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Introduction to air Pollution

Air pollution has become one of the most pressing environmental challenges of the twenty-first century. It refers to the contamination of the atmosphere by harmful substances such as gases, particles, and biological molecules that interfere with the natural composition of the air. Although the atmosphere is a protective layer that supports life on Earth by providing oxygen, regulating temperature, and shielding against harmful radiation, human activities have increasingly disturbed this balance. As industrialization, urbanization, and technological development continue to expand, the issue of polluted air has grown more complex and widespread, affecting not only the environment but also human health and the stability of ecosystems. The concept of air pollution

is not new. Historical records show that even in ancient civilizations, people were concerned about smoke from burning wood or coal. However, the problem was limited in scale compared to today's situation. The Industrial Revolution in the eighteenth and nineteenth centuries marked a turning point, as factories, power plants, and transportation systems began releasing massive quantities of pollutants into the atmosphere. Since then, air pollution has become a global problem rather than a local one, with impacts that cross borders and continents. Pollutants released in one region can travel long distances, affecting communities and natural systems far away from their source. There are many different types of air pollutants. Some of the most common include carbon monoxide (CO), sulfur dioxide (SO₂), nitrogen oxides (NO_x), volatile organic compounds (VOCs), ozone (O₃), and particulate matter (PM). These pollutants originate from a variety of sources such as vehicle emissions, industrial discharges, burning of fossil fuels, agricultural activities, and even natural events like wildfires and volcanic eruptions. While certain natural processes contribute to air pollution, human activity has become the dominant and most harmful factor. The interaction of these pollutants in the atmosphere often leads to secondary problems, such as acid rain, smog formation, and global climate change. The consequences of air pollution are severe and far-reaching. On the human level, exposure to polluted air is strongly associated with respiratory diseases, cardiovascular disorders, reduced lung function, and premature death. Children, the elderly, and individuals with pre-existing health conditions are especially vulnerable. According to the World Health Organization (WHO), millions of premature deaths each year are linked to poor air quality, making it a leading risk factor for global health. On the environmental level, air pollution contributes to soil degradation, water contamination, loss of biodiversity, and damage to forests and crops. Moreover, greenhouse gases such as carbon dioxide and methane are accelerating climate change, leading to extreme weather events, rising sea levels, and other long-term consequences that threaten the sustainability of life on Earth. Addressing air pollution requires collective action and a combination of strategies. Governments play a crucial role by setting environmental regulations, monitoring emissions, and promoting cleaner technologies. Industries are encouraged to adopt sustainable practices, invest in renewable energy, and reduce dependence on fossil fuels. Individuals can also contribute by making conscious lifestyle choices, such as using public transportation, conserving energy, and supporting policies that protect the environment. In addition, international cooperation is essential, since air pollution does not

recognize political borders and often requires regional or global solutions. In conclusion, air pollution is not merely an environmental concern; it is a social, economic, and health issue that demands urgent attention. It is a challenge that connects human well-being with the condition of the planet, reminding us that our survival depends on clean air and a stable climate. Understanding the causes, types, and impacts of air pollution is the first step toward finding effective solutions. By combining scientific knowledge, technological innovation, policy development, and public awareness, societies can work together to reduce pollution and safeguard the atmosphere for present and future generations.

