



# Investigating Air Pollution

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## Introduction

How clean is the air we breathe? How does the air look, taste, feel and smell in our community? What is the connection between air quality and our health? In this lab, several experiments will be performed to determine the quality of the air in our school and community.

## Background

The major components of pollution-free, dry air are nitrogen (78%), oxygen (20.95%), argon (0.934%) and carbon dioxide (0.0314%). Air also contains trace quantities of neon, ammonia, helium, methane and krypton. If any other substances are added to the atmosphere, an imbalance occurs that can lead to the degradation of the air. The air in our area is probably polluted to some extent. Air pollution is considered the most widespread and noticeable form of pollution. Each year in the United States, 147 million metric tons of air pollution is released into the air as a result of human activity. Worldwide, nearly two billion tons of air pollutants are released into the atmosphere.

There are five major types of air pollutants: 1) particulate matter, 2) sulfur oxides, 3) nitrogen oxides, 4) carbon monoxide and 5) volatile organic compounds.

1. **Particulate matter**, also known as aerosols, is defined as any group of liquid droplets or solid materials suspended in the air. Particulate matter includes dust, lint, smoke, pollen and ash, as well as, many other suspended materials. Particulate matter is often the most visible and noticeable type of air pollution and can be harmful to many organisms. Natural sources of particulate matter in the air worldwide account for more than ten times the pollution than human sources, although in many cities, more than 90% of suspended particulate matter is due to human intervention.
2. **Sulfur oxides** occur in air from both natural and human sources. Natural sources such as volcanoes, sea spray and dust from dry soils all account for sulfur in the atmosphere. The major source of sulfur in the air caused by humans is sulfur dioxide, which comes from the combustion of coal & oil and the smelting of ores. Sulfur dioxide is a corrosive, colorless gas that is a constituent of *smog*. It is very toxic by inhalation and poses a serious health hazard to humans. Sulfur oxides are also one of the two major classes of gases that lead to *acid rain*, nitrogen oxide the other.
3. **Nitrogen oxide** is present in the atmosphere mainly from the burning of fossil fuels. Many fossil fuels contain small amounts of nitrogen-containing compounds that produce nitrogen oxides upon combustion. Nitrogen oxide combines with the water in the atmosphere to produce acidic precipitation. Unpolluted rainwater and other forms of precipitation generally do not have a pH of 7 (neutral). Rather, dissolved carbon dioxide in the atmosphere generally lowers the *pH of rainwater to about 5.2-5.5 (acidic)*. In contrast, nitrogen oxide and sulfur oxides can cause the pH of rainwater to be as low as 2.5, resulting in acid rain. Acid rain may cause stress for aquatic life in bodies of water. In fact, many lakes in the United States have become so acidic that organisms that used to flourish have disappeared. Acid rain causes soils to become more acidic and also washes away essential nutrients from the soil. The acidity of the rain can also cause direct harm to plants by damaging leaves and preventing the germination of seeds. On a more visible, though less life-threatening level, acids released into our atmosphere can severely damage statues and erode artwork on buildings.
4. **Carbon monoxide** is a colorless, odorless gas that is highly toxic to humans and other organisms. It is present in the atmosphere mainly from the incomplete combustion of fossil fuels. If an internal combustion engine does not have the proper mix of fuel and air, carbon monoxide is formed instead of carbon dioxide. Carbon monoxide actually inhibits the circulatory system in animals by competing with oxygen for the binding sites on hemoglobin. Every year, about one billion metric tons of carbon monoxide are released into the air from the exhaust vapors of cars, trucks and other vehicles.
5. **Volatile organic compounds (VOCs)** are organic chemicals that persist in the atmosphere as gases. Plants are considered the largest source of volatile organic compound production. In addition to natural sources of these compounds, a high number of man-made synthetic organic chemicals such as toluene, benzene, phenols and chloroform are also released into the atmosphere. The major source of volatile organic pollution is the evaporation of gasoline from gas stations when customers are refueling.