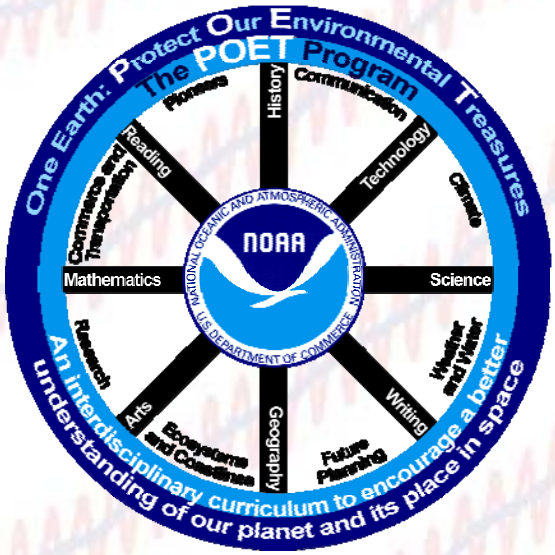
Carbon Dioxide and Seasons

Category

Mathematics, Science, Technology

Real World Connection

Climate, Research, Future Planning



Materials

Calculator

Data for Global Monthly Mean Carbon Dioxide Concentrations (Included)

Problem Question

How does the carbon dioxide concentration (monthly – globally averaged) change as Earth's seasons change throughout several years?

Prior Knowledge What I Know	Conclusion What I Learned
Based on your prior knowledge, answer the problem question to the best of your ability.	*Answer the problem question after completing the activity.*

Background Information

CO_2 - is there too much or too little? Without CO_2, Earth would be a frozen rock-like object orbiting our Sun. With too much CO_2, our usually comfortable planet would resemble a steamy cauldron of chemical soup! Understanding CO_2 and its role in Earth's carbon cycle will help us to determine how much CO_2 is too much or too little to support the vast array of life on Earth. The carbon cycle is a natural series of events on planet Earth. Plants take in CO_2 and give off oxygen (O_2); whereas, animals take in O_2 and emit CO_2. In addition, some CO_2 dissolves in seawater where it is used by creatures in the sea during photosynthesis and by other micro-organisms to produce calcium carbonate ($CaCO_3$) shells. These processes help control the amount of CO_2 in our atmosphere. Human beings complicate Earth's natural carbon cycle. By burning fossil fuels, we increase the amount of CO_2 in our atmosphere. Driving automobiles, heating buildings, and producing consumer goods all add to the concentration of CO_2. To help unravel the mystery of the intricate carbon cycle, researchers monitor the amount of CO_2 in the atmosphere looking for clues.

FYI

The Carbon dioxide (CO_2) concentration in Earth's atmosphere is measured in parts per million (ppm). For example, a carbon dioxide concentration of 350 ppm means that there are 350 parts of carbon dioxide in a total of one million parts of dry air.

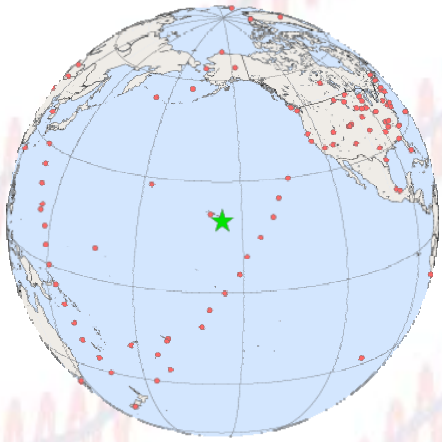


Figure 8-1. Mauna Loa Observatory (MLO) – Location and Image

Procedure

In this activity, you will plot a curve for the monthly average CO_2 (ppm) concentration found in the Earth's atmosphere over several years. In much the same way a scientist would monitor concentrations of gases in the atmosphere, you will look for changes and trends, as well as maximum and minimum concentrations, using data collected at the Mauna Loa Observatory on the Island of Hawaii. Established in 1957, on the northern flank of the Mauna Loa Volcano, at an elevation of 3397 meters (11,145 feet), the Mauna Loa Observatory has grown to become the Earth's premier long-term atmospheric monitoring facility and is the site where the ever-increasing concentrations of global atmospheric CO_2 were determined.

1. Using data from Table 8-1, plot the points corresponding to the recent global monthly mean CO_2 concentration over time on Figure 8-2.
2. Print a title at the top of your graph in the white box.

Carbon Dioxide Concentrations (Parts per Million - ppm)

Month												Cal. Year
Jan (1)	Feb (2)	Mar (3)	Apr (4)	May (5)	Jun (6)	Jul (7)	Aug (8)	Sep (9)	Oct (10)	Nov (11)	Dec (12)	
372.31	372.68	373.19	373.53	373.52	372.67	371.24	370.16	370.48	371.74	373.09	374.09	2002
374.75	375.29	375.72	376.19	376.33	375.48	373.93	372.71	372.91	374.20	375.48	376.32	2003
376.97	377.49	377.91	378.28	378.21	377.33	375.79	374.34	374.24	375.56	377.01	378.00	2004
378.59	379.00	379.61	380.12	380.24	379.41	377.69	376.47	376.56	377.88	379.35	380.34	2005
381.11	381.74	382.14	382.46	382.40	381.54	379.85	378.27	378.38	379.78	381.13	382.09	2006
382.73	383.22	383.69	384.00	383.88	382.94							2007

Table 8-1. Global Monthly Mean Carbon Dioxide Concentrations – January 2002 through June 2007

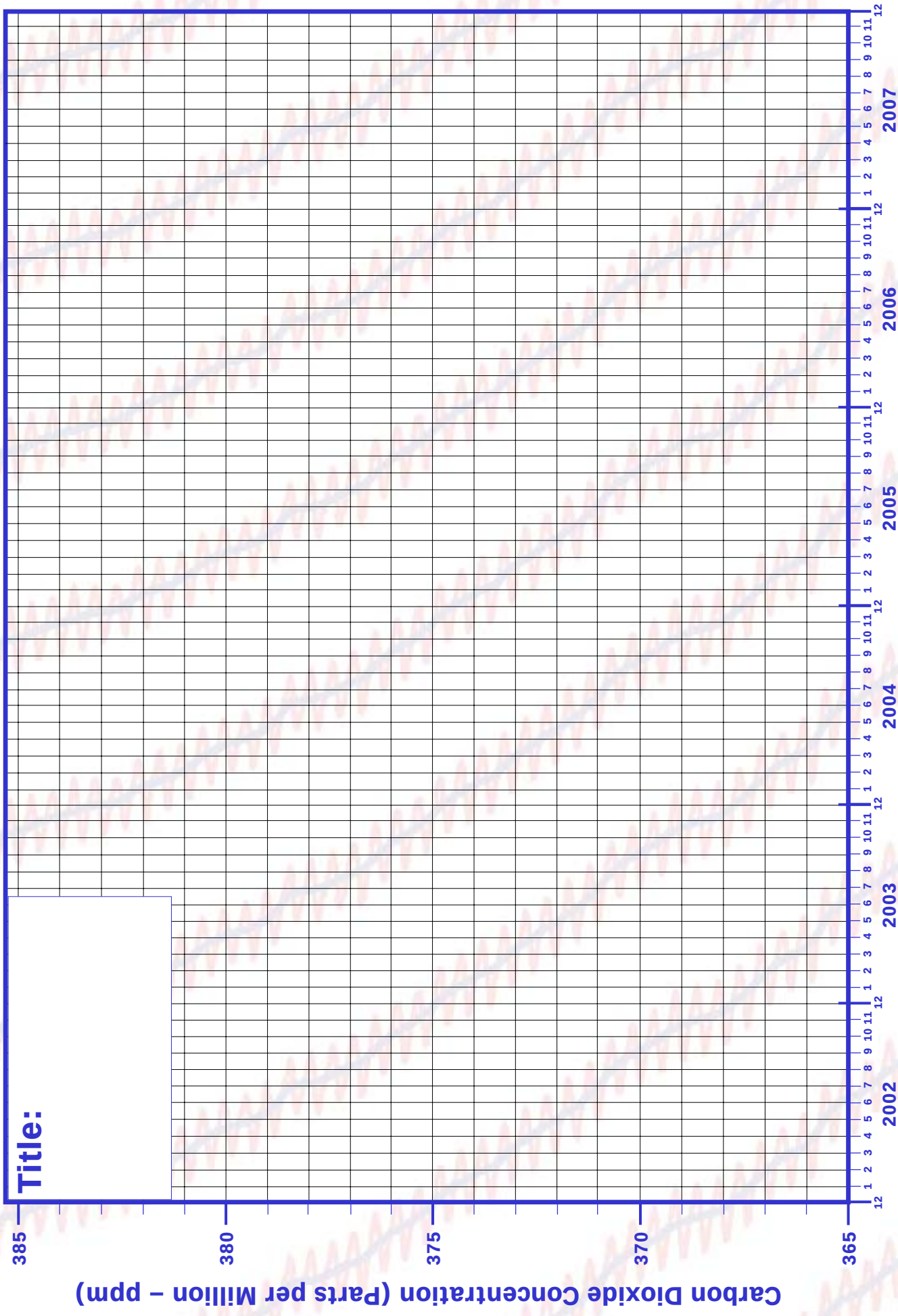


Figure 8-2. Graph for Carbon Dioxide Plot

Questions

1. What patterns do you notice in your graph? (Keep these patterns in mind as you answer the following questions.).

2. What is the mathematical range for the CO_2 concentration between January 2002, and June 2007?

3. Calculate the mean CO_2 concentration for each year listed in the table below. Then complete the table using your calculations.

Year	Mean CO_2 Concentration (ppm)	Amount of CO_2 Change (ppm)	Change Since the Previous Year (Increase, Decrease, Unchanged)
2002			
2003			
2004			
2005			
2006			

Does the CO_2 concentration increase, decrease, or remain unchanged from year to year?

4. Typically, during what month and during what season is the CO_2 concentration highest? Lowest?

5. Rounded to the nearest tenth, what month(s) between January and June 2007, has(have) the highest CO_2 concentration occurred? Explain.

Questions – Continued

6. Using a colored pencil, extend your graph keeping the same patterns that you identified earlier. Predict the CO_2 concentration for December 2007.

7. There is more land in the Northern Hemisphere than in the Southern Hemisphere. How might this difference affect CO_2 concentration?

8. Earlier, you noticed that your line graph has a repeating pattern. Explain.