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What is Air Pollution?

The air we breathe contains many impurities, ranging from smoke that comes from open fires to invisible gases emitted by the tailpipes of cars. These and other pollutants affect human health, damage fragile ecosystems, reduce visibility, and even damage property. They also have profound impacts on climate.

Our atmosphere, which consists mostly of nitrogen (78%) and oxygen (21%), has always contained many trace chemicals and particles. Even before humans began to have an impact, volcanoes belched enormous amounts of ash and sulfur dioxide into the atmosphere. Winds whip up dust from deserts and smoke from forest fires. Even plants and animals emit subtle amounts of chemicals into the atmosphere—a process that scientists are just beginning to unravel.

But when people use the word “pollution,” they generally mean human-related emissions that degrade the atmosphere. We’re all familiar with the haze or brown cloud of smog that hangs over many of the world’s largest cities, obscuring the Sun and sometimes irritating our lungs and eyes. Common types of air pollution include:

**carbon monoxide**, an odorless gas that forms when carbon in fuels is not burned completely

**ground-level ozone**, the result of a chemical reaction when sunlight acts on nitrogen oxides and volatile organic compounds (more on ground-level ozone[link+target: Ozone in the atmosphere#What about ground-level ozone]

**nitrogen dioxide**, a brownish gas that comes primarily from vehicle emissions, electric utilities, and burning wood

**particulate matter**, which may contain a mix of suspended liquid or solid particles, including dust or soot or the sulfate form of sulfur dioxide. Tiny airborne particulate is also known
as aerosol.

**sulfur dioxide**, a gas from burning fuels that contain sulfur (such as coal or oil).

Some pollution is the result of human-generated emissions interacting with naturally forming chemicals. At NCAR, for example, researchers study the ways that trees and other plants emit certain chemicals, known as **volatile organic compounds**. These chemicals can react with human-generated industrial emissions of nitrogen oxides to form ground-level ozone, a major component of smog.

Pollution's many negative impacts on human health and the environment have been well documented. Nitrogen dioxide, for example, can cause inflammation of the lungs and other respiratory ailments. A related pollutant, nitric oxide, produces haze, damages plants, degrades fabrics, and forms nitrate salts that can corrode metals. **Acid rain**, formed from emissions of sulfur dioxide and nitrogen oxide, kills life in lakes and streams and damages buildings and monuments.

**Small airborne particles are especially dangerous** because people can breathe them deep into their lungs, triggering inflammatory reactions. Some of the most innovative research into these ultrafine aerosols is being conducted at NCAR, where scientists have developed a tool to measure the chemical composition of particles as small as four nanometers, or one hundred-millionth of an inch. (This is so small that it's equivalent to splitting the thickness of a human hair about 50,000 times.) The effort will help determine how such particles are formed.