in origin (e.g. microplastics)
  - **Intentional** (e.g. industrial waste discharged into rivers) or **unintentional** (e.g. accidental oil spills from oil tankers)
- Pollution results from the release of substances that degrade the sustainable quality of air, water, and soil, negatively impacting human quality of life

## Main Sources of Pollution

- Pollutants can come in various forms, including:
  - Organic or inorganic substances
  - Light, sound, or heat energy
  - Biological agents
  - Invasive species
- Human activities, including the combustion of fossil fuels, are the major sources of pollution
- Defining pollution levels is challenging and depends on the nature of the environment. For example:
  - Oil slicks pose a more significant threat in Arctic areas than in tropical ones due to slower decomposition rates in colder environments
  - Pollution levels that do not pose a risk to healthy adults can still affect young children, the elderly, or asthmatics

### The Major Sources of Pollution



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Source	Type of Pollution	Activity	Effects
<b>Energy Production</b>	Sulfur dioxide, nitrogen oxides, particulates	Burning fossil fuels	Acid rain, photochemical smog, respiratory problems
<b>Agriculture</b>	Pesticides, fertilisers, animal waste	Spraying crops with pesticides, spreading fertilisers on fields, runoff from manure and silage	<b>Bioaccumulation, biomagnification, eutrophication</b>
<b>Industry</b>	Toxic spills and leaks	Industrial accidents e.g. chemical factories	Release of toxic substances into the environment e.g. Minamata, Japan and Bhopal, India
<b>Domestic Waste</b>	Solid domestic waste, sewage, chemical waste	Waste dumped in landfill sites, waste from toilets, household cleaning products	Contamination of groundwater, release of methane, eutrophication, disease
<b>Transport</b>	Exhaust fumes from vehicles, runoff from roads	Driving, fuel and oil leaks channelled into surrounding land and watercourses by road drainage	Air pollution, respiratory problems, climate change, contamination of streams and soils
<b>Natural</b>	Volcanic ash, particulate pollution	Volcanic eruptions, wildfires, dust storms	Respiratory problems, acid rain, habitat destruction



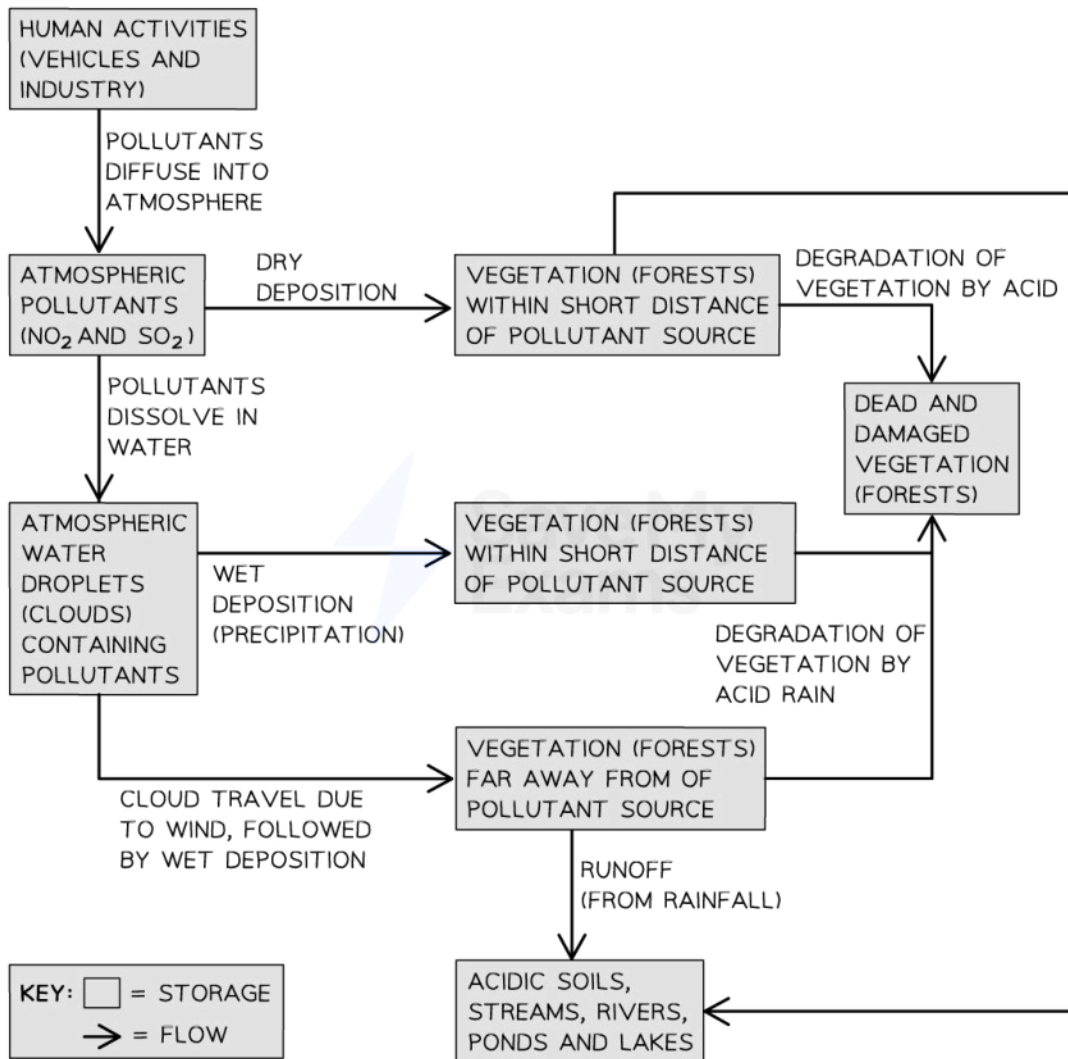
### Worked Example

Construct a systems diagram to show the impacts of air pollution from the pollutants nitrogen dioxide and sulfur dioxide, focussing on the formation of acid rain and its effects.

### Answer



Your notes



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### Examiner Tips and Tricks

Although natural pollution can exist (e.g. in the form of ash from volcanic eruptions or dust from dust storms) the syllabus refers to pollution as the introduction of pollutants to the environment through **human activity**, so you should focus on revising human sources of pollution for your exams.



Your notes

## Different Types of Pollution

### Types of Pollution

- Pollution can be classified based on different criteria, including:
  - Point source pollution vs non-point source pollution
  - Persistent pollution vs biodegradable pollution
  - Acute effects of pollution vs chronic effects of pollution
  - Primary pollution vs secondary pollution

#### Classifying Pollution

Point Source	Non-Point Source
Point source pollution comes from a single identifiable source, such as a factory or a sewage treatment plant	Non-point source pollution comes from dispersed sources, such as runoff from agricultural fields or urban areas

Persistent	Biodegradable
Persistent pollution does not degrade or break down quickly, such as heavy metals or certain pesticides	Biodegradable pollution can be broken down by natural processes, such as organic waste

Acute Effects	Chronic Effects
Acute effects of pollution occur in a high concentration for a short period of time, such as an oil spill	Chronic effects of pollution occur over a long period of time in lower concentrations, such as air pollution from vehicle emissions

Primary	Secondary

Primary pollutants are directly emitted into the environment, such as carbon monoxide or particulate matter from burning fossil fuels	Secondary pollutants form when primary pollutants undergo physical or chemical reactions in the atmosphere, such as the formation of ozone from nitrogen oxides and volatile organic compounds
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## Effects of DDT on Animals



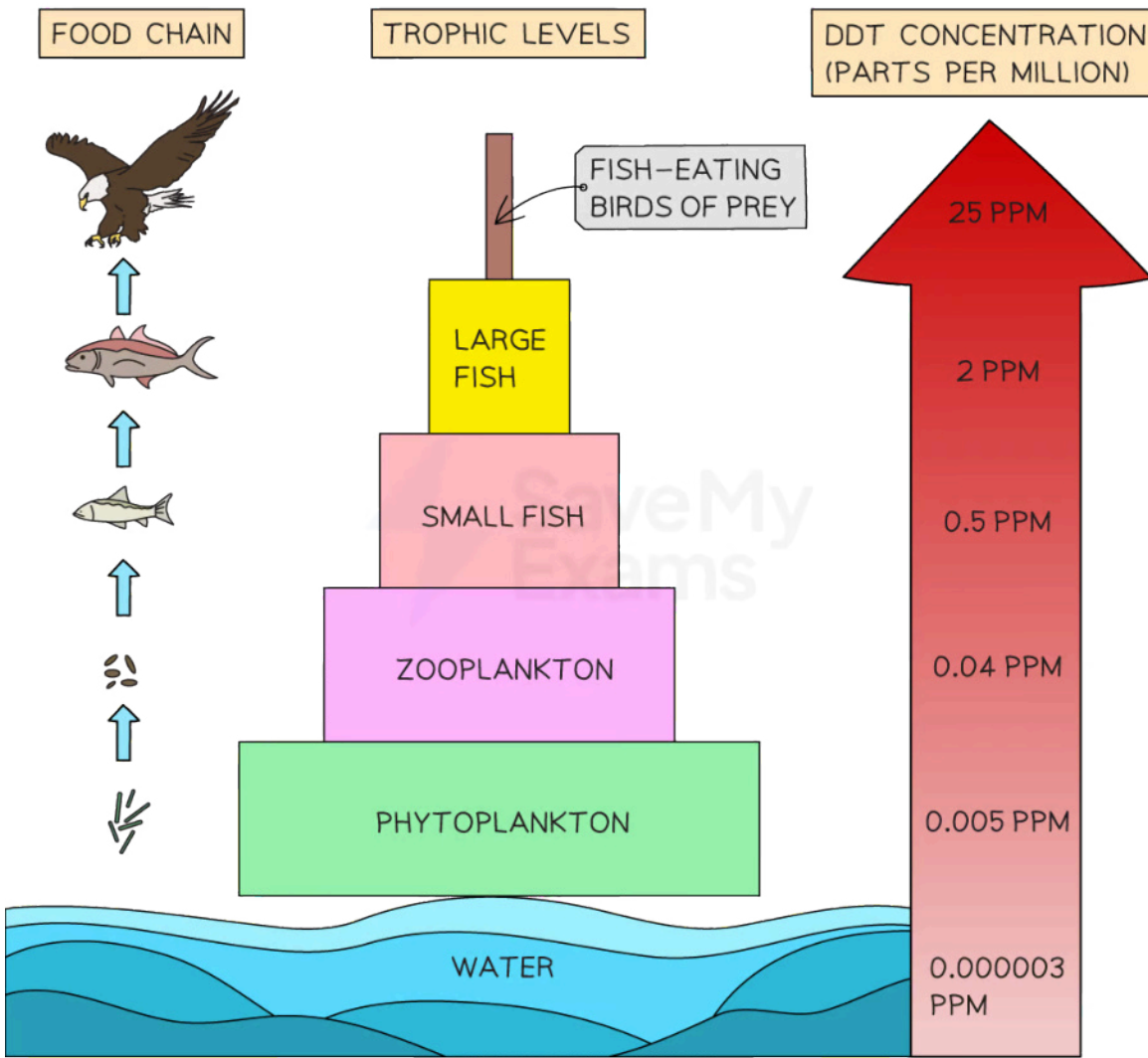
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# Effects of Using DDT

- Dichlorodiphenyltrichloroethane (DDT) was widely used as a **pesticide** from the 1940s until it was banned in many countries in the 1970s due to its environmental and health impacts
  - It is an example of a conflict between the utility of a 'pollutant' and its effect on the environment
- DDT is a powerful **insecticide**, so it was effective in controlling insect-borne human diseases, such as **malaria** (transmitted by mosquitoes) and **typhus** (transmitted by lice), particularly in tropical regions
- However, it was discovered that DDT was also causing harm to **non-target organisms**, such as birds and fish, through **biomagnification**
  - This means that top predators, such as eagles and falcons, were receiving **high doses** of DDT, which caused them to lay eggs with thin shells, resulting in reproductive failure
- The conflict between the utility of DDT in controlling diseases and its environmental impacts led to a ban on its use in many countries, including the United States
  - Its use has been restricted under the Stockholm Convention on Persistent Organic Pollutants
  - The use of DDT remains controversial, with some arguing that it should be allowed for use in **disease control** in areas where it is the most effective option, while others argue that the environmental impacts are too significant to justify its use
- DDT highlights the importance of considering the potential environmental impacts of any chemical or substance before it is used, particularly when it will be widely distributed into the environment
  - It also shows that sometimes a **trade-off** must be made between the benefits and the negative impacts of a substance



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*Through the process of biomagnification, the concentration of DDT in the tissues of organisms increases at successively higher trophic levels in a food chain*



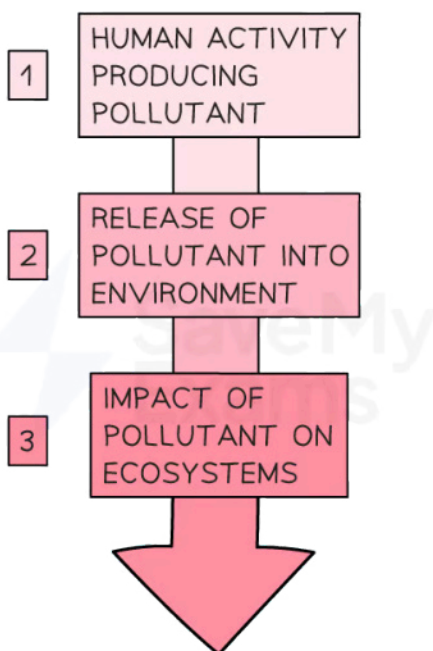


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## Pollution Management

# Pollution Management

- Human activities, such as farming and industrial practices, urbanisation, development of transport, and energy production, are the major causes of pollution
  - The amount of material released into the environment determines the **impact**
- There are three main stages leading to the impact of pollutants on the environment
  - Stage 1: Human activity producing the pollutant
  - Stage 2: Releasing of the pollutant into the environment
  - Stage 3: The impact of the pollutant on ecosystems



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### *The main stages leading to the impact of pollutants*

- There are three strategies for managing the impacts of pollution (which relate to the stages of pollutant impact shown above):
  - Changing human activity

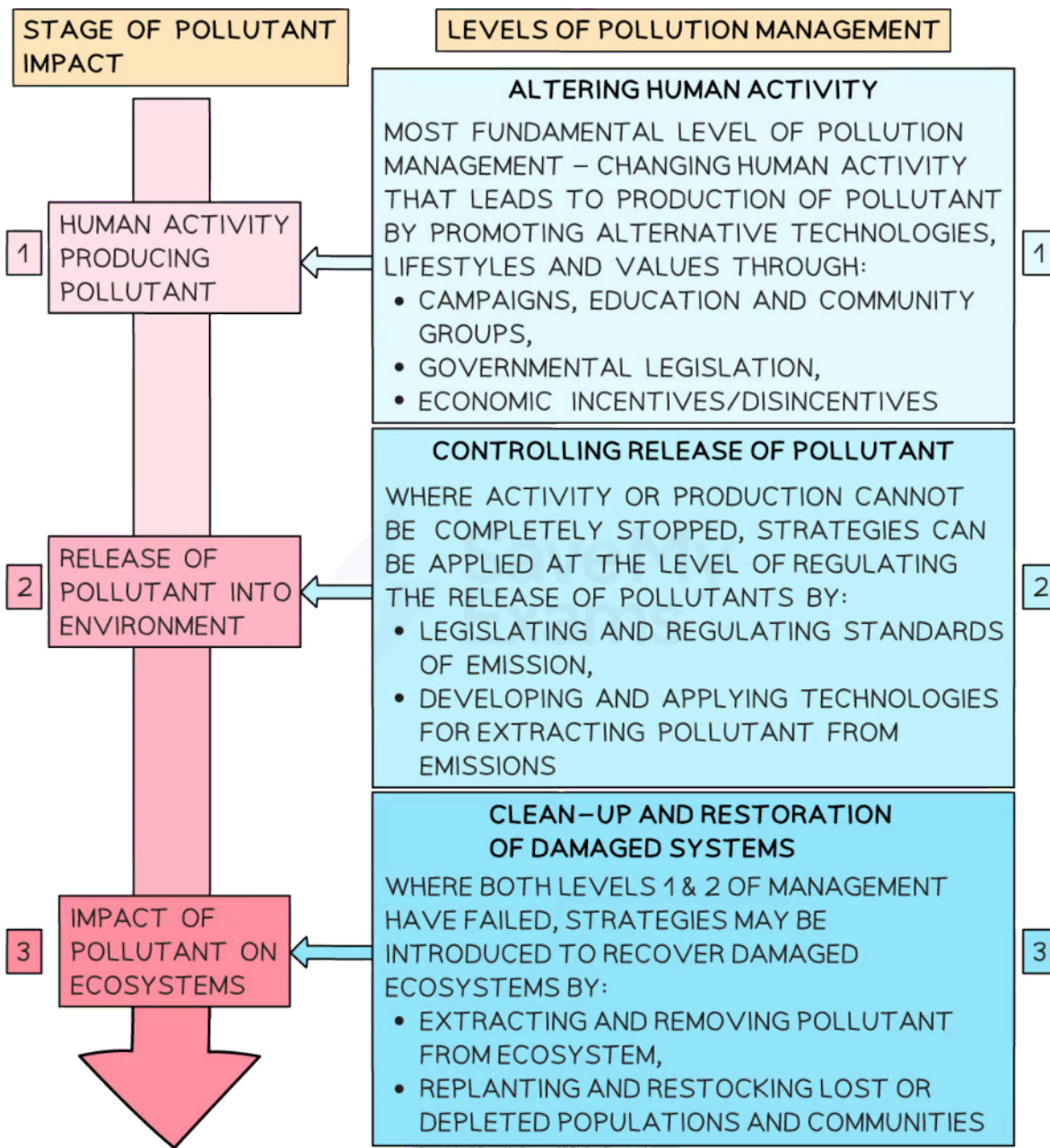
- Regulating and reducing quantities of pollutants released at the point of emission
- Cleaning up the pollutants and restoring the ecosystem after pollution has occurred
- **Modern technology** can reduce the impact of pollution by **managing** these three stages of pollutant impacts, for example:
  - Stage 1 could be managed by introducing electric and hybrid cars that use less fossil fuel
  - Stage 2 could be managed by fitting catalytic converters to car exhaust systems or adding scrubbers to industrial chimneys to remove toxic chemicals and allow for their reuse
  - Stage 3 could be managed by using synthetic membranes to capture chemical spills (e.g. mats designed to capture and hold hydrocarbons)



Your notes



Your notes



*The main strategies for managing the impacts of pollution*