

Air Quality Unit



Examine causes of air quality and pollution. Enact community action projects to drive equitable solutions.

Air Quality Instructional Outline

Contents:

- *Unit Description*
- *Learning Objectives*
- *Essential Questions*
- *Unit Contents*
- *Educational Standards*

Unit Description

In this unit, students learn about the composition of air, study air pollutants, and identify sources of atmospheric pollutants. Students conduct field testing to monitor local air quality, understand the policies that protect air quality, and evaluate the environmental justice implications of poor air quality.

Learning Objectives

Students will be able to:

- Evaluate the chemical composition of the atmosphere and air pollutants.
- Analyze threats to human health from air pollution.
- Evaluate federal, state, and local policies that regulate air pollution.

Essential Questions

- How does human activity impact air quality?
- How does air quality relate to environmental justice and how can we ensure a healthy environment for all?
- How does poor air quality affect human health?



Lesson Overview

Estimated Time

Nine 45-minute classes (6.75 hours)

Standards Covered

NGSS: HS-ESS3-6

CTE: EEU A7.1-7.5

CCSS.ELA-LITERACY: RST. 9-10.3, RST 9-10.7

Objectives: Students will be able to:

- Evaluate the chemical composition of the atmosphere and air pollutants
- Analyze threats to human health from air pollution

Prep Time

- 1 hour per lesson

Handouts

- [How to Use your AirBeam](#)
- [Monitoring Local Air Pollution](#)
- [Smog in a Jar](#)
- [Exploring Environmental Justice with Maps in Cities](#)

Materials (for each student/group):

- AirBeam Kit (handheld device and tablet) - [Buy](#) or [Request from SEI](#) - 1 kit per student group (3-4 students)
- Computers with internet for ArcGIS and CalEnviroScreen
- Smog in a Jar: Glass jar, 6x2 inch strip of paper, water, ice cubes, aluminum foil, matches or a lighter - one kit per student group (3-4 students) or one set for a teacher demonstration

Lesson: Understanding Air Quality and Air Pollution

Students will explore the chemical composition of air and the effect of pollutants in the air on human health and the environment. They will utilize air quality testing technology to measure air quality and hypothesize causes of air quality at their site.

KEY WORDS

Air Pollutants: Any compound that, in high enough concentrations, can be harmful to the health of living systems

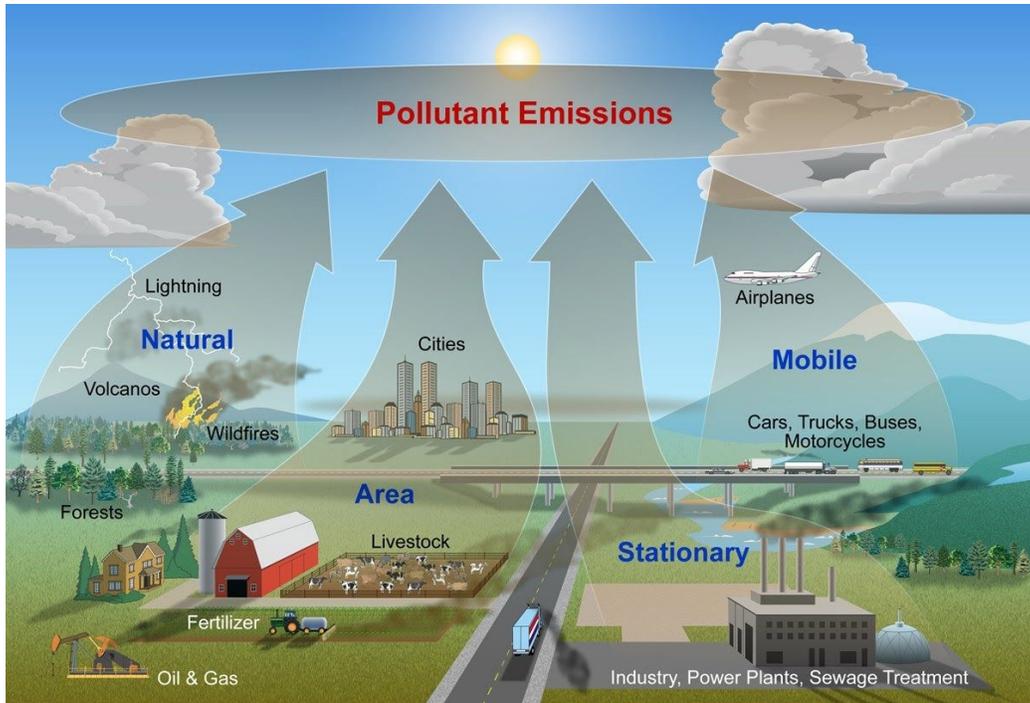
Air Quality Index: Measurement of air quality set by the EPA determined by the amount of dangerous pollutants in the air

Particle: Complex mixture of extremely small solid and liquid components. PM2.5 and PM10 refer to the diameter of the particle (2.5 and 10 micrometers)

Ground Level Ozone: A pollutant formed when nitrogen oxides (NO_x), volatile organic compounds (VOCs), and sunlight react at ground level, also known as smog

PREPARATION

- Gather Materials: see [Monitoring Air Quality](#) and [Smog in a Jar](#) activities
- Print the following handouts:
 - [How to Use your AirBeam](#)-1 per group
 - [Monitoring Local Air Pollution](#)-1 per student
 - [Smog in a Jar](#) - 1 per group
 - [Exploring Environmental Justice with Maps](#) - 1 per student
 - [Exploring Environmental Justice in Your City](#) - 1 per student



Have students write down or discuss: What are some air pollutants that you've heard of?

Some examples can be: ash from wildfires, solid particles from power plants, dust, or smog.

- Air pollutants are classified as primary or secondary. Primary air pollutants are emitted directly from the source, such as sulfur and nitrogen oxides from factories. These oxides interact with other naturally occurring elements in the air to produce additional pollutants, these are called secondary pollutants. Ground level ozone is created when NO_x and SO_x interact with chemicals in the air and sunlight.
- There are six common types of air pollution, identified by the EPA as “Criteria Air Pollutants”³, which this unit will explore: Ground-level Ozone, Particulate Matter, Carbon Monoxide, Lead, Sulfur Dioxide, and Nitrogen Dioxide.

Criteria Pollutants:

The EPA sets National Ambient Air Quality Standards (NAAQS) based on levels of six common pollutants. These pollutants are harmful to both human health and the environment, so it is important to monitor and reduce their levels.

² National Parks Service. Pollutant Emissions, 2018, U.S. National Parks Service Where Does Air Pollution Come From?, accessed February 14, 2020, <https://www.nps.gov/subjects/air/sources.htm>.

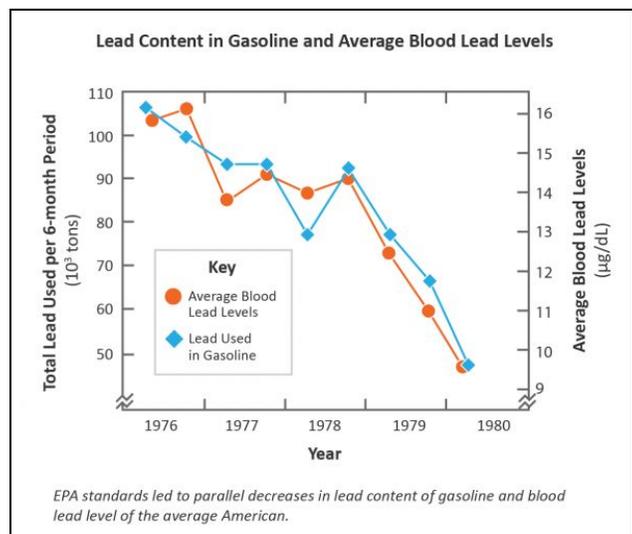
³ U.S. Environmental Protection Agency, Criteria Air Pollutants, <https://www.epa.gov/criteria-air-pollutants> (accessed February 14, 2020).

Carbon Monoxide

- Carbon Monoxide (CO) is a colorless and odorless gas that is released when something is burned. The primary sources of CO are cars, trucks, and other vehicles that burn fossil fuels.
- Carbon Monoxide causes sore throats, coughs, and breathing difficulty. At high levels, and in enclosed spaces CO can be deadly.

Lead

- The largest source of lead in the air was previously emissions from cars and trucks running on leaded gasoline. Since lead in gasoline was banned in the mid 1990s, major sources of lead pollution include industrial processes such as lead smelting, a process used to produce usable lead from ore, and battery recycling.
- At the gasoline pump, regular gasoline is also referred to as “unleaded”, meaning there is no lead in the petroleum. Today, all gasoline in the U.S. must be unleaded.



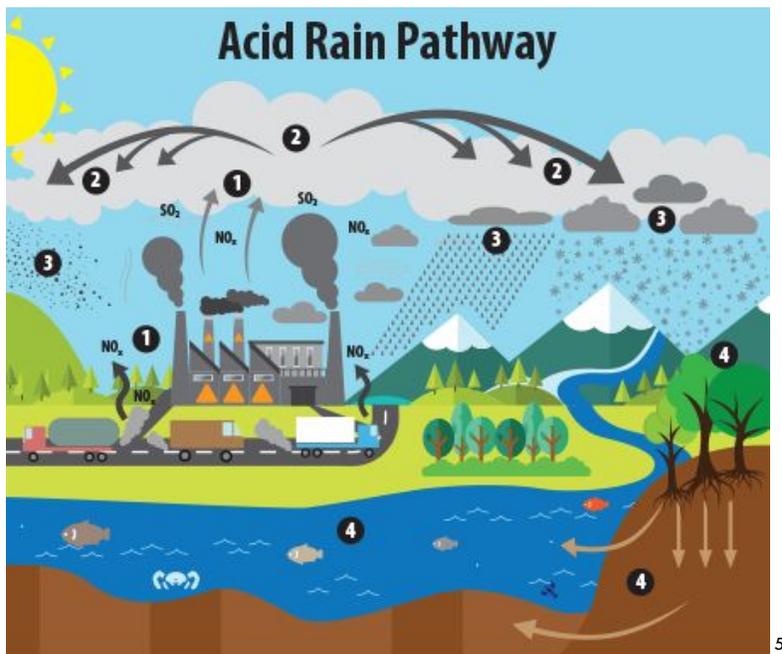
- Once in a human body, lead accumulates in the blood and bones and can have a range of health consequences. In children, even very low levels of lead can damage the nervous systems' development, leading to lowered IQ, learning difficulties, and behavioral issues.

Sulfur Dioxides (SO₂) and Nitrogen Dioxide (NO₂)

- The largest source of sulfur dioxide and nitrogen dioxide in the atmosphere are vehicles, power plants, and other industrial facilities that burn fossil fuels.
- Levels of sulfur dioxide and nitrogen dioxide act as an indicator for the entire group of sulfur oxides (SO_x) and nitrogen oxides (NO_x).
- Exposure to these two pollutants can have damaging effects on the respiratory system, and prolonged exposure can lead to asthma. SO_x and NO_x also react in the atmosphere to create

⁴ US Environmental Protection Agency, *History of Reducing Air Pollution from Transportation in the United States*, <https://www.epa.gov/transportation-air-pollution-and-climate-change/accomplishments-and-success-air-pollution-transportation> (accessed February 28, 2020)

particulate matter, another criteria pollutant. High levels of SO_x and NO_x in the atmosphere can lead to acid rain, which is damaging to natural ecosystems.



Particulate Matter ($\text{PM}_{2.5}$ and PM_{10})

- A **particle** is a complex mixture of extremely small solid and liquid components. Particles can be made up of organic compounds, combustion products, dust, or any other very small compounds in the air.
- When measuring particulate matter pollution, two different kinds of particulate matter are usually referred to: $\text{PM}_{2.5}$ and PM_{10} . The numbers refer to the diameter of the particles, 2.5 μm and 10 μm . For reference, these are $1/5$ and $1/20$ the diameter of a human hair.

Students will revisit Particulate Matter, measuring PM pollution levels using handheld monitoring devices, and its effect on human health in *Activity: Monitoring and Mapping Local Air Pollution*

⁵ U.S. Environmental Protection Agency, *Acid Rain Pathway*, <https://www.epa.gov/acidrain/what-acid-rain> (accessed February 14, 2020).