STUDENT STUDY PROJECT

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Title of the project Pollution and Natural Resources

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Pollution and Natural Resources

Sources of pollution

Air pollution can be formed through both natural and man-made processes. Some examples of these are listed below:

Natural Sources

Some of the natural sources of air pollution are organic compounds from plants, sea salt, suspended soils and dusts (e.g. from the Sahara).

Other natural sources are released during catastrophes such as volcanic eruptions and forest fires. Large amounts of harmful gases and smoke are released which can increase background pollution levels for years - even in areas far away from the original source. Ozone is one of the most common natural air pollutants.

Man Made Sources

Transport - Roads and Rails

Vehicles like cars, vans, buses and Lorries run on petrol or diesel. When these fuels are burnt in the engine, pollutants are given out from the exhaust of the vehicles. This means road traffic is one of the biggest sources of air pollution in Scotland. Near busy roads are the main pollutants are nitrogen oxides, carbon monoxide and particulate matter. Larger vehicles with bigger engines release more pollution in to the atmosphere.

Trains cause a lot less pollution than the same journey made by car. However, trains still pollute the environment. Electric trains use the electricity which is generated at power stations. When these fuels are burnt, pollutants like nitrogen oxides, sulphur dioxide and particulate matter are released into the atmosphere.

Agriculture

Animals like cows and sheep release a massive amount of methane through belching and breaking wind.

Methane is a colorless gas which is produced in their stomachs when bacteria break down the food that they eat.

Across the whole world, livestock is the biggest source of methane. Methane is the second most important greenhouse gas which can cause climate change.

Industry and Power Generation

During the Industrial Revolution in the 1800s lots of factories, such as cotton factories, were built in Scotland near to the large towns and cities. Today the main industrial hubs tend to be in the countryside away from cities. Nitrogen dioxide and sulphur dioxide are the main pollutants associated with industrial processes.

To generate electricity fuels such as coal, gas or oil are burned at power stations. When these fuels are burnt they release nitrogen oxides, sulphur dioxide and particulate matter as well as greenhouse gases which can cause climate change.

Waste

In the UK, methane emitted from waste disposal is the largest emitter, with agriculture and livestock coming second.

Methane is released into the atmosphere when the waste that we throw away decomposes. Methane is the second most important greenhouse gas after carbon dioxide, which means that it also contributes towards climate change.

Impacts on me, my family, my friends

Air pollution at very high levels can have negative effects on everyone in the family from your little brother or sister to your Grandparents. It is estimated that you breathe 20,000 liters of air each day. This means the more polluted the air is, the more dangerous chemicals we breathe into our lungs.

Babies and small children are more likely to be affected by air pollution as they:

- breathe faster than adults
- have a developing lung and immune system

Children's lungs, immune system and brain continue to rapidly develop until approximately age 6, and the cell layer lining the inside of the respiratory tract is particularly permeable during this age period meaning pollution is easily absorbed. Compared to adults, children also have a larger lung surface area in relation to their body weight, and breathe 50% more air per kilogram of body weight.

Young adults will also be affected by poor air quality if they have any lung or heart conditions. Those living in cities with high exposure to air pollutants are at increased risk of developing asthma, pneumonia and other lower respiratory infections.

Parents and Grandparents can also be affected by air pollution. As people age, their bodies are less able to compensate for the effects of pollution. Poor air quality can aggravate any pre-existing health issues such as asthma and heart problems.

Ozone and Particulate Matter (PM) (especially smaller, fine particle pollution called PM 2.5) have the greatest potential to affect the health of older adults. Fine particle pollution have been linked to asthma attacks, heart attacks and the development of chronic bronchitis. Ozone, even at low levels, can exacerbate respiratory diseases.

How do we monitor air pollution?

Air pollution is monitored at certain sites around Scotland 24 hours a day. There are many different ways of sampling the air to check how polluted it is.

Ways to sample ambient air

There are 5 main methods of sampling air quality:

1. Passive Monitoring

- Diffusion tubes absorb a specific pollutant from the ambient air - no power supply is needed
- Diffusion tubes normally monitor for 2-4 weeks at a time
- The tubes must be sent to a laboratory for analysis to see how much pollution they have detected

2. Active (Semi Automatic) Sampling

- An analyzer pulls the ambient air through a filter for a set period of time e.g. one filter per day
- The filters are then collected and sent to a laboratory for analysis to see how much pollution they have detected

3. Automatic point monitoring

- Ambient air is pulled through an analyzer which recognizes the chosen gas and will calculate its concentration
- Automatic sites monitor pollutants 24hours a day
- Data is sent from the site directly to your computer which means it can be seen instantly

4. Photochemical and optical sensor systems

- These are portable monitoring tools that can continuously monitor a range of pollutants. The sensors are of low sensitivity and mostly suitable for identifying hotspots at roadsides and near point sources.
- Data can be downloaded to your computer and analyzed.

5. Remote optical/long-path monitoring

- This method of sampling detects pollution between a light source and a detector which are placed separately at a site
- Real time measurements can be taken with this type of sampling.
- Data can be sent from the analyzer directly to your computer which means it can be seen instantly

Monitoring site locations

Monitoring sites are classified according to the type of environment in which they are located. This will give a good indication of what pollutants are likely to be found here e.g. Nitrogen Dioxide if there is heavy traffic.

Typical monitoring location types are described in the table below.

Location	Description	Source Influences
Urban	A site within a town or city environment	Vehicle, commercial, space heating
Kerbside	A site sampling within 1m of the kerb of a busy road.	Local traffic

Location	Description	Source Influences
Roadside	A site sampling between 1m of the kerbside of a busy road and the back of the pavement. Typically this will be within 5m of the road, but could be up to 15m.	Local traffic
Suburban	A location type situated in a residential area on the outskirts of a town or city.	Traffic, commercial, space heating, regional transport, urban plume downwind of a city.
Urban Background	An urban location distanced from sources and therefore broadly representative of city-wide background conditions e.g. urban residential areas	Vehicle, commercial, space heating
Urban Centre	An urban location representative of typical population exposure in towns or city centres e.g. pedestrian precincts and shopping areas	Vehicle, commercial, space heating
Urban Industrial	An area where industrial sources make an important contribution to the total pollution burden. Intermediate. 20-30m from the kerb of a busy road.	Industrial, motor vehicles.
Rural	An open countryside location, in an area of low population density distanced as far as possible from roads, populated and industrial areas.	Regional long-range transport, urban plume.
Remote	A site in open country, located in an isolated rural area, experiencing regional background pollutant concentrations for much of the time.	Regional/hemispheric background.
Intermediate	20-30m from the kerb of a busy road	Vehicle, commercial, space heating.
Airport	Monitoring within the boundary of an airport perimeter.	Aircraft, vehicle, commercial, space heating.
Other	Any special source-orientated or location category covering monitoring undertaken in relation to specific emission sources.	May be power stations, car parks or tunnels

Health information

Poor air quality can have short and long term effects on people of all ages. The table below outlines the effects of different pollutants at very high levels.

Pollutant	Health effects at very high levels
Carbon Monoxide (CO)	Carbon Monoxide reduces the amount of oxygen carried around the body in red blood cells. The result is that vital organs, such as the brain, nervous tissues and the heart, do not receive enough oxygen to work properly. Children are particularly at risk because they are smaller and their bodies are still growing and developing. People with existing heart problems are also likely to be affected.
Nitrogen Dioxide (NO_2) Sulphur Dioxide (SO_2) Ozone (O_3)	These gases irritate the lining of the nose, airways and lungs. They increase the symptoms of those suffering from lung diseases and increase the likelihood of respiratory problems.
Particulate	Fine particles can cause a number of health problems as they are carried deep into the lungs.

CAUSES OF WATER POLLUTION

Thousands have lived without love, not one without water." Yet while we all know water is crucial for life, we trash it anyway. Some 80 percent of the world's wastewater is dumped—largely untreated—back into the environment, polluting rivers, lakes, and oceans.

This widespread problem of water pollution is jeopardizing our health. Unsafe water kills more people each year than war and all other forms of violence combined. Meanwhile, our drinkable water sources are finite: Less than 1 percent of the earths freshwater are actually accessible to us. Without action, the challenges will only increase by 2050, when global demand for freshwater is expected to be one-third greater than it is now.

Sip a glass of cool, clear water as you read this, and you may think water pollution is a problem. . . somewhere else. But while most Americans have access to safe drinking water, potentially harmful contaminants—from arsenic to copper to lead—have been found in the tap water of every single state in the nation.

Still, we're not hopeless against the threat to clean water. To better understand the problem and what we can do about it, here's an overview of what water pollution is, what causes it, and how we can protect ourselves.

Groundwater

When rain falls and seeps deep into the earth, filling the cracks, crevices, and porous spaces of an aquifer (basically an underground storehouse of water), it becomes groundwater—one of our least visible but most important natural resources. Nearly 40 percent of Americans rely on groundwater, pumped to the earth's surface, for drinking water. For some folks in rural areas, it's their only freshwater source. Groundwater gets polluted when contaminants—from pesticides and fertilizers to waste leached from landfills and septic systems—make their way into an aquifer, rendering it unsafe for human use. Ridding groundwater of contaminants can be difficult to impossible, as well as costly. Once polluted, an aquifer may be unusable for decades, or even thousands of years. Groundwater can also spread contamination far from the original polluting source as it seeps into streams, lakes, and oceans.

Surface water

Covering about 70 percent of the earth, surface water is what fills our oceans, lakes, rivers, and all those other blue bits on the world map. Surface water from freshwater sources (that is, from sources other than the ocean) accounts for more than 60 percent of the water delivered to American homes. But a significant pool of that water is in peril. According to the most recent surveys on national water quality from the U.S. Environmental Protection Agency, nearly half of our rivers and streams and more than one-third of our lakes are polluted and unfit for swimming, fishing, and drinking. Nutrient pollution, which includes nitrates and phosphates, is the leading type of contamination in these freshwater sources. While plants and animals need these nutrients to grow, they have become a major pollutant due to farm waste and fertilizer runoff. Municipal and industrial waste discharges contribute their fair share of toxins as well. There's also all the random junk that industry and individuals dump directly into waterways.

Ocean water

Eighty percent of ocean pollution (also called marine pollution) originates on land—whether along the coast or far inland. Contaminants such as chemicals, nutrients, and heavy metals are carried from farms, factories, and cities by streams and rivers into our bays and estuaries; from there they travel out to sea. Meanwhile, marine debris—particularly plastic—is blown in by the wind or washed in via storm drains and sewers. Our seas

are also sometimes spoiled by oil spills and leaks—big and small—and are consistently soaking up carbon pollution from the air. The ocean absorbs as much as a quarter of man-made carbon emissions.

Point source

When contamination originates from a single source, it's called point source pollution. Examples include wastewater (also called effluent) discharged legally or illegally by a manufacturer, oil refinery, or wastewater treatment facility, as well as contamination from leaking septic systems, chemical and oil spills, and illegal dumping. The EPA regulates point source pollution by establishing limits on what can be discharged by a facility directly into a body of water. While point source pollution originates from a specific place, it can affect miles of waterways and ocean.

Nonpoint source

Nonpoint source pollution is contamination derived from diffuse sources. These may include agricultural or storm water runoff or debris blown into waterways from land. **Nonpoint source pollution is** the leading cause of water pollution in U.S. waters, but it's difficult to regulate, since there's no single, identifiable culprit.

Tran boundary

It goes without saying that water pollution can't be contained by a line on a map. Tran boundary pollution is the result of contaminated water from one country spilling into the waters of another. Contamination can result from a disaster—like an oil spill—or the slow, downriver creep of industrial, agricultural, or municipal discharge.

Agricultural

Not only is the agricultural sector the biggest consumer of global freshwater resources, with farming and livestock production using about 70 percent of the earth's surface water supplies, but it's also a serious water polluter. Around the world, agriculture is the leading cause of water

degradation. In the United States, agricultural pollution is the top source of contamination in rivers and streams, the second-biggest source in wetlands, and the third main source in lakes. It's also a major contributor of contamination to estuaries and groundwater. Every time it rains, fertilizers, pesticides, and animal waste from farms and livestock operations wash nutrients and pathogens—such bacteria and viruses—into our waterways. Nutrient pollution, caused by excess nitrogen and phosphorus in water or air, is the number-one threat to water quality worldwide and can cause algal blooms, a toxic soup of blue-green algae that can be harmful to people and wildlife.

Sewage and wastewater

Used water is wastewater. It comes from our sinks, showers, and toilets (think sewage) and from commercial, industrial, and agricultural activities (think metals, solvents, and toxic sludge). The term also includes storm water runoff, which occurs when rainfall carries road salts, oil, grease, chemicals, and debris from impermeable surfaces into our waterways

More than 80 percent of the world's wastewater flows back into the environment without being treated or reused, according to the United Nations; in some least-developed countries, the figure tops 95 percent. In the United States, wastewater treatment facilities process about 34 billion gallons of wastewater per day. These facilities reduce the amount of pollutants such as pathogens, phosphorus, and nitrogen in sewage, as well as heavy metals and toxic chemicals in industrial waste, before discharging the treated waters back into waterways. That's when all goes well. But according to EPA estimates, our nation's aging and easily overwhelmed sewage treatment systems also release more than 850 billion gallons of untreated wastewater each year.

Oil pollution

Big spills may dominate headlines, but consumers account for the vast majority of oil pollution in our seas, including oil and gasoline that drips from millions of cars and trucks every day. Moreover, nearly half of the estimated 1 million tons of oil that makes its way into marine environments each year comes not from tanker spills but from land-based sources such as factories, farms, and cities. At sea, tanker spills account for about 10 percent of the oil in waters around the world, while regular operations of the shipping industry—through both legal and illegal discharges—contribute about one-third. Oil is also naturally released from under the ocean floor through fractures known as seeps.

Radioactive substances

Radioactive waste is any pollution that emits radiation beyond what is naturally released by the environment. It's generated by uranium mining, nuclear power plants, and the production and testing of military weapons, as well as by universities and hospitals that use radioactive materials for research and medicine. Radioactive waste can persist in the environment for thousands of years, making disposal a major challenge. Consider the decommissioned Hanford nuclear weapons production site in Washington, where the cleanup of 56 million gallons of radioactive waste is expected to cost more than $100 billion and last through 2060. Accidentally released or improperly disposed of contaminants threaten groundwater, surface water, and marine resources.

Effects of Water Pollution

On human health

To put it bluntly: Water pollution kills. In fact, it caused 1.8 million deaths in 2015, according to a study published in *The Lancet*. Contaminated water can also make you ill. Every year, unsafe water sickens about 1 billion people. And low-income communities are disproportionately at risk because their homes are often closest to the most polluting industries.

Waterborne pathogens, in the form of disease-causing bacteria and viruses from human and animal waste, are a major cause of illness from contaminated drinking water. Diseases spread by unsafe water include cholera, giardia, and typhoid. Even in wealthy nations, accidental or illegal releases from sewage treatment facilities, as well as runoff from farms and urban areas, contribute harmful pathogens to waterways. Thousands of people across the United States are sickened every year by Legionnaires' disease (a severe form of pneumonia contracted from water sources like cooling towers and piped water), with cases cropping up from California's Disneyland to Manhattan's Upper East Side.

Meanwhile, ocean acidification is making it tougher for shellfish and coral to survive. Though they absorb about a quarter of the carbon pollution created each year by burning fossil fuels, oceans are becoming more acidic. This process makes it harder for shellfish and other species to build shells and may impact the nervous systems of sharks, clownfish, and other marine life.