

EXPERIMENT 3:

MEASURING ATMOSPHERIC OZONE FROM THE GROUND

DIFFICULTY: MODERATE TO ADVANCED

BACKGROUND

The Earth's upper ozone layer acts like a sunscreen, or a shield that protects organisms on Earth from the dangerous ultraviolet radiation (UV rays) given off by the Sun. Prior to 1978, consumer aerosol products in the US used chlorofluorocarbons (CFCs) as propellants. CFCs rise to the Earth's upper ozone layer and react with the ozone. The effect is destructive and reduces the upper ozone layer's ability to absorb the Sun's UV rays. Scientists and environmentalists were concerned that the use of aerosol products might result in an increase in UV rays reaching lower levels of our atmosphere. Consequently, the Environmental Protection Agency (EPA) banned the use of CFC propellants in 1978.

Scientists on the ground can determine the presence and amount of ozone in the atmosphere by measuring the amount of UV radiation being absorbed by the atmosphere. They can then calculate how much ozone must be present in order to absorb that amount of UV radiation. Ozone presence is typically measured in **Dobson units** (DU), with one Dobson unit equivalent to a 0.1 mm layer of ozone (at 0°C and 1 atmosphere of pressure). This represents how thick the ozone layer would be if it were located at the Earth's surface at 32°F. Measurements are typically taken at 12:00 noon local time from about 350 ozone recording stations worldwide. The data is often publicly accessible from a variety of online databases.

LEARNING GOALS

1. The student will learn how scientists and environmentalists measure atmospheric ozone from the ground.
2. The student will learn the role atmospheric ozone plays in affecting weather.
3. The student will learn to use relevant data to determine what factors will produce impact changes in the ozone layer.

MATERIALS

- Computer with Internet access
- Graphing materials or graphing software

PROCEDURE

1. In order to track atmospheric ozone from the ground, the student must often first determine the specific latitude and longitude of the site. This information is available on maps, GPS units, or from various geo-science websites such as :
<http://www.naffis.com/maphacks/latandlon.html>.
2. Many atmospheric ozone tracking measuring stations are operated by U.S. governmental agencies, such as the EPA and the National Aeronautics and Space Administration (NASA). The EPA's AIRNow site allows people to monitor atmospheric ozone from a variety of ground stations, using data obtained from its website: <http://airnow.gov>. The student may use this site to track various ozone-related weather and environmental conditions. This site provides locations of **Ozone Monitoring Stations**, current and archived **Air Quality Index**, and **Daily UV Index** health standards.

DISCUSSION

1. *How does the daily ozone profile compare with daily weather?* The student might track the ozone level (Dobson units, parts-per-million, etc.) and compare it to the daily high temperature to see if there is a correlation (*i.e. does high ozone level cause higher-than-average temperature? Or might it result from the higher than normal temperatures?*).
2. *How does the daily ozone profile compare with seasonal changes?* The student might track the level seasonally and see if there appears to be regular seasonal changes.

3. *Does a catastrophic event (such as volcanic eruption, earthquake, hurricane, etc.) seem to have any effect on atmospheric ozone level?* The student might check the archives to see if data collected shortly after such an event might produce a noticeable impact on the ozone level.

4. *Does the ground measure atmospheric ozone level correlate to that measured from satellite?* What might cause any differences?

- 5.. *Does the atmospheric ozone level measured from ground seem to change in industrial areas after the CFC ban in 1978?* (Remember such an impact might not be instantaneous).