

Is CO₂ to blame for atmospheric temperature rising?

Subject: Mathematics

Grade Level: 9th – 11th

Rational or Purpose: This lesson is designed to help students understand properties of correlations. Students will apply the concept of correlation to postulate a hypothesis in the relationship between global temperature and CO₂ concentration.

Materials:

ESI Outreach Lecture Series No. 55 PowerPoint Presentation

Computer with spreadsheet function (e.g. MS Excel) - optional

Lesson Duration: 50 minutes for 2 lessons (1st: 20 minutes; 2nd: 30 minutes)

TEKS Objectives:

111.35. Precalculus (c) (P3) (c)

Background Information:

When news reports talk about extreme weather on somewhere on Earth, sometimes they will mention about global warming or climate change. If the report goes a little deeper, they will evaluate the carbon emission of some developed and developing country. To convince audience that it is anthropogenic carbon dioxide emission that causes climate change, they may display a diagram similar to this:

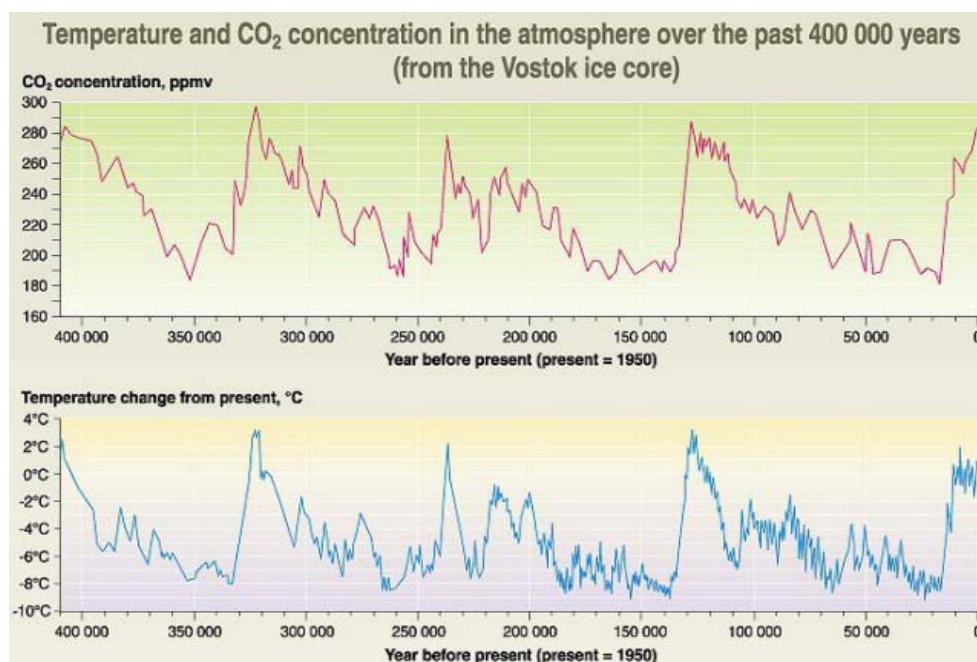


Fig 1 (Source: IPCC Report on Climate Change)

Audience may be easily convinced because they see two graphs that close resemble to each other. This suggested that, over hundreds of thousand of years, they share a similar trend in history. If we would plot another graph with only CO₂ concentration in ppmv and temperature from present in °C, we shall see a graph like this:

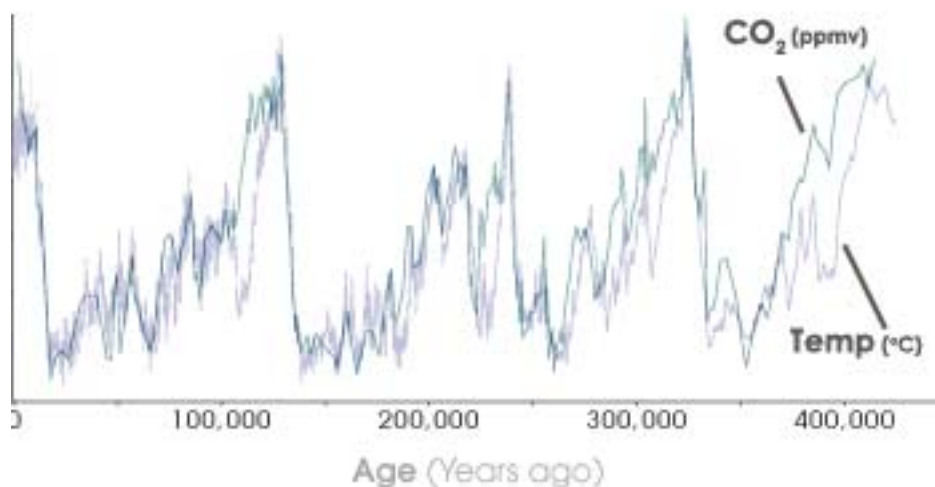


Fig. 2 (Source: NASA Earth Observatory)

From this graph, we put two dependent variables together and observed a general trend, or correlation. Then we are able to hypothesize that carbon dioxide causes an increase in global temperature. To prove that such hypothesis is valid and true, there are a lot of testing must be done. Therefore, putting two unrelated (initially) dependent variables together on a plot may give us useful hints on research and discovery.

Activity

Before the activity begins, students must clearly understand the concept of slope because this understanding will greatly help students' understanding on correlation. Some concepts that students must know are: positive slope, negative slope, zero slope.

In a correlation graph, we put two dependent variables together. (Unlike regular graphs, no independent variable is located on the x-axis.) These two dependent variables may or may not have any relationship with each other. If they have relationship, we can use this correlation graph to determine how close they are related to each other.

Teachers are encouraged to incorporate computers with spreadsheet program (e.g. MS Excel®) to conduct this activity. With the chart wizard (scatter plot) in MS Excel, a plot (Fig.2) can be easily created.

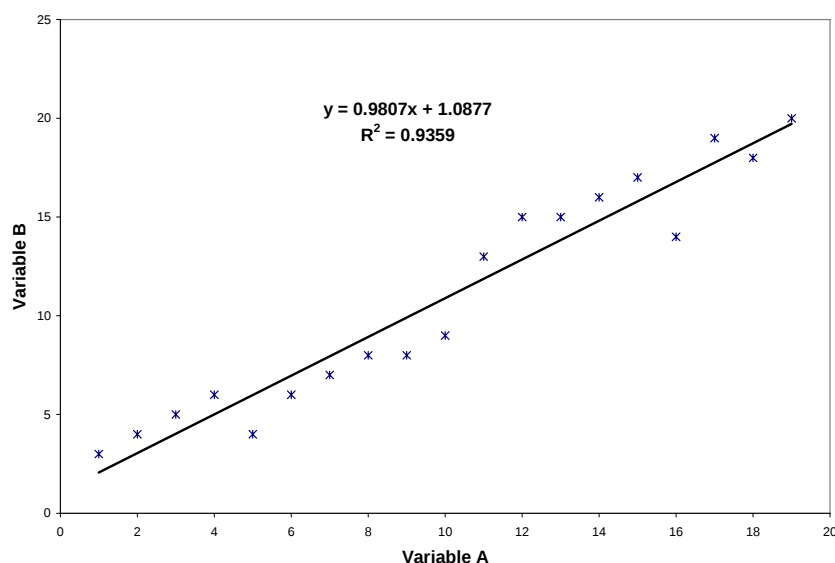


Fig. 2

Teacher shall explain carefully on several properties on the graph: data points, trend line, equation, R^2 , and axes.

Data Points: Points plotted on the graph based on the data obtained from experiments or observations

Trend Line: A line postulated based on data points to represent a trend from the data

Equation: Represents the trend line, can be used for approximation purpose if both variables are closely related and a value of either variable is available

R-square: Represents how closely two variables are related in the given relationship (in this case it will be linear)

Axes: Represent any given variable; variables can be switched between these two axes because the axes will not change their relationship (if any)

Procedure

1. In the first class period, teacher will explain the basic knowledge of correlation. Teacher will make use of blackboard to show “positive correlation”, “negative correlation”, and “no correlation” by drawing simple graphs.
2. After students understand the concept, teacher will ask students to list three (3) examples of each correlation and explain why they think so. For homework of first lesson, students will find two (2) more examples for positive and negative correlations. Write a brief paragraph to conclude the relationship. (E.g. I think the intake of fat and the number of heart disease are positively correlated. The more fat a person eats in a meal, it will cause some substance to accumulate in the blood vessel...)

3. In the second class, students are divided in groups. Each student will share their “correlations” and the group will pick one to present it on the blackboard by draw out the sample graph. The group representative will explain how the factors correlate to each other. Students are welcome to express their agreement or disagreement of the correlation.
4. By now, every student must have a very clear concept on correlation. Use the remaining class time for the following task:

On Earth today, many people are combating and suffering from the consequence of global climate change. As we have introduced earlier, there is clearly a positive correlation between carbon dioxide and global mean temperature. This correlation is just one of the many hints to show us that climate change is in progress.

For each group, you will pick one of the following choices and investigate how they correlate to each other. You will need to find some quantitative information on internet to create a table with at least eight (8) data points, so that your group can make a correlation graph. The (a) Topic; (b) Brief Introduction; (c) Correlation Graph; and (d) Graph Conclusion will be written on a poster board/paper. If possible, can you predict the trend of the graph?

Here are the choices of topics:

- A. Sea Water Temperature and Number of Hurricane per year*
- B. Area of Tropical Forest and Carbon Dioxide Concentration*
- C. Carbon Dioxide Concentration and Sea Level*
- D. Sea Water Temperature and Carbon Dioxide Concentration*

(Student may use computer to input data points and obtain the trend line, equation, and R^2 .)