Community Health

What is in the air?

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Abstract

Air is a mixture of gasses, water vapor and aerosols, which include particulate matter (PM) like dust, microorganisms, and ash. Dust, a significant component of PM, originates from dry soil vulnerable to wind erosion, affecting air quality when suspended in the atmosphere. The Salton Sea, exemplifying this phenomenon, releases minerals and microorganisms into the air due to its shrinking lakebed. There is an intricate interplay between atmospheric components, human health, and ecosystems, emphasizing the need for a comprehensive understanding of the air we breathe.

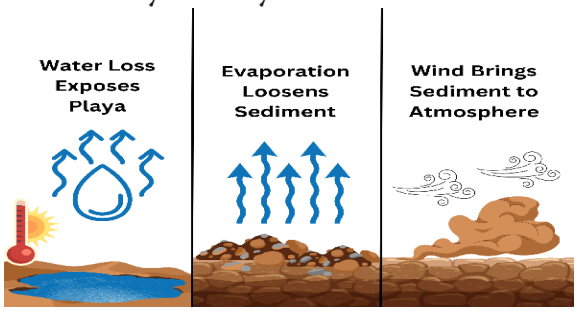
Introduction

Air is all around us; it is the mixture of gases that surrounds the Earth. Most of the gases in air, such as nitrogen, and oxygen, are naturally occurring. Many beings on Earth, including humans, need the oxygen in the air to survive. Here we will explore what is in the air we breathe and highlight the organisms that make their home in the atmosphere.

In addition to gases, the air can hold other things, such as water vapor (water as a gas) and aerosols. Aerosols are solid particles suspended in the air and include dust, spray from water bodies such as oceans and lakes, microorganisms, and ash from fires and volcanoes. Collectively these particles are known as particulate matter (PM). Though these particles are usually hard to see, particulate matter is involved in regulating our climate and impacts human health. Particulate matter is categorized by size: Fine particles are less than 2.5 micrometers (μm) in diameter, and coarse particles are between 2.5 – 10 micrometers in diameter. To give you an idea of how small these particles are, a red blood cell would be a coarse particle at 7 micrometers. Most bacteria, which range from 1-2 micrometers in diameter and 5-10 micrometers long, would be classified as fine particles.

What is in the Dust?

Dust is a major component of particulate matter in the atmosphere and originates from soil that is often dry and vulnerable to wind erosion. Dust emissions are related to poor air quality; when more dust particulates are in the atmosphere, air quality decreases. This has been observed in the Salton Sea, an extremely salty lake that is rapidly shrinking due to evaporation and the diversion of incoming water. As the Salton Sea shrinks, the playa (i.e., lakebed) is exposed and begins to dry, which loosens the particulates in the soil. When strong, seasonal winds enter the region, they introduce the soil minerals into the atmosphere where they can settle downwind or be carried for long distances. Some minerals found in Salton Sea dust include magnesium (Mg), sulfate (SO4), sodium (Na), calcium (Ca), and selenium (Se). These minerals can occur naturally in the Salton Sea or may come from pollution being fed into the Salton Sea by nearby rivers.



Microorganisms in the Dust

In addition to a variety of minerals, dust contains a unique set of microorganisms that can withstand harsh and fluctuating atmospheric conditions. Microorganisms that reside in aeolian, or windblown, dust must withstand radiation from the sun, a lack of moisture and nutrients, physical strain by the wind, and changes in pressure and temperature. Because the Salton Sea is a difficult ecosystem to survive in, the microorganisms that come from the Salton Sea could be well adapted to thrive in the atmosphere. Preliminary results show that Salton Sea dust is populated with gram-negative bacteria, which have an outer membrane made of large molecules called lipopolysaccharides (LPS). These molecules allow the bacteria to attach to the dust particles, using the particles as a source of nutrition and protection in the air. Unfortunately, lipopolysaccharides are also toxic to humans and other animals and are strong activators of our immune system if eaten or inhaled.

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