



TAKE CARE OF TEXAS: EDUCATOR MATERIALS

LESSON PLAN

Texas & the Clean Air Act

Objectives

Students will gain a better understanding of the Clean Air Act and how it continues to help improve overall air quality for Texans.

Prerequisites

Students should understand that our air contains many particles and gases that are mostly invisible to the naked eye.

Duration

40 minutes

Materials

- Student Worksheets
- Two clear 1-gallon containers (per student or per classroom)
- Stir Stick
- Measuring Cups
- Lemonade Mix
- Salt
- Ground Pepper
- Food Coloring (Red, Green, & Yellow)

Introduction

Can you imagine a world where the air we breathe is filled with clouds of smoke?

In the 1950s and 1960s, Texans, along with the rest of America, observed that their major cities were beginning to be covered by a dense haze of air pollution. In metropolitan areas of Texas like Houston, Dallas-Fort Worth, and San Antonio, air pollution was visible for most of the day and became a hazard for motorists and pedestrians alike.



Figure 1: Smoke from the burning of discarded auto batteries from a factory near Houston, Texas, April 1972: Marc St. Gil - NARA (#549634)



M-73b-1 (1/25)

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This pollution was linked to unregulated emissions from cars, trucks, and factories. Since there were no controls on these sources, air pollution was rampant. The U.S. Congress passed the Clean Air Act (CAA) in 1970 and made major revisions in 1977 and 1990. Currently, the CAA requires the United States Environmental Protection Agency (EPA) to establish air quality standards for six key widespread air pollutants: carbon monoxide, nitrogen dioxide, ozone, particulate matter, sulfur dioxide, and lead. The CAA also requires states to adopt enforceable plans to achieve and maintain air quality that meets those standards.

The Texas Commission on Environmental Quality (TCEQ) is the state agency responsible for developing state plans to meet these air quality standards in Texas. TCEQ also sets up and maintains hundreds of air quality monitors across the state to measure these air pollutants.

In this activity, we will use data from the EPA's **National Emissions Inventory** webpage to create visual representations of how our air quality has changed since the CAA was passed. We will use the following data to create ratios for the ingredients in our experiments.

Pollutant	1990	2019
CO	143.6 mil tons	44.7 mil tons
NO _x	25.2 mil tons	8.7 mil tons
O ₃	N/A	N/A
PM ₁₀	3.2 mil tons	2.3 mil tons
SO ₂	23.1 mil tons	2.0 mil tons

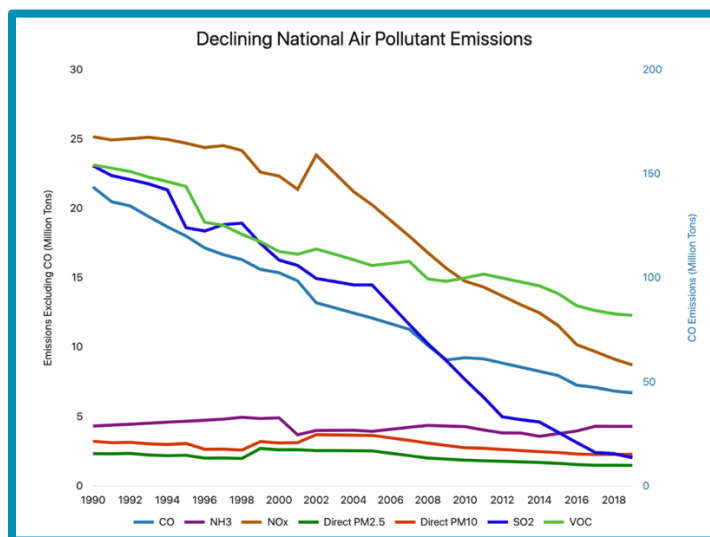


Figure 2: U.S. EPA National Emissions Inventory

Procedure

The CAA helps us control the sometimes-invisible air pollutants that can be harmful to humans. In this experiment, we will use different visible materials to show these unseen pollutants.

One container will represent the air quality in the U.S. before the CAA was passed, and the other container will represent our current air quality.

1. Fill both containers with water. This water will be your "air."
2. Gather the materials that will be representing the six criteria air pollutants that were designated by the EPA. The materials will correspond to the pollutants listed in the chart below:
3. We will start with Carbon Monoxide (CO). This pollutant comes from exhaust from cars, trucks, and other machines. In 1990, the US was emitting 143.6 million tons of CO, but in 2019 we only produced 44.7 million tons. That gives us a ratio of about 3:1. After adding the "pollutant," mix the solutions together.
4. Next, we will add Nitrogen Dioxide (NO₂). This pollutant also primarily comes from the burning of fossil fuels. In Texas, NO₂ is monitored along with other

Glossary

- **Carbon Monoxide** – an odorless gas that is emitted from cars, trucks, and factories through the burning of a fuel source. When inhaled in large amounts, carbon monoxide can limit blood flow to the brain.
- Lead
- **Nitrogen Dioxide** – a very reactive gas that is primarily produced through the burning of fossil fuels. In high

amounts, it can irritate one's respiratory system, and could also contribute to detrimental environmental effects such as acid rain.

- **Ozone** – a gas that forms when three oxygen molecules bond together. It performs a very important job in our upper atmosphere by protecting the earth from the sun's harmful rays. This blanket of ozone is called the ozone layer. However, when ozone is in our lower atmosphere, where we breathe air, it can be harmful to humans.
- **Particulate Matter** – a mixture of small particles and water droplets in the air. When it is present in large amounts, it is unhealthy for people to breathe, especially if they have asthma or other health conditions that might make them sensitive to air pollution.
- **Sulfur Dioxide** – a gas that is released through the burning of sulfurous materials, commonly produced by power plants and other industrial facilities.
- **United States Environmental Protection Agency (EPA)** – the government organization created by President Richard Nixon in 1970 for environmental protection and compliance with the Clean Air Act (CAA).

Applicable TEKS

Science TEKS (*Adopted 2021*)

- **6th Grade** – §112.18.b. 1A,B; 2A-D; 3A-C; 4A,B; 5SA,C,G; 11B.
- **7th Grade** – §112.19.b. 1A,B; 2A-D; 3A-C; 4A,B; 5A,G.
- **8th Grade** – §112.20.b. 1A,B; 2A-D; 3A-C; 4A,B; 5A,G; 11B.