

Teaching Activity: Methane and Population: What's the Connection?

Introduction: Methane, CH₄, is our most abundant hydrocarbon and a major component of natural gas. It is a highly efficient absorber of infrared (IR) radiation, and although its present atmospheric concentration is only about 1.68 parts per million (ppm), its rate of increase is cause for concern. If, as expected, the atmospheric concentration of methane doubles in the next 30 years, the cumulative warming effect of methane and the other greenhouse gases will equal that of carbon dioxide alone.

Analysis of air bubbles preserved in glacial ice cores has shown that the methane concentration in the atmosphere held steady for the last 10,000 years. About 300 years ago, however, the methane level began to rise and in 100 years has increased drastically. The current rate of increase of methane (1%) is greater than that of carbon dioxide (0.4%).

There is no clear consensus among scientists as to why the methane concentration is rising so rapidly. Much of it is thought to come from the breakdown of plant material in anaerobic (oxygen depleted) environments, such as swamps and rice paddies, in the heating of plant material underground, in the guts of ruminant animals (cattle) and in termite mounds. Most of these activities are the direct result of human population growth in developing countries and careful analysis of available statistics of both events shows a close correlation between them.

Objectives:

- To create a line graph of atmospheric methane concentrations over the past 450 years;
- To analyze the correlation between world population trends and the rise in methane concentrations;

Important Terms: Hydrocarbon, infrared radiation, parts per million (ppm), ice bubble analysis, ruminant animals, termites, anaerobic environment;

Materials: Copy of Student Activity Sheet, ruler, pencil/pen, colored pencils;

Procedure:

1. The attached graph shows human population growth over the past 400 years.
 - Notice that there are two Y-axes:
 - Methane Concentration in ppm on the left;
 - World Population (Billions) on the right;
 - Notice that there is only one X-axis: Year;
2. Read over and discuss both the **Introduction** and the graph with the class.
 - Point out the way the graph is formatted.
 - Discuss the rise in human population and possible reasons and results.

- Answer any questions students have regarding the meanings of the measurement units.

3. Draw attention to the **Data Table** of methane concentrations for the last 400 years.

- Those prior to 1979 were obtained from analysis of air bubbles caught in glacial ice.
- Tell students that they are to use this information to plot the methane concentration on the same graph as human population.
 - They will refer to the Y-axis on the left side for methane levels.
 - They will then draw a smooth curve to fit through the methane points that they plotted using a colored pencil.

4. After completing the graphing part of the activity, students should answer the **ANALYSIS/COMPREHENSION** questions.

Student Activity Sheet: Methane and Population:

What's the Connection?

Introduction: Methane, CH_4 , is our most abundant hydrocarbon and a major component of natural gas. It is a highly efficient absorber of infrared (IR) radiation, and although its present atmospheric concentration is only about 1.68 parts per million (ppm), its rate of increase is cause for concern. If, as expected, the atmospheric concentration of methane doubles in the next 30 years, the cumulative warming effect of methane and the other greenhouse gases will equal that of carbon dioxide alone.

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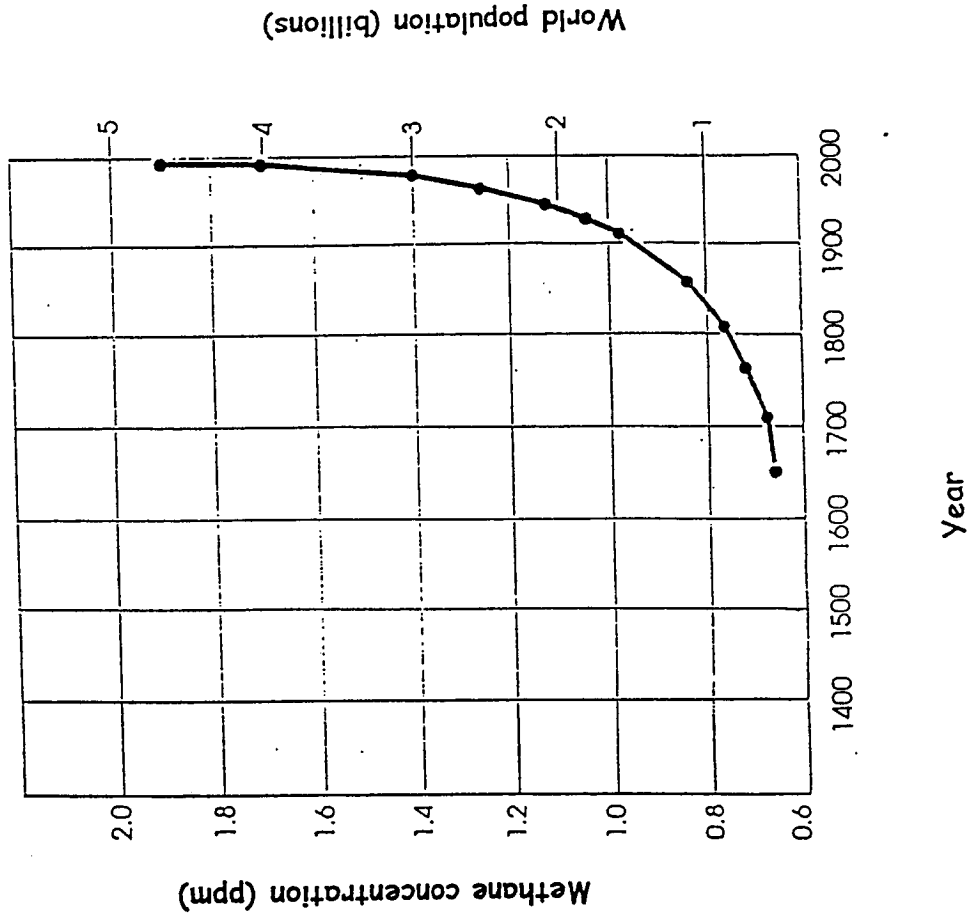
1. Read over and discuss the **Introduction** and the line graph with your teacher.
2. Focus on the **Data Table** of methane concentrations for the past 400 years.
 - Use this information to plot the methane concentrations on the same graph as the population data.
 - Refer to the Y-axis on the left side for methane levels.
 - Draw a smooth curve to fit through the methane points that you have plotted using a colored pencil.
3. Complete the **ANALYSIS/COMPREHENSION** questions.

Student Activity Sheet #1: Methane and Population

DATA TABLE: Methane Concentrations (ppm) 1500-1996

YEAR	CONCENTRATION (ppm)
1500	0.64
1530	0.72
1590	0.66
1620	0.68
1670	0.65
1715	0.72
1750	0.70
1790	0.78
1820	0.76
1850	0.80
1870	0.84
1879	0.86
1915	0.95
1950	1.15
1970	1.30
1979	1.54
1983	1.60
1984	1.63
1986	1.65
1988	1.68
1990	1.70
1992	1.72
1994	1.76
1996	1.80

GRAPH: Human Population and CH4 Production



Student Activity Sheet #2: Methane and Population

ANALYSIS/COMPREHENSION

1. According to the graph, what was human population like before the mid-18th century? _____

2. When did the population make a sharp curve upward? _____
3. Approximately when did the population pass the 1 billion mark? _____
the 2 Billion mark? _____ the 4 billion mark? _____
4. If the rate of population growth continues at its present rate, when should it pass the 6 billion mark? _____
5. Until what year did the CH₄ concentration remain relatively steady?

6. From 1820 until 1990, what was the percent of increase of methane?

7. How does the growth in human population compare with the increase in concentration of atmospheric methane? _____

8. How can you explain the relationship between the two graphs? _____

9. What reasons could you give for this relationship? _____

10. Based on the trend you see in the graph, what would you predict for the year 2050 for both population and methane? _____

