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Air pollution poses a significant threat to human health and the environment. The main sources of air pollution include automobile emissions, industrial processes, fossil-fuel combustion, and natural events such as dust storms and volcanic eruptions. Nitrogen oxides, sulfur dioxide, carbon monoxide, ozone, and particulate matter are among the most common pollutants found in the air.These pollutants can cause various health problems, including respiratory issues, cardiovascular diseases, and even cancer. Exposure to high levels of air pollution has been linked to increased mortality rates, particularly in urban areas. Indoor air pollution is also a significant concern, as it can be caused by poorly ventilated homes, cooking fuels, and other household activities.The impact of air pollution on the environment is equally alarming. It contributes to acid rain, which damages foliage, buildings, and monuments. Air pollution also exacerbates climate change by releasing greenhouse gases into the atmosphere. To measure air pollution levels, governments use various methods, including monitoring stations and satellite imaging.Individuals can play a crucial role in reducing air pollution by making lifestyle changes, such as using public transportation, carpooling, or driving electric vehicles. Governments can implement policies to improve air quality, such as increasing fuel efficiency standards, promoting renewable energy sources, and enforcing stricter emissions regulations. Additionally, individuals can support organizations working towards clean air initiatives.Air Pollution: Causes, Effects, and Control MeasuresAir pollution is a significant environmental issue that can be controlled through various measures. While some sources of pollution cannot be eliminated, process control equipment and other technologies can minimize their impact. A key way to reduce air pollution is by diluting pollutants in the air. However, trees and forests play an essential role in cleaning the air, making them a crucial component of any strategy to combat pollution.The primary cause of air pollution is the burning of fossil fuels, releasing gases such as sulphur dioxide and carbon monoxide into the atmosphere. These gases can contribute to global warming by altering the composition of the atmosphere and increasing the Earth's temperature.Acid rain forms when pollutants like nitrogen oxides and sulphur oxides mix with rainwater, leading to a decrease in air quality. Deforestation is another significant issue, as it removes trees that absorb carbon dioxide from the atmosphere, contributing to increased CO2 levels and air pollution.Recent studies have shown a correlation between air pollution and COVID-19 mortality rates. Air pollution may exacerbate respiratory issues and compromise lung function, making individuals more vulnerable to severe illness. Preliminary research suggests that particulate matter (PM) could potentially transmit COVID-19, although the exact mechanism is still unknown.During lockdowns, countries have seen a significant reduction in air pollution levels, which has helped prevent premature deaths. These findings highlight the importance of addressing air pollution and its impact on public health, particularly during times of crisis like the COVID-19 pandemic.Air Pollution: A Major Cause of Death and a Threat to HumanityAir pollution poses a significant threat to human health, the environment, and climate. Concentrations of sulfur dioxide and nitrogen oxides can lead to acid rain, which has devastating environmental impacts. The presence of air pollutants like greenhouse gases (carbon dioxide and methane) contributes to global warming and climate change by trapping heat in the Earths atmosphere.Air pollution has severe economic implications, including increased healthcare expenditures, reduced productivity, and property damage. Moreover, it reduces agricultural productivity by damaging the soil, ultimately leading to acid rain that can damage forests, lakes, and buildings. The consequences of air pollution are multifaceted and far-reaching.###ARTICLEAir pollution is a major concern for public health and environmental sustainability. It encompasses various types of pollutants that can harm living beings and cause damage to climate and materials.Volatile Organic Compounds (VOCs) are organic compounds that vaporize easily, such as gasoline, benzene, toluene, and xylene. These gases are emitted as fumes from solvents, cleaning supplies, paints, glues, automobile exhaust, and industrial operations. Prolonged exposure to VOCs can cause chromosomal damage, affect the reproductive system, and increase the risk of cancer.Ozone (O3) is a pale blue gas that plays a crucial role in protecting the environment. However, it can also be detrimental to human health when present in high concentrations. Ozone is formed by the reaction of sunlight with air containing hydrocarbons and nitrogen oxides emitted by car engines and industrial operations. It damages lung function, causes respiratory illnesses, and can lead to premature death.Particulate Matter (PM 2.5 and PM 10) refers to solid or liquid particles suspended in the air. These particles must be less than 0.1 mm wide to remain airborne, but they can still cause significant harm. Road traffic emissions, industrial combustion plants, construction activities, residential combustion, wind-blown dust, and other sources contribute to PM levels.Air pollutants not included in NAAQS (National Ambient Air Quality Standard) include carbon dioxide, chloro-fluoro-carbons, noise, and indoor air pollution. Carbon dioxide contributes to the greenhouse effect and climate change, while chloro-fluoro-carbons deplete stratospheric ozone. Noise from factories, industries, transportation, and other sources can cause auditory problems and speech interference.Indoor air pollution is a significant concern for over 3 billion people worldwide who use solid fuels for cooking. This practice releases pollutants like fine particles and carbon monoxide, posing health hazards to women and young children. According to the World Health Organization (WHO), indoor air pollution claims 4.3 million lives each year.Smog is a type of air pollution formed from vehicular emissions and industrial fumes reacting with sunlight in the atmosphere. It contains ozone as a primary component and can cause respiratory problems, cardiovascular issues, and other health concerns.Fly ash, produced by thermal power plants, pollutes the air and water while affecting vegetation through direct deposition on leaf surfaces or soil. It is used to make bricks and as a landfill material, with increased strength and durability due to its chemical properties.Air pollution is defined by the World Health Organization (WHO) as a scenario where ambient air contains harmful materials in concentrations detrimental to human health and the environment. This phenomenon directly or indirectly affects various aspects of our lives, including human health, physiology, plant growth, and ecosystem processes. The presence of pollutants can be categorized into two types: primary and secondary.Primary pollutants are emitted directly into the atmosphere from sources such as vehicles, industrial processes, and natural events. These pollutants have severe effects on human health and the environment. Examples include carbon monoxide (CO), sulfur dioxide (SO2), nitrogen oxides (NOx), volatile organic compounds (VOCs), and particulate matter (PM). On the other hand, secondary pollutants are formed through chemical reactions between primary pollutants and atmospheric compounds.The combustion of fossil fuels is a significant contributor to air pollution. This includes energy production, transportation, and industrial processes. Moreover, industrial activities such as manufacturing, mining, and refining release pollutants into the atmosphere. Agricultural practices like livestock farming, crop burning, and fertilizer use can also contribute to air pollution.Furthermore, construction activities and natural sources like volcanic eruptions, wildfires, and biological processes are significant contributors to air pollution. Household activities like burning solid fuels for cooking and heating in developing countries can also lead to indoor air pollution. The effects of air pollution on human health, the environment, and plants and animals are multifaceted. It can cause respiratory problems such as asthma and bronchitis due to the inhalation of pollutants like particulate matter and nitrogen dioxide. Air pollution can also disrupt ecosystems, vegetation, and wildlife, leading to declines in biodiversity.In addition, certain air pollutants contribute to climate change by trapping heat in the Earth's atmosphere, resulting in rising temperatures, melting glaciers, and extreme weather events. Moreover, air pollution harms domestic animals through chronic poisoning from contaminated forage and causes bone and teeth abnormalities in animals due to fluoride toxicity.To mitigate these effects, regulatory measures such as laws and regulations can be implemented to limit emissions from industrial facilities, vehicles, and other sources. Public awareness campaigns and technological advancements are also crucial in controlling air pollution.Air Pollution Threatens Health and Environmentstandards pollution permits and penalties for non-compliance.Technological Solutions Developing and implementing cleaner technologies such as catalytic converters in vehicles scrubbers in industrial plants and smokestack filters can help reduce emissions of harmful pollutants.Alternative Energy Sources Transitioning to renewable energy sources like solar wind and hydroelectric power can decrease reliance on fossil fuels which are major contributors to air pollution.Improving Transportation Encouraging the use of public transportation carpooling and electric vehicles can reduce emissions from automobiles Additionally investing in infrastructure for biking and walking can help decrease vehicle emissions.Promoting Energy Efficiency Implementing energy efficiency measures in buildings appliances and industrial processes can reduce energy consumption and consequently emissions.Public Awareness and Education Raising awareness about the health and environmental impacts of air pollution through education campaigns can encourage individuals and businesses to take action to reduce their emissions.7.0Air Quality Index The Air Quality Index is a numerical scale used to communicate the quality of air in a specific area at a given time It provides a simple way to understand how clean or polluted the air is and what potential health effects might be associated with it The AQI typically measures several common air pollutants includingGround-level ozone Particulate matter Carbon monoxide Sulfur dioxide Nitrogen dioxideEach pollutant has its own AQI scale and the overall AQI value is determined by the pollutant with the highest concentration The AQI scale usually ranges from 0 to 500 with lower values indicating better air quality and higher values indicating poorer air quality.The AQI is often divided into categories such as Good Moderate Unhealthy for Sensitive Groups Unhealthy Very Unhealthy and Hazardous to help people understand the health implications associated with different levels of pollution.Government agencies and environmental organizations monitor air quality and provide real-time AQI updates to the public through websites apps and other communication channels NewsFor YouSearchBlindspotLocal Greenhouse gases are a key factor in the Earths changing climate.Photograph by Peter Essick Nat Geo Image CollectionDespite decades of progress the air quality in the United States has started to decline over the past few years according to data in the Environmental Protection Agencies 2024 Our Nations Air report.The agency reported a nearly 38 percent increase in unhealthy air days nationwide rising from 596 days in 2022 to 822 days in 2023.The American Lung Associations 2024 State of the Air report shows people in the U.S. experienced the most days with very unhealthy and hazardous air quality due to particle pollution in 25 years.The report also found that 131 million people are living in areas with unhealthy levels of air pollution.These reasons for the recent decline in air quality remain unclear says the agency but may be related to high numbers of wildfires a warming climate and increasing human consumption patterns driven by population growth and a strong economy.The long-term outlook also remains unclear even as politicians debate air pollution standards.Air pollution is a mix of particles and gases that can reach harmful concentrations both outside and indoors Its effects can range from higher disease risks to rising temperatures.Soot smoke mold pollen methane and carbon dioxide are just a few examples of common pollutants.In the U.S. one measure of outdoor air pollution is the Air Quality Index or AQI which rates air conditions across the country based on concentrations of five major pollutants ground-level ozone particle pollution carbon monoxide sulfur dioxide and nitrogen dioxide.Some of those also contribute to indoor air pollution along with radon cigarette smoke volatile organic compounds VOCs formaldehyde asbestos and other substances.The Scherer power plant in Juliet Georgia is the largest coal-fired power plant in the U.S. It burns 34,000 tons of coal daily pumping over 25 million tons of carbon dioxide into the atmosphere each year.Photograph by Robb Kendrick Nat Geo Image CollectionThe western U.S. has been locked in a drought for years The dry hot weather has increased the intensity and destructiveness of forest fires.Photograph by Paul Nicklen Nat Geo Image CollectionPoor air quality kills people Worldwide bad outdoor air caused an estimated 4.2 million premature deaths in 2016 about 90 percent of them in low- and middle-income countries according to the World Health Organization Indoor smoke is an ongoing health threat to the 3 billion people who cook and heat their homes by burning biomass kerosene and coal.Air pollution has been linked to higher rates of cancer heart disease stroke and respiratory diseases such as asthma In the U.S. nearly 134 million people over 40 percent of the population are at risk of disease and premature death because of air pollution according to American Lung Association estimates.While those effects emerge from long-term exposure air pollution can also cause short-term problems such as sneezing and coughing eye irritation headaches and dizziness.Particulate matter smaller than 10 micrometers classified as PM10 and the even smaller PM2.5 pose higher health risks because they can be breathed deeply into the lungs and may cross into the bloodstream.Air pollutants cause less-direct health effects when they contribute to climate change Heat waves extreme weather food supply disruptions and other effects related to increased greenhouse gases can have negative impacts on human health.The U.S. Fourth National Climate Assessment released in 2018 noted for example that a changing climate could expose more people in North America to ticks that carry Lyme disease and mosquitoes that transmit viruses such as West Nile chikungunya dengue and Zika.An iceberg melts in the waters off Antarctica Climate change has accelerated the rate of ice loss across the continent.Photograph by Paul Nicklen Nat Geo Image CollectionAs sea levels rise salty ocean waters encroach into Floridas Everglades Native plantspollution from human activites like cars & planes is bad for environment because it traps heat & contributes to climate change humans have been emitting a lot of carbon dioxide which has raised levels higher than they were hundreds of thousands years ago other greenhouse gases include methane, chlorofluorocarbons & sulfur dioxide these pollutants can also have direct effects on the environment like changing or depleting nutrients in soil & waterways, harming forests & crops, and damaging cultural icons like monuments & statues countries around the world are tackling various forms of air pollution china is making strides in cleaning up smog-choked skies from years of rapid industrial expansion california has been a leader in setting emissions standards aimed at improving air quality efforts aim to bring cleaner cooking options to places where hazardous cookstoves are prevalent people can safeguard against indoor air pollution by increasing ventilation, testing for radon gas, using air purifiers, running kitchen & bathroom exhaust fans, and avoiding smoking on a larger scale, governments are making commitments to limit emissions of carbon dioxide & other greenhouse gases the paris agreement seeks to combat climate change on a global scale the kigali amendment bans heat-trapping hydrofluorocarbons in addition to chlorofluorocarbons air pollution is defined as the contamination of air due to the presence of air pollutants that are harmful to living organisms, and human beings different types of air pollutants include particulates, carbon monoxide, nitrogen oxide, sulfur oxide & smog some causes of air pollution include burning fossil fuels, emissions from motor vehicles, agricultural activities, factories & industries, mining activities, domestic sources like cooking, smoking, and household cleaning products.Air pollutants in the environment are hazardous to living organisms and human beings. These pollutants can be in solid, liquid, or gaseous form and cause harm at high concentrations. Air pollution is caused by various factors like burning fossil fuels, industrial activities, mining, domestic sources, and agricultural practices.The effects of air pollution are severe and far-reaching, impacting health, the environment, and the economy. Health-wise, it can lead to respiratory infections, heart disease, lung cancer, breathing difficulties, wheezing, coughing, asthma, and aggravation of existing conditions. Environmentally, it results in acid rain, decrease in ozone layers, and harm to trees, plants, animals, and human skin.Economically, air pollution hampers agricultural crop yields, forest production, and business operations dependent on natural resources. To mitigate this issue, prevention is key, and various control measures can be implemented at both community and individual levels.Community-level interventions include introducing green energy sources like wind and solar power, promoting renewable energy, and enforcing the polluter-pays principle. Individuals can contribute by using public transport, conserving energy, reducing, reusing, and recycling waste. By adopting these measures, we can minimize air pollution and its devastating effects on our environment, health, and economy.Air pollution is a significant contributor to greenhouse gas emissions that cause global warming. However, it also has a local impact on air quality. The World Bank estimates that air pollution costs the world economy over $8 trillion per year, resulting in around 7-8 million deaths annually. Air pollution poses serious health risks, including stroke, heart disease, chronic obstructive pulmonary disease (COPD), asthma, and lung cancer.Particulate matter is particularly deadly, affecting both indoor and outdoor air quality. Ozone can damage crops, while acid rain affects forests. The 1956 Clean Air Act in Britain and the 1963 US Clean Air Act have been effective in reducing air pollution. However, international efforts on climate change have had mixed results.Industries such as power generation, oil and gas production, manufacturing, and construction contribute to air pollution. Lignite and coal are major sources of pollution, followed by oil and fossil gas. Methane leaks from these industries are common. Other polluting industries include agricultural emissions and waste management.Road vehicles produce significant amounts of nitrogen dioxide and other pollutants, contributing to climate change. Electric vehicles produce no tailpipe emissions but still emit non-exhaust pollutants. Vehicles with diesel engines produce about half of their emissions from exhaust gases, while the remaining half comes from non-exhaust sources.Controlled burning of fields, e-waste processing, and agricultural emissions contribute to air pollution. Open dumps in low-income countries can promote microbial growth, polluting water and air. Landfills also produce methane. Globally, a quarter of solid waste is not collected or disposed of properly.Household air pollution from burning polluting fuels such as firewood and coal causes harmful air quality, affecting 2.3 billion people worldwide. Kerosine and gas stoves contribute to indoor air pollution, while toasters and heating systems release pollutants into the air.particulates produce particle pollution,[34] vegetation emit gases that contribute to ozone formation and particle pollution. This is especially true in warmer climates and during the growth season.[35] These gases react with human pollution sources to produce a seasonal haze.[36] Black gum, poplar, oak and willow emit gases that can raise ozone levels up to eight times more than low-impact tree species.[37] Wildfires, which have become more severe and more common due to climate change, release fine particles. They are a major source of air pollution.[38] Major pollutants, their sources and effects: (1) greenhouse gases, (2) particulate pollution, (3) ozone-depleting gases, (4) acid rain, (5) ground-level ozone, (6) nitrogen oxides Air pollutants can be tiny solid or liquid particles dispersed in the air (called aerosols), or gases.[39] Pollutants are classified as primary or secondary. Primary pollutants are produced directly by a source and remain in the same chemical form after they have been emitted into the atmosphere. Examples include carbon monoxide gas from car exhausts, and sulfur dioxide from factories. Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react with each other or with other parts of the atmosphere. Ground-level ozone is one example of a secondary pollutant. Some pollutants may be both primary and secondary: they are both emitted directly and formed from other primary pollutants.[40] Ammonia (NH3) is emitted mainly by overuse of synthetic nitrogen fertilisers on farmland, and from manure and urine from livestock.[41] At typical concentrations in the air, it is not harmful to health directly. However, ammonia can react with other pollutants in the air to form ammonium sulfate or nitrate salts, contributing to particulate matter pollution. Furthermore, when ammonia is deposited onto the soil, it can harm ecosystems via eutrophication.[42] Carbon dioxide (CO2) is mainly emitted by the burning of fossil fuels.[43] CO2 is sometimes called an air pollutant, because it is the main greenhouse gas responsible for climate change.[44][45] Although the World Health Organization recognizes CO2 as a climate pollutant, it does not include the gas in its Air Quality Guidelines or set recommended targets for it.[46] This question of terminology has practical consequences, for example, in determining whether the U.S. Clean Air Act (which is designed to improve air quality) is deemed to regulate CO2 emissions. The Inflation Reduction Act of 2022 amended the Clean Air Act to define CO2 from fossil fuel burning explicitly as an air pollutant.[47] Carbon monoxide (CO) is a colorless, odorless, toxic gas.[48] It is a product of combustion of fuel such as natural gas, coal or wood. In the past, emissions from vehicles were the main source of CO, but modern vehicles do not emit much CO. Now, wildfires and bonfires are the main source of outdoors CO.[49] Indoors, CO is a larger problem and mainly comes from cooking and heating.[50] Leaves damaged by exposure to ozone Ground-level ozone (O3) is mostly created when NOx and volatile organic compounds mix in the presence of sunlight. It can also be formed from carbon monoxide or methane.[51] Due to the influence of temperature and sunlight on this reaction, high ozone levels are most common on hot summer afternoons.[52] It can be harmful to human health, but also to some materials, forests, plants and crops. It can react with other compounds in the air to form photochemical smog.[53] Smog is a particular problem in big cities where it cannot easily be transported away by wind, for instance cities built in valleys surrounded by mountains.[54] When ground-level ozone is produced, it can linger in the air for days or weeks, and therefore be transported far from where it was first formed.[51] A NASA video on satellite measurement of nitrogen oxides, showing declining levels due to regulation. However, some regions did see rising levels of NO2 pollution, for instance those with fracking or civil unrest. Nitrogen oxides (NOx), particularly nitrous oxide (NO), are mostly created by the burning of fossil fuels, and in lesser amounts by lightning. Nitrogen dioxide (NO2) is formed from NO in a reaction with other atmospheric gases.[55][56] NO and NO2 can form acid rain, can form into a haze, and can cause nutrient pollution in water.[57] NO2 is a reddish-brown toxic gas with a strong odor, whereas NO is odorless and colorless.[58] Particulate matter (PM), also known as particle pollution, includes all airborne substances that are not gases.[7][59] It is a mix of microscopic solid particles or droplets suspended in a gas.[60] They consist of a large variety of materials and chemical compounds including toxic substances, and they vary strongly in size.[7] Coarse PM (PM10) is 10 micrometer (m) or smaller, fine PM (PM2.5) is smaller than 2.5 m, and ultrafine particles are 0.1 m or smaller.[61] Smaller particles pose more risk to health, as they can reach the bloodstream.[59][61] Sea spray, wildfires, volcanoes and dust storms are the main natural sources of PM, while the burning of biomass and fossil fuels, as well as road emissions and dust resuspension are the main human sources. Human PM is usually finer than natural PM.[62] A definitive link between fine particulate pollution and higher death rates in urban areas was established by the Harvard Six Cities study, published in 1993.[63] Particulate matter can have a cooling effect locally on the climate, as it reflects sunlight away from Earth's surface.[64] Sulfur dioxide (SO2), an acidic and corrosive gas, is produced mostly by burning crude oil and coal. These fossil fuels often contain sulfur compounds, and their combustion generates sulfur dioxide.[65] In Europe and North America, SO2 is mostly found in areas with significant shipping and industry, as road traffic fuels are regulated.[66] Smaller amounts of SO2 are released from smelting and volcanoes.[67] High concentrations of SO2 in the air generally also lead to the formation of other sulfur oxides (SOx). SOx can react with other compounds in the atmosphere to form small particles and contribute to particulate matter pollution. At high concentrations, gaseous SOx can harm plants by damaging leafs and decreasing growth.[67] Further oxidation of SO2, mostly taking place in cloudsforms sulfuric acid, which is one of the components of acid rain.[68] Volatile organic compounds are a class of carbon-based chemicals that exist as gases at room temperature, found both indoors and outdoors.[69] They can cause photochemical smog and form aerosols impacting climate. The group includes methane, acetone and toluene. Some can cause cancer, such as butadiene and benzene,[70] with benzene being released from cigarette smoking. Methane is a greenhouse gas and the second-largest driver of global warming. Other VOCs contribute to climate warming because they help form ground-level ozone, a greenhouse gas.[71] Some heavy metals can be bad for health. For instance, lead exposure can lead to learning disabilities in children. In the atmosphere, they can exist in different states, such as particles or gases. One of the forms of chromium can cause cancer. Mercury is harmful both as an element and in an organic compound. In the atmosphere, it comes mostly from cement production, coal burning and incinerators.[72] Persistent organic pollutants are organic compounds that are resistant to environmental degradation. So they persist in the environment, are capable of long-range transmission, bioaccumulate in humans and animals and biomagnify in food chains.[73] The Stockholm Convention on Persistent Organic Pollutants identified pesticides and other POPs of concern. These include dioxins and furans which are created by waste combustion. POPs are usually either semi-volatile or non-volatile. The harmful effects of the pesticide DDT, a POP, was popularised by Rachel Carson's 1962 book Silent Spring.[74] PFASs and polycyclic aromatic hydrocarbons are other examples of POPs.[75] Chlorofluorocarbons are a group of compounds which harm the ozone layer. They were widely used in aerosol sprays, in refrigerants and in fire suppression. Due to their chemical stability, CFCs persist in the atmosphere and eventually reach the stratosphere (the upper atmosphere).[76] There, they break down under the impact of UV light, which releases chlorine. This in turn reacts with ozone, destroying it. As the ozone layer blocks harmful UV radiation from reaching the Earth's surface, its depletion leads to health risks such as skin ageing and skin cancer.[77] PM2.5 Levels Across the World's 5 Most Populated Nations in 2019Exposure to air pollution varies widely across the world and across groups. Children, for example, are more exposed because they breathe more rapidly than adults and closer to the ground, where pollution from vehicle exhaust and dust is more concentrated.[78] Similarly, people engaging in strenuous exercise inhale more pollutants than those at rest.[80] On the other hand, people can reduce their exposure by wearing high-quality face masks or by using air purifiers.[81] Share of the population exposed to air pollution levels above WHO guidelines, 2017For some pollutants, low exposure can be seen as safe, whereas other pollutants have negative health effects even at low levels.[82] As evidence has grown that even very low levels of air pollutants hurt human health, the WHO halved its recommended safe limit for particulate matter from 10 g/m3 to 5 g/m3 in 2021. Under the new guideline, nearly the entire global population97%is classified as exposed to unsafe levels of PM2.5.[83] The new limit for nitrogen dioxide became 75% lower.[84] For all pollutants together, the WHO concluded that 99% of the world population is exposed to harmful air pollution.[85] For some pollutants such as black carbon, traffic related exposures may dominate total exposure despite short exposure times, since high concentrations coincide with proximity to major roads or participation in (motorized) traffic.[86] A large portion of total daily exposure occurs as short peaks of high concentrations.[87] Main articles: Toxic hotspot and Environmental justice While air pollution affects a variety of populations, some groups are more exposed. In many regions, there are disparities in exposure to pollution by race and income. This is especially true in countries with high inequalities in incomes and healthcare, like the United States. Polluting industries and roads are more likely to be placed in poorer communities, and people in these communities are more likely to work outdoors, leading to additional exposure.[88] Residents in public housing, who are generally low-income and cannot easily move to healthier neighborhoods, are highly affected by nearby refineries and chemical plants.[89] Additionally, lower-income communities more often perform polluting activities, such as using solid biofuels for cooking.[90][91] Communities with a low socioeconomic status and minority groups are also more vulnerable to pollution than more privileged communities.[92] Lower-income groups might for instance have less access to healthcare.[88] In the United States, Blacks and Latinos generally face more pollution than Whites and Asians.[93] Further information: List of most polluted cities in the world by particulate matter concentration and List of least polluted cities by particulate matter concentration Top 5 most polluted cities in 2024[94] City PM2.5 concentration Byrnihat, India 128 Delhi, India 108 Karaganda, Kazakhstan 105 Mullanpur, India 102 Lahore, Pakistan 102 Exposure to outdoor air pollution is worst in lower-middle income countries in line with the environmental Kuznets curve, which postulates that pollution is worst in economies that rely on manufacturing but have not yet been able to prioritize environmental regulation.[88] Indoor air pollution is worst in low-income countries, in particularly south-east Asia, the western Pacific and Africa.[95] Outdoor air pollution is usually concentrated in densely populated metropolitan areas, especially in developing countries where environmental regulations are relatively lax or nonexistent. Urbanization leads to a rapid rise in premature mortality due to air pollution in fast-growing tropical cities.[96] Indoor air pollution on the other hand is most common in rural areas, which may lack access to clean cooking fuels.[95] Further information: Environmental health The share of total deaths from indoor air pollution, 2017 Air pollution is an important risk factor for various diseases, such as COPD (a common lung disease), stroke,Air pollution is a significant threat to global health, linked to various diseases including lung cancer, pneumonia, and cataracts. The World Health Organization (WHO) has reported that 99% of the world's population lives in areas with air pollution that exceeds recommended levels. People living in poverty, babies, and older individuals are disproportionately affected by air pollution, with pregnancy also becoming more risky when exposed to pollutants.Estimates suggest that 6.7 million people die annually from air pollution, with outdoor particulate pollution being the largest cause of death, accounting for 4.7 million deaths. Indoor air pollution is also a significant concern, contributing to an estimated 3.1 million deaths. Cardiovascular disease, including stroke and coronary heart disease, is significantly affected by air pollution.The risks associated with air pollution are highest in regions with higher levels of pollutants, particularly among the elderly and those who are overweight. Air pollution is linked to increased risk of cardiovascular mortality, chronic obstructive pulmonary disease (COPD), and asthma. The mechanisms behind these associations are not fully understood but likely include systemic inflammation and oxidative stress.In India, air pollution contributed to 2.1 million deaths in 2021, while China saw 2.4 million deaths. In some countries, more than 20% of deaths were attributed to air pollution. Eliminating energy-related emissions in the United States could prevent up to 59,400 premature deaths annually and provide $678 billion in benefits from avoided PM2.5-related illness and death.Air pollution is linked to various health problems, including lung cancer, kidney disease, and respiratory issues such as asthma and pneumonia. Exposure to poor air quality during pregnancy can lead to miscarriages, stillbirths, and birth defects, while also increasing the risk of low birth weight. In addition, air pollution has been associated with an increased risk of autism in children.The effects of air pollution on brain health are also concerning. Studies have shown that exposure to poor air quality during childhood may negatively affect cognitive function and neurodevelopment, while prenatal exposure may also impact neurodevelopment. Air pollution has also been linked to neurodegenerative diseases such as Alzheimer's disease and Parkinson's disease, as well as mental health issues like depression and anxiety.Furthermore, air pollution can have a significant impact on the environment. Acid rain caused by pollutants in the atmosphere can damage buildings and statues made of specific stones, while also causing lake acidification and forest diebacks in Northern Europe. The acidity in water bodies and soils can lead to nutrient pollution, harming organisms that need oxygen to live.Air pollution can also affect the economy through its health effects, such as reduced productivity at work and the costs of healthcare. It has a strong impact on agricultural output, crop yield, and tourism, and can even increase the risk of accidents due to poor visibility.In some regions, air pollution is a significant problem due to the burning of biomass fuels for cooking. In South and East Asia, pregnant women are frequently exposed to indoor air pollution, while in the Middle East, North Africa, and West sub-Saharan Africa, fine PM comes from natural sources such as dust storms.Air pollution is a significant concern that affects not only human health but also the economy and environment. The World Bank estimated that PM2.5 pollution in 2019 cost the world economy over $8 trillion, which is about 6% of global GDP. In India and China, the loss of GDP was over 10%. Most of this loss came from the loss of life, with around 85% of it attributed to the loss of health due to air pollution.The value of statistical life, which tries to estimate how much people would be willing to pay to reduce their risk of dying, varies by country and is difficult to estimate for low- and middle-income countries. The direct market impacts on productivity loss, healthcare use, and crop losses are expected to rise to 1% of GDP by 2060, according to the OECD. The Caspian region and China will see the largest impact.Air pollution also affects energy production, as it reduces the amount of sunlight that reaches solar panels. It causes them to become dirty, further reducing their energy output. Ancient people suffered from blackening of the lungs caused by open fires in poorly ventilated homes, as shown by mummified remains found in Peru, Egypt, and Britain.Recorded complaints of air pollution date back to ancient Greece and Rome. Outdoor air pollution became a problem with the rise of cities, caused by household smoke and early industrial activities like smelting and mining. The Industrial Revolution saw outdoor air pollution rise strongly, mostly due to the large-scale burning of coal. By the 19th century, buildings around industrial plants began to blacken, while public parks started to wither.However, business leaders and politicians were enthusiastic about industry, thinking that heavy black smoke meant prosperity, high profits, and high wages. The Miasma theory, which falsely explained how deadly epidemics like cholera, yellow fever, and malaria originated and spread, was a prominent idea in the 18th and 19th centuries. It said that illnesses were caused by breathing in a mysterious "miasma" a harmful vapor that arose from decaying organic matter.The theory collapsed when physicians accepted the new germ theory of disease in the late 19th century. Germs coughed up by an infected person or spread by certain types of mosquitoes or hookworms were the real reason people caught infectious diseases. Anti-smoke groups emerged in Britain in the 1830s and in the US in the 1880s, but legislation against pollution was weak due to conflicting industrial interests.The interwar period saw a move from coal to gas and oil, which reduced air pollution, but this trend reversed when World War II broke out. The United Kingdom suffered its worst air pollution during the 1952 Great Smog of London, leading to the Clean Air Act 1956. The US also started regulating air pollution after the 1948 Donora Smog, which killed 20 people.Japan followed suit in the 1960s, but other heavily polluted regions, such as the Soviet Union and China, did not implement effective regulation. Technological disasters have caused severe problems with air pollution, including the 1984 Bhopal Disaster in India, which killed at least 20,000 people and affected around 600,000.In recent years, there has been less success in curbing greenhouse gas emissions, mostly from fossil fuels. The 1997 Kyoto Protocol introduced modest reduction targets but lacked strong enforcement, while the 2015 Paris Agreement set no binding limits, instead encouraging countries to raise their ambition over time.Air pollution can be monitored using different techniques, including satellites and remote sensing, as well as low-cost monitors for indoor air quality and air quality sensors incorporated into drones. Some websites attempt to map air pollution levels using available data, providing a simple way to communicate changes in air quality and associated health risks to the public.###ARTICLEAir quality indexes can indicate good air quality, hazardous conditions for sensitive groups, and general hazards.## Models and Emission FactorsWhen data is unavailable or projected pollution levels are uncertain, estimates can be derived using models or emission factors. Air pollutant emission factors link the amount of a pollutant released into the air to a related activity, such as coal-power stations. Regulatory agencies use these models to assess whether new sources of air pollution would exceed acceptable levels.## Pollution Prevention and AbatementPollution prevention seeks to minimize pollution through sustainable manufacturing processes, renewable energy transitions, and adjustments to industrial activities. Thermal oxidisers can be used to abate hazardous air pollutants and odorous emissions. Various technologies are available to reduce air pollution, including scrubbers, catalysts, and renewable energy sources.The rise in greenhouse gas levels since the Kyoto Protocol and Paris Agreement has led to a continued increase in successful efforts to address air pollution, with recognition from the UN General Assembly as a human right.The concept of clean cooking access for all has gained significant attention in recent years, with a focus on reducing greenhouse gas emissions and improving public health. A comprehensive analysis of the available data suggests that air pollution from household energy sources is a pressing concern, particularly in Europe.According to a report by the International Energy Agency (IEA), burning household energy can release pollutants into the atmosphere, posing serious health risks, especially for women and children. The World Health Organization (WHO) estimates that 40,000 Europeans die each year due to poor indoor air quality caused by gas stoves.Moreover, research has shown that wood-burning heaters and other biomass combustion sources contribute significantly to air pollution. A study published in the journal Atmospheric Chemistry and Physics found that wildfires can produce hazardous pollutants, including particulate matter, carbon monoxide, and volatile organic compounds.In addition, greenhouse gases such as carbon dioxide, nitrous oxide, and methane are released from household energy sources, contributing to climate change. The United States Environmental Protection Agency (EPA) estimates that about 25% of U.S. carbon dioxide emissions come from electricity generation, which is often linked to household energy use.To mitigate these issues, various strategies can be implemented, such as increasing energy efficiency, adopting cleaner energy sources like solar and wind power, and promoting sustainable practices in the home.###ARTICLEInter-annual trends of ultrafine particles in urban Europe.Air pollution remains a major health concern globally, with the World Health Organization estimating that air pollution causes over seven million premature deaths worldwide each year. Urban areas are particularly vulnerable due to high levels of air pollutants such as particulate matter (PM), nitrogen dioxide (NO2), ozone (O3), and volatile organic compounds (VOCs). Ultrafine particles (UFPs) are a significant contributor to air pollution, with their small size allowing them to penetrate deep into the lungs and cause inflammation. The present study investigated inter-annual trends of UFPs in urban Europe.Data from the European Union's EMEC network was used to analyze UFP concentrations over a period of 10 years. Concentrations were measured at six urban sites across Europe, with a total of 3,000 samples taken annually. The data showed significant inter-annual variability in UFP concentrations, with highest concentrations recorded during the winter months. A comparison of winter and summer concentrations revealed that UFPs were up to three times higher in winter than in summer.The study also investigated the relationship between UFP concentrations and other air pollutants, finding a strong correlation between UFPs and NO2 levels. The researchers suggested that this may be due to the formation of secondary organic aerosols (SOA) through the reaction of NOx with VOCs. The study highlighted the need for continued monitoring of UFPs in urban areas to better understand their impact on public health.The present study contributes to our understanding of the complex relationships between air pollutants and human health. By analyzing inter-annual trends of UFPs in urban Europe, this research provides valuable insights into the sources and sinks of these fine particles and highlights the need for continued action to reduce their levels in the atmosphere.### Reference information removedAir pollution is a major public health concern in India, with far-reaching consequences for the environment and human wellbeing.The State of Global Air Report 2024 reveals alarming statistics on the impact of air pollution on children's health globally. The report, published by the Institute for Health Metrics and Evaluation, UNICEF, and the Health Effects Institute, highlights the significant health risks associated with exposure to poor air quality.Air pollution is a leading risk factor for various health problems in children, including respiratory issues, cardiovascular disease, and even stroke. According to the report, outdoor air pollution can cause up to 2.9 million premature deaths worldwide each year, with children being disproportionately affected.The report emphasizes that air pollution is not just an environmental issue but also a public health concern that requires immediate attention. The data shows that exposure to poor air quality during childhood can have long-lasting effects on respiratory and cardiovascular health, increasing the risk of developing chronic diseases later in life.Furthermore, research suggests that even low levels of air pollution can cause significant harm to children's brains and nervous systems, potentially leading to neurodevelopmental disorders such as autism spectrum disorder. The report highlights the need for urgent action to reduce air pollution and protect children's health.The good news is that many countries are taking steps to improve their air quality, and some cities have already implemented effective measures to reduce emissions. However, more needs to be done globally to address this critical issue. The report urges policymakers, stakeholders, and individuals to work together to create cleaner air, promote sustainable transportation options, and support research on the health impacts of air pollution.The State of Global Air Report 2024 is a wake-up call for us all to take action against air pollution and its devastating effects on children's health. By working together, we can create a healthier future for our children and ensure that they grow up in an environment free from the risks associated with poor air quality.A growing body of evidence suggests that air pollution may be having a profound impact on our mental well-being, with far-reaching consequences for individuals and society as a whole.Research has consistently shown that exposure to poor air quality can have a devastating effect on mental health, increasing the risk of depression and anxiety disorders. Studies have found that even low levels of particulate matter (PM) in the air can lead to increased symptoms of depression and anxiety, while higher levels can even be linked to suicidal thoughts.The relationship between air pollution and mental health is complex and multifaceted, with various factors at play. For example, air pollution has been shown to affect cognitive function, with exposure to poor air quality leading to decreased attention span, memory loss, and reduced productivity.Moreover, the emotional impact of living in areas with high levels of air pollution cannot be overstated. The constant stress of coping with poor air quality can take a significant toll on mental health, leading to feelings of frustration, anger, and hopelessness.However, there is also evidence to suggest that improving air quality can have a positive impact on mental health. For example, studies have found that people living in areas with cleaner air are more likely to experience improved mood and reduced symptoms of depression and anxiety.###A GLOBAL PROBLEM WITH GLOBAL SOLUTIONSThe importance of air pollution monitoring cannot be overstated as it holds the key to maintaining a healthy environment and ensuring public well-being. Governments and international organizations have recognized the significance of this issue, investing heavily in research and development of low-cost air pollution monitors that can effectively track and mitigate pollutants.These innovative tools are designed to provide real-time data on air quality, enabling swift action to be taken when necessary. By doing so, they contribute significantly to reducing exposure to hazardous pollutants and promoting a healthier environment for all.Moreover, advances in technology have made it possible to create comprehensive networks

of chemicals used to make paints impacting breathing. World Health Organization recognizes air pollution as major threat human health depending on type pollutant different effects experienced such as cardiovascular respiratory illnesses skin diseases cancer risk climate change acid rain ozone depletion risks wildlife. To reduce air pollution conserve energy turn off electrical devices not in use utilize energy-saving technology like CFLs significantly reduces pollution using renewable energy sources geothermal solar wind energy reduces air pollution more significantly many countries implement these resources monitoring spatiotemporal air quality may be required to assess effects of interventions improve air quality public health safety. Brimblecombe Peter History of Air Pollution Williams Ian Environmental Chemistry vanLoon Gary W Duffy Stephen J Environmental Chemistry Harrison R Understanding Our Environment About Author Millions people globally affected by environmental challenge air pollution involves emission harmful pollutants into atmosphere negatively impacts human health ecosystems Earth overall gaining insight into air pollution causes types consequences crucial for creating effective measures to alleviate it.Air pollution is a complex issue that involves chemical reactions between primary pollutants and additional atmospheric components, often leading to more severe environmental problems. For instance, ozone is formed through the reaction of nitrogen oxides and volatile organic compounds in sunlight, while smog comprises smoke and fog usually resulting from industrial emissions and vehicle exhaust. Sulphuric acid, on the other hand, is created by oxidizing sulphur dioxide.ControlAdditional Control and Prevention of Air PollutionMinimising Industrial Emissions: Implementing stricter regulations and using advanced technologies to control and treat emissions at the source can greatly reduce pollutants released into the atmosphere.Fuel Substitution: Replacing petrol and diesel with cleaner alternatives like Compressed Natural Gas (CNG) in vehicles can lower emissions of harmful gases.Equipment Maintenance: Regularly maintaining and upgrading industrial equipment ensures optimal performance and reduces the emission of pollutants.Dilution of Pollutants: Increasing ventilation and dispersing pollutants over larger areas can mitigate their concentration in the air.Tree Plantation: Planting trees absorb carbon dioxide (CO) and other pollutants, acting as natural air purifiers and enhancing air quality.Fun Facts About Air PollutionInvisible Threat: Many air pollutants are invisible to the naked eye, making it difficult to detect pollution levels without specialised equipment.Historical Impact: The Great Smog of London in 1952 led to the introduction of the Clean Air Act in the UK, a landmark legislation in environmental protection.Urban Heat Islands: Air pollution leads to the urban heat island effect, causing cities to be notably warmer than nearby rural regions because of human activities.Microplastics: Tiny plastic particles, known as microplastics, are now recognised as emerging air pollutants with potential health risks.Global Efforts: The Paris Agreement aims to reduce greenhouse gas emissions globally, addressing one of the root causes of air pollution and climate change.Real-Life ApplicationsUnderstanding air pollution has practical applications that benefit society and the environment.Urban Planning: Designing cities with green spaces and efficient public transport systems can reduce air pollution levels.Health Policies: Implementing policies that limit emissions from industries and vehicles can improve public health outcomes.Technological Innovations: Developing cleaner technologies, such as electric vehicles and renewable energy systems, contributes to reducing air pollution.Environmental Monitoring: Using sensors and satellite data to monitor air quality helps in making informed decisions and issuing health advisories.Public Awareness Campaigns: Educating the public about the sources and effects of air pollution encourages behavioural changes that can lead to cleaner air.Recent Advancements in Air Pollution ResearchOngoing research continues to enhance our understanding and ability to combat air pollution effectively.Advanced Filtration Systems: Innovations in air filtration technology, such as HEPA filters and electrostatic precipitators, improve the removal of fine particulate matter from industrial emissions and indoor environments.Green Chemistry: Developing environmentally friendly chemical processes reduces the production of harmful pollutants in manufacturing and other industries.Bioremediation: Utilising microorganisms and plants to absorb and neutralise pollutants from the air offers sustainable solutions for cleaning contaminated environments.Real-Time Air Quality Monitoring: Advances in sensor technology enable real-time tracking of air pollution levels, facilitating timely interventions and policy implementations.Policy Development: Research-driven policies that integrate scientific findings with regulatory measures ensure effective management of air pollution sources.ConclusionAir pollution is a complicated environmental challenge that demands comprehensive understanding and proactive measures. By recognising the sources and types of pollutants, understanding their effects, and implementing effective control strategies, we can make significant progress in improving air quality and protecting both human health and the environment. At Vedantu, we are committed to providing detailed and accessible educational resources to empower students and parents in their journey towards a cleaner and healthier planet.GlossaryAir Pollutants: Substances in the air that can harm human health and the environment.Sulphur Dioxide (SO): A gas produced by burning fossil fuels containing sulphur.Nitrogen Oxides (NO): Gases produced from vehicle emissions and industrial processes.Particulate Matter (PM): Tiny particles suspended in the air, including dust, soot, and smoke.Volatile Organic Compounds (VOCs): Organic chemicals that easily become vapours or gases, contributing to smog formation.Ozone (O): A molecule composed of three oxygen atoms, existing in the stratosphere and troposphere with different effects.Global Warming: The long-term rise in Earth's average temperature due to greenhouse gas emissions.Acid Rain: Precipitation with acidic components, caused by emissions of sulphur dioxide and nitrogen oxides.Ozone Layer: A region of the Earth's stratosphere containing a high concentration of ozone, protecting life from harmful UV radiation.Bioremediation: The use of living organisms to remove or neutralise pollutants from the environment.Greenhouse Gases: Gases that retain heat in the atmosphere enhance the greenhouse effect and lead to global warming.Urban Heat Island: An urban area significantly warmer than its surrounding rural areas due to human activities.Check out these Pages as Well to Learn More:Water Pollution ControlEnvironmental Issues

Air pollution effects. What is air pollution discuss its causes effects and control measures. What is air pollution make a flowchart to describe its causes and effects. What is air pollution write its causes and effects. What is air pollution explain its causes and effects on human life. What is air pollution explain its causes and effects in detail. What is air pollution effects on the environment. What caused air pollution. What is air pollution causes and effects essay. What is air pollution causes effects and control measures.