

Temperature Inversion



Target Grade Levels

Eighth - Tenth

Time

30 minutes

Materials

- wide-mouthed gallon jar with cover
- plastic bags
- chilled sand bags
- hot water
- funnel
- incense
- plastic tubing
- twist-ties
- masking tape

Knowledge and Skills (TEKS)

- Science:
 - Experience in drawing conclusions about the processes and outcomes of a scientific investigation.
 - The student shall relate objects, scientific principles, and activities to daily life, and explain natural processes and phenomena.

Overview

To demonstrate what happens when a temperature inversion occurs, which can trap air pollutants near the surface of the earth.

Background Information

Tiny solid particles from automobile exhaust, soot from factory smokestacks, fireplaces, and brush or trash burning are largely responsible for the formation of the haze that can be seen hovering over many large cities and industrial areas. Many people who breathe this particle pollution experience some discomfort and suffer some health problems. The severity of this form of pollution is increased when local weather conditions and/or the unique topography of a region cause the pollutants to be trapped in a layer of still air that prevents them from moving away from the area.

Usually, the air that is close to the ground is warmer than that which is found at higher altitudes. This is because there is less pressure at higher altitudes than near the ground and as a volume of air expands it cools. Since there is less pressure, there are fewer collisions of molecules because they have to travel farther before they encounter another molecule. (It is the collisions that give off heat, which we measure as air temperature.) However, this is only true for a column of air with uniform density. When the density of the air at the surface is dramatically different than the air above it (that is, dense, cold, dry air is at the surface and less dense, warmer, moister air is above) then we see a warmer temperature at say 5,000 feet than at the surface. This almost always happens at night and happens frequently during the day in the winter months.

When the air is especially still at times like these, the cooler air, because of its greater density, settles close to the ground, and the warmer air forms a blanket above it in a temperature inversion. Pollutants in the air, such as smoke and soot, are also trapped close to the ground. Fog, formed when moisture in the cool air condenses close to the earth's surface, becomes smog when combined with these pollutants.

Procedure

1) Vocabulary

- a) temperature inversion
- b) soot
- c) haze
- d) particle pollution

2) Activities

- a) Discuss the concept of temperature inversion.
- b) Place a wide-mouthed gallon jar on a table top where all students can view it easily.
- c) Place a very cold sand bag in the bottom of the jar.
- d) Fill a small plastic bag with very hot water. Use twist-ties to close the tops
- e) Suspend the plastic bag containing hot water inside the jar by taping their closed top edges to the rim of the jar.
- f) Attach one end of a length of plastic tubing to a funnel stem and place the free end in the jar.
- g) Position the mouth of the funnel over a small container of burning incense.
- h) Hold the jar top securely in place atop the jar and direct smoke from the incense through the funnel and tube into the jar.
- i) Observe the activity in the jar, discuss.