



## Earth Central: Ozone Experiment

### Ground-Level Ozone

Ground-level ozone is “bad ozone” because it’s a highly caustic chemical that reacts with (literally burns) plants and tissue like your lungs. Worst of all, it makes rubber bands become brittle. (Hey, I have a thing about rubber bands, okay?)

We will be using specially treated papers that contain chemicals that change color in the presence of ozone. The individual papers contain two chemicals: the one in the top circle is used for approximately one hour readings and turns purple; the one in the bottom circle is used for all day readings and turns brown. Past experience with the papers suggests that they are not well calibrated, but they can still be used with the proper experimental design to study relative ozone levels effectively.

Ground level ozone normally requires sunlight to form, but many other factors may affect local levels. Here are some sample questions about possible causes of ozone variation:

*How are ozone levels related to nearness to roads, gas stations, dumps, copying machines?*

*What are ozone levels like indoors vs. outdoors? in air-conditioned vs. “energy-efficient” classrooms?*

*How might ozone relate to playground locations? gyms? lunch areas?*

*If you carried out a longer term experiment, you might look at relationships with temperature, humidity, wind, precipitation, elevation, stratospheric ozone levels, etc.*

### Conducting Experiments with the Ozone-Sensitive Papers

1. Keep the papers inside a zip-lock bag as much as possible to avoid unintended exposure to ozone. Make sure to get as much air out as possible.
2. Avoid touching the chemically treated part of the paper—it’s not dangerous, but you may affect the results.
3. Decide on four locations you would like to test. Write them down on a notecards along with the date of the experiment and weather conditions, but leave space to write the starting and ending times, and leave the lower right corner free to tape the ozone paper.
4. To conduct an experiment, cut the chemically treated part of the paper into quarters. Tape them to the notecards by the untreated part of the paper with the chemically treated “corner” in the corner of the card. Make sure the chemically-treated side of the paper faces outward.
5. Let all the test papers have the same amount of exposure time. When the experiment is completed you can put a piece of clear tape over the ozone paper to prevent further reactions. Compare the colors to each other.

## Some Notes About Ozone Levels

On the test strips, the darker the color, the higher the concentration of ground-level ozone. Roughly speaking, deep purple and dark brown (for 1 and 8 hour exposures respectively) correspond to levels of about 100-200 ppb.

ppb = Parts per billion volume air concentration

**3–10 ppb:** The threshold of odor perception by the average person in clean air. Typical indoor level when outdoor ozone level is low.

**50 ppb:** Maximum allowable ozone concentration recommended by ASHRAE in an air conditioned and ventilated space.

**100 ppb:** The maximum allowable ozone concentration in industrial working areas: permissible human exposure - 8 hours per day, 6 days a week.

**150–510 ppb:** Typical peak concentrations in American cities.

**300 ppb:** The threshold level at which nasal and throat irritation will result. Some species of plant life began to show signs of ozone effects.

**500 ppb:** The ozone level at which Los Angeles, California, declares its Smog Alert No. 1. Can cause nausea and headaches in some individuals. Extended exposure could cause lung edema (an abnormal accumulation of serous fluid in connective tissue or serous cavity). Enhances the susceptibility to respiratory infections.

**1000–1500 ppb:** Los Angeles, California, declares its Smog Alert No. 2 at 1000 ppb, No. 3 at 1500 ppb. When this range of ozone concentration was inhaled by human volunteers for 2 hours, it caused headache, pain in the chest, and dryness of the respiratory tract, which subsided after a few days.

**12000 ppb:** Experimentation showed that a 3 hour exposure at this level was lethal for Guinea pigs.

**50000 ppb:** Exposure at this concentration for 60 minutes would probably be fatal to humans.

## Source for Ozone-Sensitive Papers

Vistanomics <http://www.ecobadge.com/>

Eco Badge Kit (30 test cards) \$38.95

The Eco Badge Lesson Books "Middle School" (150 test cards) \$119.95

Ozone Services <http://www.o3zone.com/ozoneser/>

Ozone Test Strips - 12 tests - Range 0-105ppb \$13.50

Ozone Test Strips - 30 tests - Range 0-105ppb \$33.00