Name _____ Class _____ Date _____

Skills Practice Lab

MATH/GRAPHING

Methyl Bromide: The Ozone's Enemy

Ozone molecules, O_3, are produced naturally by ultraviolet radiation from the sun. They exist in small quantities in the stratosphere, a layer of Earth's atmosphere located approximately 18 km to 50 km above Earth's surface. In Section 13-2, you learned about the protective function of stratospheric ozone and about chemicals, such as chlorofluorocarbons (CFCs), that contribute to the depletion of the ozone layer.

Methyl bromide is another example of a chemical whose use has come under scrutiny. Methyl bromide also is identified as an ozone-depleting chemical. It is a broad-spectrum pesticide, which means that it kills many types of organisms, such as insects, nematodes, weeds, and rodents. Methyl bromide is toxic and can cause respiratory and central nervous system problems in humans. A large proportion of the methyl bromide introduced into the environment by humans eventually enters the atmosphere, where it damages ozone.

Scientists use the ozone depletion potential (ODP) to compare a substance's ability to destroy ozone with that of the chlorofluorocarbon CFC-11, defined as having an ODP of 1. The higher the ODP of a substance, the more ozone-destroying potential it has. Methyl bromide has an ODP of 0.6. The Clean Air Act requires the complete phasing out of methyl bromide by 2005, with the exception of emergency and quarantine uses.

In this lab, you will analyze historical data that include estimates of consumption of methyl bromide and concentrations of stratospheric ozone over Antarctica.

OBJECTIVES

Graph data and analyze patterns within the data.

Decide whether a plot represents a cause-and-effect relationship among variables.

MATERIALS

- colored pens or pencils
- graph paper

Procedure

1. The thickness of the ozone layer within a column of atmosphere is measured in Dobson units (DU). The ozone layer in the stratosphere is several kilometers thick due to the low pressure at that distance above Earth's surface. But if you were to bring the average ozone layer to Earth's surface, atmospheric pressure (1 atm) would compress it to a thickness of only 3 millimeters, or 0.3 cm. To standardize comparisons of the ozone layer's thickness, the Dobson unit is defined as 0.001 atm-cm. How many Dobson units represent the average thickness of stratospheric ozone?

Methyl Bromide and Ozone Data

Year	Metric Tons Sold	Dobson units
1979	--	263
1980	--	226
1981	--	238
1982	--	218
1983	--	198
1984	45,572	196
1985	48,273	183
1986	50,455	233
1987	55,690	150
1988	60,610	235
1989	62,570	150
1990	66,644	178
1991	73,600	139
1992	71,858	150
1993	72,658	122
1994	73,731	130
1995	68,857	135
1996	71,425	150

Methyl bromide (and total column ozone measured at Halley Bay, Antarctica)
--Indicates data not reported here

2. The table above includes estimates of worldwide production of methyl bromide from 1984 to 1996 and the changing thickness of the ozone layer over Halley Bay, Antarctica, between the years 1979 and 1996. On a piece of graph paper, plot the methyl bromide data from the chart. Put the years 1979 through 1996 on the x-axis and metric tons of methyl bromide produced on the y-axis. Label the y-axis in increments of 5,000 metric tons. Connect these points from year to year to make a line graph.

3. On the same graph, create a second vertical y-axis on the right side. Label it with Dobson units from 80 to 300 in increments of 10. Graph the ozone layer data. Use a different-colored pencil to connect these data points from year to year.

Analysis

1. Examining Data What was happening to the ozone layer in the years before methyl bromide data are shown?

2. **Explaining Events** Give possible explanations for the change in the thickness of the ozone layer in the years 1979–1983.

Conclusions

3. **Analyzing Graphs** Does the increased use of methyl bromide correlate with the decrease of the ozone layer thickness over Antarctica? Explain.

4. **Evaluating Methods** If there is a correlation, does this prove that methyl bromide causes ozone destruction? Explain.

Extension

1. **Research and Communications** Use the Internet, if available, to research total column ozone in your neighborhood or another area that interests you. Determine the latitude and longitude for your area of choice as input data. Global total ozone data are continuously monitored via satellite, and some historical data are archived. Plot the data over a number of years as you did for step 3 in the Procedure. Describe any trends you find in DUs (Dobson units) for your area over time. Compare your results with those who have selected different regions.